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Foreword

Georges Dassis

President

European Economic and Social Committee (EESC)

After the fall of the Berlin wall we had a unique opportunity to unite the whole continent and we made good use of it. Today, 28 countries are united within the EU. Together we have been successful in many ways. But the road ahead is still fraught with difficulties and we need to do more and to act more assertively and more consistently.

During these two and a half years, the EESC, on behalf of organised civil society in each of our countries, will be the voice that urges EU policymakers to find solutions to the most pressing issues and supports them through the process. I have started my mandate by providing my colleagues with [a brief inventory of the main proposals that our Committee has made](#) and which we will stand for:

Economic and Monetary Union – the basis for economic and social success

We need to strengthen social, political and economic cohesion in the EU and deepen economic and monetary integration as a basis for a properly functioning EMU. EMU is the cornerstone of the EU's future development. Greater fiscal harmonisation is vital, including cooperation in the fight against tax fraud, tax evasion and tax avoidance. The euro area needs to be equipped with the necessary instruments to foster convergence and Europe's competitiveness. Divergences in the functioning of labour markets, wage-setting systems and welfare systems need to be removed. Europe needs a radical social reform, including a basic income, Eurobonds and a financial transaction tax. Economic priorities should be established by the European Parliament with the involvement of civil society and the social partners: we cannot rely on unelected bodies to steer the euro area.

The largest single market will only be strong once it is completed

A single market with over 500 million consumers has significant power. This is why we need to move ahead to finally complete the single European market. Priority must be given to the creation of a real energy union and to the implementation of the digital single market in order to unlock all its opportunities and create new jobs, particularly for young people entering the labour market. There are no limits to what creativity and innovation can do to develop concepts to help Europeans get back into work.

Migration challenges need common responsibility

Solidarity cannot be a one-way street; it must be based on a collective effort. The current migration crisis could be a turning point for the EU in matters of solidarity and mutual trust. It has to be addressed by sharing the burden between all 28 Member States. The EU needs to develop a common migration policy and guidelines for the successful integration of migrants. Migration and integration will be among the main challenges in the years ahead and common policies are indispensable, including negotiations with countries of origin.

The power of civil society

The migration crisis shows us that even the best organised State would be lost without a strong and engaged civil society. Citizens have an understanding of what is necessary, what is possible and what is unacceptable. It is therefore important for civil society to make its voice heard by European policymakers. It is our duty at the EESC to relay its concerns at European level and to present its proposals in a concrete and effective way to the key decision-making institutions.

Only a united Europe will be able to overcome these major challenges and to play a significant role on the international stage. Civil society is ready to make its contribution to this end, both by developing innovative, concrete and consensual proposals and by taking action on the ground to implement them. "Civil society" means our businesses, our workers and citizens' associations and movements of all kinds. In other words, it is the lifeblood of our countries. It refers to those who create, produce, work, commit and take action. ■





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Introduction

As we head towards the end of 2015, Europe will come together next month at a crucial meeting in Paris, with the aim to achieve a legally binding and universal agreement on climate change. This will be the first time in over 20 years of UN negotiations that this will happen.

COP21, also known as the 2015 Paris Climate Conference, is crucial in the fight to reduce global warming. As we eagerly await the outcome of COP21, which is held from 30 November – 11 December, the November edition of Adjacent Government highlights some areas that could be considered integral to that mission of reducing global warming by 2 degrees Celsius.

For example, an article by Dr Johnathan Cobb at the World Nuclear Association asks the question: Is nuclear energy the answer to climate change? Judith Shapiro of the Carbon Capture and Storage Association also outlines how CCS can help Europe in the fight. Our environment section also features key editorial from Karmenu Vella, Commissioner for the Environment, and the International Arctic Research Centre on how the Arctic impacts on climate change.

We kick off the November edition with a foreword from the new President of the European Economic and Social Committee (EESC), George Dassis. In his introduction he details key challenges

heading into 2016, and the importance of political, social and economic cohesion throughout the EU.

In this final edition for 2015, we also focus our attention on key health challenges. Our cancer research focus shines a light on the importance of key research to develop treatment and new drugs in the fight against cancer. The focus takes a look at a number of different areas including paediatric oncology and gynaecological oncology.

Key articles within the section include a piece from Professor Giles Vassal at the European Society for Paediatric Oncology, and a piece from the European Organisation for Research for Treatment of Cancer.

Another area we look at in this edition is the integral role of STEM education throughout Europe. Articles focus on engineering and the significance of recruiting the engineers of the future. Feature editorials from Tamzin Caffrey at Engineering UK, and Naomi Climer at the Institute of Engineering and Technology highlight this.

We also give thought to educational standards; CBRN; infectious diseases; sexual health; obesity; and fraud within healthcare, in this winter edition.

As always we hope you find the articles informative and useful, and welcome any feedback you may have. ■

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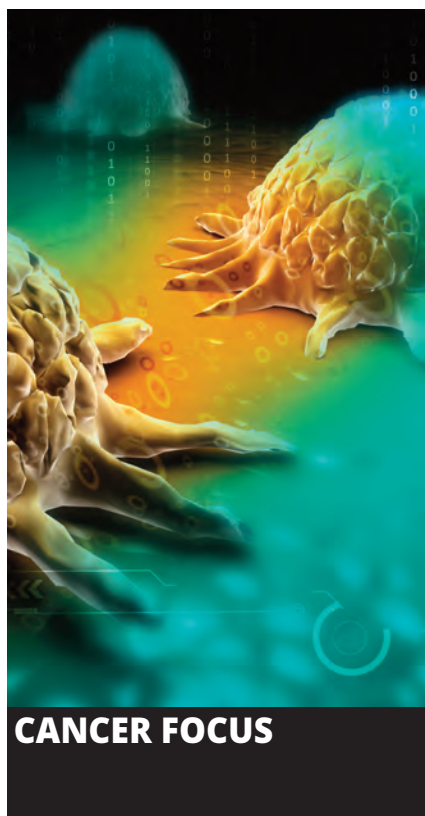
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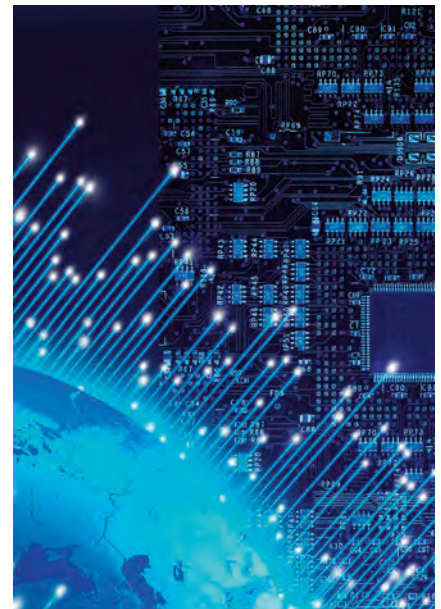
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The 4 Ps of health policy in Europe

In a speech given at the European Health Forum, EU Commissioner for Health Vytenis Andriukaitis outlines how Prevention, Protection, Promotion and Participation are key principles to improve healthcare systems...

Last time as Health Commissioner-nominate I had the chance to present the guiding principles of my mandate: prevention, promotion, protection. These 3 principals have a new friend – Participation – and are still guiding me in my work.

I'd like to lead you through some of them starting with the rising risk factors provoking chronic diseases which afflicts our societies and threatens the sustainability of our health systems. This causes major expenditures in our health systems.

I will never tire of stressing that we need a major shift in the way we finance, organise and operate our health systems.

We need more public health. We need more prevention. And for this we certainly need a greater understanding that people's health – our health resource – is our most precious economic resource to which all Ministers must contribute.

To keep people in good health and prevent diseases, we need literacy; we need education; we need affordable healthy food; we need appropriate houses; public spaces where people can exercise; we need healthy working and living conditions; and decent living standards.

In turn, this fosters good health, which translates into a productive workforce. And of course we need to address the main risk factors of all chronic diseases: tobacco, alcohol, poor nutrition, lack of physical activity and pollution.

These risk factors directly affect citizens' quality of life as well as national health systems, government budgets and the productivity of our economies.

Tobacco alone kills 700,000 people every year; and translates into treatment bills of €25bn with productivity losses of over €8m. Up to 7% of EU health budgets are spent on diseases linked to obesity.

Trans fatty acids create challenges to cardiovascular diseases. We are also currently finalising a report on “trans fatty acids”. We will examine various options on the way forward at EU level. Thousands of people die on the roads every year because they drink too much alcohol.

There is so much focus on deaths caused by armed conflicts, war, and oppression. I want to see the same focus on preventing deaths caused by tobacco, alcohol, and too much salt, sugar and trans fats.

This is not a problem at the margins of the system. It is at the very centre of the health, demographic and economic challenges of our societies. It also relates directly to our values of solidarity and equality.

I would also like to underline my belief in the importance of mobilising health professionals and NGOs to support work on improving public health in the short and long term.

Health Priorities – AMR and Health systems

Let me turn now to antimicrobial resistance – a major threat to health all over the world. We are already improving surveillance, supporting appropriate use of antimicrobials in human and animal health and stimulating research. And we will need to continue our efforts in this regard.

To cope with today’s challenges, health systems need to be preventive, effective and efficient.

Universal coverage of public health preventive measures for all people and universal access to health are essential pillars of our health systems.

On one hand we have to reach all those who are at risk. On the other hand we also have to help those who are in need of care, and provide them with the best possible treatment.

Health systems are also of fundamental importance in contributing to the Europe 2020, the EU agenda for

growth and jobs. The first target of EU 2020 focuses on employment – we aim to see 75% of the population at the working age with a job by 2020.

Health will contribute towards this goal in 2 ways:

- Firstly, good health is an economic factor and a precondition for long and productive working lives.
- Secondly, the health sector is a net job creator. And we can create even more jobs and training opportunities for public health professionals to work on promotion and prevention.

Europe 2020 also sets the target of investing at least 3% of GDP in research and innovation. Healthcare offers vast reward opportunities for such investment. Think of biotechnologies, genomics, eHealth or novel medicines.

The health sector can also contribute to the energy efficiency goals – for example, hospitals work 24 hours a day and consume a lot of energy – some are already relying on renewable energy, for example solar panels.

Finally, we know that access to quality healthcare reduces inequalities and lowers the risk of falling in poverty. This reinforces healthcare as a pillar of our social protection systems.

This article is part of a speech given by the Commissioner at the European Health Forum:

http://ec.europa.eu/commission/2014-2019/andriukaitis/announcements/european-health-forum-gastein-closing-speech_en

.....
Vytenis Andriukaitis

Commissioner for Health and Food Safety

European Commission

http://ec.europa.eu/commission/2014-2019/andriukaitis_en

Research into the psychosocial determinants and correlates of health:

Pathways to Improved Well-Being...

Some live a long productive life in relative health, while others instead become ill, die prematurely, or live with an impoverished quality of life for years. Across the globe, and particularly among industrialised nations, chronic conditions have become the leading causes of disease and mortality. The social and personal costs of such diseases are considerable and likely to increase with the aging of our population.

What contributes to illness and premature death, and what can we do about it? The answers may surprise you.

Determinants of health and disease: Much more than you expect!

Research suggests that it is the interplay of a myriad of biological, environmental, social, and psychological factors that contributes to health and most illnesses.

Lifestyle factors as example

Lifestyle behaviours account for upwards of 50% of many diseases. So why do so few people alter their unhealthy lifestyle when informed about what health behaviours are bad for them? Research into the biopsychosocial determinants of health has shown that there are factors that contribute to the behaviours that one adopts and maintains that are not typically addressed by health practitioners. These include forces within the individual's environment

(for example, lack of access to safe or affordable alternatives, lack of support) and the individual himself (for example, values, beliefs about the behaviour or suggested alternatives, self-esteem, psychological stress or distress, coping abilities). Importantly, research has also shown that when such factors are addressed in treatment, success rates are by far superior to current practices.

“This research represents but a tiny part of the tremendous and important work currently being performed across the globe with potential to inform health reforms that will make global health possible in the young and old alike.”

The Heart & Mind Research Unit in Behavioural and Complementary Medicine that I lead at the Montreal Heart Institute seeks to understand what and how psychosocial and psychophysiological factors impact health, with the goal to apply this knowledge in improving wellbeing and preventing disease.

Together with a pan-Canadian interdisciplinary team led by Robert Nolan (Toronto), we are currently evaluating the efficacy of a web-based intervention in improving the self-care behaviours, coping skills, and quality of life of patients with congestive heart failure. We have developed tailored

ehealth interventions based on state-of-the-art empirical psychosocial and medical research. Such programs can help patients navigate through the multiple difficulties associated with the diagnosis and management of life-altering conditions that can make adherence to recommendations so tenuous.

However, psychological distress factors can influence health independently of lifestyle. A case in point, the prevalence of coronary artery disease (CAD) is increased in individuals who are more hostile, depressed, and/or who have experienced trauma in their lives. These factors similarly increase risk of further morbidity and mortality among those who have already suffered a myocardial infarction (MI). While the exact mechanisms remain to be elucidated, it likely reflects the impact of psychological factors on multiple bodily functions relevant to cardiovascular integrity.

We have shown, for example, in a prospective study of initially healthy adults that individuals who are more hostile show more disturbances across a cluster of metabolic (obesity, blood pressure, glucose, triglycerides, HDL) and inflammatory risk factors and these disturbances worsen over time.

In BEL-AGE, we are further exploring mechanisms through which environmental and psychological factors

contribute to premature ageing and CAD morbidity/mortality. By study's end, 1518 men and women with and without CAD will have been followed over time. Telomere length is of particular interest. Telomeres cap and protect the end of our chromosomes. As telomeres shorten with age and consecutive cell divisions, organisms become more vulnerable to disease and premature aging or death. BEL-AGE will provide us with a unique opportunity to examine whether psychological risk factors contribute to CAD development, progression, and mortality, in part, through more rapid shortening of telomeres, and whether these effects are independent of, moderated or mediated by other behavioural (lifestyle), social, environmental, or biological processes.

Individual differences

The determinants, degree, time-course, and consequences of disease are often different in men and women, as a result of biological and gender-related factors. We have shown, for example, that they differ in the number and type of symptoms associated with CAD, a fact that may delay or complicate diagnosis and treatment of CAD in women. We have documented sex differences in lifestyle, prevalence of psychological distress, physiological responses to psychological stress, as well as differential impact of these stress responses on metabolic disturbances. We have similarly shown differential time course and response of inflammatory activity to stress and age in men and women, as function of hostility. Why then are "One-size fits all" approaches used?

Consequences of disease

Physical illnesses can wreak havoc on a person's life. We have noted considerable psychological distress across

various patient populations, including those undergoing investigation for CAD, those who suffered a MI, those undergoing cardiac surgery, and in patients suffering from recurrent syncope (fainting). In all cases, psychological morbidity was under-diagnosed and treated, and failure to address psychological issues was associated with a worst medical prognosis, impoverished quality of life, and loss of functioning.

Psychosocial factors that contribute to, result from, or complicate disease and its treatment should be important targets for prevention and intervention. We showed, for example, dramatic improvements in psychological health, functioning, and syncope recurrence when we addressed pertinent psychological factors in a standardised cognitive-behavioural intervention in a small pilot randomised study in patients with recurrent syncope. Separate evidence is emerging that complementary psychological interventions, for example, that target stress or hostility, can further reduce morbidity and mortality in those that have suffered a MI. We are currently conducting two pilot studies to evaluate the acceptability and efficacy of stress management approaches in improving psychological and physical health in individuals suffering from congestive heart failure and metabolic syndrome.

This research represents but a tiny part of the tremendous and important work currently being performed across the globe with potential to inform health reforms that will make global health possible in the young and old alike.

We face several challenges, among which is the scepticism of some

decision makers regarding the importance of psychosocial issues in clinical practice and research, as well as reduced funding opportunities. Yet, psychological distress is one of the most important causes of invalidity and loss of productivity worldwide, and research has shown the potential for cost- and life-saving benefits of addressing psychosocial needs.



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Working wounded: Preventing Work Disability through Accommodation

Disability is an important public health problem: it excludes individuals from full participation in society, education, and employment, and increases their dependency on social security and care. Persons with disabilities have lower participation rates in the labour force than those without. Work is important: good work keeps you healthy, good health keeps you working. Since older adults are choosing (and often need) to remain in the workforce, the problem of work disability is expected to increase dramatically over the next decade. Older workers with more potential for health-related issues will present new challenges for preventing work disability.

Dr. Kristman's program of research proposes to target the prevention of work disability through accommodation. Accommodation is defined as modifications to work and work environments designed to enable participation in work. These include both formal and informal accommodations and adaptations at various stakeholder levels (workers, workplaces, organizations, sectors, policy, educational institutions, the health care system, etc.). Accommodated work has been shown to be an effective means of preventing work disability for workers with low back pain in the US. Dr. Kristman's program of research will expand on accommodation as a means for decreasing work disability due to other chronic illnesses beyond low back pain, especially for those chronic illnesses highly prevalent in older age.

The overall objective of the proposed program of research is to prevent work disability through the provision of work accommodation. The research program aims to answer three specific research questions:

- How can stakeholders identify or develop accommodations for workers trying to return to the labour force?
- How can workplaces and employers support the implementation and application of workplace accommodations?
- How do we measure and demonstrate the health and economic impacts of workplace accommodation for all stakeholders (i.e., workers, employment-seekers and their families, employers, governments, insurers, unions and associations, etc.)?

Work disability prevention is a transdisciplinary problem and hence, requires a transdisciplinary approach. Dr. Kristman's background training has provided her with strong methodological and analytical skills in epidemiology. Therefore, her approach is epidemiological in nature, but is also very collaborative, as to utilize the skills of individuals from many disciplines. These varying perspectives will increase understanding of the issues, enhance the depth of the research, and improve knowledge translation to stakeholders.

The research program will develop strong evidence and approaches that support interventions and policies



Dr. Vicki Kristman is an Associate Professor in the Department of Health Sciences at Lakehead University, Thunder Bay, Ontario, Canada and Associate Scientist at the Institute for Work & Health in Toronto, Ontario. She also holds appointments in the Northern Ontario School of Medicine, the Dalla Lana School of Public Health at the University of Toronto, the Center for Applied Health Research at St. Joseph's Care Group in Thunder Bay, and in the Center for Education and Research on Aging and Health at Lakehead University. Kristman completed post-doctoral training at the University Health Network in Toronto. During that time she completed the CIHR strategic training program in Work Disability Prevention. She completed her doctoral work in epidemiology from the University of Toronto. In 2014, she was awarded a prestigious CIHR New Investigator Award for her program of research on "Preventing Work Disability through Accommodation".



focused on accommodation and enabling healthy work. This evidence will lead to improved workplace accommodation and decreased work disability, potentially saving billions of dollars in direct and indirect costs associated with work disability. Beyond just cost savings, more importantly the health of the working population will improve. Research from the past 30 years provides undeniable evidence that work and health benefit each other.

CIHR-funded Supervisor training Randomized Controlled Trial

Supervisors of injured workers play a key role in preventing prolonged work absences. Providing supervisors with tools to improve their response to musculoskeletal and other workplace injuries may improve worker health and disability outcomes. The purpose of this current ongoing study is to determine if a supervisor training program can improve work

disability outcomes for injured workers. The project involves employers in Canada and the US. Work units within participating companies are randomized to either receive the training or not. All supervisors within those work units randomized to receive the training are given 2 two-hour sessions of supervisor training. The goals of the training program consist of increasing opportunity for problem solving to reduce injury rates, improving supervisor response to prevent or decrease work disability, and improving communication between supervisors, employees and health care providers. Worker outcomes, to be determined from workplace records, include number of lost-time injuries, duration of lost-time injuries in days, and number of days of sick leave. Results from this study will provide a strong conceptual basis for the inclusion of supervisor training in the implementation of future workplace intervention trials.

Dr. Kristman is seeking corporate partners for involvement in this project. If you are interested in learning more, please contact Dr. Kristman at 1-(807) 343-8961 or vkristman@lakeheadu.ca.



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Aspirin the new cancer drug



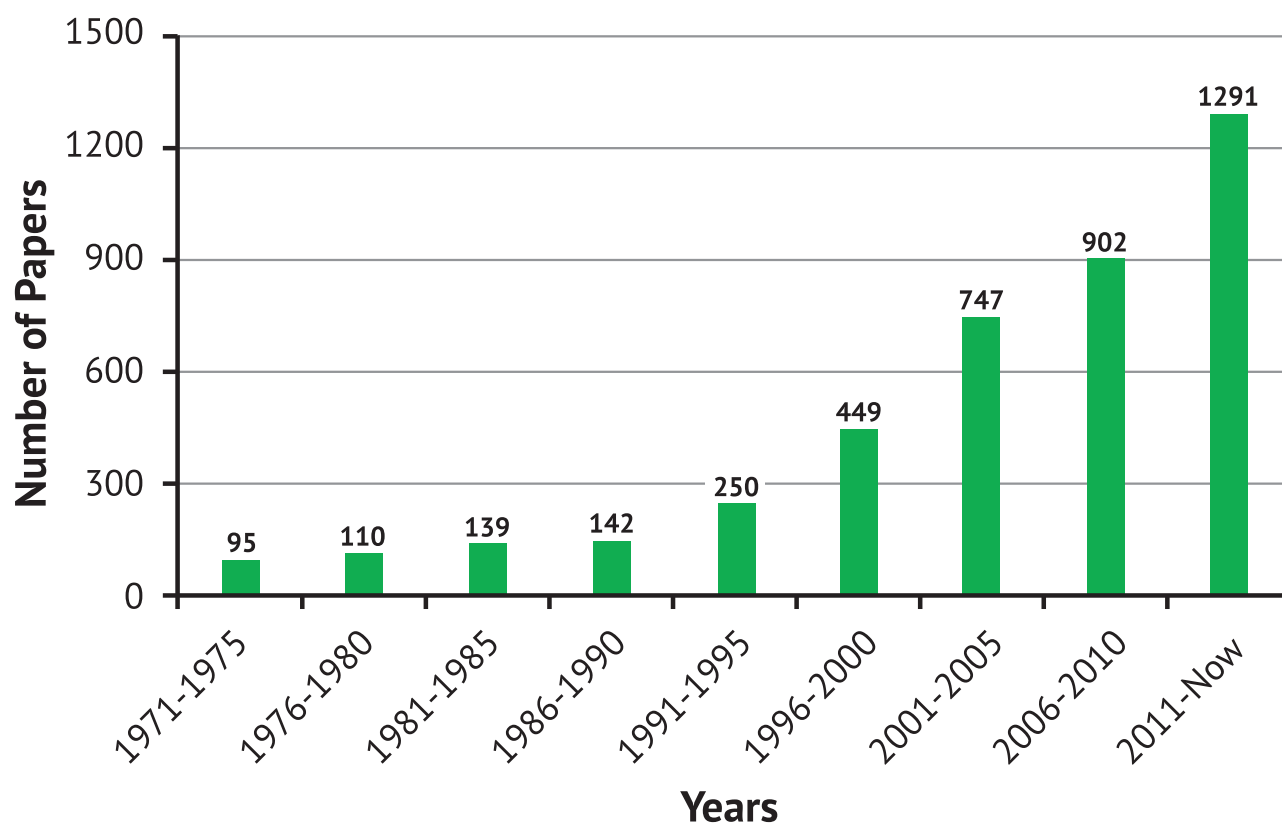
Aspirin, which was first synthesized by Felix Hoffman >100 years ago has been referred to as The Wonder Drug due to its multiple therapeutic actions. These include, in addition to its well-known actions to reduce fever, pain and inflammation, the utility of aspirin for cardiac patients including the treatment of primary and secondary cardiovascular events, thrombosis and stroke as well as reducing the severity of a myocardial infarct if taken shortly after onset. In addition, regular aspirin consumption has benefits in reducing the incidence and/or severity of a number of diseases including Alzheimer's and Parkinson's, diabetes and a multitude of cancers. It is the last indication that is the subject of this profile.

In reviewing the literature on the subject, it is meaningful that after the

initial reports that cancer incidence appeared to be reduced in regular users of aspirin in 1970's, there has been an explosion of publications with >1,200 papers published over the past 5 years (see Figure). These publications all have a common message that regular users of low-dose aspirin (which can range from taking a tablet containing 75mg-325mg, 2-7 days/week) can reduce a subjects risk in developing a vast number (>20) of cancers by 20-40% that are responsible for the preponderance of cancer-related hospitalizations/costs, morbidity and mortality. Included are meta-analyses of large populations (>100,000 subjects) being followed for 20 or more years (Women's Health Study, Health Professional Follow-up Study, Nurses' Health Study). Thus the results are extremely compelling making aspirin one of the most effective anti-cancer drugs available today at a bargain price.

Another very exciting development is the observation for a number of cancers including colorectal and breast cancer, that even if taken post-diagnosis aspirin can reduce the metastatic spread of the cancer, as well as markedly prolonging patient survival (in some reports doubling life expectancy). These remarkable actions have led a subcommittee of the US Preventive Services Task Force (USPSTF) to recommend in September 2015 that subjects between the ages of 50-69 years of age take low-dose aspirin daily for 10 years or more to prevent colorectal cancer (the 3rd major cancer affecting the Western World), with the proviso that they consult their physician to make sure they don't have any underlying risk factors, most notably a history of peptic ulcer disease due to the well-known effects of aspirin and related NSAIDs to cause gastrointestinal (GI) ulcers and bleeding.

Publications using keywords aspirin and cancer



The major interest of our laboratory is to elucidate the mechanism by which aspirin can prevent cancer and potentially treat pre-existing cancers, and at the same time reduce the GI side effects of this Wonder Drug. With regard to its anti-neoplastic actions we are focusing on aspirin's anti-platelet action, as the platelet is known to be a major player in both cardiovascular disease (notably the formation of thrombi that can cause vascular occlusion leading to strokes and myocardial infarction and its less well-appreciated ability to promote the growth of cancers (due to the well-established linkage of cancer and venous thrombosis thought to be caused by an increase in platelet numbers during late-stage cancer). With regard to GI safety, based upon our laboratory findings over the past 30 years, a novel phospholipid-based

aspirin (PL2200Aspirin) is under development by PLx Pharma, LLC with evidence that this newly FDA-approved drug reduces aspirin-induced surface injury to the upper GI tract in animal studies and limited clinical trials, without affecting its prominent anti-platelet activity.

Conclusion and outlook

As the evidence builds, there is increased appreciation of the use of low-dose aspirin in both the prevention (leading to the new guidelines of the USPSTF) and possibly treatment of cancer as an adjuvant therapy with established chemo/immunotherapy. This new use of aspirin comes with certain risks, notably related to GI ulceration and bleeding, leading to the pressing need for a GI-safer aspirin for high-risk subjects, which is currently under development.

Disclosure: Professor Lichtenberger is the Scientific Founder of PLx Pharma LLC, and is a shareholder.



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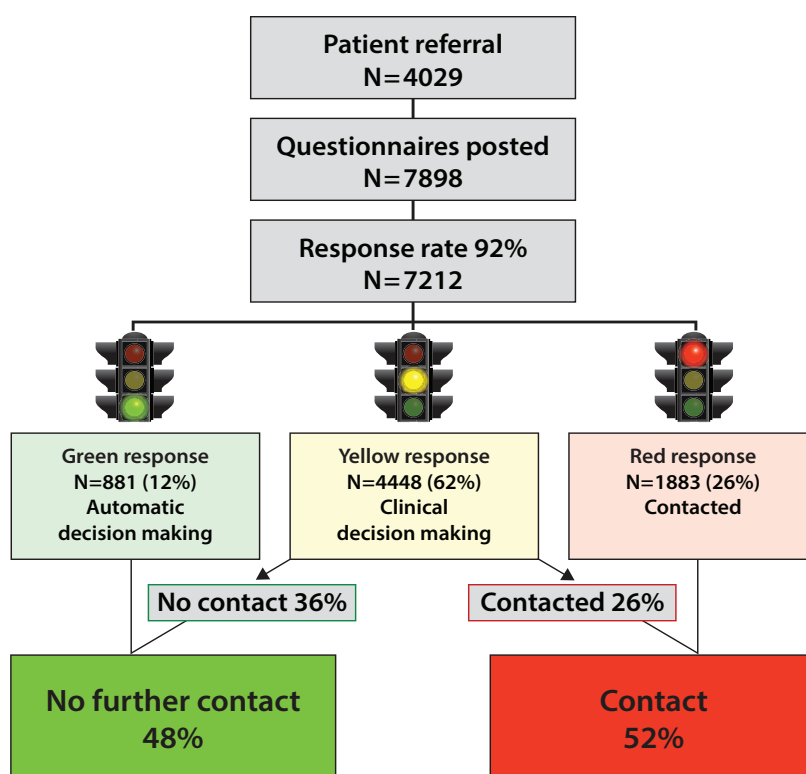
Success with Tele HealthCare at scale in Central Denmark Region

Often telemedicine and remote management of chronic diseases are only applied in small scale and have not become an integral part of daily practise. In Central Denmark Region we have, however, succeeded in implementing telemedicine at a larger scale and into daily practise. This article highlights a few examples of successful large scale interventions and their reasons for success.

One of the reasons for success is that health care professionals are combining new ways of working with the use of standardised eHealth care solutions. Furthermore, we aim at using generic technological solutions that can be used for different patient groups.

The patient as an active co-player

The key to successful implementation of telemedicine at a larger scale is intense focus on other factors than the technology itself. Attention is brought to new care models with extensive patient engagement and personalisation of services. We have succeeded in engaging patients in their own health management by systematically using patient reported outcome on health status and by applying home monitoring combined with educating our patients in better understanding their own health. The result is high quality in treatment, high patient security and empowerment of the patients.



Patient Reported Outcome in AmbuFlex reduces the number of face-to-face consultations for outpatients by 48%

Outpatient visits according to needs

Traditionally, control of outpatients is part of a standardised treatment programme. However, often the consultation proves unnecessary and could be avoided if the health professionals had had access to few essential data on the state of the patient prior to a consultation.

Knowledge of the state of the patient is provided via questionnaires answered by the patients at home without causing extra time consumption for the health professionals involved. The questionnaires, in the system called AmbuFlex, are used to assess the patient's needs

for a physical consultation. The data from the questionnaires provide clinical decision support in terms of allocating which patients should be seen in the outpatient clinic.

More than 4,000 patients diagnosed with epilepsy use the generic system AmbuFlex for reporting on the status of their health. Data reveals that close to every second outpatient visit can be replaced by a new questionnaire instead of a face to face consultation. The same system is in use for a wide range of patient groups. Furthermore it has recently been decided to deploy the use of patient reported outcome nationwide.



Women with complicated pregnancies monitor the health of their unborn child at home, thus avoiding long term hospitalisation



Digital photos and cross sectional care plans improve treatment of diabetic foot ulcers and venous leg ulcers

Home monitoring of complicated pregnancies

Another example of tele healthcare at a larger scale is home monitoring of women with complicated pregnancies for example the risk of pregnancy toxemia or when the water brakes before due date. By monitoring clinical key indicators and using customized electronic questionnaires in the system called OpenTele, hospitalizations can often be avoided or shortened.

The patients obtain a sense of security and reduced uncertainty due to the fact that the frequent remote monitoring is followed by a close dialogue with the hospital via phone or the built-in secure messaging system. The patients learn more about their health condition and in some cases the costs have been reduced with 77% compared with traditional patient treatment that can involve hospitalization for several weeks.

Generic solution

OpenTele is flexible and can be used to combine a number of different clinical values thus being suitable for a wide

range of different diseases. The solution was developed in a national context involving three different regions. More than 1,500 patients have used the platform for monitoring diabetes, chronic obstructive pulmonary disease, inflammatory bowel disease and complicated pregnancies.

Focus on coordination across sectors

Telemedicine has a high level of attention, to ensure high quality in patient flows across sectors and timely treatment of patients with chronic health conditions.

We have obtained valuable knowledge from the large scale project telemedical assessment of ulcers. The project targets patients with diabetic foot ulcers or venous leg ulcers, where digital images and shared care plans are accessed by healthcare staff in hospitals, community nurses and patients.

The goal is to reduce outpatient consultations, provide easier access to specialists at the hospitals, improve patient safety and enable patients to

save time for transportation. Approximately 1,000 patients have been included.

The next large scale initiative is proving cross sectional tele healthcare for patients with chronic obstructive pulmonary disease.

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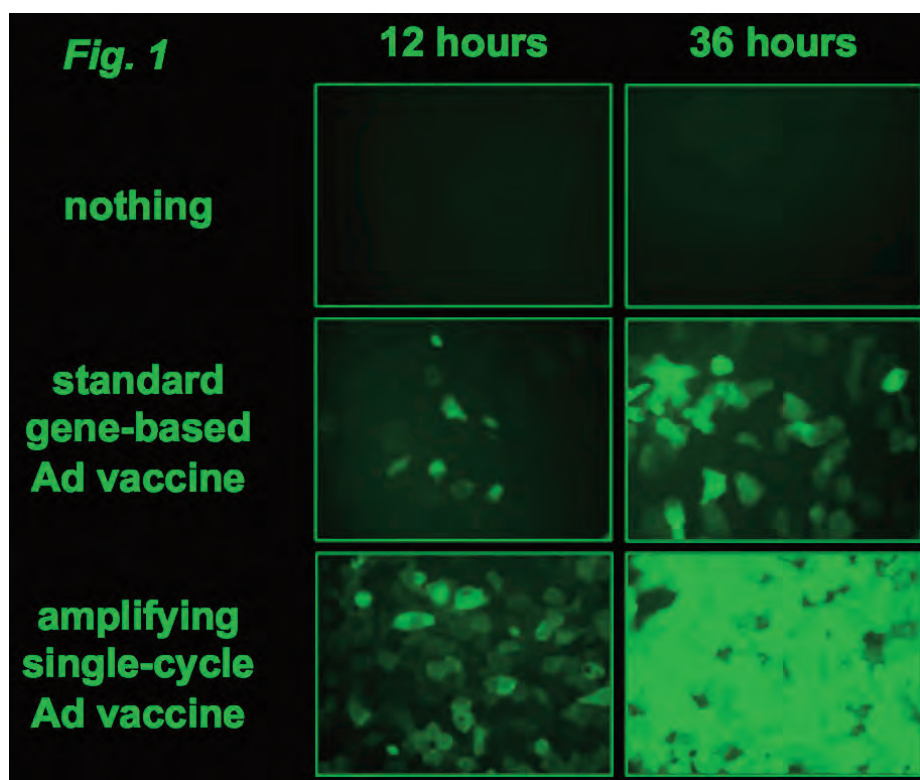
Next generation vaccines

Global Vaccines

Vaccination is the most cost effective medical intervention. The basic premise of vaccines is to prevent infections and diseases before they happen. Vaccines are also relatively blind to wealth and are a cost-effective means to serve not only wealthy countries, but also people in economically-disadvantaged locations. It has been said that all of the easy vaccines have been made and we are now faced with engineering to protect against some of the most intractable infectious diseases and cancer.

Next Generation Amplifying Vaccines Live-Attenuated Vaccines

Some of the best vaccines humans receive are live-attenuated vaccines that use the actual pathogen itself as a vaccine. A live attenuated vaccine is potent because it can infect the host and drive antibody and cellular immune responses necessary to kill bugs inside and outside of cells in the body. While live-attenuated vaccines are potent, they run a finite risk of actually causing the disease they aim to prevent. Damaging a virus or bacteria “a little bit” can be tricky and sometimes fully wild pathogens can survive engineering for safety. Tragic examples of this include vaccine-associated polio outbreaks currently in Africa and Asia. In other cases of highly mutating viruses like HIV-1, a live-attenuated form of the vaccine can actually mutate itself back into a



pathogen. From this, live-attenuated vaccines are potent, but carry significant risks, and should be used only when absolutely necessary.

Simple Protein Vaccines

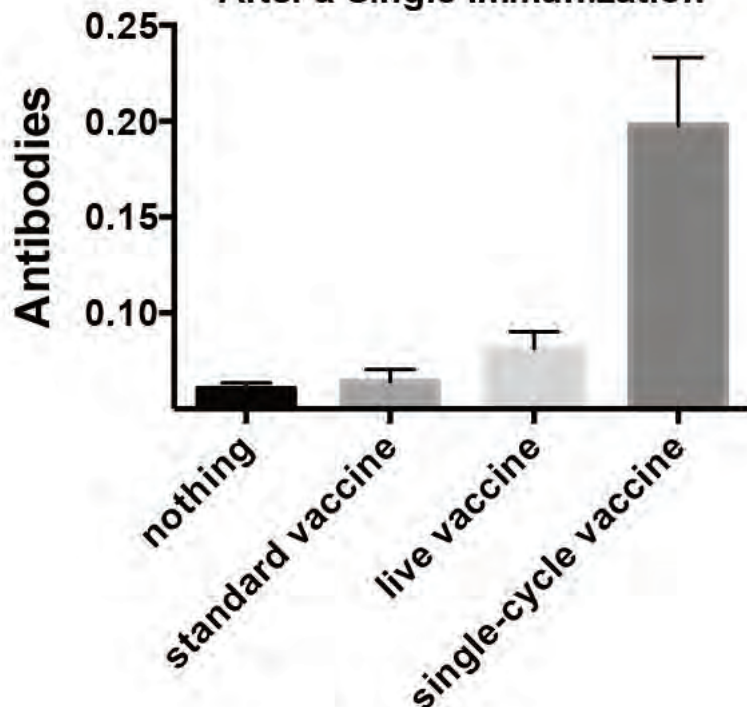
Like humans, viruses and bacteria have genes that serve as blue prints to make them what they are. These gene blue prints are used mostly to make proteins. Some, but not all of the many proteins that a pathogen produces are targeted when live-attenuated pathogens are used as vaccines. Given the risks of attenuated vaccines, one safer approach is to pluck individual genes out of the pathogen and use them to make proteins vaccines without any pathogen.

Examples include hepatitis B virus (HBV) and the human papillomavirus (HPV). Protein vaccines are the exception rather than the rule in the vaccine world because they are usually markedly less potent. Protein vaccines can be “suped” up by adding chemicals known as adjuvants that excite the immune system. While these increase protein vaccine potency, they also increase the potency of side effects including pain, swelling, and in rare cases neurological effects.

Meeting in the Middle: Gene-based Vaccines

Instead of using the potentially dangerous pathogen as a vaccine or its weak proteins a vaccine, we use their

Fig. 2. Vaccine Responses 12 Weeks After a Single Immunization



Michael A Barry Phd, Professor

genes against them as gene-based vaccines. Gene-based vaccines carry no risk of infection because we do not deliver all the genes of the pathogen, so cannot make the pathogen. While safer, they are also more potent than protein vaccines, because gene-based vaccines are delivered into a person's own cells and these cells act as a factory to make our vaccine for us in the body. This is a more natural and effective way of stimulating the immune system that mimics a natural infection, but without any infection.

Single-cycle Amplifying Gene-based Vaccines

Gene-based vaccines usually deliver one copy of a vaccine gene to a cell and make only a little protein to activate the immune system. For example, a standard gene-based vaccine vector based on adenovirus (Ad) delivers its gene to human cells and makes low

amounts of green protein (Figure 1). In mice, they are potent. However, this low protein production generally makes them weak in humans that are 300 times larger. To compensate, gene-based vaccines frequently have to be used at higher and higher doses. Increasing vaccine dose not only increases potency, but also increases side effects.

To "super" these vaccines, we re-engineered them to be amplified to copy each vaccine gene up to 100,000-fold in each cell. For example, these "single-cycle" Ad vaccines initially deliver genes in the same number of cells, but then amplify green vaccine protein production to amplify vaccine effects (Figure 1).

These amplifying single cycle Ad vaccines are now documented to generate markedly stronger immune

responses as vaccines than standard gene-based vaccines or fully live gene-based vaccines (Figure 2). Based on this, our single-cycle Ad vaccines are now being harnessed against HIV, influenza, Ebola, MRSA, and TB.



Michael A Barry Phd Professor

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ACHIEVING THE IMPOSSIBLE: 310 DAYS PRESSURE ULCER FREE

The prevailing pressure ulcer crisis

Globally, **pressure ulcers affect 15.3% of patients**, across a variety of care settings^{1,2,3,4,5}. 20-25% of beds are occupied each day by patients with pressure ulcers⁶. 60-80% of these are hospital acquired⁶. The cost to treat an individual ulcer ranges from £1,064-£1,551⁷. **Pressure ulcers cost the NHS an estimated £1.4bn-£2.1bn** annually (4% of total expenditure)⁷.

Mölnlycke Health Care through research and product development have introduced a solution proven to help reduce the risk and occurrence of avoidable pressure ulcers. Prof. Nick Santamaria's RCT shows a **76% fall in incidence of hospital acquired pressure ulcers when using dressing in prevention**⁸. Our dressing Mepilex® Border Sacrum has been demonstrated to impact four extrinsic factors that can contribute to developing pressure ulcers; these being to redistribute shear, redistribute pressure, reduce friction, and to maintain an optimal microclimate^{9,10,11}.



University College London Hospital, Critical Care Unit have demonstrated a significant decrease in pressure ulcer incidence and prevalence.

The unit is a 35 bedded multi-specialty facility which accepts level 2-3 critically ill patients. The unit receives elective and emergency surgical admissions and emergency admissions via the wards and the accident & emergency department. The workforce comprises 200 whole-time equivalent nurses & nursing assistants, and a multi-disciplinary team of approximately 50.

Given the risk factors that most Critical Care Unit (CCU) patients present with, a rapid and immediate assessment of patient risk is required in order to ensure that these potential or actual risks are alleviated as far as possible.

After discussion amongst members of the multidisciplinary team at UCLH, it was agreed that given the need to reduce the number of pressure ulcers on their unit (19.9 acquired PUs per 1,000 in 2011)¹², and various local and national quality drivers, they would explore a 'whole team' approach to pressure ulcer prevention, including the prophylactic use of dressings on sacrum and heels.

There were a number of outcomes that they wanted to achieve:

- **Eliminate all pressure ulcers on UCLH Critical Care Unit**
- **Embed a culture of candor and harm free care within the Multi-Disciplinary Team**
- **Embrace Quality Improvement methodology**
- **Improve and support teamwork and communication**
- **Improve the patient experience and outcomes**

UCLH set about achieving their outcomes by developing an all encompassing intervention protocol that demonstrated a shift in culture from cure to prevention. The nurses use their clinical judgment on a minute by minute basis to assess the level of risk. They discuss their mistakes, celebrate their successes and have introduced Bay Safety Huddles which encourage staff to question the needs and individual risks to each patient. The final piece to their intervention protocol was the prophylactic use of dressings.

A Mepilex® Border Sacrum Dressing is applied to all level 3 patients, high risk patients or anyone that is of concern. The dressing is peeled back once per shift and the sacrum inspected by two nurses, and the dressing changed as required.

These changes in practice helped pressure ulcer incidence in their critical care unit to decrease from 19.9 per 1,000 patient population to 0.84 per 1,000 patient population in 2014¹³. Incredibly, they went **310 days pressure ulcer free!**

Watch this short video below, to hear from Elaine Thorpe, Critical Care Matron, University College London Hospital



Mölnlycke Health Care is a global provider of healthcare solutions. We have two complementary areas of focus, Wound Care and Surgical Solutions, both which work in parallel to benefit patients and healthcare professionals alike. Mölnlycke Health Care has a history of developing innovative wound care dressings for nearly 70 years. Over that period our aim has been to improve the quality of life for millions of people.

We offer support to the health care sector in a variety of different ways; to name a few we aim to provide our customers with clinical education and resources, most

of our solutions come complete with a wide range of evidence, both clinical and value justification and we aim to support in controlling costs and meet financial objectives. We work with NHS Establishments individually and help them meet the challenges that they are facing so that the quality of care that a patient receives remains best in class.

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- ¹² University College Hospital London, Pressure Ulcer Incidence, 2011
- ¹³ University College Hospital London, Pressure Ulcer Incidence, 2014



Figure 1. Mepilex® Border Sacrum

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Creating sustainable ehealth systems

Shared Services of the Ministry of Health (SPMS) Portugal fostering European convergence and inspiration for local interoperability...

More than creating a myriad of ehealth solutions, National eHealth Authorities, like SPMS (Shared Services of the Ministry of Health) in Portugal, face the challenge of building them in an interoperable manner. Therefore, looking towards a sustainable and interoperable eHealth ecosystem, SPMS has been investing, for the last years, in several National and European wide key initiatives.

Following the vision set by the eHealth European Interoperability Framework (depicted in Figure 1) and through an active enrolment and leading role in some key initiative (e.g. EXPAND project – www.expandproject.eu), SPMS has been seeking and achieving tremendous outcomes at different strategic, tactic and operational levels. This has organisational, as well as, country level impacts, namely:

- Provision of eHealth services for PT citizens living abroad, as well as for visiting citizens;
- Learn and inspire organisational changes to comply with best practices around EU;

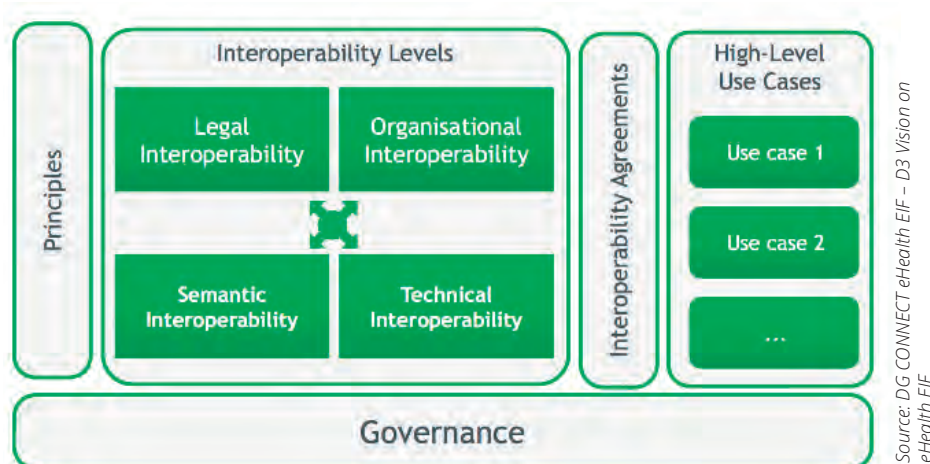


Figure 1: eHealth European Interoperability Framework

- Innovate in critical eHealth knowledge intensive fields;
- Promote convergence with the EU policies and guidelines.

From the EXPAND perspective (adopted internally at SPMS) the current EU project ecosystem (depicted in Figure 2) is organised in three layers:

- Policy and Governance;
- Sustainable Development;
- National activities (MS activities).

SPMS has been actively contributing

on the three ecosystem layers, participating in eight recently finished or on-going initiatives (refer to Table 1 for details), from 2013, projecting towards 2017, and currently preparing its application for CEF funds to launch live cross-border ehealth services. Alongside the effort in the international area, as way to localise best practices and develop a interoperability culture in the nation, SPMS has been very active on promoting and boosting national activities regarding interoperability competence centres and standardisation as such was practically inexistent before 2013.

Table 1 – European project participation

Project	Type	Short description
epSOS	LSP	Exchange of Patient Summaries and ePrescriptions across EU
Trillium Bridge	FP7 CSA	Bridging Patient Summaries across the Atlantic
e-SENS	LSP	Technological enhancement of epSOS Pilots
EXPAND	CIP TN	Sustaining and handover of EU projects eHealth mature assets
ASSESS CT	H2020 CSA	Investigate the fitness of SNOMED CT as a potential standard for EU-wide eHealth deployments
eStandards	H2020 CSA	Strengthen standards & interoperability, by alignment the adoption of standards in eHealth products and services
VALUeHEALTH	H2020 CSA	Demonstrate how eHealth IOP can deliver value for stakeholders, to justify sustainable investments in EU IOP
JaseHN (eHN-JA)	HP-PJ JA	Act as the main preparatory body for the eHN, by developing political recommendations and instruments for cooperation

Mostly such effort has been focussed on the activities of developing and launching a competence centre looking into semantics and terminology release, not just of SNOMED CT but other terminology alignment exercises. In the so called: CTC.PT – Clinical Terminologies Centre (www.ctcpt.net). The aim of which is to harmonise and orchestrate the use of clinical terminology for recording health information;

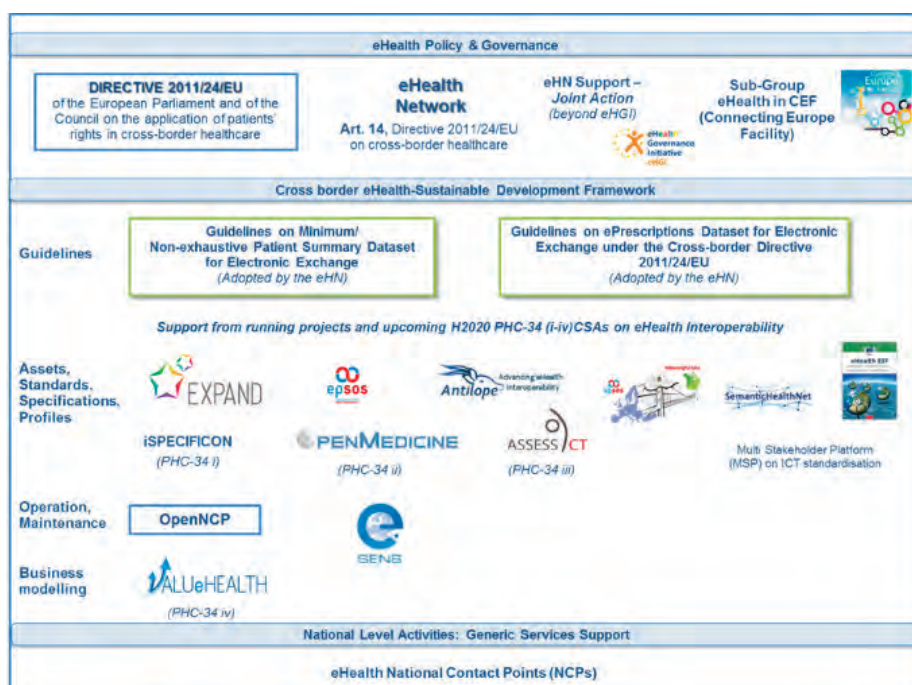


Figure 2: Key eHealth European projects ecosystem

and support the introduction of good practices leading to disambiguation of the meaning and increase of the information generated by health professionals use. At a technical interoperability level efforts with eHealth industry envision launching in 2015 the IHE.PT – Portuguese chapter from IHE Europe for fomenting the adoption of IHE profiles in eHealth ITC deployment, and HL7.PT – Portuguese Affiliate from HL7 International, which goal is to promote and localise HL7 standards in Portugal. As an culmination of this SPMS is looking to host a IHE promoted EXPANDTHON – project conetathon for real-life testing of eHealth digital services cross-border interoperable solutions.

In the context of cross border eHealth information services, looking to offer real IT/eHealth services in Portugal we have developed the following services/systems:

1. PDS the Portuguese Health Data Pratform – International Portal (linked to the large scale pilots: epSOS, e-SENS)

- Delivers Portuguese Health Professionals the ability to access to foreign citizens Patient Summaries and, in the future, ePrescriptions;

- Provide Portuguese Citizens an information service allowing a foreign Health Professional to access the citizens Patient Summary (only if the citizens has previously provided consent) and, in the future, ePrescriptions.

2. Program for Patients Mobility, Protocols and Regulations, constituted of different sub-systems:

- Information System for National Billing of Migrants;
 - Handles the national invoices resulting from actual expenditure arising from the treatment of international patients in NHS;
- Information System for Managing International Protocols and Regulations;
 - Is responsible for supporting the Regulation (EC) No 883/2004 and the Regulation (EC) No 898/2009 for the sickness flows and it will communicate with the international message exchange platform of EESSI – Electronic Exchange of Social Security Information. The invoices concerning bilateral protocols between Portugal and other countries (e.g.: Cape Verde, Andorra) are also managed by SIGAI;
- Electronic Exchange of Social Security Information;
- Information System for Managing and Supporting Patients Mobility and

- Portal of the Directive 2011/24/EU;
- Consists of several workflows that support the process of requests for medical assistance abroad according to national regulations, the process of medical assistance for evacuated patients from PALOP countries and the process of applying for a S2 authorisation;
- A portal was created to inform on aspects related to the UE Directive 2011/24/UE on the application of patients' rights in cross-border healthcare.

With a very stringent budget, and under austerity, many would wonder why Portugal would spend energy and resources on interoperability efforts. One of the main gains is that at present with an adapted version of the eHealth EIF, which we call LOSTI2 (Legal, Organisational, Semantic Technical International and Artificial Intelligence) most national projects have been framed with an interoperability spirit.

SPMS is now working on the next level as we see it. Ensure these initiatives reach higher levels of maturity, in order to achieve the overarching goal: the provision of the best, reliable and sustainable eHealth services to Health Professionals and Citizens from Portugal and abroad.



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Can TB be eliminated altogether?

Dr Masoud Dara, Senior Advisor at the World Health Organization explains the challenges of tackling TB to Editor Laura Evans, and why antibiotic resistance is such a problem...

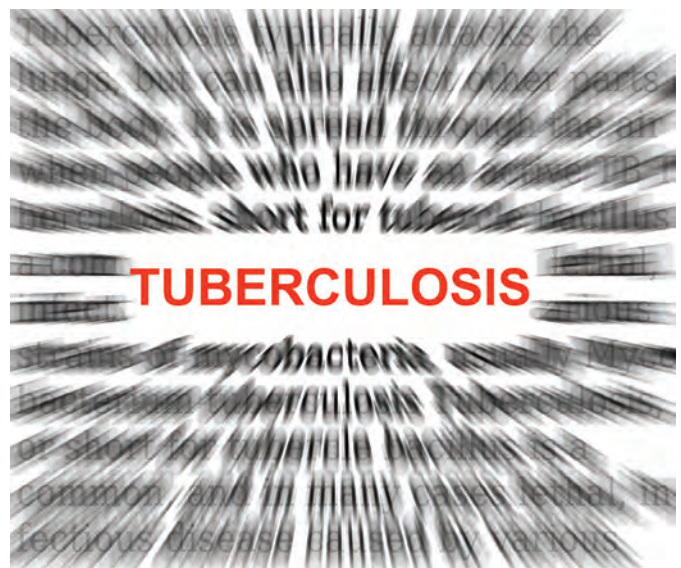
According to the World Health Organization, infectious diseases are caused by 'pathogenic microorganisms, such as bacteria, viruses, parasites and fungi. Such diseases can be spread from person to person, directly or indirectly. Tuberculosis, measles, meningococcal meningitis, chikungunya virus, malaria, plague, HIV/AIDS, rubella, and viral hepatitis all fall under the category of infectious diseases.

Tuberculosis (TB) in particular is a global public health threat which resulted in 1.5 million deaths in 2013 and caused 9 million people to fall ill in the same year. Editor Laura Evans spoke to Dr Masoud Dara from the World Health Organization Regional Office for Europe about tuberculosis (TB), and what the main challenges are in regards to treating this infectious disease.

"There is good news and bad news when we're talking about TB," explained Dr Dara. "The good news is that through effective implementation of the WHO recommended strategy, 37 million lives were saved between 2000 and 2013 in the world and the number of TB cases is reducing in Europe. In the last 5 years we have noticed a 6% annual decrease, which is the fastest decline among all WHO regions.

"The bad news, however, is that the rate of drug resistance among new cases is on rise. This form of the disease is very difficult to cure."

Tackling tuberculosis has become a major public health priority and Dr Dara believes that infectious diseases can be treated by "breaking the transmission cycle". He believes that it is crucial at a policy level that infectious diseases such as tuberculosis become a priority for governments worldwide, translating to adequate human and financial resources are needed to move towards eliminating the disease.



"If you do not invest now you have to spend much more in the future," he adds.

"Every case that is not treated correctly is going to infect 10-15 people per year – that's why it's important to scale up targeted activities to detect and cure all cases now. TB prevention and control programmes are very cost effective. A recent analysis published in the Economist presented TB control interventions as the fourth most effective value for money intervention to reach the Sustainable Development Goals¹ with every \$1 spent leading to \$43 saving."

Most people with TB are cured with a 6 month treatment regime, and in many countries 80-90% of people are successfully cured following the recommended treatment. However, drug resistance can occur if medicines not taken properly or are of poor quality. Under these conditions, amplification of resistance can occur and multidrug resistance tuberculosis (MDR-TB) can emerge, which is a form of the disease, resistant to the two most important medicines we have. Resistant strains can then be transmitted to

others particularly in crowded settings such as prisons or hospitals, leading to further spread of the disease.

“If the patient has MDR-TB then they need further treatment which can last up to 2.5 years,” says Dr Dara. “This treatment is with 6 or 7 drugs and there can be many adverse events – including suicidal thoughts, liver damage and hearing problems. Due to these side effects, patients often stop the treatment or only take some of their medicines, which can make it even more difficult to treat.”

“Tackling tuberculosis has become a major public health priority and Dr Dara believes that infectious diseases can be treated by “breaking the transmission cycle”.

In 2013, 480,000 people developed multidrug-resistant TB in the world. Currently only half of those patients are successfully cured. It is believed that \$2 bn per year is needed to fill the resource gaps for implementing the existing TB interventions.

“The treatments success heavily depends on whether you have good diagnostic tools to rapidly detect resistance,” says Dr Dara. “Time is very precious in terms of diagnosing the right pattern of resistance to give the right treatment. If the patient is given treatment that is not based on the resistance pattern, you could create more resistance. This is then called amplification, which you need to avoid because it will lead to more and more resistance and the patient will have no options for treatment.”

In September the World Health Organization launched a new End TB Strategy. The new agenda highlights strategic directions to integrate digital health into TB prevention and care activities.

“The End TB Strategy is quite important and has 3 main pillars to focus on,” explains Dr Dara. “The first is ensuring the best care is given to patients, and all patients. The second is making sure you have a patient-centred health system and supportive environment which can cater for the patient’s needs.

If the patient has to travel and get a bus every day for treatment for example, that could lead to interrupting the treatment.”

Another very important aspect is special support such as nutritional and psychological support to help patients finish their treatment. The third pillar of the End TB Strategy is research and development. Dr Dara emphasises that it is extremely important to scale up research and development for new tools particularly a new effective vaccine and shorter and more effective treatment regime.

“In WHO Office for Europe we have worked with our Member States and partners and adapted the End TB Strategy to the Regional context and prepared a 5 year Tuberculosis Action Plan 2016-2020 with even more ambitious targets than those of the global level. The 65th WHO Regional Committee adopted this plan on 17 September 2015. Together with our partners, we will assist the Member States to implement the Plan.

“The main goal is to decrease TB rates faster and improve treatment outcomes of all TB cases, which are achievable if all countries fully implement the Action Plan” he says.

The question stands as to whether we can eliminate TB altogether, and Dr Masoud is hopeful. Elimination would be less than 1 TB case per million of the population, he believes that to reach this we need substantial increase in investment in research and development for new tools including new vaccines and rapid access to them across the world. ■

1 The economics of optimism, The Economist 24 January 2015
<http://www.economist.com/news/finance-and-economics/21640361-debate-heats-up-about-what-goals-world-should-set-itself-2030>

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Prevention of congenital CMV disease: a possible European health enterprise

Cytomegalovirus (CMV) is a common virus of the herpes family. It can be spread through bodily fluids, close contact with children and bodily contact such as kissing. CMV can be contracted at any age, but the majority of people are infected during childhood and do not notice it as, in the majority of cases, the first infection is asymptomatic or presents with a mild, aspecific flu-like syndrome.

Although the virus stays in your body for the rest of your life, it rarely causes any further problems unless it is reactivated. This 'reactivation' is often the result of a weakened immune system usually brought about by conditions such as untreated HIV, cancer or taking immunosuppressant medication. As there is currently no vaccine for CMV, immunoglobulins – a class of proteins present in the serum and cells of the immune system, that function as antibodies – are used to treat thousands of patients at risk of reactivation and re-infection, with some efficacy.

The first infection with CMV (or its reactivation) can be very dangerous when occurring in pregnant women, as the virus can pass through the placenta to the foetus. In the majority of cases, the virus does not harm the child; however, in some instances, it can have a serious impact on the development of the foetus and lead to signs such as jaundice, low birth weight and an enlarged liver and spleen. A small proportion of babies with congenital CMV develop long-term

clinically relevant deficits, including neurological syndromes, hearing loss, visual impairment and learning difficulties. Indeed, CMV is the leading cause of birth defects and childhood disabilities in the US, and likely it has a comparable impact in Europe.

Our study team at the Infectious Disease Unit, Pescara General Hospital, Italy, has recently set up a research protocol to explore the possibility that the infusion of high-dose, aspecific immunoglobulins may reduce the risk of mother to child transmission for CMV, as well as that the risk of foetal CMV disease whenever transmission occurs.

Previous studies have already shown that repeated infusions of immunoglobulins may be an attractive, atoxic and safe means of reducing the transmission of CMV and possibly its impact on foetuses after transmission.

Two different formulations of immunoglobulins are available so far: hyper-immune globulins (HIG) and aspecific intravenous immunoglobulins (IVIG). HIG are purified from the blood of people who are CMV-positive (100 per cent); thus, their blood is rich in antibodies specific to combating CMV. On the other hand, IVIG are derived from the blood of unselected donors of European descent, CMV-positive due to untested exposure in approximately 80 to 90 per cent of cases. The difference in percentages of people with CMV is therefore modest in Europe, where most donors are

recruited. The 2 preparations, as a consequence, are very similar in terms of concentration of CMV-specific antibodies. An interesting study recently showed that IVIGs contain a higher proportion of a peculiar class of CMV-specific antibodies, mostly responsible for neutralising the cytopathogenic activity of CMV *in vivo*.

In 2010, a monocentric longitudinal study was started at our site, Pescara, Italy, for the administration of IVIG to pregnant women with primary CMV infection, to test the hypothesis that high dose IVIG could be at least as effective as HIG in transferring passive immunity for CMV in pregnancy; interestingly, IVIG was produced at a quarter the cost of HIG. After 5 years, close to 400 women were enrolled and cared for in the protocol. We observed a lower rate of CMV transmission than previously reported and only two cases of possible CMV related neurodeficits after more than 2 years of follow-up. These effects are likely attributable to IVIG infusions during pregnancy. Furthermore, using antivirals in symptomatic babies, we observed a regression in hearing deficits in all ensuing cases.

Until now, our study concentrated on the maternal side of prevention. Administering IVIG to the mother was our main intervention to protect the foetus from transmission and damage of CMV. However, our next step forward will be set up in collaboration with neonatologists and paediatricians, to include the child's point of



view. We are aiming to start with another, international research protocol, which will include administering IVIG to the CMV-infected newborn. Indeed, the development of a complete immune response to pathogens takes approximately 16-20 weeks, the immune system reaching maturity for intracellular pathogens like CMV only at 34 weeks of gestation. So the hypothesis that some little patients from birth to 16-20 weeks of life be at increased and preventable risk of CMV immune damage needs to be tested, combining IVIG administration to the mother with IVIG administration to the newborn through 20 weeks of life. We hope in this way to further limit the occurrence of long-term neurocognitive consequences of congenital CMV infection.

In conclusion, although a small proportion of women are infected by CMV during pregnancy, babies who get infected may suffer from compli-

cations both short- and long-term, and for those affected the consequences can be devastating. This is one of the major health threats throughout Europe for pregnancies. We want to make a major health intervention of this, as proud European citizens. We plan to join Europe to produce research that may make it feasible to stop congenital CMV disease. We would like to develop and demonstrate the efficacy of a tool which makes it easy to prevent and control CMV infection in pregnancy, administering IVIG to the mother and newborn, as soon diagnosis of CMV infection is done throughout Europe.

The current monocentric study was completely based on institutional funds, managed with the invaluable help of the Fondazione Onlus Camillo de Lellis, which provided us strong administrative and logistic support and leading us to approach new European funding possibilities. Such a collabora-

tion made it possible to realise the study and helped us to maintain our scientific and intellectual freedom.



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Sexual Health: an integral approach

Martin van Rijn, State Secretary of Health, Welfare and Sport in the Netherlands highlights how in all their programs they aim to build awareness and resilience to sexual health problems...

In the Netherlands we have found that an integral approach is the best way to promote good sexual health. Sexual health covers much more than controlling sexually transmitted infections (STIs). Sexual health is about enjoying healthy relationships based on equality and being resilient. Sexual health is about access to reliable education and contraception; about the reduction of unintentional pregnancies and about combatting sexual violence.

The gains of this integral approach can be measured by the broad access to low-threshold facilities, by good comprehensive sexual education and by a relatively low number of teenage pregnancies and abortions.

This article focuses on the sexual health of young people. From the age of 12 until the mid-twenties, people undergo almost continuous and critical changes in their sexual development. In order to gain an insight of the state of the sexual health of young people, I have commissioned a program to monitor this group at 5 year intervals.

STI-clinics and local health authorities

At the base of the Dutch approach lies the regular health care system. General practitioners work according to standardised guidelines on sexual health. They offer STI testing and care, as well as referral to regular specialised help in case of unintended pregnancies, abortion or sexual violence. Additionally and in support of public health issues relating to infectious diseases I subsidise STI-clinics and sexuality counselling by local health authorities.

These facilities test for and treat STIs, including HIV, but they also deal with regular sexual health issues. Low-threshold help is offered free of charge, anonymously if needed. It is offered to targeted,

well-defined high risk groups, vulnerable populations, young people and victims of sexual violence.

STIs and HIV are not mandatorily reported diseases in the Netherlands, but thanks to the monitoring and registration at these sexual health care centres, we can gain a good insight into the incidence of STIs in key populations, including young adults. Other sexual topics can likewise be monitored. Moreover, local health authorities have customised their approach to fit the needs of young people by offering e-health facilities such as chat and email consultations.

Non-governmental organisation (NGOs)

Several NGOs receive government funding to support professionals in various settings of sexual health. NGOs, in cooperation with the local health authorities, provide comprehensive sexual education in schools. They have also developed educational resources about love, relationships and sexuality, such as the docu-series 'Long live Love'. These resources address the needs of secondary schools but are adaptable to the needs of other schools, such as vocational institutions. The series covers issues such as puberty, falling in love, relationships, sexual diversity, safe sex, contraception among others, in an integrated way.

Another example is the widely appreciated television program 'Dokter Corrie' aimed at primary school children. The program dares to touch taboo issues in a humorous and respectful way.

NGOs have also developed specific resources for social media; some of which have received awards internationally for their innovative approach and broad reach. I am very proud of the recently international acknowledgement of the website www.sense.info, a website with interactive information on all sexual



Martin van Rijn
State Secretary of Health,
Welfare and Sport

health related topics, inclusive the online game 'Can you fix it' in which youngsters themselves can direct the outcome of a film scene by changing the communication or behaviour of one of the actors. The game was awarded the prestigious Lovie in the European online awards for winning gold as the 'people's winner', as well as the jury's silver award.

In all our programs we aim to build awareness and resilience, to allow young people to make informed and sensible choices, and to access reliable information and care when needed.

International awareness

I believe sexual health requires ongoing attention because young people continuously reach new milestones in their sexual development as they mature. Also internationally, sexual health needs constant awareness. In the first place because infectious diseases themselves are crossing borders, but also because sexual health is still a complex and difficult topic, not in the least because of cultural differences, association with shame and stigmatisation. This trend will only increase, because of the globalisation, with more people travelling, migrant problems etc. The

subject also affects human rights, violence, human trafficking and infectious disease control.

Different countries need different solutions, but we can learn from each other. As a start, let's all aim for meeting the goals set internationally by the WHO, UNAIDS and ECDC in the elimination of HIV. For instance, even though the Dutch are a worldwide exception to the rule of HIV being a notifiable disease, the Dutch approach of registration and monitoring of people in care is exemplary. All HIV-treatment centres enter patient data into a national registry guaranteeing a well-documented continuation of care. From this data, it is evident that the Netherlands meets the international goals.

In the same way, we are determined to achieve our aims of an emotionally and physically resilient, well-informed youth population in our own cultural setting. ■

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Martin van Rijn

State Secretary of Health, Welfare and Sport

Ministry of Health, Welfare and Sport – Netherlands

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Are we standing in our own way on the path to a cure for HIV/AIDS

Although there are many reasons to celebrate the life-extending benefits from antiretroviral therapeutics (ART) for HIV/AIDS and the ability to chronically manage patients' disease for decades, the majority of people around the world living with the virus do not have access to ART and those that do, have over decades developed life-threatening side effects. Our inability to identify a cure to HIV lies not only in the as-of-yet failure of the medical research community to identify and develop appropriate means of ridding the body of the virus but also government and industrial policies that promote public opinion exclusively focused on chronic management scenarios instead of broadly exploring innovation for cure.

"An inconvenient truth"

(Davis Guggenheim)

There are approximately 37 million people living with HIV and 39 million have died of AIDS-related diseases since the start of the epidemic in 1981. As of March 2015, only 15 million people have access to treatments for HIV. It is estimated that one fifth of people infected with HIV in the USA have not been diagnosed and only half the patients with access to ART in the USA take prescribed medication. Durable suppression of HIV is only achieved in 25% of the patients who are linked to medical care and receiving ART. The etiologies for these statistics are hotly debated but as concerning as these numbers are, they are likely to be gross underesti-

mates of the magnitude of the global epidemic. As the majority of Americans are not routinely tested for HIV, the virus can go years without being diagnosed in an HIV positive person. With these statistics it is no wonder that every day an estimated 5,600 people globally become newly infected with the virus. Importantly, the statistics we are analysing are biased for populations who can or are willing to access HIV testing/treatment programs and where government policies or cultural beliefs allow the health status of individuals to be revealed.

Despite the research on HIV and AIDS from academic institutions, industry and advocacy groups and dedicated efforts of AIDS treatment activists that

forced government policy for early and expanded access to experimental drugs, the medical community and society are struggling with the fact that we are barely managing the HIV epidemic and AIDS crisis. For years we have been locked into thinking of solutions in terms of a chronic disease with life-long treatment. The past 30 years in which anti retroviral drugs (ARV) have been identified and treatment modalities have been refined are remarkable in their success in prolonging the lives of people infected with HIV. These years also have the inconvenient truth that they reflect with one exception, the Berlin patient, failure to discover a cure or achieve sustained viral suppression without ever changing drug regimens.



Cocktails, cascades and a conundrum

At this time, decision makers speak of an 'HIV Care Continuum', underwritten as policy by a United States Federal initiative and supported by the Center for Disease Control (CDC) and the National Institutes of Health (NIH). This four-part recommendation includes comprehensive HIV testing and diagnosis, linking and maintaining all HIV positive individuals to a health-care provider, providing all HIV positive patients with life-long access to ART and ensuring that for each patient, viral loads remain suppressed. The impracticality of this management model as a solution to the global AIDS pandemic can be appreciated in both social and economic considerations. In fact, while the ink is still wet on the HIV Care Continuum initiative, we already know that its goals are not broadly achievable due to significant attrition from care and treatment dubbed as the 'care cascade'.

Two potential limitations of the new policy are the magnitude of chemical production that will be necessary to meet the global demand for ARV (i.e. how do we produce this quantity of chemistry, for that many people, for all years that their disease will need to be managed) and an inadequate mechanism in place that can ensure long term compliance (i.e. uninterrupted access to healthcare and ART to a diverse global community with disparate education, infrastructure, cultural and religious beliefs). The limitations of this model will be exacerbated by the recent announcement from the World Health Organization (WHO) that they have reversed their policy from one of 'don't treat with ART until individuals become significantly immune-compromised'



Dr. Harold Charles Smith

to advocating that 'everyone be given ART immediately after diagnosis'. The recommendations go further to include pre-exposure prophylactic ART treatment (PrEP) for HIV negative individuals who are at high risk of infection. We now are faced with the conundrum of an expanded and global epidemic with a need to supply ART and access to medical care for decades on a planetary scale. Given the improbability of this course of action, discovering a cure to HIV/AIDS has to become an overriding priority.

A challenge to the imagination for those who could make a difference

Key opinion leaders (KOLs) have in recent years said that they now "dare to imagine" a cure yet others say we cannot go there because 'there be dragons' in charting a course to cure, i.e. a cure is not possible. The HIV community is encouraged by talk about HIV eradication but are confused over the course that is being prescribed. The negative outlook toward curing HIV/AIDS actually has held back adequate funding for cure research by actively discouraging it for many years as 'intellectually unsound'. There is a peer review system comprised of experts from academia and

industry that adjudicates and ranks research proposals submitted to government and private foundations. A majority of those who served in peer review have been in lockstep with the dogma that a cure was not possible and they put the 'thumbs down' on priority scores that determine grant funding for hypotheses for the eradication of HIV. Simply put, if one could not state a hypothesis for a cure, then specific research objectives could not be articulated in a funding proposal for testing opportunities to cure HIV. Eventually word got out and such ideas no longer were submitted for consideration or they were couched as being for therapy. In that way, KOL's and rank and file scientists themselves influenced capitalisation and development of new concepts. I hasten to add that in this era gone by, had academic scientists inadvertently found a cure to HIV, it is unlikely that they would have suppressed findings simply based on government or foundation funding priorities. But cure has the potential of being a disruptive technology for the pharmaceutical industry and Wall Street. So it is not clear how industries would manage the impact of a cure on sales of life-long ART that have held reliable billion dollar profits from the sales of so-called 'block buster' drugs.

"A rose by any other name would smell as sweet"

(William Shakespeare)

Many members of the drug discovery and drug development communities remain astonished by the about-face that is now referred to as 'cure research'. The past structure leaves many scientists uncomfortable with the direction for and implementation of this change in emphasis. The many

years of the chronic therapeutic management mindset has left the map for ideation with many information voids. The years required for exploration have been squandered. Confusion is a typical symptom of deep shock that may explain why eradication research has become mired in a debate over what the word 'cure' means? Recent media blitzes have tragically rushed to be first to proclaim (define) a cure that turned out not to be. Trying to define cure as what can or cannot be achieved has been distracting. We certainly will know a cure when we find the overt evidence in someone like the Berlin patient.

We have to accept and stop arguing about whether a cure can only be 'functional' (no replicating virus detectable but genetic analysis will demonstrate the presence of HIV genomes) or what most would understand to be an absolute cure (the complete elimination of HIV genetic material from the patient's body). Will a cure be achievable for everyone who has HIV or only possible for certain strains of the virus? Will a cure only be achievable for patients with particular genetic backgrounds? Can a cure be achieved that enables an ART-free future or will there be a remission period that requires maintenance boosts over time? While one might speculate about the answer to these questions, a cure in any form MUST be acceptable, no matter how limited.

Learning from the past but encumbered by it

Eradication of HIV and prevention of new infections with the use of an HIV vaccine is a logical and appealing cure strategy that has been evaluated for many years. In fact, this has been the only 'cure talk' that was tolerated

before the recent glasnost on cure research. A vaccine strategy that is capable of neutralising one or multiple strains of HIV and does so for extended periods of time has not been achieved. Clearly there is precedent in other diseases that justifies continued pursuit of a broadly neutralising vaccine strategy. These endeavors have yielded a fascinating understanding of the acquired immune system relative to HIV that may yet triangulate investigators toward a curative vaccine strategy.

"There are approximately 37 million people living with HIV and 39 million have died of AIDS-related diseases since the start of the epidemic in 1981. As of March 2015, only 15 million people have access to treatments for HIV known as antiretroviral therapy (ART)."

Otherwise, cure research includes a reversal on the epidemic-long policy endorsed by government and industry to restrict innovation to new classes of drugs that interact with proteins and functions encoded solely by HIV. We know that HIV encoded functions must co-opt cellular and biochemical infrastructure and raw materials in order to replicate the virus. However, therapeutic strategies to thwart the virus by targeting pathways in the cell are discouraged and sidelined with speculation that they might be fraught with adverse effects. The development of many experimental ARV compounds has in fact been suspended by the systematic and industrial application of these criteria.

This position only makes sense if one chooses to ignore the fact that most

FDA-approved ARVs can have serious side effects that will almost certainly manifest in chronically treated patients.

For decades the efficacy of a new drug candidate has been assessed pre-clinically by the ability of HIV to evolve drug resistance to it in the laboratory. This policy is based on the premise that if a drug is interacting with an important viral target, the virus will figure out a way to become drug-resistant. Said in a different way, all ARVs that have been brought to market are already known to select for minority subspecies of HIV and therefore they have anticipated 'use until dates' (i.e. not curative). The industry and venture capital firms demand this proof and failure to establish it evokes silence in the room.

These policies certainly will become fodder for future debates on how to eradicate HIV. Would a new drug that is curative be able to satisfy these criteria? The Berlin patient was cured of HIV while treating him for his cancer. Certainly cancer eradication is not without significant side effects and risks. One has to wonder whether taking a toxic drug for 6 months to a year might not be worth the potential of a life-long cure for HIV/AIDS? If the answer to this question is yes, then it evokes concern that the rubric we have been following for drug approval may be responsible for why a cure has never been found in the 30 years of ARV development?

Given the industry-wide position of 'well tolerated' new drugs, it is curious that there has been lightning-fast uptake of the concept known as 'shock and kill'. The premise is that viral reservoirs (cells infected by HIV but not shedding virus) are the major

reason why ART cannot eradicate HIV. In this strategy, viral reservoirs are forced to express HIV so that the body's inflammatory and immune responses can identify and eliminate them. The drugs being evaluated in clinical trials are known as histone deacetylase inhibitors (HDACi) and are a class of drugs that induce gene expression by changing the structure of human chromosomes. Although these drugs have clinical applications as mood stabilisers, anti-epileptics, anti-inflammatory and anti-cancer treatments, they are fairly toxic, and their effect is not limited to viral genes. The use of HDACi treatment in HIV patients has been pushed through to clinical trials despite significant concern and skepticism in the scientific community. The public media has hastily portrayed HDACi as a 'cure' drug because in clinical trials it induced expression of HIV (viremia) from viral reservoirs in patients whose viral loads would have otherwise been suppressed by the ART they were receiving. Further studies will determine whether the activation of viral reservoirs with HDACi, or by any other means, will safely destroy all viral reservoirs, prevent the induced viremia from forming new reservoirs and provide, potentially in combination with ARV, a cure?

Links in the chain of responsibility

New findings from university and biotech labs have been largely portrayed as academic and ignored by the HIV media, KOLs and pharmaceutical industry. These new ideas are the background noise for a select cast of speakers invited to HIV conferences. Federal and foundation research grants are very difficult to get and typically only support incremental discoveries. Moreover, research uni-



Timothy Ray Brown, the Berlin Patient, Speaks to the ACTG

versities, due to their non profit tax status and professed need to protect their intellectual freedom, largely do not see it as their responsibility to do more than basic science, patent their ideas and wait for an industrial partner. Faculty and their students are generally discouraged by institutional policy from participating in contract research for drug development and cannot participate in commercialisation. Venture capital will not invest in new ideas unless there is a clear path (flip) to an industrial partner. Consequently ideas for cure (and therapeutics) at an early stage of development and the biotech companies bold enough to push them forwards are struggling in a financial 'valley of death'. The HIV-positive population will continue to grow unless everyone takes responsibility for discovering a cure and the monopoly on resources is dispersed.

"When you come to a fork in the road, take it"

(Yogi Berra)

It is essential that new research ideas and innovative approaches for cure are rapidly reviewed and diverse and divergent proposals become adequately funded so that they can be vetted, not lost in endless KOL debates in the media and at meetings on HIV/AIDS. Biotechnology needs to

be preserved and the biotech industry should be facilitated under a mandate to bridge the valley of death for the development of ideas for eradication as a matter of government policy. Government relationship with the pharmaceutical industry and taxation policies need to change such that resource allocations are incentivised for the development of new ideas for eradication. Society should demand of governments, foundations and HIV advocacy groups to demonstrate the political will to create a new fund, one of military budget proportions, for the discovery of a cure(s) for HIV/AIDS so that we can truly win a global war on HIV rather than manage the engagement.

Dr. Harold C. Smith, Ph.D. is the founder, CEO and President of OyaGen, Inc, a biotechnology company in Rochester, NY USA dedicated to the discovery and development of novel therapeutic approaches and eradication strategies for HIV/AIDS based on APOBEC host cell, viral restriction factors. He also is a tenured full professor in biochemistry and biophysics at the University of Rochester, School of Medicine and Dentistry where he conducts basic research on HIV and RNA biology and mentors undergraduates and graduate students in research and critical thinking.
[https://en.wikipedia.org/wiki/Harold_Smith_\(scientist\)](https://en.wikipedia.org/wiki/Harold_Smith_(scientist))



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Cardiovascular diseases at the heart of Dutch research

Adjacent Government outlines how the Dutch Heart Foundation is helping to tackle cardiovascular disease throughout the Netherlands...

The [World Health Organisation \(WHO\)](#) estimates that globally, 17.5 million people die each year from cardiovascular diseases (CVD). CVDs are disorders of the heart and blood vessels and include: coronary heart disease, cerebrovascular disease, and rheumatic heart disease. Figures show that 80% of all CVD deaths are due to heart attacks or strokes. Of the 17.5 million deaths worldwide in 2012, 4 million of those were in Europe alone. CVD causes 47% of all deaths in Europe, and 40% in the EU.

[In the Netherlands it is estimated](#) that more than 100 people a day are diagnosed with a heart disease. Reportedly there are 1 million cardiovascular patients in the Netherlands, with 1000 people hospitalised daily due to heart disease. It is also believed that 240,000 people in the country live with the after-effects of a stroke, caused by a CVD.

The [Dutch Heart Foundation](#) supports and funds research in order to prevent these types of diseases. Over the coming years the Foundation has announced that it will give priority to 5 key topic areas:

- Earlier detection of cardiovascular disease;
- Cardiovascular disease in women;
- Better treatment of heart failure and arrhythmias;
- Acute treatment of strokes;
- New ways to maintain a healthy lifestyle.

There are many contributing factors that can lead to a person developing a heart disease, including: an unhealthy diet; inactivity; smoking; alcohol; diabetes; and mental health conditions. Early detection can play a pivotal role in successful treatment and survival.

The Foundation has provided funding for research into earlier detection of cardiovascular diseases. [€10m was made available for researchers](#) to investigate complaints and signs, to map genetic predisposition, and develop new tests for cardiovascular disease as early as possible.

Joining forces with Technology Foundation STW, who will provide €2.5m of the funding, the Dutch Heart Foundation expects the collaboration to bring together expertise and networks.

Director of the Foundation, Floris Italianer said: "Only by joining forces can we defeat cardiovascular disease. That we will act together with STW is therefore an important step."

Grants from the Foundation can support research to help improve researchers' understanding of CVDs such as heart valve disease. This is when abnormalities in the heart cause one or more of its valves to narrow, harden or leak. This results in less blood passing through the heart valve, or a portion of the blood flowing back into the heart again.

[In 2009 the Foundation provided €900,000](#) of funding to Eindhoven University of Technology, and a further €5m in 2013, to continue their work into developing new 'intelligent' heart valves.

Funding such as this from the Foundation is key in order to prevent further deaths from cardiovascular diseases, and in the development of ground-breaking new treatments. ■

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Rebuilding tissues inside the human body

The creation of living tissues to replace or repair damaged tissues or organs in the human body has defied clinicians and researchers for centuries. Yet, only by the end of the last century, scientific progress and systematic approaches to grow or culture new tissues outside the human body led to the first market approvals of living tissue-engineered implants.

In its most fundamental paradigm tissue engineering entails the seeding of living cells, harvested from a donor, onto a pre-shaped biodegradable support material, or scaffold, of synthetic or natural origin. This cell-scaffold construct is generally cultured in a so-called bioreactor under conditions that favor cell expansion, tissue growth and tissue function. When the tissue has reached targeted functional properties, it can be implanted (Fig. 1A). Key to the success of this approach is the synthesis of substantial new tissue by the cells to take over the function of the degrading scaffold.

Compared to other approaches for tissue regeneration, like stem cell therapies, *in vitro* tissue engineering emerged as a promising therapy to replace tissues with a predominantly mechanical function that should withstand high dynamic loads immediately upon implantation. As such, research in our group concentrated on the creation of structurally organized load-bearing tissues for the cardio-

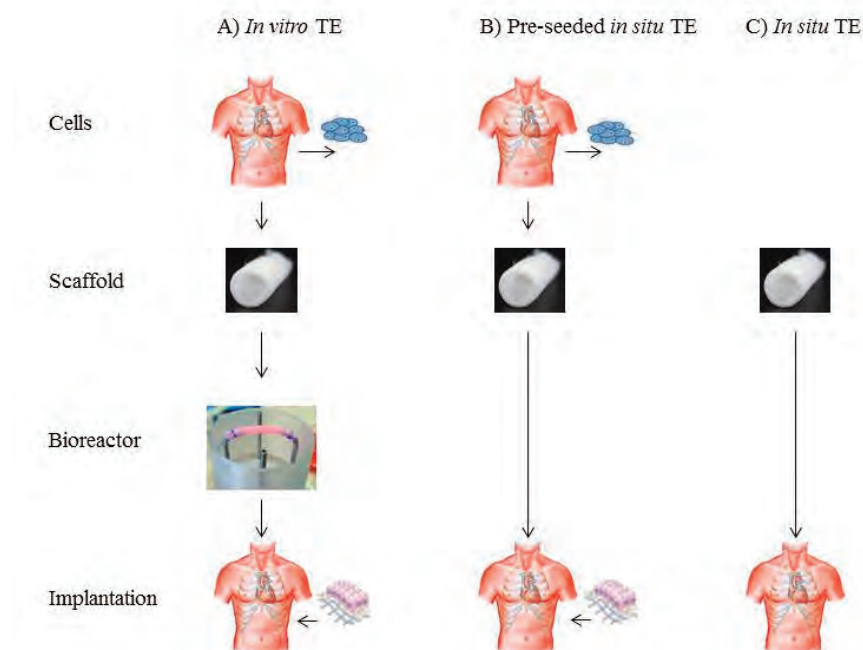


Fig 1. Paradigms of tissue engineering: A: *in vitro* tissue engineering (TE), where cells are harvested from a donor and seeded and cultured on temporary scaffolds inside a bioreactor. B and C: *In situ* tissue engineering, where tissues are created inside the human body at the site of destination using slow-degrading scaffolds. The example shown here aims at the creation of blood vessels from scaffolds that are either pre-seeded with cells harvested on the fly during the surgical procedure (B) or implanted as pristine materials (C).

vascular system: functional blood vessels, load-bearing heart valves, and supportive cardiac muscle tissues.

Heart valves

A prominent example is the heart valve. Heart valves control unidirectional flow through the heart and their damage or malfunction often leads to serious medical conditions. End-stage heart valve disease is commonly treated by replacement of the valve with a mechanical or bioprosthetic device. While these prostheses generally improve survival and quality of life, they have technical drawbacks that limit their long-term efficacy. These include thrombo-embolic complications requiring lifelong anticoagulation therapy in case of mechanical

valves, and limited durability due to calcification and structural failure in case of bioprostheses. Most importantly, prosthetic valves, including donor valves, are non-living structures that do not grow, repair or adapt. As a consequence, the life expectancy of patients after heart valve replacement is substantially lower than that of age-matched healthy individuals. The creation of a living, tissue engineered heart valve could circumvent many prostheses-related complications and would be particularly beneficial to paediatric patients.

By merging insights from engineering, life sciences and medicine, our group, in collaboration with partners from the University of Zurich, was the first

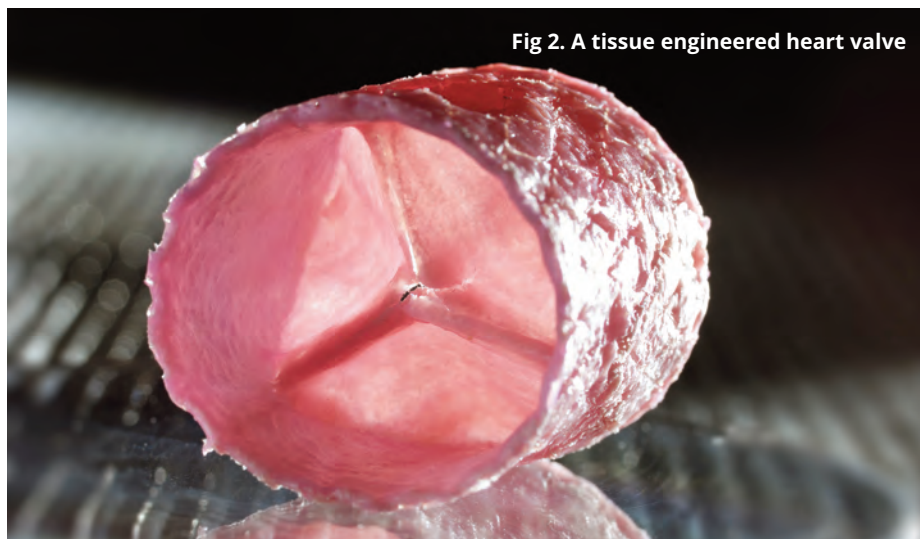


Fig 2. A tissue engineered heart valve

to develop a living tissue engineered heart valve that could withstand systemic loading and hence could function as an aortic heart valve¹ (Fig. 2). Translation of this technology to the clinic, however, was hampered by sub-optimal long-term in-vivo performance of these valves and valves from other labs – the biggest issue being valve leaflet retraction and consequent valvular leakage due to traction of the used cells. In addition, clinical introduction is hindered by the costly and laborious cell and tissue culture, associated high risks of infection, and the complex logistics and regulation of applying a living medical product.

***In situ* tissue engineering**

Recently, *in situ* tissue engineering was proposed as a route to create living heart valves inside the body (Fig. 1 B, C). In this innovative approach costly and complex tissue culture is omitted and the body itself is used as bioreactor. Cell-free valvular shaped scaffolds are implanted at the site of destination where they gradually transform into living heart valves by recruiting cells from the bloodstream. Both synthetic and biological scaffolds can be used, provided that they can function as a load-bearing heart valve upon implantation and adequately guide and control neo-tissue formation.

Contrary to *in vitro* tissue engineering, the technology is compatible with current regulation for medical devices and offers off-the-shelf availability at substantially reduced costs.

Collaboration

While this technology would constitute a simple and clinically attractive procedure, starting with the implantation of a non-living device, it requires the design of slow-degrading scaffolds that provide meticulous control over (selective) cell recruitment, cell fate, and load-bearing tissue formation. We propose the use of supramolecular polymers that can be fine-tuned with respect to degradation and mechanical properties, and functionalized with bioactive moieties to communicate with host cells in the course of tissue development^{2,3}. It is hypothesized that neo-tissue formation follows the pathways of wound healing and to align this process interaction with inflammatory and immune cells, as well as balanced tissue formation in pace with scaffold degradation in the beating heart, is critical. To achieve the essential deep understanding of these interactions, multidisciplinary consortia of material scientists, engineers, clinicians and biologists have been established. Within larger (inter)national frameworks they

collaborate with industrial partners and patient organizations to translate the technology to the clinic⁴⁻⁷.

Outlook

In situ tissue engineering holds great promise for the regeneration of damaged tissues and is foreseen to be valid for a broad range of applications. It provides the opportunity to create living tissue replacements that improve quality of life of many patients and that can outrange existing replacement therapies in terms of effectiveness, durability, availability, and costs. When successful, its simplicity and compliance with current regulatory protocols may favor a relatively smooth route to clinic.

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How Europe should act on childhood obesity

Nikolai Pushkarev, Policy Officer at the European Public Health Alliance (EPHA), outlines the importance of tackling obesity in children...

We are drowning in declarations, strategies and action plans dedicated to tackling the problem of obesity.¹ But today, about 40 years after the start of obesity's spectacular ascent, the World Health Organisation (WHO) still concludes that being overweight is on the rise in all European countries.² Obesity has increased to over 20% of the EU population, with over half of Europeans now overweight. Obesity is a risk factor for major chronic diseases, like diabetes, cancer and cardio vascular disease. It also leads to psychological suffering, affects productivity and drains health systems.

Obesity is not an individual choice. Childhood obesity, a condition now shared by a third of 11-year-olds, even less so.³ Most cultures see the child as especially worthy of protection. We attribute to children a sense of innocence and vulnerability and invest in them the hope that they may lead more accomplished lives. According to opinions within WHO, future generations may, for the first time in modern history, face a life expectancy lower than our own.⁴

So what should the EU do to tackle childhood obesity, a condition many consider particularly unfair?

The European Commission should target childhood obesity to mobilise support for policy intervention. At the same time policy-makers must realise that an effective response cannot be limited to actions aimed at children only. Children grow up in societies, not in regulatory silos. Childhood obesity already starts in the womb.^{5, 6, 7} As it is impossible to fence off children from environments that consistently promote unhealthy behaviours, these environments themselves must change. Such a transition is vital to achieve meaningful progress in rolling-back the tide of obesity.

The European Commission should abandon its over reliance on self-regulatory approaches. After over a decade of the voluntary approach – see e.g. EU Platform on Diet and Physical Activity – the figures for obesity speak for themselves, particularly for children: Self-regulation has failed. Even with the best intentions it involves a conflict of interests that is practically impossible for companies to overcome. Industry members will often say they need more time to reformulate, diversify product portfolios, to shift the focus of advertising. But time is quite a lot to ask for when limited in supply. At the end of the day, will food producers not be relieved from insecurity if an equal level playing field, high in public health, is set at European scale? They can then focus on their core business and innovation.

The European Commission must facilitate Member States' experimentation with public health measures. We already know quite a bit about what types of measures will succeed in promoting public health. Too often the Commission is more eager to protect the internal market than people's wellbeing. So Finland was recently warned about its 'candy tax', which it subsequently repealed despite health benefits.⁸ Rather than issuing such warnings, a more constructive way would be to work with countries to improve national laws thereby assisting authorities live up to their commitments before citizens.

A very practical opportunity to act presents itself with the revision of the Audiovisual Media Services Directive. This instrument can be significantly enhanced to protect minors from exposure to the insidious effects of marketing of high fat, sugar and salty foods. The food industry has already applied its technique of diversion by launching a new, extended version of the voluntary "EU Pledge". The main objective of the



Pledge is not to protect children – witness that ads for sugar-pumped cereals and fizzy drinks still relentlessly reach our kids – but to fend off regulation. The European Commission should not again fall into the trap of such delaying tactics.

Another opportunity for action is to restrict the use of trans-fatty acids in food. Several European countries are introducing national bans. In October 2015, in an unprecedented move, public health and consumer groups together with some of the world’s biggest food producers wrote a common letter asking the European Commission to follow suit at EU level. The harm from trans-fats is undeniable and directly linked to obesity and cardio vascular disease, and particularly affects disadvantaged socio-economic groups.

Finally, the European Commission should show intellectual leadership on public health. It should, as promised, come forward with a comprehensive, prevention-oriented Framework on Non-Communicable Diseases and start drawing the incoherent policies governing the food system into a sustainable, health-compatible policy on agriculture and food. Then it will give true meaning to the “Health in All Policies” obligation contained in the European Treaties. ■

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Paediatric Rheumatology in 2015

Paediatric Rheumatology has become recognised within the last 20 years as a paediatric subspecialty. Previously the care of these patients was undertaken by interested adult rheumatologists. However, the National Service Framework for children recognised that children should be seen in child-friendly areas by staff trained to look after children. In the UK, there are not enough Paediatric Rheumatologists to see all of these patients, and many are still seen by adult rheumatologists, or are seen by non-specialists. This is no longer acceptable practice.



In the last 20 years arthritis treatments have emerged which have brought fundamental improvements to the outcomes of children. These improvements can be measured not only in the number of adults who are not consigned to life in a wheelchair, but less demonstrably the even greater numbers whose functionality has been maintained through their school days, enabling them to fulfil their potential in life. However, the distribution of areas of best practice is lamentably poor, creating an inequality of access to care. There is no overall grasp of the problems that the current lack of systems throws up. Specialist commissioning is, to a certain extent, addressing some of the issues, but is itself overwhelmed by the huge task it has been assigned.

As a paediatric subspecialty, Paediatric Rheumatology has 2 major drawbacks: paediatricians were not historically taught how to examine the muscu-

loskeletal system, and many of the emerging drug treatments are more familiar to oncologists or immunologists than to paediatricians. Therefore, paediatricians are often unfamiliar with the skills to look after these patients and do not have a ready source of training to close the skills gap. At the moment, there is no added incentive for District General Hospitals (DGH) to provide paediatric rheumatology clinics, and many paediatricians are unwilling to take on the responsibility of caring for these patients.

The conditions that paediatric rheumatologists look after are chronic conditions that are considered to be rare: the commonest of these is Juvenile Idiopathic Arthritis (JIA) with an incidence of 1 in a 1000 children. DGH Paediatricians who start to see children with arthritis are often surprised by the number of patients (80 to 100 per DGH) they see. These children need to be seen frequently within the first

year of their diagnosis (and when their arthritis flares), as well as every 3 months once their disease is under control to monitor their growth and ensure their joints are developing normally. Added to this cohort will be children with musculoskeletal aches and pains that mimic arthritis: most DGHs should be running a regular Paediatric Rheumatology clinic.

BSPAR (British Society for Paediatric and Adolescent Rheumatology), in conjunction with ARMA (The Arthritis and Musculoskeletal Alliance), have published Standards of Care for JIA which have been internationally recognised. These describe the support that children with arthritis need access to: this includes access to physiotherapists, specialist nurses and occupational therapists. Paediatric musculoskeletal physiotherapists are needed for children with musculoskeletal aches and pains, whether they are due to arthritis or the more



common biomechanical problems (such as a muscle imbalance). This care should be provided locally: at the moment, the specialist centres are trying to plug this gap and are being overwhelmed. Patients with difficulties in activities of daily living (due to disease or pain) should have the support of an occupational therapist to help with access to schooling or to help them maintain their independence at home. The patients with arthritis, and other inflammatory diseases requiring immunosuppressant medication, should have the support of a clinical nurse specialist to help them understand their disease, their medication and to oversee the monitoring of the medication.

At the moment, most of this care depends on Paediatric Rheumatology Centres that have developed in a haphazard way. Each centre has been built up by an interested doctor, with no regard to population numbers or geography. Each centre has developed its own model of care with varying levels of support local to the family. Not all patients have access to a specialist centre and these will often be looked after by adult rheumatologists.

This inequality in care leads to a wide variation in outcomes: research has shown that delay to diagnosis is a poor prognostic factor for good outcome in

many inflammatory diseases. Arthritis is often viewed as an unexciting condition which is not life-threatening. Children with inflammatory diseases are at risk of life-threatening events, which are often poorly recognised until too late. Paediatricians, quite rightly, set great store in whether a child looks well or not. Unfortunately, these children often look relatively well, with only the blood tests indicating the severity of their underlying condition, until they collapse and end up in intensive care. Though this only occurs in the smaller number of children with systemic illness (rather than illness restricted to just the joints), the early stages are eminently treatable. Even with children whose disease is restricted to just one joint, such as the knee, the joint damage caused by arthritis leads to an inability to walk, leg length discrepancy and secondary spinal deformity. Children with multiple joints affected used to end up severely disabled with stunted growth, often in wheelchairs and unable to lead independent lives.

The advent of better medication in the last 20 years (methotrexate and then biologic agents such as etanercept) has improved outcomes enormously by controlling inflammation and allowing normal growth and development to take place. Teams looking after these patients have seen a shift from

struggling to keep these patients moving despite their joint problems, to supporting patients to regain normal strength and to maintain full access to their education.

There is a financial as well as a human cost in failing to provide proper care in the early years of disease. Stinting on preventive treatment in early years multiplies exponentially the cost of support and care in the rest of life. Existing Paediatric Rheumatology Centres are all oversubscribed and specialist commissioning aside, there is no attempt by government or the NHS to address the lack of an overall strategy to save children from unnecessary lifelong hardship. Paediatric Rheumatology teams are keen to improve the care of the children, but lack the time to train local teams to set up, and maintain, appropriate care. The tools exist, but we are failing our children by not enabling them to be put to use.



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Improving healthcare in Belgium

Adjacent Government outlines key priorities of the Belgian Minister for Public Health, Maggie De Block...

Ensuring citizens lead a healthy lifestyle is a cornerstone of policy for governments worldwide. Throughout Europe, Ministers and MPs are bringing the issue to the forefront with proposals for healthy eating strategies and taxes on sugary food and drink.

Healthy eating and reducing obesity is part of the action plan of the new Belgian Minister for Public Health, [Maggie De Block](#). Since coming into office last year De Block has caused quite a media stir. The Minister has been criticised across Europe for being overweight herself. However, one of her main priorities in her new role has been to tackle obesity and, De Block who practiced medicine as a GP for 25 years, has subsequently been labelled the Thatcher of Belgian politics.

Obesity is a problem that is seen across the developed world, not just in Belgium. However, according to figures released by the World Health Organization (WHO) in May, the obesity crisis will affect 9 out of 10 women in Belgium by 2030.

In the fight against obesity the Belgian government have added a new tax on soft drinks, which also applies to diet drinks and sugar-free drinks. Public Health Minister De Block stated it was not feasible to differentiate between the two different soft drink categories in the short term.

"This is a first step. The sugar tax is still in the works, while the framework of the tax shift is moving along somewhat faster," she said.

Despite criticism, in February 2015, the Minister was voted the most popular politician in Belgium. Other priorities including investing in innovation, as reflected in the government's October healthcare

budget announcement for 2016. The budget includes €402m to help IT departments in hospitals to implement the eHealth Action Plan. The aim is that by 2019 all hospitals will have an electronic record for each patient.

Speaking about the budget announcement, De Block said: "Our healthcare system must be able to follow the new trends and we must continue to invest in innovation, so that we guarantee our patients' quality of care, and give them access to new, often highly individual therapies. That's enough of a reason to cut back wherever possible, so that we can invest where necessary."

Also included in the new budget plan is €4.68m for specialised psychiatric hospitals to ensure the diagnosis and treatment of mental healthcare. In parallel with cuts that have been made, Minister De Block authorised €164.3m to free up new initiatives both for the provision and organisation of care.

"These are not easy times," said De Block. "We must cut our coat according to our cloth. We have to economise. But at the same time we must protect the patients. We see so precisely all the expenses and we consult with the sectors concerned."

Despite what people might think about the new Health Minister, she certainly has the patients in mind when considering her policies. Whether she can make meaningful progress on the obesity problem, only time will tell. ■

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3D body scanning: measuring body volume for obesity assessment

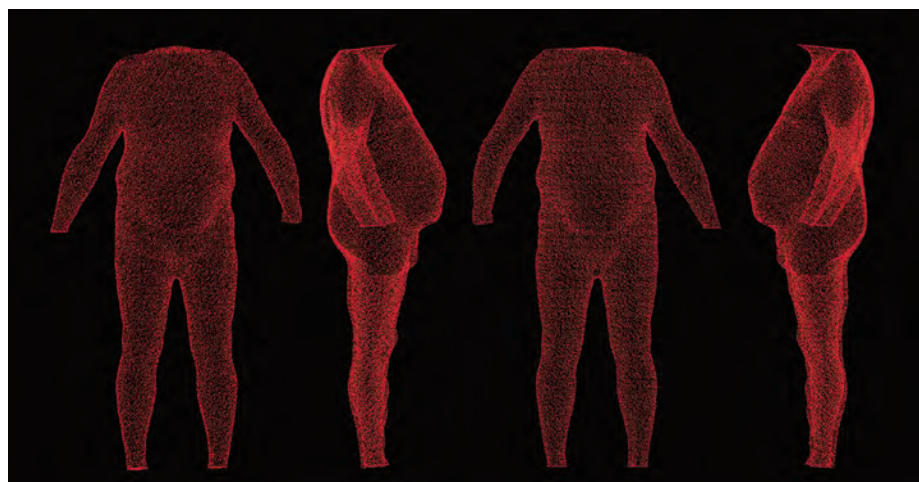
A research group at University College Ghent is developing a method to measure body fat using 3D body scanning...

Obesity is a condition in which the amount of fat tissue is increased resulting in adverse effects on health and is associated with increased morbidity and mortality¹. This state of fat accumulation is linked to increased risks of type 2 diabetes, cardiovascular disease, fatty liver, sleep apnea syndrome and certain types of cancer and a decreased life expectancy.

The prevalence of overweight and obesity has increased dramatically worldwide and the number of people struggling with obesity today has doubled the past three decades. Among the Belgian adult population, 48% are too heavy for their height: 34% of the adult population are overweight, while 14% suffer from obesity. Overweight is more frequent in men (41%) than women (28%), but there is no difference between men and women with regard to obesity (14%). What is distinctly alarming is that more than half of all individuals in the 45-54 age group are overweight and one of five people in the 55-74 age group are obese².

Weight indexes

In both clinical and scientific practice, assessment of body fat is not always possible because of costs, available time or limited access to the necessary measuring devices. Therefore, body weight indexes are often used as a proxy measure for the assessment of the degree of adiposity. The body



3D bodyscan of an obese man (front, right, back and left)

mass index (BMI), developed by the Belgian scientist Adolphe Quetelet in 1832, is calculated as the ratio of body weight in kg, over body height in meter. According to the World Health Organization, a person with a BMI equal to or more than 25 is considered to be overweight. A person with a BMI of 30 or more is generally considered obese.

Although the BMI is quick and easy to calculate, its accuracy to diagnose obesity has shown to be limited, particularly for individuals in the intermediate BMI ranges³. Also, the BMI was originally designed to be used at the population level and is therefore not as effective in individual cases because body weight is influenced by more than fat tissue alone. Furthermore, the relationship between BMI and health can vary with ethnicity making global comparisons problematic.

Therefore, it has been suggested that future research on body composition measurement should focus more on body shape and volume rather than body mass. With the advent of 3D body scanning technology, it is possible to obtain accurate and reliable anthropometric measures of an individual. Also, 3D body scans provide information on an individual's body volume and body shape. Because a body scan results in a digital avatar, the distribution of body mass and fat deposition can be visualised and processed on a higher level compared to manual anthropometric measurements.

Innovative research

At University College Ghent in Belgium a team of researchers is involved in the Anthropometric based Estimation of adiPoSity (ADEPS) project. They use state-of-the-art technology like 3D body scanning and air displacement

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plethysmography to study the extent to which body fat percentage can be predicted using anthropometric measurements. The objective of the ADEPS project is to gauge body fat percentage from readily available anthropometric measures that don't require sophisticated equipment.

A 3D bodyscanner uses structured white light technology to produce consistent point clouds and body models with a 3D-point accuracy of less than 1 mm. From a set of bodyscans a procedure is developed to determine total body volume. Derivation of body volume, together with measurement of body mass,

permits calculation of body density and subsequent estimation of percent fat and fat-free mass.

Using advanced statistical modelling the investigators will identify which anthropometric measurements provided by the body scan are useful predictors for body fat percentage resulting in predictive models. These models will then be validated using a reference method for body fat percentage determination. Resulting predictive equations will be converted into population-specific nomograms for convenient assessment of body fat percentage from simple and manual measurable anthropometrics that

are useful in clinical practice and research. In developing this tool, the ADEPS project offers a practical contribution to getting a grip on obesity, the largest preventable health problem of our time.

“Results from our research will allow clinicians and researchers to assess the amount of body fat at a minimal cost and without using advanced equipment.”

The results from the ADPES project are to be expected by the end of 2016.

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Combining health and the environment

Céline Fremault, Minister of Housing, Quality of Life, Environment and Energy at the Government of Brussels-Capital Region outlines her plans to develop healthy environments in the City for all residents...

As Minister of the Environment and Quality of life, I wanted to link the 2 areas together as much as possible in my political actions for public health.

The preservation of citizens' health is a major issue in a city like Brussels Region. In this sense, it is especially encouraging for the people of Brussels to adopt lifestyles respectful of their health, and also the environment.

Since my appointment as Minister of the Environment and Quality of life, I have instructed my administration teams to work on a local and sustainable healthy eating strategy. The strategy "GoodFood" was born and will be presented to all of my government later this year.

Through the media and social networks: many people are wondering about the contents of their plates and are interested more in quality labels and proximity.

The overall environmental vision that I take, and in which the "GoodFood" strategy fits perfectly, puts people at the heart of food considerations – the air quality, nature, energy, noise pollution, for example. The person is then associated with his house and his neighbourhood, city, region, country, etc.

"Better production, eating well" is the leitmotif of the new food strategy: it will reconnect the city to its feeder system through urban agriculture (professional and non-professional), to inform consumers the food boasts a "GoodFood" label and canteens encourage the provision of local and sustainable menus.

The goals we have set ourselves for 2020 reflect our ambition:



Image: © Morgane Delfosse

**Céline Fremault,
Minister of Housing,
Quality of Life,
Environment and
Energy**

- 30% of households to include healthy food options, as part of their diet;
- 30% of Brussels will experience the concept "GoodFood" and change their eating behaviour;
- 50 school canteens and 40 public canteens to include the "GoodFood" strategy;
- Double the number of vegetable gardens in schools;
- 50 "GoodFood" restaurants in Brussels;
- 30% reduction of food waste;
- On average, reducing greenhouse gases by 10% per meal.

As well as creating healthy living through what's on people's plates, it can also be maintained by taking part in sporting activities. Further to this, more and more specialists stimulate sport mainly for medical



Image: © Morgane Delfosse

reasons. Sport is thus a growing business, whether in a gym or outdoors. Green spaces are favourite places for doing sport within towns. However, it must be integrated with other functions of green areas according to their status (a park or nature reserve) and the capacity of each site.

In Brussels, we are fortunate to live in a city with many green spaces. The challenge lies in their conservation and deployment, as this is a grey area, while we are in the population boom and the city become more densified.

My administration currently manages 60 playgrounds and sports areas. Amortised, we are proceeding with their replacement or restoration. Before beginning construction of these sites, we conducted a wider reflection on the outline to make these areas of tomorrow.

The report states that if there are more than 300 regional and communal play areas, their distribution is not ideal: there's a lack of green areas in the poorest areas of the city where the demand is however big: there is a lack of playing areas suitable for families, girls, older children (10 –12 years-old) and disabled children ; some devices do not allow wide

use and limit the potential for the playground; it has been demonstrated that children like to appropriate the spaces for informal games created between the modules equipment. Our policy of "games mesh" will thus try to answer all of these observations and develop sports activities throughout Brussels' parks.

This strategy aims to establish a gaming grid, an extensive network of recreational and sports areas, such as desired and spontaneous. Connected together these areas could ensure sufficient geographical coverage and amplify playful quality, which the existing offer. A network that, across the street, the neighbourhood, the town and the region, would give children and (future generations) a special place to play sport. ■

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Community Health

Dr Leonard Jack, Director of Community Health at the National Center for Chronic Disease Prevention and Health Promotion – CDC, outlines the importance of increasing access to physical activity opportunities for all Americans...

Chronic diseases – such as heart disease, stroke, type 2 diabetes, obesity, and cancer – are among the most common, costly, and preventable of all health problems. They cause 7 out of 10 American deaths; they gobble up 86% of America's health care costs. More than half of all adults in the United States have at least one chronic disease.

Increasing access to physical activity opportunities can improve a community's health. People who are physically active tend to live longer and have lower risk for chronic diseases. Yet, children and adults are not getting enough exercise to meet the recommended physical activity standards ¹.

The Centers for Disease Control and Prevention's Division of Community Health (DCH) strengthens community-level health efforts in towns, cities, counties, and tribal areas throughout the nation. Improving Americans' health means:

- Reducing risk factors such as physical inactivity, poor nutrition, and limited or no access to quality health care;

- Addressing social issues that impact health, such as poverty, lack of education, racism, and discrimination;
- Improving environments and community conditions, such as lack of opportunity for physical activity or too few options for healthy eating;
- Forming strong multi-sectoral partnerships to make healthy living easier everywhere people live, learn, work and play.

Improving Access to Physical Activity

Two-thirds of adults ² and nearly one-third of children and teens ³ in the United States are overweight or obese – and physical inactivity is a leading contributor to this epidemic. DCH helps community partners carry out evidence-based strategies to remove barriers that keep people from being active and getting the exercise they need. In many communities, it's hard to find safe places for children and their families to exercise and play. Parks, playgrounds, and other outdoor recreation areas may be too far away or poorly maintained. For too many communities, these factors combine to make physical activity a challenge.

Increasing physical activity opportunities is part of a comprehensive approach to community health. The best successes grow from strong partnerships between schools, local parks, businesses, and faith-based organisations. Effective programs use a combination of approaches. They establish policies that support safe walk and bike routes to school; adopt joint-use agreements to increase access to safe places for residents to exercise; expand existing bike trails at parks and recreational facilities; establish worksite wellness policies that include options for physical activity during work hours; and develop community design plans that improve pedestrian options for safe walk and bike paths.

Examples of DCH awardee activities to increase access to physical activity opportunities include:

As of March 2014, at least 87,000 students, parents, teachers, principals, school district personnel and after-school providers in Broward County, Florida, have greater access to high-quality after-school physical activity programs. Through partnerships with the YMCA of Broward County and the Alliance for a Healthier Generation, Broward County started the evidenced-based national physical activity program, SPARK (Sports, Play and Active Recreation for Kids), in 41 after-school programs. Educational events informed children, parents, and school personnel about the importance of moderate-to-vigorous physical activity.

As of March 2014, an estimated 7,800 low-income residents of Cumberland Valley, Kentucky, have access to recreation and fitness facilities for physical activity. Microclinic International provided technical assistance to approximately 20 stakeholders, including school districts and local governments, in using joint-use agreements – formal agreements, often between a school district and a city or county, that allow families to use public property after hours for physical activity. Emphasis was placed on identifying recreation and fitness facilities in locations where low-income residents had little access to physical activity opportunities.

As of March 2014, approximately 8,300 low-income workers in Iowa have better access to physical activity

opportunities at work sites. They include a Polk County employer who provides three 15-minute physical activity breaks per day. In addition, a number of employers across the state offer worksite wellness incentives that promote physical activity.

As of December 2013, some 457,000 residents in Texas have more opportunities to get active. Smith County schools made physical activity part of daily classroom routine. Williamson County posted trail signs in parks in low-income neighborhoods. In 4 counties (Webb, Comel, McLennan, and Jim Wells), school systems and community groups agreed to allow people to use fields, indoor tracks, and recreation centers.

Nearly 7,100 members of the Saginaw Chippewa Indian Tribe, Hannahville Indian and Bays Mills Indian communities in Michigan have greater access to free and low-cost opportunities for physical activity. These include new or expanded community fitness centers.

Nashville, Tennessee encouraged physical activity for its 600,000 residents through a free bicycle-sharing program. Nashville GreenBikes lets residents check out bikes at community centers and other city-wide locations directly linked to greenways, bike lanes, and shared-use bike routes. ■

For more information about how DCH awardees are improving access to physical activity opportunities, visit <http://www.cdc.gov/NCCDPHP/dch/index.htm>.

1 <http://www.cdc.gov/physicalactivity/basics/index.htm>

2 <http://jama.jamanetwork.com/article.aspx?articleid=1104933>

3 <http://www.cdc.gov/healthyschools/obesity/facts.htm>

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The rhythm and reason for heart rate monitoring in sport

In sport, fatigue is not only the demise of the athlete's ability to reach peak performance but it also can increase the risk for serious injury. Alpine skiing is a technically demanding event. Injuries often occur in the final section of the racecourse, presumably when fatigue is peaking, and becoming a contributing factor to performance outcome. For example, downhill skiers have to contend with the largest vertical drop of all the alpine disciplines and most racers reach speeds over 120 km/hr on a typical World Cup (WC) course. It seems reasonable that these athletes should only enter into a competitive WC race when they are at their peak readiness to perform.

Readiness for competition

Sport scientists, coaches and athletes are aware that continuous training with insufficient recovery will gradually lead to increased fatigue and lower performance. Therefore most coaches want to track, both positive and negative changes in performance responses in their athletes. A simple and current method for measuring intensity is the Borg Rating of Perceived Exertion (RPE) Scale. A modification of this includes the category (C) ratio (R) scale, (CR10) from zero to 10, which is used when fatigue is involved with breathlessness. We further expand on this by adding a training dependent approach, with the sessional rating of perceived exertion (sRPE) on days when there are multiple workouts. The athlete records their RPE for each training session by filling out a secure

online questionnaire. A daily training load is computed as the sum of the sRPE for all the training sessions on that specific day (sRPE X training duration in minutes). Another method with perhaps more precision is to use a heart rate monitor that measures the beat-to-beat interval, or the RR interval. This method is noninvasive and can be used for observing training intensity and readiness for competition. Heart rate monitors are easily paired with technology that uploads or syncs directly onto a mobile device or computer where Wi-Fi is available; a perfect combination for travelling athletes and coaches.

Heart Rate Variability

Measurement of the beat-to-beat interval identifies that heart rate is not constant. The measurement of the variation in the time interval between heartbeats is referred to as heart rate variability (HRV). For example the normal resting heart rate for adults ranges from 60 to 80 beats per minute (bpm) and well-conditioned athletes typically have resting values of 40 to 60 bpm. If we use 60 bpm as an average then the interval between successive heartbeats would mathematically be 1.0 sec but in a dynamic real situation it would fluctuate or vary from 0.5 sec up to 2.0 sec.

Generally a high HRV indicates dominance of the parasympathetic response, the side of the autonomic nervous system (ANS) that promotes relaxation, digestion, sleep, and recovery. A low HRV indicates dominance of

the sympathetic response, the fight or flight side of the nervous system associated with acute stress or functional overreaching. Low HRVs have been associated with overtraining and chronic inflammation.

Overtraining and Recovery Analysis

Heart rate or cardiac autonomic regulation, is lessened in an overtraining state as well as after an intense training session. A simultaneous shift in favour of sympathetic (increasing heart rate) over parasympathetic (reducing heart rate) dominance occurs. Overtraining and recovery analysis monitors the balance between the low and high frequencies within the heart-beat. The two common forms of HRV analysis are often designated as time- and frequency-domain measures.

Time and Frequency Domain Measures

Time domain measures are the means and standard deviations (SD) of R-R intervals recorded by a continuous electrocardiogram (ECG), where NN (normal-to-normal) intervals represent all the R-R intervals. One of the variables of time domain measures the SDNN, which reflects all the cyclic components responsible for variability in the duration of the ECG recording. The SDNN estimates overall HRV and the average NN intervals are calculated over short periods, usually 5 minutes (SDANN).

Spectral analysis involves a series of successive R-R intervals and assigns



bands of frequency by counting the number of NN intervals that match each band. So high frequency (HF, 0.15 to 0.4 Hz), represents parasympathetic activity and is generally considered to be a marker of vagal activity and low frequency (LF, 0.04 to 0.15 Hz,) is influenced by both sympathetic and parasympathetic activity. The ratio of HF:LF represents the balance of parasympathetic and sympathetic activity.

From a practicality perspective time domain methods are preferred to frequency domain methods when short-term recordings are used and coaches with athletes in a field setting are also more likely to focus on parasympathetic regulation or modulation.

Parasympathetic modulation

The most commonly used measures derived from interval differences include the RMSSD, which is the square root of the mean squared differences of successive NN intervals or the SD1 (standard deviation of instantaneous beat-to-beat R-R interval variability in m/s). Both reflect parasympathetic modulation. The time

domain indices can be captured over a very limited period of time as alluded to (e.g., 10 s to 1 min) and are compatible with the short duration of the recordings usually performed by athletes in the field. The RMSSD can be calculated with an Excel spreadsheet and therefore does not require any sophisticated software package.

Standardised

The method used to capture the beats must be standardised, without excessive noise or lost beats and easy for the athlete to accomplish. Recording the heart rate immediately upon waking fulfills these criteria. The athlete should be instructed to leave the heart monitor beside the bed before going to sleep, to minimise disturbances when putting it on in a supine position. The recordings should be five to six minutes in duration, synchronised and saved to the athlete's mobile phone and uploaded to a secure laptop. Each athlete will have a signature HRV and therefore compliance will be an important contributor to observing a fatigue shifted HRV pattern. The frequency of the records will be different for each

athlete and the data will only be useful if there are sufficient recordings by the athlete.

Summary

The majority of the studies evaluating the efficacy of HRV measurements in athlete populations have focused on male endurance athletes. We (Sean Wallace and Matt Jordon) have recently completed a pilot study that has identified that HRV was sensitive enough to detect changes in an elite female alpine skier's training status, specifically when she entered phases of functional overreach and subsequent recovery. Our preliminary results also appear to be the first of its kind to detect an extreme drop in HRV prior to a musculoskeletal injury. Future research will be needed to identify the true relationship between training status and HRV in elite alpine skiers.



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Inferior Vena Cava Ultrasound and Shortness of Breath

The role of ultrasound for Inferior Vena Cava measurement (IVC) in patients presenting with shortness of breath is often debated. Authors have disputed different modes and points of measurement and with varying probe placement.¹⁻⁵ Additionally, patient position, habitus, degree of respiratory distress, and the presence of mechanical ventilation can influence the size and collapsibility of the IVC. Common agreement may be found from a recent metanalysis suggesting a moderate level of evidence supporting the IVC diameter is low in hypovolemic patients as compared with euvolemic patients.⁶

The caval index calculates the percentage collapse of the IVC: $\text{IVC expiratory diameter} - \text{IVC inspiratory diameter}$, divided by the IVC expiratory diameter $\times 100 = \text{caval index (\%)}$. In the setting of shortness of breath, a caval index near 100% suggests complete collapse of the IVC and is indicative of volume depletion. The closer the number to 0% the more likely the patient has intravascular volume overload.⁷ Additionally, cardiac tamponade from pericardial effusion should be considered with a non-collapsible IVC in patients who present with shortness of breath. The BRIPPED scan is a screening tool for patients with shortness of breath of unclear etiology. Among its components discussed below, the scan simplifies the caval index by qualitatively evaluating

the collapse of the IVC. Figure 1 demonstrates a collapsed IVC in a patient presenting to the Emergency Department with shortness of breath due to congestive heart failure. This patient is intravascularly depleted and required intravenous fluids. Figure 2 demonstrates a dilated IVC in a patient with shortness of breath due to congestive heart failure with intravascular volume overload. Additionally BRIPPED screens patients for pericardial effusion and other etiologies of shortness of breath.

“A low frequency phased array or curvilinear probe is used to visualise the IVC long axis, and dynamic imaging is used to assess collapsibility as either complete or less than 40%.”

The IVC is visualised in the long axis plane in patients who are semi-recumbent or supine. The IVC should be visualised as it enters the right atrium, to differentiate it from the aorta that runs parallel to the IVC. With the BRIPPED protocol, the sonographer may image the IVC, and obtain cardiac windows using the same lower frequency phased array probe to evaluate ejection fraction and pericardial effusion. The probe is placed below the xiphoid bone, and the probe marker rotated towards the patient's head. Alternatively, the probe may be placed anterior to the mid axillary



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line, with the probe marker towards the head.

BRIPPED Protocol:

The BRIPPED scan is an effective screening tool for shortness of breath that evaluates pulmonary B-lines, Right ventricle size and strain, Inferior Vena Cava (IVC) collapsibility, Pleural and Pericardial Effusion, Pneumothorax, Ejection Fraction of the left ventricle, and lower extremity Deep Venous Thrombosis.

B-lines: Sonographic pulmonary B-lines have been shown to correlate with congestive heart failure.^{8-11, 15, 16} A high frequency linear probe is used to evaluate at minimum 2 mid clavicular apical lung windows.

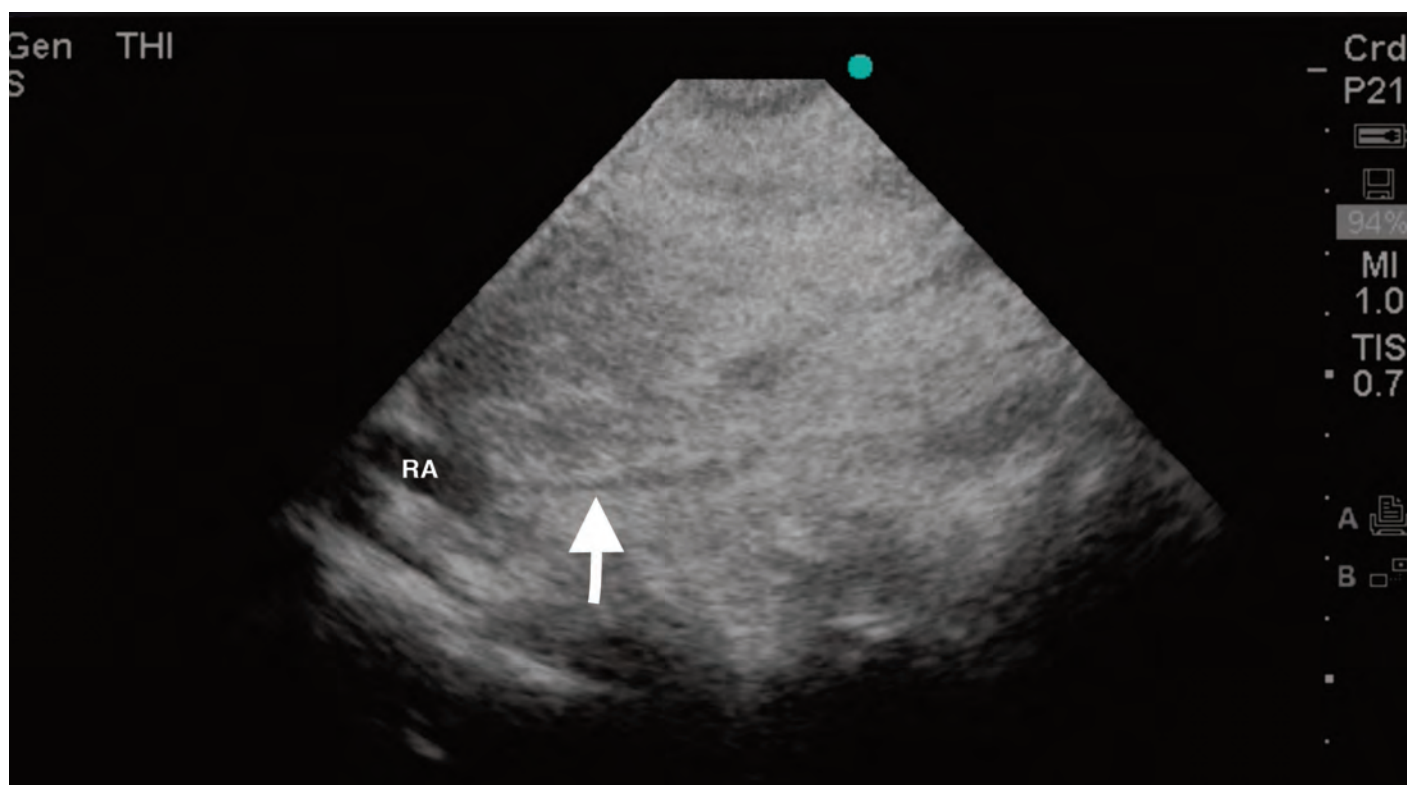


Fig 1: IVC (arrow) collapses with inspiration. RA = Right Atrium

RV strain: Right ventricular (RV) enlargement can be caused by a Pulmonary Embolus (PE), acute RV infarct, Congestive Heart Failure (CHF), pulmonary valve stenosis or pulmonary hypertension, and is a risk factor for early mortality in PE.¹⁷ A low frequency phased array probe is used to evaluate RV strain in an apical 4 chamber view.

IVC-size and collapsibility: Using an IVC size cutoff of 2.0 cm has been shown to have a sensitivity of 73% and specificity of 85% for a Right Atrial Pressure (RAP) above or below 10 mmHg. The collapsibility during forced inspiration of less than 40% has even greater accuracy for elevated RAP (sensitivity 91%, specificity 94%, NPV

97%).¹⁸ A low frequency phased array or curvilinear probe is used to visualise the IVC long axis, and dynamic imaging is used to assess collapsibility as either complete or less than 40%.

Pneumothorax: Bedside ultrasound is more accurate than supine chest x-ray with diagnostic ability approaching that of CT.^{19,20} The same windows for B-lines are utilised for pneumothorax screening. Additionally any area of decreased breath sounds, or crepitus palpated along the chest wall is evaluated for pneumothorax with a high frequency linear probe.

Pleural effusion: EUS has been shown to have an accuracy similar to a CXR for evaluation of pleural

effusion.^{13,14} A low frequency phased array or curvilinear probe is used to evaluate each mid axillary line at the costophrenic angle in the sitting patient.

“The BRIPPED protocol can be performed in its entirety from a head to toe approach, switching between transducers, or completing the exam with one transducer then switching to the next.”

Pericardial effusion: EUS has a sensitivity of 96% and specificity of 98% compared to formal echocardiography.²¹ A low frequency phased array probe is used to evaluate pericardial effusion from an apical 4 chamber

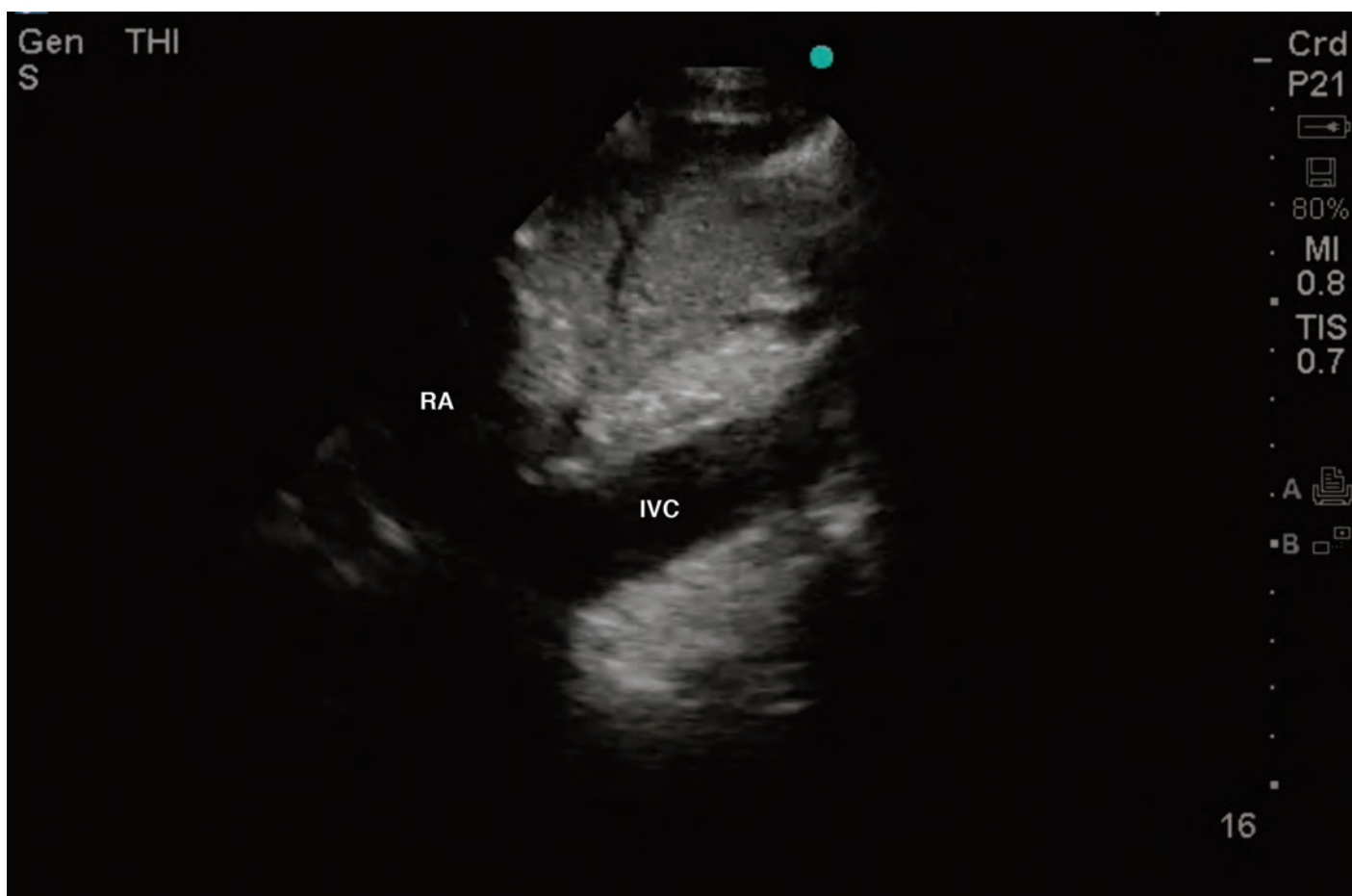


Fig 2: Dilated IVC with minimal respiratory variation. RA = Right Atrium

view and a parasternal long axis view of the heart.

“The BRIPPED scan is a screening tool for patients with shortness of breath of unclear etiology.”

EF: The qualitative assessment of left ventricular ejection fraction by emergency physicians has been shown to correlate well with an assessment by a cardiologist.²²⁻²⁴ The same low frequency probe and parasternal long axis used to evaluate pericardial effusion is used to evaluate ejection

fraction. Dynamic qualitative assessment of ejection fraction is classified as normal, depressed, or severely depressed.

DVT in lower extremities: Ultrasound was performed by emergency physicians using a two point compression venous ultrasound on patients with suspected lower extremity DVT. This approach had a 100% sensitivity and 99% specificity in diagnosing DVT, compared to a reference venous ultrasound in radiology.²⁵ A high frequency linear probe evaluates compressibility of the common femoral and popliteal

veins with dynamic scanning. If pretest probability is higher for DVT, then additional fields are included, starting below the inguinal ligament at the common femoral vein, and each segment of vessel is compressed every 2 cm to the trifurcation of the popliteal artery distally.

The BRIPPED protocol can be performed in its entirety from a head to toe approach, switching between transducers, or completing the exam with one transducer then switching to the next. An example of the latter would be to first use the low frequency

probe to evaluate the parasternal long axis and apical 4 chamber, noting the presence or absence of pericardial effusion, ejection fraction, and RV strain. Then the long axis of the IVC is evaluated for dynamic collapsibility. Moving laterally, the costophrenic angles are evaluated bilaterally for pleural effusion. The probe is switched to the high frequency probe to evaluate each lung apex is evaluated in the mid clavicular line for the presence of pneumothorax and B lines. Lastly, the dynamic 2 point DVT screening is performed with compression ultrasound. The BRIPPED protocol and other bedside ultrasound resources can be viewed here:

<http://www.anatomyguy.com/b-ripped-scan-for-evaluation-of-emergency-department-patients-with-shortness-of-breath/>

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The renal disease research agenda

Adjacent Government considers the role of associations such as the International Society of Nephrology in advancing research into kidney diseases...

Each of your kidneys filter around 230 litres of blood per day, removing around 2.3 litres of salts, excess fluid and other waste products to be excreted as urine. They also perform a number of other functions, such as releasing the hormones that regulate blood pressure and producing an active form of vitamin D necessary for strong, healthy bones. Any loss of function in these vital organs can therefore have serious health consequences, including kidney failure in the most serious cases.

While many kidney diseases can be treated successfully and risk factors can be limited by carefully controlling contributing conditions like diabetes and high blood pressure, there is currently no cure for chronic kidney disease (CKD). Particularly in Western Europe and North America, the most common causes of CKD are hypertension and diabetes. Much research is under way to find specific treatments for various diseases of the kidney, to understand the development of CKD, and to improve quality of life for patients dealing with the early stages of disease as well as end stage renal disease (ESRD).

Local, national and international organisations such as the International Society of Nephrology (ISN) are in the vanguard when it comes to raising awareness around prevention and early detection of preventable renal diseases. This is the primary aim of World Kidney Day, which will next take place on 10 March 2016 with a focus on reaching children who may be at risk from an early age.

The introduction of an internationally recognised classification system highlighted the fact that there is relatively little national variation in the prevalence of CKD. Across Iceland, Norway, the US and other predominantly Caucasian populations, roughly 10% of

adults have stage 3-5 CKD, where stage 1 represents healthy kidney functions and stage 5 means ESRD.

Aspiring towards the elimination of kidney disease worldwide, the mission of the ISN is to advance diagnosis, treatment and prevention in both developed and developing countries. As well as supporting research into optimal care for people diagnosed with kidney diseases, the Society funds several awards and prizes for basic and clinical research. These include the Alfred Newton Richards Award for basic research in fields relevant to nephrology, the Jean Hamburger Award for outstanding research with a clinical emphasis, and the Amgen International Prize for therapeutic advancement in nephrology.

In addition, the Genzyme Renal Innovations Program (GRIP) issues grants to clinicians and fellows in order to advance medical knowledge and practice through innovative research projects. In collaboration with Danone Nutricia Research, the ISN have established the Hydration for Kidney Health (H4KH) Initiative to stimulate interest in the effects of hydration on healthy kidney function.

The number of people suffering with renal diseases including CKD is set to rise as populations grow and age, and with the increasing prevalence of major risk factors like diabetes and hypertension. In these circumstances, the work of bodies such as the ISN and the research it supports in finding new therapies cannot be underestimated. ■

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From bedside to bench to bedside

Medical research is big business. Current estimates suggest £6 billion is spent on medical/pharmaceutical research in the UK; a total greater than the GDP of some countries! Of course, we don't do it for the money; our drive is the advancement of science, to save lives and alleviate suffering. It is true that big pharma make big profits, but I believe that most of my fellow scientists working in big pharma share my motivation and that those working in smaller companies and in academia do what they do because they want to make a difference; they want to find cures. Cancer Research UK tell us that "one day we will beat cancer", and who wouldn't want that? Here at the SWT Institute for Renal Research we would be ecstatic if we helped to beat kidney disease; and we believe we can. We are currently investigating avenues that we truly believe could lead to therapies that will stop or even reverse the relentless progression of fibrosis that leads to organ failure.

"In 2014 the UK health minister, Jeremy Hunt, said his policy is a "move away from a culture of "doctor knows best" to "patient knows best"."

Like most other scientific researchers, we equip ourselves with an in depth knowledge of pathology, we keep up to date with advancements in experimental techniques and we meet and discuss with other experts to help develop ideas and hypotheses. We



test our hypotheses through rigorous execution of good scientific practice to move our understanding forward, make discoveries and hopefully find "the cure". Of course, there are many examples of the role of luck in the discovery of new treatments. Minkowski and von Mering weren't looking for insulin when they made dogs diabetic by removing their pancreas; Viagra wasn't invented to treat impotence, it was an ineffective heart medicine with an interesting side-effect; perhaps most famous is the well documented discovery of penicillin. We could do with such luck again in our search for new antimicrobials. Almost regardless of how such breakthroughs are made we welcome them, but in chronic conditions without cures we have different challenges.

Chronic kidney disease poses challenges to doctors and scientists but mostly to patients. The gradual destruction of such an important

organ causes problems throughout the body that we address with various therapies. If we are trying to improve the quality of life of the patient perhaps we should spend more time asking the patient what it is that is distressing for them. I'm reminded of the paradox in diabetes where clinicians and scientists are occupied with the adverse effect of high sugar levels but my brother in law, a diabetic, is much more frightened of hypoglycemia, which causes him real immediate distress. A patient survey carried out by Kidney Research UK told us that the number one research priority was to "find a cure", but perhaps if the question had been "What would make your life better", the answer may have been different.

While enjoying the refreshments after the AGM of the Kidney Fund, a patient led UK registered charity, I found myself sitting chatting with 2 transplant recipients. As we talked I noticed



that one of them wasn't eating while the other happily partook. It transpired that the one who wasn't eating never did when he was not at home and, even at home was cautious, for fear of what he shouldn't eat. There were many foods he was worried about but salt was his major concern; the other patient said he didn't know so he didn't bother. Many people are worried about their salt intake but a kidney transplant recipient has more cause than most. We know that sodium handling is different in the denervated kidney.

This issue is probably known to others but its poignancy for me was highlighted by these two patients. As director of the Institute I am in the privileged position of not only being a possible vector between the patients and our overworked dieticians but also working with two renal consultants with expertise and a serious interest in salt and blood pressure. We will shortly be starting a project into salt consumption, sodium handling and blood pressure in renal transplant patients.

The complex dietary needs of patients with chronic kidney disease are what keeps our dieticians occupied, not least their relatively high level of malnutrition; a particular issue when they have an extended stay in hospital where we know that malnutrition can be associated with reduced immune responses, slow wound healing and increased lengths of stay. What I hadn't been aware of, until one of the dieticians told me, is that we don't know which patients are at risk of malnutrition as the assessment used had not been validated in this patient group. I worked with this bright and motivated dietician on exactly that assessment. The result of her work, which earned her a Master's Degree, was that the assessment was inappropriate and if we are really concerned about the nutritional status of our renal patients we need a new tool.

Setting national and international priorities can be useful. I hope that Prime Minister David Cameron's "dementia challenge" pays real dividends; if the Dutch decision to prioritise research into artificial or

regenerated kidneys is a success we will all have a lot to be thankful for; and former US president Jimmy Carter's campaign to eradicate Guinea Worm has been truly inspirational and successful.

There is, however, also room for research to develop on a smaller scale; the result of a conversation with a patient. The triumvirate of a patient led charity in the Kidney Fund, the busy dynamic South West Thames Renal Unit and our Research Institute represent an example of patients, health professionals and scientists working together and how they can be a powerful force in bringing research from the bedside to the bench and back to the bedside. In 2014 the UK health minister, Jeremy Hunt, said his policy is a "move away from a culture of "doctor knows best" to "patient knows best"". Our policy for research and care is slightly different; we believe none of us know more than all of us.



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Partnerships for success

Ellen Rowles from Action PR Ltd, sheds light on why third party partnerships hold the key to success in improving leisure facilities for schools and colleges...

In these times of economic uncertainty and budgetary constraints, many local authority schools and colleges are exploring alternative ways to improve their fitness offering, whilst seeing a return on investment.

According to the latest research from Sport England, education sites are a key provider of sports facilities in England, as they own over a third (39%) of all facilities. Furthermore, 77% of sports halls and 61% of artificial grass pitches are located on school, college and university sites.

For many, the opening up of school sports facilities is a cost-effective means of maximising access for all in the community to sporting opportunities. However, it's not only the community that benefits from this practice. The schools and colleges also gain from having additional and improved facilities, wider networks with a range of other organisations such as local sports clubs and an improved relationship with their communities.

"There are numerous benefits from working with a third party partner: it helps the health of pupils and opens up educational institutions to a wider range of community groups, which can lead to the development of new pathways for pupils. It also allows young people to make the transition from school sport to community sport and helps them realise opportunities, leading to a habit of lifelong participation," says Jez Gray, Head of Sport and Public Services at Carshalton College.

"At Carshalton College we've seen a huge benefit to working in partnership with a leisure solutions provider. We simply didn't have the knowledge, expertise or capital to be able to invest in the right facilities. Working with the provider has meant we can create in



partnership a facility that meets the needs of our pupils while securing future provision for the community."

Downlands Community School Success

Before 2006, Downlands Community School in Hassocks, West Sussex, had poor sports facilities mainly comprising a first floor gymnasium. As a result, community use was not a priority. However, this changed when a culmination of a number of grants enabled the school to develop a stand-alone Sports Centre. Funding for the £2m building came from the Big Lottery, West Sussex Council. In addition, Downlands secured a football foundation grant of £282,000 towards a new 3G floodlit pitch. These new sports facilities meant the school could offer a community programme.

After exploring a range of options and management models, the school and governors decided to appoint Freedom Leisure – a not-for-profit leisure trust. One



of the main factors for outsourcing the community management was to enable the school to continue to focus on teaching and learning whilst allowing Freedom Leisure to use its professional skills in leisure management to develop the Sports Centre.

Making It Work:

It was essential that this facility worked for both the school and as a commercial entity for the community to enjoy. Working in partnership with Downlands and drawing on its 15 years’ expertise in operating leisure facilities the arrangement has successfully resulted in the creation of a strategy that ticks both education and business boxes.

Staffing

Freedom Leisure provides a team of expert staff to run the facility including a full-time Centre Manager and two Duty Managers. The team also includes 5 fitness instructors who are specially trained to offer a programme for young adults. The on-site team is supported by an Area Manager and Freedom Leisure’s Head Office which offer additional support including HR, IT, marketing, fitness, health and safety and business management.

Ethos

Downlands School prides itself on being a high performing, inclusive, community school and is committed to excellence in all it does. By contracting Freedom Leisure to deliver a successful management model that is open 364 days of the year, Downlands can focus on teaching and running an outstanding

school. The Centre Manager also works with the school’s PE staff to identify students who are considering a career in the leisure industry and provides them with work and training opportunities.

Sustainability

To ensure the centre is sustainable, Freedom Leisure runs a number different initiatives, most recently developing outdoor Boot Camps to make the most of the extensive school grounds. This has also created an extra revenue stream as sessions are available to non-members as well as current members.

The centre now has over 4,000 community visitors per month and over 50,000 annually as well as over 60 students and staff regularly using the fitness suite. All of which leads to greater health benefits and the potential for wider community participation in sport and fitness.

Top tips

If you are involved in a capital project – get the design right for both curriculum and community use and consider the staffing implications of your design.

Explore a range of management models – a not-for-profit model is a perfect partner for a school.

Ensure your management partner has a flexible approach and that you understand each other’s requirements. Look closely at the ethos and values of the organisation and make sure they are compatible with yours.

Offer coffee! – A community café is a great way to encourage parents and the wider community to engage with your facility. ■

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Highlighting eczema in the workplace

Prof. Dr. Swen Malte John from University of Osnabrück, Germany and Chair of the Media and PR Committee at the EADV shines the light on eczema...

Eczema is a general term for a kind of inflammation of the skin. In 2010, it was estimated that approx. 3.5% of the total world population is affected by eczema. Atopic dermatitis, considered as a hereditary, frequently severe form of eczema, often starts in early infancy. Every 5th child in Northern Europe nowadays is affected by atopic dermatitis, frequency has been increasing through the last decades. In many countries in Europe – and in the US, eczema is the most common work-related health problem and accounts for over 35% of occupational illnesses, like in Denmark or Germany.

The most frequent kind of eczema is contact dermatitis and atopic individuals are more prone to developing this kind of dermatitis, which accounts for almost 90% of skin disorders acquired in the workplace. Contact dermatitis can be divided into irritant contact dermatitis that involves a non-immunologic response to a skin irritant such as water, acids, alkalis and others. In contrast, allergic contact dermatitis is caused by a skin inflammation driven by an immunologic cell mediated reaction to an antigenic substance (e.g. epoxy resin, potassium dichromate, hair dyes). Both can result in skin inflammation with clinically characteristic signs of redness, swelling, blistering, flaking, cracking and itching.

Unfortunately, work-related eczemas are often underreported because their association with the working environment is frequently not recognised. Contact dermatitis affects individuals from all ages, both sexes and a large variety of occupations. High risk industries for occupational eczema include healthcare, hairdressing/beauticians, metal work, construction, manufacturing, food production, agriculture, printing, and janitorial services. The most affected body sites are the hands; the single most

relevant occupational risk factor is wet work, followed by occupational exposure to multiple irritants and allergens. The permanent increase of allergens to which people are exposed at home and at their workplaces also adds to the complexity of the challenge.

Within the European Union the costs of occupational eczema-related medical treatment, sick leave and loss of productivity vastly exceeds €5bn annually. In the US, total annual costs for work-related eczema amounts to more than \$1bn. For affected individuals, the chronic course of dermatitis may result in detrimental socioeconomic and psychological consequences, including social exclusion, job loss and long-term unemployment.

The good news is that most forms of eczema can be successfully prevented if detected early and appropriate dermatological interventions are being applied. Prevention measures include specific teaching of affected individuals on proper personal skin protection and care. Lack of information is one of the greatest risks at home and the workplace. Unfortunately, the effectiveness of targeted prevention measures is as yet not entirely recognised by patients, workers and employers. Concerning workers, one uniform finding common to various European intervention studies is the lack of knowledge pertaining to the causes of eczema and the proper means of personal skin protection: Using crude brushes and abrasives or even organic solvents to clean the skin is completely obsolete but still common. To-date, there are effective ways of cleaning which are much less harmful. Using protective creams beforehand reduces the amount of soiling. There are furthermore various minimal contact techniques including avoiding contamination to hazards, and there is a tremendous variety of gloves, which have to be carefully and

individually chosen. Before the detailed advice on improved skin protection is given there should be dermatological consultations and meticulous patch testing of affected individuals. Good experiences have been made by providing patients as well as workers at risk with individually tailored instructions on the use of gloves, protective creams and skin care in the framework of multidisciplinary seminars.

The following 2 figures show by way of example that prevention pays: In Germany, rehabilitation and compensation costs in the hairdressing trade have been reduced by 77% cent from €32m per year to less than €8m per year over the last 15 years due to systematic and early preventive intervention strategies. In Switzerland, the numbers of registered work-related skin diseases have dropped by approximately 45% from 1,100 to 600 between 2000 and 2008 due to the multiple prevention efforts undertaken at different levels. Furthermore, the pan European EADV campaign “healthy skin@work” emphasises that prevention does not stop outside work but needs to be equally applied at home and leisure. Dermatologists – in cooperation with other disciplines – can save patients’ health and jobs, and thus reduce costs for tax-payers and insurance systems.

If you need further information, please consult the websites of the national dermatological societies, or of the EADV and the European Society of Contact Dermatitis (ESCD), which will provide useful information and contacts, or consult a local dermatologist. For specific knowledge how to protect your skin against eczema in hairdressing find exemplarily the web-based skin& beauty toolbox: www.safehair.eu . ■

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EADV Task Force on Occupational Skin Diseases

European Initiative for the Prevention of Occupational Skin Diseases (EPOS)

ICOH Scientific Committee “Occupational and Environmental Dermatoses” (SC-OED)

EU Horizon2020 COST Action “Development and Implementation of European Standards on Prevention of Occupational Skin Diseases (StanDerm)”(TD1206)

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Reducing waste in research through core outcome sets

Prioritising health research is an important mechanism for improving health and welfare, yet much of this research money is wasted. The inefficient use of research funding can be solved by ensuring that researchers answer questions that are important to healthcare users, by using efficient study designs, avoiding duplication of effort, measuring clinically relevant things and ensuring that results are reported transparently, in full and in a timely way (Chalmers and Glaziou 2009). Although some progress has been made in this regard through initiatives such as the All Trials Campaign (www.alltrials.net), so much more can be achieved by working together (Moher et al 2015).

For many years, the Centre of Evidence Based Dermatology at the University of Nottingham has endeavoured to ensure that its work is based on an appraisal of the existing knowledge base through systematic reviews, and that prioritised research questions are addressed using large, high quality pragmatic, multi-centre clinical trials, followed by full publication and active disseminations strategies to a community of users.

In this way, we hope to improve research efficiency and to achieve maximum benefits for patients and healthcare providers. One important way of improving the quality of clinical trials and systematic reviews is to establish an internationally agreed core outcome set, which is the focus of this commentary.

What are core outcome sets and why are they important?

A core outcome set is a minimum set of outcomes that are agreed by all relevant stakeholders as being the most important aspects to be measured when evaluating treatment response in clinical trials (Clarke 2007). They reflect aspects of the disease that may be affected by treatments, and commonly include domains such as symptoms, physical signs, quality of life and harms.

“If you are a funder of medical research, we appeal for you to consider funding applications seeking to establish core outcome sets because they represent the foundation on which all future research builds.”

In the absence of an agreed core outcome set, many trials are conducted, but the results of the trials are difficult to compare because the same outcomes have not been used.

Clinical decision-making is best informed by combining results of different trials in systematic reviews – but without a common language (as provided by a core outcome set), meta-analyses are often impossible and conclusions are limited.

What can the research community do?

Funders, academic institutions, journal editors and researchers have an ethical duty to ensure that the information provided by participants of clinical

trials is used to best effect. Such an aspiration can only be achieved by working together internationally and agreeing a consistent way of measuring important outcomes, in a way that is valid and reliable.

Only by working together, using transparent and rigorous methodology, will the research community have fulfilled its obligation to patients and funders of medical research to ensure that research funding, time and effort are not wasted.

Experiences in the field of eczema

The Centre of Evidence Based Dermatology has been leading efforts to improve the quality of clinical trials in dermatology for many years. In 2008 Williams and Schmitt initiated the Harmonising Outcome Measure for Eczema (HOME) initiative. This group of clinicians, patients, researchers, regulatory bodies and representatives of the pharmaceutical industry are working together to achieve international consensus over a core outcome set for eczema (www.homeforeczema.org).

Over the last 6 years, much progress has been made resulting in international agreement over what should be measured:

- Clinician-assessed signs;
- Patient-assessed symptoms;
- Quality of Life;
- Long-term control.

What we need are **core** outcomes that are used in all trials



The Group has also achieved consensus that eczema signs should be captured using the Eczema Area and Severity Index (EASI) instrument, and that symptoms should be captured using the Patient Oriented Eczema Measure (POEM) scale. Decisions over the best quality of life scales, and the best way of capturing long-term control of eczema will be discussed at the next consensus meeting in Brazil in 2017.

An important outcome for the group has been the development and adoption of the HOME Roadmap (www.homeforeczema.org), which provides a useful guide for other groups developing core outcome sets.

Core outcome sets in dermatology

The success of the HOME initiative has prompted other researchers around the world to establish core outcome sets for other skin conditions such as psoriasis, vitiligo and hidradenitis suppurativa (www.comet-initiative.org).

In order to support these groups and to provide methodological advice on how to develop internationally agreed high quality core outcome sets, the Cochrane Skin Group Core Outcome Set Initiative (CSG-COUSIN), led by Schmitt, has been established. CSG-COUSIN provides a virtual hub for dermatology core outcome set developers, with the remit of sharing best practice and expertise (www.uniklinikum-dresden.de/COUSIN).

How can you get involved?

Membership of both HOME and CSG-COUSIN is free and open to anyone with an interest in core outcome set development. For regular updates and details of forthcoming activities please check our websites or get in contact with the individual project co-ordinator (HOME@nottingham.ac.uk or COUSIN@uniklinikum-dresden.de). If you are interested in developing a core outcome set in a specific skin condition, then register your interest (COUSIN@uniklinikum-dresden.de).

If you are a funder of medical research, we appeal for you to consider funding applications seeking to establish core outcome sets because they represent the foundation on which all future research builds.

“...we hope to improve research efficiency and to achieve maximum benefits for patients and healthcare providers.”

Regulatory bodies and pharmaceutical companies involved in the development and approval of new drugs can also play their part by speedily adopting agreed core outcome sets, so that the results of future research can be combined and placed in context throughout the world.



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Systems medicine approaches in dermatology

Although a small field in medicine, dermatological diseases are very frequent and span a wide range of illnesses such as allergies, inflammation (e.g. atopic dermatitis, psoriasis), autoimmune diseases or malignancies (e.g. melanoma). Thus, translational dermatological research is an important, innovative field for future basic and clinical research for many diseases in which treatment is still an unmet medical need.

Skin conditions under investigation

The major areas of dermatology under investigation at the Charles Institute are atopic dermatitis, rosacea, itch and other inflammatory skin conditions (Director: Professor Martin Steinhoff, Professor Frank Powell), cell signalling (Professor Cormac Taylor), wound healing and epidermolysis bullosa (Dr Wenxin Wang) and melanoma genetics (Dr Simon Furney). These areas are explored using a wide range of innovative techniques: disease models, 3D skin models, proteomics, genomics, metabolomics, cell signalling, immunology, systems biology, and state-of-the-art imaging.

Itch serves as a self-protective system under normal conditions, but chronic itch can have a debilitating impact on quality of life. Chronic itch can be caused by skin conditions such as atopic dermatitis (eczema) and contact dermatitis, or after zoster (shingles), by systemic disorders or certain medications. Terminally ill cancer patients, for example, often experience such severe itch in response to morphine

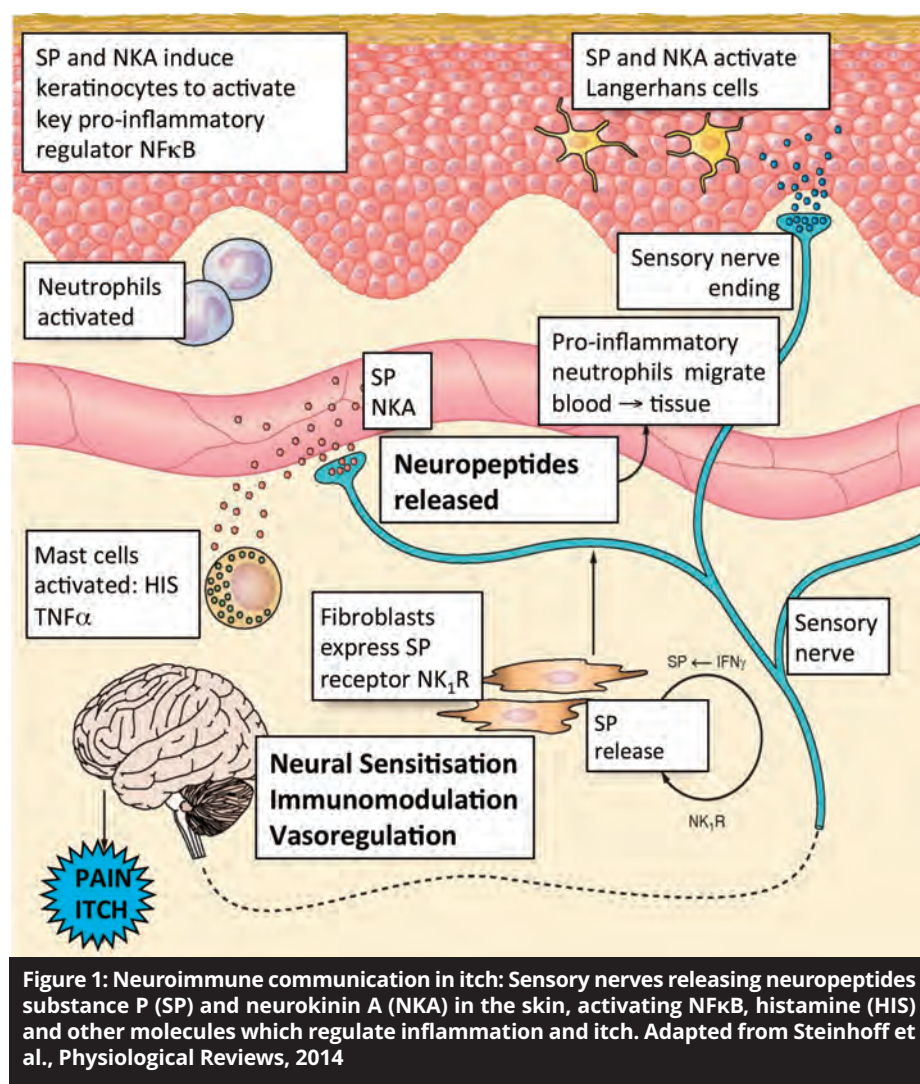


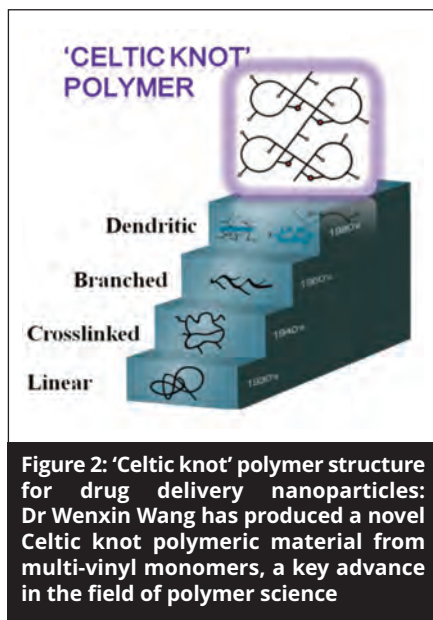
Figure 1: Neuroimmune communication in itch: Sensory nerves releasing neuropeptides substance P (SP) and neurokinin A (NKA) in the skin, activating NFκB, histamine (HIS) and other molecules which regulate inflammation and itch. Adapted from Steinhoff et al., *Physiological Reviews*, 2014

that many choose to live in pain rather than take the medication. Steinhoff's laboratory is discovering more about the mechanisms of itch (Fig. 1). A large part of their work focuses on endothelin-1, and they have shown that it is possible to turn the dial up or down on the level of itch by targeting this pathway.

Epidermolysis bullosa is a family of genetic skin diseases characterised by skin fragility, resulting in blisters, chronic wounds, scarring and skin

cancer. In an effort to find a cure to this devastating disease, the Wang team has developed a non-viral, polymer-based vector carrying normal collagen type VII expression to cells in which it is missing. Unlike most genetic therapies, this is designed to be applied directly to the skin.

Wang's laboratory designs and builds polymers with a variety of defined shapes illustrated in Fig. 2 which can be specifically tailored to suit the application. This distinctive combina-



tion of chemical and biological expertise offers promising prospects for application to many areas of bioscience, including drug delivery, immunology and the development of vaccines, biodetection and biosensor, antimicrobials and antiviral agents.

Another target group of patients in Wang's sights is people with diabetes. Over time, diabetes can damage the nerves and circulation of the lower limbs, and if wounds form they can be very hard to heal and in severe cases the person may need an amputation. The Wang group has been looking at the specific needs of diabetic wounds and has developed a tailored biomaterial that could be used in dressings to carry therapeutic agents such as stem cells and growth factors.

Rosacea is a chronic inflammatory skin disorder with symptoms of dry, sensitive facial skin that commonly affects middle-aged people, with a

particularly high incidence among people of Celtic extraction. As an example of modern translational research, Steinhoff's recent findings gave new insights into the pathophysiology of rosacea, which is so far incompletely understood. Using a combination of transcriptomics and immunohistochemistry, his group elucidated for the first time the complex pathways of genes involved in this condition (Journal of Investigative Dermatology 2015). Another approach led by Prof. Frank Powell focuses on deciphering the role of the Demodex mite, a microscopic organism associated with the inflammatory lesions which affect rosacea patients.

Translational research

At the UCD Charles Institute of Dermatology, the vision is to establish a centre of excellence for translational dermatology research in Ireland, working with colleagues in dermatology clinics at UCD's affiliated hospitals. The goal is to understand the pathophysiology of skin diseases in a translational fashion. The outstanding infrastructure with patient care clinics, clinical trial units, and a new €20m research centre for over 70 scientists provides a unique opportunity to comprehensively study the pathophysiology of various skin diseases, develop new treatments and perform innovative clinical trials for patients with treatment-resistant skin diseases.

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Galderma; German Research Foundation; Leo Foundation; L'Oreal; Maruho; National Institutes of Health (NIH); Pfizer; Salix; Science Foundation Ireland; Tigercat; Toray; Vertex.

Director biography

Professor Martin Steinhoff is a clinical dermatologist as well as a basic scientist with 20 years' experience in translational dermatological research. He is a trained dermatologist, allergist and phlebologist with specific interests in neuroimmunology, inflammatory skin diseases and systems medicine. After his appointment as associate professor in Germany (2005-2008), he worked at the University of California, San Francisco, as full professor (2009-2013) with NIH-funded research. Steinhoff began his position as professorial chair of dermatology and director of the UCD Charles Institute of Dermatology in January 2014.



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Innovative solutions to acute medical care

Dr Andrew Goddard, Royal College of Physicians registrar and consultant gastroenterologist highlights how innovative solutions can assist and improve acute medicine...

Last winter we saw unprecedented demand on accident and emergency (A&E) departments across the country, with many struggling to cope with the volume of patients and with many others having to declare major incidents. My colleagues in A&E are often the first to feel this extra demand. However, hospital physicians, those who admit medical patients into the wider hospital, also see this increase in demand and often have to deal with a complex picture of patient admission, care pathways and transfers of care back out into the community.

Winter 2014/15 had a large impact on the work of physicians and I am sure, once again, that this winter will be tough. We know finances are stretched (a recent survey¹ of our members highlighted that 85% of them believed that current health service funding is not sufficient to meet the current demand). We also know that rotas for doctors in our hospitals are still not being filled. But at present there is no prospect of new money coming and there is no swift solution to the rota gaps issue.

In conjunction with these short term seasonal issues, hospitals are also having to cope with an ever increasing demand from an often frail and aging population. Our report, *Hospitals on the Edge*², highlighted nearly two thirds of people admitted to hospital are over 65 years old, and increasingly are frail, have multiple complex conditions or have a diagnosis of dementia.

However, though the picture painted is stark – here at the Royal College of Physicians (RCP) we are providing our membership with new ways to approach care in an acute setting.

One way, we have done this is to provide practical guidance to physicians in this often complicated area of care. The Acute Care Toolkit: 'Acute medical care for frail older people'³ part of a wider series, has a wide range of recommendations to aid in the care of frail older people, including:

- early comprehensive geriatric assessment (CGA) for frail older people;
- aligning emergency, acute medical and geriatric services to deliver high-quality care for older people;
- advanced planning of care in order to prevent future admissions.

It is work like this that will help physicians dealing with acute medical admissions on the ground, however in addition to our Acute Care Toolkit series⁴, the RCP has in recent years been working on providing system wide solutions to many of questions that present themselves 'at the door' to physicians.

"Medicine is a brilliant career with great opportunities to really innovate and make a difference. Acute medical care faces many challenges but at the RCP we are looking to find innovative and sustainable solutions to these often very complex problems."

The RCP's Future Hospital Programme, which lead on from the work of *Hospitals on the edge*, has over the last year been developing new models of care. Given time and political backing, this programme has the potential to solve much of the growing pressure seen



in the NHS. One stand out example is that of Worthing Hospital's 'Emergency Floor'⁵. Opened last year, the Emergency floor focuses care around the patient, with their treatment led by one consultant, within a multi-disciplinary team, in a single setting. The effect is that the patient receives care from many different hospital doctors without having to be moved around the hospital – which leads to shorter hospital stays and shorter recovery times for the patient. It provides a truly joined up service.

Medicine is a brilliant career with great opportunities to really innovate and make a difference. Acute medical care faces many challenges but at the RCP we are looking to find innovative and sustainable solutions to these often very complex problems. ■

¹ <https://www.rcplondon.ac.uk/search?text=update%20nhs%20doctors%20view>

² <https://www.rcplondon.ac.uk/guidelines-policy/hospitals-edge-time-action>

³ <https://www.rcplondon.ac.uk/guidelines-policy/acute-care-toolkit-3-acute-medical-care-frail-older-people>

⁴ <https://www.rcplondon.ac.uk/projects/acute-care-toolkits>

⁵ <http://www.westernsussexhospitals.nhs.uk/news/emergency-floor-wins-prestigious-support/>

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Research opportunities in Acute Medicine

Dinesen L^{1,2}, Poots AJ¹, Bell D^{1,2}.

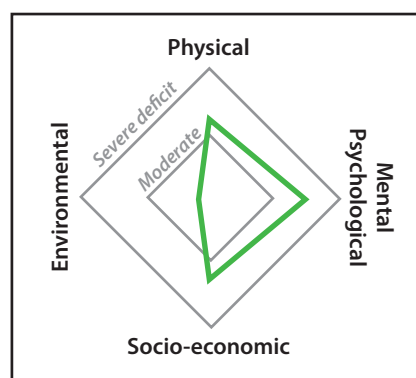
1.NIHR CLAHRC NW London, Imperial College London

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What is Acute Medicine?

Acute medicine is the part of internal medicine concerned with the immediate and early specialist management of adult patients who present to, or from within, hospitals as urgencies or emergencies and traditionally this include the first 72 hours of care in a well-staffed and equipped Acute Medical Unit. As such, acute medicine and acute physicians manage a large number of patients per day with complex health needs across a broad range of illness severity.

Acute medicine has a growing academic base but research in acute care needs to increase and accelerate for two main reasons. The first is to ensure we design adaptive systems for health care delivery in an increasingly complex environment related to the increasing demand and advances in technological intervention and diagnostics. The second is to better understand and treat patients with complex needs who are increasingly exposed to a cocktail of medicines which can have interactions, some with significant harm¹. Acute medicine has developed over the past 10 years owing to a complex interplay of factors; it is now established in several European countries and is developing in Singapore and Malaysia. As the demand for acute physicians grows it is imperative that we provide increased research opportunities for clinicians and non-clinicians, to ensure best medical practice. This means that major grant funders need to recognise the patient need for research in this area and pump prime grants and new academic posts. Translational



To improve frailty model and produce a clinically meaningful score:

Primary Care

Social Care

Secondary Care

For patient usage

Figure 1 – the four domain conceptualisation of frailty

research² is recognised as an essential area for research and with Acute Medicine' acting as the front gate for secondary care, its main role is likely to be in closing any second translation gap between primary research and practice, thereby ensuring that patients receive consistent, high quality, patient-centred care.

Research opportunities in Acute Medicine

The research opportunities span a broad range: from managing a single disease entity such as venous thromboembolism and stress hyperglycaemia to complex needs patients and polypharmacy, evaluation of illness severity assessment scores (including NEWS), technological interventions such as non-invasive ventilator support through to the design of health care systems. Some examples of recent research and future research opportunities are described in the next section.

Frailty in the context of Acute Medicine

Frailty is usually seen as a condition of

ageing with two main models commonly used to describe frailty in the context of research: namely the phenotype and the cumulative deficit models^{3, 4}. These models, while valuable, are probably too simplistic in the context of acute illness. While an acute presentation will usually be driven by a physical illness and the associated pathophysiological decompensation there is a complex interplay between the patients environment, social and psychological wellbeing (Figure 1). This may be seen as obvious in many cases, but assessing and measuring this to facilitate better clinical decision making and going support is not routine in clinical practice. To this end our research programme has recently published on the role of large data in defining outcomes for complex needs elderly patients in acute care based on the use of 'geriatric syndromes'^{5, 6} and this work is now informing the basis of a four domain simple clinical frailty score that can be calculated at point of entry to care and longitudinally.

This score will use the four domains

described above and the aim is to validate this work across a range of clinical environments, conditions such as brain injury, and age groups above 16 years old. This study is on-going, funded through the National Institute of Health Research (NIHR) Collaboration for Leadership in Applied Health Research and Care North West London (CLAHRC NWL); but collaboratively across international centres would allow this work to be developed more effectively and help to minimise the translational gap that exists in this area.

CLAHRC NWL and patient leaders co-developed My Medication Passport, a hugely successful project. My Medication Passport is a written record, either in paper or smartphone app, of a person's medication, designed to improve communication between healthcare professionals and patients, and to provide a record for the patient themselves to be in charge of their medication and any changes made to their medication⁷. Also CLAHRC NWL is involved in de-prescribing and optimising medication review.

Acute Medicine and System design

Acute Medicine's ability, in common with emergency medicine and intensive care, to deliver high quality and efficient care is influenced by the patient and staff environment. Yet relatively little research has been conducted in this area, whether at the level of building design or the optimal use of information technology. It could be argued that in hospital and departmental design we reproduce the mistakes of the past; for instance having large distance between Emergency Departments, and acute medical units slows patient flow. Equally, in relation to information technology, we use what is provided rather than as an

enabler to facilitate high quality care; for example, differing IT systems between specialties hinders transfers of knowledge across transfers of care. To resolve this Medicine needs to move beyond the current research paradigms to work more closely with developing information technology and social media, and to look beyond traditional medical research (for instance collaborating with engineering, design, art, and other social sciences) to design responsive and adaptive health care systems, organisations and departments. High volume specialties, such as Acute Medicine, and patients will benefit most by embracing a varied epistemological approach, drawing on differing knowledge bases to provide innovative solutions. Preliminary work with the Royal College of Art and Imperial College London has suggested four design features for Acute Medical care:

- Visibility of information and the clinical (patient) areas
- Sharing of information between and across professional groups
- Empowerment of patients and staff in decision making
- Follow up of outcomes

Building on this will require a rethink of information and information systems to create a reliable and systematic view of care needs in real time, and a new approach to building and environmental design. Collaboration across different health care systems would provide enhancements to this work, providing greater generalisability of output.

Summary

The potential for academic medicine

to develop in acute medicine is significant and will require new thinking that recognises the needs of the large cohort of patients who are admitted to hospitals around the world 24 hours per day seven days per week. Costs are related to patient needs and for most hospitals this reflects a large proportion of the budget. To improve care and efficiency requires research funders and industry to recognise the importance of acute care and to invest in the future for this vulnerable and complex patient group. Collaboration across disciplines and nations will provide innovative and generalisable knowledge for these improvements; and, coupled with the varied patient cohort, this provides many research opportunities and rewarding field in which to work.

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Promoting good oral health

Adjacent Government sheds light on how organisations such as WHO and the National Institute of Dental and Craniofacial Research (NIDCR) are raising awareness of oral diseases and prevention...

Most people brush their teeth in the morning and before bed. This simple act can help to prevent a whole host of complications when it comes to oral health.

Maintaining good oral health is not only about having clean teeth, it can be essential to your general health and quality of life. The World Health Organization (WHO) reports ¹ that 60-90% of school children and nearly 100% of adults worldwide have dental cavities. They also reported that oral disease in children and adults is higher among poor and disadvantaged population groups.

Risk factors that can trigger poor oral health and diseases include: an unhealthy diet; smoking; drinking an unhealthy amount of alcohol; poor oral hygiene, and social determinants. According to WHO the most common oral diseases are dental cavities; periodontal (gum) diseases; oral cancer; oral infectious diseases; trauma from injuries, and hereditary lesions.

In America the Centers for Disease Control and Prevention (CDC) ² highlight that over the past 10 years, the number of adults aged over 60 years missing all their natural teeth has declined from 31% to 25%. For adults aged between 40 and 59 years, this figure has reduced from 9% to 5%. This does mean, however, that 1 in 20 middle-aged people in America are missing all their teeth.

Research into oral health can play an essential role in developing techniques and treatments to help prevent tooth decay and gum diseases. The National Institute of Dental and Craniofacial Research, part of the National Institutes of Health, recently funded ³ a consortium for research into childhood oral health disparities.

Ten research grants totalling \$7m will be awarded with an aim of improving oral health in childhood. NIDCR Director Martha J. Somerman said: "By establishing this research consortium NIDCR seeks to lead national efforts in reducing childhood oral health disparities.

“Among the projects awarded are those that test innovative health promotion and disease prevention strategies and evaluate and refine existing programs and policies.”

If tackled early on in childhood, oral health problems can be eliminated by the time they reach adulthood. Research like this can also help when tackling health disparities among populations. In March 2015, the National Center for Health Statistics reported that Hispanic/Latino children and black children are twice more likely to have un-treated tooth decay in primary teeth.

“Research has shown that individual-level approaches alone are not sufficient to reduce rates of tooth decay and other oral diseases,” said NIDCR Health Disparities Research Program Director Ruth Nowjack-Raymer. “Therefore, the consortium’s research projects will involve holistic, population health and other approaches to take decisive action against oral health disparities at multiple levels of influence, such as families, neighbourhood, and health care systems.”

Global organisations such as the NIDCR and WHO play a vital role in providing information and raising awareness for health issues such as oral diseases. Early protection and prevention is an essential tool when attempting to reduce oral health diseases worldwide. Making people aware of the pitfalls of bad oral health can be key to reducing the number of people losing their natural teeth and developing further health complications through these problems.

In order to tackle oral health globally, the WHO launched their Global Oral Health Programme (ORH) ⁴. WHO states that: “High relative risk of oral disease relates to socio-cultural determinants such as poor living conditions; low education; lack of traditions, beliefs and culture in support of oral health.

“Moreover, control of oral disease depends on availability and accessibility of oral health systems but reduction of risks to disease is only possible if services are oriented towards primary health care and prevention.”

The Oral Health programme aims to put greater emphasis on developing global policies in oral health promotion and disease prevention. WHO sees oral health as part of total health and playing a key role in ensuring quality of life.

“In America the Centers for Disease Control and Prevention (CDC) ² highlight that over the past 10 years, the number of adults aged over 60 years missing all their natural teeth has declined from 31% to 25%. For adults aged between 40 and 59 years, this figure has reduced from 9% to 5%.”

The programme focuses on areas that can cause oral health problems, and works within local communities to give high priority to the elderly and children. Initiatives within the programme include self-care practices in relation to oral hygiene, which is an essential part of good oral health. The programme also works towards the formulation of national and community policies on effective control of diet and nutrition risk factors for dental diseases, oral cancer and cranio-facial development.

Ensuring that the people who need it most have the right information to help further prevention is essential. If people are unaware of the problems that poor oral health can cause, how can they do anything about it? The above article highlights that oral health is not a minor problem, and more needs to be done to raise awareness of this, especially in countries that do not have the means and funds to do so. ■

1 <http://www.who.int/mediacentre/factsheets/fs318/en/>

2 http://www.cdc.gov/oralhealth/publications/factsheets/sgr2000_05.htm

3 <http://www.nidcr.nih.gov/research/ResearchResults/NewsReleases/CurrentNewsReleases/NIH-funds-consortium-for-childhood-oral-health-disparities-research.htm>

4 http://www.who.int/oral_health/strategies/en/

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Dental diagnostics system (DDS)

Providing clear information for patient and provider...

Our medical colleagues have been capturing the causes of death for centuries using standardised diagnostic terms. The first international conference to revise the International Classification of Diseases (ICD) was convened in 1900. In 1948, the World Health Organisation (WHO) took responsibility for the now renamed International Classification of Diseases, Injuries, and Causes of Death with the sixth edition. The WHO expects to launch ICD-11 in 2020. Oral health diagnoses are classified in the early and current revisions of ICD. However, they are not granular enough and difficult to find throughout the ICD volumes. Additionally, the dental profession does not mandate documentation of a dental diagnosis as part of the billing process and consequently, diagnoses are not captured in a structured format. Hence, until recently dentistry did not capture why a tooth becomes non-vital or why it had to be extracted, much to the disadvantage of clinical dentistry, dental public health and dental quality improvement efforts.

Several attempts to address this problem have been made throughout the years, including the development of the Toronto codes in 1999 and the Systemised Nomenclature of Dentistry (SNODENT) by the American Dental Association (ADA). SNODENT, which is integrated into SNOMED, has proved largely ineffective as a chair-side terminology, not least because it is

composed of more than 7,000 terms, is not widely available and is yet to be finalised.

“The DDS aligns dentistry with medicine, in terms of establishing standard clinical practice. Enabling diagnoses to be clearly recorded after examination and providing care is important to facilitating communication between clinicians, patients, epidemiologists, researchers and students.”

To meet the need for a comprehensive yet concise set of dental diagnostic terms, a happy medium between ICD sparseness and SNODENT/SNOMED enormity, an academic workgroup came together in 2009 to create and implement the EZCodes dental diagnostic terminology, later renamed Dental Diagnostic System (DDS). Key motivators included the dire need for the dental profession to enter a diagnosis in the patient record that is clear and can be used to inform both the provider and the patient. A standardised terminology can capture a granular diagnosis in the electronic health record (EHR) that then helps inform the providers of the specific treatment procedures appropriate for the chosen diagnoses. For the patient it will specify information why a certain procedure is being done, by providing detailed reasoning behind each procedure. From an educational

perspective, it allows faculty to create a diagnostic-centered academic approach that will facilitate students to learn.

Led by Dr. Elsbeth Kalenderian from Harvard School of Dental Medicine, an academic workgroup developed the first diagnostic interface terminology specifically applicable to the field of dentistry. The Dental Diagnostic System (DDS) – formerly known as EZCodes, contains dental diagnostic terms at the granularity level required by practicing dentists chair-side. Developing the DDS terminology was an iterative process that began with the University of California, San Francisco School of Dentistry's Toronto Z skeleton, as it was representative of dental clinical practice. The Z Codes were based on the original Toronto codes proposed earlier, but never widely adopted. This Z skeleton was then populated with concepts from the American Academy of Periodontology, the American Board of Endodontics, UCSF own Z codes and International Classification of Disease terms to ensure adequate concept orientation. The first version of the DDS diagnostic terminology was produced following two rounds of discussion with domain experts and subsequent review by the workgroup. This produced DDS-2010 with 1,158 terms in 13 categories and 78 sub-categories. Subsequent revisions produced a robust DDS terminology with DDS-2015 consisting of 1589



terms, in 17 categories and 107 sub-categories.

Members of the workgroup include Drs. Joel White, Muhammad Walji, Oluwabunmi Tokede, Maxim Lagerweij, and Rachel Ramoni. All are united by a common goal to improve dental research, education and patient care by creating a go-to terminology for clinical and public health research. There were several considerations for the workgroup members to take into account during the process of developing a terminology that should be easy to use in the clinic and be usable for research through secondary data analysis. First and foremost, the team must ensure that clinicians use the standardised terminology consistently and accurately. Hence the DDS research team completes ongoing validation and measuring of DDS utilisation.

The DDS aligns dentistry with medicine, in terms of establishing standard clinical practice. Enabling diagnoses to be clearly recorded after examination

and providing care is important to facilitating communication between clinicians, patients, epidemiologists, researchers and students. While the standardisation of dental diagnostic terminologies is of obvious benefit to dentistry, it is important that additional consideration is given to how the terminology will be shared. Facilitating and encouraging its use is key to the DDS realising its potential. With that in mind, NIH/NIDCR is supporting the development of the DDS implementation toolkit, which will enable the terminology to be rolled out to non-academic dental institutions and general practitioners.

Eighteen dental institutions from the US, Canada and Europe use the DDS for patient care, teaching and research. Ten additional schools are slated to implement the DDS terminology within the next year. Incorporated within axiUm, Exan Corporation's dental EHR, the DDS is available to almost every dental school in the US. Two other EHR vendors are revising their EHR

interface in order to effectively upload the DDS. This as a result of pressure from their users who are concerned about government mandates to document a diagnosis as part of Medicaid reimbursement requirements. The DDS has been shown to be useful and accurate, and its terms are routinely paired with dental procedures providing a treasure trove of usable data on dental diagnosis and treatment for appropriateness of care and outcome research.

The DDS is a crucial component of the BigMouth Dental Data Repository (which houses data from six institutions with nearly 2 million patients). Structured data entry is essential for developing effective electronic data repository systems and helping clinicians and researchers use them in a meaningful way. With the creation of the DDS, the team has made this possible.



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Auditor

The real cost of healthcare fraud

Jim Gee, Partner and Head of Forensic and Counter Fraud Services at PKF Littlejohn sheds light on the impact of fraud on the healthcare sector...

Fraud is a challenging problem no matter what sector it impacts on. Its economic effects are clear – worse public services, less financially stable and profitable companies, diminished levels of disposable income for all of us, charities deprived of resources needed for charitable purposes. In every sector of every country, fraud has a pernicious impact.

However, in the healthcare sector there is a direct, negative impact on human life. Whatever country we live in what we all have in common is that our people want and need to be healthy. There are healthy people who fear ill health, sick people who yearn to be well, older people who want to enjoy their later years and young people who need the foundations of lifelong good health.

At present we have a fraudulent or corrupt minority who are prepared to divert the funds which are intended to keep us all well. That minority exists in

all countries – and even in the UK's National Health Service (NHS). Every penny lost to fraud and corruption drains the lifeblood from our healthcare systems and undermines their capacity to provide essential treatment.

PKF Littlejohn and the Centre for Counter Fraud Studies at University of Portsmouth have published the latest global (and UK) research concerning the extent to which this happens – 'The Financial Cost of Healthcare Fraud Report 2015'.

The Report doesn't just look at detected fraud or the individual cases which have come to light and been prosecuted. Because there is no crime which has a 100% detection rate, adding together detected fraud significantly underestimates the problem. The Report also doesn't rely on survey-based information where those involved are asked for their opinions about the level of fraud.



Jim Gee, Partner and Head of Forensic and Counter Fraud Services

just this – reducing the cost of fraud by up to 60% and delivering £811m of financial benefits to fund better patient care.

“At present we have a fraudulent or corrupt minority who are prepared to divert the funds which are intended to keep us all well.”

So what is to be done? It is the view of the authors of the Report that there are 3 first steps for the NHS to take to reduce the cost of fraud:

1) The NHS needs to re-adopt an approach which is focussed on reducing the cost of fraud not just investigating and prosecuting individual examples (although this is important too);

2) It therefore needs to re-commence loss measurement exercises across key expenditure streams. It is only with accurate knowledge about the nature and extent of fraud that proportionate, effective action can be taken to reduce its extent; and

3) It needs to re-create a powerful, well-resourced organisation to lead this work with a remit and authority across all parts of the NHS.

This is an urgent task for those who manage the NHS. It is hoped that the report provides an evidence base for renewed action to protect it as it needs to be protected. ■

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Instead it considers 107 statistically valid and highly accurate loss measurement exercises looking at the total cost of fraud (and error). The data considered covers 17 years and 14 different types of healthcare expenditure in different countries, with a total value of £2.9 trillion.

Across this massive global dataset it shows average losses of 6.2% with 88% of the loss measurement exercises showing losses of greater than 3% and an increase of almost 11% in this cost since 2007.

In the UK's NHS, the report looks at losses in 6 areas of expenditure and 3 of patient charge income, using the NHS's own data where it has measured losses or global data where it has not. Total losses for the NHS (for fraud alone) are estimated to be between £3.73 and £5.74bn depending on the assumptions made – either way an enormous sum which is not being devoted to patient care.

In the context of the NHS having to make efficiency savings over coming years and the annual pressures for additional expenditure as new treatments become available, this is a cost which the NHS needs to do more to manage and minimise. The report cites the period between 1998 and 2006 when the NHS did

Controlling healthcare fraud in Europe: the 13th labour of Hercules?

"Fraud control is a miserable business. Failure to detect fraud is bad news, and finding fraud is bad news too"

This controversial conclusion in Malcom Sparrow's book *"License to steal. How fraud bleeds the American Healthcare system"* edited in 2000, says it all.

1. Some case examples can demonstrate THE NATURE OF THE PROBLEM of healthcare fraud control perfectly.

Eight **Italian doctors** have been sentenced to prison in 2010 for carrying out dozens of unnecessary operations for financial gain. The doctors, who were working at a Milanese clinic, carried out more than 80 unnecessary operations. In one case an 88 year old woman underwent 3 lung operations – with a payment of €11,300 per procedure – when a single operation was all that was medically needed. In another, an 18 year old girl underwent a medically unnecessary mastectomy removal. The clinic's chief consultant was sentenced to 15 and a half years in prison.

A **French pharmacist** was sentenced to 2 years in prison and a fine of €350,000 for claiming reimbursement of medication not sold. He colluded with patients who accepted a bribe to add medicine to their prescription.

Pricing information from **Belgian hospital pharmacies** matched with acquisition data of contrast liquid showed in 45 cases that more liquid was billed than originally purchased.

Over a period of one year up to €2.5 million was fraudulently billed.

Hospitals in many countries bill the entire drug carton to health insurance where only half or less of the pills have been administered to a patient.

Patients are bribing doctors to obtain a disability or other welfare allowance (France); they use false (European) health insurance cards (Belgium) and there is collusion between patients and providers in order to invoice non provided health-care abroad (Netherlands).

There is also fraud committed by **suppliers** and manufacturers where the exploding market of counterfeit medicine is finding its way to the patients via the internet and the so called underground economy.

There is however, that annoying perception that pharma companies have not always been walking the straight path. The fact that 10 of the largest pharma companies have been named and shamed in the media between 2007 and 2015 and had to pay millions, in some cases billions of dollars in settlements, has added to what can be called at least 'the perception' that the industry is walking a thin line.

Reading John Virapens' confession of an insider in his book *"Side effect death"* and Ben Goldacre's *"Bad Pharma: How Drug Companies Mislead Doctors and Harm Patients"* emphasises the fact that pharma is under intense scrutiny.

And then there is the problem of **medical tourism**...

German hospitals have been colluding with an Arabian medical tourism agency defrauding Arabian patients and German health insurance by up-coding and up-billing the invoices to be paid by Arabian patients who come to Germany for treatment.

2. EXACERBATING FACTORS

Fraud control is not an easy task. It is a hard nut to crack. In some areas and sectors this is even more so than others. This is certainly the case for countering fraud in healthcare. Healthcare is a difficult terrain for fraud fighters. Moreover, it is one of the last taboos.

The reasons are, there is little transparency, stakeholders are organized in powerful lobbies, and there is an astonishing tendency to avoid the "F" word.

According to Malcolm Sparrow there are exacerbating factors in health insurance and public financing:

Public and private insurers are seen by significant segments of the population as socially acceptable targets for fraud, there is an absence of clear distinctions between criminal fraud and other forms of abuse, and above all there is the total absence of 'measurement' of fraud. Healthcare fraud is considered to be a moral hazard, not an important business cost.



3. THE IMPORTANCE OF CLEAR DEFINITIONS FOR CORRECT REPORTING ON THE EXTENT OF FRAUD: THE EHFCN WASTE TYPOLOGY ©

Notwithstanding the fact that there are many different healthcare systems throughout Europe, there are common patterns of fraud, waste, corruption and abuse detectable.

In current times of financial crisis, cost-cutting in healthcare is one of the more common austerity measures taken in many countries. EHFCN however continues to repeat, as a mantra, that before doing so, it is paramount to look for where healthcare money is being WASTED.

In line with the findings of a Thomson Reuters study (Thomson-Reuters- 2009, White Paper, “Where can \$700 Billion in waste be cut annually from the US healthcare system?”) estimates are that **approximately 30% of the healthcare budgets in Europe are wasted.**

According to the New England Healthcare Institute ‘Waste’ can be defined as *“Healthcare spending that can be reduced without reducing the quality of care”*.

A. About WASTE

1. Red flags indicating aberrant healthcare expenditure can be triggered by a wide variety of causes ranging from simple **ignorance and error** at one end of the spectrum to **fraud and corruption** at the other.

Fraudulent waste, in particular fraudulent “overconsumption” or **unnecessary or too expensive care**, can sometimes be flagrant but often blends with gray zones near “error” (unjustly obtaining a benefit of any nature by unintentionally breaking a rule or guideline) and so called “abuse”. **Both fraud and error may not be mixed in statistics. It incriminates the innocent, honest majority.**

Abuse (unjustly obtaining a benefit of any nature by knowingly stretching a rule or a guideline, or by taking advantage of an absence of rule or guideline) is a word frequently used instead of “fraud” as it does not imply the intentional breaking of a rule, but rather “stretching” it by lack of standard interpretation, or when the rule itself, such as **a medical guideline** or EBM (evidenced based medicine) is not legally enforceable. Disregard of medical guidelines and EBM causes waste, in turn **generating financial losses estimated to be considerably more important than the ones by fraud, in particular 15%.**

2. Similar to the way obvious violations of **billing rules** are dealt with, a comprehensive approach should also apply to the disregard of **medical guidelines and EBM**. Much of its effectiveness however depends on the actual existence of guidelines and on the enforcement procedures in place.

3. A strategy to fight healthcare waste can only be effective when both ends of the spectrum – ignorance, error and fraudulent abuse – are tackled.

- initially: by observation, study and analysis of the prevalence of waste phenomena as an economic reality in healthcare
- subsequently: by prevention (campaigns of information and education), and
- incentives for good practice
- further: by redress of the money lost and
- ultimately: with repressive sanctioning.

This strategy has, to a certain extent, proven its effectiveness with regard to enhancing compliance with billing rules in private and social health insurance as well as in national health funds systems.

Preventive actions have also been successful in campaigns aiming at enhancing compliance with medical guidelines, calling upon professional standards and ethics.

4. Where strategies usually fall short however, is in successfully addressing fraudulent waste (in general not necessary/too expensive care). The main reason is the non existence of enforceable rules or guidelines with universal compulsive authority. As a consequence no sanction can be imposed and as appeal upon professional standards and ethics fails, the fraudulent waste continues to go unpunished.

B. BILLING FRAUD or illegally obtaining a benefit of any nature by intentionally breaking a rule

Non compliance with billing rules or incorrect billing continues to be a major concern in any healthcare system.

The challenge remains to distinguish error from fraud in the first place and to set up strategies to tackle both consistently.

Preventively focusing on establishing a uniform straightforward billing system and educating providers to use it properly, has seen to be most rewarding to reduce errors.

Tackling fraudulent billing however needs a specific organizational approach making resources available for analysis, detection and investigation. This raises the issue of return on investment.

The answer to the question whether a health insurer or a national health fund wants to go the extra mile, beyond the “easy” recuperation of losses due to error, is mostly of political nature. Tackling healthcare fraud and abuse head-on disturbs the financier-provider relationship as it touches upon 4 major paradigms:

- that healthcare should be provided at all costs
- that more is always better
- that expensive is always best
- that the professional integrity of healthcare providers is never to be challenged.

As a consequence fraud stays untouched and is accounted for as a **moral hazard**, continuing to generate an important financial and ethical deficit.

Tackling healthcare fraud however is a condition for enabling a **paradigm shift** in the mind of the financiers and of the healthcare providers: that only quality care should be paid for (correctly). Taking on billing fraud is the first important step to changing the lenient attitude of insurers, patients and providers towards wasting healthcare money by billing and paying incorrectly for (not provided) care.

Healthcare fraud, is estimated to generate financial losses between 3 and 10% in Europe with an average of 6.5%.

C. Corruption or illegally obtaining a benefit of any nature by abuse of power with third party involvement

1. EHFCN collaborated with ECORYS in drafting the [“Study on Corruption in Healthcare”](#) on request of the European Commission.

2. The study, made public on 19 December 2013, concludes that the overall impact of corruption in healthcare on society and on individuals is much larger than the monetary value of the sums involved.

Estimates of losses to corruption in healthcare are not available.

D. FUTURE CHALLENGES

It is important to look **ahead** at what the next 10 years might bring us: in

particular, at what the challenges might be for fraud control in a healthcare environment, a healthcare environment changing at lightning speed, driven by technology and the diktat of the globalized market of products and services (healthcare included).

How will the financial sustainability of healthcare systems be guaranteed? Will maximization of profit determine how healthcare will be provided, at the loss of patient-focused quality care? Which areas of healthcare will become specifically vulnerable to fraud, waste and corruption and how will fraudsters respond to this changing environment?

Are there factors we are not taking into consideration **now** as there is no urgency felt to deal with them or they simply aren't on the radar yet... factors that will become predominant ones in a near future determining how the scarce healthcare money will be spent? And consequently create unethical competition for healthcare resources between providers, patients, the industry and health insurers.

Will healthcare budgets be outplayed by the high cost of climate change? Extreme heat in France in 2012 resulted in 15,000 additional deaths. Or by the cost of taking on terrorism?

Or will tele and ehealth add another layer of opaque financial transactions to the healthcare sector already suffering from a lack of transparency?

Will the inevitable epidemic consequences of unhealthy living suck up most of the healthcare resources leaving no room for fraud control? A NATPOL survey in Poland shows that

the number of Poles suffering from diabetes will increase by 2.5% annually, and from hypertension by 2%.

Will the actual top 2 areas of fraudster interest, durable medical equipment and aversion of prescription medicine be replaced by other areas of interest?

OR will medically unnecessary diagnostic laboratory and radiology continue to increase, as well as medically unnecessary orthopedic surgery and invasive cardiology or costly and customized oncology treatment?

What about areas of actual overdiagnosis and "special interest" such as dermatology, podiatry, chiropractic services, allergic testing, sleep studies and associated CPAP machines, physical therapy, ambulance fraud, targeting of "high revenue diseases" such as hepatitis C, Alzheimers, psoriasis and "orphan drugs"?

Will all of these continue to generate increasing costs for health insurance or will they be replaced by other even more lucrative ones?

And most importantly: will the necessary resources (rules, tools and people) to reduce waste in healthcare be made available?

The answer to these questions will shape the future of healthcare fraud control and the financial sustainability of healthcare in particular.

And the answer is situated at the highest political level in Europe. Nationally and internationally.

EHFCN has formally been established in 2005 as a not for profit international association by Belgian law.

The Network is membership based. The actual 16 members from 14 European countries represent public and private healthcare insurers, health financiers and payers who all have the countering of fraud, waste and corruption in healthcare as their core business or as part of their mission.

The aim of EHFCN is to improve European healthcare systems by reducing losses to fraud, waste and corruption and its objective is to help members to be more efficient and effective in their work of prevention, detection, investigation, sanctioning and redress of healthcare fraud, and waste and corruption, with the ultimate goal of preventing money being lost and returning money to healthcare services for the benefit of every patient.

EHFCN provides its members with high quality information, tools, training, global links and access to professional consultancy. It also promotes the sharing of good practice, joint work, bilateral agreements and the development of common working standards.



Paul Vincke
Managing Director
 European Healthcare Fraud and
 Corruption Network
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- Euro Consumer Heart Index 2008
- Euro Diabetes Care Index 2008, 2014
- Euro HIV Index 2009
- Euro Patient Empowerment Index 2009
- Nordic COPD Index 2010
- Tobacco Harm Prevention Index 2011
- Euro Headache Index 2011
- Euro Hepatitis Index 2012
- Euro Vision Scorecard 2013
- Euro Pancreatic Cancer Index 2014

Sweden, others

- Health Consumer Index Sweden 2004, 2005, 2006
- Diabetes Care Index Sweden 2006, 2007, 2008
- Breast Cancer Index Sweden 2006
- Vaccination Index Sweden 2007, 2008
- Renal Care Index Sweden 2007, 2008
- Smoke Cessation Index Sweden 2008
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Creating sustainable and efficient healthcare properties

Kerry Bourne, Director of Property Consultancy at Essentia, looks at how the NHS can make best use of its buildings in order to create a sustainable and more efficient healthcare estate...

It's no secret that the NHS is facing a major financial challenge. The ageing population is growing, science is providing new drugs and technology to which patients want access, and funding cannot keep pace without huge increases in productivity and efficiency.

The vast number of healthcare properties that make up the NHS estate have an important role to play in this drive for efficiency. We need to think about how NHS buildings are being used, whether they are fit-for-purpose, how they might deliver additional value, and increasingly, how we deliver a more integrated public sector estate.

Integrating the public sector estate

The Department of Health introduced a guidance document, "Local Estates Strategies: A Framework for

Commissioners" in June this year, placing emphasis on a collaborative approach within the public sector to ensure greater efficiencies and higher quality of patient care. This is an important change. Local estates strategies now have the potential to support new models of care and start to break down traditional boundaries between primary care, community care and hospitals.

Essentia has been helping several clinical commissioning groups across the South to deliver these Local Estates Strategies, working with stakeholder groups comprising local authorities, GP groups, acute and mental health trusts, and others. The clear feeling from all involved is that we need to "get on with it". There are many opportunities to use existing estates more efficiently and more effectively, and to improve the overall patient experience.



Kerry Bourne,
Director of Property
Consultancy, Essentia

Strategic estate management is critical. In order to be better integrated, trusts need to scrutinise their property portfolios and identify sites suitable for sharing and those that should be released for sale. Such collaboration allows trusts that are unable to expand due to landlocked sites to do so through the sharing of healthcare facilities from other providers.

We need to think about the public sector estate as a whole - having a joined-up approach will reduce duplication and overlaps. For example, local councils and hospitals could share buildings and facilities, and back office functions such as IT and finance. A number of clinical and social services could be co-located, eg. on GP community sites, reducing cost and making things easier for patients who currently face multiple appointments on multiple sites.

The role of rationalisation

Another area which can pay financial dividends for the NHS is property disposal. Having grown organically over many years, NHS trusts often have large sprawling estates with clinical services spread over multiple sites. This can lead to inefficiencies with sites no longer being fit-for-purpose. Rather than accepting the status quo, trusts need to actively consider what size estate they actually need to operate and whether they could release funds by selling off unwanted sites and/or use the estate, space and buildings more efficiently. We'd all fill a 10-bedroom house if we were given one, but we might only need a 2-bedroom flat!

This presents a particular opportunity for trusts in London, many of which own large portfolios of under-

used property that if released for sale could generate significant funds to be re-invested in frontline service provision. For example, Southwark Council has set a goal of building at least 7,000 new homes in the next decade; trusts could take advantage of the rising demand for new brownfield sites and release much-needed capital. Further, we should acknowledge that many trusts operate from Victorian buildings that are simply not suited for a modern hospital setting. If these sites were to be redeveloped, there would be scope to create new, state-of-the-art facilities in more appropriate locations. Essentia recently acted for Barts Health NHS Trust in the sale of the London Chest Hospital, an aged Victorian building no longer used for clinical services. The sale generated £49.6m for investment in new services and modern facilities.

Disposal is not always the best route

A year ago, the predictions were that we were entering an intense period of estate rationalisation and property disposal. Time has proved us only partially correct. There has been rationalisation but the story has almost equally been about commercial development through joint ventures and strategic estates partnerships. This will help NHS trusts to achieve their ambition to invest and to grow, whilst reducing overall cost. Trusts are learning that you don't have to get rid of everything – but you don't have to own everything either.

Conclusion

Creating a sustainable and efficient healthcare estate is not an easy thing to do. It requires a flexible approach and a desire and willingness to do things differently. But it will happen because not doing it is not an option. The NHS should and could lead the way in creating a more joined-up approach to the whole public sector estate, delivering higher quality care more efficiently and in a financially sustainable manner. ■

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Kerry Bourne

Director of Property Consultancy

Essentia

www.essentia.uk.com/

Are we prepared for an ageing society?

Dr Mark Britnell, Chairman and Partner of the Global Health Practice at KPMG answers Adjacent Government's questions about the impact of an ageing society on the economy and NHS services...

As populations grow and get older and more complex, there is an ever growing pressure on healthcare budgets and services. In the UK there are around 11.4 million people aged 65 or over. Over a third of the total population in the UK is 50 years plus – 23.2 million, and 14.9 million aged 60 and over. This means there are now more people in the UK aged 60 and over than there are under 18. By 2030, the number of people aged 60 or over is expected to pass the 20 million mark. The proportion of people aged 65 plus will rise from 17.7% to 23.5% in 2034. ¹

Chairman and Partner of the Global Health Practice at KPMG, Dr Mark Britnell tells Adjacent Government what he believes are the main challenges facing the healthcare sector in the UK, and how an ageing population could affect this.

What are the main challenges facing the healthcare sector in the UK?

In many ways, the underlying pressures on the UK's health service are no different to the challenges facing other developed countries. Our population is getting older and more complex to treat, care is getting more expensive and health workers more in demand, a lot of care is wasteful but we find it hard to separate what's ineffective from effective at scale.

The UK has a very efficient health service – we pay a lot less than many of our neighbours, yet our outcomes are for the most part just as good. The NHS is facing 10 years of flat funding while demand rises, and it's very difficult to achieve efficient savings of 3-4% year on year over that kind of period. I haven't seen it done in any other country. Of course, as the economy grows again, one would expect some of the proceeds of growth to be re-invested in the NHS.

Are we prepared for an ageing society?

No, but very few countries are. Ageing is the kind of long-term challenge that politicians find very difficult to rally the required momentum and urgency for. It's not as immediate a concern as a hospital going into deficit, or a care quality scandal, or junior doctors going on strike. It lies at the heart of many of these things, but leaders are too often consumed by the tyranny of the present. Research among board members that I talk about in my book shows that in other industries leaders are twice as likely to be focussed on short-term operational challenges than preparing for long-term planning, but that in healthcare leaders are 3 times as likely to perform this way. That said, we saw Japan in 2000 make a politically brave decision to introduce a new social insurance policy for aged care, and this seems to have worked.

How does an ageing society have an impact on the economy?

The economic challenges of ageing societies are well documented, in particular the ratio of working age people to those who have retired. In 1950 there were 12 people aged 15-64 for every one over 65. That figure is around 8 today and will be 4 by 2050. That's an incredible shift and one that has profound implications in terms of who is contributing to health insurance (whether that's public or private) and who is drawing on it.

That said, people are often slow to recognise the economic opportunity of an ageing society. The extra 600 million over 60s we're going to see between now and 2030 are going to demand all manner of new goods and services. Merrill Lynch has estimated the 'silver economy' to be worth some \$15tn by 2020 (from \$8tn in 2010), and forward-looking companies are already starting to focus on what baby boomers are



going to want in their later years – especially in Asia.

Are there lessons to be learnt from Europe and the systems they are already using to be more prepared?

In my book I highlight Germany – which now has the world's lowest birth rate – as having designed a very careful and consistent package of reforms for long term care. I particularly admire the way that patients can now opt to pay family members to care for them as an alternative to professionals.

Really, however, it's some of the Asian nations that are leading the way in responding to ageing. Japan in particular has made bold decisions, like the introduction of a 1% income tax for over 40s to pay

for a new system of national aged care insurance. It is also innovating, for example by allowing non-health sectors to be part of the solution, in what I call a 'whole of society' response to healthy ageing. The national postal service in Japan has been recruited to train its postmen to look in on older people while they do their rounds. I also admire Singapore's blend of individual responsibility with state guarantees. They have just announced significant tax breaks for people that live with or near their elderly parents – a smart way of creating a less institutional approach to care.

What role can technology play to improve services and access to care?

Technology – in particular mobile phones and wearable monitors – will have a profound impact on



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- The values and universal healthcare of the UK;
- The primary care of Israel;
- The community services of Brazil;
- The mental health and wellbeing of Australia;
- The health promotion of the Nordic countries;
- The patient and community empowerment in parts of Africa;
- The research and development of the United States;
- The innovation, flair and speed of India;
- The information, communication and technology of Singapore;
- The choice of France;
- The funding of Switzerland;
- The aged care of Japan.

Ultimately, though, the most important thing I've learned from my work in 60 countries over the last 6 years is that we all have something to teach and something to learn. ■

¹ http://www.ageuk.org.uk/Documents/ENGB/Factsheets/Later_Life_UK_factsheet.pdf?dtrk=true

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how healthcare is delivered to older people. The consumer health market is currently dominated by fitness fanatics and the worried well, but is at the cusp of becoming mainstream for those chronically ill patients who really stand to benefit. The benefits come from an efficiency and quality perspective – we can predict illness better, reach people faster and motivate them to manage their own treatment. However, we shouldn't lose sight of the fact that human trust and contact are the foundation for all good care. Devices and algorithms should be used to support, not restrict that.

Does a perfect health system exist?

No, but there are elements of excellence in many countries that we can draw on. In my book I highlight 12 components of particular nations that, were they woven together, would give something close to perfection:

Drug development for Alzheimer's disease

Alzheimer's disease (AD) is a major problem of health and a national priority in developed countries. Despite enormous efforts by governments, the scientific community and the pharmaceutical industry over the past 50 years, no therapeutic breakthroughs have yet been achieved, and the drugs available for the treatment of AD are not cost-effective. In terms of costs, AD accounts for \$226 billion/year in the USA and €160 billion/year in Europe (>50% are costs of informal care, and 10-20% are pharmacological treatment costs). It is estimated that in the USA alone the direct cost of AD in people over 65 years of age could be over \$1.1 trillion in 2050 (from 2015 to 2050, the estimated medical costs would be about \$20.8 trillion).

During the past 10 years, over 1,000 different compounds have been screened as candidate drugs for AD; there have been over 400 unsuccessful formal attempts to develop new drugs, and at present fewer than 100 clinical trials with AD-related drugs are in progress worldwide.

Recent data reported by Jeffrey L Cummings, Travis Morstorf and Kate Zhong (Alzheimer's Research & Therapy 2014, 6:37) indicate that during the 2002-2012 period, 413 AD trials were performed (124 Phase 1 trials, 206 Phase 2 trials, and 83 Phase 3 trials) (78% of them sponsored by pharmaceutical companies). Registered trials addressed symptomatic agents (36.6%), disease-modifying small molecules (35.1%) and disease-modifying

immunotherapies (18%), with a very high attrition rate (overall success rate: 0.4%; failure: 99.6%).

These numbers reflect that the pharmacological history of AD is a chain of repetitive failures. Potential reasons to explain this historical setback might be that: (i) the molecular pathology of dementia is still poorly understood; (ii) drug targets are inappropriate, not fitting into the real etiology of the disease; (iii) most treatments are symptomatic, but not anti-pathogenic; (iv) the genetic component of dementia is poorly defined; and (v) the understanding of genome-drug interactions is very limited. Therefore, there is an urgent need to improve these poor results, since the approval of a new disease-modifying drug by 2025, capable of delaying AD onset by 3-5 years, would reduce the prevalence of AD by 30% and, consequently, reduce the cost of AD in the USA at an estimated rate of \$300-\$400 billion/year by 2050.

The most important issue for efficient drug development and subsequent therapeutic intervention is understanding disease pathogenesis. AD is a complex disorder in which multiple defects distributed across the human genome, together with diverse environmental factors, cerebrovascular dysfunction, and epigenetic phenomena are potentially involved. Major AD-related pathogenic events include genomic and epigenetic defects which may lead to the phenotypic expression of extracellular A β deposition in senile plaques and vessels as the result of



Ramón Cacabelos

the abnormal processing of APP by secretases, intracellular neurofibrillary tangle formation due to hyperphosphorylation of tau protein, dendritic desarborization, synaptic loss, and premature neuronal death, accompanied by gliosis, microglia activation, neuroinflammatory reactions, ROS generation, neurotrophic failure, and neurotransmitter dysfunction. This cascade of deleterious events can be differentiated into primary and secondary pathogenic factors which can serve as candidate targets for drug development.

In addition to the drugs approved by the FDA since 1993 (tacrine, donepezil, rivastigmine, galantamine, memantine), most candidate strategies fall into 6 major categories: (i) novel cholinesterase inhibitors and neurotransmitter regulators, (ii) anti-A β

treatments (APP regulators, A β breakers, active and passive immunotherapy with vaccines and antibodies, β - and γ -secretase inhibitors or modulators), (iii) anti-tau treatments, (iv) pleiotropic products (most of these of natural origin), (v) epigenetic intervention, and (vi) combination therapies.

“During the past 10 years, over 1,000 different compounds have been screened as candidate drugs for AD; there have been over 400 unsuccessful formal attempts to develop new drugs, and at present fewer than 100 clinical trials with AD-related drugs are in progress worldwide.”

Therapeutic setbacks with candidate AD drugs suffered during past decades might be valuable for researchers and for the pharmaceutical industry to identify wrong decisions and technical mistakes; however, they are very costly and disappointing, with negative consequences for future investments. Probably the most relevant problem in the development of novel drugs with potential anti-neurodegenerative effects is that neuronal death starts 30-40 years before the clinical onset of the disease, when brain maturation stops around the age of 30-35. When the first symptoms appear in the elderly, thousands of millions of neurons have already died, and there is no drug capable of inducing neuronal resurrection. Therefore, it is clear that an efficient treatment should be administered many years before the onset of the disease. This situation requires important conceptual changes in the management of AD and in the

development of new drugs for this devastating disorder: (i) the development of preventive medicines; (ii) new regulations for the administration of preventive treatments; (iii) early identification of the population at risk with specific biomarkers; and (iv) development of preventive protocols (i.e. initiation time, duration, costs, evaluation of chronic effects, etc).

In the mid-term, the optimization of AD therapeutics requires the establishment of new postulates regarding (i) the costs of medicines (improvement in cost-effectiveness), (ii) the assessment of protocols for a multifactorial treatment, (iii) the implementation of novel therapeutics addressing causative factors (primary targets), (iv) the setting-up of pharmacogenomic strategies for drug development, (v) the incorporation of pharmacogenomic and epigenetic protocols into the clinical setting (epigenetic changes are potentially reversible with pharmacologic intervention), and (vi) new regulations for the development of vaccines and/or other preventive strategies to treat susceptible patients in presymptomatic conditions.

The incorporation of pharmacogenomics and pharmacoeconomics into drug development in preclinical stages and in clinical trials would bring about several benefits: (i) to identify candidate drugs for specific targets on a predictive basis (not relying on serendipity or trial-and-error assays); (ii) to reduce costs and time in preclinical studies; (iii) to identify candidate patients with the ideal genomic profile to receive a particular drug; (iv) to adapt the dose in over 90% of the cases according to the condition of

CYP-related extensive (EM), intermediate (IM), poor (PM) or ultra-rapid (UM) metabolizer (diminishing the occurrence of direct side-effects in 30-50% of cases); (v) to ensure drug penetration into the brain (drug transporter genotyping); (vi) to reduce drug interactions by 30-50% (avoiding the administration of inhibitors or inducers capable of modifying the normal enzymatic activity on a particular substrate) (AD patients may take 6-10 drugs/day); (vii) to enhance efficacy and to reduce toxicity; and (viii) to eliminate unnecessary costs (>30% of pharmaceutical global costs) derived from the consequences of inappropriate drug (or patient) selection and the overmedication administered in order to mitigate ADRs.



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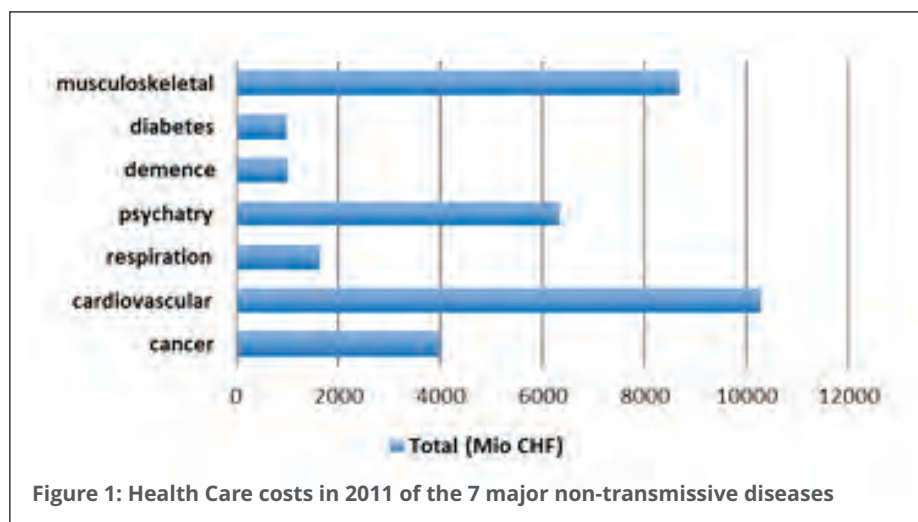
Therapies for weak muscles

It is estimated that ten percent of the costs of health care in Switzerland (or an equivalent of 500 billion Euros per annum in the EU) being associated with lost work is related to injury or dysfunction of the musculoskeletal system (Fig. 1). Surgical and subsequent rehabilitative interventions are important part of the therapy that re-establishes musculoskeletal function.

The Laboratory for Muscle Plasticity at Balgrist University Hospital aims to bring light into the underlying mechanisms in skeletal muscle with the goal of translating the findings into more effective clinical applications.

Skeletal muscle plays a major part in control of movement and posture and affects whole body metabolism through its effects on energy expenditure. Affections ranging from simple overuse injury to rupture of tendon and bones, or disease, lead to deconditioning of skeletal muscle as a result of inactivity and damage signals¹. The consequent loss in muscle strength and fatigue resistance exerts a distinct negative impact on the quality of life and may render the affected individuals dependent. In these situations a surgical intervention and rehabilitation may be indicated, yet may come too late as irreversible changes may have resulted.

Focus on muscle plasticity: The laboratory for muscle plasticity investigates the mechanisms that underlie the conditioning of skeletal muscle structure and function during recovery



from surgical interventions and rehabilitation. As shown through research on Sport Performance this process is driven by mechanical and metabolic stimuli. It is mediated through a gene response that instructs adjustments in muscle composition with the repeated impact of exercise during training. In consequence, force production and fatigue resistance of muscle may be improved or maintained.

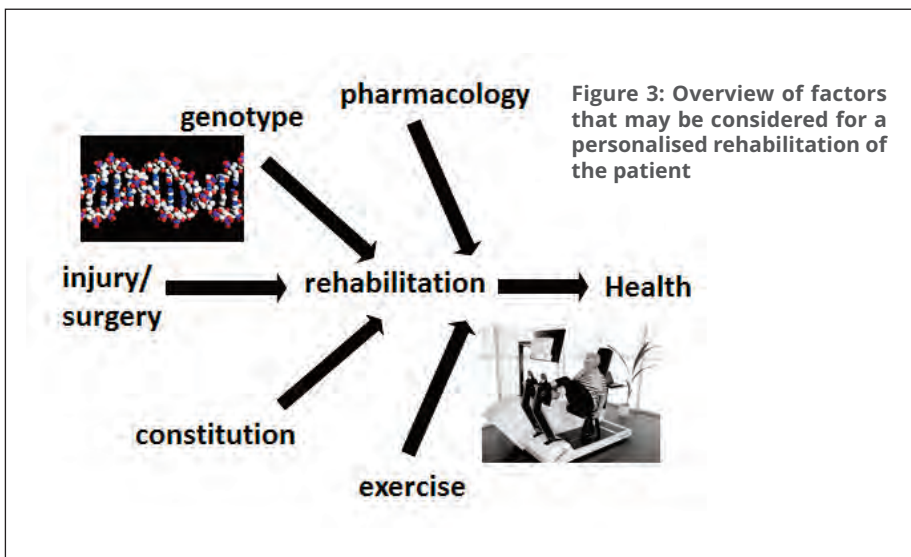
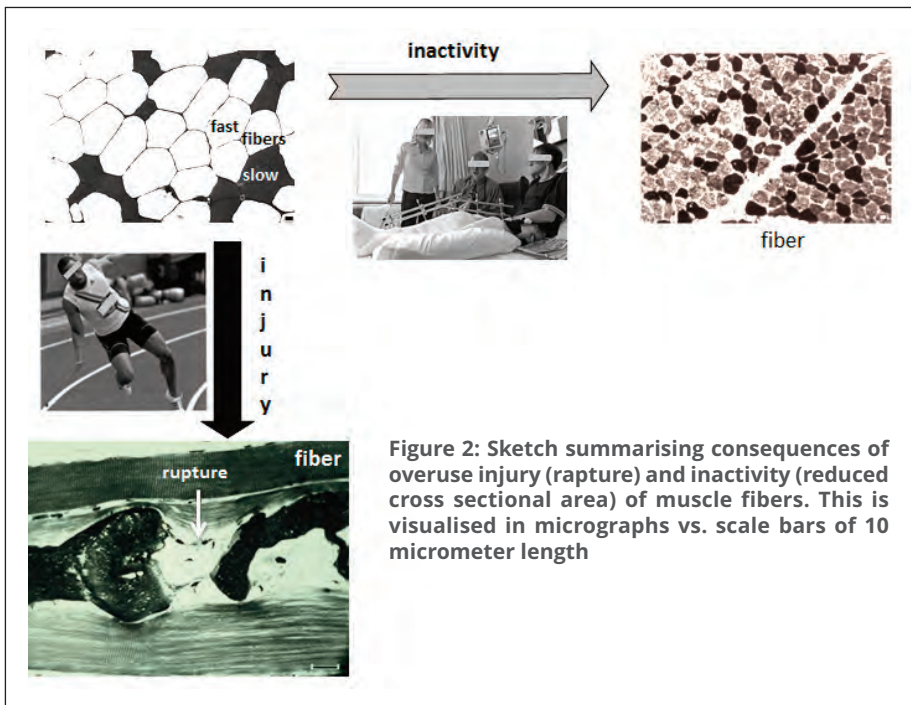
On the opposite muscle's functional capacity is reduced in the absence of a physiological stimulus by a reduction in the size of muscle fibers and their content in mitochondria (Fig. 2).

In fact, while the safety and effectiveness of physical factors for muscle conditioning are well established, the dose-effect relationship between exercise and muscle adaptation is often not fully respected in clinical practice. An example of this biological regulation is the important role of muscle contraction and loading in preserving muscle mass of the bedridden musculoskeletal patient after

surgery which otherwise loose muscle mass at a pronounce rate. Genetic factors (so called gene polymorphisms) importantly affect this adaptation². This indicates that gene polymorphisms contribute to the inter-individual variability of the response to surgical interventions and rehabilitation.

“The Laboratory for Muscle Plasticity at Balgrist University Hospital aims to bring light into the underlying mechanisms in skeletal muscle with the goal of translating the findings into more effective clinical applications.”

Research projects: The emphasis of the research team lead by Prof. Martin Flück at Balgrist is put on major musculoskeletal affections that arise in the context of the Orthopedic Clinics at Balgrist Hospital. A special focus is put on resolving the contribution of gene polymorphisms to inter-individual differences in the healing of muscle with re-attachment of the ruptured rotator



cuff tendon, and the strengthening of skeletal muscle with rehabilitative exercise in patients.

The aim is to develop personalised forms of interventions that maximise muscle adaptation (Fig. 3). The latter approach is based on our previous work that points out the important exercise-intensity and exercise-type related influence of gene polymorphisms on the muscle response to the leisure type Sports activities ³. This opens a venue to tailor the therapeutic

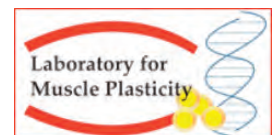
tically effective exercise intervention for patients which otherwise would demonstrate little plasticity to a generic exercise stimulus and for which pharmaceuticals alone do not work due to the importance of activity-induced muscle metabolism for muscle adaptations.

Patient-lead research: By the end of 2015 the laboratory will undertake a major step towards an expansion when it will move in brand new research facilities in what is to

become the Balgrist Campus (<http://www.balgristcampus.ch/en/>). A key ingredient of this research facility will an open-space landscape where research and development into musculoskeletal medicine is integrated under one roof between clinicians, biologist, engineers, and industry. The facility situates in the vicinity of the orthopedic hospital at Balgrist; thus providing a pipeline for a reality-driven approach that re-integrates questions from bedside to bench and returns to the patient. The laboratory for muscle plasticity is looking for potential partners that may want to exploit the research options presented in the future Campus in the frame of collaboration.

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Plans to reduce dementia in Denmark

Adjacent Government outlines how the Danish Minister for Health and Elderly Affairs' aims to make the country dementia friendly...

It is estimated that there are currently around 39,000 Danes diagnosed with Alzheimer's or another form of dementia. In the coming years these figures are predicted to rise as the growing population ages. The risk of developing dementia increases with age, and estimates show that more than every fifth person in Denmark aged 85 or over will develop some form of dementia.

In Denmark the government are aiming to tackle the problem and help people to receive treatment as early as possible, to prevent associated issues in the next few years.

The Minister for Health and Elderly Affairs in Denmark has recently outlined plans to work on a new National Action Plan to fight dementia. Minister Sophie Løhde aims to make the nation a dementia friendly society and strengthen the fight against the growing number of people with the disease.

The government aims to draw up a new national dementia action plan which will help to give people with dementia and their families a better life. They want to ensure that patients get the right care and that their families also receive the support needed to cope with this life changing health issue.

Minster Sophie Løhde said: "Dementia is a terrible disease, which completely changes the lives of the people who have it, and their relatives. The person affected by dementia, loses not only himself and his past, but often the relationship with his wife, his children and grandchildren, friends and acquaintances, and it is quite a tragedy for the family.

"As a society we need to be able to help both sufferers and their relatives who stand on the side-lines. Therefore, we are now in the process of developing a

national dementia action plan inter alia, to equip the health sector to more quickly treat people with dementia and to ensure that their relatives are not worn down, but can get support and relief."

The new Action Plan will be based on 3 main objectives:

- Denmark should be a dementia friendly country, in which people with the disease can live a dignified and secure life;
- Treatment and care of people with dementia should be based on individual needs and values and offered in a continuous course, with a focus on early intervention, latest knowledge and increased research;
- Caregivers must be actively involved while also receiving support.

Løhde stressed that to make the plan successful, it is crucial that key players are also involved in the work:

"My starting point is dialogue and participation. I will use the coming months to travel across the country and listen to and gather knowledge and experience from, among other dementia patients, relatives and health and nursing staff. I will draw inspiration from European countries, who have worked to improve conditions for people with dementia and are more advanced dementia than we are," she said. ■

For more information regarding the Action Plan, please visit the Ministry's website: <http://www.sum.dk/>

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Citizens with mental illness are helped by tele-rehabilitation using video technologies

Citizens with mental disorder face a number of challenges returning to everyday life following discharge from psychiatric hospital. The citizens often feel insecure, anxious, and at risk of readmission rate to psychiatric hospital. In Denmark, municipalities are offering support services for citizens with mental illness in their recovery process after discharge from hospital. Municipal social workers visit the citizens in their home from one time a week to several times a day, talk

with them about feelings of insecurity and offer assistance in helping them structure their daily routine.

In 2013, the Danish municipality of Esbjerg began a research project focusing on tele-rehabilitation for citizens with mental illness, where video technology is used to facilitate improved dialogue between the citizens and their social worker. The aims of the research project are twofold: (1), to reduce readmission of the citizens to a psychiatric hospital, and (2), to

prevent worsening of symptoms by giving the citizens the possibility to communicate virtually with a team of social workers on a 24/7 basis.

In the United States, tele-psychiatry has been a part of routine care delivery for citizens with mental illness for years. In Europe, however, tele-psychiatry is still not integrated into routine care delivery, and little research has been performed. The research project in Esbjerg Municipality is one of the first initiatives within this field in Europe.



“The preliminary findings from the project have shown positive results, and the next step will be to implement the system on a larger scale in Esbjerg Municipality during the coming years.”

The target group for the research trial are citizens diagnosed with depression, schizophrenia, paranoia and manic-depression who have been discharged from hospital. The citizens receive video technology installed in their

homes so that they can communicate with their social worker. Each citizen is assessed after having used the system for a period of 6-18 months. A total of 57 adult citizens have been included in the project: 30 females (mean age 35.3) and 27 males (mean age 39.7).

Preliminary findings from qualitative interviews with the citizens have shown that the video system had given the citizens a feeling of safety and security and helped them to develop new individual coping strategies to avoid admission to hospital. The citizens stated that via the video technology, they could get in contact with a social worker at any hour of the day, whenever they needed to talk about their feelings, heard voices or were having hallucinations.

Some citizens diagnosed with paranoia, however, found it difficult to stand directly in front of the web camera for communication with the social worker. Instead, they chose to stand next to the camera when communicating with their social worker.

The social workers reported that the video technologies have improved their collaboration and communication with the citizens with mental illness. The video technology has been easy to use, and they report having saved time on transportation. The social workers reported that they can now tailor their intervention on a more individual basis and provide higher quality support to those citizens with mental illness.

“The preliminary findings from the project have shown positive results, and the next step will be to implement the system on a larger scale in Esbjerg Municipality during the coming years,” explains Britta Martinsen, CEO of Social Services in the Municipality of Esbjerg.

Esbjerg Municipality have started to plan to scale up the pilot project. They plan to integrate the video technology into the daily work routine for the social workers so that it serves up to 150 citizens with mental illness.



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Can we sustain an ageing population?

With people living longer, and health systems under strain, Adjacent Government looks at the worldwide impact of an ageing population...

The World Health Organization (WHO) predicts that between now and 2050, the number of people over the age of 60 worldwide is likely to rise, from 11% in 2000 to 22%. The proportion of over 60's is expected to increase from 605 million to 2 billion over the same period. The biggest concern with these figures is the detrimental impact an ageing population can have on our health systems.¹

In November 2014, Dr John Beard, Director of the Department of Ageing and Life Course at WHO warned that, "Deep and fundamental reforms of health and social care systems will be required."²

As people reach age 75 and over, the risk of chronic diseases can increase. It is estimated that around 25-30% of people aged 85 or older will have some degree of cognitive decline, such as dementia. If we continue to see a rise in the number of people that can no longer look after themselves, it will have a huge bearing not only on social care services, but also the economy.

For the first time in history, it is predicted that by 2020 the number of people aged 60 or over will outnumber the number of children aged under 5. Worldwide expectancy will continue to rise with 80% of these older people believed to be living in low-income and middle-income countries, says The World Health Organization (WHO). The long-term challenges of illness and reduced wellbeing will not only affect the patient, but also their family. With forecasts predicted to accelerate, latest estimates indicate that the number of people with dementia is anticipated to rise further, from 44 million in 2014, to 135 million in 2050.

Dr Ties Boerma, Director of the Department of Health Statistics and Informatics at WHO said, "We must be careful that these reforms do not reinforce the inequalities that drive much of the poor health and functional limitation we see in older age.

"While some interventions will be universally applicable, it will be important that countries monitor the health and functioning of their ageing populations to under-

stand health trends and design programmes that meet the specific needs identified.”

Dr Boerma added: “Cross-national surveys such as the WHO study on Global Ageing and Adult Health (SAGE), the Gallup World Poll, and other longitudinal cohorts’ studies of ageing in Brazil, China, India and South Korea, are beginning to redress the balance and provide the evidence for policy, but much more remains to be done.”

WHO believes that strategies are needed to help prevent and better manage chronic conditions that blight ageing populations. “Collectively, we need to look beyond the costs commonly associated with ageing to think about the benefits that an older, healthier, happier and more productive older population can bring to society as a whole,” added Dr Chatterji, also from the Department of Health Statistics and Information Systems at WHO.

Francesca Colombo, Head of the Health Division at the OECD told Adjacent Government³ that she believes an ageing population is “an opportunity,” and that we need “to take ageing as something to celebrate.”

She believes that encouraging healthier lifestyles early in life can help to prevent the development of chronic diseases, and other disabilities. However she explained it is vital services do not become over stretched to help deal with the ageing population.

She said: “Health systems must adapt to changing patterns of morbidity and disease burden. Health systems across the OECD are still too much hospital focused and struggle to innovate approached to care for an ageing population.

“The way health systems have developed is more orientated towards the treatment of disease and dealing with acute episodes of care, rather than focussing on preventing ill health, managing chronic care needs and encouraging continuity of care.”

She added that GPs and primary care providers should play a more central role, working alongside community health and social care services.

WHO have launched a draft ‘Global Strategy and Action Plan on Ageing and Health’⁴ The Strategy aims to define the goals, strategies and actions that WHO will pursue, and to clearly lay these out for public health action. With the Strategy WHO aim to provide a comprehensive framework for action on ageing and health, identify gaps and suggest future priorities.

Strategic objectives for the next 5 years are:

- Fostering healthy ageing in every country;
- Aligning health systems to the needs of the older populations;
- Developing long terms care systems;
- Creating age-friendly environments;
- Improving measuring, monitoring and understanding.

The draft Strategy is currently open for consultation, and an updated version is to be presented to the WHO Executive Board in January 2016. ■

¹ <http://www.who.int/ageing/about/facts/en/>

² <http://www.who.int/mediacentre/news/releases/2014/lancet-ageing-series/en/>

³ <http://www.adjacentgovernment.co.uk/lg-edition-007/adapting-ageing-population-2/20387/>

⁴ <http://www.who.int/ageing/global-strategy/GSAP-ageing-health-draft.pdf?ua=1>

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How to avoid the longevity trap?

Prof. Thomas von Zglinicki, Scientific Director of the Newcastle University Institute for Ageing, argues that interventions that slow down the human ageing process are the only possibility to avoid all of us spending ever longer at ill health towards the end of our lives.

Over the last 170 years, human life expectancy has been constantly increasing by 2-3 months every year without any indication of a slow-down. Historically, there have been different reasons for this increase, but presently, the main cause is probably improved medical management of chronic, age-associated disease. Today, all major diseases share two common things: Age is their most important common risk factor, and modern medicine, while becoming increasingly good at managing them, cannot generally cure them. In other words, more and more people live longer but suffer from an increasing number of severe chronic diseases, often resulting in decreased capability to perform their daily activities. In Europe, for instance, average life expectancy for a 50 year old person increased by 1.2 years for men and 1.1 years for women between 2005 and 2010, while healthy life expectancy increased only by 0.5 and 0.4 years, respectively, over the same time frame. Moreover, inequalities between countries in healthy life expectancy were much larger (about 3-4 fold) than those for life expectancy and actually increased with time, mostly due to increasing material deprivation and long-term unemployment. Accordingly, in a significant number of European countries, healthy life expectancy did in fact

decrease between 2005 and 2010¹. In the UK, 85 year olds suffer from 5 (women) or 4 (men) chronic diseases on average at the same time². Similar trends exist worldwide, both in developed and low-income countries. Thus, a 'longevity trap' is becoming manifest, driven by continuously increasing life expectancy together with stagnating healthy life expectancy. Unchecked, this trap will soon become unsustainable in terms of both individual suffering and societal resources spent.

Responding to this situation, the European Innovation Partnership on Active and Healthy Ageing (EIP-AHA) has formulated the goal of increasing healthy life expectancy at birth at EU average by two years by 2020, i.e. to increase healthy life expectancy as fast as life expectancy³. In terms of the longevity trap, this would just maintain the status quo. This is an ambitious goal and it is far from clear how it can be achieved. The WHO in its present World Report on Ageing and Health⁴ concludes that "a transformation of health systems that moves away from disease-based curative models and towards the provision of older-person-centred and integrated care" is required. While this will be essential to ease the burden of an ageing population, it will not resolve the situation.

There are exceptions that stem this tide, however: Humans that are hereditarily long-lived (centenarians and supercentenarians, people that reach an age of 110 years) not only live long, but most often maintain good health and independence for



Thomas von Zglinicki

much longer than the general population. Typically, they suffer only for a short period of ill health and dependency at the very end of their lives. Moreover, they as well as their descendants maintain low levels of risk factors for adverse age-related outcomes (including markers for chronic inflammation and telomere length) until very late in their lives⁵. These data suggest that centenarians and even more so super-centenarians are (genetically and epigenetically) 'made up' to age slower, and that it is this slow ageing process that enables them to remain healthy for a much longer fraction of their lives.

How can we copy the success story of the centenarians? Can we find safe interventions that reduce the rate of ageing and thus postpone the risk for incidence of all chronic age-related diseases, dependency and frailty together? The short answer is yes. Mechanistic ageing biology has gone a long way in recent times towards understanding the functional networks that govern the ageing process. In

terms of interventions that can prolong healthy lifespan, for a long while only dietary restriction and (with limitations) certain lifestyle interventions were confirmed as effective in mammals, both of which have major compliance problems in humans. Now, however, it is possible to identify drug leads that not only prolong lifespan but significantly postpone the onset of age-related functional decline and frailty in mammals.

Two examples: In 2014, we showed for the first time that chronic progressive inflammation, which is well known to be associated with ageing and age-related disease in humans, is actually a cause of accelerated ageing in mice. Treating the animals with a simple and cheap anti-inflammatory drug did not help mice that aged slowly, but improved markers of cell and tissue ageing in the fast-ageing animals to levels as good as in the slow agers ⁶. If these results could be translated into humans, it might become possible to help those among us who are disadvantaged by a faster ageing rate and thus counteract the socioeconomic, lifestyle and biological factors that cause huge gaps in healthy life expectancy between individuals and population groups.

Another example is the case of metformin. Metformin is a long-established drug prescribed to treat patients with type 2 diabetes and metabolic syndrome. It partially suppresses the activity of complex I in the mitochondrial electron transport chain thus limiting mitochondrial respiration. Unchecked complex I activity and enhanced complex I abundance is predictive for short lifespan in mice ⁷. In 2013, it was definitely established that chronic treatment of mice with low doses of metformin improved

their healthspan and lifespan ⁸. Now, the first large human trial to treat ageing, aiming to postpone the onset of multiple age-related diseases together rather than to treat or delay incidence of a single disease, is getting underway (TAME: Treating Ageing with Metformin). If this study is successful, it may well mark the onset of not less than a revolution in medicine: a shift from the single disease curative approach towards multi-preventive interventions in an ageing environment.

There are still huge problems that need to be overcome. For this type of long-term, possibly chronic preventive treatments risks of side-effects have to be even more carefully assessed. Clinical trial design and their underlying legal framework have to be adjusted to enable focus on 'soft' outcomes and multi-morbidity. Very few possible lead substances for drug development have so far been validated in mammals because of the long time frames, high costs and large uncertainty of success involved in candidate drug testing for healthy longevity. However, creating a better future for when we are old will be well worth the effort.

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Innovate to reduce Healthcare Associated Infections

Healthcare Associated Infections (HAI) is presented as one of the most common complications in healthcare services. Each year, 4.1 million patients across EU countries acquire an HAI, resulting in a 7,1% prevalence and direct annual overall medical costs of €7 billion. In the UK, prevalence rate of hospital infections was 6,4% in 2012 and in Portugal this rate was 10,6% against 9,8% registered in 2009. While in the USA alone, it is estimated a prevalence of 4.5 per 100 patients, with 90.000 deaths annually and estimated costs rising from \$35 to \$45 billion.

The most prevalent HAI's are from the urinary tract, with 27% across EU countries, followed by infections of the respiratory tract, with 24% of prevalence. These infections can also occur in the skin (19%), in the surgical site (17%) and also in blood (10%).

However, according to the European Centre for Disease Prevention and Control approximately 20 to 30% of these HAI's could be preventable by intensive hygiene and control programmes.



Observing this reality, in November 2013 a technology based start-up focused on the research, development and commercialisation of innovative healthcare solutions was founded – ihcare – innovation hospital care.

showercare® - a most awaited solution for in Bed Personal Hygiene Care

Providing for a patient's hygiene, especially one with a high degree of dependence, either by motor disability or therapeutic indication, is part of the daily routine for many patients and healthcare professionals.

The personal hygiene care is essential to guarantee minimum levels of comfort and dignity of the in bed patient, as well as essential to success of clinical intervention and it is at the very core of healthcare excellence and ensuing reduction of HAI's.

In hospitals can be stated that the main problem associated with patient's hygiene is that they are often deficient, leading to situations of high prevalence of HAI's. Equipment, procedures and common practice currently available make this task difficult to uphold, leading to enormous operational difficulties, even when some level of improvement in comfort for the patient is achieved.

Until now, the patient's hygiene is performed making use of relatively small sized bath basins. These bath basins remain the century old technique of choice for personal in bed hygiene, with very low level of

comfort, both for the patient and caregiver and with severe limitations on the control of crossed infections, documented in several scientific publications.



Bath basins were proven to be reservoirs for pathogenic bacteria and a potential source of HAI's transmission, with the additional downside of not offering a sensible solution for patient bathing. The period in which the waters remains stagnant in basins and its dumping in shared sanitation facilities, causes the exponential proliferation of HAI's microorganisms, actively contributing to cross-contamination increase.

Following this, showercare® solution arises as a system for patient's in bed hygiene, with running hot water, which allows the end user, with a high degree of dependence, to enjoy a bath with high levels of hygiene, dignity, comfort and maximum privacy, thus contributing to the implementation of an effective and much needed means of fighting HAI's.

showercare® comprises an innovative solution for in-bed hygiene, setting a new standard for healthcare in patient's personal hygiene, innovating from other existing solutions with several quite distinctive advantages. This novel system is characterised by remaining continuously in the bed (deploy on demand), being easy to use since transfer and/or movement of the patient to a bathing area is not necessary.

And also because it is a fully integrated, autonomous and confined system for multiple running hot water baths. This hygiene care, with running hot water, helps maintain hemodynamic stability levels, thereby contributing to enhancing comfort.

Besides that, showercare® contribute to a reduction in the prevalence of HAI's and its direct involvement in the reduction of hospital stay and associated cost.

Thus, despite showercare®'s main users are patients, all of the major stakeholders involved can significantly benefit from showercare® usage. Public or Private healthcare systems to healthcare professionals, they all benefit from using showercare®.

For health professionals showercare® allows a reduction on time spent with hygiene procedures (up to 50%), ensuring comfort and dignity to all parties involved on in-bed bathing and allowing them to refocus their attention towards a better assessment of the patient's condition and render bathing as a comfortable moment to all parties, averting unnecessary efforts.

Healthcare Units and Health Systems, both public and private also benefit from showercare® implementation since this solution provides an effective and much needed means to prevent HAI's, reducing expense with additional medical treatment and hospital stay and since it can efficiently streamline bed baths with significant operational and time spending gains, reducing poor patients hygiene run-



ning costs with substantial gains to underlying health system.

With the implementation of showercare® it will be possible to reduce up to 50% of HAI's and associated costs, to improve patient global healthcare and doing so it helps professional to address people with high degree of dependence personal hygiene whether in hospitals, healthcare units or at home.

These solutions deliver high return on everyday activities, as task and resource usage is optimised with measurable positive impact on health facilities KPI's.

As a business, showercare® system, was distinguished in several business idea & plans national competitions, by well-known entities and personalities in the field, namely in the healthcare sector. During the year 2016, in partnership with Centro Hospitalar e Universitário de Coimbra (CHUC), the largest hospital unit in Portugal, will occur the entry in hospital context of showercare® with it first's clinic assays. After this phase, the perspective of full market entry is at the beginning of 2017.

Thus, ihcare's mission aims at significant improve patient comfort and wellbeing by offering effective means for Healthcare Acquired Infections combat, with overall improvement of clinical, personal and financial levels.

Regarding this, ihcare envisions to become a highly recognisable company in the fields of research, development and commercialisation of innovative healthcare solutions, offering professionals and institutions a high added value and technically sustainable alternative for healthcare excellence. More information can be found at www.ihcare.pt.

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Integrating Innovation in the In-Home and Senior Care Sector

A focused approach

"The ageing trends of population, and the rising costs of health and social care systems in developed countries are pushing the economies into one of the major sustainability challenges that our societies have faced".¹

With a respectful and collaborative approach Comfort Keepers strives to help clients and partners secure the care they require, cultivating positive relationships with referring professionals to provide the highest possible level of quality of life for their clients. It routinely collaborates with skilled agencies, senior and rehabilitation facilities, hospitals, corporate clients and non-profit organizations, all with an integrated approach.

Comfort Keepers Portugal

Comfort Keepers has been in Portugal since 2006, in an effort to transpose the company's global market experience in over 750 offices throughout seven countries and to provide solutions which meet the requirements of the Portuguese ageing population.

Through a network of 650 employees Comfort Keepers is responsible for providing Outsourcing, Staffing and Management services to more than 3,000 users with needs pertaining to In-Home Services, Nursing, Assistance to young parents and Solutions for employers.

The place for Innovation

Comfort Keepers² is continuously seeking new processes aimed at promoting its customers' Psychological, Physical, Social and Environmental welfare and autonomy by providing a holistic

system of Interactive Care™. This concern with service quality has been steadily recognized and Comfort Keepers is currently the only company in its sector to be presented with the ISO 9001:2008 Certification in Portugal.

Developments in technology have impacted the in-home and care sector, providing original tools with which to answer specific challenges and customer concerns. "Information systems (...) can help in connecting elderly, care providers, health personnel, and family and friends"³ contributing with solutions aimed at facilitating interaction and connectivity. Comfort Keepers takes an active role in innovative projects currently being developed in the Portuguese market:

Active@Home tackles the challenge of supporting independently living by providing technology for falls prevention through an intervention that uses the concepts of games, exploring these activities potential in engaging physical, cognitive and social skills. The end-user participation in projected business cases will be significant, with 20 test users in Switzerland, The Netherlands and Portugal.

The Organizational Life Assistant project, coordinated by Microsoft Portugal, aims to offer an answer to unique social challenges by providing an innovative virtual presence that supports instrumental activities of daily living needs of older adults, mediating and facilitating interaction between senior citizens and their informal caregivers or other services or professionals through technological solutions.

The objective of the All4AAL – Ambient Assisted Living for All project is the development of an ecosystem of solutions for Ambient Assisted Living (AAL) associated to a business model and validated through large scale trial.

The creation of support modules for seniors obtained through the use of the Service Design methodology has allowed its phased application through various areas of operation, such as Health, Safety and Social Support. The practical use of these tools has already enabled the implementation of a "Active-Ageing Check-up", which is now a common tool in the evaluation of physical, psychological and social conditions of Comfort Keepers' customers. The project consortium is made up of 30 Portuguese institutions and involves the contribution of more than 200 Portuguese engineers, scientists and researchers.

¹ Monteiro, Jorge. "Improve Quality of Life – Additional Criteria for Health and Social Care Information Technology Acceptance in an Ageing World", in pHealth 2012 – Proceedings of the 9th International Conference on Wearable Micro and Nano Technologies for Personalized Health, 2012.

² Master Franchisor of Comfort Keepers in Portugal

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Digitalising healthcare in Finland

Maritta Korhonen, Head of Development at the Ministry of Health and Social Affairs in Finland tells Editor Laura Evans about the changes being implemented to health and social care services to bring Finland into the digital world...

According to a survey published by the European Commission in 2000, Finland has the highest number of people who are satisfied with their hospital care system in the EU. The quality of service from healthcare in the country is considered to be good. In the same survey 88% of respondents were satisfied with the service, compared with the EU average of 41.3%.

Although the current situation is satisfactory, things are changing in Finland. With the big wave of digitalisation that is hitting public services, Finland is jumping aboard and reforming their health and social care sector. eHealth refers to tools and services using information and communication technologies (ICTs) in the health care sector. Not only can patients benefit from improved access to care and quality of care, healthcare providers can also profit from improved efficiency for their work and more user-friendly systems.

Finland has been a forerunner in the adoption of electronic health care records and electronic tools. In the last 30 years, the country has moved from local systems to regional information exchange and national information standardisation and availability. Editor Laura Evans spoke to Maritta Korhonen, Head of Development at the Ministry of Health and Social Affairs in Finland about the changes being made and the challenges that come with them.

"At the moment we have national centralised services for e-prescription and for the archiving and sharing of the patient data, between different health care service providers," explains Korhonen.

"We also have a national user interface for patients who can see their e-prescriptions and their health records and manage and monitor the use of their data. Not all patient data has been nationally

standardised but by 2020 we hope to have the majority on the national database.”

Korhonen believes that the benefits of these changes are monumental to patients and health care professionals throughout the country. As well as ensuring patients can view information regarding their healthcare, it can also speed up the processes. As she outlines:

“There are many ways in which these new ideas of sharing the data can benefit both the patient and healthcare professional. It speeds up and standardises processes. For example, if you go to the pharmacy you no longer need paper and all the data is there when needed.

“Also, the health care record can now be shared with the patient. They can see all the medication information, and it allows him or her to become more active in the process. As we believe in Finland, the patient is not an object anymore, but he or she is a responsible subject in his or her process and in decisions made together with health care professionals.”

One of the main priorities of the new government in Finland, as a tool in social and health care reform is digitalisation. Healthcare reforms are high on the government’s agenda, with an aim to join up social welfare and health care services. This means new opportunities for health and social care process renewal and reassessment of old practices.

“One of the most important issues in our new government programme is this reform in the next few years, to be fulfilled in 2019,” explains Korhonen.

“Social care and healthcare will be joined together, so they are no longer separate service sectors for citizens. Part of this solution will be that the data must be shared. Research conducted in the northern part of Finland revealed that 10% of our patients use about 70-80% of the services in the healthcare sector.

“But, the same patients also use 70-80% of social care services. Which is why it is important that the details shared between social and health care, for patients using both services – in the future is totally integrated.”

As part of the National Finnish eHealth and eSocial strategy 2020, the government aims to make digital health and social care services more accessible to patients. The plan is to have all the information and data that patients need in one place.

“If for example, you have a minor healthcare problem, or need information on how to eat more healthily, reliable information for that will be easily available,” she says.

“We are trying to make some services digital. For example, if you have an uncomplicated illness with typical clear symptoms, online services would advise the type of medication and treatment you might need, dependant on your symptoms. The system would in the future also give you a hint of what to do by yourself and also the prescription you would need. All in all the idea is making the process simpler and accessible for the patient.”

There could be many challenges that come with making such major changes to healthcare services. However, Korhonen believes that the biggest challenge is changing the attitudes of healthcare professionals. “Usually when you are digitalising services, the problems are wide-ranging, but we have found in Finland that problems due to technology are usually quite easy to solve,” she explains.

“Changing the attitudes of the professionals and sometimes also those of the patients – this is the most difficult challenge. It comes along with how to change the processes, the way we have been working. However, digitalisation and eHealth is here, it’s not something that is coming or something that we must discuss or can prevent. Its here and we just have to see the change as a possibility to make things happen in a new and better way.” ■

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Welcome to the House for Children and Adolescents

In November 2013 it was ready to be launched – The House for Children and Adolescents. Over 100 professionals moved into the House, under the same roof, to give integrated help, guidance and treatment to families with children under 18 years. Previously there had been 17 different addresses for children's services, one profession here and another there.



The House for Children and Adolescents is located at the former garrison area in the City of Lappeenranta

The House for Children and Adolescents, integrating social and health care, offers its know-how and concrete help to the inhabitants of South Karelia, Finland (population 133 000). Various processes including every day work habits were – and are – developed to a new kind of integrated easy access service that works tightly on the frame of preventive work and problem solving.

The professionals working in the House for Children and Adolescents are from different areas of expertise. There are social workers, child and adolescence psychiatrists, psychiatric nurses, family workers, psychologists, pediatrician, general practitioners (part of student health care) and office

workers. Depending on the matter of the child (and one's family) they form multidisciplinary teams that can support the family in a crisis or on a matter that can be solved with more time and patience.

There are eight main principles that concern both Family services and The House for Children and Adolescents:

1 Easy access. The help-seeker doesn't have to know what kind of help he/she needs. Contacting methods are easy (e.g. mobil, walk-in, e-contact), there is no referral needed.

2 Counselling and early support. First one to five times evaluation for all new patients.

3 Straight guidance to right address. Patients with certain symptoms are guided straight to the special department (such as child welfare).

4 The whole family is taken into consideration, not just the one who looks for help.

5 A contact person will be named for every family.

6 Tailored treatment plans to those who need care from many departments at the same time (such as child welfare and psychiatry).

7 Cooperation inside the house and also outside with schools, daycare and child health centers. The family can give a permission to exchange the needed information in a multitasking team.

8 Treatment and support at homes and schools.

After the first year of activity there are several results to be seen: The customers get now help easier and at the right time. They are also more confident on getting help. The service system is more equal than before and the access is easier. The Institutional child care has decreased, there has been less custody cases and short term placement from home. The knowledge and know-how of professionals has increased.

However, the development work continues. Prevention has even greater meaning than before.

The House for Children and Adolescents is located at the former garrison area in the City of Lappeenranta.



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The elderly and their wellbeing – how do we know what they need?

Merja Tepponen, Chief Development Officer at South Karelia Social and Health Care District in Finland details the importance of having the right integrated systems and services in place to care for the elderly...

We all expect that we have the possibility to make a stand and have opinions on our healthcare services and treatment, throughout ageing. This article focuses on the service needs assessment process of elderly people. This process helps to analyse and determine a person's needs for care and various services. The social and health care system are both based on the service needs assessment that takes place in various stages of the process and varies widely depending on a person's situation. It includes the assessment of one's service, treatment or support needs. In Finland the service needs and treatment assessment meet certain time limits governed by the law.

As we get older, we should have the possibility and means to live in our own home, as independently as

possible. We might need some assistant, home care and technology to do so, which may come from public or private carers. There are new systems and service models that, for example, combine the knowledge and know-how of a local public authority, private health care and nursing entrepreneurs, as well as hospitals and home care. Volunteers, families and friends bring great value to this. The aim is promoting elderly's wellbeing, health, ability to function and work capacity with high-quality, cost-efficient and flexible services that are adaptable to the needs and age structure of the population. This model can be rolled out across different areas.

We also need to have the right to choose where we live if not at home. The primary care of elderly care is to allow the elderly to live in their own homes for as

long as possible and needed. However, if an elderly person cannot stay at home even with home care services, the right type of care in a nursing home has to be defined.

The assessment takes place in an elderly person's home. The service needs assessment should be based on common criteria, but the emphasis on a special part of the criteria may vary. There are several ways to measure one's performance and need of help, for example with the help of Mini-Mental State Examination (MMSE) and Geriatric Depression Scale (GDS-15). There are also tests for nutrition and alcohol abuse etc. Different types of tests help the professionals to assess one's situation and needs. However, as we are all individuals these assessments should always be carried out holistically. A special feature of the service needs assessment process is that it's continuous by nature. One can enter the process several times as one's situation and condition change over time. The customers in home care are evaluated often so that possible changes are noticed early on.

There is a growing belief that new communication technologies can contribute to the improvement of an elderly person's quality of life and health etc. (European Commission 2010). IT-solutions and (health) technology can improve an elderly person's chances to manage at home and support daily activities. In most cases they increase the quality and flexibility of life. They bring for example security, social networks and connections to the outer world by web cameras, broadband connections, smart home devices or video phones. In addition, managing and empowering one's own health has become a more important way to increase wellbeing and coping at home. For example vital sign measurements are getting easier to

use and the information is available to the health care professionals and elderly people themselves via Personal Health Records (PHR) directly. This supports the management of different diseases and works preventive. It's both challenging, as well as interesting to educate and participate people (incl. the elderly) in managing their own health.

“As we get older, we should have the possibility and means to live in our own home, as independently as possible.”

There is still a great need to develop more productive and functional ways of supporting elderly people to sustain a good quality of life. Wellbeing consists of several things such as psychological and physical wellbeing, nutrition, social environment etc. By networking and multi-professional work the actors can support the elderly best and speed up the processes in different services. This is where the in-time transfer of information is critical. ■



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Main strategies in active and healthy ageing in Europe

The importance of identifying the users groups and their profiling

Active and Healthy Ageing (AHA) is a main direction in the HORIZON2020. One of the basic tasks is to face the challenge of turning existing research efforts to reality for healthy and chronic diseased elderly people across Europe. Existing flexible ICT solutions could assist elderly users in organising, carrying out and completing daily tasks and functions having been part of their life for years and provide essential stability and adjustment factors for continuing to be and feel independent. Thus, within AHA we will need to develop all-around, personalised, multi-faceted existing ICT solutions and services addressing diverse daily activities (shopping, eating, physical activity, commuting, mental stimulation, communication, social interaction, etc.) to elderly users taking largely into account cognitive impairments and their carers living in their own home or in care centres.

Current practices

As aforementioned, ICT solutions are existing applications and services which will be improved and most solutions are considered to be at technology readiness level 7 and above. Several solutions are already commercial or open source products and available for use and others were developed within the framework of European projects and are prototypes.

It is expected that we start from a relative mature level 5 (levels: 1-9) for the

majority of tools and we anticipate to reach a TRL of 7 more for around 75% of tools within the next 7 years.

It is clear that the needs and requirements for the addressed user groups at an early stage of developing chronic diseases or changing states in their organism functioning are essential and are a cornerstone within an extended and flexible evaluation framework.

For example in the case of cognitive impairment, the main user groups are:

1. Mild Cognitive Impairment (MCI)

people are usually elderly who have lost cognitive functioning on at least one aspect, with no sign of dementia, and who still function in daily activities. People with MCI are estimated to account for 20% of the elderly over 65. ICT solutions as interventions might have more potential for people with mild cognitive impairment, as these are still in the early stages of forgetting and are still active, eager, and can learn new functionalities.

2. Early stages of Dementia, people have been diagnosed with dementia but they are still maintaining some aspects of their daily functions (early signs of dementia are apparent) and users have been diagnosed by specialists (i.e. neurologist, neuropsychologist) and might be under medication. The improvement in daily functioning is usually rather limited compared to

the deteriorating effects of the disease. Since early and moderate dementia users can still carry out certain activities with assistance.

3. Cognitive impairment as a co-morbid condition, users with other conditions and diseases with cognitive impairment as a co-condition is a common situation among the elderly. Increased medical co-morbidity is evident in elderly. High rates of medical co-morbidity are evident in elderly living at large urban areas due to low socio-economic status (SES) and poorer access to health services.

4. Caregivers, either formal (i.e. healthcare, social, etc.), or informal (i.e. family members and friends) that need to be empowered with knowledge and tools to support the elderly in their everyday life activities. Informal caregivers often struggle combining work and caring for their relatives, resulting in strains on their own health and coping mechanisms.

In addition, there are many **stakeholders** with an interest in, but not a direct involvement in day-to-day care provision. Some main stakeholders, are described briefly below:

Regulatory authorities on local, national or international level, regulating a wide range of aspects from device safety and essential performance, via legal, ethical and privacy related issues. This group

includes an Ethics Control Board with external expertise and representatives from all the pilot sites for ensuring applicable regulations are respected.

User interest organisations work to serve the interest of their members. This group involves care centres and organisations for elderly people and dementia centres with experience in working with and for users with cognitive decline.

Standardisation bodies are organisations that define how AAL care systems should work in a consistent manner (i.e. members of Continua Alliance). Furthermore, another important standardisation body is INFOTERM, aiming to promote and support standardisation actions in the AHA area.

Public bodies, insurance companies and care organisations are important as they define care standards offered and the reimbursement levels provided. We need to interface these stakeholders primarily via on-site care centers, outpatient clinics, hospitals, organisations, dementia research centers and their networks.

It is in the domain of consumers' study that the move away from the 'medicalisation' has been more radical with the introduction of the concept of **resilience** in opposition to that of frailty. The concept of resilience can be defined and measured along two dimensions: a) capacity to function in terms activities of daily life or of disability-free status; and b) Socio-Economic Status (SES), where we include not only more tangible dimensions (income, education attainment) but also social support and networks.

Using these two dimensions we can determine the taxonomy. We identify four archetypes (so in qualitative and ideographic fashion) that have different needs, should be the target of different interventions, and possibly of more granular monitoring indicators. For the sake of simplicity we describe the four segments considering the extreme (low/high) and neglecting the nuanced and intermediate situations.

Dependent. These are individuals with low SES and with poor health severely hampering the capacity to function. They may also suffer from isolation and lack of social support, which means little or no access even to informal care. They need public support for immediate care.

Assisted. These are individuals with good SES yet suffering from health related limitations. Since they can afford it, they are likely to seek quality of life improvements and can afford to buy care and other support, or can rely on social support and networks. They can potentially demand and pay for assisted living and other aides to independent life. They may be the target of some of the services that can be brought to market and can afford to pay for them.

At risk. These are individuals with low SES but holding onto normal life due to their good health status enabling resilience at least in one dimension. They are at risk in the sense that lack of SES resources may bring them easily in the condition of the dependent elderly, when and if, a health problem emerges and limits their functioning capacities. They may be the target of pre-empting public policies such as for instance health

awareness and prevention services or skills building measures.

Active elderly. These are individuals with high resilience they are ageing well and actively and we could also call them the 'discerning old'. They are likely to seek quality of experience and demand for luxury goods and leisure such as smart homes.

Based on the above baseline for user profiling, the main innovation that is needed is to estimate the real life depiction of a large-scale effort to estimate the potentially positive effect of ICT solution on AHA such as in cognitive decline and multi-morbid elderly for statistically adequate number of users which reflect the diversity of real users with actual cognitive impairments for a long period of time. Ensuring the inclusion of significant indicators for assuring successful assessment and investigation of the Quality of Life indicators ensures the extrapolation of findings and the viable transfer of knowledge to business modelling and health service provision with measurable and generalisable indicators as ROI and SROI have been accepted to be.



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Meeting the needs of the elderly in France

Laurence Rossignol, Minister of State for the Family, Elderly People and Adult Care in France outlines how the government are prioritising care for the elderly...

France has decided to address the issue of ageing through the use of “autonomy” – as opposed to “dependency.” This is not merely a semantic change. It reflects a genuine political commitment. Indeed, “dependency” refers to a form of passivity whereas, when using “autonomy”, I stress a positive view of elderly people. It tells that, in order to enable individuals to remain active members of society, our ambition is to delay as much as possible the decrease of autonomy.

The French government is thus considering ageing as a circuit. Through the new legislation on ageing that I am presenting to the parliament this year, I aim to introduce a genuine and profound change in the scope taken to consider ageing.

Social and health care policies are now increasingly considering the individual comprehensively.

The greater knowledge we have acquired in the field of ageing tells us that we must also take into consideration individual needs at every stage of the life cycle. Public policies must therefore show a great capacity to adapt to those evolving and plural needs.

This change of paradigm implies that we find solutions to enable an efficient coordination between all the actors involved.

The first and overriding priority of the French government is to prevent the loss of autonomy, so as to ensure individuals a harmonious path into old age. Less than one quarter of people aged 80 and above are in an identified situation of decreased autonomy – which proves that strengthening active preventive policies is necessary.

A vast majority of people (90%) wishes to grow old in

their own home. But ageing at home does not mean being stuck at home. Elderly people still want to meet up with friends, go to the GP, go on a walk etc. We must therefore give people the capacities to remain active members of society, which is precisely what local councils do. They are responsible for the organisation of public spaces, the setting out of benches, and the design of transport facilities (frequency and appropriate bus driving, for instance). All these public utilities have a non-negligible impact on elderly people's mobility and thus, on their autonomy.

The government has implemented an initiative, the ‘national mobilisation against isolation of elderly people’, which encompasses actors from the charity and the institutional sectors who work together. This initiative reflects this government's commitment to work towards a united society, where each one of us feels responsible for the wellbeing of the other.

Loss of autonomy can't forever be avoided. Anticipation does not mean denying the existence of the phenomenon. We must instead make sure that, even if the health of elderly people is deteriorating, they keep on experiencing the best life conditions possible.

I lead a policy that: supports individuals who are facing this difficulty and adapts society to ageing. France is devoting about €12bn to adult care, which shows our country's full commitment to the issue.

90% of people are ready to undergo home adaptation if their health declines. To respect people's choices and life plan, public authorities must implement facilitating measures.

I am therefore presenting a new legislation which introduces a national strategy for housing adaptation. Thanks to specific subsidies, 15,000 private homes will



be renovated in 2016 to meet elderly people's needs. My target is to have reached 80,000 homes by 2017.

This legislation also proposes the development of microcredit to help modest households finance their construction work. Finally, tax credits will allow elderly people to have an easier access to new technologies for their home, especially in terms of domotic.

Designing policies for fragile elderly people also entails creating measures to bring support to their kin. In France, 4.3 million individuals are informal carers for elderly people. The fantastic work they do is essential in that it enables elderly people to stay at home, but it is also an intense commitment that can lead to great fatigue and burn out.

I therefore work so that the status of "caregiver" is recognised and, when it gets implemented, this legislation will introduce for them a "right to rest". In practice, this will mean that caregivers will be granted a sum of money to finance for stay for the old person they take care of in a day-care centre. This subsidy will also be increased if the caregiver requires a sudden hospital intervention.

The challenge we face is not so much to set up appropriate policies for an ageing society, but rather to critically consider the policies we need to implement in a society where an increasing number of individuals are living older.

Priority should be given to prevention and that public authorities should, indeed, enable society to prevent the decrease of autonomy; but not only. Public authorities also have a duty to accommodate the changes entailed by a decreasing autonomy and they must support our older counterparts who are facing a loss in their autonomy. ■

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Reducing mental health disorders in Spain

Adjacent Government sheds light on how the Spanish Ministry of Health and Social Services aims to reduce mental health disorders throughout the country...

It is estimated that at any given time, around 450 million people in the world are suffering with a mental or behavioural disorder. According to the World Health Organization (WHO), mental health illnesses account for nearly 20% of diseases in Europe, personally affecting one in four people.

OCED data ¹ from 2014 has revealed that people with severe mental health conditions are 6-7 times more likely to be unemployed than people without. Those with a mild-to-moderate condition are 2-3 times more likely to be unemployed than someone with a severe disorder.

Stigma remains high around people with mental health problems, and people with these conditions remain one of the groups most discriminated against in society.

As a whole mental health disorders constitute the most common health burden in Europe, before cardiovascular disease and cancer. In Spain it is reported that at least 9% of the population suffers at least one mental disorder, and that more than 15% will suffer it throughout their life.

Compared with other European countries, Spain has a low mortality rate from suicide and self-harm: 2.6 in women compared with 4.8 in the rest of Europe, and 9.1 in men – vs. 21.3 in Europe.

Last month the Minister of Health and Social Services and Equality in Spain, Alfonso Alonso introduced the new National Mental Health Strategy ². The new Strategy aims to reduce mortality rates associated with mental health illnesses and improve efforts in prevention and early detection.

In Spain, it is estimated that by 2020, of the 10 conditions resulting in the greatest disability, 5 are mental disorders – which brings mental health to the top of the government's agenda. The Minister stressed the need to address the problems which those affected by these diseases face.

The significant impact these disorders have on the economy was also highlighted by Alonso. The cost of mental health disorders currently stands at around €83.749.000 per year, or roughly 8% of Spain's GDP.

In his speech, Alonso stressed the significance of young people within this area. About 20% of children and adolescents present some kind of psychiatric disorder. The new Strategy is updated from the first version adopted in 2006, and includes novel courses of action such as: attention to and intervention with families, improving information systems autonomy, and patient rights or participation of agents and institutions.

Alonso spoke prior to World Mental Health Day, which is marked on 10 October each year. The theme for 2015 was 'Dignity in Mental Health' and the focus was on what can be done to ensure people with mental health problems can live with dignity. ■

¹ <http://www.oecd.org/els/health-systems/Focus-on-Health-Making-Mental-Health-Count.pdf>

² <http://www.msssi.gob.es/en/gabinete/notasPrensa.do?id=3789>

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“Virtual reality for mental health”

To treat people suffering from Anxiety and Phobias, therapists have used the most successful evidence-based protocol of Exposure Therapy – gradually exposing a patient to stimuli that produce anxiety, then retraining physiological awareness, building coping skills, and instilling realistic thoughts.

Cognitive Behavioural Therapists today are using tools such as imagination, printed images, and “en vivo” (i.e. real) exposure, combined with relaxation techniques, to deliver exposure therapy. While this is effective, there are several challenges holding back the best available treatment.

Imagining one’s fears is taxing – not all patients can do it, and it can also be difficult for the therapist to guide the patient through the exercise. Subsequently incorporating live exposure causes more difficulty for many patients, and is not always possible – if a patient has fear of flying, for example, it is expensive to accompany them in flight!

Virtual Reality has been strongly researched in psychology because of immersion, or the perception of being truly transported to another setting. Since the 1990s, hundreds of studies have confirmed benefits of Virtual Reality Exposure Therapy, including lower dropout rates and higher willingness to undergo VR exposure over traditional exposure. There have been few technological advances truly useful to psychologists over the last century; Virtual Reality brings new

tools that not only reduce dropout rates and patient resistance, but enhance treatment potential and deliver best practices easily.

Psious is a company of psychologists working with engineers to design virtual environments based on two decades of fundamental research. The Toolsuite, helping treat patients since 2014, empowers therapists to easily deliver best practices in exposure therapy for phobias and anxiety disorders. Therapists immerse their patient in relevant anxiety stimuli, as they control and monitor the patient’s environment from their web browser. Along with a better method, the Tool-suite gives therapists added value in patient management & engagement.

More support is provided through a relaxation tool applicable across many therapeutic techniques. Biomonitoring data from the patient are referenced to stimuli controlled by the therapist to show the patient their progress over sessions, providing immediate feedback.

The company has been recognized as the market leader with profiles in CNN, Wired, and The Wall Street Journal, as well as awards from the River Accelerator, Hitlab, and TechTour. By using a web-based platform with consumer mobile devices, what used to cost thousands of dollars and years of training is now accessible for under \$100, to say nothing of improvements in realism and design. Psious has the market-leading position and a global footprint, with Spanish and English

versions reaching ten countries. Patient success stories include people that have overcome decades of fear to finally take a flight, ride public transportation, and successfully give speeches in public.

“Since the 1990s, hundreds of studies have confirmed benefits of Virtual Reality Exposure Therapy, including lower dropout rates and higher willingness to undergo VR exposure over traditional exposure.”

Psious continues to expand the technological toolbox beyond anxiety disorders, while ensuring best-in-class training programs for integrating VR into therapy. As the company evolves, the focus will remain on enabling therapists to deliver the best service to their patients, not replacing their work but making it more effective, engaging, and streamlined.

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Making best clinical practices easier to deliver for treatment of anxiety and phobias



Connecting the dots between physical and mental health

Ophelie Martin, Communications Officer at Mental Health Europe shares insights on the link between physical and mental health, illustrating facts with her own personal story...

According to the World Health Organization, “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”¹ The medical community has known for a long time that physical and mental health problems are intertwined, and that is why the global health community emphasises the mantra: there can be no health without mental health. Yet, as this article seeks to show, while this fact is known, it is not born out in practice by many health professionals as well as health care systems around the world.

We now know that people with long term physical diseases are twice as likely to have some kind of mental health issue. The prevalence of major depression is consistently higher for persons with physical illness, and yet, it has been estimated that while 25% of all individuals with cancer are depressed only 2%² receive treatment for depression. Researchers³ have also found that mental health issues are directly associated to a number of somatic diseases, such as asthma, pulmonary problems, musculoskeletal disorders (such as arthritis), neurological diseases and chronic pain conditions. The connection seems to be reciprocal: chronic somatic diseases often result in serious mental health problems and vice versa. More alarmingly, people living with severe mental health problems such as schizophrenia, major depressive disorder or bipolar disorder report poorer physical health in general and have shorter life expectancy than those without mental health conditions⁴. These facts alone should encourage health professionals and decision-makers to address the link between mental and physical health more effectively.

Once people experiencing mental health problems are diagnosed with a certain condition, they tend to

be labeled as “mentally ill” which can sometimes have unintended life-altering consequences. It must be acknowledged that the stigma around mental ill health is also experienced in today’s health care systems, because of lack of knowledge and appropriate training of health professionals on how to treat those affected by both physical and mental health problems.

Poor treatment or lack of treatment for physical health for those with mental health problems is a lived reality for many. My own personal story can illustrate how serious stigma against people with mental health problems within the medical community can drastically change their health prospects. My father, a 63-year old loving family man diagnosed with bipolar disorders and schizophrenia, went to his GP many times constantly complaining of severe stomach pain. His GP was aware of his condition and wrongly assumed the pain was linked to his mental health problems and as a result failed to examine him properly. A few months later, my father died from pancreatic cancer, in part due to the fact that it was not diagnosed in a timely fashion by his GP. His GP repeatedly reassured him that it “would get better”. I have asked myself this question over the years: would my father’s GP have treated a person without mental health problems, who had presented consistently with stomach pain, in the same manner? This is just one single example among other unacceptable and heartbreaking stories from across Europe and beyond.

Research⁵ has highlighted the ‘treatment gap’ for people with mental health problems – 9 out of 10 individuals’ experiencing mental illness worldwide are not able to access appropriate care and treatment. A recent Quality Watch Report⁶ shows that too often a person’s mental health care is collected in isolation of their physical health care. This too often results in



the physical health needs of people with mental health ill-health remaining unidentified. How can this treatment gap be addressed? What can we do to combat stigma and promote a better understanding of mental health?

Mental Health Europe believes that health is not only a medical concern but also a human rights issue. If the link between physical and mental health is not properly addressed then health systems cannot respond to the health needs of rights holders, thus depriving them of their right to the highest attainable standards of health as outlined in Article 12 of the UN Convention on Economic, Social and Cultural Rights. To address the link between mental and physical health efficiently, a variety of training, educational and awareness-raising programmes targeted at health professionals, carers and volunteers in the community should be launched and supported by both national and EU financial instruments. To avoid additional health problems and misdiagnoses, greater investment in health promotion and disease prevention should be emphasised especially in the case of individuals who already have mental or chronic physical difficulties.

MHE is working together with members to ensure that mental health is high on the agenda at European and national levels, advocating for the human rights, social inclusion and access to healthcare of people with mental health problems. One in 4 people in the world will be affected by mental health problems at

some point in their lives. Health systems must be prepared to address comorbidity of mental and physical ill-health as well as the treatment gap for persons with mental health problems. If some of the above actions, particularly training for health professionals, had been implemented when my father attended at his GP the very first time he felt that something was not right, the care he received could have saved his life. ■

Mental Health Europe is an umbrella organisation which represents associations, organisations and individuals active in the field of mental health and well-being in Europe, including (ex) users of mental health services, service providers volunteers and professionals. Mental Health Europe envisions a Europe where people with mental health problems live as full citizens with access to appropriate services and support, where positive mental health and well- being are given high priority in the political spectrum and on the European health and social agenda, and where meaningful participation is guaranteed at all levels of decision-making.

¹ <http://www.who.int/about/definition/en/print.html>
² http://www.researchgate.net/publication/5928479_Increased_12-Month_Prevalence_Rates_of_Mental_Disorders_in_Patients_with_Chronic_Somatic_Diseases
³ <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0032190>
⁴ http://www.mhe-sme.org/fileadmin/Position_papers/Study_on_the_interlink_between_mental_and_physical_health_July_2014.pdf
⁵ <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2570037/>
⁶ http://www.qualitywatch.org.uk/sites/files/qualitywatch/field/field_document/QualityWatch_Mental_ill_health_and_hospital_use_full_report.pdf

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The Palatinate region braces itself/you

Roads to resilience – a Palatinate initiative for the promotion of preventive approaches beyond the health care system...

Strategies based on prevention improve the population's mental health. Nevertheless prevention programmes cause less than 7% of the overall health system cost in Germany.

With regard to the treatment of mentally ill persons with complex needs for help we have decided to think in a radically new way:

Our idea is to strengthen resilience on different social levels such as the individual, families, enterprises and communities.

“Technological advances, growing market dynamics or aging workforces are just a few examples of megatrends that may trigger crisis situations, which are cropping up in organisations such as companies or administrations in ever more rapid pace.”

The ability to advance personally in times of crisis and not to be broken by these, to be able to cope well with changes and with the ups and downs of life – this is what is known as resilience. Resilience is of utmost relevance both for individuals and organisations.

Resilience at an individual level, i.e. the strengthening of an individual's mental resistance, is a key aspect of the services provided by the Pfalz-klinikum für Psychiatrie und Neurologie



– AdÖR (Service Provider for Mental Health). Around 30,000 people are treated and cared for at their 12 locations annually, either as in-patients, in day clinics or as out-patients. In order to boost their mental health on a long term basis and to counteract any further increase in mental illnesses, the main focus of the efforts has to be on prevention. The preventive fostering of individual resilience will therefore play a central role.

Above all, however, there is need for action in the fostering of organisational

resilience. Technological advances, growing market dynamics or aging workforces are just a few examples of megatrends that may trigger crisis situations, which are cropping up in organisations such as companies or administrations in ever more rapid pace. Such situations almost invariably call for rapid and comprehensive change to ensure a company's survival.

And we have to think about ways to improve resilience on the level of the community, where people live too. Only these three levels are helpful to



built a powerful and sustainable prevention strategy.

For this, we have brought together experts from different institutions in the field of science and practice (sociologists, anthropologists, economists, pedagogues, psychiatrists, communication scientists, ergonomists and so on) in order to promote salutogenesis at community level through the thematic fields of work/school/leisure (instead of pathogenetic approaches on which the health system has mainly focused so far).

The foremost requirement for this purpose is preliminary, comprehensive communication research aiming at the identification of stigmatising attitudes and their replacement by new relevant information (for example by means of metaphors). It is only sound knowledge of how communication works or does not work that offers the possibility of establishing a broad know-how

of resilience-promoting factors and framework conditions among the citizens.

“Our idea is to strengthen resilience on different social levels such as the individual, families, enterprises and communities.”

The results are reflected in a binational project with a similar, newly founded initiative (Blackpool Better Start) in Blackpool, Great Britain.

With this concept we also tread new paths when designing the context of health communication.

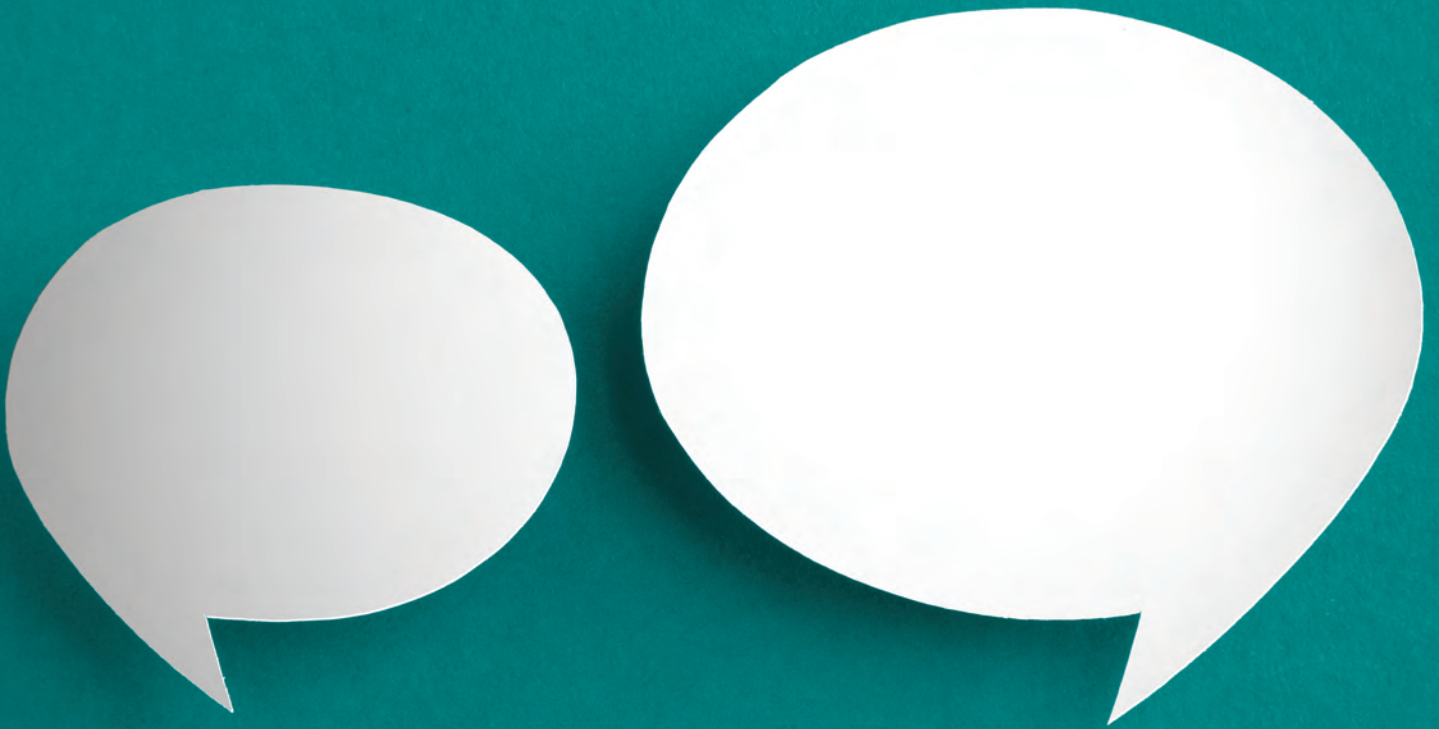
The Palatinate region braces itself/you initiative as a socio-ecological and multi-agency approach is aimed at building networks for “knowledge mobilisation”, establishing action alliances and learning platforms and various projects to be presented

using the example of resilience in enterprises and resilience promoting programmes in schools and on the community level.



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Reducing the burden of cancer

Adjacent Government highlights the work of the National Cancer Institute (NCI), to reduce and treat cancer...

The National Cancer Institute (NCI) is the U.S. Federal government's primary agency for cancer research and training. As part of the National Institutes of Health (NIH) they coordinate with the National Cancer Programme, which conducts and supports research, training, health information dissemination and other programs related to cancer – i.e. diagnosis, prevention, and treatment. Real progress is being made against cancer worldwide, and due to the work of NCI and medical researchers throughout the U.S., in 2012 there were approximately 14 million cancer survivors throughout the country.

The NCI estimated that in 2015, 1,658,370 new cases of cancer will be diagnosed in the U.S. and 589,430 people will die from the disease. Approximately 39.6% of men and women will be diagnosed with cancer at some point in their life, with breast, lung, bronchus, prostate, colon, bladder, melanoma of the skin and rectum cancer named the most common cancers in 2015. ¹

Throughout the U.S. the rate of new cancers overall has been declining for more than a decade. Through new treatments and understanding for the detection and diagnosis, people living with cancer are living longer and with a better quality of life than ever before.

In a blog post ² by Acting NCI Director, Doug Lowy, M.D, he discusses the critical contribution of basic science in fostering progress against cancer.

“Over the past 2 decades, we have made significant progress in diagnosing and treating cancer- progress that is reflected in the continuing declines in cancer death rates and the increasing numbers of cancer survivors. This progress is only possible because of our efforts to understand the biological mechanisms underpinning cancer.

“When or where the next major advance in cancer research will occur is unknown, but it always begins

with basic research – often in areas which a direct application to medicine may not be immediately apparent, including areas such as physics, mathematics and materials science.”

Ensuring people receive the right treatment for their cancer is integral to their quality of life. Treatments for cancer can come in many forms. Some people require a combination of measures, whilst others only have one type. The majority of people with cancer do have combination treatment, which could consist of surgery with chemotherapy and/or radiation therapy.

Treatments and new drugs are tested using clinical trials. Cancer patients at any stage of their treatment can take part in these, and they are key to developing new methods to prevent, detect and treat cancer.

Clinical trials can also bring to light new information and outcomes to researchers in regards to the cancer and the way it reacts to drugs. At NCI a clinical trial has recently revealed some interesting results in regards to precision medicine and the most common type of lymphoma.

Lymphoma is a cancer that begins in cells of the lymph system and can be almost anywhere in the body. The joint study conducted by the NCI, and Pharmacyclics Sunnyvale, California revealed that patients with a specific molecular subtype of diffuse large B cell lymphoma (DLBCL) are more likely to respond to a specific drug than patients with another molecular subtype of the disease.³

Several years ago, NCI scientists identified two primary subtypes of DLBCL based on characteristic patterns of gene activity with the lymphoma cells. This discovery led the researchers to believe that targeted treatments could be developed.

Louis Staudt from the NCI Centre for Cancer Genomics, who co-led the study, said: “Clinical trials such as this are critical for translating basic molecular findings into effective therapies.”

Study co-leader Wyndham Wilson of the NCI added: “This is the first clinical study to demonstrate the importance of precision medicine in lymphomas.”

Target therapy is the foundation of precision medicine and works by targeting the changes in cancer cells that help them grow, divide and spread. Most cancer patients will have a target for a certain drug, so they can be treated with that drug. However, most of the time the tumour will need to be tested to see if it contains markers for which we have drugs. Most targeted therapies help the immune systems destroy cancer cells; stop the cancer cells from growing; stop signals that help for blood vessels; deliver cell-killing substances to cancer cells; cause cancer cell death; and starve cancer of the hormones it needs to grow.⁴

However, there are some drawbacks to targeted therapy, as there is with most cancer treatments. Cancer cells may become resistant to them and drugs for targets are hard to develop.

With detailed research and funding, cancer treatments have come a long way over the years. However, the questions still remain: why haven't we found a cure yet? Treatments available can extend life, and if caught at the right time many people do survive cancer. Due to the complicated nature of cancer and the number of types there are, it is still proving a difficult task to find that cure to eliminate this awful and life changing disease.

Organisations like the NCI play a pivotal role in getting us closer to finding that cure. Ongoing cancer research and clinical trials to test and develop new drugs could be that crucial step to help patients live a longer and happier life, with or without cancer. ■

¹ <http://www.cancer.gov/about-cancer/what-is-cancer/statistics>

² <http://www.cancer.gov/news-events/cancer-currents-blog/2015/bypass-basic-science>

³ <http://www.cancer.gov/news-events/press-releases/2015/ibrutinib-lymphoma-subtype>

⁴ <http://www.cancer.gov/about-cancer/treatment/types/targeted-therapies>

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Combining biology with physics to solve the cancer problem

It is an exciting time for the field of oncology. Breakthroughs in immunotherapy, metabolism, and other targeted drug therapies are redefining how we approach cancer and its treatment. However, much work remains to be done because the initial tumor responses that these new treatments achieve do not typically last for more than one year. This sobering fact has shifted efforts toward understanding how cancers survive therapies. While biology is certainly playing an important role in this phenomenon of therapeutic resistance, the underlying physics of the tumor is also contributing.

Ancient Greeks recognised that tumors had different physical properties than the surrounding normal tissue, hence “oncology” was derived from the Greek word “onco” which means “mass.” In the modern era, we recognise that the physical properties of tumors differ also. This is how radiologists visualise and diagnose some cancers. The tumors exhibit a broad range of imaging characteristics to indicate that they are different: e.g., occasionally low enhancement, sometimes high enhancement, abnormal shape, disruption of normal anatomy, and misformed blood vessels. All of these characteristics represent physical cues that the underlying tumor is different from normal tissue.

Under the microscope, tumors also exhibit these physical differences from normal tissues. The classification of tumors according to physical properties is intrinsic to the medical practice

of pathologists. These physicians will take cell and nuclear shape, the surrounding cells, fibrous matrix, blood vessels, and architecture of the tumor and normal tissue into account to render a diagnosis.

“We hope to integrate principles of physics into oncologic clinical practice to achieve our goal of improving outcomes of patients with cancer.”

What is becoming increasingly apparent in our work and the work of others is that these imaging and pathology characteristics not only have a diagnostic application, but also therapeutic implications. The physical makeup of a tumor with lots of fibrous matrix and few blood vessels directly implies that it will have a different drug distribution and response than a tumor with very little matrix and lots of blood vessels. We have developed ways to measure these physical properties and to quantify and predict the effects of these properties on therapeutic outcomes with mathematical models based on the physics of mass and momentum transport. In this manner, we believe we shed light on the mechanisms by which tumors survive promising treatments such as immunotherapy and other targeted drugs.

We have demonstrated proof of concept of this using conventional chemotherapies in patients. We recently published work in this regard for pancreatic cancer (Koay et al., J Clin

Invest 2014; PMC3973100), as well as glioblastoma and liver metastases from colorectal cancer (Pascal et al., Proc Natl Acad Sci USA 2013; PMC3761643). These studies demonstrate how measurements of the physical properties of tumors can be used to predict how a tumor will respond to treatment (Fig. 1). Importantly, these physical properties, including the volume of the tumor that is occupied by blood (BVF), the typical size of the blood vessels (rb), and the typical distance among blood vessels (L), can be measured directly from the tissue or indirectly from diagnostic imaging. We also coupled these physical measurements with the biological expression of cellular transporters of drugs to improve our predictions. These predictions are based on the same physical conservation laws that govern weather patterns, that describe the synthesis of oil and gas products, and that are responsible for the dynamics of stars and celestial bodies, as just a few examples. Importantly, these tumor measurements can be done prior to treatment, enabling physicians to make rational choices about how to treat an individual. Moreover, these insights could lead to novel ways to treat tumors by altering their physical properties, thereby making them more likely to respond to certain drugs.

We are now applying these same concepts to emerging therapeutic strategies such as immunotherapy. Here, we anticipate that coupling our physical measurements with biological assessments will be critical to improv-

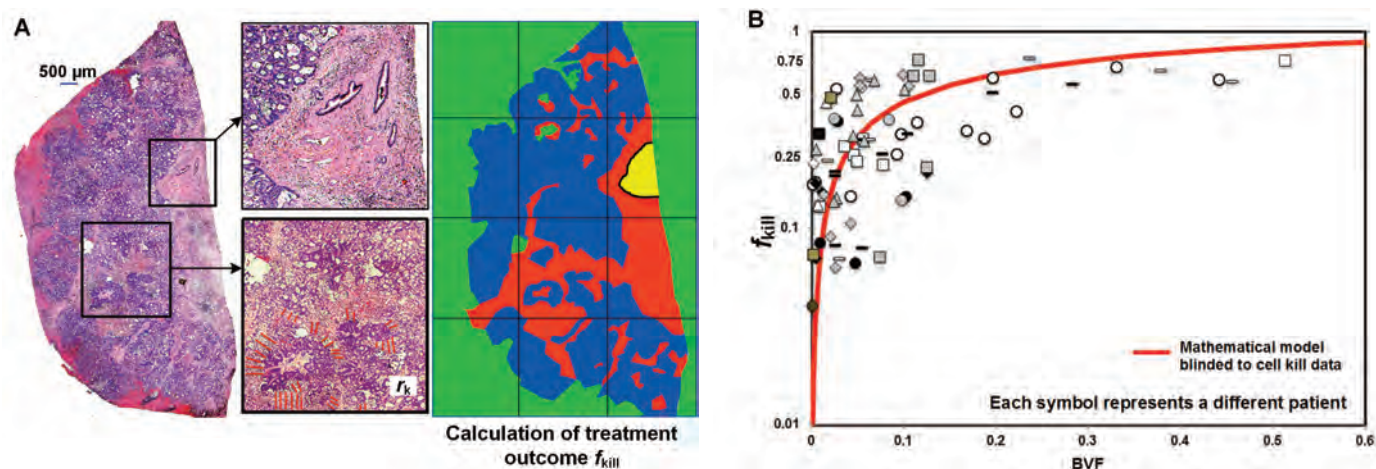


Figure 1: A mechanistic model of tumor kill from chemotherapy in patients with colorectal cancer (CRC) metastatic to liver (f_{kill}). (A) Determination of model parameters from histology measurements. The panel on the right with a green background is a segmented, computerized image of a histologic section shown on the left. Color scheme: dead tumor (red); live tumor (blue); no tumor (green); portal triad and central vein (yellow). (B) The model (red line) describes heterogeneous response in 11 patients. These results demonstrate significant correlation of local tumor kill with perfusive and diffusive transport properties of tissue. Adapted from Pascal et al., PNAS 110 (35): 14266-71

ing treatment efficacy. Additionally, we are taking our initial findings in colorectal cancer and pancreatic cancer to the next steps through ongoing trials at MD Anderson Cancer Center and elsewhere. For example, we are developing new imaging techniques in pancreatic cancer to measure the physical properties of these tumors and identifying how these properties differentiate aggressive from less aggressive disease. These insights allow us to stratify patients into different groups, and by doing so, we can make informed decisions about how to treat these patients.

“It is an exciting time for the field of oncology. Breakthroughs in immunotherapy, metabolism, and other targeted drug therapies are redefining how we approach cancer and its treatment.”

This type of research lies at the cusp of multiple fields, including medicine, biology, engineering, mathematics,

and physics. We work with experts in each of these areas to help us make the measurements and develop the tools we need to test our models. This highly integrated and collaborative work is unique in the area of oncology and has yielded new insights of how to approach the cancer problem. We hope to integrate principles of physics into oncologic clinical practice to achieve our goal of improving outcomes of patients with cancer.

Additional resources:

<http://physics.cancer.gov/>

<http://www.internationalinnovation.com/taking-cancer-out-of-the-equation/>

<http://www.jci.org/articles/view/73455>

<http://www.pnas.org/content/110/35/14266.long>

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New considerations for breast cancer screening of obese, post-menopausal women

The scope of the problem of breast cancer

Obesity has been linked to increased risk for several important cancers, including breast cancer in post-menopausal women. In the US, there are about 125 new cases of breast cancer and about 22 deaths per 100,000 women each year. The median age at diagnosis is 61 years, and the median age at death is 68 years¹. In the US in 2014, about 233,000 women were diagnosed and about 40,000 women died from breast cancer¹. In the UK in 2011, about 49,900 women were diagnosed and about 11,600 women died from breast cancer². Accounting for population and clinical differences, UK rates are slightly higher than US rates.

Benefits and harms of cancer screening

Early detection of breast cancer in several countries has been well established to save lives, as shown by the shift in the incidence and mortality curves over time upon the introduction of breast screening programs³. The total number of women screened in FY2009/10 in the UK was nearly 2,020,000². However, there is active debate about 'over-diagnosis', i.e., the false positive identification by mammography of a suspected lesion that does not progress to invasive breast cancer. Over-diagnosis is a significant problem when the low-risk, general population is screened, because there is greater chance that a sensitive method will reveal a suspected abnormality that turns out not to be a significant problem.

The converse problem of 'under-diagnosis' occurs when the screening tool is insufficiently sensitive to catch an abnormality that actually will be an invasive cancer later. The ratio of benefit to harm is difficult to assess, and varies by age range, region of a country, ethnicity and other factors. The harms of over-diagnosis and overtreatment range from distress and discomfort, to unnecessary mastectomies and radiotherapy. New tools to improve over- and under-diagnosis rates and stratify risk groups are needed.

Obesity exacerbates breast cancer incidence and reduces survival

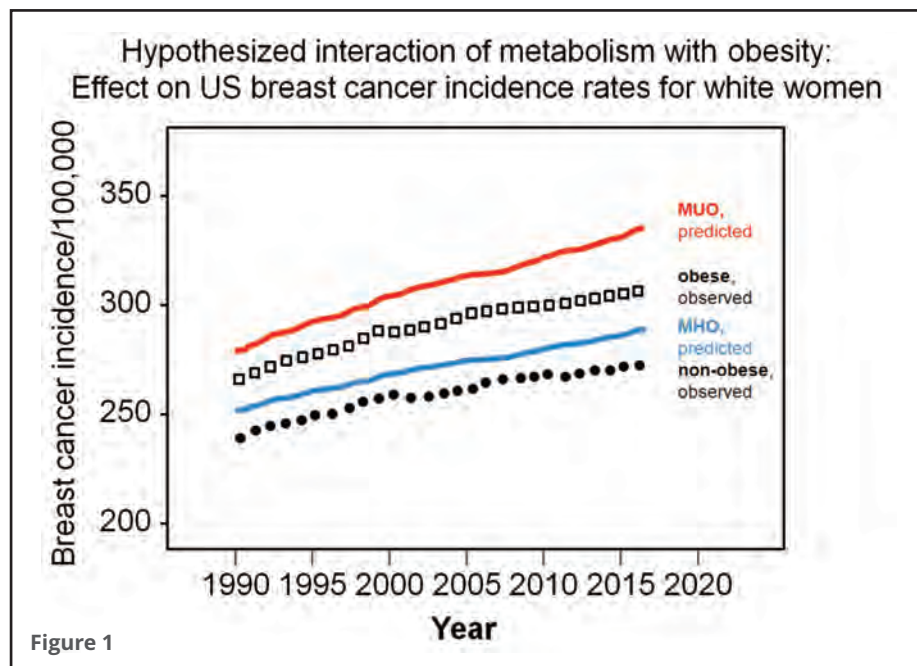
Alarming, obesity is now considered to be one of the most important preventable causes of several cancers⁴, including breast cancer^{5,6}. Insulin-resistant obesity is a metabolically abnormal state featuring chronic systemic⁷ and local inflammation of adipose tissue⁸. The inflammatory biomarkers frequently found in blood of obese adults include C-reactive protein⁹ and other acute phase proteins, e.g., interleukin (IL)-1 β , IL-6 and IL-17. In insulin-resistant 'metabolically unhealthy' obese (MUO) humans, inflammatory macrophages infiltrate insulin-resistant fat and are associated with elevated cardiovascular risk¹⁰. These local and systemic biomarkers have also been linked to breast cancer outcomes¹¹. The field of obesity-associated cancer can yet learn a great deal from the cardiovascular disease field, where it has long been appreciated that inflammatory cytokine profiles are informative of cardiovascular risk. Biomarker profiles for cardiovascular disease and diabetes may overlap in informative ways with risks for specific obesity-associated cancers, including breast cancer in post-menopausal women, a group that experiences elevated risk.

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"In the UK in 2011, about 49,900 women were diagnosed and about 11,600 women died from breast cancer."

'Metabolically healthy' obesity protects against breast cancer

Different kinds of obesity are associated with different risks for breast cancer. We have shown in animal models that systemic inflammation^{12,13} and macrophages that infiltrate adipose tissue⁸ are associated with metabolic status¹⁴. Certain adults have lower inflammation despite obesity and enjoy protection from cardiovascular and diabetes risks^{15,16}; this phenotype is well recognised and is termed 'metabolically healthy' obesity (MHO)¹⁷. These apparently protected adults have reduced macrophage infiltration of fat, as well as reduced systemic inflammation^{18,19}, and preserved insulin sensitivity and glucose control^{20,21}. Similar patterns hold in obese African American women:



about one-quarter of whom²² are 'metabolically healthy'. We have recently shown that this phenotype protects against certain obesity-associated cancers²³, likely through changes in the cancer microenvironment. Interestingly, this cancer protection parallels protection from cardiovascular risk in metabolically healthy obese women²⁴, which is intermediate between lean and healthy, and MUO.

"Cancer protection parallels protection from cardiovascular risk in metabolically healthy obese women."

Combining metabolic and inflammatory information with mammography screening

Breast density as observed during mammography has been linked to increased breast cancer risk, and current recommendations take this factor into account when counseling women about their risks. The aforementioned considerations suggest a new rationale for a clinical trial to

develop an evidence base for inflammatory and metabolic profiling of obese women, at the time of mammography, which could be included in their risk assessment for incident breast cancer. The hypothesis would be that MHO women will show lower breast cancer risk over time (Figure 1, adapted from primary data²⁵), compared to MUO women, who have higher risk. This approach separates out the different kinds of obesity and should both reduce costs and save lives, using a more refined approach to breast screening. The ratio of benefit to harm would also be expected to improve.

Governmental funding agencies should consider issuing a request for proposals for research to address this question in actual populations in the UK and US.

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More choice for cancer patients



Emerging from the Swiss-based organisation Reliable Cancer Therapies, founded in 2009 by Belgian entrepreneur Luc Verelst, the Belgian-based Anticancer Fund (ACF) is a private not-for-profit foundation dedicated to expanding the range of treatment options available to cancer patients. It is this central focus on patients which is the common theme that runs through the diverse activities of the ACF – both in terms of its day to day activities and also in its approach to scientific and clinical research.



To read the digital ebook



A European leader in cancer clinical trials

Denis Lacombe, John Bean and Mathilde Fenoulhet from the European Organisation for Research and Treatment of Cancer (EORTC) outline how clinical trials play an integral role in tackling cancer...

The European Organisation for Research and Treatment of Cancer (EORTC) is a European, academic, cancer clinical research organisation. A leader in promoting multidisciplinary cancer research, the EORTC is today one of Europe's leading players in facilitating the passage of experimental discoveries into new treatments for patients with a view to prolong survival and improve quality of life.

Optimising multimodal cancer treatments

The EORTC has been able to improve the standard of cancer treatment by testing more effective therapeutic strategies based on combinations of drugs and/or surgery and/or radiotherapy that are already in use and also through the development of new drugs and other innovative approaches. Its trials not only improve treatment efficacy with the use of new and significantly more efficient drugs for treating cancer but are also important in identifying useful clinical and biological parameters to adapt treatment strategies.

Importance of international academic clinical trials

The work of the EORTC also fills an important niche in the clinical trial landscape; its international academic

trials can address common and devastating malignancies where even a small improvement in survival would have a major impact on public health. They promote cross fertilisation, standardisation of reference treatments, and harmonisation of quality assurance across borders. These international trials play an important role in studies involving rare tumours. The low incidence of these makes international cooperation obligatory, and the EORTC's broad network of clinical trial expertise makes conducting these studies practical. Indeed, the EORTC addresses a wide range of unmet clinical situations, specific populations, rare tumours, dose de-escalation, quality of life, etc., in fact, a whole host of studies which do not fall within the scope of the pharmaceutical industry.

Quality assurance is another hallmark of EORTC clinical trial research

The quality of radiotherapy can substantially impact overall therapeutic strategy. The integrated radiotherapy quality assurance platform takes into account everything needed to develop truly effective combined treatment modalities. Here, the EORTC harmonises radiotherapy treatment techniques between centres, standardises credentialing of modern radiotherapy

techniques, and enhances compliance with the trial protocol and cost effectiveness, and increases public and regulatory acceptance of the drug effect.

Surgery is an important discipline in cancer treatment, and the SURCARE quality assurance in surgery partnership between the EORTC and the European Society of Surgical Oncology provides opportunities to conduct prospective studies that will lead towards improvements in the quality of surgery in cancer clinical trials.

Quality Assurance in Medical Imaging is also important, because reliable, non-invasive staging of disease and response to therapy is crucial for patient management. The EORTC Imaging Platform ensures proper implementation of the different medical imaging modalities, protocol and imaging guideline compliance, quality control of scans, analysis of deviations, and process improvements for clinical trials.

Access to human biological materials, in sufficient quality and quantity and linked to high quality clinical data is essential to accelerate clinical and translational cancer research. In this respect, all EORTC studies and projects comply with all applicable ethical and legal requirements and quality assurance requirements regarding the collection of human biological materials. All human biological materials collections are stored in a validated storage facility and comply with the EORTC's Human Biological Material Collection, Storage and Use policy.

An international leader in addressing quality of life issues

Quality of life results from clinical trials have had a positive impact on clinical practice in the treatment of numerous diseases such as brain, breast, melanoma, lung and ovarian cancer. The EORTC performs studies on Health related quality of life at the individual patient level and as a prognostic factor, and it has set global standards for translation, cross cultural adaptation, and computer-adaptive testing. The Quality of Life Core Questionnaire, the QLQ-C30, is one of the most widely used cancer specific health related quality of life questionnaires in the world. This questionnaire has been translated and linguistically validated into more than 90 languages and extended with over 40 validated modules for specific diseases.

Challenges ahead

The identification of molecular alterations in the cancer, and the possibility to specifically and selectively target them, has dramatically improved treatment efficacy in cancer patients. Cancer genetics has led to increasingly fragmented populations eligible for specific treatments. Precision medicine targets specific sets of molecular alterations, only useful for the relevant subsets of patients.

The EORTC has embraced this change with a strategy to first understand the biology and then propose a clinical trial and not the other way round. Through SPECTA - Screening Patients for Efficient Clinical Trial Access - oncologists can now allocate patients to clinical trials based on both their clinical characteristics as well as the molecular profiles of their tumours.

Programs such as SPECTA will help advance treatments for diseases that were previously seen as a single entity. Moreover, such Pan-European research efforts involve partnerships with a variety of stakeholders including not just academic groups and learned Societies, but also patient organisations, cancer leagues, regulatory agencies and the pharmaceutical industry. Involvement in these endeavours enables the EORTC to pursue its mission and shape the future of cancer therapy. ■

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Obesity, fatty liver disease and liver cancer in Europe

Alterations in our way of living over the last decades, including high caloric intake (e.g. through high fructose and high fat diet) combined with a sedentary lifestyle, have augmented the incidence of overweight and metabolic syndrome, characterised by abdominal obesity, insulin resistance, hypertonia and dyslipidemia. This trend is observed not only in industrialised countries such as the United States of America or Europe but also step by step in developed as well as developing countries.

Overweight and metabolic syndrome lead to diseases of several kinds, including coronary heart diseases, Type 2 diabetes, and also cancer (e.g. liver, colorectal). Epidemiological data clearly indicate that overweight and metabolic syndrome are reaching pandemic dimensions in industrialised countries. Notably, it is suggested that newly developing countries – as a consequence of industrialisation and adaptation of their lifestyle – will also experience a steep increase in overweight and metabolic syndrome-triggered diseases. In the past ten years, the rate of obesity has doubled in adults and tripled in children in the USA. A similar trend has also been observed in Europe.

The liver – which is the most important metabolic organ – is strongly affected by a chronic state of overweight and metabolic syndrome. Non-alcoholic fatty liver disease (NAFLD),



the most frequent liver disease worldwide, is a clinical manifestation of overweight and metabolic syndrome. NAFLD is a chronic disease that can last several decades, characterised by predominant macrovesicular steatosis of the liver. Although the prevalence of NAFLD is increasing globally, epidemiology and demographic characteristics of NAFLD vary worldwide. It is becoming increasingly clear that a number of pathways are involved in the pathogenesis of NAFLD and NASH and its progression to advanced stages of liver disease. These pathways may be diverse in different cohorts of patients suffering from the condition, and understanding which pathways play a role in its development will be critical before launching treatment modalities.

A significant number of NAFLD patients develop nonalcoholic steatohepatitis (NASH), fibrosis and consequently hepatocellular carcinoma (HCC). In recent years, obesity, leading to metabolic syndrome, steatosis and steatohepatitis, has attracted increased attention due to an increased HCC incidence in the US and Europe. In line with this, the most common etiology for HCC in industrialised countries has recently switched from chronic viral infections (e.g. hepatitis B and hepatitis C virus) to obesity, making HCC the most rapidly increasing type of cancer in the US, with a similar trend observed in Europe. Today we lack a detailed understanding of how chronic steatosis develops into NASH and what factors control its transition from NASH to HCC. At the same time, no

therapeutics exist to efficiently treat NASH, and treatment options for the therapy of late stage HCC are limited and prolong the lifespan of patients for between three to six months.

“In the past ten years, the rate of obesity has doubled in adults and tripled in children in the USA. A similar trend has also been observed in Europe.”

In laboratory mice, NASH can be induced by several different diets, such as a methionine/choline-deficient (MCD) or choline-deficient diet (CD) but not by a high-fat diet (HFD) alone. However, C57BL/6 mice fed with MCD or CD do not develop obesity or metabolic syndrome, and the diet has to be discontinued after a few months due to weight loss (up to 40%) or occasional cachexia. Hence, these approaches do not recapitulate NASH and its consequences (e.g. transition to HCC) in humans, and appropriate mouse models for genetically and mechanistically dissecting NAFLD-induced NASH and NASH-triggered HCC development have been thus far lacking.

Deficiency in the essential nutrient choline was described in NAFLD patients to exacerbate NAFLD and NASH. Moreover, humans with inadequate choline uptake were shown to have defects in hepatic lipoprotein secretion, oxidative damage caused by mitochondrial dysfunction and ER stress.

Based on the clinical observations of choline deficiency to exacerbate NAFLD

and NASH patients, we have recently combined choline deficiency with a high fat diet (CD-HFD) as a chronic diet for laboratory mice, which may lead to metabolic syndrome, steatosis, liver damage and NASH, thus delivering the ‘second hit’ that promotes dietary-induced liver carcinogenesis – similar to the human situation. This approach has enabled us to establish a chronic mouse model of NASH and metabolic syndrome, triggering subsequent HCC in a wild-type C57BL/6 mouse, in the absence of chemical carcinogens or genetic mutations predisposing to NASH or HCC development (Wolf et al., Cancer Cell, 2014). CD-HFD-treated mice display obesity, overweight, insulin resistance, liver damage and fibrosis and hepatic mitochondrial damage, dyslipidemia and NASH, as observed in human patients. HCC developed 12 months post-CD-HFD start and resembled histologically, genetically and morphologically human HCC. Interestingly, by using this novel model we could show that adaptive immune cells (e.g. cytotoxic T-cells as well as natural killer T cells) greatly contribute to the diet-induced liver pathology. Consequently, we also analyzed NASH patients and patients suffering from other liver diseases with concomitant lipid deposition diseases (e.g. chronic HCV infection) and could find the same activated immune cells in livers of NASH patients, as well as the same cytokines, which we identified to be causally linked to NASH and HCC disease development.

We thus believe that our mouse model recapitulates several pathophysiological aspects of human NASH and enables us to study its develop-

ment and transition to HCC. In the future, the link between activated T-cells in the liver and their crosstalk to hepatocytes could give us important insights into how we can generate novel therapeutics for treating NASH as well as NASH-induced HCC in industrialised countries.

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Tackling cancer in children and adolescents

Professor Giles Vassal, President of the European Society for Paediatric Oncology outlines why it is crucial for Europe to come together and tackle and prevent cancer in children...

Compared to the incidence in adults, cancer is rare in children and adolescents but concerns 35,000 young people each year in Europe. Despite high survival rates (80% of them are disease free at 5 years) – thanks to high quality academic clinical research run by the European community over the last 4 decades – cancer remains the first cause of death by disease beyond 1 year of age. 6,000 children die each year of cancer. In addition, two thirds of childhood cancer survivors have long term sequelae of their treatment. There are more than 300,000 European citizens who are childhood cancer survivors.

Cancer is still a major health issue for young people in Europe that needs to be tackled by all stakeholders.

SIOPE – the European Society of Paediatric Oncology – just launched its 10 years strategic plan to increase both cure rate and quality of cure, as well as to tackle inequalities across Europe. It is crucial that policy-makers at the European and national levels make the right decisions and set up the legal environment that will make this European Cancer Plan for children and adolescents a success.

The Plan was first elaborated within the ENCCA network of excellence (European Network for Cancer research in Children and Adolescents, FP7 2011-2015), and enriched through the contributions of SIOPE members and partners, as well as parents, patients, and survivors' advocates. At the conference *'Joining efforts for a brighter future for children and adolescents with cancer – The European roadmap to Horizon 2020'* (18-19 September 2014, Brussels) approximately 160 participants from 31 countries publicly endorsed the proposal and called for a European Cancer Plan for Children and Adolescents that would address both clinical care and research.



The ultimate goal of the SIOPE Strategic Plan is to increase the survival that is free from disease and late effects- after 10 years from the disease (and beyond) by achieving the following 7 objectives:

1. **Innovative treatments:** to introduce safe and effective innovative treatments (i.e. new drugs, new technologies) into standard care;
2. **Precision cancer medicine:** to use improved risk classification as well as biological characteristics of both the tumour and patient (such as molecular and immunological factors) to help guide decisions on which therapies to use;
3. **Tumour biology:** to increase knowledge of tumour biology and speed up translation from basic research to clinical care to benefit patients;
4. **Equal access:** to bring about equal access across Europe to standard care (in both diagnosis and treatment), expertise and clinical research;

5. **TYA:** to address the specific needs of teenagers and young adults (TYA), in cooperation with adult oncology;
6. **Quality of survivorship:** to address the consequences of cancer treatment such as long-term side effects, to better understand the genetic background/risk of an individual, and to improve quality of life of childhood cancer survivors;
7. **Causes of cancer:** to understand the causes of paediatric cancers and to address prevention wherever possible and answer the question: "Why did my child get cancer?"

Cross-tumour platforms and projects are being set up to facilitate the Plan's implementation spanning the critical variables influencing success, such as outcomes research to monitor progress made, a platform to provide radiotherapy quality assurance, a multi-stakeholder platform with academia, industry, regulators and parents to improve paediatric development of new oncology drugs, as well as a research program to address ethics and psycho-social aspects of childhood cancer.

A European Reference Network will be created to facilitate cross-border healthcare and access to expertise for paediatric cancer patients across Europe no matter where they live. An efficient e-Health infrastructure is set to support such system building on the ExPO-r-Net project.

The 'Oncopolicy' programme will advocate better EU policies to address the needs of young people with cancer. Indeed, SIOPE will help the implementation of cross border clinical trials within the new Clinical trial regulation and advocate for a Data Protection regulation that will not jeopardise research efforts for children and adolescents while assuring privacy to all citizens. The implementation of the EU paediatric medicine regulation must urgently be improved in order to adequately address the needs of children with cancer. Specific new incentives might be required.

SIOPE will steer and coordinate the effective implementation of this Plan, together with all stakeholders; existing partnerships will be strengthened with adult oncologists as well as professionals from other continents, while public-private partnerships – recognising the specificities of paediatric haematology-oncology – will be established with industry. SIOPE established a partnership with Childhood Cancer International, the federation of parents, patients and survivors organisations to implement the Plan.

The SIOPE Strategic Plan was officially presented during the European Cancer Congress (25-29 September 2015, Vienna, Austria), and will be also further discussed at the EU-policy level during an event which will take place on 18th November 2015 at the European Parliament in Brussels, Belgium (more information: www.siope.eu/?p=3428).

We trust that this Plan will inspire many future initiatives in the field. It has to date already achieved an important milestone of broad multi-stakeholder consensus and we look forward to working with all relevant stakeholders to make it a success, preparing a brighter future for children and adolescents with cancer in our region. ■

Discover the SIOPE European Cancer Plan for Children and Adolescents here:

www.siope.eu/SIOPE_StrategicPlan2015

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Working towards eliminating childhood cancer

There was a time when a diagnosis of childhood cancer meant almost certain death. Through basic research and systematic clinical trials survival for all types of childhood cancer now approaches 80% in resource-rich countries. While the progress made in the 20th century was remarkable, the worldwide fight against childhood cancer remains in its infancy. Worldwide, childhood cancer affects approximately 250,000 new children each year, for reasons unknown the incidence is rising, and unfortunately in many countries, newly diagnosed children don't have access to the medicines that could cure their disease. In resource-rich countries such as the United States, cancer remains the leading cause of death by disease in children (a number that increases dramatically if the growing numbers of adult survivors that succumb to health problems caused by previous cancer therapies are included). Furthermore, successful childhood cancer treatment is associated with horrific acute toxicities and a high frequency of severe long-term health morbidities. One recent study of long-term childhood cancer survivors estimated that the cumulative incidence of either death or development of a life-threatening health condition by age 50 was 50%. Thus, as we approach the 3rd decade of the 21st century, it is imperative that we take stock of our successes and failures and chart a course that will deliver modern cancer thera-

pies to all children across the globe and work collaboratively to reduce the long-term health problems in the growing population of survivors.

In many ways the 20th century story of childhood cancer is a shining example of the promises of modern medicine. For today's long-term survivors, many of them would simply not be alive had they been born only a few decades earlier. As our technological capacities and scientific understanding continue to rapidly increase, eliminating suffering and death from childhood cancer worldwide by the end of this century is an attainable goal. But success will require unprecedented collaboration between patients, advocates, provider teams, basic scientists, industry, and governments. To achieve this lofty goal, we must begin now to invest considerable time, effort, and resources into the following 10 areas:

Establish a comprehensive worldwide longitudinal prospective cohort to study childhood cancers. Worldwide approximately 85% of childhood cancer patients reside in countries with minimal resources. In this population, there is a lack of registries that results in under-reporting of disease. This is a major barrier to understanding the true burden of childhood cancer throughout the world. For many rare pediatric cancers global clinical trials could dramatically improve our ability to test and develop new therapies.

Develop new targeted molecular therapies. The rapidly falling costs of whole genome sequencing have facilitated multiple efforts in Europe and the United States to identify new molecular targets in pediatric cancers and deliver tailored therapy. We must expand these efforts to all childhood cancer patients throughout the world and work to identify both new targets and associated novel therapeutics.

Realize the promise of immunotherapy. Recent successes with cellular therapies such as chimeric antigen receptor T cells (CAR T-cells) and immune checkpoint inhibitors have laid a strong foundation to expand the scientific application of these strategies to multiple pediatric cancers. We must dramatically increase investment in both preclinical research and clinical trials that will insure pediatric cancers benefit from the exciting advances occurring in immunology.

Create financial incentives for pharmaceutical companies that develop new therapies for childhood cancers. Private investment in drug development for pediatric cancers is miniscule. In the United States, the Creating Hope Act has established market incentives for companies working to develop drugs for rare pediatric diseases, including pediatric cancers. We must work to expand these incentive programs and identify additional strategies that will spur a new era of drug development in childhood cancer.

Insure access to curative chemotherapy regimens in resource poor countries. Across the globe, the majority of childhood cancer patients reside in countries with limited resources. Modern therapies must be delivered to these children so that the survival rates seen in countries such as the United States are available everywhere.

Develop a robust system to provide appropriate health care for all long-term survivors. As cure rates improve the number of long-term survivors increases. As we deliver modern therapy across the globe this effect will be enhanced. Since we now understand the tremendous long-term health costs associated with successful therapy, we must simultaneously work to develop a coordinated clinical effort to care for the large population of long-term survivors.

Invest in basic laboratory research aimed at understanding how pediatric cancer therapies damage normal organs and cause both acute and late toxicities. Preclinical drug development efforts are intensely focused on identifying novel therapeutics that target the cellular basis of cancers. Late effects of cancer therapies are the direct result of therapies that affect normal tissues and lead to organ dysfunction later in life. We must apply the preclinical principles that are used to develop drugs from the perspective of tumors to understanding how all chemotherapy agents interact with normal tissues and cause toxicities.

Insure access to palliative care services and medications in development for compassionate use. Despite improving overall survival rates, a significant number of children succumb to childhood cancer worldwide. These children must have access to clinical

services that provide compassionate end-of-life care. Furthermore, we must insure that a process exists by which cancer therapeutics in development can be provided to patients that have exhausted conventional treatment options.

Dramatically increase the number of physicians and scientists that care for childhood cancer patients and conduct laboratory research focusing on pediatric tumors and toxic effects of chemotherapy. To secure a future of sustained growth in research and clinical care for childhood cancers, we must dramatically increase the number of clinical providers and scientists. As we fight for increased funds we must dispel the notion that our current workforce in these areas is adequate. Foundations and institutions that raise money in the name of childhood cancer must become more transparent in proving how these funds are used to grow programs and services for childhood cancer patients. Institutions that remain opaque must be held accountable.

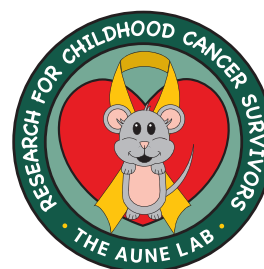
Create a worldwide fund with a sole mission is to fight childhood cancer. Currently, the global AIDS fund has approximately \$28 billion at its disposal. To achieve our goals, childhood cancer must develop a global funding strategy. Attracting high profile not-for-profit entities into this space such as the Gates Foundation and The Clinton Global Initiative must also become a top priority.

Ending suffering and death worldwide from childhood cancer is a laudable and achievable goal that can be accomplished by the end of this century. Childhood cancer remains an enormous problem and as a global community we must do better. In fact, we can and will do better.



Biography:

Dr. Gregory J. Aune, MD, PhD is the Stephanie Edlund Distinguished Professor in Pediatric Cancer Research at Greehey Children's Cancer Research Institute in San Antonio, TX. A 25-year survivor of Hodgkin's lymphoma, Dr. Aune has devoted his career to advocating for childhood cancer patients and developing preclinical animal models to study how pediatric cancer therapies damage normal organs and cause late health effects. In May 2015, he was invited to speak at a side-meeting at the 68th World Health Assembly in Geneva, Switzerland and called upon the World Health Organization to pass a resolution declaring childhood cancer a worldwide problem.



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Understanding paediatric cancer

Dr Kevin Windebank of the Royal College of Paediatrics and Child Health details how research continues to underpin improved survival rates of paediatric cancer...

Childhood cancer is rare with an average of 1,600 new cases every year in the UK.¹ Around 1 in 500 children will develop cancer by 14 years of age. The cure rate is currently over three quarters, having risen from less than a third in the 1970s. As a result the number of adult survivors of childhood cancer in the population is approaching 1 in 1000, and will continue to increase. The types of cancer seen in children are different to those seen in adults. A third are acute leukaemias/lymphomas with brain tumours comprising a quarter. Bone and kidney tumours each represent around 5% of the total. Children do not get lung, breast or bowel cancer.

There are several factors that have contributed to the dramatic improvement in outcome for children with cancer. Young children are perceived as less hardy than adults. Actually, the opposite is generally the case beyond the first few months of life. Children are programmed to grow and develop and so they have a much higher capacity than adults to endure and repair physical damage. This means that they can tolerate relatively much higher doses of toxic therapy. In practice this results in their cancer being exposed to a much greater dose intensity of chemotherapy and radiotherapy, leading to enhanced responses. Unfortunately, however, there is often collateral damage that does not immediately manifest itself. Very effective chemotherapeutic agents that cause severe, but tolerable, acute side effects can also unintentionally cause chronic low level heart, lung, kidney and nerve damage that only causes problems in later life. There is also the risk of developing a treatment related "second malignancy." Although cured, survivors need to be aware of any potential problems they may encounter in the later decades of their lives as a result of their treatment.

Another critical factor relates to the organisation of specialist services. Across the developed world childhood cancer services are concentrated in specialist units. In the UK there is a network of paediatric specialists (Children's Cancer & Leukaemia Group) working across 21 tertiary hospitals that oversee children's treatment with coordinated input from local hospitals where appropriate. This concentration of expertise and highly proficient networking has ensured sharing of experience and the organisation of effective treatments at both national and international levels. Survival rates are also increasing in teenagers. Their cause has been successfully promoted over the last 25 years in the UK by the Teenage Cancer Trust charity. It has raised funds to build and equip 28 specialist units across the country and fund 27 specialist nurses and 23 youth support workers.

Research continues to underpin improved survival rates. Laboratory based studies have revealed the underlying molecular defects in the majority of childhood cancers allowing the exploration of novel targeted therapies. Clinical trials have increased our understanding of how best to use available and new modalities and the importance of improved supportive care. Whilst it has been difficult to involve children in very early testing of new drugs (Phase 1) it is relatively straightforward to design protocols where the "best first line treatment so far" is modified in a variety of ways which are then studied in the context of a randomised trial (Phase 3). In the extensive sequential series of Medical Research Council UKALL trials for acute leukaemia, the vast majority of modifications have lead to better survival. Importantly, within these trials it has been possible to identify early on those children who need more treatment to prevent their disease from relapsing. Across the board the success



of clinical trials has depended on the continued advances in the accuracy of laboratory diagnostic techniques and the availability of increasingly sophisticated imaging procedures.

Genetic mutations causing abnormal signalling pathway behaviours in cancer cells are becoming increasingly recognised. Once such anomalies are characterised it becomes possible to design targeted inhibitors or blocking monoclonal antibodies. Although in their early stages these targeted therapies are producing very exciting results. Undoubtedly this strategy will increasingly become the basis for cancer treatment, rather than the blanket poisoning of over-active cells with relatively nonspecific chemotherapy. Radiotherapy remains a critical modality in many situations. The increased availability of more sophisticated techniques such as proton beam therapy will contribute to better outcomes. It is critical that drug companies and civil regulatory bodies ensure that novel therapies are developed and made available to treat children in a timely fashion.

Whilst most childhood cancer cannot be prevented, it is recognised that survival is influenced by the stage at which the diagnosis is made. So alongside

research it is important to promote awareness of the early warning signs of the various childhood cancers amongst the general community and primary carers. Unfortunately, as it is rare and the early symptoms can be non-specific, diagnosis is often delayed. Whilst not ideal, it is understandable given the organisation of primary care services in the UK.

Finally, whilst it is rare, cancer is the most common cause of death in children between the ages of 1 and 15. It is expensive to treat but if it costs £70,000 to cure an infant of leukaemia who will then live into their 70s, it is a small price to pay of £1000 per year of life gained. ■

1 Cancer Research UK – <http://www.cancerresearchuk.org/health-professional/cancer-statistics/childrens-cancers>

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Cultural adaptation of depression prevention

CATCH-IT Intervention

Depression onset frequently occurs during adolescence and has a prevalence during one's lifetime of 25% in the United States. An early intervention for mental health in teens is needed; one that prevents the onset of major depression. However, this type of prevention intervention is hard to develop and implement. Dr. Benjamin Van Voorhees has spent over a decade developing a behavioral vaccine for primary care providers to use when caring for teens that are starting to develop symptoms of depression. He and his colleague, psychologist Dr. Tracy Gladstone, developed Competent Adulthood Transition with Cognitive Behavioral Humanistic and Interpersonal Training, or CATCH-IT. CATCH-IT was designed to be an internet-based intervention for teens that they could use on their own time to deal with their feelings of sadness, learn coping skills and set goals for themselves. The original CATCH-IT intervention was revised after a pilot study and was titled CATCH-IT 2. In that model, motivational interviewing was added to engage the adolescents in the Internet-based behavior change program. Van Voorhees, Gladstone and colleagues reported that, on a measure of depressed mood (CES-D), scores fell in both groups from baseline to twelve weeks with statistically significant reductions sustained out to 52 week follow-up. Similarly, Van Voorhees and colleagues found that adolescents in both groups demonstrated improvements in peer social support, declines in perceived



impairment of school performance, and improvements in ratings of motivation. The current version of CATCH-IT is freely available on-line and has a growing user base (<http://catchit-public.bsd.uchicago.edu>).

“While the need for a mental health intervention was found to be substantial in this population, the study was halted after the eleventh month due to limited recruitment and enrollment.”

Development of CURB

Half of African American and Latino teens who are in need of mental health services do not receive them, as compared to 30% of non-Latino white teens. Therefore, in order to address this disparity, specifically the need for preventive interventions for depressive disorders in racial and

ethnic minorities, Dr. Van Voorhees worked with his colleagues to develop an intervention for a culturally adapted, low-cost, primary care/Internet-based depression-prevention intervention called the Chicago Urban Resiliency Building, or CURB. CURB is culturally adapted for socio-economically disadvantaged African-American and Latino adolescents, developed according to Airhihenbuwa's (1995) PEN-3 model of health promotion. Starting with the belief that health behavior is anchored in a culture, the PEN-3 model has three interdependent concepts that influence health beliefs and behaviors. These factors are Person, Extended Family, Neighborhood; Perceptions, Enablers, and Nurturers; Positive, Existential and Negative. Each concept contains factors that should be considered about the culture of interest. Changes were applied to the intervention (CATCH-IT) in order to be more cultur-



Dr. Benjamin Van Voorhees

ally acceptable. Dr. Van Voorhees and colleagues launched the CURB clinical trial, for adolescents ages 13-17 that were recruited from primary care offices where they were screened for risk of future depression. Teens screening positive for depressed mood were assigned to either the CURB intervention group or the wait-list control group.

CURB was implemented in seven primary care clinics located in the metropolitan Chicago area that served racial/ethnic minority adolescents. While the need for a mental health intervention was found to be substantial in this population, the study was halted after the eleventh month due to limited recruitment and enrollment. In order to explain this disconnect between high need but

low enrollment, an evaluation of the intervention through community based participatory research was undertaken.

“An early intervention for mental health in teens is needed; one that prevents the onset of major depression. However, this type of prevention intervention is hard to develop and implement.”

Evaluation of Intervention through Community Based Participatory Research

In order to evaluate CURB, Dr. Van Voorhees and colleagues took a multidimensional approach to community based participatory research. In order to really understand the social processes at work, what was needed was for them to conduct mixed methods studies – both quantitative and qualitative. With funding from the Robert Wood Johnson Foundation, they looked at the perspective of the providers, the perspective of teens, as well as functioning of proxy group sessions with African American and Latino teens in community centers. By examining these perspectives – collecting qualitative data from these stakeholders, as well as quantitative measurement of the public health impact of the potential intervention – they have repositioned a future CURB intervention that reflects the community’s needs and perceptions. The team interviewed nurses and doctors at the clinics where CURB had been implemented to understand the

barriers to conducting the study. The team also conducted nine focus groups with African American and Latino teens to discuss how they would prefer to see a mental health intervention and what would be important to them in the intervention. The research team also examined the potential public health impact of the study on the clinics’ population, taking into account the hardship of the neighborhood and the cohesion of the clinic staff on that impact. Only then will they be effective in fully developing, testing and implementing a more successful intervention.



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Highlighting ‘basic research’ for cancer treatment

Professor Paul Workman, Chief Executive of The Institute of Cancer Research, London outlines why ‘basic research’ is critical for understanding and treating cancer...

Cancer research often makes the biggest headlines at the point when it begins to benefit patients.

The Institute of Cancer Research (ICR), London, is very well known for this kind of ‘translational research’ – where we move new research ideas and approaches out of the laboratory and into the clinic for the first time. This in turn leads on to later-stage clinical research, where the benefit for people with cancer is eventually demonstrated in larger trials.

But in order to come up with innovative approaches to cancer treatment, we need first to have made exciting new scientific discoveries that illuminate our understanding of the molecular basis of cancer.

First understand – then translate

This earlier stage of research goes by a number of names – basic research, fundamental research, discovery research, exploratory research, or sometimes ‘pure’ or ‘blue skies’ research.

Basic research generates and tests new ideas, principles and theories about the world. The research findings can often be surprising and unexpected.

Fundamental cancer research is crucial because it leads to incremental and sometimes spectacular advances in our understanding of the molecular basis of malignant disease – explaining how tumours grow, invade, spread and evolve.

Here at the ICR, we have always believed that to defeat cancer it’s essential that we carry out basic research on this disease in tandem with translational and clinical research. What’s more, we believe that all

of our research needs to be integrated closely with the care of cancer patients.

This is why the ICR’s partnership with The Royal Marsden hospital is so important. By embedding our basic, translational and clinical research with the care of cancer patients we can ensure not only that the earlier-stage research is connected and channelled to clinical need, but also that we achieve the most rapid possible progression of new ideas and treatments into routine clinical practice.

Basic, translational and clinical research at the ICR

Proof of the importance of basic cancer research discoveries can be found in the ICR’s history.

In the early 1960s, here at the ICR we provided the first conclusive evidence that the basic cause of cancer is damage to our DNA. It was a discovery that changed scientific opinion dramatically – since up until that point, proteins had widely been thought to be the site of action for cancer-causing chemicals.

This paradigm shift paved the way for the ICR and others to discover, at first one by one, the particular genes that undergo cancer-causing changes in their DNA code, and ultimately to understand their mechanisms of action – such as many genes that increase the risk of cancers that run in families.

It was an ICR team that discovered the BRCA2 gene – mutations in which dramatically increase the risk of developing breast cancer, and of several other cancer types.

As a result, families with a history of breast, ovarian

and prostate cancer can now be assessed for future risk, and where necessary offered preventative measures or close monitoring. And the ICR's Professor Alan Ashworth and colleagues then built on the discovery of the gene by devising a brand new approach for treating women with inherited BRCA mutations – by using a new type of drugs called PARP inhibitors that specifically kill cancer cells with these BRCA defects.

“This earlier stage of research goes by a number of names – basic research, fundamental research, discovery research, exploratory research, or sometimes ‘pure’ or ‘blue skies’ research.”

We also played a major role in uncovering the role played by mutations in the BRAF gene in cancers such as malignant melanoma. It was that discovery which allowed others to make drugs to block faulty versions of BRAF, giving us the new cancer drugs vemurafenib and dabrafenib. These were the first drugs in decades to be approved for lethal melanoma, and have both been recommended for use on the NHS by NICE. Other research originating at the ICR has produced new panRAF drugs that could be even more effective.

It was researchers at the ICR too who first made the basic discovery that explained the function of a then poorly understood organ called the thymus – and its critical role in the immune system. That discovery underpinned all of modern immunology, and paved the way for the breakthrough immunotherapies which are now, 50 years later, producing such powerful anti-cancer effects in cancer patients.

The ICR's basic research has also played a leading role in meeting what I believe to be the biggest challenge we face in treating cancer today – the genetic diversity of tumours, and their ability to become drug resistant.

The problem is that cancers evolve and develop resistance to treatment in a kind of Darwinian survival of the fittest – which I like to describe as the ‘survival of the nastiest’.

One of the ICR's leading scientists, Professor Mel Greaves, was a pioneer in what is known as ‘clonal

evolution’ in cancer. This basic research provided a fundamentally new insight that changes the way we think about how cancers develop and behave, and is now beginning to shape the way we design and implement new treatments.

Research culture

From the beginning of my career, I have always sought to bridge basic and applied research and I find the interface between the two – and especially multidisciplinary team science – exciting and rewarding.

As Chief Executive and President of the ICR, a high priority for me is to foster an organisational culture which allows basic cancer research to thrive alongside the translational and clinical research that is essential to our mission.

It's true that basic research can be unpredictable – in the discoveries made, and in where they lead. That's in the nature of this kind of research. We can though make sure that the basic cancer research we do is integrated very effectively with the more applied work we carry out at the ICR.

We need to embrace the unpredictability of basic cancer research and continue to invest in it. Otherwise, we will deny ourselves the opportunities to make those unexpected scientific discoveries that can, eventually, have a huge impact on people with cancer.

Without basic cancer research we have nothing to translate to the clinic.

Finding the right balance and making everything connect is crucial for success. ■

This article is an edited form of a post which previously appeared on Professor Workman's 'The Drug Discoverer' blog at icr.ac.uk.

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Stem Cells and immunity

Stem cells, Chromosomal instability and Cancer

Life expectancy in the western world has been on the rise, leading to an upshift in median age that will continue in the next decades¹. As a consequence of population ageing, the incidence of ageing-related ailments has escalated; not only degenerative diseases such as Parkinson or Alzheimer, but also the number of people affected by cancers has risen drastically. Notwithstanding its impact on society, the underlying mechanisms are still not completely understood, translating into relatively coarse and unspecific cancer treatments. Only in the last few years has the treatment of some forms of cancer evolved into a more guided approach, and years of investigation will still be needed to design intelligent treatments for a wide variety of cancers.

Stem cell biology of cancer

Stem cells have a central role in most if not all ageing-related ailments. In most of the diseases studied, the depletion of stem cells and reduction of their proliferative capacity seems to be the main cause of tissue degeneration. In cancer, however, excess growth is the central underlying mechanism. The role of stem cells in tissue homeostasis depends on the equilibrium between differentiation and self-renewal. Whereas stem cell differentiation into more specialised cell types is the mechanism that produces the somatic tissues, self-renewal assures the maintenance of an undifferentiated cell population that maintains a

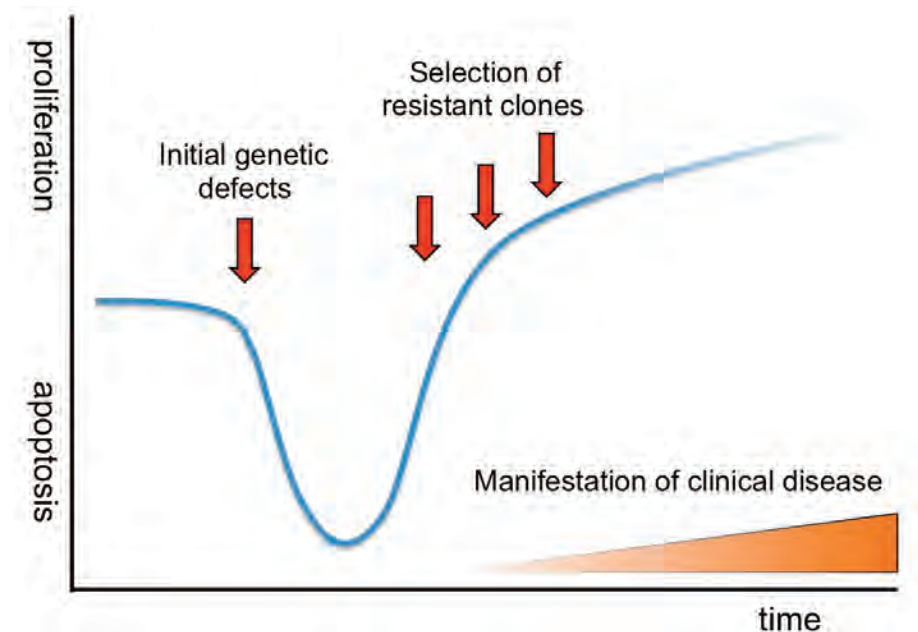


Figure 1: Stem cell depletion and cancer. Whereas the majority of ageing stem cells will enter senescence or apoptosis upon accumulation of genetic defects, a small proportion might survive and evolve into the rapidly dividing resistant population that causes cancer

proliferative capacity. In cancer, the equilibrium between differentiation and self-renewal is disturbed, provoking the accumulation of a population of poorly differentiated but highly proliferative cells.

The identification of a stem cell population at the heart of tumor growth² comprises yet another link between ageing and cancer; the role of stem cells in cancer is just as important as in degenerative diseases. Whereas stem cell depletion and their uncontrolled growth appear unrelated phenomena, they are in fact closely related; whereas a proportion of stem cells are lost during ageing, the

surviving stem cells have an increased chance of chromosome alterations.

Chromosomal Instability (CIN)

A key difference between healthy, normal stem cells and tumor cells is the acquisition of genomic alterations by the latter. Most carcinomas present some form of genetic instability, either as an accumulation of intragenic mutations or as a large-scale alterations – translocations, deletions and numerical changes – termed chromosomal instability (CIN). Although the hypothesis that CIN itself can cause cancer has taken a long time before being accepted, CIN is frequently detected in tumors before intragenic

mutations and thus comprises a driving force in carcinogenesis³. Current theories suggest that CIN can induce cellular transformation through gene dosage or gene translocation; the genome fragments gained or lost in CIN frequently contain hundreds of genes, each of which can affect a pathway regulation step. The extra copies of many genes in CIN cause a gross imbalance in cellular regulation, which easily spills over into other pathways including cell cycle control⁴. Pathway interconnectedness thus appears to be the Achilles' heel of genomic stability in mammals.

Stem cells, CIN, and cancer therapy

Because of their unique role in tissue renewal, stem cells have a combination of characteristics that renders them susceptible to genetic damage, transformation, and tumor initiation. Stem cells not only undergo rapid growth and division, but also seem to be tolerant for gene dosage effects that would induce apoptosis in other cell types. Notwithstanding their resistance, cancer stem cell theory clearly indicates that this population must be targeted to treat carcinomas efficiently.

Traditional anticancer therapy depends on tumor cell eradication by cytotoxic drugs, through the induction of additional chromosome defects that lead to apoptosis or necrosis. Although the efficacy of the classical cancer treatments has advanced tremendously, they still suffer from side effects, such as the shutdown of stem cells in skin, intestine, and immune system. Thus, a drawback of many

chemotherapeutics is the low capacity to distinguish between cancer cells and rapidly dividing non-cancer cells. In addition, most of the chemotherapeutic compounds favor selection of resistant and aggressive cancer cells.

The last decade has seen the development of new therapies, aimed at a more specific elimination of cancer cells while reducing toxic effects. One phenomenon in particular, oncogene addiction, might yield novel targets for anticancer therapies⁵. In oncogene addiction, the cancer's need for survival leads to activation of the corresponding signal pathways, to an extent where cells become completely dependent. Oncogene addiction has been characterised in only a few types of cancer so far, but preliminary results are promising. Oncogene addiction seems to increase with tumor progression, so targeting survival pathways might be the way to treat advanced cancer, where classical therapies lose efficiency. For example, the high level expression of HER that characterises the most aggressive forms of breast cancer is exploited for treatment with the neutralising antibody Herceptin®, improving the prognosis of HER-positive tumors. Novel targets in signaling pathways must be seen as an addition to classical therapies for now, but further characterisation of pathways might help to treat a wide range of cancers. Especially the targets that overlap with stemness and differentiation are interesting, for the possibility to attack cancer stem cells.

Concluding remarks

The fundamental way in which cancer is treated is just recently being mod-

ernised. New therapies will hopefully be able to discriminate better between cancer cells and healthy stem cells, and be tolerated better by the patient than current treatment schedules. The combination of data from stem cell biology, tumor evolution, and genetic analysis of patient material has greatly improved our understanding of cancer biology. Still, continued efforts are needed to use this knowledge for the benefit of cancer patients.

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Cancer research in Norway

Cancer research has come a long way over the years, here Adjacent Government highlights how in Norway they are making it their top priority...

Over the last 10 years in Norway life sciences and medical research has come a long way, with researchers being able to tackle some of the major healthcare challenges.

In 2012, [The Norwegian Cancer Society](#) reported that there were 30,099 new cases of cancer, with prostate, breast, lung and colon being the most common burdens; these accounted for 45% of total cases. Almost half of cancers in Norway are diagnosed in people aged 70 or over, and roughly 2 out of 3 patients are alive 5 years after being diagnosed.

The Research Council of Norway has funded cancer research through a variety of schemes. Introducing the [Strategic Initiative on Cancer Research](#) in 2000, the Council understands that research is one of the primary tools to combat cancer, aiming for improved prevention, diagnosis and treatment.

Through this initiative the Research Council aims to focus on clinical research, with an aim of giving patients the opportunity to live longer and healthy lives cancer free.

In 2013 the Norwegian government launched their National Cancer Strategy 2013 – 2017, [Together – against cancer](#). Through the strategy the government and the Ministry of Health and Care Services aim to establish a higher level of cancer care in the country.

At the time of launching the Strategy, Former Minister for Health and Care Services, Jonas Hagr Store said: "Cancer challenges us all in various ways. Even though treatment has improved and an increasing number of patients survive cancer, the number of individuals affected is also increasing.

"Cancer is not one, but many different diseases. One of the greatest challenges faced by cancer care

is therefore the development of more targeted and personalised cancer treatment, adapted to the specific type of cancer and the individual's qualities, opportunities and needs."

In order to develop more targeted treatments, research must play a key role. In [October this year](#), Director General for the Research Council of Norway Avrid Hallen said: "In the national budget proposal for 2016, the government is giving research and innovation a more important role than ever in the restructuring of the Norwegian economy.

"Given the current economic situation, it is both correct and necessary to strengthen industry-orientated research, long-term basic research and mobilisation for participation in EU research programmes, as the government is now doing."

Funding from the Research Council is integral to support and boost areas such as cancer research. They reported that the budget proposal recommends an increase of NOK 25 million for the support scheme for laboratories and equipment.

"The investment in world-leading research groups will make it possible to bring to fruition top-quality work led by our best researchers. This will enable Norway to cultivate a greater number of internationally leading research groups that can distinguish themselves on the research front," said Mr Hallen. ■

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Improved cancer care: Integrating palliative care and oncology

Norwegian cancer researchers launch a project to improve care for cancer patients with limited life expectancy

Europe has about 3.5 million new cancer cases per year, and the number is rising. Advances in treatment options have led to more patients getting cured and prolonged survival for those with incurable disease. However, a major concern in cancer care is the rapidly increasing complexity of treatment, which leads to escalating costs threatening the sustainability of the services. One important contributor to this scenario is the increasing use of chemotherapy during the patient's last year of life – often without documented efficacy. Patients receiving intensive oncologic treatment during their final months or weeks have a poorer quality of life than those who receive symptom-directed treatment. Indeed, recent studies show that introducing a palliative care approach at an early stage in patients with incurable disease may improve their quality of life and even prolong survival.



PALLiON

In 2014, Norway's four Regional Health Authorities announced a call for cross-regional research projects to strengthen

clinical research and health services research. The program was administered through the Research Council of Norway, and cancer research was one of the prioritized areas.

Against the backdrop described above, leading researchers in oncology and palliative care submitted a proposal to test the efficacy of an intervention integrating oncology and palliative care services for cancer patients with a life expectancy of less than one year – PALLiON. The proposal was highly ranked and received €3 million (25 million NOK) funding for a five-year project. PALLiON was the only cancer-related study to be funded within this call.

Collaborative effort

PALLiON is designed as a national, multi-centre, cluster-randomized trial. This means that the intervention is performed at an institutional level, with six hospitals forming the 'active cluster' in which the intervention takes place. Six matching hospitals constitute the 'control cluster'. The 12 hospitals have been recruited from all health care regions in Norway and range from small, local hospitals to large university clinics. A total of 550 patients who are receiving chemotherapy and have a life expectancy of less than one year will be included in the study.

PALLiON will be coordinated from Oslo University Hospital, with Professor Jon Håvard Loge as Principal Investigator. The Project Management group has members from the University Hospitals in Bergen, Trondheim, and Oslo, supported by a distinguished international reference group.

"...a major concern in cancer care is the rapidly increasing complexity of treatment, which leads to escalating costs threatening the sustainability of the services."

Complex intervention

The intervention to be tested in the PALLiON study consists of three parts: Systematic electronic assessment of symptoms, implementation of an integrated care pathway, and an educational program for oncologists and palliative care physicians.

Pain, fatigue, loss of appetite and other distressing symptoms are common in patients with advanced cancer. Lack of a systematic assessment has been identified as one of the barriers to effective symptom control. In PALLiON, symptoms will be frequently and systematically assessed by means of EIR, a computer program developed at the European Palliative Care Research Centre (PRC) at the Norwegian University of Science and Technology in Trondheim.



PALLiON central project group. Back row, from left: Professor Per Grøttum, Head of Technical Transfer Eivind Andersen, Professor Nina Aass (hidden), Director, Professor Stein Kaasa, Postdoc Tonje Lundebj, Professor Arnstein Finset, Principal Investigator, Professor Jon Håvard Loge, Research Nurse Signe Danielsen. Front row: Project Administrator Torunn Wester, Professor Dagny Faksvåg Haugen, Postdoc Kjersti S. Grotmol, Professor Marianne Jensen Hjermsstad, PhD student Hilde Krogstad and Statistician Cinzia Brunelli. The participants represent Oncology, Palliative Medicine, Medical Informatics, Behavioural Sciences and Communication, Psychology, Medical Statistics and Oncology Nursing, and are affiliated with Oslo University Hospital and the University of Oslo, St Olavs Hospital, Trondheim University Hospital and the Norwegian University of Science and Technology, and Haukeland University Hospital and the University of Bergen.

The integrated care pathway gives an outline of the patient pathway, integrating oncologic treatment, palliative care and end-of-life care, and hospital as well as community care. The aim of the pathway is to promote early integration of the palliative care approach, and to reduce the variability in clinical practice.

The educational program is tailored to the other elements of the intervention, but puts the main emphasis on communication, prognostication and symptom management.

Project goals

Combined, the three elements of the intervention are expected to improve symptom management, improve quality of life for the patients and their families, and empower them to play

an active part in decision-making. We also hypothesize that the intervention will lead to reduced hospital stays and increased use of community-based care in the final months of life. The main outcome measure of the project will be the proportion of patients treated with chemotherapy in the last three months of life.

The detailed study protocol is under preparation. This also includes assessment of all study sites at baseline. A study organization has been set up at Oslo University Hospital, and interdisciplinary teams are working on the different elements of the intervention. Local study coordinators and groups are being established at all project sites.

Inclusion of patients will start in September 2016.



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Research at Oslo University Hospital in the field of Gynecologic cancer

Oslø University Hospital (OUS) is a big hospital formed by the merger of 4 hospitals. The State Hospital, the Norwegian Radium Hospital, Ullevaal Hospital and Aker Hospital. It serves as a local hospital for about 600,000 inhabitants and as a referral center for about 2.8 million people. As a big University center OUS is heavily dependent on research and development.

In the field of gynecologic oncology we are engaged in international clinical trials and in more basic research, but also in refinements of diagnostic and therapeutic procedures.

In the field of international clinical trials, our department has participated in some important studies on ovarian cancer. Standard treatment for ovarian cancer is surgery, if the patient is fit, followed by chemotherapy. The goal for surgery is to remove all visible tumor elements. The ICON7 trial showed a benefit of adding bevacizumab to chemotherapy for patients with a high risk of relapse. This group consisted of patients with residual tumor of 1 cm or more after surgery for ovarian cancer or stage 4. The patients received bevacizumab together with standard chemotherapy, followed by maintenance treatment with bevacizumab for a total treatment period of 12 months. For the high risk group, survival was prolonged by 4.8 months from 34.5 to 39.3 months. The length of the maintenance phase in the

ICON7 study was chosen somewhat arbitrarily. It is a question whether the maintenance phase should be extended until progression of the tumor. This is the basis for an ongoing study (OVAR17), for which we do not yet know the results. Another important study is the Calypso study on relapsed ovarian cancer resistant to standard carboplatin based chemotherapy. Patients were randomized to either chemotherapy or chemotherapy and bevacizumab. The treating physician could choose between 3 commonly used chemotherapies. This study showed a prolongation of the median time to relapse from 3.4 with chemo alone to 6.7 months with chemo and bevacizumab. Survival was somewhat, although not statistically significant, increased from 13.3 to 16.6 months. The addition of bevacizumab was very effective in treating ascites, which can be very troublesome for this group of patients.

Some 10-15% of patients with ovarian cancer have a defect in the BRCA genes. This defect is heritable. Our department offers free testing of the BRCA genes to all patients with ovarian cancer. In the case of a defect gene, the patient can then pass this information to her children. Knowledge about the status of the BRCA genes also has implications for the treatment of the patient. In a previous study (Lancet Oncol. 2014 Jul;15(8):852-61) it was shown that maintenance treatment with Olaparib (a PARP

inhibitor) prolonged the median time to progression by 6.9 months from 4.3 to 11.2 months in patients having a BRCA defect tumor. The patients received maintenance treatment with Olaparib after having chemotherapy for a relapse of ovarian cancer occurring 6 months or later after previous platinum based chemotherapy. We participated in studies on another PARP inhibitor to further evaluate the effect of these drugs after the initial treatment and after later relapse.

For families with a defect BRCA gene, this implies a considerable burden. The women in the family have to decide whether they want to test the status of their gene. In case of a defect gene they have to decide whether they prefer risk reducing surgery by removing the ovaries and fallopian tubes at the age of 35-40 years. The psychologic stress, effect on quality of life and also somatic side effects have been the topic for a recent PhD study from our department.

In the department for pathology at our hospital, Professor Ben Davidson and his colleagues have done a tremendous job by evaluating the importance of a number of genes for resistance to chemotherapy. Detailed knowledge about the biology of tumors is important for drug development. In some cases the treatment for each individual patient can also be guided by knowledge about the biology of the patient's tumor.



For some tumors, important signal pathways in the tumor are already known. In well differentiated serous ovarian cancer, the MEK pathway is such an example. We participate in a study to evaluate the effect on survival by blocking the MEK pathway.

Immunotherapy has become much in focus in recent years after the success first obtained in malignant melanoma and later on in other tumor forms. Studies in gynecologic cancer on checkpoint inhibitors have just started. Our department participates in a couple of phase II studies and a phase III study is in development.

In cervical cancer, the 5-year survival in Norway is about 78%. There are a number of reasons for this high survival rate such as the effect of screening on stage distribution, living conditions and the quality of health

care. In our department, we have used a lot of resources in research and development on treatment aspects of cervical cancer. The delineation of the tumor and metastases is important for good treatment planning. We use DCE-MRI routinely for this purpose. It has for some time been well known that hypoxia in the tumor decreases the susceptibility to radiation. Detection of hypoxic tumors or hypoxic parts in the tumor might therefore be of clinical relevance by either increasing the dose of radiation to these parts of the tumor or by administering some drug that could increase the sensitivity to radiation of these hypoxic tumor cells. Researchers in our institution have found that, by texture analysis of pictures obtained by DCE-MRI, they could predict the outcome for the patient. Other researchers have worked on the importance of genes and their expres-

sion in cervical cancer. They have developed and validated a gene list identifying hypoxic tumors. This list has been compared to the findings by texture analysis of DCE-MRI and they fit together. This can be used to select patients for studies on the effect of drugs with special effect on hypoxic cells given alongside radiotherapy.



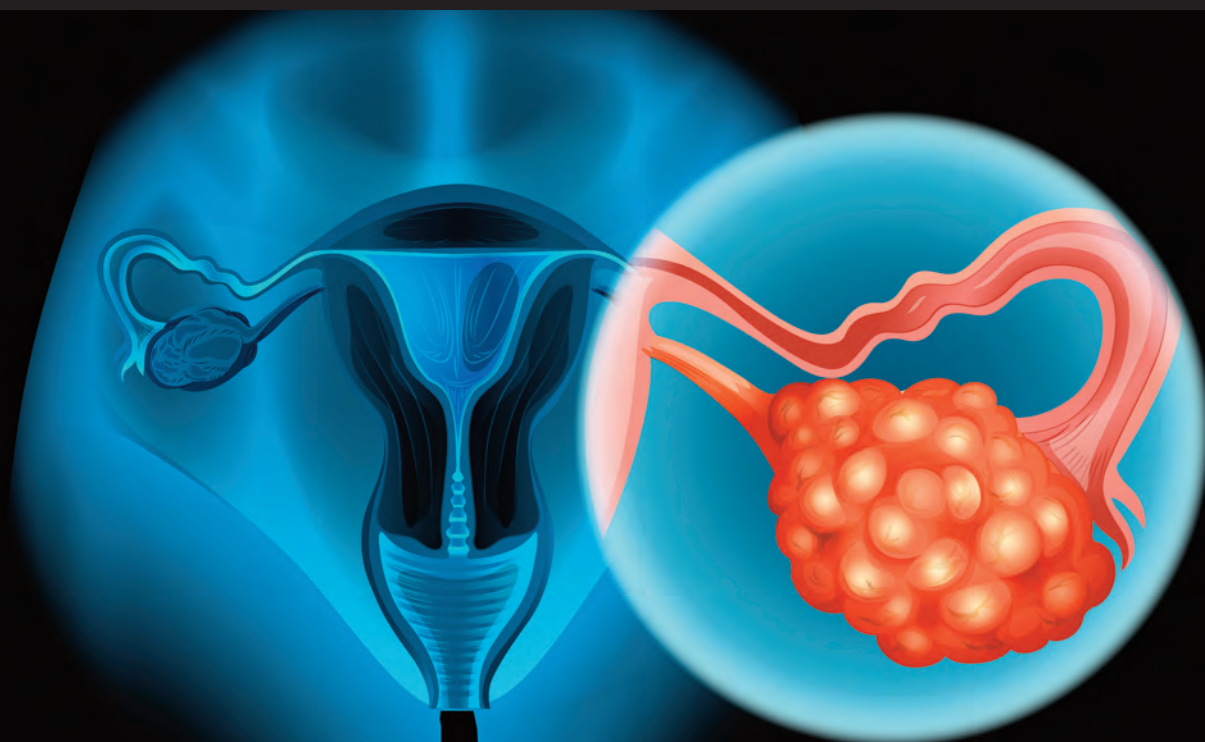
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Gynaecological cancers

– prevention and early detection

Murat Gultekin, Vice-President of the European Society of Gynaecological Oncology (ESGO) highlights the importance of early detection of gynaecological cancers for prevention...

According to World Cancer Report 2014 (IARC), at least one third of cancers are preventable. This is true for gynaecological cancers, especially cervical cancer. However, less than 5% of the whole cancer control budget in the EU is spared for prevention. A great majority of the total budget is still spent on treatment of cancer and only 25 of the 28 EU member states have a strategic cancer control plan.

Based on the UN General Assembly Resolution in 2011, cancer control and prevention will be the main focus for all countries within the next decade. New data estimates that the \$18bn increase in funding per year by the international community could result in a 30% reduction in cancer deaths in low and middle-income countries by 2030.

In this respect scientific and non-scientific societies including ESGO have initiated new awareness campaigns. ESGO is the principal European society

of gynaecological oncology contributing to the study, prevention and treatment of gynecological cancer which also organises state of the art symposiums to upgrade the knowledge and skills about the highlighted topics, via the world's most famous experts. In order to lead in several gynaecological cancers prevention, ESGO has decided to organise a 2016 symposium focusing on the prevention of gynaecological cancers, with specialised lectures on primary, secondary and tertiary prevention of cervical, endometrial, breast and ovarian cancers. In addition to the up to date scientific reviews, this meeting will also give an opportunity to reach and train all relevant groups such as cancer patients, their relatives and the young generation of European doctors. With almost 30 worldwide famous scientists, lecturers and 500 attendees from all around Europe and the Middle East Region, the 2016 ESGO State of Art Symposium-Antalya/Turkey will be a trademark and a cornerstone on gynecological cancer prevention strategies.

Cervical Cancer

Cervical cancer is the 4th most common cancer of women around the world. Although it is a preventable, 2 women every 1 hour in the European Union, currently lose their lives because of this type of cancer.

HPV is the main causative agent of cervical cancers and more than 70% of these cancers are related to HPV type 16 and 18. This is important because it means that a great majority of these cancers can be prevented via HPV vaccination and cancer related deaths can be avoided by early diagnosis through screening.

HPV Vaccination

Cervical cancer can be prevented and this can begin from childhood. We can save our children’s lives by vaccinating our children and avoid at least 3 out of 4 deaths by an effective HPV vaccination. These vaccinations are FDA approved, effective and safe vaccines, against to known oncogenic HPV types. Unlike most other vaccines, which are administered to children under the age of 5, HPV vaccines are inoculated to girls aged 9 to 13.

In contrast with the fact that HPV vaccines can prevent every 4 of 5 deaths from the cervical cancer and don’t have serious side effects, vaccination rates are still low around the world. According to VAERS (Vaccine Adverse Event Reporting System) about 92% of the side effect reports were classified as non-serious. The most common side effects are; injection problems, fever, headache, nausea and muscle or joint pain. Despite speculations the vaccine was found to not have any relation to a risk of multiple sclerosis in many scientific studies.

Screening

Besides prevention, early detection by screening still remains important. Population based, effective and well-designed screening programs should be the goal of achievement for all countries in a view of public health. In addition to the ongoing cytology programs, countries have many different screening strategies such as VIA/ VILI/ HPV DNA or a combination of all. Recent evidence shows HPV DNA can be safely used alone for cervical cancer, with its high scientific value and scientifically proven success.

Uterine Cancer

The most common type of uterine corpus cancer is

endometrial cancer, which is the 5th most common cancer of women in the world. It is mostly symptomatic and could be easily diagnosed and totally curable at early stages. It is generally seen after the menopause with only 5% of the cases under 40 years of age. Most of these cancers are related to obesity and high estrogen exposure. There aren’t any feasible and acceptable screening methods for endometrial cancer, however it is important to be aware of the fact that any postmenopausal bleeding may be an early sign of it.

Ovarian Cancer

Ovarian cancer is the 7th most common cancer among women in the world and it is the most deadly gynecologic cancer. Although there are not any adoptable screening methods for this cancer at a community level, it is curable if diagnosed in the early stages. It is important to raise public awareness about the symptoms of ovarian cancer so it can be detected earlier. There is also a genetic proportion of this cancer but only 10% of ovarian cancer cases have this liability. Women who have a family history of ovarian, endometrial or colorectal cancer could be screened for genetic predisposition and be prevented by some measures. There are many studies on ovarian cancer which may lead screening and early diagnosis or new treatment options.

Conclusion

More than 70% of gynecological cancers can be prevented and the harm caused by them can be reduced by several measures such as screening and vaccination programs. It is important to be aware of first the importance of prevention then the importance of early diagnosis.

In conclusion; “Raising Awareness” should be our first as this is the most important initial point for saving more people’s life. ■

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Flying the flag for cancer research

Adjacent Government highlights the efforts made by the Welsh Government to improve cancer care and research throughout the country...

Due to an ageing population, the demand for cancer care is ever increasing. In Wales, cancer is one of the two biggest causes of premature death, which is why tackling the disease is a top priority for the Welsh government. In 2014 ¹ they reported that the nation was spending more on cancer care, than ever before.

Figures revealed by the government highlighted that the total spend on cancer care had increased from £356.8m in 2011-12, to £360.9m for the year 2012-13. At the time, Minister for Health and Social Services Mark Drakeford said that the investment was made in clinically effective cancer treatments, which have a proven evidence base.

Speaking about the figures back in 2014 ², Drakeford said: "I'm determined to ensure every patient in Wales gets the best quality care they need and deserve. These figures show we are now spending more than ever on cancer care in Wales.

"This demonstrates our absolute determination to invest in health services that deliver the very best outcomes for the people of Wales. This means investing in medicines which are proven to work. I have consistently rejected calls to establish a cancer drug fund in Wales. To do so would prioritise cancer over other life-threatening conditions and divert money away from medicines which are proven to work."

A new report [Together for Health – Cancer Delivery Plan](#) reveals that more people in Wales are surviving cancer, even though the number of people diagnosed has risen. Between 1995 and 2011 there believed to have been on average, around 16,400 new cases of cancer every year in Wales. By 2012 that had risen to more than 18,000. The report also revealed that among

people aged under 75, there was a 25% reduction in mortality rates between those same years. It also stated that since 1995, there has been a 17.5% improvement in the number of people alive one year after diagnosis and a 20.1% improvement in the 5 year survival rate.³

As one of the government's key aims is to reduce the incidence of cancer throughout the nation, improving services is integral to this. In February last year, Mark Drakeford spoke to Assembly Members ⁴ about his plans for improvements in cancer care.

"Cancer is about more than 'waiting times'," he said. "It is about people and their care. In our recent Cancer Patient Experience Survey, I was pleased to see that so many people rate their care highly."

Published in 2014, the Cancer Patient Experience Survey was run in partnership with Macmillan Cancer Support and asked patients to rate their experience and provide feedback on the care and treatment they have received. Over 7,000 cancer patients were surveyed for the report, and it highlighted areas of care which needed improvement.

"The clear message of the survey is the majority of people receive excellent care and support in a wide range of areas," said Drakeford.

"The survey did not just concentrate on medication or surgical procedures. It considered the whole journey faced by a person, starting when they are first given a diagnosis of cancer. I am pleased to report that 85% of people said they were always treated with respect and dignity by staff; 87% had confidence and trust in the doctors and nurses caring for them and 94% said they had enough privacy when being treated.

“I was very pleased to learn that Wales has the biggest increase in cancer survival rates in the UK. While our cancer survival improvement has been the best in the UK, we are still to reach the levels achieved in a number of other European countries. We need to continue to make progress here.”⁵

As well as cancer care and treatment, Wales is home to one of the UK’s leading centres for cancer research at Cardiff University. The university has recently joined up with a number of Chinese universities to work collaboratively in the field of medical research, particularly cancer research.

Research at the university has played a major collaborative role in a multi-disciplinary, international effort to understand the molecular basis, diagnosis, prevention and treatment of cancer. This has led to long-term survival rates in the UK doubling over the last 40 years.

Around £5m has been invested into the Cardiff University-Peking University Cancer Institute⁶, in order to support pre-clinical translational research. Through the Cardiff Cancer Collaborative, they hope to maximise the benefits to patients with 5 key areas of research strength:

- Tumour and environment;
- Drug discovery, development and delivery;
- Cancer immunology;
- Personalised cancer genetics (and other translational research);
- Clinical trials (and other clinical interventions).

The approach taken by the Cardiff Cancer Collaborative brings together all facets of cancer research activity in a united hub of expertise under a single strategy.



**Mark Drakeford,
Minister for
Health and Social
Services, Wales**

Further investments have been made, including £3m for the European Cancer Stem Cell Research Institute.

Wales continues to make strides in its aim to tackle cancer and play a central role in cancer research. They may only be a small nation, but they are certainly off to a great start. ■

1 <http://gov.wales/newsroom/healthandsocialcare/2014/140611cancer/?lang=en>
2 IBID
3 <http://gov.wales/newsroom/healthandsocialcare/2015/150114cancer/?lang=en>
4 <http://gov.wales/about/cabinet/cabinetstatements/2014/cancer-services/?lang=en>
5 IBID
6 <http://www.cardiff.ac.uk/research/explore/research-topics/biomedical-and-life-sciences/cancer>

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China to the UK: Tackling cancer across borders

The China – United Kingdom Cancer (CUKC) Conference 2015 welcomed approximately 200 experts, including senior medics, scientists and scholars from world-leading, international institutions to discuss strategies to fight cancer. The two-day event invited presentations from leading scientists and clinicians on effective cancer prevention, early diagnosis, aggressive treatment and rehabilitation recovery in basic and translational research, clinical treatment and research transformation. The thought-provoking sessions provided delegates with an opportunity to listen to scientific breakthroughs, learn from knowledge exchange and debate current challenges in cancer research. The sessions were complemented by exhibitions from industry sponsors and a display of approximately 100 research posters, for scientific discussion.

The highly prestigious event was jointly hosted by Cardiff University, Peking University, Capital Medical University (CMU) and Yiling Group, together forming the Cardiff China Medical Research Collaborative (CCMRC). The conference opened with addresses from international keynote speakers including First Minister of Wales, Carwyn Jones, Cardiff University's President and Vice-Chancellor, Professor Colin Riordan, Peking University Cancer Hospital and Institute's President, Professor Jiafu Ji, Professor Xiaomin Wang, Vice-President, Capital Medical University (CMU) and Mr Shen Yang, Minister Counsellor for Education, Chinese Embassy in UK.



CUKC 2015 delegation at the National Museum, Cardiff

Speaking at the welcome address ceremony at the National Museum, Cardiff, First Minister of Wales Carwyn Jones said: "It is a delight to see the impact of partnership working across international borders where institutions are joined by a shared ambition and willingness to tackle cancer; this fits with our over-arching policy framework in Wales called 'together for health.' A diagnosis of cancer is a major event in the lives of increasing numbers of people. There has been considerable progress in cancer care in Wales over the past 12 months. Working together against cancer, we can do even more."

The conference's co-chairmen, Professor Lu, President of Capital Medical University and Professor Ji, President of Peking University Cancer Hospital and Institute expressed their views of the event: Professor Lu said: "CUKC facilitates and deepens the collaboration between China and the UK. The event provides a worldwide, influen-

tial academic platform for oncology research," with Professor Ji adding, "Cancer is a key health issue in China, UK and worldwide. This conference brings together like-minded experts to address these enormously resource-consuming challenges which are beyond any single institution or country's capacity."

Key outcomes from CUKC 2015

Research platforms

The new platforms are in addition to ongoing joint projects in gastric, colorectal and pancreatic cancer:

- Lung Cancer Platform between Peking University, CMU and other UK institutions. The collaboration was a direct result of the CUKC 2015 Lung Cancer session
- Liver Metastases Platform between Cardiff, Oxford and Liverpool University, Peking University, CMU and Teaching Hospitals in China



Carwyn Jones, First Minister of Wales, during the Welcome address

- Ovarian Cancer Platform between Cardiff University, Peking University, Chongqing University. This platform will complement the existing relationship between the institutions and strengthen the China/Wales link
- Brain Tumour Platform. This was identified as a new priority and a framework is being drafted

Education

CUKC 2015's poster display provided a developmental opportunity for the next generation of researchers. Scholars and scientists were welcomed to submit their abstracts for poster consideration and present over the two days.¹ Honorary Chair of the Scientific Committee, and Nobel Prize Laureate Sir Martin Evans said, "It is wonderful to see the outstanding quality of the posters exhibited."

Innovation

Yiling Group are in the final stages of licensing Cardiff University's cancer technology which will lead to further opportunities in the future.

International engagement

CUKC 2015 also provided an opportunity to reflect on the collaborations

successes to date, specifically the exchange of scholars and students which has accelerated since the launch of CCMRC in 2014.

CCMRC, which is based in Cardiff University's School of Medicine, represents an internationally renowned cancer research team. The vibrant research community has supported a number of projects, resulting in the creation of several spinout companies. As well as providing opportunities for research, CCMRC supports the educational development of junior researchers and academics, including undergraduate and postgraduate students and clinical fellows, through teaching activities, research studentships and clinical fellowships. The collaboration enables the four partners to undertake large-scale research, education and trials in cancer and in other areas of medicine. Over the past year, awards have included: China-UK Cancer Research International Collaboration Base (Beijing) with CMU, Key Laboratories of Cancer Invasion and Metastasis with CMU, awarded by the Beijing Government and the successful award of Natural Science Foundation research grants with Peking University.

Director of CCMRC, Professor Wen G. Jiang, said: "CUKC 2015 showcased past successes and refocused future priorities. The attendance by senior officials and leaders in the field of cancer research shows the importance attached to cancer research across the world. We will continue to expand our links with China and look forward to expanding the exchange programmes in 2016."

CUKC 2016 will be held in the Beijing National Convention Centre from the 13th-15th May. The four partners will continue to fight cancer together through the international collaborative.

¹ Abstracts from the conference were published in the International Institute of Anticancer Research (IIAR), *Anticancer Research* July 2015 vol. 35 no. 7 4283-4369 and are also available on Highwire Press: <http://ar.iiarjournals.org/content/35/7/4283.full.pdf+html>

Written by Ceri Frayne, Executive Officer, Cardiff China Medical Research Collaborative (CCMRC), Cardiff University, and Professor Wen G. Jiang, Dean of International, Director Cardiff China Medical Research Collaborative (CCMRC), Cardiff University



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Innovation potential in the digital age

In a Speech at the conference ICT 2015 Innovate, Connect, Transform, Carlos Moedas, EU Commissioner for Research, Science and Innovation outlines how embracing digitalisation can help drive forward innovation...

Kept indoors during the French revolutionary years – and in search of a worthwhile distraction – a young Parisian called Sophie Germain turned to studying her father's library. From intellectual works like Montucla's *Histoire des Mathématiques*, Sophie soon discovered a deep love and a remarkable talent for mathematics.

She even taught herself Latin to decipher the works of Newton and Euler.

As a woman, Sophie could not attend the new Paris Ecole Polytechnique, but thanks to an innovation in education, she was able to obtain lecture notes from various professors, working under the nom de plume of M. LeBlanc.

Through every barrier imaginable was thrown in her path, Sophie Germain succeeded through hard work and perseverance: educating herself, hiding her true identity and withstanding the social pressure to conform to traditional expectations.

What I take from her story is that there have always been barriers to thought and innovation, but those barriers can be overcome. By teaching herself, Sophie brought a fresh perspective to her field. She could see the solutions others couldn't and we can learn a great deal from her example, when breaking down the barriers to innovation in the 21st century.

The way I see it, we have reached an age of transition. The digital world can no longer be contained and we must adjust to a new reality!

So, I'm going to talk to you about 3 things:

- How digital processes are changing the way we do business;
- What we risk if we falter in adjusting to that change; and
- Why we really don't want to miss this opportunity to innovate better.

My first point is that, in this digital age, data and communication now underpin global trade and commerce and increasingly so.

The internet enables instant cross-border communication, so that everyone from tech entrepreneurs, to universities, to artists now has multiple entry points into global markets.

Today, someone's open-source software or mobile application can set a traditional market to zero overnight.

Today, every business is physical and every business is digital.

According to the McKinsey Global Institute's 2014 report on Global flows in a digital age, digital is exercising ever more influence on global GDP growth.

Digital technologies are not only changing how we do business, but creating entirely new kinds of business, whether improving services, making them more accessible, or digitalising them entirely.

So, you could say, the digital age is making market access more open and democratic, while speeding up



Carlos Moedas, EU Commissioner for Research, Science and Innovation

the movement of information goods and services at an exponential rate.

There is no way to slow this down.

In Accenture's Technology Vision 2015 survey, 60% of respondents said they plan to engage new digital partners within their respective industries over the next 2 years.

The transformation is already underway.

We have one choice, and that's to take advantage of this new way of thinking, working and innovating.

My second point is that we risk a great deal, if we become mere observers to the transition happening all around us.

Governments can no longer ignore the digital age and its implications for health, food, water and energy – 4 areas all vital to our immediate future.

The challenge for Europe is therefore to exert influence on digital markets. As long as the digital age brings with it simpler, more accessible, more affordable options to citizens and consumers, it will only gain momentum.

We must position ourselves to lead on solutions to the universal problems of the digital age before they are solved by someone else. Problems like record amounts of data, the cost of data storage, or keeping up with advances in data science to name a few.

If we fail to act, if we fail to adapt:

- We risk losing pace, while the rest of the world moves on;
- We risk our business models becoming obsolete; and
- We will be left vulnerable every time there's a new economic shock.

This brings me to my third point: why we really don't want to miss this opportunity to innovate better. Everyone – citizens, governments, companies – everyone, can now consider how they want to work and how they wish to collaborate.

Citizens can now engage in online democratic processes – from live-streaming political debate, to participating in public consultations. Consumers can now demand better service, by favouring digital business models that improve customer experience. Researchers and academics can tap into unprecedented

amounts of information and review their research results among a global community of peers and patients in a remote village can now consult a doctor at the tap of an app.

The possibilities are endless and they're already transforming our society. Digital is changing the process of innovation: from top-down to bottom-up – from the company to the citizen.

It's no exaggeration that our lives – virtually every aspect of our human experience – can be improved by connecting one human being to another. Digital is compelling openness and diversity in everything we do, and that's a recipe for better, higher kinds of innovation than we've aspired to before. Innovation based on European values.

As you know, the vision behind the Digital Single Market is to move from 28 markets to a single European one. A fully functional Digital Single Market could contribute as much as €415bn per year to our economy and create hundreds of thousands of new jobs.

In research, science and innovation, we're looking at these issues in light of my 3 priorities: Open Innovation, Open Science and Open to the World.

To name a few examples, we're working with member states to launch a European Open Science Agenda. We're considering the merits of developing a European Open Science Cloud. We're encouraging the removal of legal barriers to Open Science and Open Innovation – particularly regarding the use of Text and Data Mining (TDM) techniques for scientific activities and we're supporting the further digitisation of European industry, as well as merging the digital and the physical in our Horizon 2020 calls.

In this period of transition – in order to reach such a milestone as the Digital Single Market – my question to you is:

How do we go from observing the influence of the digital age, to experimenting with it, shaping it, making the most of it?

The answer cannot possibly come from politicians alone. It must evolve organically from your needs and aspirations. It must start with the vision citizens want for their future. Only then can we inform our policy and digital strategy in a lasting and effective way.

So I call on you to make your vision for the digital age in Europe known! Take a keen interest in how the Digital Single Market develops in the areas that matter most to you!

Finally, as I see it, there is an unmistakeable buzz and optimism surrounding digital enterprise in Europe. I could point to any number of new and exciting initiatives but, as a continent, we're still in our digital adolescence. We still have the luxury of choosing the direction we want to take. We still have plenty of room to grow.

If we capitalise on that buzz, on that energy, now, before the momentum passes, I believe we can achieve incredible things in Europe. We can mature into a digital continent! We can be a global force for a very European kind of digital innovation.

We're very lucky that we don't have to hide our candles, or teach ourselves Latin or hide our true identity like Sophie Germain.

We are all that stands our way.

So let's use Europe's unique perspective to see the solutions others can't. Let's research digital, invest in digital and skill-up in digital! Let's build momentum!

Today and not tomorrow. ■

This is a speech taken from the European Commission website:
http://europa.eu/rapid/press-release_SPEECH-15-5887_en.htm

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Carlos Moedas

**EU Commissioner for Research,
 Science and Innovation**

European Commission

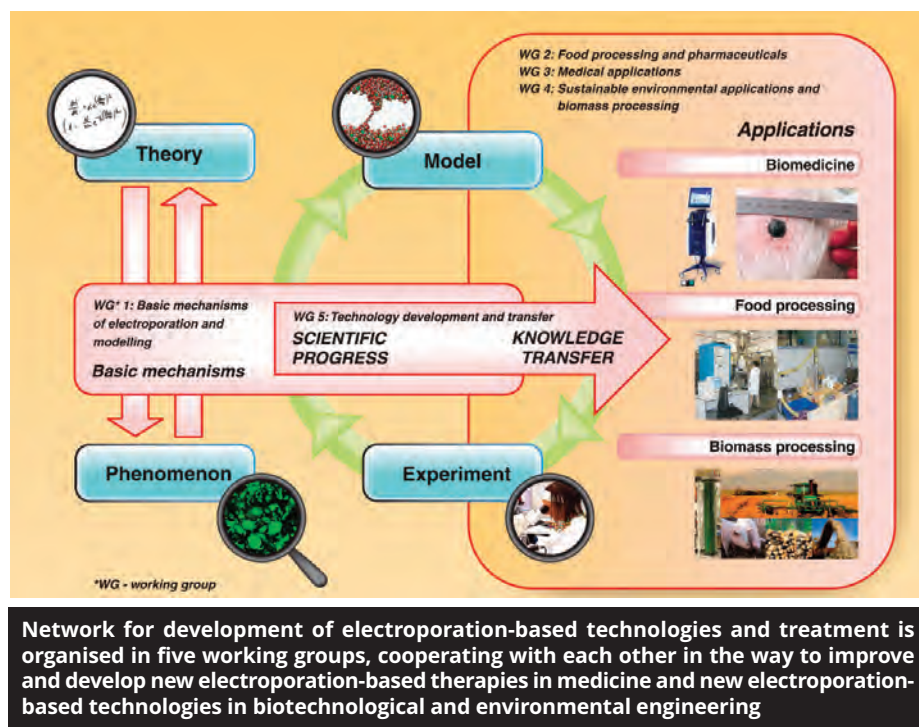
www.ec.europa.eu/commission/2014-2019/moedas_en

European network for development of electroporation-based technologies and treatments

A project within the European Cooperation in Science and Technology framework – COST Action TD1104 – was launched in 2012, with the aim of optimising existing electroporation-based technologies and treatments and exploring new applications in biology, medicine, pharmacy, food industry and environmental science.

The aim of the project COST TD1104 with acronym EP4Bio²Med is cooperation between researchers in the field of electroporation all over the world (see: www.electroporation.net). Establishing better communication links between research groups is important for increasing effectiveness of researches in the field of electroporation, which promotes faster adoption of electroporation-based technologies and treatments into the set of common and standardised practices of treatment and processing. “The goal of the project is to foster development of new and existing electroporation-based adoption. The project also facilitates coordination and interdisciplinary exchange of knowledge and know-how between researchers from different scientific fields and countries, from academic and industrial environment to final practitioners,” emphasises the chair of the COST Action TD1104, Prof. Dr. Damijan Miklavčič.

Currently, the COST Action TD1104 consortium connects 575 researchers



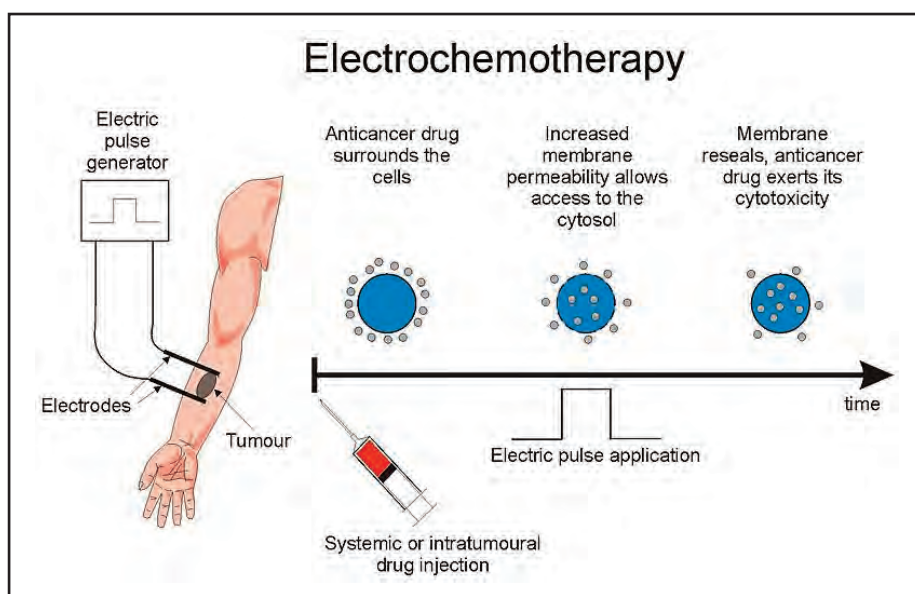
from 240 institutions and 27 companies from 43 countries, bringing together the world-class experts on electroporation, active in research and developing applications of electroporation across the industrial and scientific spectrum (e.g. tumor ablation, food processing, cryopreservation, wine production...).

The project and its members are organised in five working groups. Expected results of enhanced collaboration will contribute to improvement and invention of new electroporation-based therapies in medicine and new electroporation-based technologies in biotechnological and environmental engineering, leading to, among other, better

cancer and gene therapies, more economical processing of raw food materials, higher food safety, and responsible use of natural resources that will help protecting environment.

And what is electroporation all about?

In 1972, Neumann and Rosenheck reported first observations of transient permeability changes in the vesicle membranes as a consequence of vesicle exposure to an external electric field. The method was later termed electroporation. Electroporation can be controlled; when treated cells do not survive, the process is called irreversible electroporation and when cells survive, we use expression reversible electroporation.



Principle of electrochemotherapy. Non-permeant or poorly permeant anticancer drug with intracellular target, injected either systemically or intra-tumourally, surrounds tumour cells. Application of adequate electric pulses causes an increase in membrane permeability, which allows for the entrance of anticancer drug into the cells to exert its cytotoxic action (reperoduced from Dev, 1994)

Among the most known and promising electroporation-based applications is the use of irreversible electroporation in biotechnology for microbial deactivation in fresh, waste, sea or oilfield reinjection water as well as in food processing. In food processing irreversible electroporation (also referred to as PEF treatment) is used as a method of food pasteurisation and for improving extract quality as well as yield in extraction of valuable intracellular compounds.

Irreversible electroporation has proved effective in releasing proteins from bacteria, yeast and cells that contain complex structures enclosed within membranes. Thus it can extract DNA molecules from bacteria cells, with a yield comparable to that obtained by chemical extraction. Electroporation is also being used for extracting intracellular components from plants. It has been shown that the quantity and purity of extracted components can be greatly increased relative to those achieved using conventional methods. One of the most

promising industrial-scale applications is in sugar extraction from sugar beets. Electroporation has also been shown to be an energy-efficient drying method for green biomass, which serves as a source material for biofuel. Electroporation treatment prior to conventional pressing reduces the required drying energy by more than 50 %.

In medicine, irreversible electroporation can be used for non-thermal tissue ablation by means of irreversible electroporation, while reversible electroporation can be used for gene electrotransfer for gene therapy and DNA vaccination or in electrochemotherapy.

Electrochemotherapy is already well-established and among the most promising applications of reversible electroporation. Electrochemotherapy is a local antitumor treatment in which electric pulses are applied to the tumor after injection of a membrane-impermeant anticancer drug. The drug enters tumor cells after the pores have been formed on the mem-



Professor Damijan Miklavčič

brane and therefore kills tumor cells. The number of patients benefiting from electrochemotherapy is rapidly increasing as electrochemotherapy is used in more than 150 hospitals across Europe.

COST Action TD1104 is now in its 4th – final year and has organised in September the 1st World Congress on Electroporation in Portorož, Slovenia attended by 400 participants from 42 countries. The 2nd world congress is already announced for September 2017.

Prepared by Tina Stepišnik and Damijan Miklavčič, University of Ljubljana.



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Medical image analysis

On the bridge between the lab and the clinic...

Medical imaging plays a critical role for diagnosis, treatment planning and follow-up and also in biomedical research. Quantitative analysis of medical images, in addition to the traditional merely visual qualitative radiological interpretation, is rapidly gaining importance in view of the evolution towards a more personalised medicine based on detailed patient-specific patho-anatomical and physiological parameters that can be derived from the images. Due to the large amount of data and the complexity of 3D tomographic medical images acquired with a wide range of different modalities based on different physical principles (such as CT, MRI, PET, US...), there is a strong need for reliable semi-automated computer-aided analysis tools to support the efficient quantification and interpretation of imaging data in routine clinical practice.

Medical image analysis is an active field of inter-disciplinary research at the interface of biomedical and engineering sciences. Progress in this field is driven on the one hand by continuous advances in medical imaging technology, and on the other hand by new demands and challenges posed by novel clinical applications. Close collaboration between different disciplines is needed to optimally match clinical requirements with technological possibilities and to fully exploit the clinical potential offered by new research developments. Such inter-

disciplinary research thrives best within the setting of a multi-disciplinary research center embedded within the clinical environment of an academic hospital. Such setting allows for easy access to representative imaging data acquired with state-of-the-art imaging equipment and for intense interactions of engineers with clinical experts from different disciplines, which is critical for assuring the clinical relevance of the research. However, walking the line between more fundamental, long-term, strategic methodological research on the one hand and more practical, short-term, application-centered research is a continuous challenge for engineers working in such environment and the balance between both is also influenced by external factors such as funding opportunities.

During the last decade significant fundamental progress has been made in the field of medical image analysis, at least in the laboratory setting. One particular breakthrough is the development of fully automated procedures for multi-modality image registration. Image registration is the ability to spatially align multiple 3D images of the same patient, i.e. determining the coordinate mapping between two image volumes that matches anatomically identical points in these images. This mapping is in general unknown a priori, as such images are typically acquired in different imaging sessions, with different

scanners or at different time points, with each time a somewhat different positioning of the patient in the scanner, and hence usually needs to be recovered retrospectively from the image content itself. Such registration is implicitly performed by the human observer when visually inspecting the images, but this is only approximate and subjective, while computer-aided image quantification requires a formal, objective registration solution. Such solution is typically restricted to a globally rigid coordinate transformation in case local tissue deformations are absent or can be ignored, while a locally flexible, deformable ('non-rigid') registration is needed when local differences between both images have to be recovered as well.

Image registration is needed whenever information from multiple images has to be compared or fused and is therefore a ubiquitous problem in medical image analysis. Some typical applications include for instance: neurosurgery planning based on MRI and PET, providing both anatomical and functional information to define the target and a safe trajectory to the target; radiotherapy planning based on CT and MRI, with CT providing information on tissue density that is needed for computing the dose distribution, while MRI allows a better discrimination of soft tissues and hence a more accurate delineation of the target volume; analysis of dynamic image sequences, such as

fMRI, for which accurate prior registration is needed to compensate for subtle intermediate involuntary patient motion; follow-up of disease evolution (e.g. lesion load in MS) by repeated imaging at subsequent time points, whereby a 4D longitudinal analysis (3D+time) facilitates the detection of subtle changes over time after proper 3D spatial alignment of all individual images; or the assessment of the outcome of a surgical intervention or other treatment by comparing pre- and post-treatment images. Today, all these applications can be successfully tackled with one and the same method, based on maximisation of mutual information between the images, a concept from information theory, which is highly robust and can be applied fully automatically without pre-processing of the images, which is a great benefit for clinical use.

While initially a goal by itself to enable more accurate fusion of images of the same patient, image registration has evolved into a computational tool that is no longer restricted to images of the same subject, but is also being applied successfully to images of different subjects. As such, image registration plays a crucial role in neuro-imaging research, for instance to create atlas templates from brain images of a group of subjects that reflect the mean anatomical shape and the shape variability within the group. Such atlases can then be used for atlas-guided analysis of novel subjects, or to detect and characterise group-wise shape differences between different groups, e.g. healthy aging and Alzheimer's disease subjects. The use of standardised atlas templates facilitates the communication of neuro-imaging findings between

researchers by making reference to the same coordinate system.

“During the last decade significant fundamental progress has been made in the field of medical image analysis, at least in the laboratory setting. One particular breakthrough is the development of fully automated procedures for multi-modality image registration.”

Developing these methodological advances into robust tools that are sufficiently sophisticated for routine clinical use, introducing such tools in clinical practice and integrating them in the clinical work flow for multi-modality diagnosis and treatment planning in individual patients, remains a major challenge. Transfer of expertise is not easy in a multi-disciplinary research setting, where different partners have different views, interests, commitments and expectations and it is not clear who should take the lead. Moreover, academic funding is primarily directed at the more visible R of research rather than the less-fancy D of development. Involvement of industrial partners is not a guarantee for success either, as medical imaging is dominated by large multinationals, which often lack flexibility and openness and struggle with the legal issue of liability when using experimental lab-proof tools for medical decision support in clinical practice. Spin-off companies, targeting a particular application niche, are likely the most promising way to go to bridge the gap between the lab and the clinic. Such spin-offs, once established provide novel career opportunities for graduated post-docs, and are therefore in pole position to harvest new talent

and knowledge trained and generated by their academic founders, which is a win-win situation for both.

Prof. Frederik Maes is professor at medical image computing at KU Leuven, Dept. ESAT/PSI, and co-author of more than 150 peer-reviewed journal publications. His work on multimodality image registration is recognised as a standard in the field and has been commercialised by Radionics Inc for neuro-surgery planning. His research is supported in part through EU funded projects (such as Dr THERAPAT) and industry collaborations. His group is embedded within the Medical Imaging Research Center of the university hospital UZ Leuven of KU Leuven and has successfully created two spin-off companies, Medicim and icoMetrix.



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Chromatin and epigenetic changes the immune response

Histone modifications and chromatin remodelling are involved in regulating the immune response to different pathogens. A proper immune response is essential in combating viruses, bacteria and parasites that are harmful for us. We have several lines of defence; from the physical barrier of the skin to specific cells in the body. The innate system is an early response and is composed of several cell types; monocytes, macrophages and natural killer cells (NK cells). These cells react unspecifically to infectious viruses, bacteria or parasites and present these agents to the adaptive immune cells. T-cells and B-cells comprise the adaptive immune system and these cells recognise specific antigens of the infectious agents. These cells constitute the memory, developing specific memory cells that can quickly be stimulated upon a further infection. Several studies have now shown that a memory exists in the absence of T-cells and B-cells, trained immunity, but the mechanisms behind are not fully understood¹.

Several recent studies have shown that both the innate and the adaptive immune system change the epigenetic landscape in response to infections. The development of immune cells in the bone marrow involves a large epigenetic reprogramming. Depending on signal, the different cells in the immune cells develops and acquire the specific gene profile for the cell



lineage^{2, 3, 4, 5, 6}. High through-put transcriptome analyses, performed together with ChIP seq of histone modifications^{7, 8} and analyses of the global DNA methylation profile^{9, 10, 11}, has shown that the change in gene expression follows changes in the epigenetic landscape in the different cell lineages. In particular, cell type specific transcription factors and signalling pathway factors are regulated by histone modifications and DNA methylation.

The further response of different immune cells to infections also involves transcriptional and epigenetic responses^{12, 13}. In response to viral infections, not only genes regulating the immune response, such as cytokines and signalling factors, are modulated, but also genes involved in DNA methylation and histone modification changed, maybe to adjust cells to the new epigenetic state. Similar changes also occur upon the induction of inflammation processes in response

to infection, but also to non-infections stimuli, such as nutrients, stress and exercise. Inflammation is the host early response induced by innate immune cells, creating fever, swelling and pain. When the response goes wrong, inflammation can be harmful. Genes involved in the inflammatory response are particularly regulated and are marked by epigenetic mechanisms¹⁴.

The immune system protects us upon infections, but can also be the cause of diseases. Allergy is caused by the immune system overreacting and autoimmune diseases, such as rheumatism and MS, are caused by the immune cells starting to attack our own tissues. Autoimmunity together with chronic inflammatory response have now been linked to many diseases and disorders, and may be the underlying cause for yet many more.

The immune response differs slightly depending on the pathogen involved. Many pathogens have evolved ways to elude or inhibit the full response of the host. The immune system has particular difficulty when combating pathogens with a life cycle in several stages. One such pathogen is the Plasmodium parasite, which is the cause for malaria. Studies towards specific antigens produced by the parasite have been investigating specific responses. The biology of the mosquito^{15, 16} has also been studied and the immune response elicited to understand to many ways the Plasmodium parasite affects its hosts. Malaria affects mainly children, those that survive are less susceptible as adults, but no real immunity is obtained. There are, however, differences in response between individuals as well as populations,

most likely caused by genetic factors. One ethnic group in Africa, the Fulani, which has been extensively studied because of the resistance to malaria. The immune response upon infection in the Fulani has been studied and compared with the response in various other neighbouring ethnic groups. These studies have mainly been SNP analyses, investigating variations in genes coding for factors in the immune response. One such example is the SNP study performed between them and the Dogon people in Mali that found genetic differences¹⁷. However, these studies have so far not been able to fully explain the differences in response between ethnic groups in the sub-Saharan region. The relative resistance found in the Fulani group could therefore be explained by other factors. Interestingly, it was shown that miRNA also involved in the response to malaria and most likely other parasites¹⁸. Hence, we are interested in studying the underlying cause for the difference in immune response on another level; in epigenetic factors, such as differences in DNA methylation and histone modification profiles as well as in non-coding RNA levels. A further phenomenon of certain complex pathogens that needs to be explained is the lack of real immunity. Immune tolerance could be part of it, but not fully explain the lack of immunity. The memory of the innate immune system, trained immunity¹, could be involved in the finding that adult people living in exposed areas are less susceptible to malaria, a protection that is lost when leaving these areas.

To understand the human immune response to complex pathogens, and

how host and the pathogen interacts, can then shed light to other responses causing a variety of diseases, such as stress-induced immune responses, autoimmunity and chronic inflammation.

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Paleogenomics: understanding species evolution and adaptation from extinct ancestral genomes

Expert in palaeogenomics, Jérôme Salse is investigating how past evolutionary events have shaped agriculturally significant traits in plants and animals by analysing ancestral genome sequences.

Research topic:

- Understanding the evolution of modern living plant and animal species by analysing the genome of their extinct ancestors;
- Transferring genes behind key biological processes from model species to species of agricultural and medical interest for applied biotechnology.

Short CV:

1997: Engineering degree from the Graduate School of Agriculture (ESAP) at Toulouse (France).

2002: PhD from the University of Perpignan (France).

2003: Junior Scientist at INRA (France).

2009: Habilitation to Direct Research diploma (HDR) at Blaise-Pascal University (UBP) in Clermont-Ferrand (France).

Since 2010: Research director of the Paleogenomics & Evolution group (PaleoEVO) at the Genetics, Diversity and Ecophysiology of Cereals (GDEC, UMR 1095 INRA-Blaise Pascal University) research unit in the INRA Centre of Clermont-Ferrand (France).

Researchers from the Paleogenomics & Evolution (PaleoEVO) team at the INRA Clermont-Ferrand-Theix-Lyon



Centre are investigating past evolutionary events, including the widespread phenomenon of polyploidy (genome doubling), behind agriculturally important traits in plants and animals.

The field of paleogenomics

Advances in extraction and characterisation techniques have made it possible to isolate DNA from preserved biological remains; in the same manner advances in bioinformatics and mathematical methods made possible to reconstruct ancestral genomes when comparing genomes of different modern species, together given birth to an entirely new field – paleogenomics. By comparing DNA sequences, and even complete genomes, from ancient remains, in silico ancestral genomes to those of modern species, it is possible to understand the evolutionary processes that have shaped organisms alive today, including our own species. Paleogenomics, in investigating species evolution from the analysis of ancestral genomes, can then be performed through the complementary in silico approach as from ancient DNA sequencing.

Unravelling extinct ancestors

Back in 2010, a 'draft sequence' of the Neanderthal genome published using archeological remains demonstrated that this species is the closest known relative of Homo sapiens, it also helped to home in on when and where Homo sapiens first appeared – between 130,000 and 250,000 years ago in Africa. Since then paleogenomics analysis have been performed in animals with the sequence of ancient DNA from mammoth, horse, bear.

Since Dr Jérôme Salse's pioneer work in 2008 in comparing modern plant genomes, ancestral genomes have been reconstructed in silico based on mathematical methods aiming at modelling the ancestral genome of modern living species. Access to a variety of plant genome sequences has facilitated in silico archeogenomics, the reconstruction of founder genomes, which can be compared to modern genomes in order to model plant evolutionary history.

These unprecedented data have revealed the evolutionary forces behind present day plant genomes,

and shed new light on how they are organised and regulated. In addition to unveil the history of modern living species, the paleogenomics studies can also contribute direct benefits to society – with the potential to help scientists determine which genes underlie important traits in crops or cause disease in cattle. With extensive expertise in the study of ancient genomes, Dr Jérôme Salse from the French National Institute for Agricultural Research (INRA) Clermont-Ferrand-Theix-Lyon Centre aims to characterise the mechanisms that have shaped plant and animal genomes throughout evolution, and pinpoint the genes underlying agriculturally significant traits.

Modern species evolution

Palaeogenomics analysis uses mathematical reconstructions of ancestral genome sequences or the sequencing of ancient DNA to study the evolution of living species. In doing so, it can elucidate the biological mechanisms that have shaped changes to genomes in the past 500 million years of evolution. These methods have revealed that modern plant and animal lineages emerged from ancestral genomes containing just seven to 12 chromosomes and 15,000-20,000 founder genes. From these genomes and associated genes alone, the diversity of life we see has developed.

There is a great deal of variety between the two kingdoms of plants and animals, for example, with animal genomes proving relatively stable and plant genomes tending to be much more dynamic. Furthermore, their genomes differ at a number of additional levels, including chromosome number, genome size and gene number – surprisingly, perhaps, wheat possesses a genome that is five times larger than that of humans. Crucially,

research done by Dr Jérôme Salse and his PaleoEVO team has helped to explain these differences.

Modern species adaptation

Palaeogenomics has revealed a major evolutionary mechanism for diversification: gene duplication. This process can occur in two forms – whole genome doubling (polyploidy) or local segmental duplication (small-scale duplication) – and has major implications for adaptation as the access to a double set of genes during evolution constitutes a route for the specialisation of duplicated gene functions to face changing environmental constraints.

Over the course of their evolutionary history plants have made full use of this phenomenon, undergoing numerous and recurrent cycles of genome doubling over the past 250 million years. These successive polyploidisations, which are much less frequent in animals, are believed to have triggered genetic changes leading to regular genome restructuring and reprogramming. As a result, plant genomes are much more dynamic – and faster evolving – than mammals.

Agronomical innovation

The PaleoEVO team thinks that these polyploidisations alter not only the structure but also the function of genes, and may explain much of the phenotypic diversity seen in plants. While the framework is in place, the details and key players in this model of evolution are yet to be provided. In characterising each step, PaleoEVO is gradually closing these gaps.

Considering wheat, the third most produced cereal in the world, as a model species to investigate the role of polyploidisation in evolution as a driving force of adaptation to environmental constraints, Dr Jérôme Salse

team aims to identify the genes behind important agricultural traits in wheat, such as yield maintenance under temperature and water constraints. By better understanding the evolutionary basis of such traits, they aim to facilitate cloning, with the ultimate goal of introducing genes into existing plant breeding programmes.

Looking ahead

Palaeogenomics is a powerful tool that is capable not only of providing new knowledge on how organisms have evolved, but also delivering translational benefits and ability to translate knowledge from model species to more complex ones in order to investigate important traits. Salse's work has helped to explain the evolutionary basis of the differences between plant and animal genomes, and will provide new tools to accelerate further progress in the field.

Since the first ancient DNA sequence was published in 1984, from a museum specimen of an extinct subspecies of zebra and the comparison of modern plant and animal genomes since 2000, the ability to infer evolutionary change will continue to expand, perhaps answering some of the biggest mysteries of evolution.



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What's so special about STEM?

Gill Collinson, Head of the National STEM Centre highlights the significance of STEM in modern life...

'STEM' is the buzz word of the moment in education. Secretary of State for Education, Nicky Morgan, summed it up last year ¹ when she said "the subjects that keep young people's options open and unlock doors to all sorts of careers are the STEM subjects: science, technology, engineering and maths." With a huge push in business, government and education to move STEM to the top of the agenda, you might be asking – what's so special about STEM?

STEM touches almost every aspect of modern life. Britain has always been at the forefront of ingenuity in STEM. Some of the most significant discoveries of the past 100 years were made in the UK. Britain started the Information Age, following on from our invention of the telephone and television with the World Wide Web, which now underpins almost every

aspect of modern life. Huge leaps in medical science would not have been possible without the British discovery of penicillin or the structure of DNA.

The UK's STEM industries also pack a punch. In 'The state of engineering' ², Engineering UK reports that in 2014, the engineering sector contributed an estimated £455.6bn, the space sector contributed £9.1bn and the information technology sector £66bn to the UK economy. The numbers of job opportunities being created in STEM industries over the next decade will be huge. The United Kingdom Commission for Employment and Skills (UKCES) 'Working Futures' model predicts that over 14 million jobs will need to be filled between 2012 and 2022. This is as a result of predicted growth in some sectors and occupations, however much of the need is as a result of people

leaving the workforce, getting promoted or retiring, with most 'hard to fill' vacancies looking for people with strong STEM knowledge and skills.

In their 2014 Education and Skills report, 'Gateway to Growth'³, the CBI highlighted the importance of STEM skills and excellent career advice in continuing to support these burgeoning industries. They predict a 52% rise in demand for highly skilled workers in engineering, science and hi-tech industries. Indeed, both the CBI and Engineering UK warn of dire economic consequences if we don't meet the demand for the number of skilled individuals required in our STEM industries. Engineering UK predicts that failure to meet this skills demand could cost the UK £27bn a year.

The government is putting the building of strong STEM skills and industry in the UK at the heart of its economic plan for the UK. In July this year, Jo Johnson, Minister for Universities and Science, announced One Nation Science⁴, a diverse program intended to boost research, skills and jobs in STEM across the UK. As part of this scheme, £67m has been set aside to find an extra 2,500 maths and physics teachers in the next 5 years, as well as to provide additional training for 15,000 existing maths and physics teachers. At the National STEM Centre, we support teachers across the UK with training and access to free, high-quality resources, to ensure they have everything they need to go out and inspire their students. The Your Life campaign⁵, another government initiative, aims to increase participation in maths, with an ambitious target to increase the number of students taking maths and physics at A level by 50% in 3 years.

In the fast-paced, global economy we need our young people to have world-class education if we're to stand a chance of keeping up. So why are STEM skills and industries so important? It's clear that the UK's future economic success and competitiveness depends on rebalancing the economy and, as part of this, expanding our knowledge-intensive industries with high levels of

productivity and innovation. We need to continue to improve the STEM skills of the workforce in order to expand sectors such as advanced manufacturing, the digital and creative sectors and green businesses, all of which are underpinned by high-level STEM skills. By investing in STEM and our young people, we will remain at the cutting-edge of new technology, pioneering new science and at the forefront of ground-breaking discoveries. From building coding skills into the primary curriculum to educating young people on the benefits of following a STEM career, we have made much progress – but there is more still to do.

"In their 2014 Education and Skills report, 'Gateway to Growth'³, the CBI highlighted the importance of STEM skills and excellent career advice in continuing to support these burgeoning industries."

Gill Collinson joined the National STEM Centre in 2014 from Siemens Energy. Gill is a Chartered Engineer and has worked across both the private and public sectors.

The National STEM Centre works with schools across the UK to support excellent STEM education. www.nationalstemcentre.org.uk . ■

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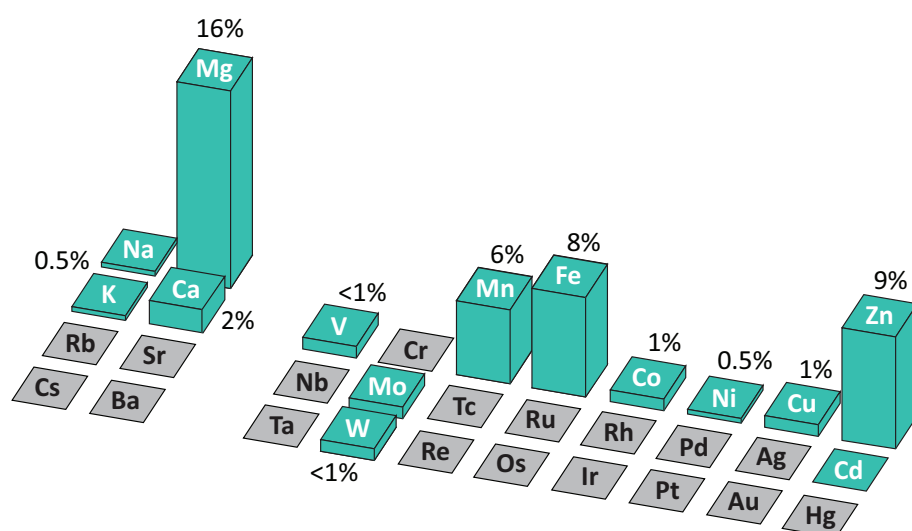
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Metals in Biology: Elements of the Bioeconomy

At the beginning of 2014 the UK Biotechnology and Biological Sciences Research Council (BBSRC) established thirteen Networks in Industrial Biotechnology and Bioenergy.¹ An aim of these networks is to reduce the barriers for initiating collaborations between the academic and business communities, especially in the arena of Industrial Biotechnology. One of the networks entitled “Metals in Biology: The elements of Biotechnology and Bioenergy”,² has seven themes: Metals in bioprocessing, metals in the environment, metal-related nutrition and supplements, metallo-enzyme engineering, tools for metals in biology, metal circuits for synthetic biology and metal-related antimicrobials. Here this network is introduced, giving background to two themes with events planned this year.

Metals are used as industrial catalysts to drive reactions that produce valuable chemicals. Metals also catalyse a substantial proportion of the reactions of life.³ Using cellular enzymes whose structures are known as a representative sub-set, nearly a half (47%) of enzymes are estimated to need metals. The proportions of the individual elements which make-up this surprisingly large fraction are illustrated (figure reproduced from Nature, 2009³). A second key observation is that metal-requiring enzymes readily bind to wrong metals in preference to the metals needed for activity.⁴ This creates the potential for



Nature (2009) 460, 823-830

enzymes to become inactivated by mismetalation. In this respect life seems perilously ill-designed, but in truth it has not been designed at all, rather it has evolved in the face of changing metal supply. This has selected for ‘circuits’ to assist proper enzyme metalation. Over the past three or more decades, many of the genes encoding components of these circuits have been discovered: Genes that encode proteins which import specific metals into cells, others which export, store or deliver metals and yet more which sense metal sufficiency or deficiency.⁴ These discoveries now create opportunities to engineer metal-circuits to enhance the metalation of desirable enzymes to the benefit of industrial biotechnology. Although beyond the scope of industrial biotechnology, this knowledge also makes it possible to study how these circuits fail in numerous chronic diseases and to devise ways to subvert metal circuits to eliminate

unwanted cells for therapeutic purposes. As an aside, a common observation from the BBSRC NIBB is that fundamental knowledge of life processes tends to spark innovation across the entire bioeconomy including biomedicine, bioenergy, agritechology, nutrition, health, ecosystem management and not solely restricted to one sector such as industrial biotechnology.

Metal circuits for synthetic biology: Isobutanol is an industrial feedstock which is typically manufactured from fossil fuels. It can also be made biologically through the action of enzymes such as Dihydroxy Acid Dehydratase (DHAD)⁵. In many organisms this enzyme uses iron in the form of iron sulfur clusters and cells have a specialised machinery for assembling and distributing these clusters.^{5,6} To generate a commercial fermentation process for the sustainable production of isobutanol, DHAD

has been engineered into yeast cells. Patents document how the iron-sensing circuitry of yeast can be adjusted to ensure a sufficient supply of iron sulphur clusters to support the extra demand created by the introduced DHAD⁵. With so-many enzymes needing metals, this exemplifies an opportunity to engineer wide-ranging metal circuits in order to enhance metalation of chosen enzymes to boost targeted reactions in support of the bioeconomy. For example, key enzymes required for the capture and utilisation of C₁-gases (carbon dioxide, carbon monoxide and methane) have exotic metal demands including the nickel-containing F430 cofactor and cobalt in vitamin B₁₂. Later this year, there will be a joint event between the Metals in Biology and the C1Net BBSRC NIBB⁷ to consider improving C₁ gas capture by manipulating metals.

Metal-related antimicrobials:

Historically, some unpleasantly hazardous metals have been used to treat infections such as mercury for syphilis, arsenic and antimony for Leishmania. In agriculture, copper sulphate in Bordeaux mixture is an effective fungicide for treating vines, and hospital trusts have replaced steel fixtures and fittings with copper ones, since copper surfaces (unlike those containing iron) are antimicrobial barriers. A range of products contain metal chelants such as Ethylene Diamine Tetra Acetic acid (EDTA) with preservative, antimicrobial, action. A well known shampoo, which generates multiple billions of dollars of revenue each year, contains Zinc Pyrithione (ZPT) which interferes with the iron handling circuitry of fungi through a cunning sequence of biochemical interactions which also involve copper.⁸ ZPT treats dandruff

which is triggered by the fungal microflora of the scalp. But there is a much longer history of using metals to fight microbes, because immune systems have evolved to exploit metals to combat infections. This is emerging as a new sub-discipline called nutritional immunity.⁹

“An aim of these networks is to reduce the barriers for initiating collaborations between the academic and business communities, especially in the arena of Industrial Biotechnology.”

Iron often limits life, from restricting primary productivity in the oceans to a most prevalent human dietary deficiency, anaemia.^{10,11} Microbial pathogens fight to obtain this valuable element from hosts, often releasing iron scavenging siderophores. This has triggered an evolutionary arms race fought on a battle ground of iron, with hosts producing defensive siderocalins to bind siderophores, in turn selecting for stealth siderophores which the siderocalins fail to recognise, combatted by stealth siderocalins from adapted hosts and so on. Host immune cells such as macrophages engulf microbes whereupon a specialised protein, Natural Resistance Associated with Macrophage Protein 1 (NRAMP1), helps to kill the entrapped invader. Some years after its discovery, NRAMP1 was found to pump vital metals such as iron from the microbe-containing compartment, presumably to starve it of essential elements. The compartment subsequently fills with a toxic dose of copper. Calprotectin is liberated from other immune cell types, classes of neutrophils, to scavenge zinc and manganese, starving microbes of these essential elements.⁹

As details of the cell biology of metals are uncovered, it becomes possible to tailor more precise antimicrobial treatments by design, not just stumbled upon empirically or by evolution. Metals, and by implication chelants, ionophores, and agents that interfere with the metal-handling systems of microbes and hosts, are increasingly recognised among the promising candidates for new antimicrobials.¹² Another upcoming BBSRC NIBB event will highlight advances in understanding metal-handling systems of microbes and hosts, explore why metals are a microbial “Achilles heel”, and encourage innovation at this academia-business interface.

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11 Nature (1999) 397, 694-697.

12 Nature (2015) 521 402.

Metals IN BIOLOGY



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New anti-infective drugs following a grand tradition

Nobel Prizes are normally awarded to scientists whose fundamental discoveries have had a major impact over a number of years in the particular field of scientific research. Just occasionally a Nobel Prize recognizes a discovery that has come directly to the consumer. From the point of view of a medicinal chemist it's notable that two good examples of this concern the Nobel Prize for Physiology or Medicine, not for chemistry. In 1988 the Nobel Prize was awarded jointly to Sir James Black, and Drs Gertrude Elion, and George Hitchings for their establishing 'important principles for drug treatment', which in practice meant the discovery of β -blockers (Black) and antibacterial agents (Elion and Hitchings). As I write the news has come through that this year the Nobel Prize for Physiology or Medicine has been awarded to William C. Campbell and Satoshi Omura for their discovery of the antiparasitic drug, avermectin, and to Youyou Tu for her discovery of the antimalarial drug, artemisin. In both cases, the clinically used products today are derivatives of the naturally occurring compounds that the Nobel Laureates

discovered and are further telling examples of a tradition of drug discovery based upon compounds isolated from plants and microorganisms.

I don't wish to imply that our research has the necessary requirements of Nobel Prize standing but these achievements and their ultimate recognition are both an encouragement and a validation of our efforts to provide new compounds to treat infectious diseases by modification of natural products to give selectivity and suitability for medicines. Our most advanced compound, MGB-BP3, is progressing well in phase 1 clinical trials in a formulation designed to treat *Clostridium difficile* infections. Our development partner, [MGB Biopharma](#), has also developed an intravenous formulation for the treatment of other Gram-positive bacterial infections building upon basic science from the University of Strathclyde. MGB-BP3 is the first in a line of new anti-infective compounds that ultimately work by controlling gene expression by binding to the minor groove of DNA in the target organism, according to the best

evidence we have. It's one of a family of compounds that we call Strathclyde MGBs (S-MGBs).

We now have S-MGBs that are effective against a wide range of infectious organisms in particular Gram-positive bacteria and trypanosomes, the disease causing agent of sleeping sickness. We've been able to make such progress and to create such impact for several reasons. Firstly the S-MGB platform uses very flexible heterocyclic chemistry so that we can tune the properties of our compounds to target different pathogens whilst remaining safe for the infected host. Secondly, we have strong team-work between many academic colleagues in chemistry and biology at Strathclyde but also at the University of Glasgow. Thirdly, we've worked in partnership with MGB Biopharma; the company's ability to raise funds in a difficult economic climate and to drive through the development programme for MGB-BP3 has been extraordinary.

The outcomes of our research are targeting problems equally important today as those that the Nobel Prize winners addressed when beginning their research. According to current plans, we should begin to see the impact of our compounds in 2018, assuming that clinical development continues successfully.



Left: MGB-BP3 formulated in capsules for treating *Clostridium difficile*

Right: a freeze-dried sample of MGB-BP3 for reconstitution as an intravenous medicine (courtesy MGB Biopharma)



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Making Britain a key place to research, innovate and grow

Adjacent Government outlines how science, research and innovation will play a key role in the UK government's long-term economic plan, as detailed by the Minister of State for Universities and Science, Jo Johnson in a recent speech...

Science, research and innovation in the UK is essential to drive growth and ensure better living standards for the next generation. The UK government is looking to make Britain the best place to innovate and develop key research. In a speech given in July, Minister for Science, [Jo Johnson](#) outlined how this could be achieved, and the role of science in the long-term economic plan.

"Great science is, of course important in its own right as well as yielding enormous practical benefits – curing diseases, driving technological innovation, promoting business and investment and informing public policy for the better," he started.

"UK taxpayers invest £10bn a year in research and innovation. This government has prioritised research funding and ensured that the ring-fence was protected this financial year, even as we had to make difficult decisions about cuts elsewhere.

"And we will invest new capital on a record scale – £6.9bn in the UK's research infrastructure up to 2020 – which will mean new equipment, new laboratories and new research institutes. The long-term commitment includes £2.9bn for a Grand Challenges Fund, which will allow us to invest in major research facilities of national significance, such as the new Turing Institute, and our new state-of-the-art Polar Research Vessel, which will enable UK polar scientists to remain at the forefront of Arctic and Antarctic research."

The Department of Business, Innovation and Skills want to ensure that Britain is the best place in Europe to innovate, patent new ideas and set up and expand a business. The government wants to boost collaboration between business and universities through their 'One Nation Science' strategy ¹.

"'One Nation Science' means two things," explains Johnson.

"Upholding the very best in British science and research. We should be proud of our science base – its one of our country's great success stories. With less than 1% of the world's population, the UK produces 16% of top quality published research.

"It also means developing that excellence for the whole country, making sure all areas and all groups of people can reach their full potential."

To help grow the next generation of scientists and engineers the government are aiming to start in schools, and improve the learning potential of young people. For the next 5 years, the government has announced £67m to recruit and train an extra 2,500 maths and physics teachers and upskill 15,000 existing maths and physics teachers.

"Our STEM Ambassadors programme is doing important work to inspire more young people into science, and especially girls. We must push for faster progress. Only one in ten computing students is female, and only 19% of girls who achieved the top grades in GCSE physics go on to study physics at A-level, compared to 49% of boys.

"Last year we initiated the Your Life campaign, which aims to increase participation in maths and science studies at age 16 and beyond, with an ambitious target to increase the number of students taking maths and physics at A level by 50% in 3 years."

The Minister spoke about the importance of people and talent for research and innovation in the UK to reach its full potential. He believes that if this is to

happen, we must make the best use of the talent we have to develop key research for the challenges we face in the future.

“When we inspire people into science and engineering, we need to make sure that they have the opportunities to progress,” said the Minister. “That’s why an important strand of the Your Life campaign is the call to action under which over 200 organisations are taking steps to encourage the appointment and progression of people from a wide range of backgrounds, particular women.

“We support the Athena Swan charter, which recognises employers’ commitment to advancing the careers of women in higher education and research, and we have funded an extension of the charter to research institutes. And, we have also set up the STEM Diversity programme, led by the Royal Society and the Royal Academy of Engineering. As part of this, the Royal Academy of Engineering is working with engineering employers to widen their approach to recruitment.”

The UK government is committed to innovation, and aims to do more to help universities and business work more closely. Innovate UK is the government agency tasked with developing a new strategic plan to help achieve their vision. As part of this plan, [Innovate UK](#) will set out how it will build on excellence throughout the UK, working with others to identify where it can invest locally in areas of strength.

“The government has already committed to a range of measures aimed at encouraging business to invest in and adopt new research and development,” said Johnson.

“These include our plans to create over 1,000 jobs in high-tech small business by 2020 through our investment in 4 University Enterprise Zones, spread across the country in Bristol, Bradford, Liverpool and Nottingham.”

The government’s commitment to science, research and innovation is quite clear. As stated in the Budget and set out in a CBI Speech earlier this year, The Chancellor has said “science is a real personal passion.”



Image: © Department for Business, Innovation and Skills

Jo Johnson, the Minister of State for Universities and Science

The Minister concluded: “I give you my personal commitment that I will also be a champion for Great British science and research. We have a once in a generation great opportunity, right now, to find an extra gear for the British economy, and ensure higher living standards for the next generation to come.” ■

1 <https://www.gov.uk/government/speeches/one-nation-science>

Comments in this article are taken from the following speech –
<https://www.gov.uk/government/speeches/research-innovate-grow-the-role-of-science-in-our-long-term-economic-plan>

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The Impact of engineering in biology and medicine: the biomedical engineer (BME)

In 2014, WHO stated: “trained and qualified biomedical engineering professionals are required to design, evaluate, regulate, maintain and manage medical devices, and train on their safe use in health systems around the world”¹.

In response, the European Economic and Social Committee stated: “Biomedical Engineering is not simply a subset of modern medicine. Modern medicine predominantly secures important advances through the use of the products of biomedical engineering”².

With this document as a start, two Euro-Parliamentarian Members, Dr Lara Comi and Dr Nicola Caputo, tabled two parliamentary questions asking why, different to the USA, the Horizon 2020 vision does not have a dedicated space for BME and why BME is not listed among the professions that the European Commission officially recognises.

The European Commission, answered that Biomedical engineering is crucial in addressing many of the challenges found in the programme.

So, what is happening? Why all this interest around the field of BME over the last few months?

The answer is not easy to arrive at, but we can attempt it. BME represents one of those cases in which Academic research is perfectly aligned to manufacturing visions and missions, and both are supporting healthcare innovations that are directly impacting the wellbeing of European Citizens and

increasing National healthcare systems and services cost-effectiveness. This chain is working so well that WHO is also benefiting from this. For instance, the initiatives that have seen the International Federation of Medical and BME, IFMBE, which is the world’s most important scientific society for BME and also an ONG officially recognised by the UN, supporting WHO on specific projects aiming to build capacities in low-income countries or to promote innovation making more affordable medical devices, are countless.

However, let us take a step back in order to understand better the context. BME is a key sector for European competitiveness. It presents a €100 billion-market size. In Europe, 20,000 companies work in this sector. This equates to 575,000 jobs and in terms of innovation, this is the first sector in patent applications – 10,412 – in 2012. Those numbers are growing very fast and the BME sector is becoming of strategic interest to Europe and other developed countries. For instance, the CNN reported in 2014 that BME was the first job in the USA for impact, growth and future prospects³. On the other hand, 90% of companies producing medical devices are SMEs and the product lifecycle is very short (18 months circa) making the time from research to the assessment to the adoption very short in comparison to other healthcare technologies (i.e. drugs). This is creating new challenges for the European Union that require a strong synergy between all the stakeholders and a proactive reaction from each actor.

What are the challenges for BME? The fact that the lifecycle of its main products, medical devices, is so short is one of the most significant challenges. Apart from inventing the future, BMEs are also called to invent how to sell it, proposing new business models that make sustainable the cycle of innovation and marketing, especially in the field of ICT for healthcare. Another huge challenge, very specific to BME, is that we do design technologies that are required, assessed, acquired and utilised by people other than engineers. If you design aircraft, you will most probably follow the specifications given by an engineer and your innovations will be assessed, acquired and even piloted by someone with the same background as yours. This means that they have been educated using the same language as the one you have been educated to, and most probably they will use this language to give you their specifications. If you work in medicine or biology, you will face that even the specification and the commissioning of a new system requisites may require outstanding empathy, apart from a solid scientific basis and experience. Additionally, if you are a BME, you will mainly work in multi-disciplinary teams. You may work one day with a cardiologist and the day after with a neurologist, and you will need to understand as much as them about cardiac cycle, Krebs cycle and mirror neurons, in order to understand deeply where your innovation can maximise your impact. However, it does not matter how many years you have spent alternating books of physiology with those of electronics and computer science, in



this moment the only opportunity you have, if you are trying to apply for a grant, is to select “other engineering” when you have to describe your field.

From the Academic prospective, a BME’s community is continuously monitoring the evolutions of the relevant markets. For instance, two European Projects in the past years contributed to the harmonization of BME curricula in Europe: Biomedea and INTERREG CRH-BME.

In answer to these challenges, and considering the results of those projects, the Warwick Engineering in Biomedicine (WEB) group at the School of Engineering, the University of Warwick, have launched a new MSc programme in Biomedical Engineering. This one-year programme takes into account the interdisciplinarity of the field and provides students with targeted modules addressing the needs of industry, healthcare providers and Academia. It covers classic topics of BME (i.e. biomedical signal processing, imaging, biological system dynamic modelling, biomechanics, tissue engineering, clinical engineering and health technologies design, system medicine) but

also topics that are not traditionally delivered as part of BME degrees such as health technology assessment, procurement and management. This is important as BMEs graduating at Warwick have a concrete feeling of the complexity of the BME field and are never naïve to the challenges that an innovation has to face to move from the lab to the market. The design of this innovative Masters degree has been possible as WEB brings together the research expertise of more than 20 biomedical engineering academics and researchers working in very different areas of BME and coming from very different professional experiences, not to mention Nations and continents. In fact, walking in the corridors of the School of Engineering, and particularly in the new building dedicated to WEB, students can engage with key figures within the main scientific international organizations on BME in UK, Europe and Worldwide, which practice an open-door policy. This includes the IEEE EMBS; the International Federation of Medical and Biological Engineering (IFMBE); and the European Alliance for Medical and Biological Engineering and Sciences (EAMBES).

Prof Christopher James, Professor of Biomedical Engineering, IEEE EMBS ADCOM (Europe Representative), IEEE EMBS UKRI Chair, IEEE Spokesperson in Europe for Healthcare Technology, Director of Warwick Engineering in Biomedicine.

Dr Leandro Pecchia, Assistant Prof of Biomedical Engineering, Chairman of the Health Technology Assessment Division of the International Federation of Medical and Biological Engineering (IFMBE), Chairman of the Public Affairs Working Group of the European Alliance for Medical and Biological Engineering and Sciences (EAMBES).

1 WHO web site, last access 26th of October 2015, http://www.who.int/medical_devices/support/en/

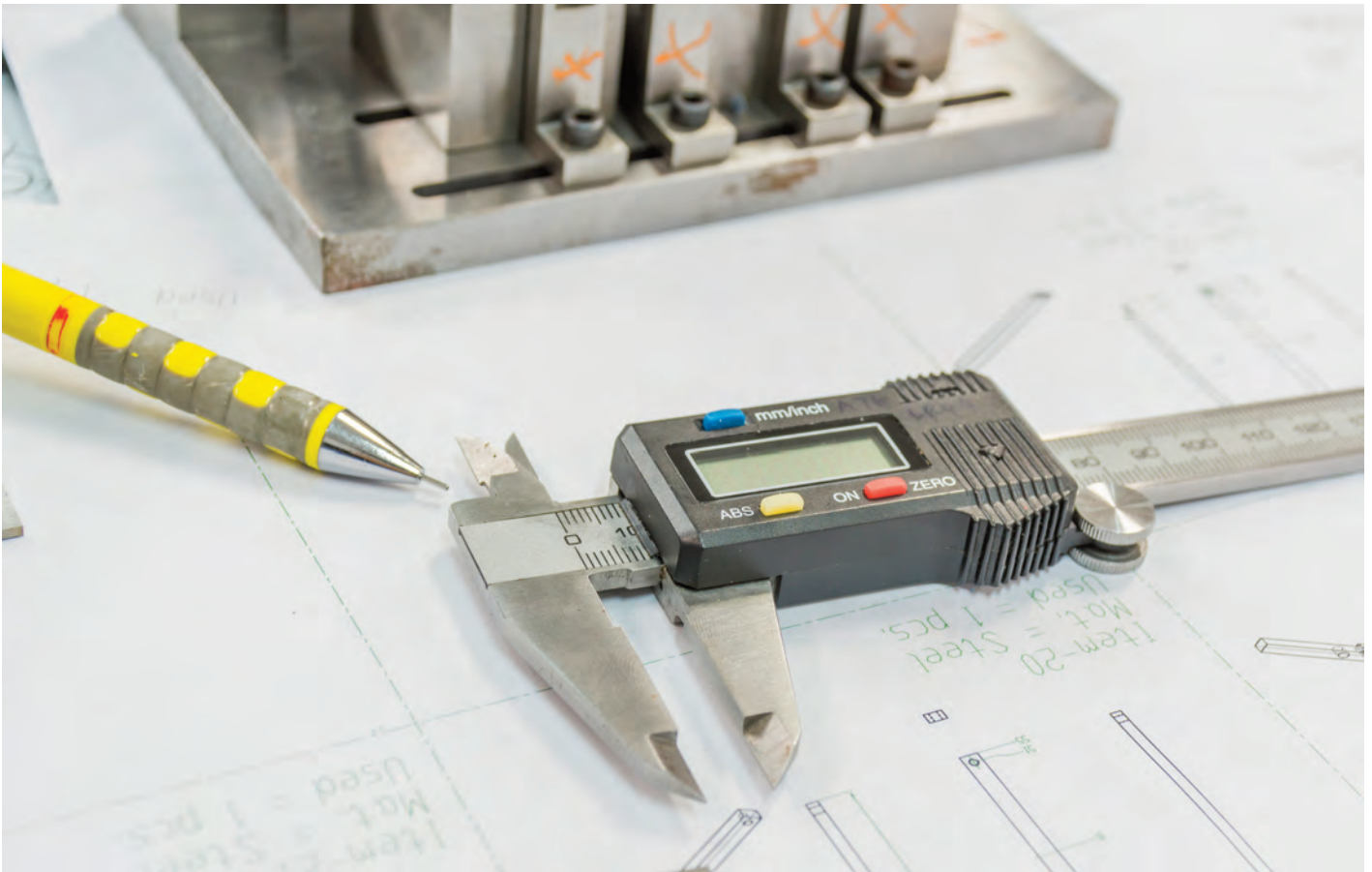
2 EUR-LEX, 2015/C 291/07: EUR-LEX, 2015/C 291/07, "Opinion of the European Economic and Social Committee on Promoting the European single market combining biomedical engineering with the medical and care services industry", Rapporteur: Edgardo Maria IOZIA, Co-rapporteur: Dirk JARRÉ

3 CNN Money, last access 27th of October 2015, <http://money.cnn.com/pf/best-jobs/2013/snapshots/1.html>



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Inspiring engineers of the future

Tamzin Caffrey, Head of Communications at EngineeringUK sheds light on what needs to be done to meet the future demand for engineers in the UK...

Britain is great at engineering and the industry continues to make a significant contribution to the economy as well as to our lives. At £1.17 trillion, it accounts for a quarter (24.9%) of UK turnover and continues to grow (latest figures put annual growth at 6.7%).

There are 5.4 million people employed in engineering in the UK, across a range of sectors, each with a vital contribution to make and each with its own challenges. Despite these strong employment numbers we still need more engineers. The projection is that engineering employers will need 1.82 million people likely to need engineering skills in the decade to 2022. Pro rata that's 182,000 people a year which, at the current rate of supply, means we're facing a shortfall of 55,000 per year (at technician level and above).

Research undertaken by the Centre for Economics and Business Research shows that filling the demand for new engineering jobs will generate an additional £27bn per year from 2022 for the UK economy. To give you an idea of what such a large figure means, that's equivalent to building 1,800 schools or 110 hospitals. There is much to gain, but there is also much to do to reach the industry's growth potential.

The number of students in science, technology, engineering and maths (STEM) is increasing but far too slowly. If we are to meet the needs of the industry we need to double the number of engineering apprentices and graduates entering the industry. We need to double the number of young people studying GCSE physics and we need more of them to continue to A level.

If we are to meet the future demand for engineers more needs to be done to inform and inspire young people and we want every 11-14 year old to have at least one engineering experience with an employer. This inspiration needs to highlight to young people and their parents the high value placed on STEM skills and promote the huge range of engineering careers available. There also needs to be more support for the teachers and advisors delivering careers information. They need to understand the range of modern scientific, technological and engineering career paths, (including the diverse vocational/technician roles) so that in turn they can advise and inspire the young people who look to them for guidance.

EngineeringUK runs 2 national programmes – The Big Bang and Tomorrow's Engineers – to inspire more young people to consider a career in engineering and keep their options open.

Companies of all sizes across the UK spend time in schools promoting engineering to young people. The Tomorrow's Engineers programme seeks to coordinate this outreach activity to boost overall reach and impact, and to engage and inspire more teenagers to continue with science and maths and consider an engineering career. Research shows this coordinated approach triples the impact of such outreach and with £27bn at stake we need to do everything we can to ensure the talent pipeline.

To support the companies and professional engineering institutions we are creating a heat map of engineering careers activities across the country through a national database that provides an accurate picture of what is happening locally. This heat map is driven by a powerful database that captures employer outreach activity. Many companies and organisations that are already working with schools are sharing data on that activity to give as comprehensive a picture as possible of current school coverage.

As this heat map develops, it will enable the identification of new opportunities and areas of duplication and work with local employers in the network to reach more schools more efficiently. We also have a

network of employer support managers working at regional level to support engineering businesses committed to widening the talent pool and inspiring the next generation. It's this coordinated local activity that has national impact and the programme has ambitions to reach 1 million young people annually within 5 years.

The Big Bang programme, which reaches children of all ages, aims to show just how many exciting and rewarding opportunities there are out there for them with the right experience and qualifications.

“Research undertaken by the Centre for Economics and Business Research shows that filling the demand for new engineering jobs will generate an additional £27bn per year from 2022 for the UK economy.”

Through the national event (The Big Bang Fair) which happens in March every year, and through a series of regional and local events, we work with partner organisations across business and industry, government and academia to try and give a flavour of the real scale of engineering and science in the UK.

The Big Bang regional programme gives young people the opportunity to experience the Fair closer to home. In 2014 more than 82,000 students and teachers visited over 100 Near Me Fairs in their local area, which added to the 70,000 visitors to the national Fair, shows just how many young people can be reached when education, business and government work in collaboration. ■

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The challenge of recruiting more women

Recently-installed IET President Naomi Climer has made it her mission to improve recruitment of women into engineering and technology roles, with oil and gas just one area under the spotlight...

Name a famous engineer or technologist and most people would undoubtedly mention Steve Jobs, Bill Gates, Isambard Kingdom Brunel or George Stephenson. Being optimistic, perhaps Ada Lovelace or Martha Lane Fox might spring to mind.

But most people would, I think, struggle to name many women who have influenced the history of engineering or technology – which makes it unsurprising that young girls are not drawn to an engineering and technology career.

“The whole of the engineering profession – including men – needs to pull together to help win this battle. There is no quick or simple fix. Instead, we need many small and subtle changes over time.”

Why does this matter? It matters because the world needs more engineers and technologists if our economies are to continue to grow, and also because diverse teams are more innovative. The truth is that a more representative workforce would be a good outcome for everyone – not just for women. A lack of diversity means we are missing out on ideas and innovation that come from the different perspectives.

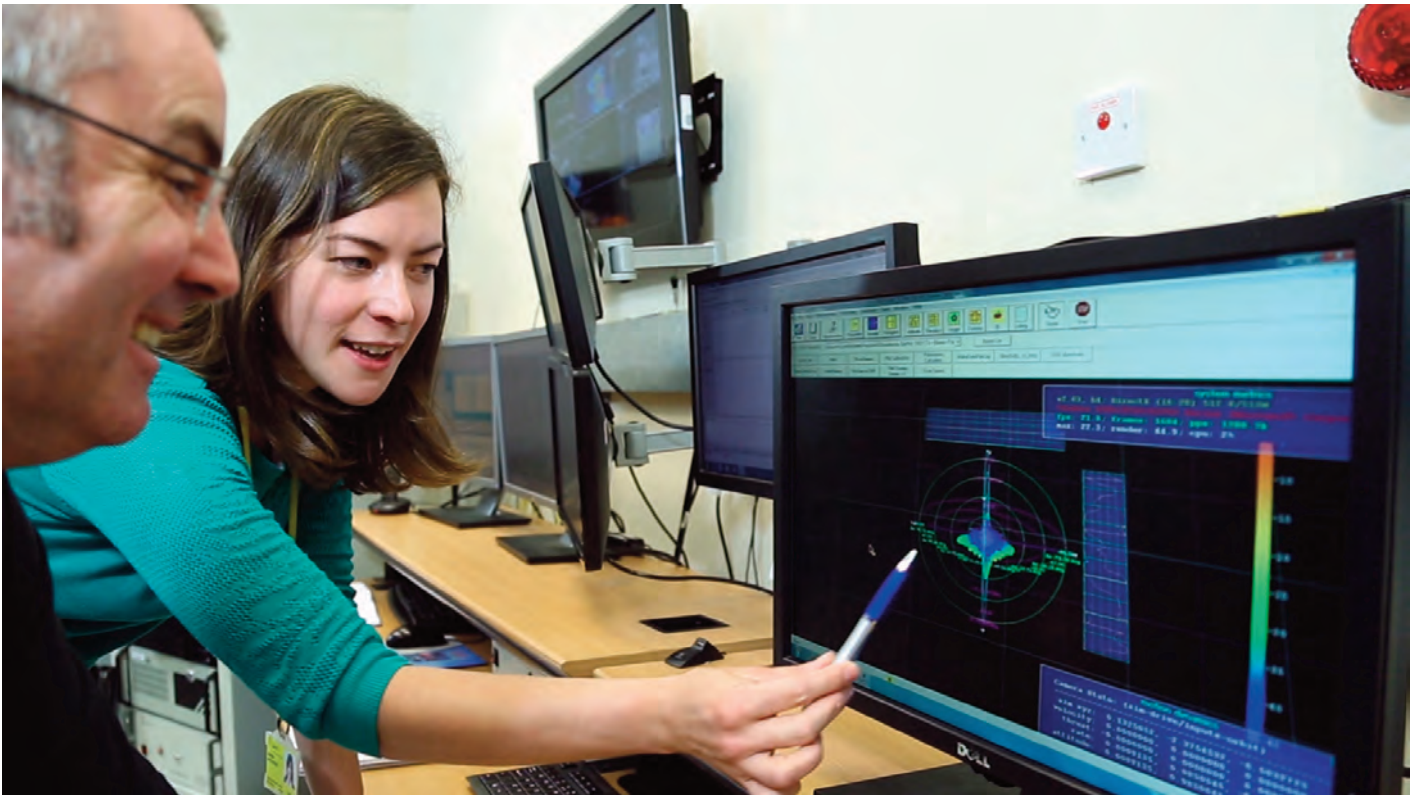
To achieve a more diverse workforce, we need more role models at every level to inspire young women by showing them what engineering and technology could look like for them. The world has changed a lot for women over the past 100 years. We earned the right to vote and have broken down boundaries in many professions – for example 50 per cent of GPs are now women, so why are we not seeing more modern day female champions emerging in engineering and technology?



Naomi Climer, President of The Institution of Engineering and Technology

Less than one in 10 engineers in the UK today are women. This is a result of a number of factors – from the careers advice girls are given in schools, to schools not instilling girls with the confidence to opt for science and maths at A-level. But, it is also due to some employers needing to make their approach to recruitment and retention more female-friendly.

More female-friendly retention and recruitment practices are a vital part of solving the challenge. There are skilled women qualified to take up existing roles, but many are leaving the profession as soon as they



Naomi Mitchison, the IET's Young Woman Engineer of the Year, is helping to dispel the myths around engineering, demonstrating that the profession is creative, exciting and rewarding

graduate and I believe there are things that companies can do to attract and retain these qualified women.

The whole of the engineering profession – including men – needs to pull together to help win this battle. There is no quick or simple fix. Instead, we need many small and subtle changes over time.

Promoting female role models

Our recent Skills Survey found that 57 per cent of engineering businesses don't have gender diversity initiatives in place. This could be as simple as things like routinely reviewing recruitment language or marketing images for engineering jobs. There are great examples of companies who have consistently worked on their diversity and it does make a difference. I would like to see companies over a certain size measure and publish their diversity figures including recruitment, retention, promotion and pay. This would help them to focus on the issue and also benchmark themselves against what other companies are achieving.

I would like to think that in 10 years' time, many more

people would be able to name a minimum of five women in engineering and technology. But this can only be achieved if we do more to create and promote these female role models and ambassadors. We need consistent efforts from parents, schools, and universities to encourage more girls to study Science, Technology, Engineering and Mathematics (STEM) subjects and aspire to a career in engineering. From industry, we need a concerted effort to attract and retain female engineers and technologists who can help address the UK's shortage of engineers – and bring a new perspective and skillset to the world's big engineering and technology challenges. ■

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Naomi Climer
President

The Institution of Engineering and Technology
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The power of basic research

Rebecca Keiser, Head of the National Science Foundation's Office of International Science & Engineering sheds light on why basic research is integral to the progress of science...

The touchscreen on your cell phone. The bar code scanner in a grocery store check-out line. Doppler radar for weather prediction and GPS – these are all part of everyday life. None would be possible without basic scientific research.

And, they would not be possible without the National Science Foundation (NSF), the only U.S. government agency charged with supporting fundamental research in all fields of science and engineering. For more than 70 years, NSF has invested in pioneers. Our mission is to promote the progress of science; advance the national health, prosperity, and welfare; and secure the national defense. Each year, we make about 11,000 awards, chosen after a rigorous review process from more than 50,000 proposals. NSF funding provides resources to individual scientists and engineers, students, teachers, institutions and centers, in all 50 states and U.S. territories.

We funded the early innovators of the Internet and supported robotics and synthetic biology when they were nascent fields. Through our science, technology, engineering and mathematics (STEM) education programs, we've also supported the next generation of scientists and engineers, students who have gone on to make astounding discoveries, win Nobel Prizes and even start a company called Google.

The beauty of basic research, the kind NSF funds, is that it can take us anywhere. Discoveries lead to new questions and new discoveries – and then usually more questions – and down the line society has an innovation like 3D printing (3 of the patented technologies used in this process were developed with NSF support). Even slightly odd research questions – like how are human populations distributed with respect to altitude? – can [lead to insights used today](#) by the food, semiconductor and biomedical industries.



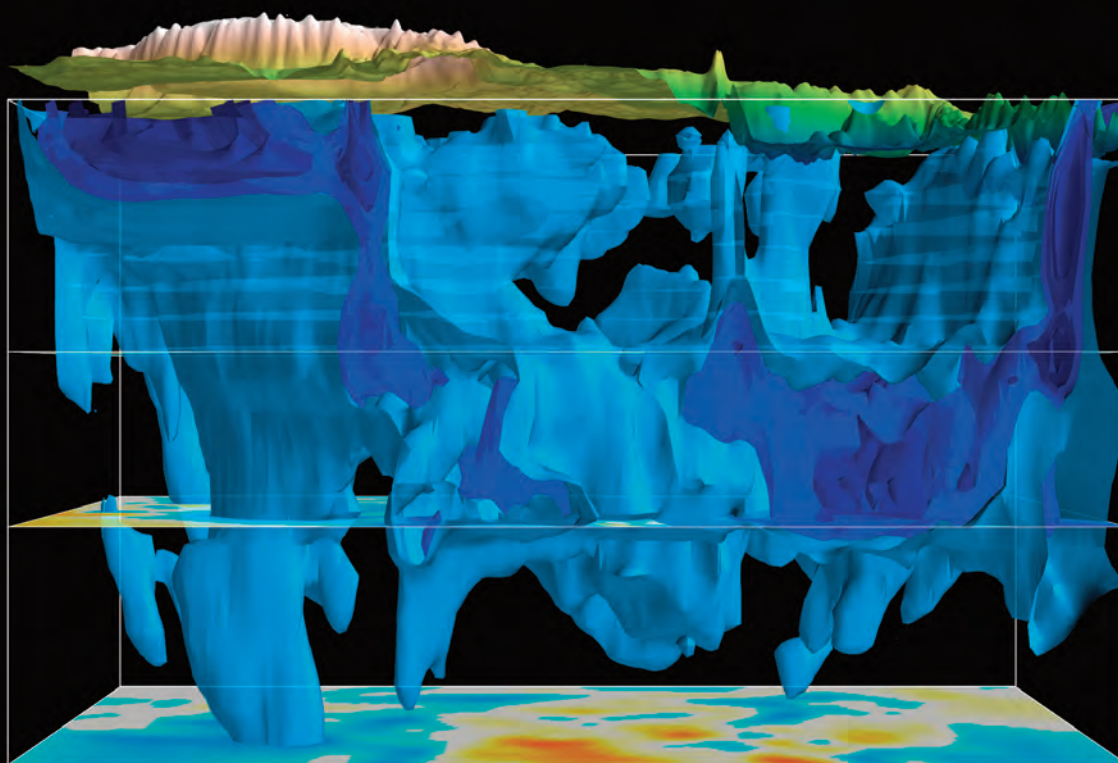
**Rebecca Keiser,
Head of the Office
of International
Science &
Engineering**

Broadly speaking, investing in basic research expands knowledge. It teaches us more about the molecules that make up our bodies, the bodies that make up our universe, and everything in between. Yet basic research is also a major economic driver.

The spectrum auction policy used by the U.S. Federal Communications Commission, for example, came out of NSF-funded economic research. This method for apportioning airwaves has brought in millions of dollars in government revenue. Early NSF investment in digital wireless technology laid the groundwork for the creation of Qualcomm, now a global company worth more than \$100bn.

Today's discoveries are often made in a global setting. More than ever before, research involves collaborators from around the world. Over the past 20 years, the percent of all scientific papers that are internationally coauthored has more than doubled, according to a July Plos One article. In fact, the more elite a scientist is, the more likely it is that they collaborate internationally.

Image: © Min Chen, Earth Science Department, Rice University



EastAsia_earthquake_model: This 3D computer simulation shows wavespeed structures beneath East Asia. An international team of researchers used NSF-funded supercomputers to make this image, using seismic data from more than 200 East Asia earthquakes. The data could help explore the earth under East Asia and the rest of the world

NSF places a high value on the importance of international cooperation; it, too, has tangible benefits to both the U.S. and our international partners.

Our [work with Japan](#) and Chile, for example, has helped scientists comprehend earthquake causes and effects, ultimately helping countries better understand and plan for these hazards. A partnership between NSF and the UK's Biotechnology and Biological Science Research Council collected a diverse group of researchers to tackle the issue of nitrogen fertiliser pollution. The [ensuing research projects](#), still ongoing, could help develop crops of the future.

Working together ensures we leverage both scientific resources and scientific funding. With our international awards, NSF funds the U.S. researchers, while our partner agencies abroad fund their portion. This enables engineers from the University of Nevada-Las Vegas, for example, to [collaborate with leading](#) roboticists in Korea on artificial muscle technology. It gives a graduate student studying marine microbes

the chance to spend a summer working in a Japanese lab specialising in that research.

Our world is facing major challenges – a changing climate, growing pressures on resources like energy and water, emerging infectious diseases. Science and engineering will play a major role in tackling these challenges. Continued support of basic research – and continued collaborations between NSF and countries around the world – will ensure the health and prosperity of citizens around the world. ■

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The climate's beating heart: Myths and maths

It stores heat, greenhouse gases and gives back at a measured rate. It is the World's Ocean. As a player in our understanding and predicting the climate on Earth, it has had a supporting role to the atmosphere. But things have changed and it is moving to center-stage.

To a great extent, our understanding of the climate comes from massive mathematical models. There are only a few around the world that make the cut in the Intergovernmental Panel on Climate Change's list (see www.ipcc.ch). The idea of a full climate model, now often known as an Earth system model, is to create a mathematical replica of the Earth. We have only one Earth and so experimentation in the normal sense is impossible on the full climate system. But the computational output of a climate model can tell what is likely to happen under a particular scenario, for instance from a certain pattern of greenhouse gas emissions in the future.

The primary concern in climate change is the heating of the air that sustains life on Earth. We know the ocean is involved as heating leads to ice melting and that will lead to sea level rise. A myth is that the Ocean is a passive partner in this process. Its role in regulating the climate and moderating its change is enormous. But, in the twentieth century, climate models treated the ocean as a slab. If it is so important, how did they get away with such a crude representation? The answer lies in what the models were then used for: to test the



prediction that our climate would be warming over the long term, upwards of fifty years. On such time scales, the variability of the ocean is not that important.

The climate community accepts that the case for climate change, as well as its causes in anthropogenic emissions, is now closed. The focus has shifted to prediction on shorter time-scales, driven by an interest in what will happen in five, ten, or twenty years. The thinking is that we are committed to considerable climate change already and we need to know how it will impact us in specific ways. On this time scale, the ocean will play a critical and active role.

It is a myth is that we know everything about the ocean from taking measurements. Of course, we know a lot

more than we did in the past. This has been made possible through international efforts, such as the ARGO project (www.argo.net), and the availability of new autonomous vehicles taking measurements. These so-called gliders can be viewed as waterborne drones. But the ocean is vast and deep and what we observe is only a small fraction of the whole. So, how do we fill in all the missing information? The answer is again to use a mathematical model.

We know how the ocean must work from its underlying physics. It all comes from classical mechanics and the mathematical equations were formulated over 200 years ago. Although new simplifications are coming along all the time, the basic set of equations used in the models have remained the same.

How does this help us fill in all the missing information? The picture to have here is of a massive three-dimensional grid filling the ocean, both in breadth and depth. A full description of the ocean would consist of an assignment of physical variable values at each node of this grid. The physical variables will include: flow velocity, temperature, pressure, and density among others. The observations, coming from all these measuring instruments, will tell us the values of these quantities at some of the nodes. It is a myth that the remaining values can be found just by interpolation; there are simply too few nodes reporting and too many possibilities for how the interpolation might work. This is where the mathematical equations come in as they can tell us, through computation of the model, what constrains the physical variables across the entire grid. This process of merging data and model is known as data assimilation (DA).

It is hard to underestimate the importance of DA. While much work is devoted to big data, it is often not recognised that data comes from different sources and that fact influences how we can effectively tease out the most accurate information. DA works as follows: the model gives an estimate of the system state, which is in our case an assignment of physical variable values at each grid node, and is evolving in time in a way that is provided by solving the equations on a large computer. At observation times, two things should happen: first, the estimate of the system state needs to be adjusted in light of the observational data. Inevitably, the

inaccuracies in the model will have driven the estimate off track and there would be little hope of a match with observations. Secondly, certain parameters set in the model will need adjustment in the light of observations coming from the real world. This is a way in which the model can learn from observations.

“But the ocean is vast and deep and what we observe is only a small fraction of the whole. So, how do we fill in all the missing information? The answer is again to use a mathematical model.”

This all sounds simple enough: somebody just goes in and switches out a few values in the model. But to ensure physical consistency, we cannot perform this task arbitrarily and the whole process ends up being as complex as the underlying model itself. The issues are further exacerbated by the fact that the observations are often not of the physical variables of the model, but something related to them by a further model!

There are a plethora of mathematical challenges in data assimilation, particularly for the ocean. The hardest, and arguably most important, is simultaneously dealing with the inherent nonlinearity in the system and its high dimension. The high dimension comes from the fact that we have a number of physical variables at each grid node and the dimension is the product of the number of grid nodes, of which there will usually be a million or more, and the number of variables. We have good DA methods for nonlinear systems in low dimensions

as well as methods that work in high dimensions, but these involve linear approximations that may be broken by an underlying nonlinear system.

This issue of dealing with nonlinearity versus dimension is, in my mind, one of the greatest mathematical challenges of our day. We will not get the ocean correct until we perform data assimilation much better, and we cannot predict the climate on decadal time-scales until we get the ocean right.

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A number one funding source for Russian basic science

Alexander Khlunov, Director of the Russian Science Foundation (RSF) gives an overview of how the Foundation supports research throughout the country...

The Russian Science Foundation (RSF) was launched in November 2013; its operation is governed by a special federal law. Incorporated as a foundation, RSF proves a more flexible and effective funding tool in comparison with other institutions that finance science in Russia.

RSF's mission is to identify the most promising scientific projects and highly efficient and result-driven scientists, as well as to actively engage the country's young researchers in science.

Its support of research relies on the principle of competition and RSF organises a variety of funding competitions to appeal to the following research areas:

- **Basic and applied research projects initiated by scientific departments, organisations and universities.** Here, the Foundation reviews projects carried out by small teams set up for that purpose.
- **Support to research institutions and universities.** In this area of operation, RSF seeks out programmes led by research institutions and geared towards ground-breaking research. Each programme must include a number of large-scale projects with a significant scientific, economic and social impact.
- **Establishment of up-to-date laboratories and departments in research institutions and universities.** To make this happen, the Foundation reviews projects submitted by long-established or newly-created labs.
- **Promotion of international scientific and technological collaboration.** RSF invites projects carried out by international teams working together to solve a particular problem.

RSF provides funding opportunities to projects across 9 branches of knowledge: mathematics, computer and

Grant distribution

Type of grants	Maximum grant amount awarded per year*, USD	Grants awarded
Grants for separate research teams Grants were awarded to small-sized research teams	100 000	875
Grants for labs (departments) Grants were awarded to labs and research departments established before 1 January, 2014	400 000	161
Grants for newly created joint labs Grants were awarded to teams uniting scientists and their colleagues from universities	500 000	38
Grants for international research teams Grants were awarded to multi-national teams of scientists, each with a max. of 50% Russian researchers	200 000	30
Grants for comprehensive research programmes** Grants were awarded to research institutions or universities that submitted their comprehensive development programmes	600 000	16

*Up to 3 years, with a possible extension by another 2 years. 1 USD = 50RUB

**Up to 5 years (in 2014 - 600 000 USD, in 2015 - 5 400 000 USD, in 2016-2018 - 3 000 000 USD)

systems sciences; physics and space science; chemistry and materials science; biology and life sciences; basic medical research; agricultural sciences; Earth sciences; humanities and social sciences; engineering sciences.

In 2014, over a third of all projects supported by RSF involved basic and applied research in the socially relevant field of life sciences.

RSF is Russia's largest foundation engaged in funding of basic and applied research. Its annual budget dynamics is shown in the chart below.

The Foundation is supervised by the supervisory board, chaired by the Assistant to the President of the Russian Federation Andrei Fursenko. The Board has 15 members, counting among themselves high-ranking scientists, members of the Academy of Science and officials, including the Minister of Science and Education and the Parliament Members.

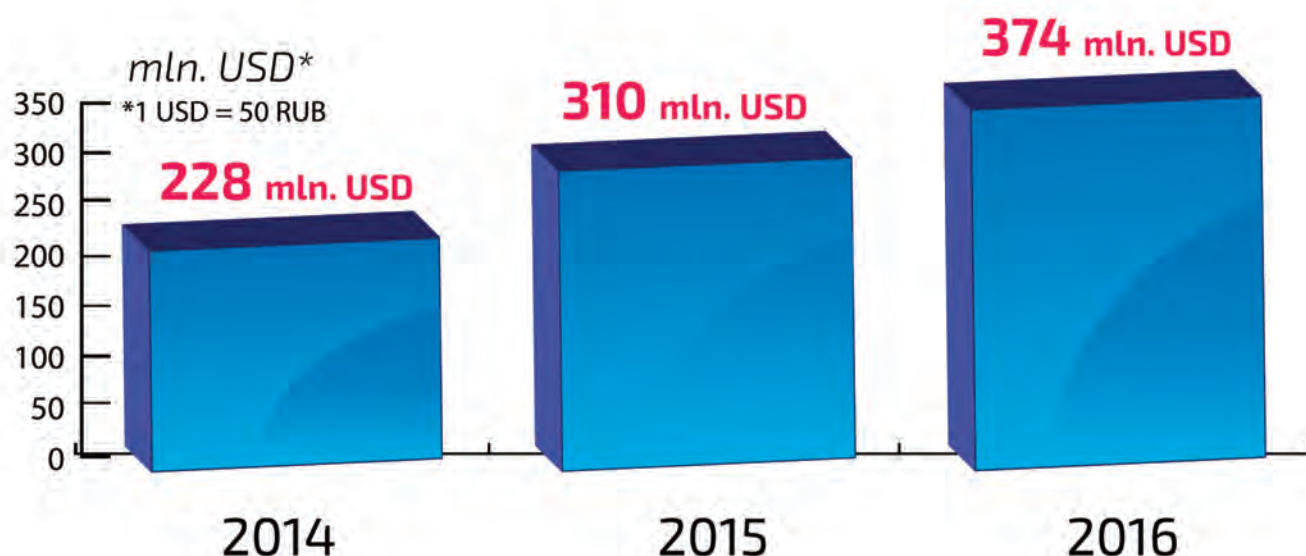
Over 3000 Russian and 1000 foreign scientists sit on the Foundation's various review boards.

The project evaluation process is shown in figure 2 and spans several review stages, including individual evaluations and discussions at sectional review boards.

RSF keenly assesses the professional expertise of the project leaders. In order to submit a funding proposal, the team leader should provide a list of publications by the team members over a 5-year period preceding the application, and be able confirm his or her relevant experience in research project execution and educational activities.

Following just 1 year of operation the Foundation's achievements are already impressive:

- RSF processed 110,000 funding applications from researchers in Russia and abroad.



Key stages of proposal evaluation

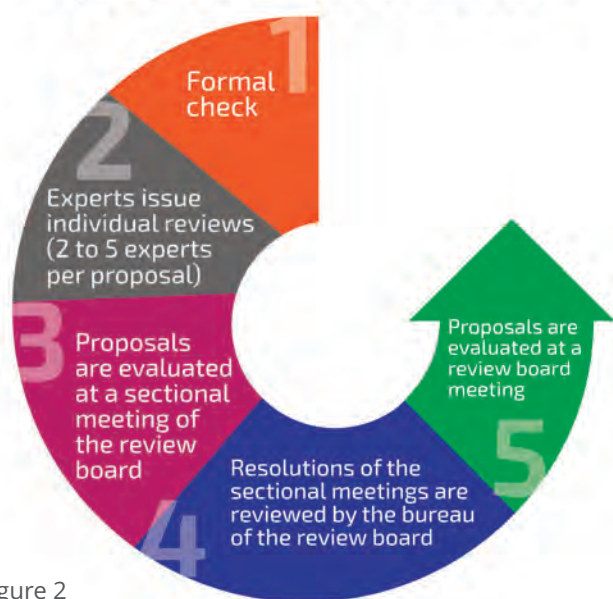


Figure 2

- 16 development programmes of research institutions and universities received funds from RSF in order to boost their research staff's career potential and conduct research and development according to the internationally recognised standards.
- 16 000 scientists from Russia and abroad are engaged in the RSF-funded projects, most of whom are aged 39 or younger.

RSF is open to collaborations and works to extend its international cooperation. The Foundation engages over 200 foreign scientists, with more than 1000 experts from 46 countries participating in proposal reviews. In June, 2015 the Foundation oversaw the launch of the first joint competition together with DFG, the German Research Foundation. ■

- 1120 projects and programmes, 383 research institutions and universities from 51 regions in Russia were awarded funds by RSF.
- 161 established labs engaged in the world-class research were supported by RSF.
- 38 new labs tackling the highly relevant problems with a societal and economic impact were established with RSF's financial support.

RSF

Russian
Science
Foundation

.....
Alexander Khlunov

Director

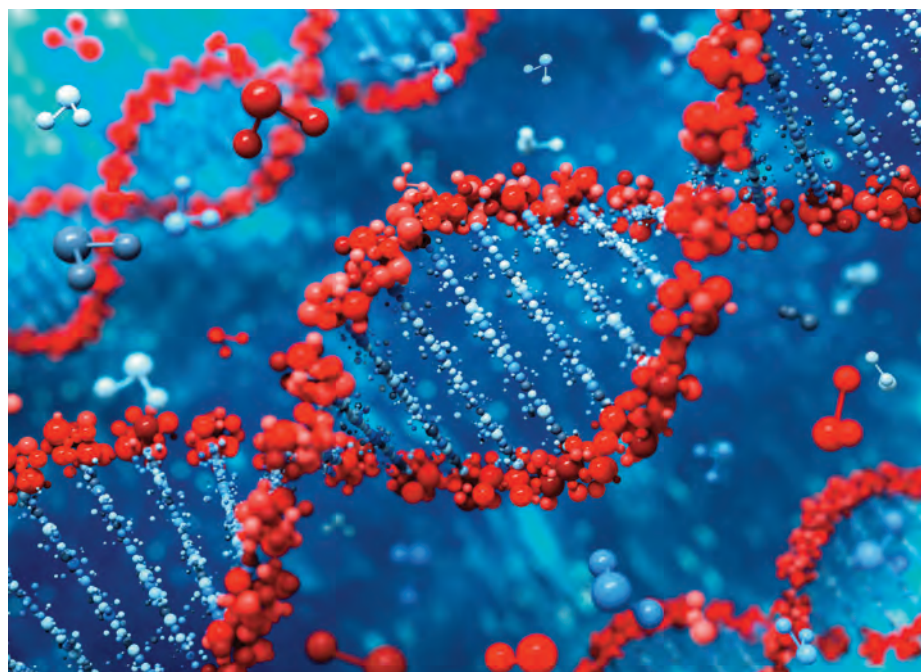
Russian Science Foundation

www.rscf.ru

Histone chaperones: the builders of chromatin

DNA is a molecule of life, which stores all genetic information necessary for organism development and function. On itself, the DNA is a simple thread-like molecule encoding the genetic text in 4 letters alphabet of A, C, G, T nucleotides. However, just as the complexity of living organisms has increased in evolution, so does the size of DNA has grown larger accommodating new genetic texts. On average, genomes of simple organisms, such as bacteria, contain 1 to 10 million nucleotides, whereas human genome comprises 6 billion nucleotides (3 billion from each parent). A distance between each nucleotide is miniscule (less than one nanometre), but the total length of human DNA contained within single cell is astonishingly large – 2 meters, and for all cells in human body the number is astronomical – 2×10^{13} meters (enough to shuttle 70 times between earth and sun).

Following these numbers, an immediate question comes to mind: how such long DNA threads are packaged within cell nucleus (a cellular compartment where DNA resides in eukaryotes), if, on average, the nuclear diameter is no more than few microns. To answer this question, one can think of two solutions: either to tangle the thread like a playing cat would do, or to wind it around a spool like in a cassette tape. The former solution is attractive as it requires little energy, but the latter solution has been chosen by nature as it keeps DNA thread ordered. Using the analogy with the tape cassette, the whole process looks like this: a short



stretch of DNA wraps two times around a spool followed by an even shorter stretch, called linker DNA. Then, an adjacent stretch of DNA wraps around another spool and the process is repeated many times until all DNA is packaged. In total, in every human cell 2 meters of DNA wraps onto about 25 million of spools. The resulting structure, also known as a “beads on a string”, comprises a backbone of chromatin fibre, which is further assembled into chromosomes through a series of coiling and looping mediated by nuclear proteins. Together, this is what makes it possible to squeeze long DNA threads into a tiny nucleus in an ordered, fractal-like fashion. Eventually, dressing of DNA into chromatin affects all genomic processes. This brings mechanisms of DNA packaging into a spotlight of multiple basic and clinical studies concerning eukaryotic genome stability, replication and expression.

Histone chaperones represent a diverse family of proteins that help DNA to wind around the spools, which at molecular level comprise protein complexes of 8 histone proteins, also known as a histone core. Initially, histone chaperones were discovered by Ronald Laskey in late 70th in an attempt to reproduce the DNA packaging mechanism in a test tube. Alas, when DNA was mixed with histones no wrapping has occurred. Instead, due to the differences in charge (DNA is a negatively charged polymer, while histones are positively charged molecules) histones stick randomly all around the DNA resulting in protein-DNA aggregate, which has nothing in common with cellular chromatin. However, he has noted that Nucleoplasmin, a protein from an African clawed frog eggs, when added to reaction, all of a sudden helped DNA to wrap around a histone core. Laskey coined the term “molecular chaper-

one", which he later renamed to "histone chaperone", to describe proteins, which prevent histone-DNA aggregation and assist DNA wrapping around a histone core, but which, on themselves, are excluded from the final histone-DNA complex, called nucleosome. Since this groundbreaking discovery was made, many researchers went off in a quest of new histone chaperones, which led to uncovering of a zoo of such molecules. Curiously, but the same discovery also helped the development of a field of "molecular chaperones", which focuses on general mechanisms of protein folding protein complexes assembly, and goes far beyond DNA wrapping around the histone core.

When I joined the field of histone chaperones, about 15 years ago, most of the studies were driven by biochemists, who followed molecular mechanisms of DNA packaging into histones in test tube reactions. However, little was known about the biology of histone chaperones. To address this question, I set my research on fruit flies and went into two directions: genetics investigation of histone chaperones' developmental functions combined with proteomics survey of their interaction networks. Both approaches turned to be complementary to each other and led to a number of surprising discoveries, which showed that histone chaperones play many more biological functions than were originally anticipated from biochemical studies.

My early enthusiasm in histone chaperones research has been substantially warmed up when I have found that, in flies, histone chaperones cooperate

with ATP-dependent chromatin remodellers in gene control. ATP-dependent remodelling of chromatin is an energy driven process of histone core sliding along the DNA in small steps of about 10 nucleotides via transient unwinding and rewinding of DNA. Later biochemical studies revealed that histone chaperones may intervene into this process to capture and remove histones from DNA at the unwinding phase. Thus, depending on cellular demands histone chaperones can perform two opposite jobs by helping in wrapping and unwrapping of DNA to and from the histone core.

In addition to sliding of histone core, chromatin structure can be modified by covalent attachment or removal of small chemical groups to and from histone molecules. There are many of such groups (phosphate: $-\text{PO}_3^{2-}$; methyl: $-\text{CH}_3$; acetyl: $-\text{COCH}_3$, etc.) decorating histone proteins in intricate combinatorial patterns. These patterns constitute a "histone code", which comprises an important layer of chromatin regulation. Sure enough, my work and the work of others has revealed that histone chaperones cooperate with enzymes responsible for histone modifications. For example, together with my colleagues we discovered that histone chaperones ASF1 and NAP1 facilitate the removal of methyl and acetyl groups from histones. This, in turn, provides a signal to the cell to shut down the genes at chromatin loci from where these two groups have been removed. Interestingly, ASF1 and NAP1 mediate histone demethylation and deacetylation at chromatin loci harbouring developmental genes, such as genes involved

in NOTCH signalling pathway. Thus, in addition to rather general DNA packaging function, histone chaperones also play significant roles in developmental gene silencing.

"Initially, histone chaperones were discovered by Ronald Laskey in late 70th in an attempt to reproduce the DNA packaging mechanism in a test tube."

In the following issues, I will cover more on histone chaperones and will highlight their other chromatin and chromosomal functions, but, going back to my first published article on the subject, I wish to emphasise here that histone chaperones may act like a grease for chromatin remodelling machinery to make it work smoothly.



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Highlighting research in Kazakhstan

Adjacent Government highlights how Kazakhstan is making its mark on the science and research community in Europe...

When you think of science and research excellence you don't automatically think of Kazakhstan. However, the country has been described as one of the most economically significant and scientifically progressive nations of Central Asia. Last year the President of Kazakhstan Nursultan Nazarbayev outlined his political strategy up until 2050, detailing the importance of investing in science and "the development of high-tech sectors."

The President said: "During the second and subsequent five-year plans, we should establish the industries of mobile and multimedia technology, nanotechnology and space technology, robotics, genetic engineering, and future energy exploration.

"The key priority of the government's work is to create most favourable conditions for Kazakhstan's business, mainly small and medium-sized enterprises. In the next 10 – 15 years, it is necessary to develop a knowledge-intensive basis for the economy. Without this basis, we cannot join the group of developed countries. And it must be founded on advanced science."

The President explained the development of a "knowledge-based economy" is one of his key priorities for the next 5 years in order to increase the capacity of science in the country. He said: "We need a concrete plan for the gradual increase of science financing for specific research and scientific discoveries. These are essential to the country and we need to bring them to the level of developed countries.

"To accelerate the transfer of knowledge and new technologies to the country, we need to fully use the potential of foreign direct investment. In cooperation with foreign companies we need to set up design and engineering centers."

The [Ministry for Education](#) and Science is the main department that is tasked with implementing science

policy. The country perfected its science focus in 2010 when the Law on Science was passed.

The Law established the importance of research and gave priority along with science education. New types of higher education institutes were introduced called "research universities".

In June this year Astana in Kazakhstan became the new home of the International Science and Technology Center. The ISTC headquarters were originally located in Moscow, but Kazakhstan has agreed to host the new headquarters in 2011, which will be located at Nazarbayev University until 2017.

The move paves the way for a new chapter for ISTC, which will see the Government of Kazakhstan officially take over as the host country.

The ISTC supports basic applied research and contributes to the solution of national, as well as international, science and technology problems. It is an intergovernmental organisation that was founded by the Europe Union, Japan, Russia, and the United States in 1992. There are said to be strong links between the research and business communities of Kazakhstan and ISTC. The country became a member of the Center in 1995 and partners have since funded 184 projects worth \$66m across the numerous fields of science supported in Kazakhstan.

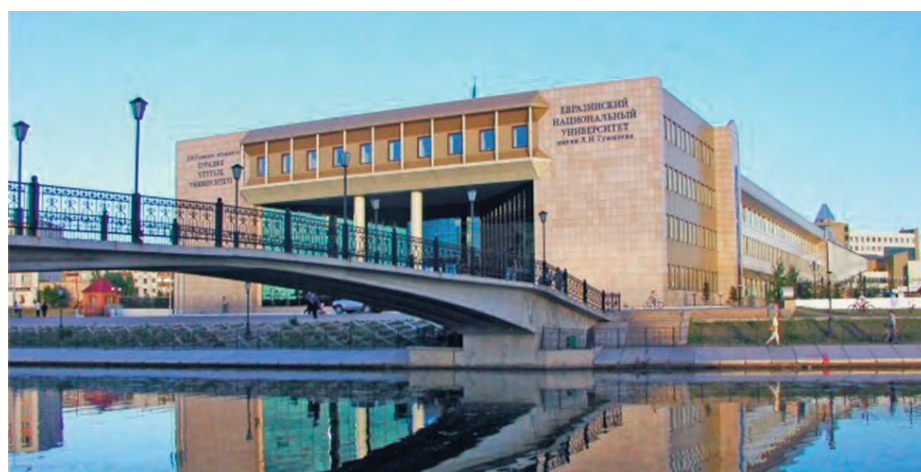
Although the country might not be the first 'go to' location for science and research, it seems they are certainly making a mark on the research community. ■

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Addressing the world's water shortage

Acute shortage of the drinking water reserves across the globe is one of the biggest problems these days. According to the study conducted by NASA in cooperation with the University of California on the underground natural reservoirs of water for the period of 2003-2013, the water supplies in underground aquifers are rapidly shrinking. Just over 30 percent (13 out of 37) of the largest underground water reservoirs are drying up at the moment. The fact that 35 percent of the world's drinking water comes from these underground sources means the situation could be described as critical.

According to the Agency for Regulation of Natural Monopolies, the groundwater reserves of Kazakhstan are estimated at 19 billion cubic meters, with an annual intake of water around 1.4 billion cubic meters. Providing the population of all regions with high-quality drinking water is one of the most urgent and difficult problems for the ecological security of Kazakhstan. According to the Ministry of Health of the Republic of Kazakhstan, the current state of sewerage systems resulted in a lack of sanitary and epidemiological welfare of the country's population. Thus, the quality of water from the 1 category open reservoirs used for centralized water supply in Kazakhstan declined on chemical indicators compared to 2009. Out of 1,989 water samples, 151 (7.6%) did not meet the standards of microbiological indicators – 4.5%.



The problem with drinking water purification is that it requires the joint efforts of industry, scientists and government together. There are a number of government programs aimed at addressing the problem. Thus, in the years 2002-2010 the "Drinking Water" industry program was launched by the government to provide settlements with reserves of drinking water. In 2011, the Ministry of Economic Development and Trade has planned an industry program called "Ak Bulak" to ensure settlements with drinking water for the years 2011-2020. The state program's developers indicate that one of the most affordable and effective ways to improve the quality of water is the use of individual purifications, mobile and stationary water purification filters. Thus, the Interdisciplinary Research Complex was established in 2006 at the University, and since 2010 has been working with the Intergovernmental Organization "Joint Institute for Nuclear Research" (JINR) on the

development of filters based on track membranes.

Analysis of the literature and patent documentation in the field of water treatment with the use of track membranes has indicated significant potential and limitless possibilities of this technology. At the heart of track membrane a polyethylene terephthalate film is irradiated with a heavy ion accelerator DC-60. After irradiation, the film is subjected to chemical etching, in which the latent tracks are converted into pores of the necessary diameter.

Filters based on track membranes are considered as a logical solution to the problems arising in the processing of drinking, technical and ultrapure water. This is due to a number of advantages of membrane technology as compared to conventional water treatment systems, such as the stability of the purification quality – even with substantial fluctuations in the



composition of the source water, the compactness of the equipment, high level of automation, and low operating costs. Membrane technology produces drinking water not only safe in chemical and microbiological terms, but also physiologically full in terms of macro- and microelement composition. As a result of this project, "Bulak-M", a line for the production of individual filters was launched and entered the retail market and was later exported to African countries.

It is notable that at this point in Kazakhstan no enterprise except L.N. Gumilyov Eurasian National University is carrying out a complete production

cycle of track membranes. Thus, in the high technology sector, there is no alternative import substitution, and demands of the consumer market are replenished by the products of foreign companies.

Engineering profile laboratory for the development of membrane technology-based accelerator DC-60 has become a starting point for the development of innovative technologies focused on the result of high demand. The accelerator DC-60 is the first major research nuclear physics facility complex established in the CIS. In the process of its design the most advanced physics ideas and technical

solutions were used to create one of the world's best-in-class accelerators. The research group consists of scientists, graduate and undergraduate students, and PhD students of the L.N.Gumilyov Eurasian National University.

Today, it is evident that the research activity of the complex is proof of a successful integration of education and science in solving the urgent problems of mankind. Due to the persistently increasing of the world's population this problem of drinking water has reached a global scale. Therefore, it is hard to deny that interdisciplinary approach in this area is one of the most effective. Basically, this is exactly what the creation of the research complex was supposed to bring in the ecology studies and life science.



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Exon skipping: making sense out of nonsense

Associate Professor Michela Alessandra Denti, Principal Investigator of the Laboratory of RNA Biology and Biotechnology at the Centre for Integrative Biology of the University of Trento, discusses how modulation of RNA splicing can represent a cure for inherited diseases...

RNA impacts nearly every aspect of gene expression and it is now clear that a large portion of human genetic diseases are caused by mistakes in RNA metabolism. It has become progressively evident that RNA is not just a carrier of genetic information, but also a catalyst and a guide for sequence-specific recognition and processing of other RNA molecules.

The growing body of knowledge concerning RNAs is opening up exciting and unprecedented avenues for research: RNA molecules are today, at the same time, targets of therapeutic intervention and novel therapeutic molecules to treat human diseases.

RNA splicing

'RNA splicing' is a process that all messenger RNAs (mRNAs) undergo in the cell. Once transcription of a gene begins in the nucleus, the transcript undergoes a complex series of processes all devoted to the production of a mature mRNA, collectively dubbed "mRNA processing". One of these events, called RNA splicing, consists in the removal of intervening sequences ("introns") and the joining of the coding portions of the transcript ("exons").

RNA splicing is a major way by which the cell can induce transcriptional diversity, mainly through alternative splicing, and apply a fine control on this diversity. The proper recognition of introns and exons is mediated by cis-acting sequences on the pre-mRNA and trans-acting protein factors, constituting the splicing machinery.

Gene mutations can alter RNA splicing

Several gene mutations, which cause different rare inherited diseases, affect the splicing of specific mRNAs.

Generally, mutations residing in introns are categorised as splicing mutations because the amino acid sequence of the protein is not altered, thus the problem most likely concerns proper splicing. However, splicing mutations can also be found in the exons, altering or not the coding sequence. In this case, their identification as a splicing mutation is much more difficult, as it requires analysis of the splicing pattern. Today it is believed that more than 50% of mutations act by altering the splicing pattern. Their effect can be retention of a part of an intron or the use of alternative splice sites, ultimately causing the insertion of a stop ("nonsense") codon. This in turn would cause the messenger RNA to produce a truncated, hence not functional, protein. Correct identification of these mutations is of pivotal importance for the development of therapeutic approaches.

Modulating RNA splicing as a cure for inherited diseases

At variance with mainstream gene therapy approaches, which aim at replacing the mutated gene with a functional DNA copy of the gene itself, the therapeutic approach called "exon-skipping" aims at correcting the mRNA transcribed from the mutated gene. By introducing small RNA molecules, scientists mask the mRNA to the attack of the splicing machinery, inducing it to jump certain portions of the mRNA, thus restoring the correct message. Exon-skipping holds a great deal of promise as a potential cure for genetic diseases, and several clinical trials on Duchenne Muscular Dystrophy have supported the notion that the technique could one day become commonplace for many other inherited diseases.

Aside from splicing mutations, antisense-mediated splicing-correction approaches can potentially be

utilised for the correction of missense and nonsense mutations, as well as for small insertions and deletions. In all cases where a mutation causes the introduction of a stop codon or frameshift leading to a premature termination of the transcript, the possibility to interfere with the proper recognition, by the splicing machinery, of the exon carrying the mutation (therapeutic exon skipping) can be the right strategy to follow. The result of this approach is a shorter mature mRNA, missing the portion encoded by the skipped exon, but resulting in a restored protein. Such an approach has been proven successful to restore dystrophin in the muscles of Duchenne Muscular Dystrophy patients.

The most widely studied approach for the correction of aberrant splicing is the use of antisense oligonucleotides, short synthetic molecules that target the pre-mRNA and that can be delivered to the affected tissue by local injection or through intravenous injection and delivery via the circulation. As the effect of antisense oligonucleotides is time-limited, to have a durable effect repeated administration is required. In this view, scientists are also studying the possibility of using engineered small antisense RNA molecules, produced by endogenous transcription of DNA vectors provided to the affected organ using viral or non-viral delivery systems.

RNA splicing is an extremely complex and fundamental cellular process that has been so far barely considered as a therapeutic target, even if it can be seen as a highly appealing one for its importance in the cell context. The ability to modulate splicing can in fact offer several advantages over other conventional gene replacement approaches.

By definition, antisense-based therapeutic approaches act following base-pairing with their mRNA target, thus giving the possibility of obtaining a great specificity of

action. Since they act at the mRNA level, the endogenous transcriptional regulation of the target gene is always maintained. This means that the therapeutic effect is obtained only where and when the target pre-mRNA is present. Splicing-correction approaches also allow a fine-tuning over the relative abundance of splicing isoforms because, by acting at a pre-mRNA level, it is relatively easy to modulate their ratio. The availability of several different molecular tools that can be used to manipulate splicing renders these approaches a versatile and promising strategy for the multitude of genetic diseases known today.

To overcome the challenges of the exon skipping strategy, at the end on 2012 several key stake holders (scientists, clinicians, regulators, industry and patients) came together in COST (European Cooperation in the field of Scientific and Technical Research) Action BM1207 (www.exonskipping.eu). This COST Action aims to advance the development of antisense-mediated exon skipping for rare diseases, using Duchenne muscular dystrophy, for which this approach is currently tested in phase 3 clinical trials, as a showcase. Through networking, participants belonging to 18 different countries, intend to allow clinical implementation of antisense-mediated exon skipping for as many rare disease patients as possible. ■

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It's the 'content' of cells that matters in biomedical research

One of the most remarkable things about life on earth, in all its forms, is how cells often only tens of microns in diameter have evolved to carry out the variety of tasks that they do. In multicellular organisms the situation is even more complicated, as different cell types need to work together in an orchestrated manner in functional units such as tissues and organs to maintain the health of the organism. Ultimately therefore, it is the function of individual cells in our body that determines our health, and our susceptibility to disease and infection. The discipline of cell biology serves to understand how cells work, and importantly what goes wrong in cells to cause disease. It is a discipline, with associated technologies, positioned at the centre of all fundamental biomedical research.

“...we believe that our HCS approaches provide critical information about cell organisation that can be exploited by many branches of biomedical research.”

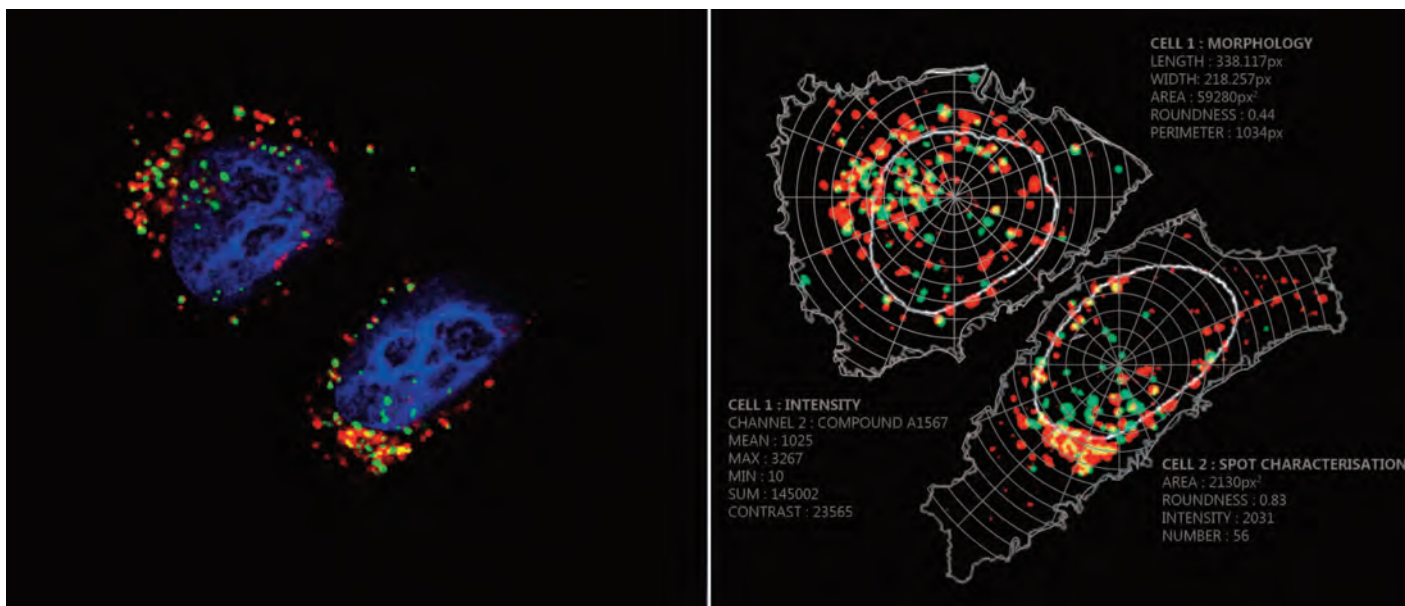
Since the mid-seventeenth century microscopy has been the primary tool for scientists to reveal the structure and organisation of cells, both in isolation and in their 'social' context. In the late twentieth and early twenty-first centuries however, the widespread application and integration of fluorescence technologies with microscopy has provided new

opportunities to reveal the innermost workings of cells. Fluorescence microscopy allows researchers to potentially view not only the cellular organelles, but also the billions of molecules – in particular proteins – that work together to provide the cell with its functionality. Therefore, in this post-genome sequencing age, how can we assign discrete function to each of the 22,000 human genes and the proteins that they encode? Furthermore, how can we identify those proteins that can cause particular disease, and those proteins that can have protective properties? Carrying out such experiments in intact and preferably living cells has obvious benefits, but clearly the scale of such experiments is challenging. Simply visualising each protein in turn (and molecular techniques in principle make this possible) requires 22,000 individual microscopy images, and so without considering any further complexity of the experiment or replicates we would need to image almost every well from 230 96-well plates in a consistent manner. Even if this is achievable, the next problem becomes one of how to interpret the images, and in such a way that we can objectively compare them. The issues are experimental scale and complexity of information.

In the last ten years this experimental approach has become a reality, and these barriers are being overcome, encompassed in a technology termed

'high content screening and analysis' – HCS / HCA. This is a fusion technology, combining lab automation, particularly in terms of the microscopy, with sophisticated software routines capable of analysing images of millions of individual cells ('high throughput') and extracting user-defined quantitative information ('content') for each cell. Since its development, labs around the world have embraced its power to address both fundamental cell biology questions and applications relevant to human health and disease. HCS can and has been used to rapidly screen massive libraries of chemical compounds to identify leads with desired cellular phenotypes, to identify host factors associated with virus infection, and reveal new triggers for cancer cell development. For cell biologists it has proved to be a particularly powerful technology when combined with RNA interference (RNAi), a molecular technique that allows researchers to inactivate genes and the proteins that they encode in a systematic manner. Carrying out RNAi experiments in an HCS format effectively allows us to dissect the function of each gene / protein in turn with respect to a particular biological question, with the output being images of cells revealing the phenotype, and also their quantitative analysis.

In the Cell Screening Lab at UCD (www.ucd.ie/hcs) we have been developing and applying HCS strate-



Left: image of two cultured human cells fluorescently labelled for various subcellular structures. Right: example of 'content' that can be extracted from these cells

gies for a number of years to address questions related to how cells transport material (cargo) between their various internal organelles. Understanding how these membrane transport processes work is of vital importance, as all cargo inside cells will only facilitate cell function if it is located in the correct place. For example, signalling receptors at the cell surface are actually synthesised and assembled in internal membranes of the endoplasmic reticulum, requiring transport through intermediate organelles for further processing prior to delivery to the cell surface. Many human diseases are associated with mistargeting of such receptors – cystic fibrosis is a well-known example. Our ongoing mission is to use RNAi at a whole genome scale to systematically dissect how such transport pathways are regulated, and ultimately to use this information to gain insight into how they can be manipulated. Improving drug delivery efficacy into cells is one good example of how this approach can be utilised. Ultimately

therefore, we believe that our HCS approaches provide critical information about cell organisation that can be exploited by many branches of biomedical research.

“In the last ten years this experimental approach has become a reality, and these barriers are being overcome...”

There are of course both technological and political challenges to overcome if HCS is to continue providing valuable data to the scientific community. From a technological perspective there is a move towards use of more complex 3-dimensional multi-cell type models, which although may better represent the in vivo situation, they are more difficult to image and precisely quantify, requiring confocal HCS technology. Politically, HCS is a relatively expensive technique, both in terms of its hardware and the reagents needed to carry out large-scale screens. In the current challenging environ-

ment of research grant availability, funding bodies often prioritise more advanced or applied projects that might return gain in the short term. Ignoring HCS projects would be foolish, as they show real promise to deliver advanced cell biology knowledge that will inform and drive the direction of future biomedical research.



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Research excellence in Germany

With the renegotiation of the Pact for Research and Innovation, Germany seeks to cement an international reputation for excellence in science, research and development, as Adjacent Government highlights...

Germany's science and innovation system is now well positioned - even by international standards. Never before has so much been invested in Germany in research and development (R&D). Between 2005 and 2013, nominal R&D spending in Germany rose by almost 70%.

In a speech Federal Minister for Education and Research, Johanna Wanka detailed further how reliability for funding in research is integral to achieve excellence:

"How the money is used is equally important, and even more important for science is reliability. Through the Pact for Research and Innovation, we guarantee reliability for extramural research institutions, which in itself is very valuable.

During the coalition negotiations, we were in a difficult situation. A number of states said that they were not prepared and did not feel able to continue the pact because of their financial situation. Some also referred to their own colleges, which would also be strengthened. At this point, it was only right and very important that the federal government has committed to carrying on the Pact for Research and Innovation alone.

In Germany we have achieved a very high standard throughout the higher education system. The Excellence Initiative has brought movement into the system and moved us to measure outcomes.

You must understand that I do not want to prejudge the results of Imboden Commission which is currently evaluating the Excellence Initiative. I would like to decide in the first quarter of next year what will happen next. It is existential for Germany to promote excellence. I am therefore grateful for all suggestions that are made.

With academic freedom and academic responsibility, the scientific elite is growing. The career paths within

the science system are in need of reform. Since 2005 a lot of money has come into the system, usually temporarily. This was associated with a huge increase in short-term contracts. The balance between permanent professorial jobs and temporary jobs is out of kilter. Do not misunderstand me: A scientific system needs both. Too many permanent jobs makes the system inefficient, at the expense of the next generation. But it is no longer right that we should have as many temporary positions as we do at the moment.

With the BAföG [Federal Training Assistance Act] changes we have already taken the first step. Thus, states now have a reliable income for permanent positions. The Science Council proposed a very satisfactory model of career goals and paths at universities last year.

Many large research infrastructures are not purely national, but occur in cooperation with numerous partners in Europe and worldwide. That means that any decision on German involvement in these projects needs a thoughtful and well-reasoned basis, guaranteeing reliability to our international partners. Important decisions lie ahead of us in the education and research policies we will make, in consensus with our partners in the scientific landscape."

The above is an abridged translation of the speech delivered at the annual meeting of the Max Planck Society on 18 June 2015. For further information please visit <https://www.bmbf.de/> ■

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Nuclear Medicine in Dusseldorf

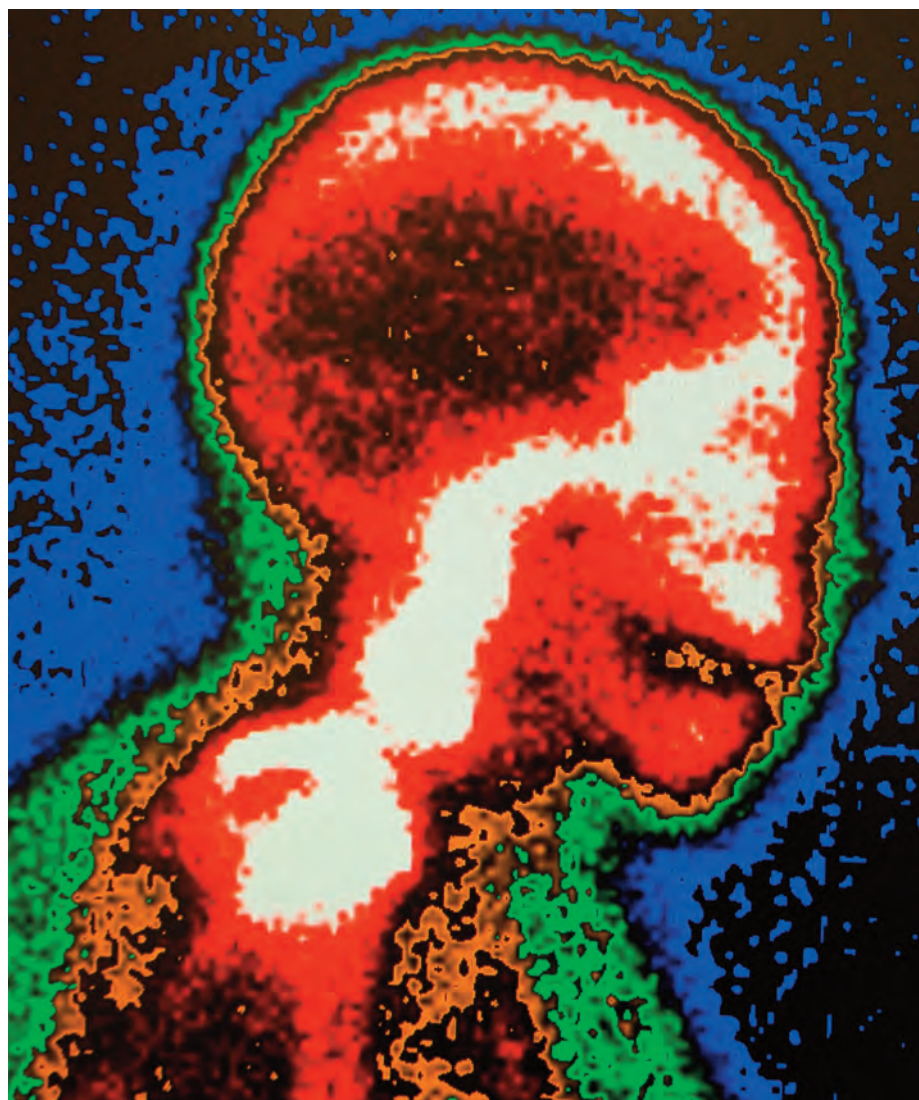
The Clinic of Nuclear Medicine at the University Hospital is located both in Düsseldorf and at the Research Center Jülich, and runs a nuclear medical out-patient department covering the whole spectrum of radioisotope scanning from thyroid and skeleton scintigraphy to examinations of amino acid metabolism for tumor diagnosis. As well as several conventional gamma cameras at both locations, the clinic also runs four SPECT cameras partly equipped with more than one detector head. There is also an out-patient department in Jülich, which specialises in thyroid disorders and excels by combining the diagnostic approaches of internal medicine with nuclear medical ones.

Part of our diagnostic spectrum are cutting-edge nuclear medical examination techniques such as positron emission tomography (PET). This method is used to examine glucose metabolism in patients suffering from cancer or cardiologic, neurological and psychiatric diseases.

Apart from the wide range of diagnostic possibilities, the Clinic of Nuclear Medicine is one of the largest nuclear medical therapy centers in Germany, specialising in the treatment of benign and malign thyroid disorders.

Patient care

In Nuclear Medicine, very small amounts of radioactive substances



are applied during diagnosis and/or treatment. These are called 'tracers', and are used to study metabolic processes or organ function within the human body. The distribution of radioactive tracers is made visible with special radiation detecting cameras. Thus, metabolic irregularities may be diagnosed which are indicative of specific metabolic diseases.

Presently, nuclear medical physicians are able to detect a number of metabolic disorders; diseases may be diagnosed in an early stage, even if organs are not altered in morphological terms. Tumor cells, for example, are characterised by elevated glucose utilisation. Therefore, Nuclear Medicine may detect the tumor earlier by labeling glucose with a radioactive

isotope and observing its consumption within the body before changes are detectable by morphological imaging methods (MRI, CT). Nuclear medical examinations may also be successfully employed for the diagnosis of brain diseases such as Parkinson's disease, Alzheimer's, or epilepsy. Today, because of Nuclear Medicine, much more is known about their causes. Investigations of the Clinic of Nuclear Medicine showed that psychiatric diseases such as depression may be related to specific biochemical changes of the brain.

Radioiodine therapy is vastly applied for the treatment of thyroid diseases. In patients suffering from thyroid cancer, tumor cells may be effectively destroyed using this method. The applied radioactive iodine almost exclusively accumulates within the tumor cells, which are destroyed by the emitted radiation.

Research and teaching

Our research focuses on the assessment of brain functions. Generally, our studies involve measurements of blood flow, glucose utilisation and neuroreceptor/transporter binding. One major field of research is the investigation of brain regions relevant to memory formation. Moreover, we investigate synaptic changes in patients with neurological and psychiatric disorders. A further aspect of our work is the employment of highly-resolving small animal cameras for the assessment of pre- and postsynaptic regulation mechanisms.



These studies aim to deepen our understanding of dysfunctions related to diseases such as Parkinson's, Alzheimer's, schizophrenia, epilepsy and depression and contribute to the development of novel therapeutic strategies.

A further key topic of our clinical research is to investigate the effects of myocardial stem cell transplantation after cardiac infarction. Furthermore, we work on several oncological projects; a variety of malign neoplasms including brain tumors, thyroid cancer and prostate cancer are investigated applying PET or SPECT and newly developed radiotracers. Additionally, in a multicenter study, infantile tumors and their response to therapy are also investigated.

A further aspect of our scientific activities is the development and employment of highly-resolving cameras suitable for the investigation of small animals.

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Cardiovascular diseases: Detecting dangerous plaques in time

The European Association for Nuclear Medicine outline how nuclear imaging techniques can now help to identify cardiovascular diseases...

With 5 million deaths per year, cardiovascular diseases (CVD) are the leading cause of mortality in Europe. In western countries over a third of the adults die from coronary artery disease and another 25 % from stroke. Unstable plaques in arteries, which play a significant role in CVD, often remain undetected until a dangerous stage has been reached. "Novel nuclear imaging techniques now enable us to identify these 'time bombs' much earlier and raise hope to be able to prevent them from becoming a threat to the patient's life," says Dr. Fabien Hyafil, expert of the European Association of Nuclear Medicine (EANM).

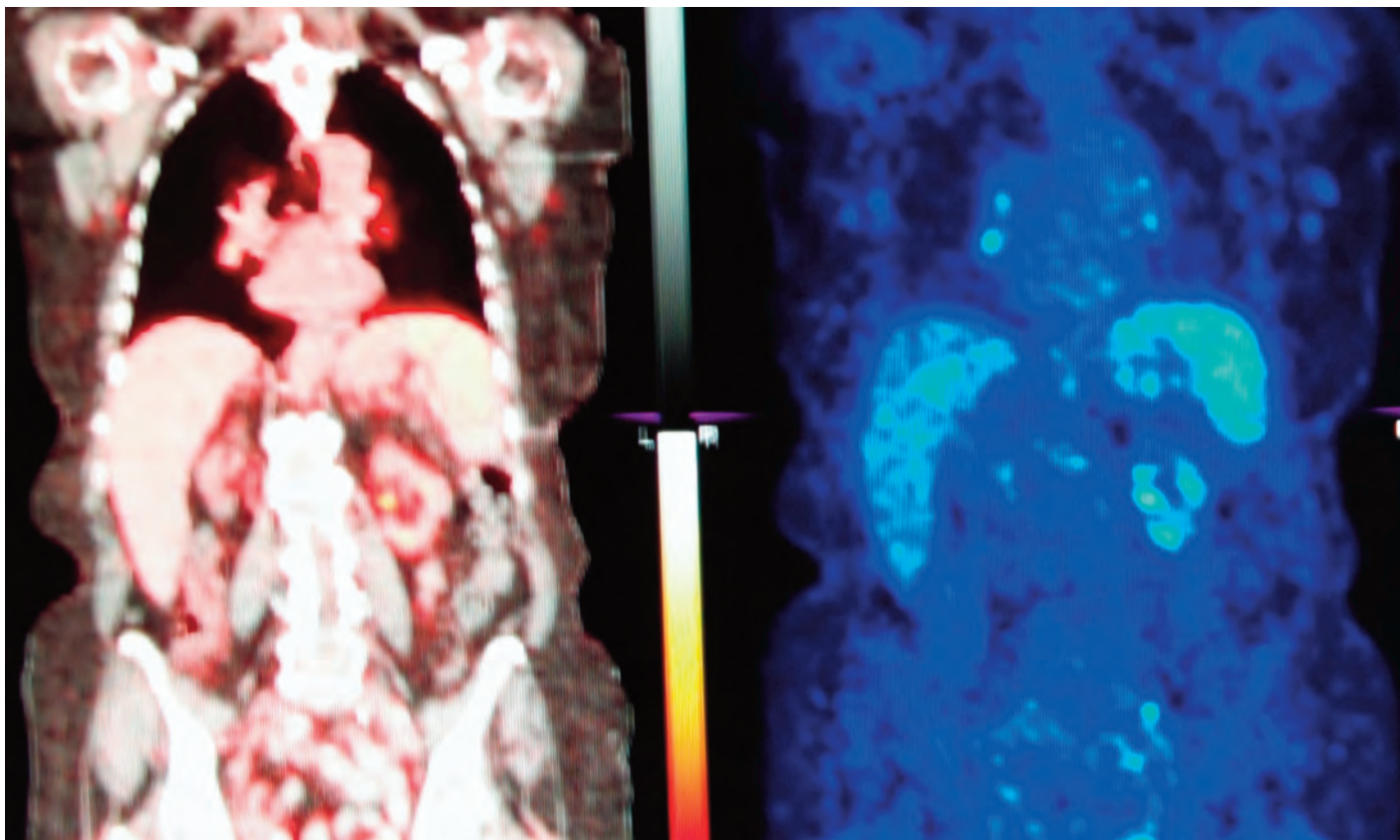
"Recent developments in molecular imaging, namely PET imaging, now allow for the detection of biological processes in the wall of vessels."

Although treatment of CVD has improved considerably over the past decades, preventive measures still often fail. In order to improve this situation innovative diagnostic approaches are essential. The vast majority of heart attacks, strokes, and peripheral vascular diseases is caused by atherosclerosis. This condition develops over time with the progressive accumulation of lipids, inflammatory cells and connective tissue within the inner layer of arterial walls leading to a local thickening of the vascular wall called atherosclerotic plaque. The increase in plaque size is progressive with aging but is accelerated through smoking, high levels of cholesterol in blood, arterial hypertension or diabetes. Once atherosclerotic plaques extend into the lumen (the inside conduit of arteries where blood circulates), the blood flow passing through arteries will be reduced. In the heart, the amount of oxygen transported to the cardiac muscle by blood will not be sufficient anymore during exercise in the regions

downstream of the stenotic plaque and this might result in angina pectoris. In some of the arterial plaques an inflammatory reaction will develop in contact with their fatty content. These plaques will grow much faster and might ultimately rupture and expel their fatty content into the arterial lumen in a way similar to an abscess. Plaque rupture stimulates clot formation in the vessel and can cause life-threatening conditions such as myocardial infarction or stroke. If the clot completely occludes the artery perfusing the heart, downstream of this occlusion no oxygen can reach the heart anymore thus causing the sudden development of an acute myocardial infarction, a local destruction of the cardiac muscle. As far as the arteries supplying the brain are concerned, they usually are not occluded completely by the clot. However, the clot might break off and obstruct arteries in the downstream circulation thus provoking a stroke. As for the treatment of CVD one of the important challenges that remain is the ability to identify the patients presenting with these dangerous, unstable atherosclerotic plaques, which might soon lead to myocardial infarction or stroke.

A tool for preventing life threats

Recent developments in molecular imaging, namely PET imaging, now allow for the detection of biological processes in the wall of vessels. Positron emission tomography (PET) imaging requires the injection of a very small amount of radioactively labelled substances into the vein, so-called tracers by which molecular or biological processes can be targeted. After injection, the tracer will diffuse and accumulate in tissues containing this specific molecule or biological process and emit a signal, which can be located very precisely through the PET imaging system. 18F-fluorodeoxyglucose (FDG) is a radioactively-marked sugar, taken up by cells with high-energy consumptions such as inflammatory



cells. After injection of FDG, PET imaging allows for the identification of atherosclerotic plaques with high inflammatory activity, a marker of unstable plaques. Furthermore, several clinical studies have shown that patients with the highest FDG uptake in their arteries were more likely to develop a cardiovascular event within the next 4 years. There was also evidence that FDG uptake in atherosclerotic plaques rapidly decreases after initiation of lipid-lowering drugs such as statins, which favour the healing of unstable plaques. Vascular FDG-PET imaging therefore is a promising tool to monitor the efficacy of new anti-atherosclerotic drugs. It is becoming largely used by the pharmaceutical industry to identify the most effective drugs for the treatment of patients with CVD. "This technique will improve our understanding of the role of vascular inflammation in the destabilisation of atherosclerotic plaques", says EANM expert Dr. Jan Bucerius. More recently, another tracer for PET imaging, sodium ^{18}F -fluoride, has been found to bind to tiny, bone-like structures named micro-calcifications. These microcalcifications cause small but continuous lesions in atherosclerotic plaques that progressively weaken them, ultimately leading to plaque rupture. In addition to FDG, sodium ^{18}F -fluoride also holds promise for the identification of dangerous plaques in patients.

"Several tracers to be used with PET imaging have now become available to identify dangerous, unstable plaques in arteries. This technique might therefore help us to identify more accurately patients at risk of acute myocardial infarction or stroke and to develop strategies to prevent these dramatic events by starting a timely preventive treatment", says

Dr. Hyafil. And Dr Bucerius points out: "One of our major goals is to introduce these promising non-invasive imaging techniques into clinical routine as soon as possible."

For further information from EANM, please also visit <https://www.facebook.com/officialEANM>

For an animated introduction to nuclear medicine, please visit the website www.whatisnuclearmedicine.com

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Boosting investment in education: Let's make it happen

In a speech at a joint event with The European Investment Bank, Tibor Navracsics, Commissioner for Education, Culture, Youth and Sport, outlines the importance of boosting investment and tackling the key challenges in Education...

When Commission President Jean-Claude Juncker presented the Investment Plan for Europe in Strasbourg almost a year ago, in front of the European Parliament, he found very powerful words to stress why we need fresh investment.

And the very first example he gave was this: "I have a vision of school children in Thessaloniki walking into a brand new classroom, decked out with computers." I bet that many in the hemicycle and beyond struggled to understand how could this happen. To understand how a new European fund whose *raison d'être* is to trigger private investment can play a role in education.

Many are still wondering. That is why I decided to organise today's conference together with the European Investment Bank. I want to make President Juncker's vision happen. I want to make sure that education benefits from the Investment Plan as much as possible. I know that together, we can reverse the alarming trend of underinvestment and get fresh money flowing into education right across Europe.

The situation is very worrying. Vice-Presidents Katainen and Baranyai have already highlighted how badly Europe is lagging behind, how hard the economic crisis hit the world of education over the past few years. This is especially grave when we look at the broader context: Today, 123 million Europeans are at risk of social exclusion. Youth unemployment is still unacceptably high in several Member States with 7 million youngsters neither working nor studying. Inequalities continue to grow with the top 20% earning more than 5 times the income of the bottom 20%. Our Union is now less inclusive and equal than before the economic crisis.



Tibor Navracsics, Commissioner for Education, Culture, Youth and Sport

Beyond this, we also have to question the efficiency of our education systems. Europe's workforce is ill-prepared for this more challenging post-crisis world. Even the fundamentals are not secured. How many people know that today, in 2015, one in five European adults struggle with reading and writing and lack basic numeracy skills? How many know that one in four are unable to use a computer, write a letter or send an email?

Tackling these challenges is crucial. Because education is the best safety net against social exclusion. Today's early school leavers are tomorrow's unemployed and impoverished. A solid education that equips young people with the skills and competences they need for the labour market is the most efficient way to fight unemployment. And, fighting unemployment is in turn the best means of fostering inclusion.

If we are serious about maintaining open, inclusive societies, we need to put people at the heart of our work and show that we are investing in their future. Most importantly, we need to regard putting money into developing people as an investment, not as an expenditure. In times of fiscal consolidation, we all know how difficult it is to keep investment at an adequate level. We are certainly not here to point our fingers at anyone. Quite the contrary. We are here to support Member States and to offer concrete solutions.

We want to help them make the most of the opportunities that the European Fund for Strategic Investments and the European Investment Bank have to offer. Both have a crucial role in boosting investment in education.

Why? For 3 reasons:

First, because the private sector can play its part in investing in education. The European Fund for Strategic Investments is based on a brand new concept, a new way of working that goes beyond grants and loans. This Fund can offer guarantees to help beneficiaries obtain loans from private banks at more favourable conditions. It can also invest in equity. It can support private-public partnerships that can bring huge benefits to education in many ways: by building and modernising school buildings, by rolling out broadband, by promoting research and projects that bring together universities and companies.

Second, and this is vital, the European Investment Bank already is and will remain a central player in education. How many of you knew that last year, it invested €4.8 bn in education, that its projects range from supporting universities in Italy to kindergartens in Belgium and primary schools in France? The European Investment Bank's on-going activities offer many possibilities as well as technical advice.

Finally, the EU Structural Funds are also part of the equation. They can complement schemes run under the Investment Plan or by the European Investment Bank. This is particularly interesting for projects

aimed at boosting investment in people, such as the training of teachers.

Thanks to the dedication and hard work of Vice-President Katainen, the European Fund for Strategic Investment is now up and running. This is the moment at which you come in. We need smart projects, and we need them as soon as possible. Your creativity and your ideas will be crucial in creating much needed fresh investment in education.

What we want to do today is to explain both the new and the existing instruments, explore possibilities and crosslinks, and examine how projects can be pooled across regions or countries so that they have a real impact. I would like to welcome all those who are presenting their own projects here today. Your examples show just what is possible, and I want to thank you.

Your discussions today are the beginning of a long journey. We, the Commission and the European Investment Bank, will be here to support you and give advice over the coming years. We will do this here in Brussels, but also in each Member State, to ensure that, together, we invest smartly in our more precious asset: our people. In Thessaloniki and all across Europe. ■

This is speech given by Commissioner Tibor Navracsics at a joint event by the European Commission and the European Investment Bank "Education and the Investment Plan for Europe"

http://europa.eu/rapid/press-release_SPEECH-15-5764_en.htm

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European Commission
www.ec.europa.eu/commission/2014-2019/navracsics_en

How technology can support teachers best

Educational technologies are advancing rapidly; new solutions, apps, and online platforms appear every day. Mobile learning, learning on demand, and media rich curricula are recent buzz words describing the “techno-pedagogical” state of the art. And not least, the research and development community is encircled by the hovering spirit of “big data”, “learning analytics”, and “educational data mining”. In educational practice, moreover, we can observe an increasing change towards a formative-centred evaluation and guidance/support of learners and a strong orientation towards competence development and individualisation. There is little doubt, that the pace and mode of learning must adapt to ever fast changing societal challenges.

Considering Europe’s classroom reality, however, we can find a different situation: The most frequent situation in schools is that they are technology lean; there is little hardware and software, internet access is often not available, too slow, or restricted. Of course, there are few schools where the opposite is the case and technology is seen as an additional basic literacy. In the end, the use of (new) technologies is often dependent on the enthusiasm and skills of individual teachers and, even when teachers are using technologies; it still is difficult to give technology applications a deeper pedagogical value.

In conclusion, in all likelihood, there is no “big data” in schools and some-

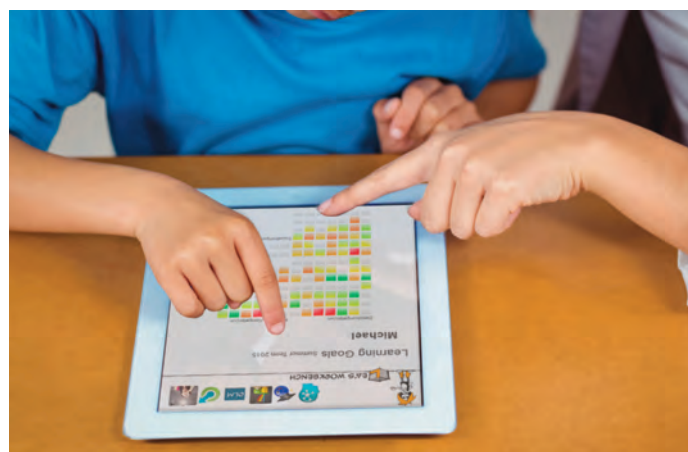
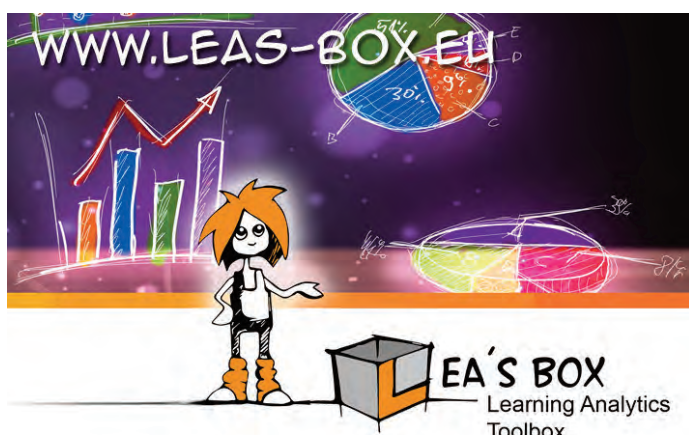
times we do not even find “little data” in European school realities. Also, there is a lack of clear psycho-pedagogical ideas of how to use the fantastic new opportunities of technology (ranging from Facebook to Minecraft). On the other hand, we do know that a smart application and analysis of educationally relevant data is the most effective way to improve personalised teaching and learning. Only if a teacher has a detailed and in-depth understanding of each individual learner’s learning trajectory, particular strengths and weaknesses and, perhaps most importantly, the competency gaps, then and only then, teachers can support their learners in an optimal formative manner, highly tailored to the concrete educational needs and goals. Certainly, teachers across Europe do a fantastic job, however, a large body of research yields that the necessary level of insight can only be reached when teachers are supported by smart technologies tailored to their particular needs and the given context conditions – technologies we can subsume under the term learning analytics.

Learning analytics is defined by the Society of Learning Analytics Research (www.solaresearch.org) as “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs”. Learning analytics consists in a multi-step, cyclical process of data collection and pre-processing, analytics and action, and post-processing. Data



Dr. Michael Kickmeier-Rust, Senior Researcher and Strategic Manager at Graz University of Technology

collection and pre-processing refers to the gathering of educational data from different learning tools and applications and preparing and translating it into an appropriate format. The analytics and action phase denotes the actual application of analytic methods, to extract meaningful patterns and information from the data and to make use of the obtained results (e.g., visualisation, feedback, recommendations, adaptation). Post-processing includes ideas of continually improving analytics by refining analytics methods or using new methods, including new data sources. Ryan Baker and George Siemens distinguish five classes of key methods currently used in learning analytics: prediction methods, structure discovery, relationship mining, discovery with models, and distillation of data for



human judgment. Rebecca Ferguson highlights that the traditional research results must now increasingly find their way into classrooms. Summarising this, the fundamental idea of learning analytics is to bring together all bits and pieces of educational relevant data, no matter from which source.

One of the most successful recent European initiatives to provide teachers with such smart educational and analytical technologies is LEA's BOX (www.leas-box.eu). The name stands for a Learning Analytics Toolbox that aims to provide teachers and learners with a range of tools to collect, aggregate and analyse data. The LEA's BOX project provides tools that allow teachers to collect data and events (e.g., test results or in-class activities) in a very simple and effective way, independent from devices or particular technological infrastructures. On the basis of data and on the basis of robust psycho-pedagogical theories, the project provides visualisations of learning progress and the structure of competencies in a variety of ways.

A key aspect when using complex intelligent technologies is also to open learner models to the users (teachers and students) to facilitate a reflection about learning and skills. Exactly this

active involvement in assessment and the communication of results is the nature of effective learning; it ignites self-reflection and a suitable adaptation of learning as well as teaching strategies. Different visualisations can be useful for supporting different needs for viewing learning data. Learning analytics visualisations tend to be closer to those found in visual analytics more generally, such as pie charts, bubble charts, or line graphs, whereas open learner models have developed visualisations such as skill meters, concept maps or hierarchical tree structures. Bringing together statistical analyses and structural, non-numerical views of competency development, most recent developments focus on structural graphs and lattices to illustrate the details of learning.

In conclusion, it is clear that the best way to support teaching and learning is to have an eye on competency development on a highly detailed and highly individualised level. In addition, we need to consider learning as a structural process that doesn't occur arbitrarily; we need to link competencies as well as prerequisite structures among them to actual curricula and teaching. The most important step is to translate such considerations into

technology that supports teachers and learners in their particular settings and infrastructural context conditions. Most likely, not the most sophisticated technology is the most effective one but that technology that meets teachers and learners where they are – today! Of course, there is no doubt that future teacher education must address an appropriate use of technology for educational purposes way more than presently it is the case. Until then, projects like LEA's BOX envision to fill the gap and make education and training smarter, more effective, and perhaps more enjoyable.



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The efit21 strategy – transforming education

The Federal Ministry for Education and Women's Affairs (BMBF) details how new digital technologies are transforming classrooms across Austria...

Information and communication technologies transform teaching and learning. New teaching and learning methods such as the flipped classroom or Massive Open Online Courses (MOOCs) are opening up the classroom: learning takes place not only during the instruction period but also during the break, in the corridor, on field trips or during leisure time. Technologies support the formation of new learning communities, flexible and class-wide collaborations, individual learning paths, as well as research-based and student-centred learning. The pupils are the focus: they assume an active role in an autonomous learning process.

With the “efit21 – digital literacy” strategy, the Federal Ministry for Education and Women's Affairs has set focused targets for the sustainable use of digital technologies and media in Austrian educational institutions. “efit21” focuses on international developments and key concepts, bringing together all relevant initiatives and projects of the Ministry under its umbrella and pursues strategic objectives:

- Systematically improve the quality of teaching and learning and integrate innovative learning scenarios into the educational process;
- Provide digital skills for personal and professional success to youth and adults;
- Convey skills relevant to the labour market through professional training and professional eSkills;
- Sustainably improve the efficiency of educational administration by the use of IT;
- Improve access to digital technologies and media, dismantle barriers to use and support better participation;
- Promote digital education institutions.



Attention to gender perspectives, participation in international projects and cooperation with different institutions and disciplines such as science and research and the economy are important principles in the implementation of the strategy.

Digital technologies and media are integrated with binding effect across the board in the curricula of all schools via the “eLearning/application of technology in the classroom” and “Media education” teaching principles, as well as partly via their own subject matter.

No child should leave school without digital skills

Children and young people grow up with technology. The world they live in should also be actively integrated into school. Studies have shown that as “digital natives”, students can often use only a narrow range of technologies competently. Therefore, it is important to provide them with a reflected approach to digital media and the Internet and lead them to be able to use the technology responsibly on their own.

Under “Digikomp8”, a group of experts has brought the digital skills ¹ together which students should possess by the end of grade 8 (age 14). The rollout is based on digital classroom examples relating to the educational topic. Digital skills were also defined and

classroom examples were developed for primary level (age 6 to 10) and secondary level II (age 15 to 18).

The saferinternet.at coordination point provides information and services for schools and school partners on various aspects of the safe use of ICT and the Internet.

Educators play a key role in conveying these skills. The “digiCHECK” tool allows teachers to check their digital literacy and skills on the basis of self-assessment questions and receive feedback on recommended measures to be taken to improve qualifications. Training modules and eEducation courses are available to the teachers. The Virtual Pedagogical University offers new training models such as collaborative online seminars and introductory units in the form of eLectures.

Taking advantage of technology potential for teaching and learning

The educational potential of ICT for education and training is still not fully being used. One of the core statements of the OECD report on the connections between technology use and student performance is that 21st-century technologies should be linked with modern educational models.²

A large number of Austrian schools have integrated ICT well into their daily routine and the development of the school; they link the technologies with educational concepts and use creative potential for the learning process. eLearning networks have established themselves in innovative schools. Mobile devices are used in notebook and tablet classes as learning tools. Learning platforms and learning-management systems are available as a central service to all schools.

The “Mobile Learning” project follows a cross-school peer-learning approach and aims to contribute to further dissemination: An eLearning-savvy school supports 2 newly joined schools on their way to digital teaching and learning with tablets. They network and implement a jointly developed educational concept at their sites. BMBF thereby also pursues a new approach to training educators (learning from colleagues through practice).

Increased use of digital educational media

Well-prepared digital educational content offers

the opportunity for effective educational use of technologies. Content portals with digital teaching materials have been established. An important milestone has now been reached in the area of digital textbooks: Through the textbook initiative, beginning in 2016 eBooks will be used for the first time in secondary level II. At another stage of expansion, interactive supplementary materials will also be included. Open Educational Resources are moving into the Austrian classroom too: In a pilot project, teachers developed OER materials, which are currently being tested in e-learning networks and assessed for quality.

Improving access to digital media for schools and learners

Access to digital media will be improved for schools and learners. The challenge for those operating educational institutions is to create the best possible framework conditions in terms of infrastructure, for example, for using ICT in teaching and learning. The expansion of Internet connections and Wi-Fi in schools is an important area for action.

BMBF follows the approach of reducing the administrative burden on federal schools via centrally provided services (e.g. centrally maintained and hosted learning platforms) and standardised applications. More favourable conditions can be achieved by concluding framework agreements (e.g. general licenses for standard software products). ■

For more information please visit www.efit21.at

1 Skills include not only user knowledge, but also awareness-raising and action-oriented aspects as well as concepts in information technology.

2 OECD report “Students, Computers and Learning: Making the Connection”.



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Federal Ministry for Education and Women's Affairs
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www.bmbf.gv.at/enfr

Can validation of non-formal learning increase employability?

Pavel Trantina, at the European Economic and Social Committee (EESC), argues the case for non-formal learning in order to gain key skills for the working world...

At the latest Education, Training and Youth Forum, organised by the European Commission in Brussels in October of this year, one word was on everyone's lips: "skills". It was often used in connection with "recognition" or "validation". It is incredible how views on the recognition of non-formal and informal learning have changed since the concept was first brought into the policy debate in the late 1990s. As the European Economic and Social Committee (EESC) stated in its recent opinion on the Validation of skills and qualifications acquired through non-formal and informal learning, "the EU cannot fail to validate the hidden wealth that lies in the experience and skills that people have acquired through non-formal or informal means".

The Council Recommendation on 20 December 2012 highlighted that "the validation of learning outcomes (knowledge, skills and competences) acquired through non-formal and informal learning can play an important role in enhancing employability and mobility, as well as increasing motivation for lifelong learning, particularly in the case of the socio-economically disadvantaged or the low-qualified."

This claim is borne out by the research. In 2012, the University of Bath and GHK Consulting drafted a study for the European Youth Forum looking at the impact of non-formal learning in youth organisations, on young people's employability. Youth organisations are important providers of such learning. This type of education is not primarily aimed at increasing employability, but research has shown that the skills acquired through youth organisations could help achieve this goal. The study confirms the widespread recognition that the skills required by employers clearly correspond to those nurtured by the non-formal learning sector. Five of the 6 most frequently required

soft skills are among those further developed by youth organisations – the sole exception being numeracy. The soft skills most sought by employers include: communication, organisation and planning, decision-making, teamwork, reliability/independence and numeracy. These soft skills are seen as key competencies for working successfully. Certain character traits are also developed, such as personal motivation, initiative and creativity, which are personal traits related to reliability/independence and entrepreneurship.

Given the high rate of youth unemployment, opportunities for interaction between public and private employment agencies, volunteer organisations (particularly those involving young people) and employers should be supported. This can serve to promote the visibility – and raise awareness of the importance and value – of non-formal education and informal learning in voluntary organisations, and also to strengthen mutual trust.

The EESC strongly believes that emphasis should be placed on identifying, recording, assessing and thus improving the outcomes of non-formal and informal learning and on doing so in a way that is as comparable as possible and comprehensible to all parties involved, particularly employers and educational institutions.

Member States should provide opportunities for people of different ages and qualification levels to have their non-formal and informal learning validated. The EESC recommends that Member States broaden the range of institutions providing the public with guidance and counselling on the benefits of validating competencies and on the options and mechanisms for doing so. Member States should, in particular, enlist employment services, youth information centres,



educational institutions, employers, trade unions, career advice centres, youth organisations, women's organisations, organisations providing support to migrants and disabled people, and public institutions.

The social partners and other civil society organisations should be made more aware of the benefits of validating non-formal and informal learning and should be given an active role in setting national qualification frameworks and determining professional qualifications.

The EESC calls on educational institutions, particularly secondary schools and universities, to promote the validation of skills and knowledge acquired through non-formal means. The EU has many examples of good practice in this field, which should be promoted.

Collective bargaining and social dialogue between unions and employers could play an important role in the process of validating non-formal education and lifelong learning and this should be used as an instrument to work on validating non-formal learning as an important contribution to the debate on employability and the instruments to support it.

The EESC has already supported the creation of the European Skills Passport and, subsequently, the Europass Experience. It is therefore disappointing that the European Commission has suspended the preparatory work on the Europass Experience and calls on it to see this initiative through to completion. Such a tool would increase the transparency of skills acquired outside of school and increase people's opportunities on the labour market. ■

The full opinion can be found at: <http://www.eesc.europa.eu/?i=portal.en.soc-opinions&itemCode=34487>



European Economic and Social Committee

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Pavel Trantina

**President of the Employment, Social Affairs
and Citizenship (SOC) Section**

European Economic and Social Committee (EESC)
www.eesc.europa.eu

Raising academic standards in UK schools

Adjacent Government looks at how the Department of Education are improving standards in schools to help pupils leave school with qualifications to find employment...

Are UK schools performing as well as they should be? Last month Adjacent Government [reported](#) that only 18% of parents in England thought that the government listened to them about their child's education. Does this mean that the government are missing a trick in regards how schools perform?

However the Department for Education have reported a different story. In figures published in October, they revealed that standards continue to rise under the Academies programme. The provisional GCSE results that were published for the first time showed that converter academies are performing 7.2% points above the national average, with 63.3% of pupils achieving the headline measure of 5+ A* to C GCSEs, including English and Maths.

Converter Academies make up the single biggest type of secondary school, representing 40% of schools. More head teachers are having the freedom to run their school in a way that works for their pupils.

The government believes that the results demonstrate that the Academies programme is "continuing to transform the landscape of English education." Speaking about the results, School Minister Nick Gibb said ¹: "As a one nation government we are committed to delivering educational excellence in every area of the country, and these results demonstrate the progress which is being made in extending opportunity and raising academic standards.

"Converter academies are leading the way in string academic standards and over time we will see the excellence and expertise of strong sponsors spread. As well as raising standards, our plan for education is ensuring more pupils leave school with qualifications



which we know will give them the best possible chance to achieve their full potential."

The government has recently focused their attention to ensuring pupils study core academic subjects. Earlier this year, Secretary of State for Education Nicky Morgan announced that all pupils starting secondary school from September must study the key [English Baccalaureate](#) (EBacc) subjects of English, maths, science, history or geography, and a language at GCSE.

The new measures aim to place the UK education systems on par with the best performing countries. The government wants to ensure that young people are able to compete with peers across the globe in when they go into or apply for full time employment.

The EBacc was introduced back in 2010 to help pupils from particular disadvantaged backgrounds study the key academic subjects. Figures show that the proportion of pupils entered into the EBacc has almost doubled, rising from 22% in 2010 to 39% in 2014.

Education Secretary Nick Morgan said ²: "As part of this government's commitment to social justice we

want every single person in the country to have access to the best opportunities Britain has to offer – starting with an excellent education.

“This means ensuring children study key subjects that provide them with the knowledge they need to reach their potential – while setting a higher bar at GCSE so young people, their parents and teachers can be sure that the grades they achieve will help them get on in life.

“And it means giving teachers the training they need to tackle low-level bad behaviour which unfairly disrupts pupils’ learning.”

The government seem to be doing all they can to ensure pupils in Britain remain focused on their education, and leave school with the ability to gain employment. Behaviour and academic ability go hand in hand in terms of achieving high at school.

In June, Schools Minister, Nick Gibb ³ announced an investigation into the impact of smart phones and tablets on behaviour of pupils. Although some schools use tablets as learning tool, teachers are reporting the growing numbers of children bringing personal devices into class. This is leading to disruption in class, which hinders teaching.

In May, the London School of Economics (LSE) found that banning mobile phones from classrooms, could benefit students’ learning by as much as an additional week’s worth of schooling over an academic year. The [report](#) suggested that banning phones would benefit low-achieving children and those from disadvantaged backgrounds.

Nick Gibb said: “Since 2010 we have given teachers more power to ensure good behaviour in the classroom. But we need to make sure the advice we give to schools and the approaches being used across the country are fit for the 21st Century when even primary school pupils may be bringing in phones or tablets.

“Whether it is the use of mobile phones in schools or the attitudes of parents to their child’s behaviour in class, we will now probe deeper into behaviour more

generally to ensure that no child has to put up with having their education disrupted by misbehaviour.”

The government certainly seems to be committed to ensuring education is one of their key priorities. The government are also inviting your say on failing schools. Launched last month, the [consultation](#) is on proposals to speed up the transformation of failing schools and schools that are deemed to be ‘coasting’.

“We are committed to delivering on our manifesto to commitment to transform failing and coasting schools, so that every child has the benefits to an excellent education,” said Nicky Morgan ⁴.

“Over the course of the last Parliament, we saw a million more pupils in good or outstanding schools. The measures outlined in this consultation will focus on the next million, extending opportunity to young people right across the country.”

The consultation which runs until 18 December will seek views on a revised ‘Schools causing concern’ guidance. This sets out how regional schools commissioners will use the new powers to turn around failing schools.

It still remains to be seen if the current Education Ministers are doing a better job than the previous Secretary of State, Michael Gove. But with the recent GCSE results, and proposals to transform schools across the UK, they are not off to a bad start. ■

1 <https://www.gov.uk/government/news/academic-standards-continue-to-rise-under-the-academies-programme>

2 <https://www.gov.uk/government/news/new-reforms-to-raise-standards-and-improve-behaviour>

3 <https://www.gov.uk/government/news/impact-of-smartphones-on-behaviour-in-lessons-to-be-reviewed>

4 <https://www.gov.uk/government/news/have-your-say-on-measures-to-transform-failing-schools>

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Philosophy within social/educational research

In the everyday and customary repetitions/reiterations of embodied practices it would be very easy to begin this brief paper concerned with opening space for philosophical discourse in mainstream educational/social research with expressions of what has been done by a small groups of colleagues in the UK and Australia in setting up an international network concerned with opening further debate about practice-based research¹. But, in our repetitions/reiterations of practices is it possible to make sense any such practices without the mediation of that 'Empire of Signs'² disseminated from 'Plato's Pharmacy'³ and many other ancient sources around the globe? In raising such a question philosophical discourse opens space for a style of writing and associated thinking that in some ways challenge the very grammars of much existing practice.

Customarily, for example, dominant forms of practice in research⁴ have always maintained a separation between the virtues of truth and justice; truth claims to the reproduction of knowledge remain the province of institutions of thought, while justice would appear to endure as the first virtue of social institutions. But, in schematic terms, in the context of the institutions of capitalism/technology on one side of research, and political economic apparatuses of security, including health, welfare and education, on the other, Kevin Flint has begun to open debate on the possibility of aligning such virtues in a reconceived event of research⁵. In so doing and in drawing

from Jacques Derrida's and Martin Heidegger's philosophies, Flint's⁶ writings open critical reflection on the language of research giving expression to the reproduction of knowledge claims located in the present. Ironically, in accord with a canonical or a communitarian ethic of research the logic of this system currently reduces the body to a standing reserve of energy and possibilities that are available for use within the dominant global system of capitalism⁷. In being aligned with moves towards justice, however, through deconstruction, the event of research opens space for the possibility of understanding more about the temporal dimensions of existence – the complex interplay of the unknowable future, what has been, and the present. In a nutshell this reconceived event of research opens space for understanding more about knowledge reproduction and its affects upon us, in our multifarious practices as human beings.

Approached in this way, the practice of research incorporating new philosophical discourse opens space⁸ for rethinking its complex relationship with education⁹, citizenship and democratic practice¹⁰, and so challenging, rather than continually being in danger of reproducing, various forms of oppression within the global capitalist system¹¹.

At issue is not knowledge reproduction from social/educational research, but the complex inter-relationship of such research with discourses of phi-

losophy and our everyday practices as human beings. Approached in this way, philosophical discourse in the papers that follow over the next 18 months will be employed in opening space for the reproduction and rethinking of possibly new language for human beings, rather than narrowly focused solely upon customary concerns about truth claims to knowledge in research. The approach used is predicated on the assumption that our essential home in this world is language.

The approach to the use of philosophical discourse in research also raises questions about the education cultivated in this process, and just how such education shapes our existence. As the novelist and neo-Marxist critic, Raymond Williams¹², once observed in walking into a railway station, a shopping arcade and so on, in our everyday practices we become educated in some way by the experience – he called it 'permanent education'. At issue is not a form of education that is bounded in some way by the current 'apparatus of education'¹³, but forms of education cultivated from, and variously shaping a multiplicity of institutional practices¹⁴. Consequently the complex inter-relationship of research, practice and education will be the subject of the next paper in this series.

In the context of the dominant global capitalist system and forms of neoliberal discourse there also remains the question of its complex inter-relationship

ship with discourses of philosophy, research, education. This will constitute the third paper that will follow in the next few months. At issue here are philosophical questions concerned with the cultivation of democratic practices and citizenship in our 'late modern'¹⁵ societies. Until now, it would seem, most commentators have delimited their focus upon questions concerned with the possible organization of democratic practices, whereas this coming paper will move towards the deconstruction of such practices in the light of educational practices in societies around the globe that are variously shaping and delimiting democratic process.

What follows from these early papers are moves towards social justice from the cultivation of authentic education in philosophical readings of the powers of language in practice. Such moves already exist in much social/educational research, but their affects upon the individual/collective body are always in danger of being dissipated and lost¹⁶.

Until this point the foregoing discourse has been concerned only with the knowledge economy. But, recent work by Paul Mason¹⁷, concerned with the 'information economy', involving many international social networks, including Facebook, Twitter and so on, also opens other vital spaces for human existence and philosophical concerns regarding moves towards social justice.

In these circumstances 'the self' is located in a complex and uncertain world; its very existence on this planet depends upon opening space for entrepreneurial practice that is no longer confined to outmoded market place economies or, indeed, contem-

poraneous information economies. At issue remains the contribution of philosophical discourse on this matter.

Forms of writing, literature, narration, poesy and so on, also open more space for moves towards education for social justice in research. But, in the context of the complexity of practice in its structuring the final papers in this series will be concerned with philosophical and deconstructive readings of the process of writing and of 'complexity' in social practice¹⁸.

¹ The 'International Association for Practice Doctorates', IAPD [www.professionaldorates.org] was first set up following a conference in London in 2009.

² Barthes, R. [2005] *Empire of Signs*, Waterlooville, UK: Anchor Books.

³ Derrida, J. [1981] *Dissemination*, trans. Johnson, B. London: Athlone Press

⁴ Flint, K.J. [2015a] *Rethinking Practice*, Research and Education: A philosophical inquiry, London and New York: Bloomsbury: 123-204

⁵ Flint, K.J. [2015b] 'Where's the justice in research' [2015 c] The 'Social Justice Turn' in Qualitative Research: Capitalism, technology and the sublime powers of the 'is'. [2015d, i]: 'Education for Social Justice in the knowledge economy: Towards a visualization of the myriad understandings of moves towards social justice in the event of research', paper in preparation.

[2015d, ii]: 'Education for Social Justice in the Information Economy: Towards a visualization of the myriad understandings of moves towards social justice in the event of information', paper in preparation.

⁶ Flint, K.J. [2015a: 123-268]

⁷ Flint, K. J. and Peim, N. [2012] *Rethinking the Education Improvement Agenda*, London and New York: Continuum.

⁸ For Henri Lefebvre space is not an empty vessel, we variously produce it and in turn it shapes our existence in various ways.

⁹ Flint, K.J. [in preparation, paper iv] *Education for Social Justice: An exploration of moves towards social justice cultivated in the complex inter-relationship of the economies of capitalism, technology and research.*

¹⁰ Flint, K.J. [in preparation, paper v]: *Opening horizons for social justice: a brief and critical examination of the forces cultivating democracy in the complex inter-relationship of capitalism with technology and research;*

Giroux, H.A. (2015) *Dangerous Thinking in the age of the new authoritarianism*, Boulder, CA and London: Paradigm Publishers. (2014a) *Neoliberalism's War on Higher Education*, Chicago, Illinois: Haymarket Books.

(2014b) *The Violence of Organized Forgetting: Thinking Beyond America's Disimagination Machine*, San Francisco, CA: City Lights Books.

(2014c) *Neoliberalism's War on Higher Education*, Chicago, IL: Haymarket Books.

(2008) *Against the Terror of Neoliberalism: Politics Beyond the Age of Greed*, Boulder, CA and London: Paradigm Publishers.

¹¹ Wallerstein, I. [2001] *Unthinking Social Science: The Limits of Nineteenth Century Paradigms*, Philadelphia, PA: Temple University Press.

Klein, N. (2000, 2010), London: Fourth Estate.

(2007) *The Shock Doctrine: The Rise of Disaster Capitalism*, London: Penguin.

(2014) *This Changes Everything: Capitalism vs. Climate*, London: Penguin

Mason, P. (2015) *Postcapitalism: A guide to the future*, UK, USA: Penguin Random House UK

¹² Williams, R. [1966] *Communications*, [Revised Edition] London: Chatto & Windus.

¹³ Foucault, M. [1977] *Discipline and Punish: The Birth of a Prison*, trans. Sheridan, A., London: Penguin Books; Agamben, G. [2009]

¹⁴ Flint, K. J. and Peim, N. [2012]; Flint, K.J. [2015a]

¹⁵ Term borrowed from Anthony Giddens [1991]: *Modernity and Self-Identity: Self and Society in the Late Modern Age*, Cambridge: Polity

¹⁶ Flint, K.J. [2015a, b, c]

¹⁷ Mason, P. [2015]

¹⁸ Osberg, D. [2015] 'Learning, Complexity and Emergent [Irreversible] Change' in, Scott, D. and Hargreaves, [eds.] *The Sage Handbook of Learning*, London and Thousand Oaks, CA: Sage Publications: 23-40

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The urban dimension of Cohesion Policy

Corina Crețu, EU Commissioner for Regional Policy outlines how Europe should be exploiting urban areas to their full potential...

An important responsibility was bestowed upon me when I came into office as Commissioner for Regional Policy: to lead this policy into the next decade and to exploit its full potential in order to create jobs and sustainable growth. It is a fact: Europe's cities are the engines of the European growth, providing jobs and services, and serving as hubs for creativity and innovation. The urban dimension of our Policy has therefore been significantly reinforced for 2014-2020.

The importance of the thematic was already reflected in the explicit inclusion, in 2012, of urban policy in the responsibilities of the Directorate-General for Regional and Urban Policy of the European Commission. This change was made in recognition of the importance of cities as key actors for the development of regions across Europe.

In the new programming period, over €80bn from the European Regional Development Fund (ERDF), half of its 2014-2020 envelope, will be spent in urban areas. In each EU member state, according to our

new Regulations, a minimum 5% of the ERDF will be invested in integrated sustainable urban development and directly managed by urban authorities, at least for the selection of operations. This will allow cities to build on positive synergies between policy fields. Furthermore €330m will fund innovative actions in the field of sustainable urban development over this 7 year period.

Overall, Cohesion Policy resources will be strategically targeted at enhancing the integrated approach to urban development, to increase the efficiency of our investments, at strengthening the role of cities in European urban policy, to better deliver on the EU goals of growth and jobs, and at increasing the level of innovation in urban policy making, to tackle the challenges that will grow in importance in future years. An urban development network set by the Commission will review the on-the-ground deployment of European funds and support the exchange of experience between cities involved in urban innovative actions and in integrated sustainable urban development.



I want to stress the paramount importance of an integrated approach to sustainable urban development: urban development is about the social, economic and physical transformation of cities. It means that everything from the advantages of economic activity, innovation, education and culture to the challenges of urban sprawl, poverty, migration, congestion and beyond, are dealt with cohesively. Integrated problems need integrated solutions. And solutions must be sustainable so that any urban development meets the needs of the present without compromising the ability of future generations to meet their own needs.

Of course for EU investments to have a maximum impact on the ground, cities and regions need to address all issues hampering the good use of the funds, especially in the field of administrative capacity. One of the priorities of my mandate is precisely to help Member States improve the way they manage and invest EU funds, by fostering the exchanges of best practices in the field of administrative capacity building and public procurement and by simplifying the access to the European Structural and Investments Funds.

Now, as you know, the Commission and the 28 Member States have agreed to bring forward an ambitious EU Urban Agenda in the coming years, which will be about enabling cities to fully contribute to our shared priorities and deliver concrete benefits for our citizens. We will pay particular attention to exploiting synergies and complementarities with other EU policies, starting with the other European Structural and Investment Funds, to make the most of the combined effect of all EU funds.

Shaping the EU Urban Agenda will give us the occasion to reflect on the urban dimension of the post-2020 Cohesion Policy, and I am looking forward to the fruitful discussions we will have on the matter with all the national, regional and local stakeholders involved in the shared management of Cohesion Policy funds. ■

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Corina Crețu

Commissioner for Regional Policy

European Commission

http://ec.europa.eu/commission/2014-2019/cretu_en

Planning for the future

Association of European Schools of Planning (AESOP), established in 1987, is an international association of universities teaching and researching in the field of spatial planning.

With over 150 institutional members, AESOP is the only representation of planning schools of Europe. AESOP mobilises its resources, taking a leading role and entering its expertise into ongoing debates and initiatives regarding planning, planning education and qualifications of future professionals.

AESOP offers a platform of exchange of planning knowledge for scholars, practitioners, and urban managers. AESOP promotes planning as a tool of improving quality of life and builds-up its agenda with professional bodies, politicians and all other key stakeholders in spatial and urban development and management across Europe.

At present, AESOP members cover a significant majority of European scholars in territorial, regional, spatial and urban planning, development and management research. The level of expertise in planning represented by the AESOP community is outstanding.

The AESOP Annual Congress, held in July, with more than 1,000 abstracts regularly submitted, has become the biggest planning assembly of scholars, practicing planners and urban managers in Europe.

AESOP runs also an annual meeting of the heads of planning schools. The meeting gives the opportunity to the departments, schools and faculties of planning to discuss and compare the challenges they have to face and the programmes they offer to the students. These meetings generated, as a result of discussions, a few interesting outcomes, such as the AESOP Experts Pool, which aims at helping schools to raise the quality of teaching.

For PhD students in planning, AESOP offers a workshop, which is associated with the annual congress. AESOP also supports the Young Academics Network, which is an independent structure of PhD students in planning.

Our association publishes also its own journal called Planning Education. All the issues of this publication are available free of charge on the AESOP website.

AESOP collaborates with more than 50 planning journals. Special connections link AESOP with disP – The Planning Review, where AESOP holds its own section.

AESOP cooperates with European organisations, both with those with an academic background focusing on territories and planning (in the broad sense of the word) – like for example European Regional Science Association (ERSA), European Urban Research Association (EURA), Regional Studies Association (RSA), International Planning



Opening of the Master Class, Brussels 12 October 2015. In the first row from the left: Nicola Dotti (Vrije Universiteit Brussel), Izabela Mironowicz (AESOP-BELO, Wrocław University of Technology), Wolfgang Petzold (Committee of the Regions), John Bachtler (RSA, University of Strathclyde), Richard Kelly (ERSA)

History Society (IPHS) and with those with more focus on practice – like European Council of Spatial Planners – Conseil Européen des Urbanistes (ECTP-CEU), International Federation for Housing and Planning (IFHP), International Society of City and Regional Planners (ISOCARP) and UN-Habitat, but above all with the European institutions, agencies and programmes, giving their growing interest in “things territorial”. This cooperation is coordinated by AESOPs representation in Brussels: AESOP Brussels European Liaison Office (BELO) responsible, among others, for representing

AESOP in the EU and networking with other organisations.

One of the important activities within BELO activities is the Lecture Series established to attract not only the planning community but also a wider audience of politicians, community leaders and organisations, business and the media to promote planning as a discipline that can help to find new tools of governance and function as an effective mediator between many stakeholders.

Among distinguished speakers were already: Klaus R. Kunzmann (in Capenberg Schloss, Germany), Andreas Faludi (in Paris), Danuta Hübner (in Brussels), Sir Peter Hall (in London), Juval Portugali (in Amsterdam), Cliff Hague (in Riga), Peter Batey (in Warsaw). The 10th Lecture, which will take place on 26th November 2015 in Berlin will focus on the important topic of migrants and the cities.

The other activity is an annual European Urban Summer School (EUSS) for young planning professionals.

Members of AESOP hosting the event and acting in cooperation with the municipalities and other local actors always offer an interesting case to illustrate the topic discussed during the summer school. Tutors represent both academia and practice. On average some 20-30 young professionals attend the EUSS.

Six editions of the European Urban Summer School (Wrocław, Lisbon, London, Madrid, Tours, Bremen) have shown convincingly that a few days of intensive interaction can produce many useful new ideas documented in the selection of books, which are available free of charge on the AESOP website.

AESOP, via BELO, cooperates with the European Commission, European Parliament, URBACT and ESPON, being invited as an academic partner of the ESPON Scientific Conference.

Responding to the invitation of the European Commission and the Committee of the Regions taking into account its field of expertise, AESOP has become involved in the OPEN DAYS



AESOP Planning Education journal #3
"Excellence in Planning Education: Local, European & Global Perspective"

University, and the Master Class for PhD students/early career researchers in the field of regional and urban policy.

Planning schools and research institutions are warmly encouraged to join AESOP. The application form is available at www.aesop-planning.eu. We encourage practitioners and urban managers to link to our activities via AESOP Brussels European Liaison Office (contact our BELO representative by email: belo@aesop-planning.eu or izabela.mironowicz@pwr.edu.pl).



AESOP Congress 2015 in Prague, 13 July 2015 – Opening Ceremony in the Bethlehem Chapel



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New Station

New

Reinventing the City Building on Creativity

Creativity, innovation and a strong focus on sustainable and attractive growth are at the very heart of the vision for the City of Varberg to become the Swedish West Coast's Creative Hot Spot by 2025. The municipality is growing quickly and has a population of more than 60,000 residents, mainly due to its location between two expanding regions – Göteborg (the West Sweden region) and Malmö (the Öresund region). Varberg is a stronghold for culture and tourism, and is especially renowned for its 13th Century fortress, long stretches of beautiful beaches and inland deciduous woodland with plenty of small lakes. It is also well known among surfers from all across northern Europe as one of the best places in Scandinavia for all kinds of surfing.

The City of Varberg is focusing strongly on sustainable development and has been acknowledged for its success in bridging the gap between public service and the diverse interests of various partners in society (e.g. commerce, business, industry, development, conservation, culture, etc.). The municipality has a sharp focus on the way ahead, and a portfolio full of solid strategies. In our vision for the future, the City of

Varberg has unique opportunities and we are acting on them. We are building a city converging around means of public transportation in a rapidly expanding region. The railroad, which has long created a barrier between the seaside and the city centre, will now be relocated into a tunnel underneath the city. To expand on this opportunity we are moving the harbour in order to further free up land for letting the city reclaim its position as a seaside town. In total, the project will result in more than 500,000 m² of land for development of our future city front. For people living, working or visiting the city of Varberg, the change will dramatically increase the freedom to experience the coastline. More places of residency, places for eating and meeting, places to shop and work, etc. – comes as a bonus.

In our vision for Varberg 2025 we are striving to be at the forefront of supporting social and cultural aspects of sustainability. The municipality is localised in the middle of a strong academic region. The University of Göteborg and Chalmers University of Technology, the University of Lund and Malmö, the University of Borås and the University of Halmstad are all located well within

An aerial photograph of the Varberg Cityfront, showing a harbor with several piers, a marina filled with sailboats, and a mix of industrial and residential buildings along the waterfront. A large teal arrow graphic points towards the city from the left.

v Cityfront

comfortable commuting distance from Varberg. This is of great importance for our local business climate and for our young. We are focused on consolidating the relationship with our academic allies even stronger, strengthening the position of our own Campus Varberg. The same is true for cultural institutions. For our growth it is key to attract enterprises and institutions that share our idea of building a more sustainable future, in the heart of a progressive region. This means that we are especially on the lookout for academic and cultural institutions, and enterprises with profiles that fit our idea of a modern sustainable city and trying to attract them into investing in Varberg.

It is often stated that the place, and the people and lifestyle associated with it, is everything. If this is true, then the City of Varberg has everything to offer.

Come to Varberg. Share our vision.



**The City of
Varberg**

www.varberg.se

Building renovations – The Nordic way

The Nordic Built “Active Roofs and Facades” project has received support from Nordic Innovation, EUDP(DK), Energimyn-digheten(SE) and Rannis(IS) allowing strong development of leading Nordic competences in the area of building renovation. This is achieved by creating transnational Public Private Partnership models to support the development of nearly zero energy building solutions and associated performance documentation – which is required in the EU building directive.

The proposed cooperation with the building industry on developing models and the demonstration of “Active House” based sustainable renovation is creating a strong Nordic alliance.

The project runs from 2014 to 2017 and involves companies which are represented in the Nordic countries and companies, from the international Active House Alliance. The development will use the best transnational competences and networks, creating greater possibilities to export technology.

The background of building renovation in both Nordic and European projects, where energy use is often 30-40% higher in practice, compared to what was expected from calculations and where innovative solutions are seldom used, is very much connected to the way the building industry is organised. Here consultants will normally only want to operate in a

conservative way. This is because, they are not only selling their expertise, but also the insurance that goes with it, and due to consultants fees being considerably reduced, it is common to work with well-known large suppliers, who can contribute to large parts of the design process. This means there is a tendency to not choose the most energy efficient solutions, but to allow more mediocre and old fashioned solutions, that the suppliers prefer. It is also common knowledge that detailed performance of equipment in practice is never controlled, there is no incentive to perform better, and higher energy use will often be explained by the user behaviour.

A main issue of the proposed Nordic Built project will be to realise the renovation projects in a much better way and secure positive involvement of consultants, so they can be more proactive, e.g. by full scale testing of innovative solutions before large scale implementation. And, by monitoring key performance indicators as a basis for negotiating guarantees of performance results as part of the overall procurement process, something which also might be used to avoid normal tendering in connection to development of renovation projects.

An important challenge is to introduce holistic oriented demands in the so-called Nordic Built Charter in practice, in involved demonstration projects.

Further background of the Nordic Built Active Roofs and Facades in Sustain-



Work on innovative ventilation solutions with heat recovery. Demonstration of improved decentralised heat recovery ventilation with low electricity use. Window integrated heat recovery ventilation in Sydhavnen in Copenhagen has been made in 2013 with great satisfaction for the involved tenant also because there was absolutely no noise and the combined injection of paper granulate insulation in the floors along the facades ensured a much lower air leakage than before. Each of two units only uses 5-6 W of electricity when providing approx. 50-60 m³/h of 95 % preheated fresh air

able Renovation project Coordinated by the Danish energy specialist company Cenergia, the project will utilise the results from the recently finalised EU-Concerto project Green Solar Cities (www.greensolarcities.com).

These results has been presented in a book by Routledge/Earthscan in 2015, while main results from Copenhagen

are illustrated in the two small videos below:

<http://vimeo.com/98926904>

<http://vimeo.com/98926905>

Important features of the workplan is e.g.:

To work along side Active House Alliance (www.activehouse.info) aiming at involving Nordic best practice producers and using the Active House Specifications in practice. Here the Finnish company ZED Consult will give a special input, whilst at the same time comparing it to existing certification schemes like LEED, Bream and DGNB as well as the Nordic Built Charter in general.

Both innovative and best practice solutions will be full scale tested in cooperation with the housing association, KAB (DK). This will realise the overall winning project of the Nordic Built Challenge architectural competition, Ellebo Garden Room in Ballerup near Copenhagen and the WSP Group working with the housing company

Trianon in Malmø, as basis of later implementation of sustainable renovation in Denmark and Sweden. There will be a special focus on innovative building integrated PV modules from the Danish company Gaia Solar together with Steni façade and roof plates with a long service life.

Besides new decentralised heat recovery ventilation (HRV) solution developed for housing renovation by the Danish companies, Øland and Ecovent will be full scale tested and documented. Innovative features that will be introduced here are window integrated inlet of air, use of a new type of "automatic filter shift box", which only need to be exchanged every 10 years. And, the use of a new intelligent control device which allows for continuous registration of airflow and electricity use through the internet. At the same time this secures a reading of the mean seasonal factor of performance (SFP) and general survey of operation.

As an alternative there will also be a focus on compact window integrated HRV solutions, both for housing



School facade in Copenhagen with window integrated heat recovery ventilation

and schools. The benefit here will be much lower total costs due to the avoidance of large amounts of duct work, but the challenges include an optimised operation in correspondence with a minimum air exhaust possibility from wet rooms based on humidity sensors. Besides this, handling of condensate from the used air in a way that does not create problems.

In Norway the building renovation specialist company, Høyer Finseth, will work with full scale testing of best practice solutions and will at the same time work with the Norwegian solar thermal panel producer AVENTA.



Here is shown an optimised decentralised HRV system from Ecovent / Øland mounted under the loft in connection to urban renewal at Gl. Kongevej in Copenhagen

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Delivering on the BIM mandate

In an interview with Lisa Carnwell, Editor, David Philp, industry sector BIM ambassador, discusses the UK's BIM journey and his latest role with the Scottish Futures Trust...

Anyone aware of BIM will know who David Philp is, but for any newcomer to the idea of digitising construction and especially BIM, Philp is certainly one of the top influencers and ambassadors for the sector.

In the early nineties, he joined Balfour Beatty as a graduate engineer, eventually becoming their Director of Technical Services and latterly BIM Programme Director. He has worked for Mace as Head of Building Information Modelling and is now Director for BIM at AECOM. But that's not all. He is a Professor at Glasgow Caledonian University and following a secondment into the Cabinet Office's Efficiency and Reform Group in 2011 he remains Head of BIM at the UK BIM Task Group. A co-founder of BIM2050 and BIM4SME he is chair of the various BIM4 working groups in addition to being recently announced as the Chair of the BIM Delivery Group for the Scottish Futures Trust.

I was lucky enough to grab some time with one of the busiest people I've ever met to discuss BIM and

the whole concept of digitising construction. We began with discussing the current thinking within the industry and where the UK sits in terms of BIM implementation.

Where are we now?

Although many people are aware of the [Digital Built Britain](#) programme, industry is still very much focussed on Level 2 and ensuring it is embedded before thinking about Level 3 BIM. There are a comprehensive suite of standards, processes, guidance and tools which will be complete around October, including the last piece of the jigsaw in terms of the soft landings standard. It is expected that the NBS BIM Toolkit will have advanced by that point too, with significant testing.

For Philp, the deadline for government to have all centrally procured projects achieve Level 2 BIM in 2016 is a starting point. He said:

"Everyone talks about getting to 2016 like its crossing a finish line, but it's actually when we start the race.



David Philp MSc, BSc, FRICS, FCIQB, FICE, FICES, FGBC

We have clients that are geared up to put Level 2 into the marketplace and we have all the standards and processes which are all tested, but perhaps most importantly, they are proven.

“From an international viewpoint, we are seeing more of our standards being used – so not just adopted within these shores. Clients from abroad such as in the Middle East are taking elements like PAS 1192-2, proving that in terms of global leadership, the UK is well-placed to capitalise and exploit our knowledge.

“If you put a lens over the UK in terms of what we have and what sets us apart, it’s that clients are creating mandates, which is a big step. We can also discuss different levels of maturity whereas other countries are discussing this rather nebulous concept called BIM.”

We still have some way to go though. Philp wants more case studies and guidance, which doesn’t necessarily have to come from institutes such as PAS,

but from others who are interested in the idea of digitisation of the discipline, and who are thinking more about digitising information management.

PAS 1192-5 Mindful security

This latest standard has now been [published](#) recognising the huge value of data sets and what is shared. It is being hailed as ‘a crucial component in Level 2 BIM and its publication marks a key milestone in the programme. It will enable BIM to be mobilised and implemented in a security-minded way whilst still realising the benefits of collaborative and digital working.’

As organisations embrace collaborative working, not only through greater openness and transparency, but also through the sharing and use of detailed models and large amounts of digital information, they must also recognise that the increasing use of, and dependence on, information and communications technologies does create some vulnerability issues.



According to an [article](#) placed in the BIM Taskgroup Newsletter in July 2015;

“Being security-minded is not about inhibiting collaboration, but instead adopting an appropriate, proportionate, need-to-know approach to the sharing and publication of data and information in order to deter and/or disrupt hostile, malicious, fraudulent and criminal behaviours and activities. In so doing in the fields of architecture, construction and engineering, the industry is better able to deliver the trustworthiness, safety and security of digital built assets.”

Philp believes that;

“We have to be more mindful of what we are protecting in terms of both the physical built asset and the digital information. If you think of Level 2 as an onion, PAS 1192-5 sits right on the outer skin. To come further in, you have to pass through there, so you have to have that mindful approach to digital technologies. For me it does two things. It gives you the screening – making sure you’re doing it right, but at the same time it’s a companion to help do this in a mindful manner. It’s all about the decision making process – the assessment of needs and taking the proportionate measures.”

Is industry ready to meet the requirements of Level 2?

BIM was brought to industry attention in the UK Government Construction Strategy published in 2011. Since then the BIM Task Group has been developing standards and requirements to enable BIM adoption. For Philp they have come a huge way in terms of digitalisation:

“We are trying to reach 3 million people and help them start their journey. When you go to conferences now, people are talking about soft landings, operational data sets and Cobie etc. How many folk were having this conversation back in 2011?” he said.

“I really think we have started to nudge industry in the right direction and I genuinely believe that by the time we reach March 2016, we will be well-placed in terms of achieving what we set out to do with the BIM mandate.”

Philp refers to how Level 2 can be achieved easily:

“A Level 2 project should be set out well by the client, with the right leadership, with the EIR, and the right framework – which is often behavioural. It’s also

important that the supply chain is moved on in terms of upskilling and their capability is tested. The requirements are quite simple really when you break it down as to what you're asking the supply chain to do – you're just asking to share information in a Common Data Environment and manage information in a structured process. If you take the word BIM out of that – it just makes common sense.”

Philp believes that it's inevitable that the industry (at all levels) will be digitised. He refers back to when the 'internet' was first mentioned, and whether it would be useful in their business. That was only 15 years ago. “We are now at the point where almost everyone has a mobile phone or an iPad type device using it as part of their day-to-day business. As simple as this sounds, this means they are working in a digital environment.”

“This is a great opportunity for Scotland to move into the digitised space and create new offerings. I'm looking forward to helping Scotland create a digital future for the Scottish built environment.”

The challenges of skills and expertise

A total digitisation of the construction industry at a simple level (such as just using a mobile phone) shouldn't be an issue. However, being able to utilise BIM at Level 2 and beyond is a challenge. Philp agrees, and thinks that academia has to address digitised construction into under-graduate courses. The current situation in terms of post-graduate integrated design is doing well, but school leavers will want to know if there's a great course that is innovative – and that includes apprentices too, understanding that we need to make the construction sector attractive in terms of a career path.

How important is accreditation?

Proving that you are BIM capable should help to secure future business, but is it that simple? Philp said:

“We love our badges don't we?! But I do agree that we need the creation of an industry data mass that gives some consistency.

“We have a good pre-qualification process in the UK, but Level 2 is not just about individual members, but a coherent supply chain you assemble for that project. You may have an organisation that has some certification, but unless you have everyone working together on a project, it could be somewhat meaningless.”

What next: The Scottish Futures Trust and why they need a BIM strategy

The need for a BIM strategy for Scotland was essentially borne out of the report of the Review of Scottish Public Sector Procurement in Construction (published in October 2013). This independent construction review looked at how public bodies involved in construction-related procurement can adopt practices that are streamlined and deliver value for taxpayers' money.

The Scottish Government has joined up with the Scottish Futures Trust (SFT) to deliver the recommendations, one of which is for BIM to be achieved within the public sector by 2017. The SFT is leading that initiative and is working on developing a strategy for a mandate.

Philp will be joining that initiative as Chair of the BIM Delivery Group. He said that:

“I'm coming in with the hindsight of all those years of the good, the bad, and the ugly side of BIM and looking at the lessons learned. I've been able to ask people such as Malcolm Taylor and Paul Morrell how they would have done anything different in terms of policy and processes, etc.

“The good thing is that a lot of the heavy lifting is already done. Level 2 as a British standard is in place, so how do we configure that to make it suitable for the Scottish public sector procurer? Essentially, we

have to examine the guidance we produce and implement the lessons learned from sectors such as oil and gas as they are pretty well-advanced in terms of how they think about digitised information management and how they manage their assets.

“...you’re just asking to share information in a Common Data Environment and manage information in a structured process. If you take the word BIM out of that – it just makes common sense.”

“We want to make sure we address appropriately the recommendations and start to build a potential roadmap and implementation strategy for Level 2 BIM by 2017 on all public sector projects.” He continued.

Implementing a BIM strategy is expected to deliver positive results for Scotland including:

- Better procurement;
- A more efficient and sustainable built environment;
- Better places to live;
- More intelligent infrastructure – something that is fit for 21st Century Scotland.

Philp wants the strategy to be outcome driven, examining what is required for 2017, but also beyond that date.

“We will be setting up communities of working groups to help inform what the strategy will look like. We are already seeing early adopters like NHS Scotland who are already well on their journey helping to upskill their procurer base. They’ve been involved in workshops all round Scotland and they have all their Level 2 artefacts in place, so we are seeing advancement already and that is pre-mandate.

“There’s a mature supply chain in Scotland too. Many organisations have worked on Level 2 projects elsewhere and there is a sense of needing to take the journey further. Of course, the BIM Task Group and the Digital Built Britain team will help to ensure the strategy is aligned and to try and harmonise it with any international thinking and standard as well” he said.

Working on the mandate will mean breaking areas down into manageable programmes such as trying to understand the client perspective and being sure to test appropriateness from all the recommendations that were set out within the public sector review.

Philp continued:

“We have to make sure we have our narrative right, making sure people know what will be expected by 2017, if not before. This is a great opportunity for Scotland to move into the digitised space and create new offerings. I’m looking forward to helping Scotland create a digital future for the Scottish built environment.

His parting comments are one of encouragement for the construction sector;

“I’m passionate about change. My journey in BIM keeps changing as to what it means, and if anything, it has become a metaphor for industry change and for more innovative working.” ■

.....
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Clearbox 

A data centric solution to a disparate problem

BIM (Building Information Modelling) continues to have a number of frustrations with connectivity and interoperability. The use of different authoring tools, by different disciplines at different stages of an assets life can cause difficulties in collaboration and result in lost time in work arounds, inefficiencies and rework as teams work from incomplete and inaccurate datasets.

Compounding the issues is the file based nature of modern BIM, when everyone wants to see different combinations of information, in different configurations to suit the way they work including Clients that wants to receive an intelligent digital asset linked to location, searchable attributed data and associated documents. We are constrained by the file and model structure established at the outset to best enable the design phase.

To resolve this we need to move to a more integrated data centric approach in which the model is simply the indicator of the source of the design information and the manipulation of the outputs and interaction with specialist tools is managed in a common data environment that is able to compile information to suit the task, the user, the access requirements and even the hardware and security considerations that may exist with complex projects for sophisticated clients.

Empowering our clients to use BIM to realise better digital management throughout the lifecycle of the design,

construction and operation of assets for capital intensive industries now seems core to the real changes necessary to respond to this opportunity. Undertaking such an approach drives out waste through data driven workflows that streamline information management and realise the capital cost reduction by making BIM available to all and allowing users to simply do things right first time.

This leads to a better informed world with information available at the point of use appropriate to the task at hand:

- Creating both 2D and 3D model files that provide geometric representation of the real world capital plant and equipment in design.
- Providing locational representation of the content, expressed visually and relevant to the other elements throughout the assets lifecycle.
- Collaborating in an environment that helps the entire team work together to produce co-ordinated outputs.

This data centric approach is core to the Clearbox solution architecture which has at its heart a data driven platform that federates the information around the consistency of the data. The solution provides the intelligent integrated links between location, associated data and documents. Federating these sources of locational information around the data as opposed to the models allows all the information to be seen in one form irrespective of the source and this

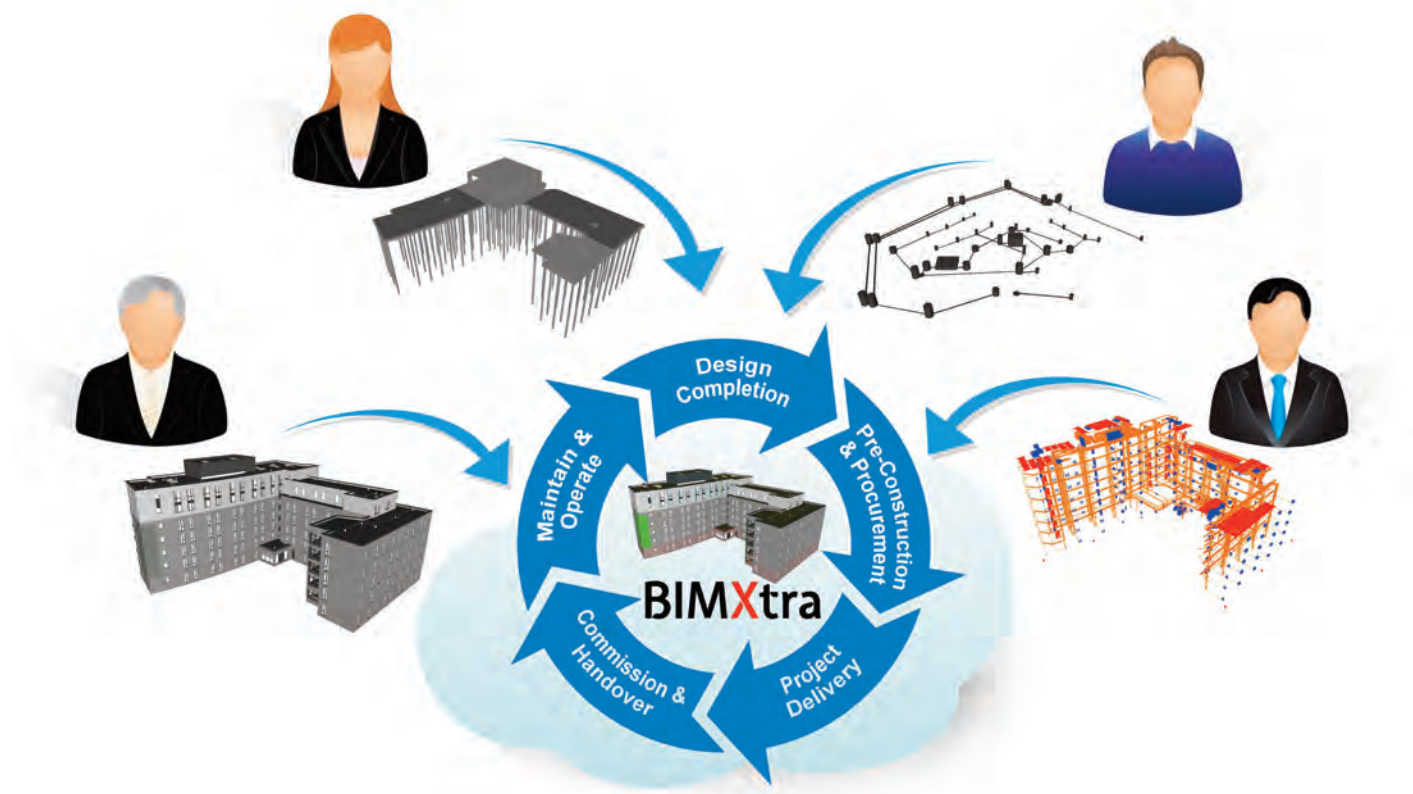


allows 2D, 3D and multiple authoring environments to be accessed in plain language as an integrated source of information.

A purpose designed viewer allows visual access to the integrated environment which by virtue of the data centric core can control the viewing and accessibility to ensure most hardware can be used with suitable access control and management of information applied at an object level instead of the traditional file level.

Clearbox aim to provide this end game as "information at the point of use, delivered pre-prepared to suit the task at hand, to enable a great customer experience". In essence while data management can take place at the most awesome processing speeds in the cloud, the issue of how fast the user gets to what he/she needs is less about the processing power and more about the right configuration of information to suit the task in hand.

For Clearbox the story does not end there because many of the issues affecting the asset creation, delivery and operation are wrapped in overcoming the unstructured nature of the data we are exposed to and the consequential ambiguity and weak



connectivity that exists between the datasets. Our efforts provide structured consistent data early in the process to allow other tools to interface and make better use of the structured datasets managing the impact of change and saving on time spent manually in more traditional transactional processes.

BIMXtra (our cloud based common data environment) sets itself apart by using the object as the common element found in every combination of the datasets required to create the information. By managing change on an object and its associated data and by enabling the addition of a variety of additional metadata on each object the process of managing the information is quickly enabled as structured data in which the limits of what can be processed within a project in this master data management approach are more a function of aspiration and configuration than technical constraint.

The availability of structured data in such an approach is now realised much earlier in the regular course of

project delivery than would be the case from more traditional file based approaches. Access to this common source of data and the ability to update subsets of data attached to an object also extends the extent of data processing that is available but then goes on to create files to provide a record of the data transacted, the configurable processes building on the structured approach of BS & PAS 1192 with WIP, Shared and Published areas of information.

As such, real time project controls mapped to the objects record the outputs as an auditable trail of the process and help to drive efficiency, accuracy and availability of consistent information delivered from a consistent business process.

In reality while BIM needs open standards to make the information more transportable between applications the more productive stretch on current tools is the ability to consistently manage the existing information delivered in a consistent form at the

point of use. Much will change from the introduction of BIM and Clearbox plan to continue to stretch the opportunity from BIM as it matures in the market. In reality the benefits are compelling and compare the transformation many business have made applying ERP in place of file based processes to their back of house accounts. We expect to see a significant move to a master data management approach to BIM over the coming years as the versatility, efficiency and familiarity of such approaches grow.



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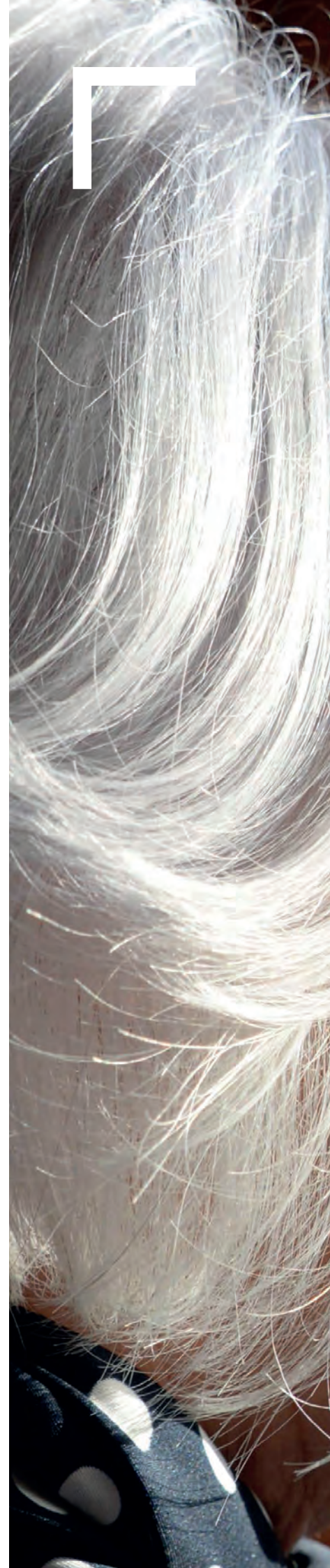
VISUAL comfort

See clearly with Multi-Comfort

Many architects and developers understand that user comfort relies on the interrelation between multiple design elements, but without an agreed standard to quantify these measures, it can be subjective. This is why Saint-Gobain has created the Multi-Comfort concept, which sets measurable standards to achieve user comfort.

The Multi-Comfort concept defines five primary comforts: thermal comfort, visual comfort, audio comfort, indoor air comfort and economic comfort, with standards in each to ensure user comfort is delivered.

Stacey Temprell, Residential Sector Director at Saint-Gobain, explains how visual comfort in buildings can affect occupant health and wellbeing, the third article in a series examining each of the five elements of the Multi-Comfort building concept.



A close-up profile of an elderly woman with white hair, looking out a window. The background is a blurred outdoor scene with greenery and a building. The text is overlaid in three grey boxes at the top.

**WE TYPICALLY SPEND 90%
OF OUR TIME INDOORS
OR IN VEHICLES**



Buildings have a big impact on our lives, as we now spend up to 90% of our time indoors – either in buildings or vehicles – whether at work, home, or in our spare time. Yet very few people think, and really challenge, how our buildings are actually performing and how they affect our health and wellbeing.

Through years of research and development of these five qualities, Saint-Gobain has created and recently launched 'My Comfort' in the UK – the Multi-Comfort building concept which delivers benefits for occupant health and wellbeing as well as the environment.

The Multi-Comfort concept and 'My Comfort' starts from the central premise that all buildings can be designed to:

- Provide the highest levels of all-round comfort for their users;
- Genuinely and positively contribute to our health and wellbeing;
- Deliver the highest levels of efficiency for their owners – saving home owners and bill payers money on energy;
- Achieve the Passivhaus standard of energy efficiency.

The four factors of thermal, audio, visual, and indoor air comfort are better understood today than ever before. However, in combination, these factors become powerful tools for designing happy, healthy, energy-efficient buildings that deliver all-round positive wellbeing effects for everyone, as well as considerable economic benefit – the fifth comfort. When designing and constructing buildings, a holistic approach is the best way to guarantee user comfort.

Visual Comfort

Visual comfort is much further reaching than basic visual performance. From very early on, man has sought means of replicating natural light, and over the years has developed artificial lighting to provide light on demand, freeing us from total daylight dependence and enabling us to spend more and more time indoors. Today, a careful balance between natural and artificial lighting is recognized as optimum, in terms of both comfort and health.

Comfortable lighting does not flicker, glare or blind. It produces good colour renderings, with limited levels of reflection and a uniform distribution of light. These are obtained by the adequate balance of three factors – the sources of light (artificial/natural), the distribution of light within the space, and its perception.

For natural light, specific metrics are needed, since it is dynamic, it has a larger intensity spectrum and is responsible for several non-visual effects. Currently, there are two kinds of competing metrics for natural light:

- Static metrics, which allow a quick assessment, but do not take into consideration either location or orientation (daylight factor %)
- Dynamic metrics (climate-based), which rely on the calculation of illuminances for each hour of the day in a certain location (daylight autonomy %)

Using daylighting autonomy techniques, the Multi-Comfort building concept allows for windows to be designed – using Saint-Gobain's advanced UK-manufactured glazing – to maximize daylight and minimize the need for artificial lighting.

The windows in a Multi-Comfort building are carefully sized, oriented and designed to help improve views, natural daylight and colour appearance while minimizing glare and solar gain.

Daylighting autonomy can considerably help the role of the lighting designer, from a profession specifying artificial lighting to one that understands natural light – a very different subject. As our living and working habits continue to change, so will our lighting needs and what we consider to be visually comfortable. For instance, if reading e-books rather than print becomes standard, the way we light places to read, such as offices, sitting rooms, and bedrooms, will have to change as well.

The facts

There is vast scientific evidence demonstrating the benefits of daylight and associated external views in most building usages:

- In hospitals, it has been proven that patients in rooms that are well lit with natural daylight, need up to 30% less pain-relief than others, that they recover faster and return home in much better spirits
- A study of workers in a Californian call centre found that having a better view out of a window was consistently associated with better overall performance; workers were found to process calls 7% to 12% faster
- A comprehensive US study in the late 1990s suggested a link between the type of office environment and the retention and recruitment of staff. One of the most significant results was the importance workers placed on the 'visual appearance of the workplace compared to many other factors'
- Office workers with more light exposure at the office have longer sleep duration, better sleep quality, more physical activity and better quality of life compared to office workers with less light exposure in the workplace, according to a study from Northwestern Medicine and the University of Illinois

There are many elements of comfort that must be considered to boost occupants' health and wellbeing. It is true that a little more financial investment in the building fabric may be needed than current Building Regulation levels to achieve such effective housing, however investment will provide economic efficiencies for the long term. By providing buildings with the lowest primary energy demand, running costs can be greatly reduced, such as heating and water bills, alongside lower maintenance costs for the owner.

At Saint-Gobain, we believe that sustainable habitat is within our reach, and by providing sustainable products and solutions, this vision can be made a reality.

Read more about Multi-Comfort here: www.multicomfort.co.uk

To find out more about Saint-Gobain, visit www.saint-gobain.co.uk, Like the Facebook page and Tweet [@SaintGobainUK](https://twitter.com/SaintGobainUK)

¹Heschong Mahone Group (2003) Windows and Offices: a Study of worker Performance and the Indoor Environment (Technical Report) for California Energy Commission, 2003, p 2-4

²American Society of Interior Designers (1999) Recruiting and Retaining: qualified Employees – by design

³www.technology4change.com, 12th August 2014

The Curve: BIM support and advice

Chris Witte, Marketing Director Knauf Insulation, and Vice Chair BIM4M2 provides a step-by-step guide on how BIM4M2 are helping manufacturers to be fit for purpose on their BIM journey...

As I sit on my train to London typing this, I can't help thinking how straightforward my journey will be today. Starting from Runcorn station, train exactly on time. Plenty of room on the train – I'm not in rush hour. Into Euston, exactly as expected, and a short walk to my meeting.

If only the journey that we manufacturers need to take on getting fit for purpose in time for April 2016 BIM compliance was so straightforward!

Well bearing in mind that this deadline is now less than 30 weeks away; the provision of structured product information in a digital format really should be on the agenda of most UK construction product manufacturers right now. But is it? In many cases I suspect not. Even where it is, how do we know whether it will impact our business significantly, in part or hardly at all? And then, if we still have the appetite for action, how do we convince the rest of our business to support us? How do we choose between internal skilling-up and the various consultants keen to advise us? Advice which is often contradictory and invariably expensive. It's not hard to see why many product manufacturers may take a 'let's wait and see' approach.

But what if there was impartial free advice that would help us move forward at the right pace for our business? What if it is asking the right questions and coming from fellow manufacturers that have been active in the BIM space recently and who have been making progress and making mistakes (let's be honest!), but learning from them?

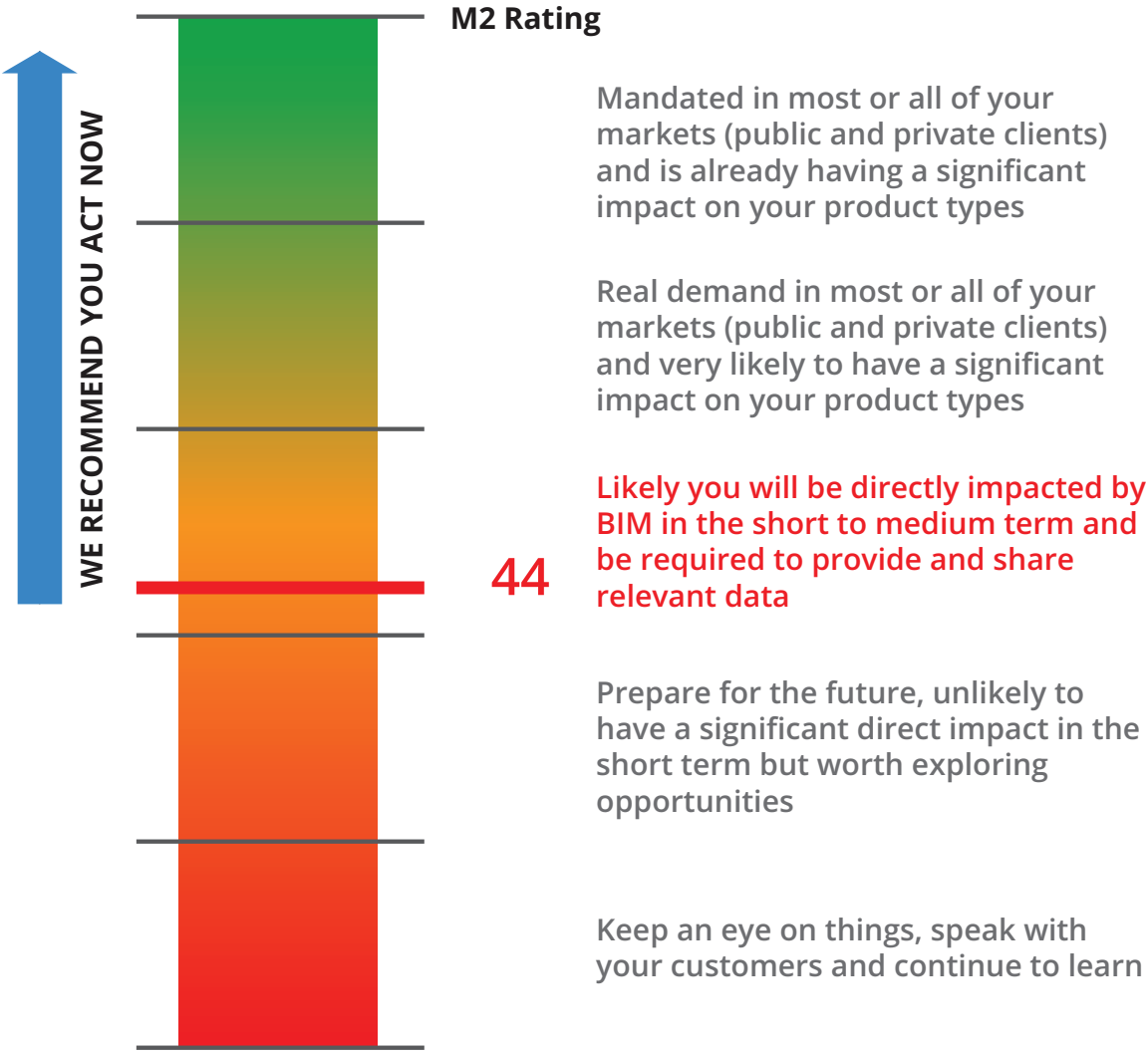
Well that's where BIM for Manufacturers and Manufacturing (BIM4M2) comes in. Formed by product manufacturers, initially from within the Construction



Chris Witte, Marketing Director Knauf Insulation, and Vice Chair BIM4M2

Products Association (CPA), but now independent from it, and linked in to the government BIM4 communities. BIM4M2 recognises there is a massive task to educate and coordinate the construction product part of the supply chain. Having benchmarked manufacturer status in the first manufacturer BIM survey late last year, it has just launched an online guidance called 'The Curve' as in – learning curve, to support manufacturers starting their BIM journey. It is the consolidated experience of a number of product manufacturers, and should enable those starting out on their journey to compress the time period from first thoughts through to initial output and measurement. The Curve from BIM4M2 is the HS2 of your BIM commute!

Let me give you a whistle-stop overview of [The Curve](#).



Estimated Commercial Risk

N.B. this is indicative only to imply potential impact, based on total sales values provided, current adoption in current sectors and current mandated standards only. The figure indicates the total sales of products that would be likely to be used on projects using BIM collaboratively, and does not include for future growth in adoption or growth in market size.

£2,688,889 or 5% of product sales

UK BIM sector uptake data provided by Barbour ABI indicates that currently 12% of projects across all sectors use BIM collaboratively. This increases to 32% for projects greater than or equal to £10million.

The journey starts with a tool that we call Compass. It asks the product manufacturer a series of questions on product type, sectors, exports and market development to provide tailored guidance relevant to a user’s business. The tool uses the latest data from Barbour ABI to provide a realistic assessment of the level of BIM adoption across a range of market sectors of interest to the manufacturer.

Users will also be given a score, which suggests how quickly and significantly they will be impacted along with an indicative potential commercial risk.

For some, the implications will be minimal because of the nature of their business. For most, the commercial implications will be sufficiently significant to prompt further action.



The information is presented as a 3 stage process:

PLAN

How to investigate and decide if BIM is for you

IMPLEMENT

What steps are required

REVIEW

Assessing how well you've done

The example above shows a manufacturer Compass score. Based on their declared £50m annual turnover, it shows that potentially 5% of their sales could be at risk from inaction on BIM, based on how they answered the Compass questions.

After completing Compass you are encouraged to look at the 'How Do I Do It' section, which is a step-by-step guide to creating a compelling business plan proposal to secure internal and /or financial resource to create your BIM content.

The guidance is quite simple in format; a series of headings, which if you click on them lead to further information.

The Plan section identifies what benefits the manufacturer should aim for with their investment in BIM. It then considers what type of solution might be appropriate, before challenging the manufacturer to consider organisation and process impacts. It is here that we manufacturers have most to gain, but some of us didn't realise that this was where the real value lies in our first attempts at BIM. We created content, made it available and thought 'job done'. Without the organisational commitment and process improvements we were in effect missing the bigger picture.

The Implement section guides you from the point of internal approval to move forward with BIM content, and on to actually implementing your plan. For example, it suggests the levels of internal training that some manufacturers are implementing; moving from basic awareness, through to specifier conversant and on to

maintenance of BIM content. It also suggests useful targets that can be set that could be relevant to most manufacturers.

The Review section is about guidance on measuring what you have implemented and most importantly how to get useful feedback in terms of user experience, so that you can confidently refine and improve on your initial implementation plans.

The final section is called Learn More. There is so much useful information that has been published on the internet to help us understand the basics from several stakeholder perspectives. Why would we try and reinvent the wheel? We have just created a short library of links under the headings: Mandatory, Useful and Nice to Know.

We believe that if manufacturers follow The Curve approach it will provide a short cut in their journey to a successful outcome on both developing and benefitting from BIM content. We would then ask that they help us improve this resource by sharing their experience with the BIM4M2 team (info@bim4m2.co.uk) ■

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Smart standards for a smart world...

Henry Lawson, Market Research Consultant at BSRIA examines the possibilities of achieving common standards which are appropriate for the myriad of different 'things' that will potentially be part of the Internet of Things...

I live about 50 miles to the west of London. When I take the train into central London I often find it ironic that the journey takes about the same time as it did when the first trains trundled out of Reading 175 years ago.

Part of this is due to sheer congestion on the railways, but partly also to the fact that the original railway was created by one of the greatest engineers of all time, Brunel, who set up his own standard – a seven-foot gauge allowing faster, safer transit than Stephenson's earlier narrower gauge. As we all know, almost two centuries later the UK, including Reading, is still using Stephenson's narrower, arguably inferior gauge.

This is perhaps the most glaring example of the dichotomy that states that (1) technology needs standards, especially where it connects different systems and (2) the standard that prevails will not necessarily be "the best", and worst case, may actually inhibit innovation.

The railways of course also connected cities, in the process standardising time itself across the UK for the first time. Today, various forecasts are telling us that by 2020, between 20 and 30 billion devices will be connected to the Internet of Things (IoT). This means that, in theory, information and instructions can be shared by everything from the watch on my wrist to the car that I drive (or that drives itself) to the buildings where I live and work, and encompass the functioning of whole regions and countries and their infrastructures.

This then raises huge questions as to how this data can be shared and utilised securely, quickly and efficiently and without creating unintended problems. If we are going to avoid anarchy, there is clearly going to be a need for standards. But how is it technically possible

to achieve common standards which are appropriate for the myriad of different "things" that will potentially be part of the "Internet of Things", let alone to ensure that they are widely adopted – unlike Brunel's brilliantly simple but now largely forgotten seven-foot gauge?

There is a long tradition of establishing standards in particular countries, in specific industries, which sometimes come to be recognised internationally. But a "standard of everything" to match the "Internet of Things" runs the risk of being too general and high level or too complex and cumbersome, not to mention too prone to being overtaken by events.

Predictably, what we are seeing is that different organisations are tackling the problem at different levels and from different angles. Well-established institutions are offering standards alongside consortia created especially for this purpose. This may seem like a recipe for chaos, if not a contradiction in terms. After all, promoting multiple standards is a bit like saying that if standards are good, then double standards are twice as good.

So what has actually been happening "on the ground"? In our own field of smart buildings, US-based Project Haystack is focussing on "developing semantic modelling solutions for data related to smart devices including: building equipment systems, automation and control devices, sensors and sensing devices". Sponsors include established building automation suppliers like Siemens, and Lynxspring, who are perhaps best known for their initiatives in building cyber security.

Looking to the wider field of smart cities, in the UK the HyperCat Consortium has been developing "a hypermedia catalogue format designed for exposing

information about IoT assets over the web". The Board includes representatives from IBM, Cisco, Fujitsu and Accenture. The consortium has also attracted support from some major names in local government and in the academic world.

A slightly different approach is taken by Vorto, an initiative supported by the Eclipse Foundation, which exists mainly to promote open-source software and whose members include IBM, SAP, Oracle, CA Group and Bosch. Bosch, the primary driver behind Vorto, describes the key objective as being to deal with the problem of "industry-specific implementations that provide individual abstraction layers for specific groups of devices." Vorto can create the code required for different types of devices to communicate efficiently.

At a more granular level the LoRa initiative provides Low Power Wide Area Networking based on a specification intended for wireless battery operated Things in regional, national or global networks. Key supporters include IBM, Cisco and numerous network providers.

It is clear from this that key industry players are already involved in initiatives at a number of levels. IBM in particular is actively engaged in several, which suggests either that the company is "hedging its bets" – which is often a sensible strategy, or that it sees them as compatible or even complementary.

While de facto standards often emerge from commercial success, they are also of course frequently created de jure by national or even supranational authorities – think of the importance of Building Regulations and energy targets to the UK Building services Industry.

In this area we are starting to see movement. In 2014 the British Standards Institute (BSI) claimed that the UK was the "first country to develop Smart Cities standards", when it published a Publically Available Specification: PAS 181 "Smart city framework – Guide



"Is that the Relationship Guidance Counsellor? My car and my home security system are refusing to talk to each other..."

to establishing strategies for smart cities and communities".

Not to be outdone, the same year the International Standards Organisation (ISO) also published ISO 37150 Smart community infrastructures – Review of existing activities relevant to metrics. Even the United Nations has been paying heed to the need for standards for the smart world. The UN's telecommunications arm, the ITU first set up a Global Standards Initiative on Internet of Things (IoT-GSI) which concluded its activities in July 2015, and which was succeeded by Study Group 20: IoT and its applications including smart cities and communities (SC&C).

There are also numerous other initiatives and projects scattered around the world, sponsored by various bodies and consortia. At this point you might start to have a nightmare about a multi-faceted Tower of Babel. Who sets the standard for all the standards?

In practice these initiatives tend to fall into three main broad categories: there are those like Project Haystack which focus on a particular sector: in this instance the built environment. There is always going to be a need for targeted standards of this kind, unless that is you create a single gargantuan all-encompassing data model capable of covering all verticals and applications. The key requirement is that such specialized standards can offer a clear “interface” with others. Other standards initiatives like LoRa concentrate on one of the “building blocks” of the IoT, in this case the need for wireless wide area networks (WANS). The national and international standards bodies tend to look at more broad functions and relationships and practices, rather than the nuts and bolts.

At present, most of the IoT standards are fairly restricted in their impact, by geography, function or by vertical. But as the IoT expands, and has more impact on day-to-day life and business – which inevitably means more problems and controversies, we can expect the demand for more rigorous standards to intensify. Cyber security is one obvious example, given that fridges, cars, planes and buildings are all susceptible to being hacked, so it is no surprise to see companies like Lynxspring taking an active role. As the worlds of big data, buildings and infrastructure converge, we can expect concerns over data privacy and data security to continue to escalate. Public concern is in turn likely to spur governments into action and possible further regulation and imposed standards. The fact that such government action is sometimes a kneejerk response that may be poorly thought out does not lessen its likely impact.

Other players that can be expected to become more influential include Apple and Google. As the current

dominant players in the Smart Devices market, the apps developed on their platforms will be a key component in a fully functioning smart world, and companies developing IoT solutions will at least need to take them into account. Past experience suggests that other new major players are likely to emerge with similar levels of influence.

So what can we do about all this? My advice to anyone who is concerned about the future impact of IoT standards on your business is to find out about the existing standards initiatives in your area of activity and to get involved, ensuring that your voice is heard. Most of these initiatives are relatively new, and for those who “buy in” now, there is a real opportunity to help to mould them so that they meet your needs, whether as a supplier, or as a user of services.

True, not all of these initiatives will bear fruit. Some will merge, be overtaken or wither on the vine. But in today's world of revolutionary change, a simple attitude of “wait and see” or “carry on regardless” is simply not going to be sustainable, in any sense of the word. ■



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The significance of steel re-use

Gary Newman, Executive Chair at the Alliance for Sustainable Building Products, summarises their involvement in creating a circular business model for the steel industry...

The Alliance for Sustainable Building Products (ASBP) is commencing work on a new project funded by [Innovate UK](#), exploring a circular business model: one where 'resources are kept in productive use for longer, following primary production – ideally at the same value/use.' The [circular business model](#) that ASBP is investigating is in the re-use of structural steel.

Currently 93% of hot rolled steel sections are recovered from buildings, and recycled, but only 5% of steel is currently re-used. There is huge potential for energy and financial savings if steel building elements are re-used rather than melted down and re-manufactured. Overcoming the barriers to this could kick-start a market worth of 25kT per year, 10% of current UK scrap arising, with a value of £12.5m. The BRE have calculated that re-used steel has only 2% of the carbon emissions of new steel. Furthermore, the re-use supply chain will demand new skills and create new employment opportunities.

This change is likely to take 5-10 years, as it would need a radical rethink around the whole design and delivery process, and a shift in culture requiring new routes for effective communication. For instance, architects and demolition experts may be working together for the first time. These new and existing relationships and exchanges of material all provide value, and the resulting 'Value Network' will be crucial to its success.

Over the past few years, many new innovations have been introduced into the construction industry. Technology developments have offered the potential for greater energy efficiency, reductions in waste and more comfortable buildings. However, the expected benefits are not always delivered, and it is not always

due to the technology. More often, it is down to a failing within the process of communication and responsibility that prevents these innovations from being successful.

This project will provide a response to this problem by exploring value networks and circular business models. Studies have shown that \$520-630bn a year in raw materials could be saved by employing 'circular business models'. By working with business, academics and the steel industry, the ASBP is tasked with investigating this question for this sector.

The potential for a re-used steel supply business will be explored with the help of a team including structural engineers Ellis and Moore, the Steel Construction Institute (SCI), and Cullinan Studio. The National Federation of Demolition Contractors, UCL Institute of Sustainable Resources, University of Cambridge and Cleveland Steel and Tubes will all contribute expertise to the project.

The ASBP are exhibiting at this year's [Greenbuild EXPO](#) in Manchester, November 10th-11th, and at [Resource](#), at Excel in London March 8th-10th 2016. ■



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BIM: Developing a Digital Built Britain

John Eynon, Chair of the CIC South East Regional BIM Hub, considers how BIM and the smart city concept work together and whether we are at the point where this can be taken forward...

In considering how BIM and the smart city concept can work together and to what benefit, we need to take a step back and just take a look at life in general.

The stark reality of our lives is that we've been digital for years. If you use a debit or credit card, the Internet, email, text, messaging or even web shopping then already there is huge digital file on you sitting somewhere in the cloud. It's quite easy for the digitally savvy types to find out quite a lot about you using the right tools without even getting out of bed. A sobering thought.

In addition, we've embraced smart technology with gusto – we all swipe, tap, pinch, spread, flip and whatever with touch screens and smart phones. Even toddlers do it! And we buy tickets, shopping, check the weather, travel, email, play games and much more with the mini computers in our pockets. We're mobile, connected, and using information 24/7. We are all data traders now.

BIM is just an extension of all this moving into the built environment industry. Sharing digital project information, between all the stakeholders, effortlessly, efficiently, around the clock, at all stages and around the lifecycle. This is all accessible on our tablets and phones –anywhere, anytime.

It is worth noting that BIM isn't just about a single project, but about sharing information across projects, sectors, estates, cities, regions, and nations even. BIM actually provides the missing link, between the project and the world.

Around the world, there are many Smart City initiatives, where urban infrastructure is being built containing sensors to provide data, on say, traffic, weather,

people movements, carbon and energy emissions and so on. These sensors share data on all kinds of things to make our lives easier – being connected to your own home's environmental systems for instance. In the UK we now have PAS 181 The Smart City Framework to provide guidance. BIM enables the built environment industry to join our connected data-centric world.

At its heart BIM is just about information, but in a digital environment. The true value of BIM lies in the asset or project lifecycle. Smart sensors can feed real time data into this data environment for the benefit of the owners and operators.

To conclude, yes we are at the point in history where this can be taken forward. The technology exists and is being used, and OK, it may not be perfect yet but we are definitely on the Smart connected journey.

Migration of the built environment industry to digital ways of working and a Smart society is a natural progression and also absolutely inevitable. Time to get on the train! ■

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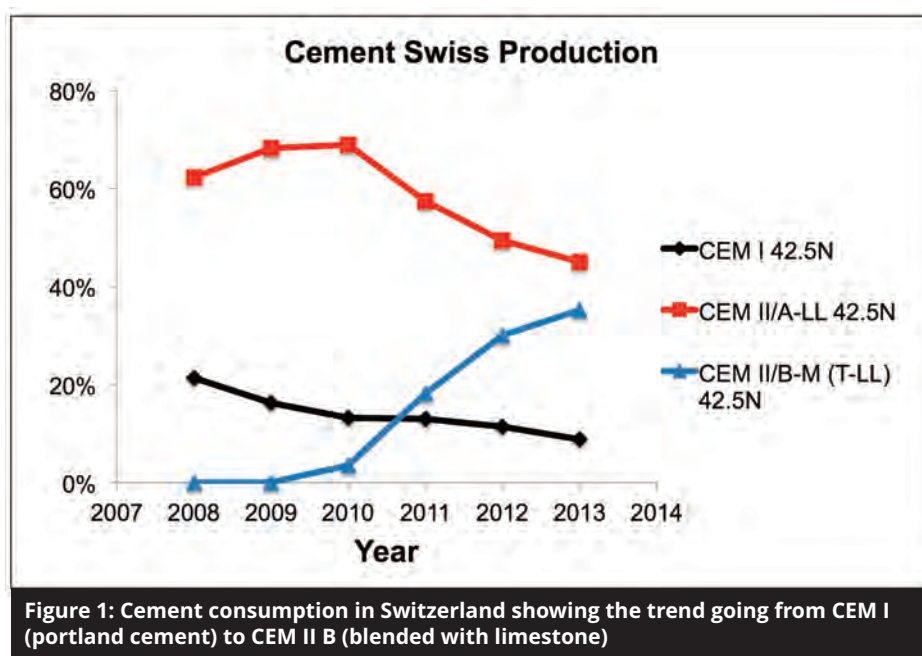
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Durability challenges for new and existing reinforced concrete structures

Concrete and reinforced/pre-stressed concrete is and will be the main construction material for civil engineering infrastructure. Much more than in the past this construction technology faces challenges that have been discussed at the International RILEM workshop held at ETH Zurich in Switzerland on 17-18 April 2012¹.

For new structures that will be built in industrialised and emerging countries to expand the civil engineering infrastructure, the challenge is to achieve long service life, practical, cost-effective solutions with materials having a reduced environmental footprint. To achieve this, the cement industry made great efforts in substituting clinker (responsible for a large part of the CO₂ emissions) with supplementary cementitious materials (SCM). This substitution is reflected in the decreasing amount of Portland cement (CEM I) and the increase of blended cements (CEM II) worldwide (figure 1). These modern binder systems containing limestone, fly-ash, oil burnt shale etc. in a complex blend are getting included (thus allowed) by more and more standardisation bodies such as the European Cement Standards EN 197-1 and their national companions. The standards include specifications on the proportions in which they are to be combined, as well as the mechanical, physical and chemical requirements for both the products and their constituents. These blends are suitable for achieving strength similar to Portland cement, thus can be used to build concrete structures.



From the point of view of the end user (engineer, owner of the structure, society) that the final product uses concrete made of cement is more important. Performance based concrete standards such as the European concrete standard EN 206-1 have thus

emerged that relate concrete durability to different types of exposure. Concrete for a bridge in the Swiss mountains (figure 2) exposed to a severe climate and de-icing salts (exposure condition XD3) must be of much higher quality compared to



Figure 2: Typical highway bridge in the Swiss Mountains with severe exposure to de-icing salts in the winter

concrete inside a building (XC1). The term “quality of concrete” includes the care with which it is executed but also its composition – thus water to cement ratio and the cement type. Whereas long experience is available with concrete structures made with Portland cement (CEM I), new blended cements have a much shorter track-record. In addition, due to the reduced clinker content, the pH of the pore solution will be lower and questions arise regarding the corrosion protection of the steel², thus the durability of these new structures both regarding the resistance against carbonation and against chloride-induced corrosion.

The civil engineering industry is currently, in many industrialised countries, in a transition phase from building new constructions to maintaining the large stock of valuable assets. This is reflected (as an example valid for other industrialised countries) in the increasing costs for maintenance of the Swiss national highway system (figure 3) compared to the costs for building new structures. These reinforced concrete structures are aging and very often show premature deterioration due to corrosion of the reinforcement. For existing infrastructure the challenge is

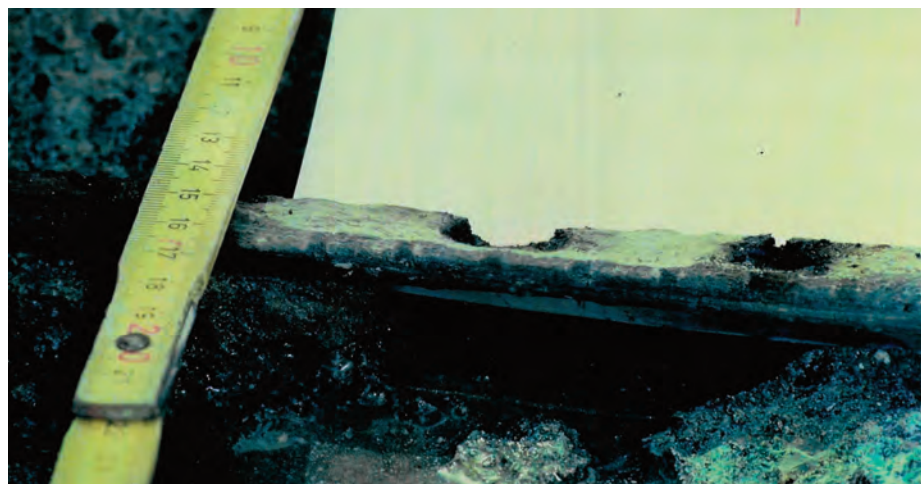


Figure 4: Localized chloride induced corrosion of the reinforcement showing that no rust is formed

thus extending the service life with a minimum of intervention, costs and traffic delay. Bridge management systems based on the results of inspection of the structures are crucial. Today visual inspection is common – once a sign of distress (cracks, rust) is detected maintenance action is decided (reactive strategy). In this way damage, especially chloride-induced corrosion of the reinforcement (figure 4) is detected only in a very late stage and maintenance costs are very high. An improved pro-active maintenance strategy requires a step forward, changing from visual inspection towards more refined techniques for inspection and

condition assessment, e.g. robotic inspection and corrosion surveys. This is particularly important for RC structures exposed to chloride ions (sea-water, de-icing salts) as internally ongoing corrosion of the reinforcement will manifest only in a very late stage at the surface.

The topics addressed here will be further focussed on in future issues of Adjacent Government.

¹ U. Angst, R.D. Hooton, J. Marchand, C.L. Page, R.J. Flatt, B. Elsener, C. Gehlen and J. Gulikers, *Materials and Corrosion* 63 (2012) No. 12

² L. Bertolini, B. Elsener, E. Redaelli, P. Pedersen, R. Polder, *Corrosion of Steel in Concrete – Prevention, Diagnosis, Repair*, WILEY VCH second edition (2013)

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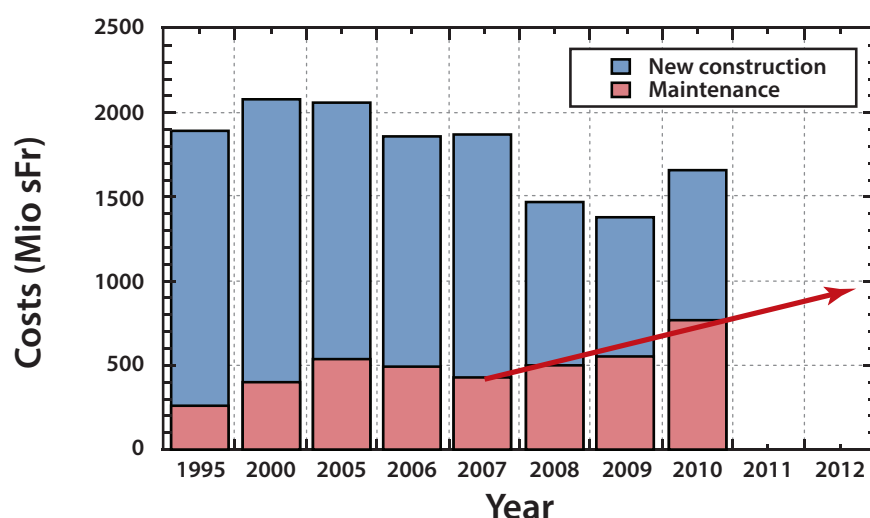


Figure 3: Increasing costs for repair and maintenance of the ageing infrastructure – example Swiss Highway System

The FM impact on construction design

Brian Atkin, Lead Technical Author of BS 8536-1 the new facilities management briefing guidance, and Stephanie Kosandiak Lead Programme Manager for Construction at BSI, discuss its impact on construction design...

We are hearing a great deal about Building Information Modelling (BIM). As the government's Level 2 BIM requirements deadline for industry looms in April 2016, this is bound to increase in pace. To support this action there are various documents in place, one of which is BS 8536-1 Briefing for design and construction. Code of practice for facilities management (Buildings infrastructure).

Ensuring that the design and construction of buildings and other facilities take account of operational performance requirements is a matter of prime concern for owners, operators and their facility managers. Too often, facilities are delivered by a project team that has not taken sufficient account of operational requirements, especially those relating to environmental management, functionality and effectiveness, security and cost. This is not to say that blame rests solely with the project team. Owners and operators need to be able to express their requirements unambiguously and maintain a watchful eye over the emerging design and construction and the extent to which both measure up to the definition of an efficient, safe and cost-effective facility.

Why do we need a new standard?

Historically, there was a paucity of guidance on briefing for design and construction for the purpose of assuring operability in the completed facility. This was largely rectified by a 2010 Code of Practice on Facilities Management Briefing (BS 8536), covering the briefing of designers on the performance requirements for a new or refurbished facility. Its aim was to introduce a more structured and rigorous approach to design that, by definition, had to take an active account of the needs of owners, operators and their facility managers in the operation and use phase, where facilities

management is the responsible discipline. In the years since the publication of BS 8536, it became increasingly clear that more could and should be done to improve the processes that result in a successful facility.

“A key feature of the underlying processes for delivery of an operational facility is an evidence-based approach to design and construction that is driven by outcomes which are explicit and measurable.”

BS 8536-1: 20151 is the response to both the need for more substantive recommendations and guidance on design and construction briefing for operability and the changing industrial landscape that construction and its clients represent. Significant among the changes in the new BS 8536-1 are:

- The incorporation of the principles of soft landings;
- A definition of the information requirements associated with “Level 2 BIM” in accordance with PAS 1192-2 (for CAPEX) and PAS 1192-3 (for OPEX);
- Security-mindedness in accordance with PAS 1192-5; and
- The requirements for post-occupancy evaluation (POE) to strengthen the link between owners, operators and their facility managers, and the design and construction team to assure performance of the design and the operational facility. BS 8536-1 is intended to have a key role in coordinating these various aspects of the project delivery process.

What does it cover?

The three-fold aim of BS 8536-1 is:



1. To improve the focus of the supply chain on performance in use;
2. To extend supply chain involvement through to operations and defined periods of aftercare; and
3. To involve the operator and facility manager from the outset.

All of the above changes should be seen in the context of a broader scope of treatment that considers operational requirements throughout design, construction, testing and commissioning, handover, start-up of operations and during defined periods of aftercare. BS 8536-1 does not, however, provide detailed guidance on design or construction – there are other standards that do – but it is concerned with information and data about the operability and performance requirements for the new or refurbished facility.

Among the other changes brought by BS 8536-1 is a close alignment with industry work stages for projects.

A key feature of the underlying processes for delivery of an operational facility is an evidence-based approach to design and construction that is driven by outcomes which are explicit and measurable. These need to reflect the requirements of the owner, operator, end-users and other key stakeholders concerning the operational performance of the facility. In fact, performance outcomes should be verified in each work stage to ensure that the facility will meet its operational requirements and avoid unwanted surprises at handover and start-up.

Sustainability in practical terms

As noted earlier, BS 8536-1 considers performance in terms of environmental, social (i.e. functionality and effectiveness), security and economic criteria – the practical side of sustainability principles – that have to be satisfied in the new or refurbished facility. These can be summarised as:

Environmental targets – energy use, CO₂ emissions, water consumption and waste reduction/disposal.

Social outcomes – functional and operational requirements of the owner, e.g. overall concept, context, uses, access, visual form, space, internal environment, durability and adaptability, and the operator's and end-users' requirements of utility, usability, safety, maintainability, inclusiveness and comfort.

Security outcomes – security-mindedness with respect to both physical and digital assets.

Economic targets – capital cost and operational cost side-by-side to support whole-life cost management.

Post-occupancy evaluation (POE) is advocated as a means for establishing if the facility is performing as expected, including measurement of actual operational performance against the required performance outcomes/targets from the above environmental, social, security and economic perspectives set at the outset of the project. Specifically, the evaluation should include an end-user satisfaction survey, an energy-use survey and an assessment of the overall performance of the facility against agreed outcomes/targets and applicable benchmarks.

“Ensuring that the design and construction of buildings and other facilities take account of operational performance requirements is a matter of prime concern for owners, operators and their facility managers.”

Finally

BS 8536-1:2015 is a standard for everyone engaged in the design, construction and operation of a new or refurbished facility. A successful team is an informed team that is capable of delivering a facility to meet defined operational performance requirements. This standard can provide the team with a blueprint for success.

A companion standard (Part 2) covering asset management of linear and geographical Infrastructure is under development.

BIM

Is the process of generating and managing information about a building, facility or infrastructure asset during its entire life-cycle. It unlocks more efficient and collaborative ways of working in the building process through the sharing of three-dimensional data by all those responsible for the design, construction and operation of buildings and infrastructure in the built environment, to produce a digital representation of physical and functional characteristics of a facility.

BIM Level 2

Is a managed 3D environment held in separate discipline 'BIM' tools with data attached where commercial data will be managed by enterprise resource planning software and integrated by proprietary interfaces. This level of BIM may utilise 4D construction sequencing and/or 5D cost information. The Government's BIM Strategy Paper calls for the industry to achieve Level 2 BIM by 2016. ■

1 BS 8536-1:2015, Briefing for design and construction – Part 1: Code of practice for facilities management (Buildings infrastructure)



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Major FM companies are achieving BAFE registration

The public sector continues to make wider use of outsourcing and Facility Management for their fire protection and there is growing awareness among Facilities managers that their responsibilities for fire protection are significant. However it can be difficult to ensure that external providers of fire safety services are capable and competent. As a result more and more of the major FM companies are achieving third party certification with BAFE.

BAFE also monitors all public sector tenders for fire protection services to encourage specifiers and purchasing bodies to use third party certificated companies. So to compete for these valuable contracts providers need to be able to demonstrate their competence.

This is not a question of recommending one company over another, as there is now such a wide range of companies available who are certificated across the UK, but it is a matter of refining choices for end users.

BAFE is the independent third party certification registration body for the fire protection industry. We develop schemes for UKAS accredited certification bodies to assess companies to recognised standards. BAFE supports specifiers and property managers to ensure that they get quality fire protection to match their risks. There are now over 1,000 companies with more than 1,250 registrations to BAFE schemes across the UK. These numbers continue to grow with end users recognising the BAFE quality standard.

The Regulatory Reform (Fire Safety) Order 2005 and the equivalent legislation in Scotland and Northern Ireland, places specific duties on the 'responsible person' or 'duty holder' and DCLG states in its guidance documents (section 8):

"Third-party certification schemes for fire protection products and related services are an effective means of providing the fullest possible assurances, offering a level of quality, reliability and safety that non-certificated products may lack."

YOU NEED BAFE

If you are looking for the Maintenance of Portable Fire Extinguishers, look for Companies accredited to BAFE Scheme SP101/ST104. Companies have to be annually certificated to ISO9001 and all technicians are regularly assessed to BAFE standards. Over 1,250 Technicians are now BAFE registered which ensures that they are properly trained and keep up to date.

For Fire Detection and Alarm systems, Companies should hold BAFE SP203-1 scheme approval for design, installation, commissioning and maintenance modules. This is the key measure of competence for quality fire alarm companies and there are now almost 800 companies in the scheme. This scheme also requires that only properly certificated product is used in the installation.

Our Emergency Lighting scheme (SP203-4) is also modular and sets out staff competence, equipment and quality criteria to be met.

BAFE has also developed a scheme for Companies who carry out Fire Risk Assessments (SP205). The scheme certificates the competence of the individual assessors as well as the quality requirements for the organisation. A competent fire risk assessment is the basis for all fire protection and is the key requirement of national legislation. There are a growing number of companies registering to the scheme, throughout the UK. If you provide FM services for clients or within your own company, you have an important responsibility to understand and implement fire protection requirements.

Becoming one of the more than 1,000 BAFE registered companies ensures that a provider has taken important steps to ensuring that their services will be delivered to national, independently certificated standards. Using a BAFE registered company is the way to ensure that you receive a competent service.



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DON'T GAMBLE WITH YOUR FIRE RISK ASSESSMENT!

If you are responsible for a business premises, the law requires that you have a fire risk assessment.

To find competent providers, you need BAFE.

Under the provisions of the Regulatory Reform (Fire Safety) Order 2005, the Duty Holder or Responsible Person for a building is required to make a Fire Risk Assessment to clarify the fire precautions necessary to ensure the safety of staff, customers and property.

At present there are no adequate means to ensure the competence and reliability of a company commissioned to carry this out.

BAFE scheme 'Life Safety Fire Risk Assessment SP205' has been developed specifically to address this situation, and will provide reassurance to the Responsible Person that they are doing everything possible to meet their obligations.

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A solid footing for the Arctic

EU Commissioner for the Environment, Karmenu Vella highlights the need for climate action and environmental protection in the Arctic...

As preparations for the UN climate conference (COP 21) in Paris this December move into full swing, one region undeniably affected by the changing climate is high on the international agenda. Temperatures in the Arctic are rising twice as fast as elsewhere in the world, ice is getting thinner, and a once barely accessible region is now attracting different kinds of attention.

The transformation looks inviting. Routes through the Arctic are shorter. The potential for natural resource extraction, and opportunities for research, jobs and growth, mean the area is under constant economic pressure.

We must balance this opportunity with an assessment of the risks. We must do this, not only for the 4 million inhabitants and their local environment, but for the rest of the globe as well. Sea levels are rising and the ice is thawing faster than our efforts so far to address them.

It may come as surprise that over 400 000 EU citizens live in the Arctic region. EU consumers provide markets for products from the region, and EU investors and businesses are major players in this development. Recognising the need for development but in a sustainable manner, EU Arctic policy aims work with the people who know the land best, the people who live there, to protect and preserve the Arctic. We are looking to promote sustainable growth by working together with our global partners.

EU engagement in the Arctic

Over the past 15 years the EU has provided more than €200m for Polar research, not to mention some regional projects that have been in place for much longer. Projects such as DAMOCLES (Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies), 'Ice2Sea' and ACCESS (Arctic Climate Change, Economy and Society) have enormously improved our understanding of how



Karmenu Vella, Commissioner for Environment,
Maritime Affairs and Fisheries

climate change is affecting the Arctic environment. A further €40m will be invested in the next 2 years to continue research for the region.

Casting the net a little wider, much larger sums have been involved to help actors on the ground. Between 2007 and 2013, the EU invested more than €1bn on regional development in the Barents region to help projects stimulating local entrepreneurship, investment in infrastructure, energy efficiency in buildings and generating energy from waste.

Managing opportunities

EU funding in northern Scandinavia can help the region move away from a resource extraction-based economy towards a forward-thinking model that fosters green growth and innovation. Opportunities include the renewables sector (hydro, wind power and ocean energy), aquaculture and tourism, but also the digital sector, including cloud services and data

centres. The Barents region alone could offer up to €140bn in investment opportunities. With that in mind, the Commission and the European External Action Service are preparing an Arctic policy by 2016 to help the region unlock these opportunities.

We need measures to preserve the Arctic high seas, ensuring that no harvesting of marine resources takes place before we have the necessary science and methods in place to ensure sustainable exploitation. This would be in line with our commitment to the UN Sustainable Development Goals (Goal 14). This commits the international community to protect the oceans globally. The EU is involved in these discussions: from fisheries management in the Arctic high seas, to the development of a network of Arctic Marine Protected Areas and setting high safety standards for Arctic vessels through the Polar Code.

A solid base for progress

All eyes are on the Paris climate conference. It remains within our power to tackle climate change and put the world on track towards limiting global warming to less than 2°C. The international community acts now. Without urgent action, climate change will transform the Arctic and the face of our planet, Europe included.

The EU is going to Paris with a clear commitment: to reduce its greenhouse gas emissions by at least 40% by 2030 from 1990 levels. We have a choice and we must have the political courage to act now, collectively, with ambition to make Paris a turning point in the global transition towards low-emission, climate-resilient societies worldwide. ■

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Karmenu Vella

**Commissioner for Environment,
Maritime Affairs and Fisheries**

European Commission

www.ec.europa.eu/commission/2014-2019/vella_en

Let us take stock of our situation regarding Earth's climate

1 Climate change is not a hoax. It is real and is happening now. The global average temperature is steadily increasing and there is no doubt that the most significant cause of this warming is the increasing concentration of CO₂ in the atmosphere.

2 There is overwhelming scientific consensus that emissions from fossil fuel combustion by humans have caused the CO₂ level in the atmosphere to increase from its steady average at 275 parts per million (ppm) to over 400 ppm in the last 215 years. There is no mystery here. James Watt patented his steam engine driven by fossil fuel 246 years ago.

3 Forecasts based on fairly robust atmospheric models indicate that a 450 ppm CO₂ level will correspond to a +2°C rise in temperature from that present prior to the industrial revolution. This is a very significant temperature increase that will cause enormous problems for Earth and its inhabitants: coastal flooding due to sea rise; an increase in the frequency and intensity of storms, which will cause droughts in some areas and extensive flooding in others; adverse effects on the reliability of food production; huge increases in human refugees from affected areas; and increases in disease propagation.

4 Sea level rise is caused by the melting of ice located at Earth's poles and glaciers. We already have extensive data showing the loss of such ice. The Arctic is particularly sensitive because ice there forms on water. While Arctic

ice was 6 feet deep in the mid-20th century, it now averages only 3 feet deep. Its areal extent is decreasing rapidly and indications are that the Arctic will be completely ice free all through the year by 2033.

5 Greenland's ice fields are melting rapidly. When all of this ice has melted, it will add 20 feet to sea level. Over 100 million people live no more than 3 feet above the current sea level.

6 Antarctica has the largest amount of ice. It too is melting. Somewhat confusing is that there are two different kinds of ice in Antarctica: ice that forms on water (sea ice), which is quite thin; and ice that forms on land, which is often kilometers thick. Sea ice can appear to increase in areal extent during a year and some have argued that this increase shows the warming trend is false. This is incorrect. When one accounts for the total volume of ice at Antarctica, one sees a steady diminution of its volume over time. Both poles are suffering warming trends and adding water to the sea.

7 There is no uncertainty about why CO₂ levels in the atmosphere are increasing. Earth's atmospheric temperature. It is a well-known fact that CO₂ is transparent to ultraviolet radiation coming from the sun, but CO₂ strongly absorbs infrared radiation that comes from Earth. CO₂ permits energy to come through the atmosphere, but prevents considerable amounts of energy from leaving. This has been known for decades. Also known is the amount of radiation that

can be absorbed by CO₂. Thus, by knowing the concentration of CO₂ and the volume of the atmosphere, it is possible to calculate using well-known laws of physics how much energy will be absorbed by CO₂ and retained as heat. It turns out that the 2 ppm increase in CO₂ (from 398 to 400 ppm in 2014) captured an additional 380 billion megawatt-hours of energy over what was captured in 2013. This energy increase is more than 10 times the energy needed to melt the 300 m³ of ice that was observed to have disappeared in the Arctic in 2014.

"The global average temperature is steadily increasing and there is no doubt that the most significant cause of this warming is the increasing concentration of CO₂ in the atmosphere."

8 Humans need to find an alternative energy source and do it quickly. Much of the known reserves of fossil fuel must never be burned or must be burned in a way that CO₂ emissions will not occur. If we do burn them without emission controls, then Earth will spiral into a severely baked planet accompanied by catastrophic suffering of flora and fauna (including humans).

9 With our current rate of increase in CO₂ emissions per year, it is clear that our atmosphere will contain 450 ppm CO₂ by 2035 and 550 ppm (corresponding to a +3°C warming) by 2100. Something is urgently needed very soon.



“Greenland’s ice fields are melting rapidly. When all of this ice has melted, it will add 20 feet to sea level. Over 100 million people live no more than 3 feet above the current sea level.”

10 A problem most people have with cutting back fossil fuel use is that they believe it will adversely impact our prosperity and economic growth. What they fail to understand is that our prosperity and economic growth are guaranteed to be horribly affected by continuing on our current road. The only way to have our global civilisation remain relatively sustainable is for us to control CO₂ emissions.

11 World leaders have met several times in recent decades to try to come to some sort of global consensus about what must be done by each

country. Virtually all of them have failed because of lack of commitment to the agreements (Kyoto) or to watered-down commitments (Copenhagen). We are collectively running out of time.

12 In Paris in December of 2015 there will be a meeting of over 200 United Nation’s countries trying to negotiate fair and on-going national commitments to stem increasing CO₂ emissions. Most political and environmental experts say this is the last chance the world has to act in a manner that will effectively limit global warming to less than +3°C compared to pre-industrial temperatures. Already negotiations are underway. Critical leadership is being found. The G7 nations agreed in June to end combustion of fossil fuels by 2100 and to reduce greenhouse gas emissions by 40-70% by 2050 compared to 2010 emission levels.

13 All governments must be committed to this action. All people must make sure their governments are held to high standards and ethical behavior. This is the fight of our lives. It is also a fight for our grandchildren’s lives.

BRConard Consulting, Incorporated

metals • environment • health • toxicology

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Is climate change affecting our minds?

Emerging research indicates that climate change impacts on mental health an increasing global concern...

Climate change is increasingly recognised as one of the greatest threats to human health of the 21st Century, with wide-ranging impacts on individuals, communities, and health systems globally. The latest synthesis evidence from the Intergovernmental Panel on Climate Change (IPCC) (2014) indicates increasing global temperatures are leading to more variable and extreme weather conditions including drought, heat waves, and extreme cold; increased frequency and severity of storms, including hurricanes; sea level rise, leading to displacement, infrastructural damage, and economic loss; and melting sea ice, glaciers, and permafrost, leading to flooding, impacts to coastlines, and changing environmental conditions.

“Climate change represents an unprecedented challenge for global mental health. The mental health impacts from climate change need to be prioritised, as they are no longer abstract...”

These changes have been linked to a variety of physical health impacts, including increased risk, prevalence, and distribution of foodborne, waterborne, and vectorborne disease; decreased nutritional opportunities from agricultural losses; morbidity and mortality from extreme weather events and heat-related stress and violence; increased risk for cardiovascular illness and respiratory illness;

and potential for violence from displacement and forced migration.

Clearly, climate change is becoming a defining issue for the health sector – but what about mental health?

Climate Change: The Next Challenge for Mental Health?

Emerging evidence is indicating that climate change and the related environmental changes will impact mental health and psychological wellbeing through multiple pathways, with expectations that the impacts will be widespread with long-lasting human suffering and high economic costs. Although knowledge is still limited about the ways in which climate change will impact mental health, there is consistency in the emerging research and projections from scientists, researchers, communities, organisations, and healthcare professionals on current and anticipated pathways and mental health outcomes:

- Natural disasters and severe storms, leading to widespread displacement, enduring psychological impacts, post-traumatic stress disorder, and increased conflicts;
- Heat waves and changing temperature regimes, resulting in increased aggression, conflict, violence, anxiety, depression, morbidity and mortality;
- Prolonged droughts, resulting in increased stress, anxiety, depression,

suicide, addictions, family stressors and violence, and conflict from migration;

- Secondary impacts, including physical health impacts, from increasing air pollution (asthma, respiratory ailments, allergies) and increased morbidity and mortality, leading to a range of psychological impacts; and infrastructural damage and land loss, leading to displacement, migration, and potential conflict.

In particular, children, women, the elderly, the poor, and those who rely on the natural environment for sustenance and livelihoods (e.g. fishers, farmers, subsistence hunters, and Indigenous populations) are considered most vulnerable to the psychological stressors of a changing climate and environment.

Case Study from the Circumpolar North

Indigenous populations across the Circumpolar North and in the Arctic 8 countries have been at the frontlines of global climate change, experiencing rapid changes in seasonal temperatures, leading to later freeze-up and earlier break-up of the sea ice, and overall declining sea ice coverage. The weather has also become increasingly unpredictable, with more frequent and extreme storms. As a result, travel is more dangerous, and many Indigenous populations are finding it increasingly difficult to travel safely to hunting grounds, feed their families, and maintain subsistence livelihoods and cultural practices. For populations who rely on the land for sustenance,

livelihoods, and connection to cultural and ancestral knowledge, even subtle alterations in environmental conditions can have devastating impacts.

From multi-year collaborative research conducted with the five Inuit communities of the Nunatsiavut region of Northern Labrador (population 2,600; 4% of the Canadian Inuit population) in Canada on the impacts of climate change on Inuit mental health, four main pathways were discovered:

- Strong emotional responses, including sadness, stress, distress, fear, anxiety, grief, and depression, due to the changing land and environment, concerns over travel safety, the loss of cultural connections to land-based activities, and the disruption to traditional knowledge transmission among generations;
- Increases in drug and alcohol usage, linked to people coping with the pain from no longer being able to access the land for hunting, trapping, fishing, and foraging and the loss of cultural identity, as well as filling 'empty' time that would have previously been filled with land-based activities;
- Potential increases in suicide ideation and attempts, linked to the strong emotional responses, the pain of losing cultural practices and traditions, and the loss of identity and self-confidence related to no longer being able to provide for family and community; and
- Magnification of other already-present mental health challenges, stemming from intergenerational trauma, pre-existing personal trauma, and the loss of regular land access, which is a strong mental health coping strategy.

"Climate change is increasingly recognised as one of the greatest threats to human health of the 21st Century..."

Moving Forward: Mental Health Adaptation

Climate change represents an unprecedented challenge for global mental health. The mental health impacts from climate change need to be prioritised, as they are no longer abstract; people around the world are already experiencing a wide range of psychological responses. We need to prepare our health systems, our policies, and our populace for coping with the mental health impacts of climate change, and begin to divert significant resources to this area. Governments, decision-makers, researchers, and healthcare providers have the opportunity and the responsibility to work together through intersectoral partnerships and collaborations to promote resilience and to create and support educational and advocacy campaigns for those working in the healthcare and health decision-making sectors.

Key Partners & Collaborators

Jack Shiwak & Charlotte Wolfrey, Rigolet Inuit Community Government.

Inez Shiwak & Marilyn Baikie, 'My Word': Storytelling & Media Lab.

Herb Jacque & Myrtle Groves, Makkovik Inuit Community Government.

Diane Gear & Greg Jacque, Postville Inuit Community Government.

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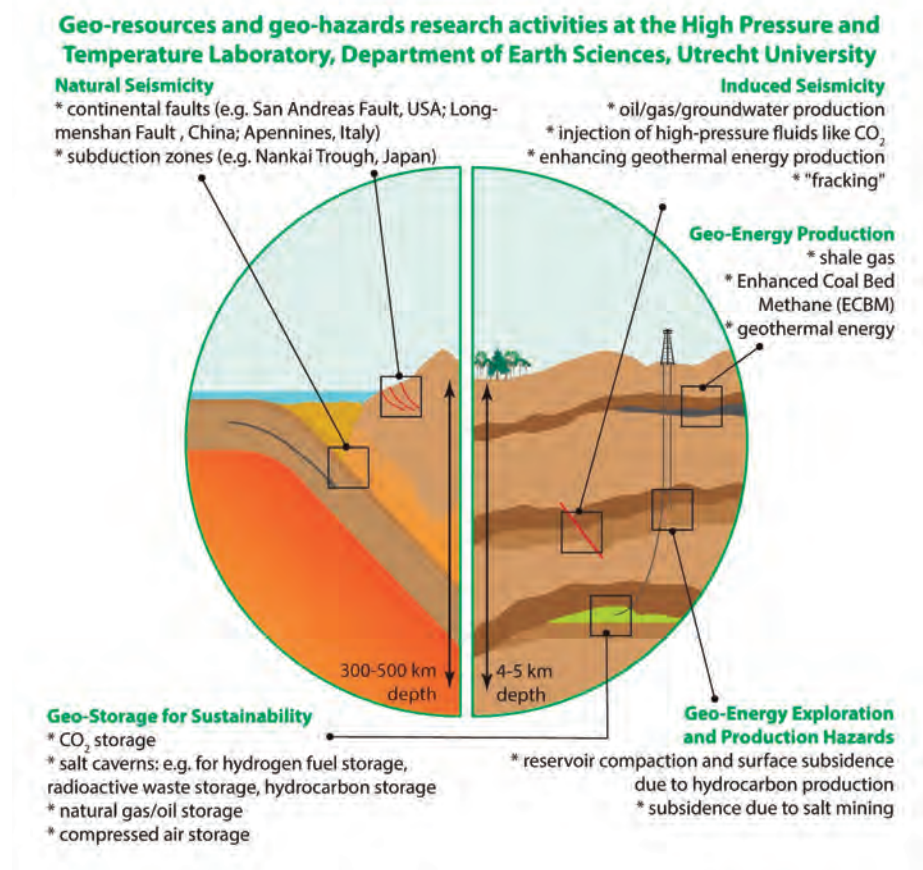
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Living with geo-resources and geo-hazards

Two of the key strategic topics on the European Committee's Horizon 2020 Roadmap revolve around geo-resources and geo-hazards, and their impact on societal and economic development. On the way towards a better policy for sustainable geo-resources production – such as oil, gas, geothermal energy and groundwater, as well as for geo-hazard risk management, such as (induced) earthquakes and volcanic eruptions – Solid Earth scientists are ideally designated to provide the necessary scientific basis. In order to understand the mechanisms driving these geological processes, scientists at the High Pressure and Temperature (HPT) Laboratory at the Department of Earth Sciences at Utrecht University, the Netherlands, investigate these issues within the university's Earth and Sustainability strategic area, and, for example, in the SEISMIC Project, funded by the European Research Council Starting Grant of Dr. André Niemeijer.

Impact on urban areas

With global energy demand soaring, easy-to-get fossil fuel resources dwindling, and rising CO₂ levels changing the climate, future energy supply is becoming a serious concern at global and regional scales. For this reason, low carbon resources such as natural gas, shale gas and geothermal energy are becoming increasingly exploited, as opposed to coal or oil. However, exploitation of the Earth's subsurface resources removes the reservoir environment from its natural chemical and physical equilibrium. Production



from reservoirs frequently causes reservoir compaction and fault reactivation, leading to surface subsidence and induced (micro)seismicity. Europe's dense population, as opposed to other areas in the world, inevitably means that most tectonically active areas are also urban areas. Natural earthquakes, even those moderate in size, can cause significant health and economic impact in such regions, like the 2009 l'Aquila earthquake. At the same time, human-induced tremors from geo-energy production efforts, such as hydrocarbon production, geothermal energy and 'fracking', have in some cases also led to significant economic damage and in general to societal unrest.

Toward sustainable energy production from the Earth

Given the potential societal and ecological impact of surface subsidence, as well as the current interest in developing geothermal energy and unconventional gas resources in densely populated areas, there is much need for obtaining better quantitative understanding of the behaviour of the reservoir rocks to improve the predictability of the impact and risks of geo-energy production. Fear of the unknown may lead to exaggerated public responses and it is therefore important to provide a solid scientific basis that separates the actual risks from the urban legends.

Extraction of fluids from the subsurface inevitably leads to (poro)elastic compaction of the reservoir, hence subsidence and occasional fault reactivation. Induced subsidence is seen in both onshore (e.g. Groningen, the Netherlands; Lacq, France) and offshore hydrocarbon fields (e.g. Ekofisk, Norwegian North Sea) and can have significant technical, economic, societal and environmental impact. These effects often exceed what is expected from purely elastic reservoir behaviour and may continue long after exploitation has ceased. This is most likely due to time-dependent compaction or 'creep deformation' of such reservoirs, driven by the reduction in pore-fluid pressure compared with the rock overburden.

In contrast, injection of fluids, e.g. for fracking or for geological storage of CO₂, could also induce deformation processes. Fracking of gas-bearing shales or tight sandstones can cause seismicity due to over-pressurisation and fracturing of the subsurface reservoir. And while CO₂ storage is considered to be a potential solution for reducing CO₂ emissions, the chemical interactions between rock and fluid could change their mechanical behaviour. Re-pressurisation of a depleted hydrocarbon field by high-pressure CO₂ could lead to slip of bounding faults. In both scenarios, the mechanical behaviour of the in-situ rock is controlled by its creep behaviour.

To date, no physically-based creep models exist to predict such effects.

'Creep laws' that have been proposed are empirical and have no mechanistic basis to constrain extrapolation from laboratory to in-situ reservoir conditions. Estimation of the seismic hazard related to fault movement has been mainly based on historical records of seismicity. However, compared to geological time-scales, our records are relatively short and thus incomplete.

Moreover, the potential for (micro) seismicity when utilizing the subsurface for injection or extraction of fluids should be evaluated beforehand. In order to accomplish this, we need to understand how the sliding strength of faults, which accommodate the bulk of the deformation, evolves with changes in the stress state or chemical environment. Furthermore, it is necessary to outline the conditions under which the reactivation of faults might lead to unstable, seismogenic slip.

Providing a basis for policy makers

In order to develop and adapt policies to regulate energy production strategies or natural hazard risk management, a fundamental understanding of the micromechanical and chemical processes that operate on the grain-to-grain scale is needed. In practice, this involves laboratory-scale (mm- to cm-scale) experiments on representative rock materials, under the thermal, pressure and chemical conditions existing in the subsurface. The experimental facilities at the HPT laboratory in Utrecht are utilized to investigate this under a wide variety

of stress, temperature and chemical conditions. These conditions range from relatively shallow sub-surface conditions (2-3 km) to those pertaining to the occurrence of mega-earthquakes like the 2011 Tohoku earthquake (20-30 km depth), which caused the tsunami that hit the Fukushima Nuclear Power Plant. Once the controlling grain-scale mechanisms are identified and quantified, the experimental results are integrated in large-scale numerical models, in close collaboration with the tectonophysics and seismology groups at Utrecht University, with the ultimate goal to provide a better, physics- and chemistry-based, evaluation of seismic hazards on regional scales.



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Carbon dynamics and geomorphic processes in a warming Arctic

Ivar Berthling, Department of Geography, NTNU, Norway

There are a number of significant feedbacks and interactions between processes and materials at the earth surface and in the atmosphere. This is a crucial point when considering global warming and climate change effects, because such feedbacks might amplify the ongoing warming. One such potential feedback that has received a significant amount of scientific and public attention is the fate of the organic carbon stored in the ground in Arctic permafrost areas. Permafrost is defined as the part of the ground that experience sub-zero temperatures for more than two years. Such temperature conditions essentially stops decay of organic matter from microbiological activity. The effect is that organic carbon that becomes buried from geomorphic and biotic processes such as sedimentation on the surface, peat development and the churning of soils subjected to freezing and thawing (among scientists referred to as cryoturbation, Fig. 1) tends to accumulate rather than be released as CO₂ or methane. Over millennia, this condition has caused both the permafrost and the active layer of Arctic soils to become a sink for organic carbon. Berthling et al.² for instance found from dating 17 samples within a 1.5 x 0.6 m section in the active layer of a sorted circle, that a large percentage of the organic carbon was old, dating back several thousand years before present.



Figure 1. Large-scale cryoturbation in sorted circles causes organic matter at the surface to be displaced towards the edges of the fine-domain, and subsequently buried from gravel from the coarse border as well as compressive movements in the fine domain¹

The total amount of soil carbon in northern permafrost areas is now estimated to 1,330–1,580 Pg³, which is equivalent to about twice the amount of carbon in the atmosphere. What is worrying is that accelerated warming in arctic regions will deepen the active layer and thaw permafrost, altering not only the temperature conditions but also the hydrology of the affected areas. The formerly sequestered organic carbon would then tend to decompose and to be released to the atmosphere, exacerbating the global increase in greenhouse gases.

Global warming could thus alter the direction of the net carbon flux in the Arctic, transforming the area from a net sink to a source for greenhouse gases. The recent review by Schuur et al.³ estimate that approximately 5-15% of the permafrost carbon stock is vulnerable to being released to the atmosphere during this century. They do not fear a catastrophic release of greenhouse gases, however, even when considering that some particularly ice-rich

permafrost areas (Yedoma complex) may experience abrupt thaw due to collapse from thermokarst processes.

Modelling, in general, remains the only opportunity for scientists – and therefore for society at large – to predict future developments, as the models in principle can account for the many interacting processes involved. Currently, connections such as those between atmospheric temperature development and soil carbon dynamics are investigated by running so-called Earth System Models (ESMs), but soil organic carbon models for permafrost conditions has only recently been implemented into ESMs and were not part of the IPCC AR5 analysis. Models can, of course, never be better than the implemented equations that describe the processes, and Schuur et al.³ list a number of key issues that needs improvement within these permafrost carbon models.

Assessment of model performance against empirical data is also crucial, and such data are often lacking with respect to their spatial distribution – after all the Arctic encompasses vast areas with limited accessibility and often challenging logistics. It must therefore be realized that neither models nor the empirical data on which to validate them corresponds directly to reality; they are only our best estimates so far. For instance, comparison between empirical data on actual soil carbon stocks in high latitudes and those simulated by the soil models implemented in an ESM show that the models perform

reasonably well at large scale, but are not able to explain variation at the scale of the model grid size⁴.

“Permafrost is defined as the part of the ground that experience sub-zero temperatures for more than two years. Such temperature conditions essentially stops decay of organic matter from microbiological activity.”

Geomorphic processes such as cryoturbation often take place on spatial scales much lower than that of the model grid sizes. Cryoturbation can thus not be explicitly modelled within an ESM and is so far approximated as a general diffusion process⁵. The yearly sequestration of carbon that comes out of such a modelling experiment is lower than what is found from field studies in the Arctic², but is still a significant improvement to gain agreement between modelled and empirical data of total soil carbon stocks. The process of solifluction has, to my knowledge, so far not been incorporated into models that try to simulate the build-up of soil carbon in permafrost environments. Both cryoturbation and solifluction may experience a transient increase in activity upon permafrost warming^{6,7}, thus potentially increasing soil organic carbon burial and to some extent counteract the effects of increased decomposition. More research is therefore essential to further our understanding of the effects of global warming on the permafrost environment, and to refine this knowledge in the Earth System Models.

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Understanding the Arctic environment

Nate Bauer and Hajo Eicken from the International Arctic Research Center (IARC), highlight how research can help gain invaluable knowledge about the Arctic and its surrounding environments...

Across the Arctic, researchers continue to identify signals that the region and its ecosystems act as an important amplifier of global climate change. While the immediate effects within the Arctic are evident in drastic changes to sea ice, glaciers, ice sheets, and permafrost, these factors may further result in changing weather at mid-latitudes and beyond. As noted in the most recent U.S. National Climate Assessment (NCA2014) ¹, more open Arctic water may play a role in a shifting jet stream associated with changes in the “polar vortex”, leading to recent, historically severe winter weather across much of the United States. Further, Arctic people and ecosystems are increasingly strained by the rapid rate of environmental change, outpacing the rest of the globe. These changes have attracted increasing global attention, as a burgeoning focal point for international diplomacy, resource development, and commercial shipping, among other urgent global interests.

The International Arctic Research Center (IARC) at the University of Alaska Fairbanks (UAF) exists to facilitate

the international, collaborative, multidisciplinary study of many of the component factors of the Arctic system, including impacts on human activities and ecosystems. The organisation and its researchers strive to highlight the potential, and the necessity, of collaboration and cooperation within Arctic science, cutting across the international research community, private and governmental agencies, indigenous organisations, and Arctic residents, industry, NGOs, and many other stakeholder groups. As America’s Arctic University, UAF – and IARC in particular – have served as centers for gathering and exchange for these groups.

Currently, over 20 international groups and 100 scientists collaborate through IARC, via projects including an internationally popular summer school for young researchers, workshops on the integration and synthesis of research, and unique international (e.g., U.S.-Russia) exchanges of data. IARC also facilitates and leads the international field activities, such as research cruises (NABOS) ² and Arctic oceanographic and terrestrial measurement studies (e.g., work supported by JAMSTEC in Japan) ³.

In March of 2015, IARC hosted a Japan-U.S. Arctic Strategy and Policy Workshop, receiving broad interest and involvement from both countries' official and research communities. Participants included Renee Tatusko, International and Arctic Policy Coordinator for NOAA's National Weather Service; Beth Kerttula, director of the White House's National Ocean Council; Mark Myers, Commissioner of Alaska's Department of Natural Resources; Dan White, UA Vice President for Academic Affairs; Komei Isozaki, Senior Coordinator at Japan's Ministry of Defense; and Yoshihisa Shirayama, Executive Director of the Japan Agency for Marine-Earth Science and Technology; among others.

Discussions at this workshop were a characteristic of IARC's diverse and wide-ranging platform, including methods for executing science and research components of a formal national Arctic Strategy – and especially the balancing of environmental protection and conservation as development occurs. Presentations also made clear the need for stronger interagency ties, and the involvement and linking of wider sections of stakeholders in Arctic concerns to relevant research efforts. The workshop also focused on the dynamic nature of Arctic research itself—on a large scale, it is difficult to determine precisely what research and monitoring will be required to plan for in the future, without first developing scenarios and reducing limitations to research jurisdictions. The need for swift and effective responses to a region experiencing transformational changes at a rate that exceeds rapid change elsewhere on the globe is fully recognised at UAF. IARC aids the transformation of knowledge into action through components such as the Scenarios Network for Alaska and Arctic Planning (SNAP) or the Alaska Center for Climate Assessment and Policy (ACCAP), both of which provide software tools, data sets, and networking opportunities for the international research community.

In the face of such auspicious international gatherings, the wide array of Arctic climate change factors and effects and the innovative research IARC conducts to profile them, and the United States' prominent 2015-17 chairmanship of the Arctic Council, UAF and

IARC will welcome the Arctic research community to Fairbanks for the 2016 Arctic Science Summit Week (ASSW) and Arctic Observing Summit. From March 9 to 20, nearly a thousand scientists, policy makers, technical experts, educators, and other Arctic authorities from around the world will visit the campus, working to develop a better understanding of the Arctic environment and its role in global policy.

Central to the event is the annual Arctic Science Summit Week, bringing together scientific organisations from around the world to coordinate activities and seek opportunities to collaborate and cooperate, in many cases meeting in person for the first time. The Arctic Observing Summit meets biennially to provide guidance and foster collaboration on sustained, coordinated observations of rapid Arctic change that can benefit all nations. The Arctic Council's Senior Arctic Officials meeting, which is part of that group's aim to foster cooperation on issues of mutual concern, will include updates on associated working groups like those on Sustainable Development and Emergency Prevention, Preparedness and Response.

Registration for all of these ASSW events is now open at assw2016.org. Find out more about IARC and its variety of Arctic research at iarc.uaf.edu. ■

1 <http://nca2014.globalchange.gov/report/our-changing-climate/melting-ice>

2 <http://nabos.iarc.uaf.edu/>

3 <http://www.iarc.uaf.edu/JAMSTEC>

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Time to invest in the blue economy

The European Union has high hopes for the marine and maritime economy, but, for the blue economy's potential to be developed, we need more cooperation between the public and private sectors, argues Adam Banaszak of the European Committee of the Regions...

I was nominated by my fellow local politicians to prepare a position paper (an 'opinion') of the Committee of the Regions (CoR) on the subject of innovation in the 'blue' – marine and maritime – economy. It has been an honour to draft the CoR's position on such an important subject, and how innovation can help unleash the potential of our seas and oceans and help create millions of jobs.

This document was prepared at the request of the European Commission by the CoR, an EU assembly of local and regional authorities that brings together 350 local politicians from across the EU to advise the EU institutions in the legislative process. We aim to ensure that EU institutions heed local governments' experience of what works and what does not. After all, the vast majority of the legislation adopted by the EU (an estimated 70%) has an impact on people's lives at the local level.

Why, more specifically, is Committee of the Regions interested in the 'blue economy'?

EU data suggest that the 'blue economy' already includes roughly 5.4 million jobs and generates a gross added value of almost £370bn a year to our economies. The European Commission has already prepared a long-term 'blue growth' strategy aimed at fostering sustainable growth across the maritime sector, making our seas and ocean an even greater contributor to the EU's economy. It is the weight of the sector and its potential that makes it so important to our local economies.

The CoR believes the development of the 'blue economy' is an excellent way to boost local economies and to create high-quality jobs in knowledge-based and investment-heavy sectors. This is also a personal conviction of mine. Significantly, the development of the blue economy would also provide local

governments with data on the state of our seas and ocean. There is also potential here for the private sector, including small and medium-sized businesses, to collaborate with the public sector.

As I argued in my opinion, which was adopted by the CoR members last December, the wealth of the sea has the potential to drive economic development far inland. With good rail, road and river infrastructure, goods can be transported swiftly and cheaply inland. While ships are and will remain, the cheapest form of long-distance freight transport, my own region of Poland (Kujawsko-Pomorskie) is a good example of how far the 'blue economy' can reach. Its capital, Toruń, lies 150 kilometres from the sea, but distance has not prevented the city from becoming home to a very large manufacturer of marine equipment, which supplies shipyards in Poland, Germany, Korea and China. A good highway means that it is possible to reach the coast from Toruń as quickly as it takes to get from one end of a clogged seaside city to another in high season.

Transport and shipbuilding are just 2 sectors with potential. Others include tourism, ocean-energy technologies (such as tidal energy and windfarms), and new technologies (such as medicines) and – I place these last because they are environmentally sensitive – extractive businesses such as fisheries, aquaculture and seabed mining. The potential is huge. If that potential is to be harnessed, national authorities, local government and business will need to cooperate.

While regional development programmes can help, local governments typically lack the resources to carry through projects by themselves. Public-private partnerships (PPP) in well-defined areas can help meet these financing needs. PPPs also act as a form of guarantee that an investment will be effective and innovative.

Unfortunately, there are still too few of these types of joint projects in the 'blue economy'. There are, though, some good examples, including applications

for protected marine areas, navigation, and logistics in ports.

Members of the CoR fully accepted my proposals for PPPs. They also backed my demand for small and medium-sized enterprises to have better access to public data. PPPs in the blue economy should not be formed solely with large private companies, as is largely the case now. SMEs account for the vast majority of businesses across the EU.

As always, the issue of genetically modified organisms became a subject of debate. I argued against allowing marine products to be genetically modified. The CoR agreed, concluding that the economic potential of the blue economy is already so great that there is no reason to intensify production in a way that poses risks to quality.

Overall, it is clear that we still use only a fraction of what our seas and ocean can offer us. This contrasts with the situation on-shore, where land is already over-exploited. The blue economy offers potential for growth, whether this is measured in jobs, income or innovation. Local governments across the EU are keen to make the most of that potential. There is now demand to make fuller use of a key element – water – that is seemingly foreign to us, but which we should manage and protect.

Adam Banaszak is the vice-president of the Kujawsko-Pomorskie regional assembly in Poland. He is the Committee of the Regions' natural-resources (NAT) Commission coordinator for the European Conservatives and Reformists, a political group to which the British Conservatives are aligned. ■

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The future is in the oceans

With a strategic goal to continue to be a key player in European marine research in the future, the Institute of Marine Research set up an event at Norway House in Brussels in October. The intention was to meet with collaborators and decision makers in Europe to inform and discuss common challenges.

Under the headline “New frontiers for blue growth”, Institute of Marine Research delivered a broad presentation of our key research fields. On the agenda were both biology and technology, development cooperation and aquaculture together with climate and polar research.

“Blue Growth is a key topic in Europe. We have a joint goal of increasing the understanding of the ocean and the opportunities that exist there”, says Communications director at IMR, Kari Østervold Toft. “The response we have had afterwards shows that the interest in what we do and the wish to strengthen cooperation is strong. This is a wonderful challenge to work on”, says Toft.

International cooperation

Development cooperation is an area where EU and Norway can profit from better coordination. Among others, data collected by Dr. Fridtjof Nansen is valuable also in projects financed by EU for example in northwest Africa. EU and Norway will continue to share knowledge and cooperate on development in this area.



The new Dr. Fridtjof Nansen vessel

At the end of 2016, the new Dr. Fridtjof Nansen will replace the existing vessel of the same name. The research vessel operates out of Cape and works mainly in south east Asia and off south western parts of Africa. Norway has also decided to set up a new program called Fish for development financed by the Norwegian Development Agency and performed in close cooperation with FAO, UN's organisation for Food and Agriculture.

MarBank

The national marine biobank in Norway, Marbank, is part of IMR. The objective for establishing Marbank as a national biobank facility was to secure and make available largely unexplored and valuable marine resources from Norwegian waters. In 2005 Marbank initiated the systematic collection of marine organisms from Arctic and sub-Arctic areas through

cooperation with existing marine institutions. From a cautious start in 2005 a total of hundreds of kilos of new biomass are now typically collected on cruises throughout the sampling season from April to October.

“Norway has also decided to set up a new program called Fish for development financed by the Norwegian Development Agency and performed in close cooperation with FAO, UN's organisation for Food and Agriculture.”

The stored and catalogued samples are distributed to academia and industry.

MAREANO maps depth and topography, sediment composition, contaminants, biotopes and habitats in Norwegian waters. The results of the



surveys are available on [this website](#), visualised through maps. A number of our partners also supply data and maps from their own studies.

Video images are particularly useful to classify the seafloor in various natural environments. Identifying biotopes and habitat types provides a useful

framework to determine biodiversity, biological production, and the ocean floor's food web. Deep ocean habitats are still not well understood in many Norwegian waters, but studies conducted by MAREANO have provided an overview of how the sea floor habitats should be categorized in areas mapped thus far.



The Pearl Chain Reef house several different coral species. The white coral, *Lophelia pertusa*, is known for building large reefs in the deep ocean off the coast of Norway; it is also an important species at the newly discovered Pearl Chain Reef. The orange coral, *Primnoa resedaeformis*, is a deep-sea gorgonian octocoral (a "seafan"). Looking closely among the corals, both a squat lobster (*Munida* sp.) and the big bivalve *Acesta excavata* can be observed.

LoVe

The ocean observatory LoVe received 60 million NOK from the Research Council of Norway. It all started in 2013, when Statoil and the Institute of Marine Research installed the first observation platform – or node – on a coral reef at Hovden off Bø in Vesterålen. Data and photos from this platform are sent ashore via a cable, and can be directly accessed over the Internet.

"LoVe has produced a string of scientific surprises over the course of the two years that it has been operating", says Olav Rune Godø, the research scientist who manages the project. "This award means that we can establish an observation system that will allow us to relate new findings to a wider context. We will now be able to monitor the warm water passing the Lofoten Islands, which carries recruitment recruiting age cohorts of year classes of fish to the cold and 'barren' Barents Sea. Similarly we will be able to estimate the size and composition of the large schools of fish that migrate past LoVe on their way to their spawning grounds," says Godø.



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Effective management of fisheries and fish quality: UNU-FTP and SDG No 14



In September 2015 the UN will release the Sustainable Development Goals (SDGs) to guide international development for the next 15 years. Out of the 17 goals, number 14 is to “Conserve and Sustainably Use the Oceans, Seas and Marine Resources for Sustainable Development”, and is a topic of particular interest to the United Nations University – Fisheries Training Programme (UNU-FTP). Unless this goal is achieved, the probability of meeting other goals and targets relating to poverty alleviation, health and nutrition is slim.

Where does the fish come from?

In the mid 1980s developing countries accounted for less than 50% of world catches, but today they account for more than 75%, although the total world catch has stayed the same. Overfishing of stocks in developed countries has been compensated for by expansion of fisheries in developing countries and increased trade in fish and fish products. In a sense the problem of overfishing has been exported, from the rich to the poor. At the same time, fish has become ever more important as a

source of animal protein and various nutrients in the diet of people in poorer countries. Almost half the global catch comes from 25-30 million small scale fishermen in developing countries, each fisherman contributing on average less than 1.5 tons per year. About 75 million people make their living from processing and trading the catch, but poor handling and processing means that much of the nutritional value is foregone and so is the opportunity for most to make a good living from the exploitation of living aquatic resources.



Managing natural wealth

The benefits people and societies derive from resources depend on how we manage them. Fisheries resources are renewable but undermanaged and overexploited in many developing countries. Excessive fishing pressure has both biological and economic consequences. Lack of appropriate policies and capacity to evaluate the status of stocks and the health of the sector make it challenging to formulate and implement adequate management measures. This not only influences the stocks, but also the ability of people to increase the value of fish through good handling, processing and marketing.

potential development possible through careful management of fisheries resources.

Since the establishment of the UNU-FTP, about 300 professionals from 50 countries have completed the 6 month training programme in Iceland, specialising in various fields of fisheries. In addition, over 1000 people have attended our short courses and workshops in our partner countries. The programme in Iceland is funded through the ODA budget of the Ministry for Foreign Affairs but also seeks partners in implementing strategic actions towards capacity enhancement in its partner countries.

In 1998 the UNU-FTP was established, reflecting the global importance of fisheries and the increasing concern of the state of world fisheries. The core element of the UNU-FTP is an annual 6 month training programme of about 20 fisheries professionals (UNU-fellows). This is conducted in Iceland, where fisheries are one of the main pillars of the economy. The UNU-FTP's close cooperation with the industry, academia, and research entities in Iceland illustrates to UNU-fellows the value of human capital to societal development and success in fisheries.

Iceland uses a rights-based system of fisheries management, based on rigorous science, with quotas set according to total allowable catch, determined for all major species. Although neither perfect nor universally applicable, the system has resulted in healthier stocks, reduced cost of fishing, improved quality and increased value of the fish, and thus demonstrated to the world that fisheries can be managed sustainably. By introducing UNU-fellows to the Icelandic fisheries sector UNU-FTP gives them an appreciation for the



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Is it time for a tornado warning system in Italy?

Mario Marcello Miglietta from the Institute of Atmospheric Sciences and Climate (ISAC-CNR), and Richard Rotunno from the National center for Atmospheric Research (NCAR) outline why there is a need to develop tornado warning systems in Europe...

The internet has become an important source of information for anyone who wants to investigate tornadoes and severe storms. As tornadoes typically cover a limited geographical area, they are generally not detected from synoptic-, and even regional-scale, meteorological station networks. Thus, historical events have been generally identified based on newspapers articles and chronicles. The possibility offered by the internet to post and share information has made images and videos of tornadoes and waterspouts the preferred way to document the occurrence of these events.

The opportunity for everyone to contribute to tornado statistics has dramatically increased the number of reports all over the world. Even in regions usually considered unaffected, or only somewhat affected, by tornadoes, such as the Mediterranean, it has become apparent that their occurrence has been largely underestimated. Together with weak waterspouts and tornadoes, large and intense vortices are occasionally observed in Europe but they have generally received limited attention from both the general public and scientists.

A couple of recent events have reinvigorated the sense that severe tornadoes may occasionally occur in the Mediterranean region, sometimes producing remarkable damage and even casualties. On 8 July 2015, an EF4¹ tornado struck the outskirts of Venice, causing one death and 72 injuries, and destroying an old villa dating back to the XVI century. On 28 November 2012, a multi-vortex EF3 tornado affected Taranto, south-eastern Italy and was one of the largest tornadoes on record in that region. This tornado caused one death and an estimated damage of €60m to the largest steel plant in Europe.



The latter event showed peculiar characteristics, which attracted deeper investigation. In fact, the tornado of Taranto took extraordinary horizontal dimensions (among the largest ever photographed in Europe) similar to the so-called “wedge” tornadoes in the USA plains, since the diameter of its visual funnel appeared to be about 700m wide. The presence of a multi-vortex structure was recorded, with some minor vortices revolving around the parent vortex, that in some cases were temporarily able to touch the ground, a typical behavior for the most intense of these events. The duration was also particularly long, as damage was reported nearly 50 minutes after, and about 50km away from, the location of landfall. The increase in wind speed with altitude in the lower 1km (the so-called “wind shear”, one of the most important ingredients for tornadic thunderstorms) was extraordinary, compared with previous cases in Italy as well as cases from the extensive dataset of events available in USA.

Issuing skillful alerts for the prediction of these events requires several obstacles to be overcome, such as the identification of the most recurrent large-scale conditions conducive to risk scenarios and a deeper understanding of the relevant mechanisms necessary for their development. Considering that in the Mediterranean-area tornadoes occur mainly near the coast, we expect that the sea and the surrounding orography play an important role, thus the theoretical framework, developed for USA Midwest severe convective weather, should be properly adapted to the peculiar and morphologically different conditions of the Mediterranean. For example, in the case of the Taranto tornado, the high surface temperature of the Ionian Sea during the event (about 2 °C higher than climatology) may have played an important role in producing intense heat fluxes and in providing energy to the parent thunderstorm of the tornado.

“The increase in wind speed with altitude in the lower 1 km (the so-called “wind shear”, one of the most important ingredients for tornadic thunderstorms) was extraordinary, compared with previous cases in Italy as well as cases from the extensive dataset of events available in USA.”

The high-impact of these recent events emphasise the need for the National Weather Services to provide a warning system dedicated to the monitoring and prediction of such severe localised convective events. In the majority of European countries there are no procedures to warn for tornadoes, which we think is inadequate considering their potential threat. We believe the development of such a warning system cannot be further postponed, due to the dramatic social impact of severe weather, which could possibly be exacerbated in a changing climate.

A potential model for this office could be the USA Storm Prediction Center ([SPC](#)),² a forecast center in charge of issuing convective outlooks, mesoscale discussions, and watches. The [European Storm Forecast Experiment](#)³ is experimenting with a European version of convective-weather outlooks at continental scale. However, a warning system able to provide

alerts at the national level, providing information at finer horizontal and temporal scales is desirable to issue warnings for selected regions that can take into account the inhomogeneity of the Mediterranean basin, similar to the practice of the Bureau of Meteorology in Australia.

Finally, the population needs to be educated to deal with severe-weather alerts. The recurring floods in the Mediterranean area in the last few years have surely increased the awareness of the risks and started to suggest the adoption of a more precautionary behavior in cases of severe weather. However, there is still a long way to go to reach an acceptable level of public awareness. An increased consciousness of severe weather threats, including tornadoes, is a necessary objective. This task requires some substantial background research, not just in meteorology but in social science, identifying whether a hazard-information flow, substantially different from the system adopted in USA, may be needed given the cultural differences that may affect how information is received by the user community. ■

1 EF: stands for Enhanced Fujita. It is the most widely used scale (from 0 to 5) that estimates the tornado wind speed, based on the damage caused to buildings and vegetation.

2 www.spc.noaa.gov

3 www.estofex.org

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Sustainable Sweden

Adjacent Government looks at how Sweden is aiming to become a sustainable nation, highlighting the government's key environmental priorities...

Sweden has gone through something of a recycling revolution in the past decade. More than 99% of all household waste is recycled in one way or another – compared to only 38% in 1975. As the country aims to become a sustainable nation, recycling stations are set up no more than 300 metres away from any residential area.

Recycling is just one area where Sweden is going green, but the country is aiming to do more. The Swedish Government recently unveiled their priorities to ensure Sweden takes the lead on sustainability and becomes one of the world's first fossil-free welfare countries ¹.

One of the first priorities for the [Ministry for Environment and Energy](#) is more renewable energy. The country's long-term vision is to have 100% renewable energy. In order to achieve this the government is proposing a "considerable increase in solar investment support to speed up the expansion of solar cell plants.

The government aims to allocate SEK 225 million in 2016 to solar energy, increasing this funding to SEK 1.4 billion by 2019. In between 2017-2019 they plan to increase support to SEK 390 million per year. Solar energy is not the only renewable the Swedish government will be supporting. Sweden plans to invest a total of SEK 50 million in the years 2017-2019, on electricity storage. Half of that investment would be for 2016 alone, with the government's main aim to establish a national forum for smart electricity grids.

As part of the sustainable revolution, the government aims to increase their investment in environmental technology. This investment will increase by SEK 62 million to "enable environment and climate technology



companies to grow". Over the next 4 years the government will also invest SEK 3 million per year into sustainable consumption, for which a strategy is currently being developed.

Support is also being given to green vehicles. A fossil-free vehicle fleet is a priority for the government. Through an extension of the fringe benefit tax subsidy, the conditions for environmentally sound cars are being developed. New support is also being introduced for electric buses and the super green car rebate is being reinforced. SEK 100 million is also being set aside by the government during 2016-2017 to promote cycling. The government also aims to invest in an upgrade of the country's existing railways.

Minister for Climate and the Environment and Deputy Prime Minister of Sweden, Asa Romson believes: "Environmental policy is to work for sustainable solutions everywhere from the board room to the supermarket."

In a statement ² of government policy, Prime Minister Stefan Lofven highlighted the key areas of focus for environmental policy. He emphasised the global challenges Sweden faces, and explained that the government will speed up climate adaption.

The Prime Minister also detailed that the transition to a sustainable and climate-smart society will generate jobs. In the statement Lofvan said:

“Sweden will become one of the world’s first fossil-free welfare countries. Emissions will be reduced at the rate necessary for globally sustainable development. The transition must be effective and provide long-term rules.

“Trains should be faster than cars and cheaper than air travel. A climate policy framework will be prepared. Sweden will also take a leading role in implementing the new UN Sustainable Development Goals.

“The government wants to take a climate leap that accelerates the transition to a more sustainable society. By taking responsibility for our climate impact in Sweden, we will demonstrate leadership in the global arena.”

[The Swedish Environmental Protection Agency](#) works on behalf of the government, and has the task of monitoring, coordinating and evaluating efforts to meet Sweden’s environmental objectives.

The Agency’s vision is for ‘a good living environment for humans and all other living things, now and for future generations’. Their key objective is to ensure that as a society the country takes action now to ensure future generations don’t have the same environmental challenges.

In a recent report ³ the Environmental Protection Agency evaluated the prospects of achieving the environmental quality objectives set by the government. The evaluation is a basis for government policies and will help to accelerate efforts to achieve objectives.

Director General of the Environmental Protection Agency, Bjorn Widmark says: “Environment is a cross cutting issue because society and the human being is dependent on ecosystems and many services. In order to achieve environmental goals and ecologically sustainable future requires all sectors of society to contribute. As well as necessary environmental measures in all policy areas.”

The report highlighted 32 priority proposals for the government. These included: coherent policies for sustainable development, governance towards a circular economy and underlying motivations and behaviours, as well as better environmental stewardship.

One of the proposals promotes steering towards a circular economy, which the Agency believes is required to decouple economic growth from environmental degradation.

“A circular economy is based on recycling tanks and is easy to understand and relate to, but for that to happen incentives need to be introduced. For example, increase the amount we reuse or repair, instead of buying new,” says Widmark.

Sweden is clearly a step ahead when it comes to having their environmental goals clearly mapped out. With the COP 21 Climate Change Conference in Paris later this year the Swedish stance could have a clear impact on the conclusions.

“The EU and climate and environment ministers have now adopted a strong negotiating position ahead of the climate summit, with demands for an ambitious process that binds all countries,” says Minister Romson.

Sweden clearly means business, watch this space. ■

1 <http://www.government.se/articles/2015/09/investments-in-climate-change-adaptation-and-energy/>

2 <http://www.government.se/articles/2015/10/statement-of-government-policy-as-it-pertains-to-the-areas-of-responsibility-of-the-ministry-of-the-environment-and-energy/>

3 <http://www.naturvardsverket.se/Nyheter-och-pressmeddelanden/Framja-och-forebygg-sa-nar-vi-miljomalen/>

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Glycol – a rare resource

Areas of Expertise:

We have developed a globally unique purification method whereby we purify used glycol so that it can be re-used. In this manner, we will save the Earth's resources since glycol is extracted from crude oil and is a non-renewable resource. In addition, glycol is a scarce commodity since demand is consistently higher than the supply. Glycol is used in a number of different industries and there is an abundance of areas of use. Below is a list of some of the most common segments and areas of use for glycol.

Research Interests:

We have developed a globally unique purification method whereby we purify used glycol so that it can be re-used.

From used glycol we produce, with our globally unique model, new re-usable glycol with concentrations up to 98.5% depending on our customers' requirements. With our re-used glycol, chemical companies are able to offer more ecofriendly options.

Today, most used glycol is incinerated. We currently collaborate with a number of recycling companies to take a more ecofriendly step toward managing glycol.

Recyctec has agreements with some municipalities for glycol management. Municipalities work according to the so-called 'waste hierarchy', which provides a hierarchy for the order in which various methods for managing waste should be used. It is based on the EU directive and is a method for



achieving the EU's environmental objectives. In co-operation with us, they will be able to contribute to taking glycol management from step four to step two in the waste hierarchy, meaning instead of energy extraction (incineration) of the glycol, we jointly take the step to re-use.

With Recyctec's assistance, airports are able to gain both financial and environmental advantages. Airports will be able to become nearly self-sufficient since the glycol can be re-used time and time again with Recyctec's help.

Working alongside Recyctec, the automotive industry can actually impact today's glycol management by ensuring the quality of the handling process and filling with re-used glycol. For example, each new vehicle that rolls out from an automotive plant can be refilled with re-used glycol, which will

enable automotive manufacturers to take another step in keeping their environmental promises.

Unfortunately, glycol is in short supply and demand is always greater. Glycol is also a non-renewable natural resource, meaning the supply will run out. This is one of the reasons that the re-use of glycol is becoming increasingly important.



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USING A GLOBALLY UNIQUE METHOD, WE PURIFY USED GLYCOL SO THAT IT CAN BE RE-USED

We have developed a globally unique purification method

whereby we purify and concentrate used glycol so that it can be re-used. In this manner, we will save the earth's resources since glycol is extracted from crude oil and is a non-renewable resource. In addition, glycol is a scarce commodity since demand is consistently higher than the supply.

Glycol is used in a number of different industries and there is an abundance of areas of use.

Our vision is to spread our knowledge throughout the world and thus contribute positively to our common environment and to a better world.

Our business concept is to refine used glycol and restore it to an industrial product using an efficient and unique eco-friendly method.

EU's WASTE HIERARCHY



Read more about us? Visit www.recyctec.se



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An action plan for a sustainable Stockholm

Katarina Luhr, Vice Mayor of Environment in the City of Stockholm outlines how they strive to become a truly sustainable city for generations to come...

Sweden's capital city Stockholm has been working on climate change mitigation and adaptation since the 1990s. The city is a frontrunner, with well implemented climate action plans and pioneering policies to ensure it meets its ambitious environmental targets. It was the first city to receive the European Green Capital award by the EU Commission in 2010. The Award acknowledged the change of mindset in policy making that had long been evident in the city's administration. Subsequently, environmental policies have become even more prioritised and sustainability is now an integral part of all strategies and city planning.

In February 2009, Stockholm signed the Covenant of Mayors. This agreement commits cities in Europe to work to reduce greenhouse gas emissions to a greater extent than required by the EU. Stockholm's carbon dioxide emissions per capita have been cut by 25% since 1990 and the city is now going to reduce its greenhouse gas emissions further – to 2.3 tonnes per capita/year by 2020 and to become a fossil fuel free city by 2040.

The climate and energy action plan describes how this goal is to be accomplished, detailing measures that provide the greatest reductions. A significant portion of the projected CO₂ reduction relates to the district heating system in Stockholm which currently utilises different kinds of waste and increasingly biofuels, replacing fossil fuels for energy.

The city's position in northern Europe puts tough demands on heating. Stockholm has chosen to invest in district heating and biofuels, the district heating grid dates back more than 50 years and covers 80% of all buildings in the city. A biomass-fuelled heating plant will come online in 2016 with a capacity



for heating 190 000 homes whilst producing 750 GWh of electricity and reducing CO₂, equivalents by 120 000 tonnes.

“Innovative green technology will enable residents to manage their own energy consumption using their smart phones.”

By increasing the ratio of olive in the energy mix in another plant, the portion of coal being used can simultaneously be reduced, lowering CO₂ emissions by another 50 000 tonnes of CO₂ equivalents. New business models for recovering energy previously going to waste were recently introduced through the Open District Heating market which enable businesses with a large surplus of heat, such as data centres and grocery stores, to sell that energy to the district heat producer.

Stockholm has also set the goal of having at least 70% of the city's food waste to be collected for the production of biogas by 2020. The gas can be used to replace natural gas in the city's gas network as well as fuel for vehicles. Currently there are more than 300 buses, as well as all refuse freighters and approximately 10.000



cars including most taxis in the city fuelled by biogas. Successful tests have been conducted using green bags for food waste. The bags are disposed of along with the rest of a household's waste with sorting taking place at a later stage at a new facility which allows for optical sorting of waste bags. This site has been commissioned and planned to be built over the coming years.

The Eco city district Hammarby Sjöstad is based on a closed eco-cycle in which waste and energy consumption is minimised and recycling is used whenever possible. The target is for the environmental impact to be cut by 50% as compared to conventional standards. Currently the next generation of eco city districts – the Stockholm Royal Seaport – is being developed in a former industrial and port area. Plans are under way for 12,000 new housing units and 35,000 workplaces that will be combined with modern port operations. The area has even higher environmental requirements than Hammarby Sjöstad and the target is to be fossil-fuel free by 2030. Innovative green technology will enable residents to manage their own energy consumption using their smart phones. Effective public transport and car pools will make it easier for residents to cope without a car of their own. Garages

will have charging posts for electric cars and kitchens will be equipped with a waste disposal unit that turns food scraps into raw materials for biofuels.

The Stockholm Biochar Project is another example of how the city engages its citizens and it will use waste from parks and gardens to produce biochar and renewable energy. Biochar is not just a carbon sink but also a fantastic soil conditioner that retains water, air and nutrients in the soil. The energy released in the production process becomes heat for the city's district heating network within the Open District Heating mentioned previously. The city will also expand the hours and areas of operation for mobile recycling centres making it easier for citizens to reuse and recycle different items but also to leave the garden waste for biochar production. ■

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In Malmö our waste becomes our fuel

Daniel Skog from the City of Malmö outlines how locally produced vehicle fuel could help the city's transport become more sustainable...

In Malmö every third trip is done on a bicycle. Also the local railways and coming trams are experiencing increased business but still there is a need for sustainable solutions for buses and cars in the city and the region.

While electric vehicles are foreseen to have a bright future in cities such as Malmö, the biogas powered vehicles have a clear benefit so far – their mileage is unrivalled. The small biogas powered cars being purchased to the City of Malmö right now have an impressive capacity of 600 kilometers.

Locally produced vehicle fuel

Another beautiful feature of biogas is that we can produce it from our waste. Malmö is now introducing mandatory food waste recycling for all citizens and businesses. This is of course a great resource for biogas production. In the region of Skåne we see biogas replacing fossil fuels in the vehicle sector as a great opportunity for reaching a fossil free energy mix. The region therefore tries to upgrade as much of the biogas produced as possible to a quality suitable for vehicle consumption.

In Malmö, the approximately 200 city buses have been gas powered since the 80's. During the later years the share of biogas, replacing fossil natural gas, has increased and reached 62,7% in 2012. In the end of this year, 2015, it will be 100% biogas. Already today the garbage trucks, a large portion of the private taxi fleet and the municipal vehicle fleet are powered by CNG/biogas. The interest for private and corporate gas powered cars is increasing.

Longer, quieter and cleaner buses runs on waste

Last year in Malmö we introduced new high capacity buses on our most frequented bus lane, connecting wealthier and poorer parts of the city. The 24 meter

long biogas hybrid-buses have separate bus lanes and have not only increased the amount of passengers with over 25% and the integration between city districts, but also significantly improved the air quality in our city. Ecological sustainability walks hand in hand with social sustainability.



Several of the city bus lines in Malmö have reached their top capacity and we need to find a public transport for a larger number of passengers. On the short term it is these first of its kind biogas hybrid buses, and on the long term trams are to be included in the fleet. Biogas powered buses and cars not only almost eliminate the climate change net effect their fossil cousins have, but they also decrease the emissions of NOx and particles in the city air which is a very welcome relief.


The system of gathering food waste, producing biogas, upgrade it to vehicle quality - and not to forget – distribute the nutritious bio sludge back on farm land, is a remarkable achievement Skåne is proud of want to share with the world. Through the BIOGASSYS project City of Malmö together with neighbor cities and actors on the biogas market therefore exports this knowledge to the broader Europe. ■

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The role of renewables in the circular economy

Henri Colens, Head of European Public Affairs at Braskem Europe GmbH, outlines the advantages of using bioplastics, and how they help to boost the bio-economy...

So much has already been written about the circular economy that it must have provided a significant boost to the paper industry. I contend that bioplastics are equally deserving of promotion, and I will explain why that is a good idea and how it can be done.

But first, let's be clear about what a bioplastic is: a polymer which is biobased or compostable, or both. The use of plant material (biomass) is the key 'start-of-life' asset they boast. Bioplastics tend to be between 30 and 50% biobased, but some can reach 100%. The plant absorbs carbon during its life, is harvested, and then used to create chemicals which can then be polymerised. The renewable feedstock means that bioplastics have low or even negative carbon footprints, unlike conventional plastics which are entirely petroleum-based. With regard to the 'end-of-life', bioplastics can be compostable and recyclable, or both.

There are clear advantages to using bioplastics. Given that packaging alone accounts for just under 15 million tons of plastic in the EU, it means that if a significant proportion was bio-based the greenhouse gas (GHG) savings would be colossal. For a fully biobased plastic, for every ton of material used, between 3 and 4 tonnes of CO₂ can be saved.

"If 'business as usual' is really to be challenged, we really need a circular bio economy."

Another significant advantage of bioplastics is that they are fantastic job creators (4 times that of renewable energy products according to a 2013 OECD report). Compared to biofuels, which are produced and then immediately burned, bioplastics have long life cycles. The products they go on to make need to be designed, converted, transported, sold, used (and

sometimes re-used), collected, sorted and recycled, either mechanically or organically.

It begs the question, if bioplastics make such a contribution to combatting climate change and boosting the bio-economy, why are they not granted similar financial incentives as petroleum-based plastics and biofuels? The question is a rather a simplistic one, but it certainly highlights a problem for legislators: namely, how to incentivise sustainable solutions. Could the circular economy provide the model?

If ‘business as usual’ is really to be challenged, we really need a circular bio economy. The fact that biobased products follow a carbon loop which reflects the natural cycle of plants is the key to understanding the potential of the upcoming legislation. A fairer economic framework for the use of biomass, greater access to feedstock, and more efficient use of it will go a long way to creating more sustainable loops for all plastic-based products. A long term goal should be to de-couple the production of materials from oil. Bioplastics are the first step on this journey.

But how can the circular economy play a role in the transition to a bioeconomy? The main priority should be to empower and encourage Member States to promote sustainability within a clearly defined framework. This way, the EU would drive an innovative and highly competitive race towards the top.

EPR schemes might be a good way to do this: the Dutch Afvalfonds Verpakkingen (Packaging Waste Fund) is a good model to follow. It grades packaging materials such as glass, metal, paper and plastic and applies a different levy to each of them based on their collection, sorting and processing costs. A more nuanced approach might give lower rates for products which are, for example, recyclable and predominantly biobased. It’s important that Member States use existing reporting and compliance schemes rather than new ones, as administrative burdens should be kept to a minimum.

An extension to this could be for legislators to set long term incremental targets for the use of biobased materials. These could be applied specifically to plastic packaging products or across a brand owner’s product portfolio. The advantages of this approach would be twofold: first, it would give the market the impetus to

innovate biobased packaging solutions; and second, it would allow Member States to further incentivise climate change mitigation.

“The circular economy should not only encourage better use of resources, but better resources themselves.”

Lastly, and perhaps the most complex solution, would be to use eco-design criteria in order to promote ‘circular’ materials. The European Commission has said it will do this. In May of this year, they set out a Circular Economy Strategy, which featured an Action Plan to tackle key measures across the value chain, including “product design”. But, the Commission hasn’t said how it will achieve this huge logistical task.

It’s tempting to fear what you don’t know, but if done well, it could be the solution. I suggest a long term approach from the outset, with direct industry involvement. The problem is that the European Commission doesn’t have the best track record on this issue: the uptake of the Ecolabel was slow, and the circular economy projects within Horizon 2020 have been interesting but narrow, with only 5 projects receiving funding.

Whatever measures to tackle eco-design are announced in December it is clear that the legislative package’s scope will have to be ambitious and forward-looking. The circular economy is a concept which strikes a chord with citizens. Most are aware of the problems which stem from a consumer society and it’s not hard to convince them that we should do more to eliminate waste. The circular economy should not only encourage better use of resources, but better resources themselves. The switch away from fossil to biobased is just such an example. It would be a waste if we didn’t seize this historic opportunity. ■

Henri Colens also sits on the Board of the European Bioplastics Association.

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Direct support for EU farmers

The EU's recent €500m aid package is good news for European farmers and agri-food markets, writes EU Agriculture Commissioner Phil Hogan...

Market difficulties and price pressures in recent months have been a cause for real concern to farmers and agri-businesses across Europe.

The €500m aid package is a significant statement of support by the Commission for European agriculture. In view of the huge challenges facing the EU at this time - both economic and social - a package of this size represents a decisive and robust response to current difficulties. And, crucially, it is only one part of a multi-pronged approach to stabilise agri markets in the short, medium and long term.

Cashflow is the immediate priority for farmers in the depressed price environment, particularly in the dairy and pigmeat sectors. For this reason, I have exceptionally allowed the advance payment of up to 70% of Direct Payments and 85% of area-based schemes under Pillar II, by 16th October. This puts much needed cash in farmers' pockets. No on the spot controls will be needed before the advanced payments are made. This derogation is a significant change, and has highlighted my willingness to be flexible and proactive in supporting producers.

The €500m package will target farmers most in need of aid. Farmers will receive €420m in direct support, with additional possibilities under Private Storage Aid for skim milk powder (SMP), cheese and pigmeat. On top of this, the increase in funding for promotion will see €30m in new money ring-fenced to promote exports of dairy products and pigmeat.

As well as directly supporting farmers, this package aims to stabilise markets in the short term. For this reason, I have proposed a new and enhanced Private Storage scheme for SMP, cheese and pigmeat.



**Phil Hogan,
EU Commissioner
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There will be an increase in the aid rate for skimmed milk powder by over 100% and the storage period will be fixed for a year. This is better for the farmer and operator on two grounds – firstly, it takes product quickly off the market and for a sufficient length of time to see a market recovery. Secondly, it covers not only the operating costs, but also the financing cost of putting product in storage versus taking a price for it now on the marketplace.

With medium term forecasts positive, and the global dairy auction price trending upwards, with a 48% increase since August, this is a potential win-win for producers and operators. By contrast, increasing intervention prices, even on a temporary basis, would take up to 18 months to implement. It would neither put money in the pocket of farmers, nor stabilise markets in the short term – it would amount to “kicking the can down the road”.

Learning from the experience of the last PSA for cheese, the new scheme will provide for a total amount of 100,000 tonnes to be broken down by Member States, based on their respective cheese



production – this will be of benefit to Irish producers, in comparison to the previous PSA.

The new PSA scheme for pigmeat will be extended to fresh lard, responding to the proposal that some of the so-called ‘fifth-quarter cuts’ should be included – an enhancement to the scheme in operation earlier this year.

Beyond these immediate measures, any medium-term solution for stable agricultural markets will require action to address imbalances in the food chain. As EU Commission President Juncker put it so eloquently in his recent State of the Union address, “there is something wrong in a market when the price of a litre of milk is less than the price of a litre of water”.

He has called on European and national competition authorities to take a close look into the structure of the market and mentioned the retail stage in particular.

This coincides with the Commission’s in-depth analysis of the whole food chain, which will also focus on market structure as well as the resulting market behaviour and

its impacts from farm gates to retailers’ shelves. The results of all this work will help us table necessary proposals as soon as possible.

We have a lot to learn from experiences in Spain and the UK, where watchdogs such as the Groceries Code Adjudicator are shining a light on problems in the food chain and taking action to restore balance.

In conclusion, I am working decisively with Ministers and MEPs to ensure that this once off, exceptional package of measures will put money in struggling producers’ pockets in the short term. It will contribute to stabilising markets and will provide a blueprint for a fair deal for producers in the food chain. ■

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Phil Hogan

EU Commissioner for Agriculture and Rural Development

European Commission

www.ec.europa.eu/commission/2014-2019/hogan_en

Peptides control organ loss in plants

Have you ever wondered why the petals fall off your tulips after a week in a vase? Why trees drop their leaves in the autumn? Why fruit fall to the ground when ripe? And why farmers suffer losses when seeds are shed before harvesting time? My research group at Department of Biosciences, University of Oslo may have found the answer. For more than fifteen years, me and my group have studied processes leading to detachment of plant organs, and the genes controlling these abscission processes.

Our main discoveries have come from studies of floral organ abscission in the plant mouse-ear cress (*Arabidopsis thaliana* among scientists). All over the world *Arabidopsis*, a small weed of the mustard family, is the favourite model for scientists studying plant development. All its genes are known, and mutants are available for most of them, which make it possible to discover their functions. We have recently used the knowledge we have acquired from research on organ shedding in *Arabidopsis* to show that the corresponding genes are present in most plants, including a large number of important crops.

Plants produce new organs like branches, leaves, or flowers regularly, but the shedding of organs, including fruits and seeds, is also part of a normal life cycle. An *Arabidopsis* plant loses its petals and other floral organs after they have served their purpose in reproduction: pollination has taken place (Figure 1A). But I discovered an

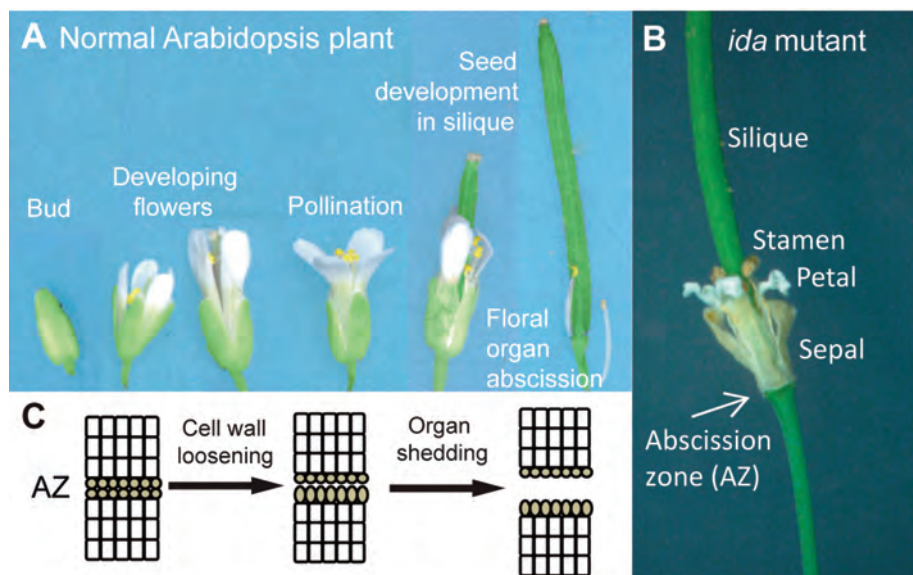


Figure 1. Floral organ abscission in *Arabidopsis thaliana*. A) Pollination takes place in the flower protected by sepals and petals. After fertilisation the silique with developing seeds starts to grow. The floral organs are not needed anymore and abscise. B) The mutant *ida* retains its floral organs indefinitely. C) Detachment of the organs takes place in abscission zones (AZ) at the base of the organs to be shed.

Arabidopsis mutant that never loses its floral organs – (Figure 1B); even after the plants were completely dry the sepal, petals and stamen remained attached. To understand why, we have to look at the plant on a cellular level.

Whenever a plant loses an organ – be it a petal, a leaf, a seed or a whole flower – there has to be a separation of cells. There are specialised cells (abscission zone, AZ, cells) at the base of the organs to be shed (Figure 1C), and degradation of the matrix connecting cell walls of adjacent AZ cell layers leads to organ separation (Figure 2).

The mutant we had found was defect in cell separation, and it was named *inflorescence deficient in abscission*, abbreviated *ida* (Figure 1B). My team identified the gene that was mutated

and found that it encoded a small peptide that trigger the abscission process by turning on genes involved in the cell separation process (Figure 2).

So why are peptides important? Over the last decade scientists have found that secreted peptides act as messengers between neighbouring cells. Peptides secreted from one layer of cells are recognized by receptors of adjacent cell layers, and this will trigger reactions that turn on sets of genes. In the case of IDA signaling, such genes encode enzymes responsible for cell separation (Figure 2). In general peptides are involved in the regulation of cell to cell communication related to all aspects of a cell's life in a multicellular organism: cell division, cell expansion, cell differentiation, cell separation and cell death. Because peptide signaling is important in all aspects of plant life, my lab

took the initiative to organise the first European Workshop on Peptide Signaling in Plants in Oslo in 2013. This initiative was welcomed and has been followed by a 2nd and 3rd workshop in Regensburg in 2014 and Ghent in 2015.

Agriculture faces major challenges to develop sustainable and affordable crop production in a world with growing populations and threatening climatic changes. Insights into the molecular details of cell to cell communication by peptides gained from *Arabidopsis* can likely be generalised. More specifically, our research suggests that IDA signalling is involved in cell separation processes in other plant species, although they may shed other organs than *Arabidopsis* (Figure 3). My group has found that IDA peptides and their signaling partners have been around for 175 million years almost unchanged, and today can be found expressed in falling autumn leaves of aspen, as well as in

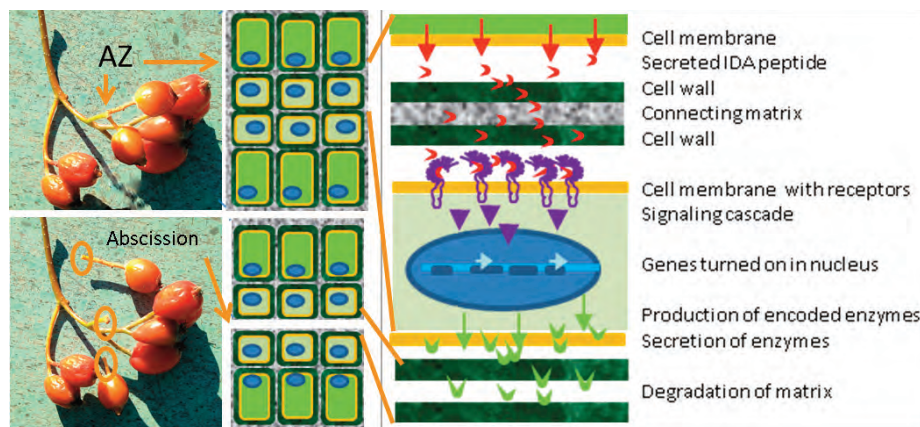


Figure 2. Floral organ abscission in *Arabidopsis thaliana*. IDA peptides are secreted across cell walls and connecting matrix to interact with the membrane-bound receptors of the neighbouring cell. This generates a signaling cascade which is transduced to the nucleus where new genes are turned on. These genes encode enzymes that are secreted and will degrade the matrix holding the cell walls of the adjacent cell layers together, resulting in cell separation.

fruit, flowers or leaves of important crops like different kinds of beans, cabbage species, tomatoes, wine grapes, palm trees and citrus trees. Thus the IDA signaling system is ancient and has been preserved virtually unchanged during evolution.

In domesticated cereals genes involved in seeds shattering are mutated. However, in many cultivated species

uncoordinated or untimely abscission of fruits and seeds results in severe (10-25%) yield losses. I am therefore excited about my team's recent findings. I started to study a pretty mutant. Now I aim to extend my research on peptide signalling and abscission to important crops. Our findings can help shape the future development of sustainable agriculture and horticulture.



Figure 3. Different species have different modes of organ shedding. Wild species may abscise leaves and fruits. In agriculture and horticulture unsynchronised or untimely abscission results in substantial yield losses.



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A Global Perspective on Agriculture Research

The USDA National Soil Dynamics Laboratory (NSDL) has a long history of research on developing sustainable agriculture. Originally founded as the Farm Tillage Machinery Laboratory in 1933 on the Auburn University campus in Auburn, Alabama, USA, it was initially charged with researching tillage, associated traction practices, and machines used in cotton production. The lab was instrumental in the development of engineering principles for modern agricultural equipment design. Currently, NSDL's mission is to develop tools, practices, and products to better manage soil for environmentally sustainable and economically profitable agricultural production systems. While the research is centered around Southeastern USA production systems, implications of findings clearly have a more global prospective, especially in the context of efforts to understand how agriculture influences global change.

The Laboratory solves agricultural problems in three major areas:

- Conservation systems;
- Organic waste management; and
- Global change.

Specific objectives include developing conservation systems that reduce drought risk and sequester soil carbon, developing environmentally sound waste management systems, and determining the effects of atmospheric CO₂ levels on above- and below-ground processes that affect crop



production, soil carbon storage, and trace gas emissions.

Currently, there are many uncertainties concerning agriculture's role in global environmental change including the effects of rising atmospheric CO₂ concentration. Agricultural practices have the potential to increase soil C storage which can positively influence soil quality and help mitigate this rise in atmospheric CO₂. Research at NSDL is examining the effects of atmospheric CO₂ on both biomass production and soil C sequestration.

The concentrations of trace gases (nitrous oxide and methane) in the atmosphere are also increasing with agriculture being a primary contributor. The NSDL has a multi-disciplinary research team investigating ways that agriculture can help reduce greenhouse gas (GHG) loss through improved practices and fertiliser use in cropping and horticulture systems. This work is evaluating new, innovative application techniques that reduce

GHG emissions, including determining fertiliser N use efficiency and fate of fertiliser N in these systems as well as changes in C and N cycling processes. This work showed that soil C storage is sensitive to soil N dynamics and that the decomposition of plant material grown under elevated CO₂ depends on crop species and indigenous soil properties. It has also led to research on the use of microbial inoculations to reduce nitrous oxide emissions.

Research at NSDL develops conservation systems that improve soil quality, conserve natural resources, and increase production efficiency by considering input costs and profitability. A major focus is to evaluate the use of alternative fertiliser sources, such as poultry litter (a poultry manure and bedding material mix), compared to commercial fertiliser in tillage systems designed to enhance soil organic matter accumulation, crop productivity, and grower profitability. Application of poultry litter to soil can improve soil

conditions and provide nutrients needed for plant production. This seems to be a viable option for South-eastern USA producers due to rising costs of inorganic fertilisers and the fact that the growing poultry industry generates large amounts of manure. Field and laboratory studies are being conducted to develop improved methods to utilise waste products for soil and crop benefits while minimising environmental degradation since improper manure application can increase hypoxia, eutrophication of

surface waters, human health problems, and GHG emissions. Furthermore, using poultry litter in conservation agricultural systems could sequester atmospheric C in soil. Research has shown that the use of poultry litter in long term research plots resulted in increased soil C levels and thus higher atmospheric C sequestration. However, best management practices must be developed for poultry litter application that maximises nutrient uptake and minimises GHG loss.

Tillage and fertilisation practices used in row crop production can alter GHG emissions from soil. A new prototype implement for applying poultry litter in subsurface bands in the soil was used in studies to determine the impact of management practices and fertiliser source and placement methods on GHG emissions. As part of this effort, a new method was developed for calculating Effective Gas Flux from soil following band application of manure or fertiliser. Banding of fertiliser resulted in the greatest concentration of gaseous loss compared to surface application and conventional tillage resulted in a higher concentration of CO₂ and N₂O loss. These results suggest that poultry litter can be used to sequester soil C, but application by banding has the potential to increase GHG emissions.



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Probiotics on poultry gut health research

The chicken industry has become one of the fastest growing livestock industries around the world due to the demand for high-quality protein by consumers. Today, modern-day broiler chickens can reach a body weight of 2 kilograms by 35 days, which represents an increase of an astonishing 5000% of their body mass. This remarkable and outstanding performance is the results of intensive genetic selection for growth rate, rigorous programs of health and management, as well as meticulous feed and nutrition programs. Feed efficiency, which is the capacity to transform vegetable protein into animal protein is considered the “money saver”, since ~ 70% of the total production cost is directly related to the feed. Therefore, any chronic sub-clinical disease that affects the gastrointestinal tract such as coccidiosis, or necrotic enteritis, is economically

more upsetting than acute infections. Likewise, dietary factors that modulate the immune system, gut health and gut microbiota are considered crucial when formulating diets and managing feeding practices. Every year, genetic lines are working to increase performance of broiler chickens. As a result, we see that the growth period and feed efficiency are continuously improved. Hence, health care and nutrition of these birds are becoming more demanding. Perhaps, that is the reason the fields of immunology, microbiology, and nutrition have joined in a surprising way in the last two decades. Several investigators have shown how dietary ingredients have a profound effect on the composition of the gut microflora, which in turn, controls the physiology of all animals. As such, nutritional components of the diet are of critical importance not only for meeting the

nutrient requirements of the host, but also for the microbiome. During their coevolution, bacterial microbiota has established multiple mechanisms to influence the eukaryotic host, in a beneficial fashion. The microbiome encrypts a variety of metabolic functions that complements the physiology of their hosts.

Over a century ago Eli Metchnikoff proposed the revolutionary idea to consume viable bacteria to promote health by modulating the intestinal microflora. The idea is more applicable now than ever since bacterial antimicrobial resistance has become a serious worldwide problem both in medical and agricultural fields. The impending ban of antibiotics in animal feed due to the current concern over the spread of antibiotic resistance genes makes a compelling case for the development of alternative

prophylactics. Nutritional approaches to counteract the debilitating effects of stress and infection may provide producers with useful alternatives to antibiotics. Improving the disease resistance of animals grown without antibiotics will not only benefit the animals' health, welfare, and production efficiency but is also a crucial strategy in the effort to improve the microbiological safe status of poultry.

“Today, modern-day broiler chickens can reach a body weight of 2 kilograms by 35 days, which represents an increase of an astonishing 5000% of their body mass.”

In recent years, gut health research has been extensively studied in human health programs, where nutritional interventions, such as probiotics, are used to ameliorate inflammatory and allergic diseases. Nevertheless, today, gut health is a major topic for research not only in humans but also in animals and it is now generally conceded that maintenance or enhancement of gut health is far more complex than just the modulation of the gut microflora through probiotics. This is not surprising considering that the gut harbors more than 640 different species of bacteria, contains over 20 different hormones, digests and absorbs the vast majority of nutrients, accounts for 20% of body energy expenditure and it is also the largest immune organ in the body. Therefore, anything that affects the health of the gut will undoubtedly influence the animal as a whole. Consequently, 'gut health' is highly complex and encompasses: The macro and micro-structural integrity of the gut; the balance of the microflora; and the status of the

immune system. Now days, beneficial bacteria-host interactions are considered an integral part of development and evolution. While largely studied because of their harmful effects on human health, there is growing appreciation that bacteria are important partners for invertebrates and vertebrates. Probiosis, although not a new concept, has only recently begun to receive an increasing level of scientific interest. In agriculture, probiotics and direct fed microbials used in animal feed are becoming accepted as potential alternatives to antibiotics for use as growth promoters, and in selected cases, for control of specific enteric pathogens. A probiotic is defined as a live microbial food supplement which benefits the host by improving its intestinal microbial balance. The presence of normal gut microflora may improve the metabolism of the host animals in various ways, including absorptive capacity, protein metabolism, energy metabolism, fiber digestion, and gut maturation. Balanced gastrointestinal microflora and immune-stimulation are major functional effects attributed to the consumption of probiotics. Many probiotic effects are mediated through immune regulation, particularly through balance control of pro-inflammatory and anti-inflammatory cytokines.

During the last 15 years, our laboratories have worked toward the identification of probiotic candidates for use in poultry. A defined lactic acid bacteria base probiotic culture (FloraMax-B11®) has demonstrated accelerated development of normal microflora in chickens and turkeys, providing increased resistance to *Salmonella* spp. infections. Published experimental and commercial studies have shown that these selected probi-

otic organisms can reduce idiopathic diarrhea in commercial turkey brooding houses. Large scale commercial trials indicated that appropriate administration of this probiotic mixture to turkeys and chickens increased performance and reduced costs of production. Further studies demonstrated that the administration of this probiotic one hour after *Salmonella* Enteritidis challenge had no effect during the first 12 hours on increasing cecal colonization by this pathogen. However, marked and rapid decreases were observed between 12 and 24 hours post-challenge. Later, using the same challenge model and microarray analysis of gut mRNA expression, gene expression differences in birds treated with this probiotic were observed compared to saline treated birds, suggesting that this probiotic shares anti-inflammatory and anti-oxidant properties that may be related with gut barrier integrity.



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Organic farming isn't bad, but sustainable agriculture is better

Gavin Whitmore, Senior Manager – Biodiversity at the European Crop Protection Association (ECPA) looks at how integrated pest management supports the sustainable intensification of agriculture...

Society is increasingly aware of the dual challenge of feeding a growing population whilst protecting the environment. Organic agriculture is often marketed as being the environmentally sound alternative to conventional agriculture, and there are surely examples where this is true. However; we need to guard against the false notion that the pesticides and practices used by organic farmers are better for the environment than those employed by farmers using modern agricultural practices.

A farmer has the very difficult task of safeguarding both the environment and future harvests. The good news is, these are not incompatible objectives.

To protect the environment farming must make efficient and sustainable use of natural resources; to achieve this harvests must be protected. Inefficient and under productive agriculture compromises efforts to protect biodiversity because more land is required to produce the same amount of food, it

wastes the scarce natural resources used to grow a failed crop, and at the global level it jeopardises food security and in-turn political stability.

Two additional challenges – population growth and climate change – will also keep farmers busy. Global population rise means we will have to produce food for an additional 2 billion people by 2050. To minimise the environmental impact of this we must minimise expansion of the agricultural land base; this means we will have to farm the farmland we have available more intensively.

Climate change only adds to this pressure; severe weather events and increased water scarcity will become an all too familiar part of the food supply challenge. Here again, agriculture can bring benefits, including efficient production methods and practices that contribute to reducing greenhouse gas emissions, increasing carbon storage and reducing the impact of extreme weather.

Intensive production plays a leading role

Exaggerated and sometimes false claims about the environmental and health benefits of organic agriculture contribute to polarising the debate on sustainability. The organic lobby has worked hard to portray organic production as antithesis and antidote to the evils of 'industrial' agriculture.

The polarised debate on sustainable agriculture has not been kind to the term 'intensive production' which is unfortunately used alongside 'industrial agriculture' and other terms derogatory of practices that do not adhere to organic standards. This is unfortunate, because the world cannot live on organic agriculture alone; sustainable intensive production will play a leading role in feeding the world and supporting environmental protection.

Integrated Pest Management – protecting crops and the environment

Highly productive agriculture requires that crops are protected from insect and animal pests, weeds and diseases; without protection 40-80% of potential harvests can be lost: this is unacceptable in a sustainable system. Pesticides help improve the efficiency of agriculture by minimising the negative impacts of biodiversity on our future harvests; but in order to be truly sustainable we must protect crops whilst minimising unwanted impacts on biodiversity, water and soil. It is about finding a balance, and for this, Integrated Pest Management (IPM) offers an important framework for action.

IPM is not a method of organic production

A requirement for pest management in the EU since 2014, IPM supports sustainable crop protection with a combination of cultural, physical, biological and chemical measures to protect crops from pests and disease. Recognised as an environmentally sound and cost-effective method for pest management, IPM encourages the best practice of using pesticides only when necessary.

IPM is compatible with organic production practices, but it is not a method of organic production; it is a means to guide sustainable crop protection practices. The pesticides approved for use in organic agriculture

can have negative impacts on human health and the environment and are therefore subject to the same policy that guides the use of synthetic chemical pesticides; they should always be used with due care, and only when necessary.

A wider framework of good agricultural practices

Whilst IPM strategy provides conventional and organic farmers a coherent strategy to balance the protection of crops with protection of the environment it is not a silver bullet for sustainable agriculture.

One of the real strengths of IPM is that it enables farmers to look beyond the unhelpful polarised debate around conventional and organic agriculture and consider optimised protection of crops and the environment. IPM allows sustainable practices because it does not exclude the use of the crop protection solutions most effective at avoiding the waste of failed crops and the indiscriminate environmental impact of chemicals not specifically formulated to manage pests.

This is where true sustainability lies; farming has to be more productive and less demanding of natural resources and the environment. Farmers are challenged to achieve high productivity with minimum waste, to increase production with less land and lower environmental impact, to manage predictable yields in an erratic climate and to maximise space for nature where competition for productive land is high.

Within a wider framework of good agricultural practices, IPM and modern pesticides are part of the solution; research and development, innovation, and the safe and sustainable use of pesticides can help ensure a safe and affordable supply of food for generations to come. ■

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Factitious foods to reduce production costs of beneficial insects

Factitious Prey for Production of Stinkbug Predators for Biological Control of Agricultural Pests

Juan A. Morales-Ramos and M. Guadalupe Rojas

Stinkbug predators (Heteroptera: Pentatomidae) are among the most efficient biological control agents against many agricultural pests including caterpillars, root worms, and particularly the Colorado potato beetle. At least one species of stinkbug predator, *Podisus maculiventris*, also known as the spined soldier bug, is commercially available in the U. S. and Europe. Studies of prey preference and suitability for growth and development of *P. maculiventris* have determined that the cabbage looper, *Trichoplusia ni*, is the best prey item for this predator. However, rearing the cabbage looper in large numbers is expensive and technically complicated. The high cost of producing the prey results in high prices of commercially produced predators, making biological control an expensive alternative to other less environmentally friendly methods of pest control.

One way to reduce the costs of producing stinkbug predators is by using factitious prey species that are easier to produce or are already commercially available. Relative success has been achieved producing *P. maculiventris* using the greater wax moth larvae, *Galleria mellonella*, as prey. Other species of commercially available insects like the yellow mealworm, *Tenebrio molitor*, have been less successful as factitious prey items for *P.*

maculiventris. The yellow mealworm is a highly desirable alternative because of its low cost and wide-spread availability. Many studies on the suitability of *T. molitor* as prey have been focused on using the larval stage of the beetle, but recent work conducted in the USDA-ARS National Biological Control Laboratory has been more successful using the pupal stage of *T. molitor* as prey for *P. maculiventris*. Studies showed that the nutritional contents of *T. molitor* drastically change during metamorphosis making pupae more suitable prey items for *P. maculiventris*. The content of protein increases and lipid content decreases three days after pupation had occurred. Younger pupae retain the nutritional characteristics of the larvae. A colony of *P. maculiventris* has been maintained in culture for 3 years using exclusively *T. molitor* pupae as food for the predators with no significant impact on life cycle parameters or fecundity.

Other stink bug predators like *Brontocoris tabidus*, *Podisus nigrispinus* and *P. distinctus* have been reared successfully using *T. molitor* pupae and the housefly, *Musca domestica*, larvae in Brazil. In China, the stinkbug predator *Arma chinensis* is being produced using silkworm, *Antheraea pernyi*, pupae as prey item. Other important stinkbug predators, like *Perillus bioculatus*, are yet to be successfully produced in factitious prey. These predators are highly selective and it is difficult to rear them using alternative prey species. Future research will focus on discovering alternative, easy

to produce, prey species to mass produce these selective predator species.

Factitious Food for Ladybird Beetles: Nutritional Route to Cost-Effective Mass Rearing for Augmentative Biological Control

Eric W. Riddick, PhD

Ladybird beetles (Coleoptera: Coccinellidae) have a distinguished record as predators of plant-feeding insects and mites throughout the world (Hodek and Evans 2012). Because of their potential to suppress insect pests, research efforts to propagate or mass rear ladybirds for augmentative biological control in greenhouses, high tunnels, and plantscapes have been ongoing. One impediment to mass rearing ladybirds in the large quantities necessary for augmentative biological control, is the cost associated with rearing natural prey (e.g., aphids) as food for many ladybird species. As a strategy to reduce costs, researchers have been using several alternative food sources (i.e., factitious foods), in lieu of natural prey (Riddick 2009). Natural prey (aphids) require rearing live host plants as food. Factitious foods can be reared on grain and other stored products. Exemplary factitious foods, including the ladybird species tested against, are listed in Table 1. Despite several decades of research, only several foods have been found suitable, to some extent, for rearing ladybirds (Riddick 2009, Riddick and Chen 2014). For example, eggs of the Mediterranean flour moth *Ephestia kuehniella* (Lepidoptera: Phycitidae) is

Table 1. Ladybird beetles, natural prey, and exemplary factitious foods used to rear them under experimental conditions in the laboratory *

Ladybird	Natural Prey	Factitious Food	Effects	Reference
<i>Cryptolaemus montrouzieri</i>	Scale insects, mealybugs	<i>Ephestia kuehniella</i> eggs	Reduced fecundity, normal longevity	Attia et al. 2011
<i>Hippodamia convergens</i>	Aphids	<i>E. kuehniella</i> eggs	Normal fecundity and longevity	Kato et al. 1999
<i>Harmonia axyridis</i>	Aphids	<i>E. kuehniella</i> eggs	Increased fecundity, body size, and survival	Specty et al. 2003
<i>Propylea japonica</i>	Aphids	<i>E. kuehniella</i> eggs	Reduced fecundity, normal survival	Hamasaki and Matsui 2006
<i>Adalia bipunctata</i>	Aphids	<i>E. kuehniella</i> eggs plus plant pollen	Development time variable, normal survival, fecundity variable	De Clercq et al. 2005, Jalali et al. 2009a, 2009b, Bonte et al. 2010
<i>A. bipunctata</i>	Aphids	<i>Artemia franciscana</i> eggs (decapsulated cysts) with plant pollen	Reduced development time, normal fecundity, increased longevity	Bonte et al. 2010
<i>Coleomegilla maculata</i>	Aphids	<i>A. franciscana</i> eggs	Normal development, reduced fecundity	Riddick et al. 2014
<i>C. maculata</i>	Aphids	<i>A. franciscana</i> egg powder	Normal development, increased fecundity	Riddick and Wu 2015

* After Riddick and Chen (2014), In **Mass Production of Beneficial Organisms: Invertebrates and Entomopathogens** (Morales-Ramos, Rojas, and Shapiro-Ilan, Eds.), Academic Press, Waltham, MA

an effective food source that supports normal development and survival, but not fecundity, in some coccinellids, such as *Cryptolaemus montrouzieri* (Attia et al. 2011; Table 1). On the other hand, *E. kuehniella* does support normal fecundity in the coccinellid *Hippodamia convergens* and increased fecundity, in comparison to natural prey, in the coccinellid *Harmonia axyridis* (Kato et al. 1999). Nevertheless, *E. kuehniella* eggs are rather expensive to mass produce; an alternative, more cost-effective factitious food is necessary (Riddick et al. 2014). As a more cost-effective alternative to *E. kuehniella*, eggs of brine shrimp *Artemia franciscana* Kellogg (Anostraca: Artemiidae) have been tested in the laboratory, with somewhat promising results (Table 1). *Adalia bipunctata* can develop and have normal fecundity when fed *A. franciscana* eggs

with plant pollen (Bonte et al. 2010). *Coleomegilla maculata* can develop normally but have reduced fecundity when fed *A. franciscana* eggs. Interestingly, fecundity improved two-fold when *A. franciscana* eggs were blended into a very fine dust-like powder (Riddick and Wu 2015). Clearly, more research on the utilization of *A. franciscana* as food for *C. maculata* and other ladybird beetles is necessary. The potential of using feeding and/or oviposition stimulants in combination with powdered *A. franciscana* eggs appears promising (Riddick and Wu 2015) and ripe for follow-up investigations.

Further reading:

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THE EVOLUTION OF YIELD IN CORN

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Why is Corn Yield so Important?

The key to feeding a growing world with less demand on scarce resources and lower environmental impacts lies in increasing yield. Research has shown that increasing corn yield results in better efficiencies in nutrient and water use thanks to the fact that corn plants that yield more also have bigger root systems and more effective leaf area. The challenge for corn producers is to find management practices that allow them to maximize yield given the soil and environmental constraints they are operating with. Among the many management options that corn producers have what practices will provide the best return on investment in terms of increasing yield with the lowest cost and risk. This publication discusses some of the key principles and practices corn growers should consider when seeking to increase yield in corn.

It is All About Intercepting Light

At the most basic level corn is a starch factory that depends in turning light energy into starch. Therefore the most critical practice in managing for higher yield is maximizing light interception. There are three management practices that can be used to increase light interception. These are growing longer season hybrids, increasing seeding rate and plant population, and decreasing row spacing. Of these three the most effective practice is increasing seeding rate and plant population. While growing hybrids that require a longer growing period increases the amount of light intercepted it also increases water requirements and does not improve root mass or leaf efficiency. Using narrow rows only increases light interception for a short period of time. In contrast high plant populations increase light interception across the entire growing period, result in improved efficiency in light interception, and along with other key management practices increase root mass in the field. Figure 1 shows the impact of increasing plant density on the morphology of corn plants. As plant population increases the corn

plant grows taller resulting in more effective placement of leaf area to intercept sunlight. This results in optimum yield potential. However, there is a limit to this response. As plant density increases so does the need for water and nutrients. When the demand for water and nutrients exceeds the ability of the environment to provide these to the plant the corn plant responds by reducing its height and yield potential is reduced. Note that in Figure 1 there is a narrow range of plant densities over which the plant reaches maximum height and productivity. Corn producers must precisely match plant population to the environment of the field.



Figure 1. Change in plant density from 29,343 plants ha⁻¹ on the left to 107,593 plants ha⁻¹ on the right.

Supporting Plant Density with the Right Management Practices

As is apparent in Figure 1 planting at a higher seeding rate is not the only step producers should use to achieve higher yield. Higher plant densities result in individual plants that have smaller root systems and thinner stalks.

These negative effects must be compensated for. There are two key practices that must be used in a systems approach along with higher seeding rates to make higher corn yield possible. These two key practices are starter fertilizer and multiple applications of nitrogen. The root is the first plant part to be developed in the growth cycle of the corn plant. The faster the corn plant grows from germination to flowering the more root mass will be produced. Since the root system is the key to better nutrient and water use efficiency this is a critical component of a high yield corn plant. Starter fertilizer which contains small amounts of nitrogen and phosphorus increases the early growth of the corn plant (Figure 2). Research shows that increasing early growth by using starter fertilizer results in a plant with more root mass and thicker stalks overcoming the negative effects of higher plant populations.



Figure 2. No planting or starter fertilizer was used on the four-row plot on the left while 22.5 L ha⁻¹ of 11-37-0 was applied in a 2 x 2 band at planting to the four-row plot on the right.

Likewise, a corn plant depends on nitrogen to maintain leaf chlorophyll levels and efficient conversion of light into starch. Unfortunately, most growers only apply nitrogen at the beginning of the season or, at most, twice at planting and again at canopy closure. Since nitrogen is mobile in the soil and subject to loss these applications often don't cover the full season nitrogen demands of the plant (Figure 3). Growers often apply more nitrogen than the plant actually needs to cover the fact that some nitrogen will be lost by the time the plant reaches the reproductive stages. A better system for producing high yield corn is to apply small amounts of nitrogen throughout the season. This approach allows growers to just meet the needs of the plant at a given time resulting in little or no waste while ensuring optimum growth and

yield. Furthermore, nitrogen rates can be adjusted as the growing season progresses to match changes in weather (particularly rainfall) resulting in maximum nitrogen use efficiency.



Figure 3. Nitrogen was applied at four different times during the growth cycle of the corn plant to the four-row plot on the right while nitrogen was only applied at planting to the four-row plot on the left.

In Summary – A High Yield Corn System

Capturing more light while increasing root mass and light use efficiency requires a systems approach to corn production. The future of high-yield corn production lies in precisely matching plant population with the environment of the field and then supporting that population with starter fertilizer and regular feeding with small amounts of nitrogen. This approach has the potential to increase yield resulting in less demand on land resources. Research at the Vernon G. James Research and Extension Center at North Carolina State University over the past three years documents that this systems approach consistently produced maximum corn yield ranging from 21.1 to 23.7 mt ha⁻¹. Only by using a systems approach can growers increase water and nutrient use efficiency in corn production resulting in better utilization of scarce resources and improving the amount of carbon fixed in a corn field resulting in less climate impacts.

Agriculture and climate change

Agriculture both contributes to, and is affected by climate change. The EU needs to reduce its greenhouse-gas emissions from agriculture and adapt its food-production system to cope. But, climate change is only one of many pressures on agriculture, The European Environment Agency explains further...

Faced with growing global demand and competition for resources, the EU's food production and consumption need to be seen in a broader context, linking agriculture, energy, and food security.

Food is a basic human need, and a healthy diet is a key component of our health and wellbeing. A complex and increasingly globalised system of production and delivery has developed over time to meet our need for food and for different flavours. In today's world, a fish caught in the Atlantic might be served within days in a restaurant in Prague alongside rice imported from India. Similarly, European food products are sold and consumed in the rest of the world.

Agriculture contributes to climate change

Before reaching our plates, our food is produced, stored, processed, packaged, transported, prepared, and served. At every stage, food provisioning releases greenhouse gases into the atmosphere. Farming in particular releases significant amounts of methane and nitrous oxide, 2 powerful greenhouse gases. Methane is produced by livestock during digestion due to enteric fermentation and is released via belches. It can also escape from stored manure and organic waste in landfills. Nitrous oxide emissions are an indirect product of organic and mineral nitrogen fertilisers.

Agriculture accounted for 10% of the EU's total greenhouse gas emissions in 2012. A significant decline in livestock numbers, more efficient application of fertilisers, and better manure management reduced the EU's emissions from agriculture by 24% between 1990 and 2012.

However, agriculture in the rest of the world is moving in the opposite direction. Between 2001 and 2011, global

emissions from crop and livestock production grew by 14%. The increase occurred mainly in developing countries, due to a rise in total agricultural output. This was driven by increased global food demand and changes in food-consumption patterns due to rising incomes in some developing countries. Emissions from enteric fermentation increased 11% in this period and accounted for 39% of the sector's total greenhouse-gas outputs in 2011.

Given the central importance of food in our lives, a further reduction of greenhouse gas emissions from agriculture remains quite challenging. Nevertheless, there is still potential to further reduce the greenhouse gas emissions linked to food production in the EU. A better integration of innovative techniques into production methods, such as capturing methane from manure, more efficient use of fertilisers, and greater efficiency in meat and dairy production (i.e. reducing emissions per unit of food produced) can help.

In addition to such efficiency gains, changes on the consumption side can help to further lower greenhouse gas emissions linked to food. In general, meat and dairy products have the highest global footprint of carbon, raw materials, and water per kilogramme of any food. In terms of greenhouse gas emissions, livestock and fodder production each generate more than 3 billion tonnes of CO₂ equivalent. Post-farm transport and processing account for only a tiny fraction of the emissions linked to food. By reducing food waste and our consumption of emission-intensive food products, we can contribute to cutting the greenhouse-gas emissions of agriculture.

Climate change affects agriculture

Crops need suitable soil, water, sunlight, and heat to grow. Warmer air temperatures have already affected



the length of the growing season over large parts of Europe. Flowering and harvest dates for cereal crops are now happening several days earlier in the season. These changes are expected to continue in many regions.

In general, in northern Europe agricultural productivity might increase due to a longer growing season and an extension of the frost-free period. Warmer temperatures and longer growing seasons might also allow new crops to be cultivated. In southern Europe, however, extreme heat events and reductions in precipitation and water availability are expected to hamper crop productivity. Crop yields are also expected to vary increasingly from year to year due to extreme weather events and other factors such as pests and diseases.

In parts of the Mediterranean area, due to extreme heat and water stress in summer months, some summer crops might be cultivated in winter instead. Other areas, such as western France and south-eastern Europe, are expected to face yield reductions due to hot and dry summers without the possibility of shifting crop production into winter.

Changes in temperatures and growing seasons might also affect the proliferation and the spreading of some species, such as insects, invasive weeds, or diseases,

all of which might in turn affect crop yields. A part of the potential yield losses can be offset by farming practices, such as rotating crops to match water availability, adjusting sowing dates to temperature and rainfall patterns, and using crop varieties better suited to new conditions (e.g. heat- and drought-resilient crops).

Land-based food sources are not the only food sources affected by climate change. The distribution of some fish stocks has already changed in the Northeast Atlantic, affecting the communities relying on these stocks throughout the supply chain. Along with increased maritime shipping, warmer water temperatures can also help facilitate the establishment of invasive marine species, causing local fish stocks to collapse.

Some EU funds, including the European Agricultural Fund for Rural Development, Common Agricultural Policy (CAP), and loans from the European Investment Bank, are available to help farmers and fishing communities to adapt to climate change. There are also other funds under the CAP aimed at helping to reduce greenhouse-gas emissions from agricultural activities.

Global market, global demand, global warming

In line with projected population growth and changes in dietary habits in favour of higher meat consumption,

the global demand for food is expected to grow by up to 70% in the coming decades. Agriculture is already one of the economic sectors with the largest environmental impact. This substantial increase in demand will unsurprisingly create additional pressures. How can we meet this increasing global demand while at the same time reducing the impacts of European food production and consumption on the environment?

Reducing the amount of food produced is not a viable solution. The EU is one of the world's largest food producers ¹, producing around one eighth of the global cereal output, two thirds of the world's wine, half of its sugar beet, and three quarters of its olive oil. Any reduction in key staples is likely to jeopardise food security in the EU and in the world, and increase global food prices. This would make it harder for many groups around the world to access affordable and nutritious food.

Producing more food out of the land that is already used for agriculture often requires heavier use of nitrogen-based fertilisers, which in turn release nitrous oxide emissions and contribute to climate change. Intensive agriculture and fertiliser use also release nitrates to the soil and to water bodies. Although not directly linked to climate change, high concentrations of nutrients (especially phosphates and nitrates) in water bodies cause eutrophication. Eutrophication promotes algae growth and depletes oxygen in the water, which in turn has severe impacts on aquatic life and water quality.

Whether in Europe or the rest of the world, meeting the growing demand for food by using more land would have serious impacts on the environment and the climate. The area's most suitable to agriculture in Europe are already cultivated to a large extent. Land, especially fertile agricultural land, is a limited resource in Europe and across the world.

Converting forest areas into agricultural land is also not a solution as this process is a source of greenhouse-gas emissions. Similar to many other land-use changes, deforestation (currently occurring mainly outside the European Union) also puts biodiversity at risk, further undermining nature's ability to cope with climate change impacts (such as absorbing heavy rainfall).

Competing demands

It is clear that the world will need to produce more food and that key resources are limited. Agriculture has high impacts on the environment and the climate. Moreover, climate change affects – and will continue to affect – how much food can be produced and where.

Who gets to produce what and where, is a socio-political question and is likely to become more controversial in the future. The global competition for these essential resources, especially with the pending impacts of climate change, is driving developed countries to purchase large patches of agricultural land in less-developed countries. Such land purchases and climate change impacts raise questions about food security in developing countries in particular. Food security is not only a matter of producing sufficient quantities of food, but also of having access to food of sufficient nutritional value.

This complex problem requires a coherent and integrated policy approach to climate change, energy, and food security. Faced with climate change and competition for scarce resources, the entire food system will need to transform itself and be much more resource efficient while continuously reducing its environmental impacts, including its greenhouse-gas emissions. We need to increase yields while reducing our dependence on agrochemicals, to reduce food waste, and to reduce our consumption of resource-intensive and greenhouse gas-intensive foods such as meat.

In doing this, we must also remember that farmers can play a key role in maintaining and managing Europe's biodiversity. They are also a critical component of the rural economy. Therefore, policy measures to tackle this highly complex problem of food and the environment should take into consideration agriculture's impacts on the environment and its socio-economic importance for many communities. ■

¹ http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_production_-_crops

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In the care of animal and human health

Research areas of The Kielanowski Institute of Animal Physiology and Nutrition of PAS in Jablonna (Poland)...

To produce healthy pork and poultry

Changes in the composition, form, and quality of feedstuffs may cause health problems in weaned piglets and inhibit their growth. However, morphological and functional changes in the digestive tract can be modulated by bioactive compounds present in feedstuffs or added to the diet. In addition to changes in morphology, a very important issue is microbial activity, mostly in the large intestine. Recent investigations in the KIAP&N have concerned the influence of various types of protein, differing in their digestibility in the small intestine and indigestible carbohydrates (resistant starch, pectin, cellulose) on fermentation processes in the large intestine and their role in digestive tract development. The effect of protein type on microbial activity in the large intestine has been found to be modified by the type of carbohydrate in the diet, which should be taken into account during formulation of diets for pigs. Other research connected with digestive tract development and microbial activity investigated the possibility of using inulin-type fructans as feed additives. Some beneficial results depended on the degree of fructan polymerisation were observed in piglets and chickens. Dietary supplementation with inulin and a probiotic preparation also had a beneficial effect.

One of the important subjects is



improvement of the functional properties of broiler chicken meat. Excess saturated fatty acids and a high proportion of n-6 to n-3 unsaturated fatty acids in human diets can promote many diseases of civilisation. Much research has been conducted to increase the deposition of polyunsaturated fatty acids, particularly from the n-3 family, in pigs and poultry. This can be achieved by using various sources of unsaturated fatty acids, including fish oil, linseed oil, and rapeseed oil in different combinations and fed them for different times before slaughter. Increased levels of unsaturated fatty acids in the diet, and finally in the meat and fat of broiler products, requires supplementation with vitamin E and selenium to counteract oxidative stress and to increase the stability of these acids during frozen storage.

An important social problem is the lack of acceptance for using feed

containing genetically modified crops for livestock. The results obtained at the KIAP&N showed the safety of such materials used in animal feeding. The use of genetically modified soybean meal and maize in broiler diets did not affect performance or immunological status, intestinal morphology, epithelial cell turnover rate in the small intestine, intestinal ecosystem composition and activity. However, it is possible to partial replacement them with non-modified legumes which meet expectations of substantial group of consumers. Among others, different varieties of pea and lupine seeds, raw or processed, as well as rapeseed products were used in pig and broiler diets supplemented with enzymes or probiotics. It was found that partial replacement of soybean meal by protein from different legumes or rapeseed products in diets for growing pigs and broiler chickens is possible without adverse effect on feed utilisation and digestive tract physiology.

Digestive processes of domestic and wild herbivores

Another line of the research carried in the KIAP&N concerns characterisation of the digestion of structural and storage carbohydrates present in the diet of herbivores, with particular focus on the role of symbiotic microorganisms (bacteria, fungi and protozoa) in these processes. The subjects of the research are both livestock animals, like sheep and cows and animals of ecological importance, like beavers, deer, fallow deer and wisents. The goals of the research are to specify the interactions between the type of food intake and the composition of the microbial population; to explore the relationships between different groups of microorganisms; and to determine the correlation between changes in microbial composition and performance parameters in animals.

Gastrointestinal tract development in neonatal piglets

Studies conducted in the KIAP&N focuses also on bioactive colostrum and milk compounds (regulatory peptides and hormones), which may affect gut maturation as well as motor functions of the small intestine. The researchers established the unique animal model that enables nursing and rearing of neonatal piglets in controlled laboratory conditions. Studies on newborn piglets have contribute not only to progress in breeding of these animals, but to a large extent can be transferred to human. Current research focuses on nutritional programming, a phenomenon based on epidemiological and animal model studies which have shown that development and growth

during early life is influenced by maternal health and diet composition.

Central regulatory mechanisms

The KIAP&N is a recognised entity in the study on the functioning of the hypothalamic-pituitary neuroendocrine axes of sheep and rats. One of the investigations is focusing on the relationship between the functional state of GnRH neurons in the hypothalamus and the expression of genes in gonadotrophs in the anterior lobe of the pituitary gland. A further area of study deals with the characteristics of the Cu-GnRH complex activity. This unique analogue of gonadoliberin is characterised by specific parameters of intracellular activity, including increased resistance to enzymatic degradation, as well as the ability to activate different pathways in pituitary gonadotrophs. Due to potential use of the Cu-GnRH complex in treatment of GnRH-gonadotropin dysfunctions, it is particularly important to conduct a comprehensive study of this molecule's activity.

Other research addresses the effect of immunological stress caused by bacterial and viral infections on the function of the gonadotropic (GnRH/LH) axis. Consequences of stress of this type include disorders of the ovulatory cycle, or even complete infertility. The focus of these studies is elucidation of the interactions between the reproductive and immune systems at the central nervous system level. The obtained results suggest that during inflammation various mediators like interleukins and cytokines evoke changes in the secretion of GnRH/LH either directly via their own receptors

or indirectly through intermediate regulatory neurons.

Another investigation studies the central mechanisms regulating the secretory activity of the pituitary during lactation. The key achievement was the identification of salsolinol in the sheep hypothalamus and determination of changes in its release in response to suckling. It has been found that dopamine-derived salsolinol may be an important terminal element in the sucking stimulus, encouraging the release of prolactin and oxytocin and making it possible to sustain increased secretion of both hormones during lactation. The latest data also shows that salsolinol participates in inhibiting the reaction of the corticotropic system to stressors, which would associate this molecule with the mechanism responsible for reducing the sensitivity of lactating mothers to stress.



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Transforming Europe's energy system

Research and innovation could accelerate Europe's energy transformation, as outlined by EU Commissioner for Energy, Miguel Arias Cañete in a speech at the SET-Plan Conference...

A rapidly changing energy and climate landscape requires realignment in the way we work. That is why the vision we have for the SET-Plan is one based on 3 principles:

Firstly, a simpler, more focused approach. We need to bring the SET-Plan up to speed with 2020/2030 goals by focusing on the priorities with the greatest potential to help us meet the objectives we have set in our Energy Union.

Second, more integration, transparency and accountability. That means putting an end to technology tribalism: innovation breakthroughs in one sector or one country should be shared across the EU energy system.

And thirdly, it needs to be powered by smart financing to make sure investment is directed to where it is needed.

If we want to fully exploit the potential of European innovation we have to look horizontally at the whole energy system across Europe. And that doesn't mean reinventing the wheel.

In fact it is about maximising the potential of the great work already happening by better linking it together. Europe needs to be as strong as the sum of all of its research parts. That will need more cross-border, cross-sector integration.

This is why the SET-Plan process will not be a stand-alone one. Together with the Strategic Transport

Research and Innovation agenda and with the Global Technology and Innovation Leadership Initiative, they will represent the 3 strands that will contribute to the research and innovation competitiveness strategy to be presented as of part of the State of the Energy Union in 2016.

More targeted approach

Getting back to the 3 principles for the new SET-Plan, allow me to start with the need for a more targeted approach. The current SET-Plan no longer quite fits with today's rapidly changing energy system. Nor has it kept speed with our ambitious climate and energy commitments.

Let me put that into context:

In just a few months we will head to Paris to secure a legally binding, ambitious global climate agreement. As you know our side of the bargain is a 40% cut in emissions, a minimum share of 27% of renewables in our energy system and a 27% improvement in our energy efficiency – all by 2030.

That's backed up by the Energy Union which explicitly commits us to becoming world leader in renewables. All of that in a changing energy system made up of more and more active prosumers, increasingly decentralised production patterns and more flexible demand. The good news is that thanks to the SET-Plan – and we've started moving in the right direction. Thanks to advances in European technology, the cost of photovoltaic (PV) systems has fallen by 50% in the last 4 years, while wind turbine prices fell by almost a third over the same period.

The reason that costs are going down is because we are constantly innovating. Our researchers are developing cleaner energy technologies which help us do more for less.

That work has helped renewables get up to 15% of our final energy consumption, 26% in the electricity sector. That's good but it's still a long way off where we need to be.

In fact we need to step up our game across the board if we are to reach our targets. Consider this:

- Three quarters of our housing stock is still energy inefficient;
- European buildings are responsible for more than one third of the EU energy-related CO₂ emissions;
- We still have millions of European homes relying on century-old analogue metering; and,
- We have a transport system responsible for a quarter of all greenhouse gas emissions.

Research and innovation will be key to the big transitions we'll need across each of those areas. That is why our vision is for a SET-Plan that focuses on a small number of big priorities. The 4 core research and innovation priorities we have highlighted are:

- Reducing the cost of renewable energy technologies to ensure Europe is world leader in the field;
- Developing smart grids that can reply to the need of energy consumers and prosumers;
- New technologies to improve energy efficiency, in particular of the building stock;
- And, increasing the sustainability of the transport system, for example through electric vehicles or reducing the cost of batteries.

In addition, Carbon Capture and Storage (CCS) and Nuclear, can be added for those member states interested in those technologies. In our communication we have highlighted a series of 10 actions to support those priorities.

More integration, transparency, accountability

Setting priorities and actions is the easy bit. Now we have to make it happen. We cannot do it without Member States' full commitment to working together and take ownership of the SET-Plan.



In the past, it has been said that the Commission was too prescriptive with its priorities, that it made life more difficult by not joining up its research arm with its energy or transport policies. We listened to that.

This time round we worked for the last 2 years with Member States and with industry to define the SET-Plan's priorities in a bottom-up way.

That is how we came up with the 10 actions and we will work with Member States and all stakeholders to define:

- the level ambition (in terms of priorities and funding),
- the modalities for the implementation and
- the timing for the delivery of results.

With the stakes so high we now need greater transparency. It is crucial that Member States know what

initiatives other countries are working on so as to avoid duplication. They need to take a far more "open-data" approach to the results of our work. We believe that that transparency will breed accountability. We will establish clear performance indicators to measure progress and take a results-orientated approach. But in return for greater integration, transparency, and accountability we have to make sure that the projects with the greatest potential have the access to the investment they need.

Smart Financing

We have all seen the results of what targeted investment can do.

Take for example of the Gemini offshore wind farm off the North Sea coast of the Netherlands.

It is the largest farm of its kind in the world. Its 600MW will supply renewable electricity for more than 1.5 million people and 785,000 households!

That's equivalent to a 1.25m ton reduction of CO₂ emissions. Not to mention the jobs and income it will bring to the region.

But, offshore wind farms are expensive – €2.8bn in this case. The truth is that large scale projects of this kind are often viewed as risky. We have to look at new ways to fund these projects – clearly public money will never be enough.

Our strategy is to leverage as much private investment as possible from as little public funding needed. With the Gemini project for example, the European Investment Bank invested €587m of EU public money. That investment acted as a guarantee and encouraged a number of other public and private actors to invest the remaining money needed.

That is exactly the thinking behind the new €315bn European Fund for Strategic Investments (EFSI). Public institutions must act as a guarantor to incentivise private funding and allow financial institutions to offer long-term financing to projects with a higher risk profile.

To support that we have doubled the funding for energy research from 2014 to 2020 and we have ring-fenced 35% of all research money for climate technologies. In fact we are investing in clean energy technologies in all parts of the EU budget – from regional to maritime funds.

There are plenty of funding opportunities at EU level. But the same spirit of collaboration of the SET-Plan applies to investment. Regional approaches might provide common investment needs: where we have common challenges we need to pool together our resources.

Conclusion

That is the foundation for our new vision for the SET-Plan. We have common energy and climate goals.

We have world leading research institutions and some of the world's top innovators.

EU companies already hold 40% of global patents for renewable energy technologies. We now need to bring all of that together.

- The new political approach to SET-Plan will prioritise the areas with the greatest potential to help us achieve our objectives.
- The new structure will ensure more cross-border, cross-sector integration, more transparency, and more accountability.
- And the range of smart financing tools at our disposal will help us direct investment where it is needed.

Discussions with Member States will continue up to and beyond Paris where I hope we can review our level of ambition upwards. That will then feed into the Commission's Strategic Communication on Research and Innovation due before the end of 2016. We have a lot of work ahead of us but I am more confident than ever that we can make it happen. ■

This article is taken from a speech –

http://europa.eu/rapid/press-release_SPEECH-15-5695_en.htm

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Miguel Arias Cañete

Commissioner for Energy and Climate Action
European Commission

http://ec.europa.eu/commission/2014-2019/arias-canete_en

What can the net energy analyst say to the investor and policymaker?

In the modern energy system, upwards of 10% of the total primary energy supply is expended to find, develop, extract, transform, and transport energy carriers to end users¹. Some particularly challenging resources, such as heavy oil, require an even larger fractional expenditure for their extraction and processing. This energy expenditure within the energy sector and the wider economy has economic, social and environmental consequences, and thus attracted much interest in the wake of the 1970's Arab oil embargo. Larger energy expenditures to support the activities of the energy sector also necessitate additional capital investment for increased throughput of energy per unit of final energy product delivered to non-energy sectors (e.g., to final consumers).

Net energy analysis (NEA) rose and then fell from favor in the energy analysis community, with high interest occurring from the years 1975 to 1985² and again in recent years – both times of high oil prices. Interest in NEA declined in the mid-1980s, as the belief grew that the method provided no additional information beyond economic analyses^{3,4}. There has been recent resurgence in interest in NEA, focused mainly on a particular metric, energy return on investment (EROI). This recent interest has been spurred by concerns over oil depletion⁵⁻⁷ and interest in the fundamental energetics of the transition to renewable resources⁸⁻¹⁰.

NEA is a broad class of methods used to determine the effectiveness of energy capture and conversion systems². The end result from NEA is often calculation of an energy return ratio (ERR), of which EROI is one example. These ERRs compare the amount of energy expended in extracting and upgrading an energy resource to the amount of useful energy provided to society. Numerous ERR's exist, and the usefulness of a given ratio depends on its formulation and the question of concern^{11,12}.

ERR's can help illuminate two important aspects of an energy system: (1) the quality of the energy resource being extracted, and (2) the ingenuity with which humans extract that energy. A shift from high-quality resources (e.g., light, sweet conventional oil) to low-quality resources (e.g., heavy oil) affects the efficiency of extraction, the cost of energy, and the overall environmental impacts from our energy system. By extension, the sophistication with which we extract and convert energy affects the end cost to users and the environmental profile of all economic activities.

In the past ten years, production of both Canadian oil sands and 'shale oil' (actually tight oil) has seen impressive growth in production. In fact, production of shale oil from the Bakken, ND and Eagle Ford, TX has reversed a four-decade decline in US production of oil, spurred primarily by historically

high oil prices. At oil prices north of 75 USD per barrel (as was the case for much of the past 5 years) both oil sands and shale oil seemed like viable resources. Since the recent drop in oil price to below 50 or 40 USD/barrel, producers of both resources are struggling^{13,14}. From an economic perspective then, these two resources appear very similar. If net energy analysis offers little insight, beyond traditional economic analysis, is there nothing that the investor or policymaker can learn from the net energy analyst?

Dr. Adam Brandt from Stanford University has spent the last five years analyzing fossil-fuel systems. His work indicates that the fractional energy expenditure of Canadian oil sands is between 30-60% (or between 10-50% if self-use of bitumen is not included), whereas the figure for shale oil is more like 2%^{15,16}.

The production of crude oil from oil sands is comprised of a sequence of highly energy intensive stages which have changed little since the resource was first tapped back in the Sixties, suggesting that there is little room for improvement in the physical process. As such, it is likely that the high cost of producing oil from oil sands is constrained by fundamental, inescapable, physical reality.

On the other hand, there is no such physical constraint on the cost of

producing shale oil, as evidenced by the low energetic cost – drilling and fracturing rock doesn't take that much energy. In this case, the financial picture is likely skewed by the fact that hydraulic fracking is a relatively new technology with only a few companies providing the service. Since those companies are in high demand, they can charge a large premium.

Looking to the future, we can expect to see the price of fracking services decline as more providers join the market or, as is happening already, delivered fracking service contracts are being renegotiated in the face of lower oil prices. Either way, the production cost of shale oil is likely to come down; an insight gained by looking at physical performance metrics, not financial ones.

Other cases exist where relying solely on financial analyses skews the picture, particularly when subsidies, labor-intensive processes or very early-stage technologies come into play. For example, a recent study of a photoelectrochemical cell for producing hydrogen powered by solar energy (artificial photosynthesis) would struggle to break even from an energy perspective, even under generous assumptions of performance¹⁷. The constraint came primarily from the materials needed to build out the large areas required. Even given impressive solar-to-hydrogen efficiencies and the lure of 'free fuel from sunlight' this is an investment that would be unlikely to pay off in the long run.

Evidently then, there are clear benefits to supplementing financial analyses with one based on a physical understanding, such as net energy analysis. Both investors and policymakers would do well to consult with such analysts, especially in volatile or emerging technology markets.

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SPIRE

Storage Platform for the
Integration of Renewable Energy

www.projectspire.eu

The EU INTERREG IVA funded Storage Platform for the Integration of Renewable Energy (SPIRE) project commenced in July 2013 with lead partner the Ulster University and partner Dundalk Institute of Technology. The Centre for Sustainable Technologies at Ulster is coordinating the project, which aims to assess the feasibility of storage technologies at large, medium and small scales.



The cost of energy is increasing due to a number of linked but separate issues. Security of energy supply is strategically critical in the face of increasing international prices, supply issues and geopolitical unrest. Energy supply depends on -

- the demand for energy services, and
- how that demand is delivered.

Energy service demand is driven primarily by economic activity and low energy prices can serve to remove barriers to economic activity. Ireland has excellent renewable energy resources and unlocking these potential resources requires energy storage.

The focus of the SPIRE Project was to minimise the barriers to the deployment of renewable energy by providing viable answers to energy storage challenges within a compact timeframe.

The technologies investigated by the project were heat pumps and thermal storage at a domestic level, flow batteries and ice banks at a commercial/industrial distributed scale and compressed air energy storage at the large utility scale. Ulster leads on modelling, scenario development and demand side management options with heat pumps and thermal storage, Dundalk leads on flow batteries and ice banks, while Gaelectric Energy Storage LTD. were appointed as



lead contractor to develop practical and theoretical assessments for compressed air energy storage.

Each technology strand engaged in cross-cutting themes in demonstrating Economic, Environmental, Cooperation and Social impacts that will see this region becoming a centre for excellence in energy storage development and exploitation.

The results and findings of the project will be published on <http://www.projectspire.eu>

The SPIRE project will span 24 months from July 2013 to June 2015 and has been offered grant aid of up to £2,932,733 out of a total project cost of £3,737,076 under Priority 2, Theme 2 (Infrastructure: Energy) of the INTERREG IVA programme 2007-2013.



European Union
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This project is part-financed by the European Union's INTERREG IVA Cross-border Programme managed by the Special EU Programmes Body

Addressing the energy storage bigger picture – The Interreg IVA SPIRE Project

The Interreg IV project SPIRE (Storage Platform for the Integration of Renewable Energy) managed by the Special European Union Projects Body provided £2.9M to address scales of energy storage required in the Ireland/Northern Ireland Cross Border Region. The project led by Ulster University's Centre for Sustainable Technologies brought together the Centre for Renewable Energy at Dundalk IT (CREDIT) and through an Official Journal of the European Community tender process, Gaelectric Energy Storage Ltd.

The aim of the project was to assess the likely volumes of energy storage required by the all-Ireland Single Electricity Market (SEM) given its likely high penetration rate (>40% by 2020) of non-dispatchable, variable wind energy. A series of scenarios examined the impacts of wind energy on the SEM developed to 2050 and incorporated alternative technologies such as advanced gas turbines and CCGTs and interconnection to other markets.

The scenarios are supported by a series of research initiatives examining different scales of energy storage, namely a) Large utility scale (represented by Compressed Air Energy Storage – CAES); b) Industrial site scale (through flow batteries and ice banks) and c) Domestic scale (through heat pumps and energy thermal storage).

CAES would be incorporated into local salt deposits at Larne, Northern Ireland, UK and proposed compressions of air to >100bar during periods of

excess wind capacity. Solution mining of a cavern at depths of about 1700m would provide 200-300MW of storage capacity and the air would be used to offset combined cycle gas turbine air compressors, thus increasing local power station efficiency.

A program of test drilling was initiated and results indicated that salt deposits at shallower depths (~900m) had greater geological complexity that first anticipated. The salts at greater depths were more suitable. CAES systems appear to be more cost effective than other large scale storage systems.

Intermediate scale energy storage supports wind turbines operating on large sites. Dundalk Institute of Technology used its 850kW wind turbine coupled with an ice-bank for cooling computer laboratories and 500kWh flow battery to evaluate system performance. The complexities of urban installations of wind turbines were evaluated through novel deployment of lidar technologies to examine the variable air flows around buildings. Results indicated that electricity and heat combinations worked well for building applications.

Ulster University developed a heat pump and thermal storage facility on its "Terrace Street" test houses. These are fully instrumented Victorian terraced houses lived in by families that are now converted successfully from gas boilers to high temperature heat pumps and 600 litres of water-based thermal storage. Initial results are promising with thermal comfort being

maintained, running costs reduced and pricing signals from the electricity system operator integrated to optimally utilise the storage when electricity demands are high and charge when electricity demands are low.

Finally, these three sets of performance characteristics were integrated into the SEM electricity market model developed in PLEXOS which indicated though a series of scenarios, the likely scales, costs and benefits on the SEM of different combinations of storage up to 2050. Demand side management with heat pumps and energy storage coupled with CAES looked promising but the overall conclusion was that there is capacity for many different approaches provided that they were assisted in their deployment through payments under ancillary services.

The author would like to thank staff, partners, Steering Committee Members (DCENR, Invest NI, Eirgrid) and the Special European Union Projects Body for their support through this challenging but fulfilling project.



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Mountain plants and recent climate change

It is well known that the current rate of warming in response to increasing 'greenhouse-gas' concentrations (e.g. CO₂) is amplified at high latitudes and with increasing elevation in mountains. This rapid warming has important implications for ecosystems, human activities, and alpine biota. Linked to this warming are glacial retreat and upward shift of tree-lines, creating further threats to alpine biodiversity.

Alpine plants grow above the tree-line in mountains globally. They occur in areas with low temperatures, very low night-time temperatures, frost, short growing-season, and high winds or extended snow-lie. Many grow very slowly; some living for 100+ years. They inhabit such extreme habitats because of their physiological tolerances and inherent requirements for cold and/or intolerance to competition from taller, rapidly growing plants of lower elevations. Some alpine plants, but not all, can be grown in lowland gardens in the absence of competition. Because of their ecological specialisation, alpine plants are potentially sensitive to climate change.

In the absence of long-term permanent recording plots, studying how alpine plants are responding to climate change requires (1) reliable botanical records from the past 100 years, (2) a repeat survey today using identical methods as the original survey, and (3) a critical comparison of past and present species occurrences.

Investigations in the European Alps



Image: © John Birks

Figure 1. Mid-elevation (left) alpine *Phyllodoce caerulea* (mountain heath) (top) and *Vaccinium vitis-idaea* (crowberry) (bottom) that have ascended 200–300m and high-elevation (right) alpine *Saxifraga cespitosa* (tufted saxifrage) (top) and *Ranunculus glacialis* (glacier buttercup) (bottom) that have shown no change in elevation

show increased species richness on high (>3000 m) summits during the last 100–150 years. Kari Klanderud showed that richness between 1600–1800 m elevation had increased since 1930 by 8–14 species and between 1800–2000 m by 5–8 species, but that richness above 2000 m showed little change in the Jotunhemien mountains (central Norway). Grasses and dwarf-shrubs (e.g. mountain heath, crowberry; figure 1) have expanded their elevational limits by 200–300 m since 1930. No high-alpine summit species such as the glacier buttercup or tufted saxifrage (figure 1) have gone extinct.

Many such resampling studies have now been done in Europe, the Caucasus and Ural mountains, parts of east Africa, and the Americas. John-Arvid Grytnes has synthesised the results of 114 resurveys of European mountains to test competing hypotheses about the causes of species shifts – atmospheric nitrogen-deposition, precipitation, temperature, land-use changes, etc. Seventy per cent of species showing detectable changes in their upper limits have moved upwards. The same species tended to move up on different mountains. There were large differences between mountains in the proportion of species shifting

upwards. This proportion is not related statistically to temperature changes. Species associated with late snow-lie have become commoner on summits. These findings suggest that plants are partly responding to climate through elevational changes in snow-lie resulting from a complex of temperature and precipitation changes. Such changes allow more competitive plants to expand upwards. This synthesis suggests that recent climate change is affecting alpine plants but that the link is more complex than a simple species response to increasing temperatures.

These field-based results contrast with predictions about impacts of future climate change on alpiners from species-climate 'niche' models. The models suggest drastic changes with many species going extinct by the next century, but, caution is needed because their coarse spatial scale (e.g. 50 x 50 km) fails to capture the fine-scale topographic and microclimatic variations so characteristic of alpine landscapes.

One important result of the resurveys is that there is little evidence for local extinctions, especially at the highest elevations where climate warming would be expected to have the greatest impact. Daniel Scherrer and Christian Körner (Basel) have shown that there is great variation in soil and surface temperatures due to numerous microhabitats within an alpine landscape created by high topographical variation (ridges, hollows, streams, etc.). Local-scale variations (7.2K for mean growing-season soil temperature) exceed IPCC warming predictions for the next 100 years. A 2K regional-

scale warming leads to a 3% loss of the currently coldest microhabitats in their study areas. Such cold microhabitats will not be lost altogether. Warm microhabitats will become more frequent and new warmer microhabitats may develop. The observed increases in plant richness seen on European mountains are likely a response to increased microhabitat diversity. Rugged alpine terrain is a 'safer' place to live under conditions of rapid climate change than flat terrain that offers no nearby 'escapes' from new thermal regimes.

Are entire alpine ecosystems changing in response to recent environmental changes? Studies of algae and animals show that major biological changes have occurred in alpine lakes during the last 100 years. These changes may result from increased atmospheric nitrogen deposition, acid-rain, or climate change, or interactions between these drivers. However, the nitrogen and acid-rain hypotheses are unlikely to be driving changes in remote lakes in the Andes studied by Neal Michelutti, Andrew Labaj, and colleagues (Kingston). Such studies demonstrate the recent development of new ecological states in remote alpine lakes, just as there have been major shifts in many arctic and temperate alpine lakes and in arctic and alpine floras.

Although alpine habitats and their biota are often thought of as 'pristine', they are being increasingly impacted, to varying extents, by climate change, nitrogen-deposition, tourism, hydro-electricity development, land-use changes, introduced species, and over-exploitation leading to erosion and landscape degradation.

Mountains cover 24% of the Earth's land surface and 26% of the world's population lives in or by mountains. They provide water for over half of mankind directly or indirectly as mountains hold about 66% of the world's freshwater as snow or ice. Stephen Venables recently wrote "Mountains are the ultimate litmus test of what is happening on our planet." Alpine plants and their recent changes are an important part of this 'litmus test'. They warrant greater study as they have much to tell us about biodiversity responses to future changes.



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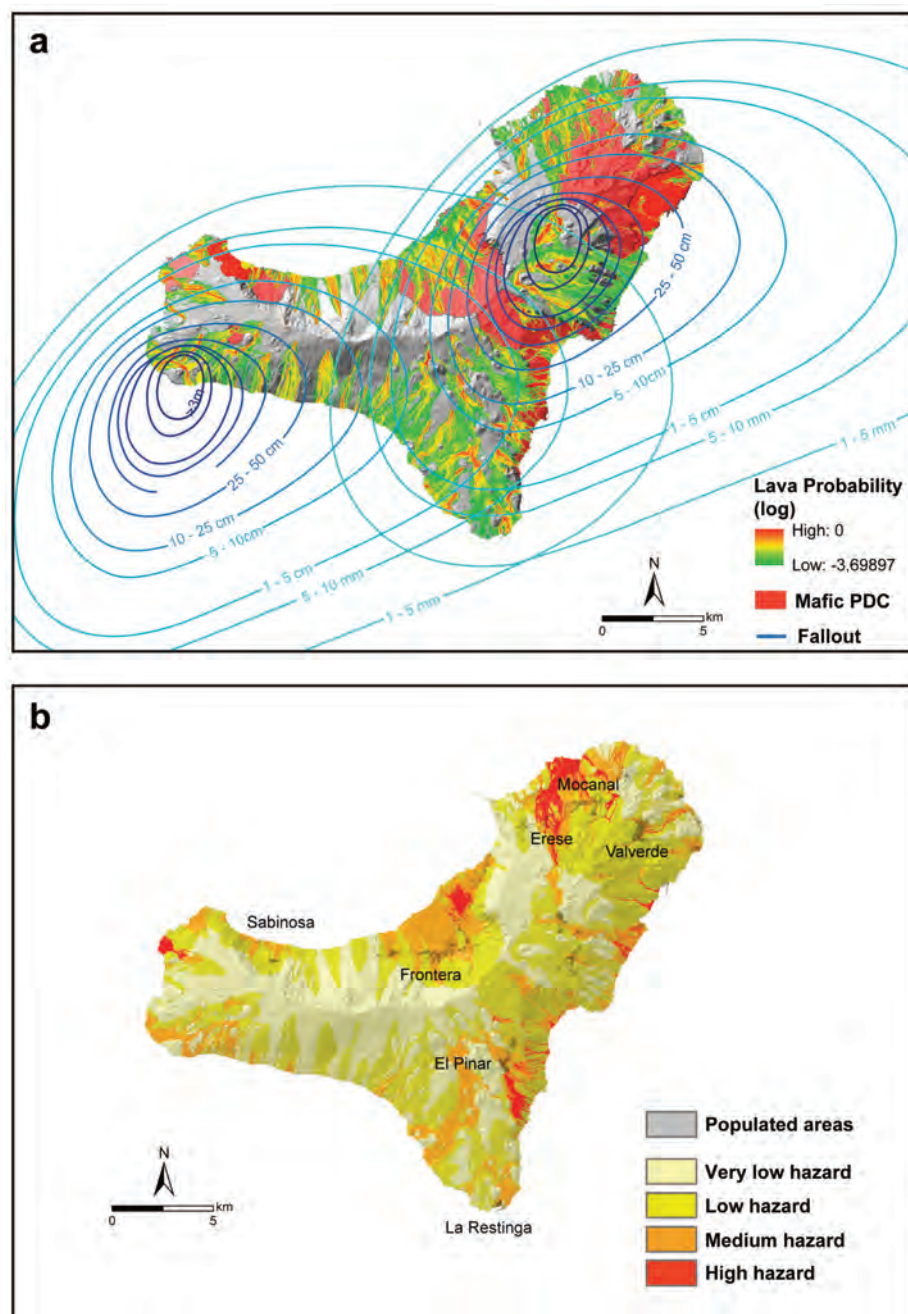
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Volcanic hazard assessment and risk management

The impact of a natural event such as a volcanic eruption can significantly disrupt human life. The long periods of quiescence that are quite common in many volcanic areas often lead to a fall in vigilance whose consequences may include a lack of preparation for dealing with a volcanic crisis. In some cases in which the volcanic area is considered as non-active due to the lack of historic eruptions, hazard may be completely ignored. Thus, it is important to evaluate the possible hazards that could affect a volcanic area and develop appropriate hazard and risk maps. Volcanic hazard assessment is one of the scientific tasks that should be conducted in any active volcanic area where the human population could be placed at risk by an eruptive episode. Possible future volcanic activity can be understood and predicted via the analysis of past eruptive behaviour and the study of the geological record.

Understanding the potential evolution of a volcanic crisis is crucial for designing effective mitigation strategies. This is especially the case for volcanoes close to densely-populated regions, where inappropriate decisions may trigger widespread loss of life, economic disruption and public distress. An outstanding goal for improving the management of volcanic crises, therefore, is to develop objective, real-time methodologies for evaluating how an emergency will develop and how scientists communicate with decision makers. In modern volcanology it is fundamental to develop models that



Volcanic hazard map of the El Hierro Island (Canary Islands), showing the areas that could be affected by the superposition of the main hazards (lava flows, pyroclastic density currents, and fallout)

combine the hazard and risk factors that decision makers need for a holistic analysis of a volcanic crisis. Final products are eruptive scenarios and their probabilities of occurrence,

vulnerability analysis, and costs estimate of false alarms and failed forecasts. Probabilistic methodologies have a prominent role in volcanic hazard assessment, so that it is



Sketch showing the tasks to be conducted to anticipate volcanic eruptions and to reduce their potential risk (Volcanic Risk Management Circle)

necessary to develop methodologies and protocols with which to provide better risk-informed support for authority decision-making.

At the Institute of Earth Sciences Jaume Almera, CSIC, of Barcelona (Spain), the Group of Volcanology of Barcelona (GVB-CSIC) lead by Prof. Joan Martí carries out volcanic hazard assessment through the development of new tools specially designed to assess and manage volcanic risk. The group includes experts in geology, physics, statistic and Geographic Information Systems (GIS) and aims to evaluate volcanic hazard and to develop new approaches to manage volcanic risk, as well as to design new databases to collect data necessary to assess it. The main focus of the group is to offer the basis on which to build the strategies that are required to successfully face up to and minimise the impact of future volcanic eruptions on volcanic areas in a homogeneous and systematic way. The approach is

based on the history of the volcano being deduced from the geological record, which allows determining how, where, and when the next eruption could be. Their methodology uses free tools that have been developed to contribute to the long- and short-term hazard assessment, both in spatial and temporal analyses, to create scenarios of different kind of hazards such as lava flows, PDCs and ashfall, and susceptibility and cost-benefit analyses.

Moreover, the group is involved in a new project, VETOOLS (Development and Implementation of e-tools for volcanic hazard assessment and risk management), funded by the European Commission – Humanitarian Aid and Civil Protection Unit, to develop specific software for hazard assessment and risk management. This project also aims at improving and developing volcanic risk assessment and management capacities in active volcanic regions; developing universal

methodologies, scenario definitions, response strategies and alert protocols to cope with the full range of volcanic threats; improving quantitative methods and tools for vulnerability and risk assessment; and defining thresholds and protocols for civil protection.

GVB aims to promote the interaction and cooperation between scientists and Civil Protection Agencies in order to share, unify, and exchange procedures, methodologies and technologies to effectively reduce the impacts of volcanic disasters by improving assessment and management of volcanic risk. The application of the tools developed include volcanic fields around the world. Their studies help to identify the gaps between strategies adopted in different regions and, consequently, to propose a unified set of procedures and requirements that any volcanic risk management strategy should incorporate at the minimum, regardless of local specific features.



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Hydropower vs ecology

Society's conflicting demands for more renewable hydropower and improving the ecological status of European lakes and rivers: Is it possible to meet both requirements?

The water management authorities face a contradicting dilemma in EU directives regulating the management of water resources in Norway and Europe. The European Water Framework Directive (EU WFD) and the Nature Diversity Act seek to preserve and improve the ecological status of lakes and rivers, whereas the European Renewable Directive and the el-certificate market promote increased production of renewable energy to reduce greenhouse gas emissions.

Norway has the potential to export renewable and flexible hydropower energy, and to serve as a "green battery" for Europe, but the above-mentioned market drivers and environmental considerations call for knowledge based and applied solutions that optimise the trade-off between renewable energy production and the preservation of local environmental conditions, and multiple user interests in existing and planned hydropower projects.

The RIVERCONN research project

The research project "Hydropower and Connectivity in Inland Rivers" – RIVERCONN, funded by the Norwegian Research Council, aims to provide new knowledge of the ecological requirements of migratory fish species in inland rivers in Norway. The key species are the salmonids European grayling (*Thymallus thymallus*) and brown trout (*Salmo trutta*). The E.

grayling are declining in numbers across Europe and are even redlisted by some countries. Many grayling populations in Norway are still viable, but several new hydropower projects give rise to a growing concern amongst fishermen as well as environmental management authorities. Hydropower dams have already fragmented many river systems in Norway, and they represent barriers or hindrances for migratory fish species. In the Glomma river, which is the largest river in Norway, 12 hydropower dams are established in the main river. These obstacles and river development raises an important question for both the hydropower companies and the water management authorities: What is the ecological significance of preserving migratory life histories? Is the preservation of a variety of naturally evolved life histories relevant to the EU WFD?

Why stress fish migrations and life histories?

Fish migrations are adaptations that allow fish to utilise several habitats to optimise survival, growth and reproduction, i.e. obtain greater net benefits and thus lifetime reproductive output. Hence, human actions that reduce or prevent fish migrations, reduce habitat quality and water flows are expected to cause reduced individual and population fitness. As a consequence, this may lead to declining populations and poor resilience capacity. Mitigation measures have primarily

focused on the stocking of hatchery reared fish to sustain and support sport fishery in regulated inland rivers in Norway, and partly on safeguarding upstream migration past hydropower dams. However, the obvious requirements for wild fish to perform return migrations past hydropower installations have by far been neglected. The EU WFD focuses on improving the ecological status of lakes and rivers, and one of its main goals is to restore the ecological connectivity of fragmented river systems. The Norwegian water management authorities have clearly stated that stocking hatchery-reared fish does not improve the ecological status of degraded water localities. Hence, it is urgent to develop new measures that safeguard natural recruitment and production of wild fish populations.

Traditional mitigation measures in fragmented rivers, such as the stocking and construction of fishways, need to be evaluated in light of new knowledge and legislative recommendations regarding their ecological effects. Fishways in European rivers have rarely been evaluated for functionality, and dysfunctional passage routes may cause high mortality and traceable evolutionary responses in wild fish populations. The scientific literature also reports an increasing body of studies showing that compensatory fish stocking programs may have limited positive or even detrimental effects on wild fish populations.

Suspension of compensatory stocking of brown trout in large river in Norway

In 1991, the environment authorities ordered the hydropower companies in the Glomma to release more than 50,000 two-year old hatchery-produced brown trout annually. The main goal of the stocking program was to maintain the important sport fishery in the river. However, relatively few resources were allocated to evaluate the effects of the program, which is also due to common practice. Fish stocking is a relatively inexpensive and simple measure to mitigate the negative consequences of hydropower development. However, the authorities and fishermen experienced a lack of success. The artificial produced brown trout had higher mortality and grew slower than wild fish. Few cases of large and attractive stocked fish in the catches of anglers were reported. In 2010, NINA implemented boat electrofishing as a new survey method in large rivers like Glomma, and the results showed that few stocked trout survived their first winter in the wild (NINA Report 1056). A big proportion were eaten by the piscivorous northern pike, and 80% of pike diet constituted more than 80% hatchery-reared trout in some reservoirs during the weeks after release. At the same time, boat electrofishing surveys gained new knowledge about the wild populations of grayling and trout, and NINA concluded that their population status should be improved despite the hydropower production. In addition, one could not exclude that the fish stocking could have a negative effect, e.g. because of undetectable outcome from competition for food and shelter, on the wild fish populations. In 2014, the water management authorities decided to revoke the stocking program.

The decision was made without major protests from municipalities or fishermen. For many anglers, both locals and visitors, wild fish are increasingly more sought after compared to stocked trout.

Is it possible to improve the ecological status in regulated rivers?

Society has decided to produce renewable hydropower in Glomma, and undamming the river is not yet considered a relevant question in Norway. The concept of environmental design seeks to optimise the trade-off between continued hydropower production and environmental considerations and preservation, e.g. how to safeguard migrations or habitat requirements of fish without losing too much hydropower. This is a research-demanding challenge, but NINA and partners in the "Centre of Environmental Design of Renewable Energy" (www.cedren.no) have developed this concept in regulated salmon rivers in Norway. Our advice to the water management authorities in Glomma is to start the process to develop this concept also for fish species like the European grayling and brown trout. To succeed with the concept of environmental design, we first have to reveal the ecological bottlenecks necessary to improve the ecological status of grayling and trout, and thereafter work out the most effective mitigation measures. Some emphasis should be placed upon threshold values for spillwater release necessary to maintain ecological connectivity. The results from the RIVERCONN-project imply that it will be mandatory to pay much effort into improving facilities for safeguarding two-way fish migrations past many hydropower dams in the future.

In conclusion: It is beyond doubt that hydropower developments generally have a negative impact on river ecosystems, but there is a great potential to reduce negative effects using environmental design to reveal ecological bottlenecks and work out goal-oriented mitigation measures. This will demand a more proactive approach applying dose-response trials designed by fish ecologists, hydropower companies and water management authorities in Norway. Supplementary stocking of hatchery-produced fish in the Glomma river is a past regime, and we should probably realise that preserving wild fish and ecological functionality after hydropower development in complex river systems like Glomma are far more demanding and expensive than continuing the supplementary stocking program. But on the other hand it will be more effective and the ecological status will be improved according to EU WFD.



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Is nuclear energy the answer to climate change?

Dr Jonathan Cobb, Senior Communications Manager at the World Nuclear Association details why nuclear power could be part of the solution to tackling climate change...

From 30th November, for 2 weeks, thousands of negotiators will meet in Paris for the COP21 climate change conference. They will be joined by tens of thousands more delegates representing non-governmental groups such as environmentalists, businesses, scientists, women, trade unions, youth and religious leaders, along with thousands of journalists. If these people genuinely wish to save the climate, they had best give serious consideration to the future role of nuclear energy.

The COP21 organisers describe the event as crucial, as it needs to achieve a new international agreement on the climate, applicable to all countries, with the aim of keeping global warming below 2°C. A key feature of the latest agreement are Nationally Appropriate Mitigation Actions (NAMAs), where governments have declared in advance what steps they are committed to taking to combat climate change. A rather big problem

is that the NAMAs declared so far do not go far enough.

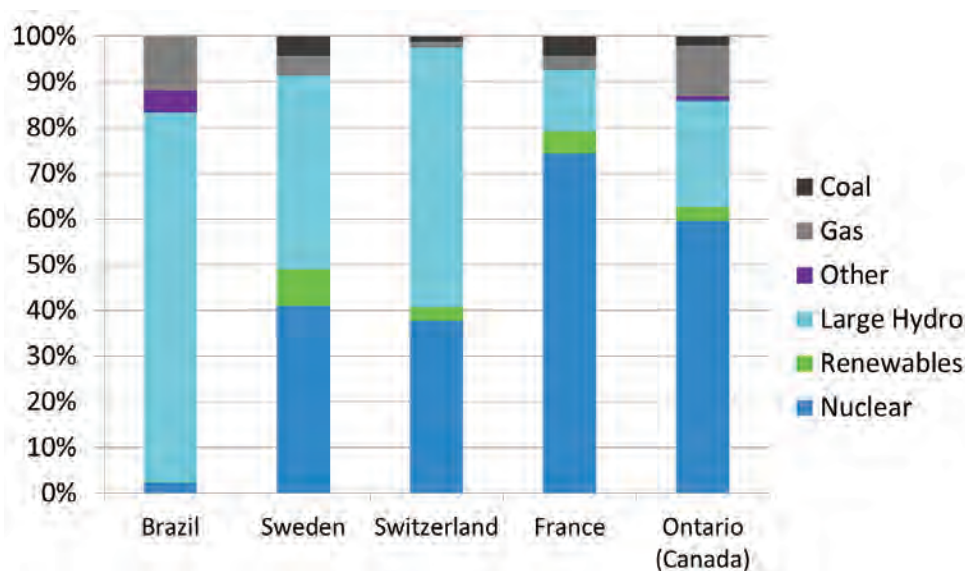
Many of the NAMAs include a description of what each government plans to do in the energy sector, in particular for electricity. Globally, electricity and heat production account for more than 40% of CO₂ emissions. That is because much of the world's electricity is currently generated by burning fossil fuels. However, electricity generation is an important focus for climate efforts, as it is one of the few major sectors where proven technologies are available that can reduce greenhouse gas emissions by the required amount.

According to the latest available data the largest single source of low carbon, non-fossil electricity generation is hydropower, supplying around 16% of the world's electricity. Second comes nuclear energy, generating about 11% with renewables other than hydro such as wind, solar and biomass, generating around 6%.

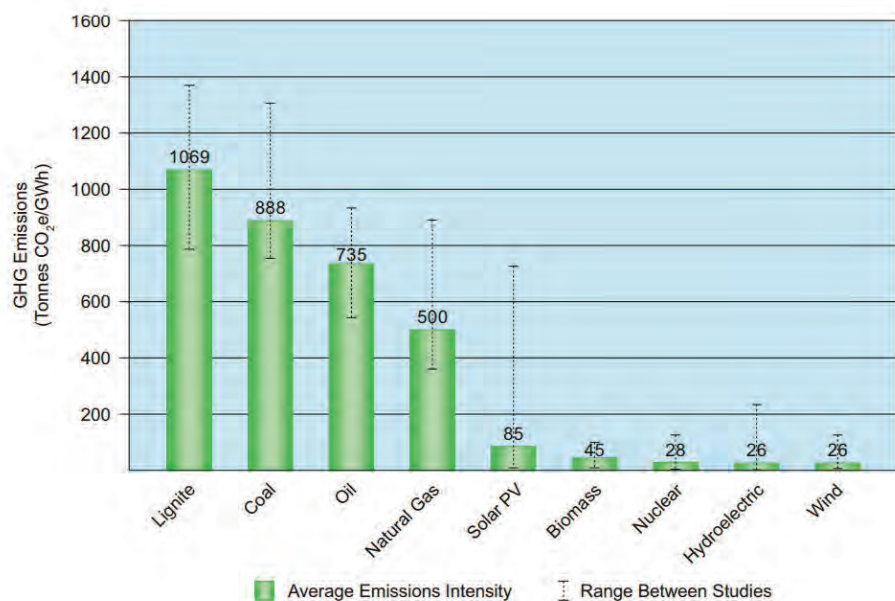
In combination about one third of global electricity comes from these low carbon sources.

Some countries have already shown the potential to achieve much greater use of low carbon electricity in their electricity generation mixes. Brazil, Sweden, Switzerland and France have all reduced reliance on fossil fuels to less than 20% of supply, as has the Canadian province of Ontario. This has been achieved through combinations of nuclear, large hydro and other renewables.

Generation mixes with low greenhouse gas emissions



Lifecycle GHG Emissions Intensity of Electricity Generation Methods



Reference: Comparison of Lifecycle Greenhouse Gas Emissions of Various Electricity Generation Sources, World Nuclear Association, 2011)

Generation mixes with low greenhouse gas emissions

Other sectors may prove a lot harder to decarbonise, which places the onus on the electricity sector to lead the way. Electricity may also be used as an alternative energy source in these other sectors.

Transport for example is another major source of greenhouse gas emissions. Electric cars are progressing to be a real alternative to petrol and diesel, but to maximise emissions reductions the additional electricity demand needs to be met by low carbon generation. Electric trains require the same. Those traveling to the Paris climate conference by Eurostar will be taking advantage of France's low carbon generation, primarily from nuclear power plants.

One question sometimes raised is whether all these low carbon generation options are truly low carbon, when the full life cycle of the technology is considered. Nuclear generation, for example, relies on the production of nuclear fuel. Similarly, wind turbines have to be manufactured and then supported by concrete foundations. Large hydro schemes often require flooding of areas of vegetation, which releases methane, a much more powerful greenhouse gas than carbon dioxide. All these activities either may

release greenhouse gases, or require energy which may come from fossil fuel sources. However, many studies show (including our own review of the literature) that the lifecycle emissions for nuclear energy and different forms of renewables, are much less than the emissions arising from burning coal, oil or gas in fossil fuel power plants.

The IPCC notes that "The life cycle GHG emissions per kWh from nuclear power plants are two orders of magnitude lower than those of fossil-fuelled electricity generation and comparable to most renewables".

It is necessary to use all available low carbon energy options to achieve the emissions reductions required to avoid the worst effects of climate change. The International Energy Agency has produced a scenario showing what would be required to limit the average level of global warming to 2 degrees Celsius. By the end of this century fossil fuel generation will need to be all but eliminated, with significant reductions by 2050. Nuclear generation is the largest single source of low carbon electricity in this scenario, with an installed capacity of 930 GWe by 2050, up from around 370 GWe today.

The task for governments is not only to agree emissions targets in Paris this December, but also to enact effective policy measures to ensure those targets will be met. Negotiators need to know that nuclear energy is part of the solution to climate change. ■

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Lower bills and healthier homes

Maria Wardrobe, Director of External Affairs at National Energy Action outlines the importance of tackling fuel poverty in the UK...

Fuel poverty remains a bigger killer across the UK than road accidents, alcohol or drug abuse combined. In our UK Fuel Poverty Monitor 2014-2015 we estimated that in addition to 125,000 needless deaths, over the next 15 years national health services could be forced to spend £22bn treating cold-related morbidity.

Current resources remain less than half of what is required to tackle the problem. The Committee for Climate Change (CCC) estimates that £1.2 – £1.8bn per annum is needed to meet the government's Fuel Poverty Strategy in England. In addition, across the UK as a whole, there are 6 million low income households living in properties which could be fatal, damage living standards or are simply too expensive to heat. The next few months will be of critical importance if we are to help. The UK government must ensure current schemes are better targeted towards those that need the most support; expand energy bill rebates so the poorest working households benefit for help automatically and secure non-departmental capital funds to improve domestic energy efficiency within the upcoming Comprehensive Spending Review.

The latter would ensure energy efficiency activity moved away from being funded solely by energy consumers or one departmental budget to become a joint capital funded initiative supported by other government departments but paid for by current infrastructure budgets. Key to this new approach is recognising domestic energy efficiency investments provide energy capacity cheaper than investment in new generation has done historically. In the process this can create local jobs and significant economic growth, while reducing gas imports and carbon emissions. Currently, despite the benefits, not £1 of the annual c. £25bn UK infrastructure budget has ever been spent on this type of initiative.

The need is great and the funds are available. If we finally get this right, not only can we reduce costs from cold related hospital admissions and stop needless deaths, we can encourage economic growth while making homes warmer and healthier.

With more than 30 years' experience, National Energy Action (NEA) works to increase strategic action against fuel poverty, while improving access to energy efficiency and related programmes. Responding to pressure from the cost of excess winter deaths and treating morbidity, the National Institute for Health and Care Excellence (NICE) recently identified key recommendations for commissioners and health and social care practitioners in providing support to vulnerable people living in cold homes. Having given evidence to the NICE committee, NEA is well placed to help local authorities and the health sector:

- Train staff on the health impacts of fuel poverty;
- Develop and implement affordable warmth strategies;
- Deliver practical installations of energy efficiency;
- Provide localised profiling and fuel poverty mapping;
- Facilitate community engagement and public awareness;
- Review ventilation and other technical building standards. ■

For more information please email: partnerships@nea.org.uk or telephone 0191 2615677 (option 8)

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Why not pre-pay?

We pre-pay for our petrol, we pre-pay for our food and many of us pre-pay for our mobile phones – so why does pre-paying for energy have such a bad rap?

Utilita want to lift the stigma from prepayment energy – the vast majority of the UK population pay for their gas and electricity via direct debit, waiting for a bill every month which arrives after the energy has been used, making it very difficult to see what is being spent until a huge bill has been ‘racked-up’. Maybe this payment method is convenient but it also comes with its fair share of frustrations if the direct debits don’t go to plan.

We believe prepayment will find its place in a new energy-smart country.

Smart metering, as with Internet shopping for retail, has the potential to change the market and customers’ experience of it, particularly in the case of prepayment energy. 13% of people in the UK use prepayment meters to pay for their energy and this number is expected to rise, furthermore a disproportionate number of prepayment meter users are on low incomes.

The first thing we need to destroy is the antiquated view of prepayment meters – if you’re forced to go into a shop to top-up a key, before returning to your home to plug-in and transfer your credit onto your meter (which may often be placed out of easy reach), then you’re with the wrong supplier. The prepayment energy service has evolved, it’s come a long way and it’s time to see its potential and look past its perceived reputation.

As part of a recent Consumer Focus (now Citizens Advice) study on prepayment smart metering in the UK, it was found that many felt there was an information gap related to smart prepayment options: “Technical solutions for smart prepayment are not as common as those for the post-paid sector; therefore, fewer reference models exist that can be drawn upon to help deliver benefit to the customer segment.”*

Installing free, prepayment smart metering systems in the homes of every customer as part of our ‘Smart Energy’ service, we have over the past seven years learned first-hand what this market demographic need, but equally how it could be benefitting a much wider group.

Prepayment smart energy has the potential to address many of the issues that those using a traditional prepayment meter face.

The challenges associated with prepayment and lack of agreed solutions, mean that few suppliers are trialling pre-pay at scale, with the resulting impact that the more challenging pre-pay issues are not being identified or resolutions sufficiently prioritised. Therefore it is anticipated that pre-pay customers, as a customer group, will be the last to benefit from the smart meter rollout.



So what are the benefits?

A competitive prepayment tariff

The bedrock of our service is in offering a competitive tariff and developing user-friendly ways to 'pay-as-you-go'. Specifically tailored to the needs of the prepayment market, we understand that people are being penalised on price when opting for a prepayment energy service over a traditional credit meter. We constantly monitor our rates across the nation to ensure our supply of energy is competitively priced and as low as wholesale and distribution costs will allow.

Control

A 'hands-on' pre-pay service – one that customers can easily understand and use to their advantage. We provide every customer with a free smart meter display allowing them to view their credit balance and usage in real-time; this helps them to budget for their energy at every step.

No more loss of supply

We understand a factor contributing to the stigma around prepayment energy is the fear that customers could lose supply easily compared with a meter

in credit mode. To combat this, we give every customer access to 'Emergency' and 'Friendly Credit', ensuring they do not lose power during evenings, weekends and bank holidays. The last thing we want is a household left without power and have developed an infrastructure to avoid this where possible.

Ease of use

Trekking to the shop with a plug-in key to top-up a prepayment supply is archaic and offers the user little flexibility. We offer convenient payment methods such as online and SMS top-up options which meet the demands of modern life.

Responsive aftercare

We hold extended hours in which customers can reach a knowledgeable Care Team Advisor; we pride ourselves on offering comprehensive aftercare. The 'Big Six' aren't built to cater for this demand, with the infrastructure of larger companies based upon serving credit users alone.

There are over 4.5 million households in the UK on a prepayment supply but the energy market is still dominated by the 'Big Six'. Utilita are pleased to be offering a service tailored to the needs of this market - with over a decade of prepayment experience and over 200,000 prepayment customers, we believe in the future of prepayment energy and the benefits it can, and will, deliver.

*<http://www.consumerfocus.org.uk/files/2013/03/Smart-Metering-Prepayment-in-Great-Britain.pdf> (Consumer Focus now Citizens Advice)



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Maintaining momentum in the North Sea

There is plenty of life left in the North Sea oil and gas industry, insists UK Minister of State for Energy, Andrea Leadsom MP...

The oil and gas industry is an essential part of the Government's plans to provide a secure, reliable energy source to UK homes for decades to come and we are committed to backing it.

I know how important this industry is to the UK. It supports 375,000 jobs, contributes around £35 billion each year to our economy and is essential to our energy security. This year, despite the challenges, there has actually been a rise in the amount of oil being produced from the North Sea. This is why we are determined to do everything we can to revitalise it.

In March, in response to the reduction in global oil prices, we took action to support the industry by cutting tax rates on North Sea oil and gas production, a measure that could be worth £1.3 billion and could boost production by 15 per cent over the next five years. We've also taken forward the rapid implementation of the Wood Review, quickly establishing the Oil and Gas Authority (OGA) so it can maximise the economic recovery of the industry. Now up and running, the OGA is already moving ahead with key projects like the £20 million Government-funded seismic survey to acquire new high-quality data in under-explored areas of the North Sea.

The £3 billion investment in the North Sea by Maersk Oil to develop its Culzean discovery, announced at the end of August, demonstrates that there is plenty of life left in this vital industry. The project will create 6,400 jobs, providing financial security for more hardworking people and their families, and increase our energy security. This is the largest discovery in the UK North Sea for a decade and further discoveries like this in the UK Continental Shelf (UKCS) are possible, though there is no doubt that it's getting tougher.

This investment is a very welcome boost when the



UK Minister of State for Energy, Andrea Leadsom

decline in global oil prices has created many challenges for this critical sector of our economy. It means that the North Sea can continue to compete globally on a level playing field. Many companies across the UK have benefited from Culzean already, and many more will benefit over its lifetime.

There are still plenty of opportunities in the UKCS. Around 42 billion barrels of oil and gas have been produced so far, and some 20 billion more might be produced, so we need to maintain momentum. We will continue to work with the OGA and the industry to ensure that we maximise the potential of the North Sea. I'm confident the sector will remain strong for many years to come. ■

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Andrea Leadsom MP
Minister of State

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Power On Connections – self service is great news for customers

Finally, following years of lobbying, Ofgem has introduced legislative changes that will change the face of Competition in Electricity Connections forever, finally creating a truly competitive and open market that will offer customers improved service and reduced costs.

These changes have the potential to revolutionise the customer experience by allowing Power On to deliver an end to end connection service to customers without any reliance upon the DNO.

Self Service for Power On

The new Competition in Connections Code of Practice was formally approved by Ofgem on 16 July of this year. The objectives of the Code of Practice can be summarised as follows:

Distribution Network Owners (DNO) must, as far as reasonably practicable, minimise their involvement in the provision of new connections by Independent Connection Providers (ICP's) to their customers.

Should an ICP require a service from the DNO to enable it to provide connections for its customer(s) then the DNO must provide the service on an equivalent basis as it would to its own connections business.

Finally, DNOs must work to harmonise their processes and procedures relating to Competition in Connections in line

with industry best practice thereby allowing ICPs to freely and easily operate across DNO boundaries.

Legally enforceable...

The Code of Practice becomes legally enforceable through the new Electricity Distribution Standard License Condition 52 that comes into force on 30 October 15. The license mandates that the DNO must adhere to their Code of Practice which shall be published and maintained through regular review. In addition to the Incentive on Customer Engagement (ICE) that came into place at the beginning of the latest Electricity Distribution Price Control (ED1), the Code of Practice is a further incentive on DNOs to take a more positive and proactive approach towards Competition in Connections.

When Ofgem completed their review of the electricity connections market in 2014, they concluded that the most appropriate way to further develop the market was to remove the DNO from the critical path of their competitors that are offering connection services to their own customers. As a result, the Code of Practice has a strong focus on DNOs empowering their competitors to undertake previously non-contestable activities themselves much like the gas connections market which has successfully operated for the last 10 to 15 years.

Ofgem set out these minimum requirements which have now been

incorporated into the Code of Practice. This means that Power On in future will be able to liaise directly with their perspective customers to obtain all of the necessary information to:

- Undertake the study of the Distribution Network to determine the most appropriate point of connection;
- Complete the design for the network extension and any required reinforcement; and
- Carry out all of the works including the final connection and network reinforcement.

When approving the Code of Practice, Ofgem added an absolute requirement for the DNOs to propose changes to the Code by 15 January 2016 to make the processes for self-determination of point of connections to, and design approval of DNO networks adoptable networks more definitive, following the completion of further process trials and stakeholder consultation by the DNOs.

Power On has built its business on a commitment to, and proven track record of delivering first class customer service in the provision of connections. Our sole focus is to deliver connections in a timely and cost effective manner.

The challenge that now lies ahead is bringing all of this into business as

usual. DNOs must provide Power On the same level of access to their network information as their own equivalent connections business or service providers.

For many DNOs this will require changes to their IT systems and processes. Those who were not ready for the October deadline will be making this information available on CDs and other similar media to ensure that we have the opportunity to hit the ground running so that we can identify our own points of connection.

Many DNOs are still running pilot or proof of concept schemes to ensure the seamless transition to this new way of working. Power on, through its leadership of the Metered Customer Connections Group (MCCG), continue to work alongside its BUUK sister company GTC to lead the way, assisting DNOs to understand the requirements of the detailed processes for Self Determination of Points of Connections, Self-Approval of Designs and Self Connection including the associated operational activities.

Power On has built its business on a commitment to, and proven track record of delivering first class customer service in the provision of connections.

Next Steps...

The first draft of the Code of Practice set out at high level what the DNO must undertake to enable Self Service to take place for ICPs. Changes are required to add some more detail and to address other issues that were excluded from the first version of the Code approved by Ofgem.

These changes will be made through the governance arrangements set out the SLC52 which outlines that any future changes need to be put to the Code of Practice governance 12 member panel comprising an equal split of DNO and Competitor electricity connections market experts.

“Power On has built its business on a commitment to, and proven track record of delivering first class customer service in the provision of connections. Our sole focus is to deliver connections in a timely and cost effective manner.”

Future proposed changes will be tested against the objectives of the Code of Practice. Where a proposed change is shown to have the potential better meet the objectives of the Code, a working group will be established by the Code governance panel to take the proposal forward.

The working group will be tasked with creating a Change Report for presentation to Ofgem for their decision on where or not to direct the DNOs to update the Code of Practice with the proposed changes.

It is anticipated that the early proposals will look to mandate that DNOs provide IDNO customers with emergency response services and the ability to trade unmetered supply inventories under the DNO's MPAN. Such changes will help support the development of IDNO networks; which in itself promotes Competition in Connections as many ICPs construct assets for adoption by IDNOs.

Finally after 15 years since its inception and following the full implementation of the COP can a truly open and competitive market place for new connections being considered as being realised.

This provides the customer with real choice and for Power On the opportunity to continue to be the nationally provide of choice.

We look forward to challenges of providing the additional enhanced services that we have been long fought for.

We believe that having control of the entire process will enhance our service offer and deliver an improved customer service and experience all of which support our mission statement.

“To deliver consistently high quality service to customers to earn their long term loyalty”.

POWER ON
connections

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Realising the CCS Ambition

Judith Shapiro, Policy and Communications Manager at The Carbon Capture and Storage Association (CCSA) asks whether the government will consider CCS in the 2015 Energy Bill...

When this publication last looked at CCS, the new Conservative majority government had just been elected. In the months since this government has been in power, changes have taken place in some industries, whereas in others – things remain the same. For CCS, we are drawing ever closer to the decision point for the projects in the competition – the first key date to watch out for is the 25th of November, when the Chancellor will publish the Spending Review 2015. In this Spending Review, all government spending will be scrutinised, which means the £1bn allocated to the CCS competition could be in danger. So all efforts are focussed on making sure the government retains this £1bn which will be essential to ensuring that both CCS competition projects can be built.

Whilst we wait for the 25th November, it is worth turning our attention to the current Energy Bill 2015, which has just completed its passage through the House of Lords. The main purpose of this Bill is to introduce the primary legislation for the new Oil and Gas Authority (OGA). The OGA was established in 2014 in response to the Wood Review which looked into actions to maximise economic recovery of oil and gas in the UK Continental Shelf. The OGA will essentially be the regulator for onshore and offshore oil and gas operations in the UK – however, what is perhaps less known is that the OGA will also have a regulatory and technical advisory role for CCS. There are obvious synergies between oil and gas and CCS such as the re-use of infrastructure, combining CCS with Enhanced Oil Recovery and using the existing skills and expertise of our world-class oil and gas industry for CCS. However, despite these synergies, the original Energy Bill contained almost nothing on CCS. The Bill has now been through first reading in the Commons, and the government has put forward a

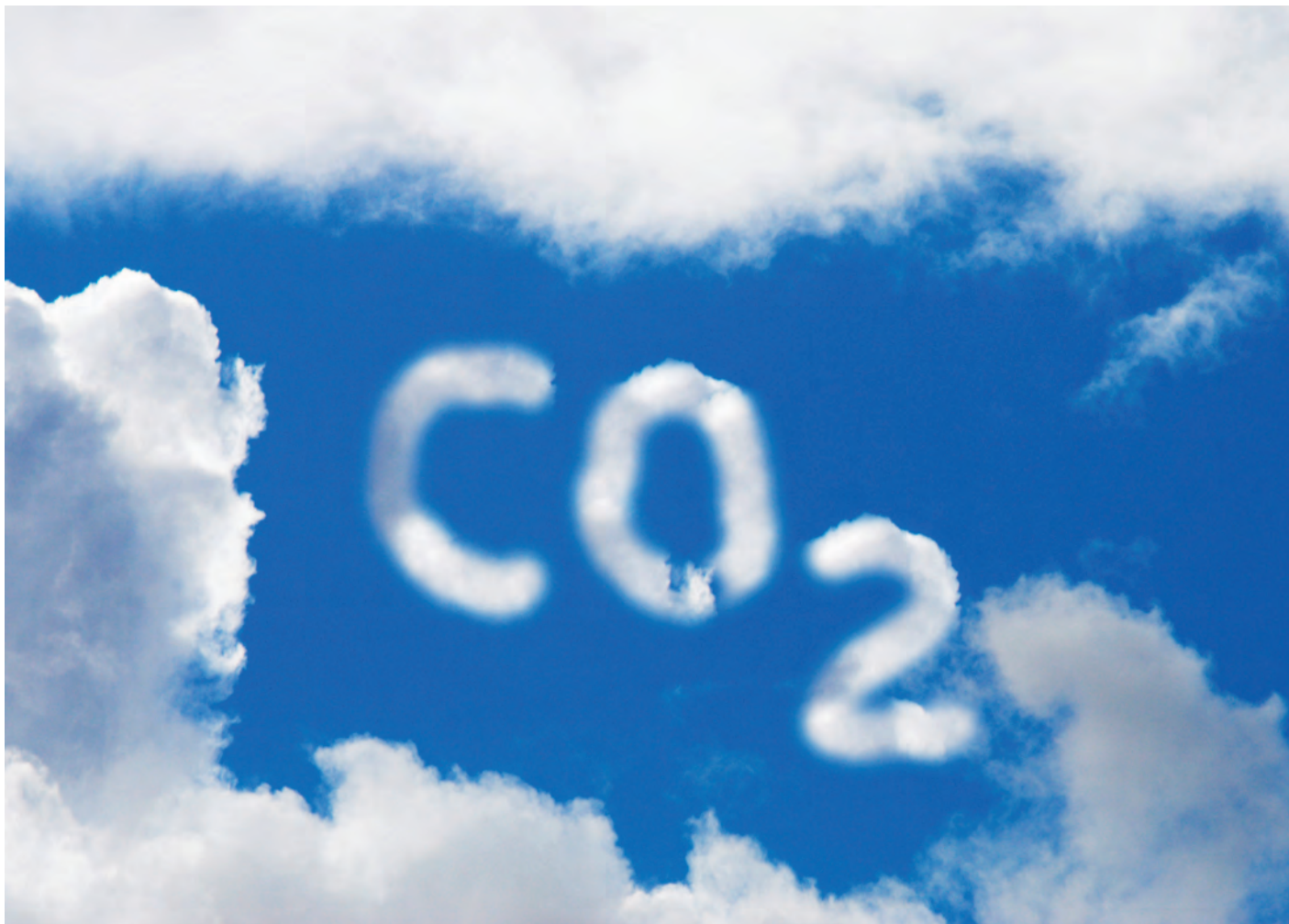
number of positive amendments regarding CCS, and it remains to be seen whether the Commons will develop CCS further within the Bill.

Earlier this year, the CCSA published a report on “Delivering CCS – Essential infrastructure for a competitive, low-carbon economy”¹. In this report, we set out the 3 key actions that would enable the UK government to deliver cost-competitive CCS in the 2020s:

Action 1: It is absolutely critical that the UK delivers 2 projects in the CCS competition – this will lay the foundations for a UK CCS industry and develop essential infrastructure to decarbonise both power and industrial emitters during the 2020s. Failure to deliver 2 projects will seriously damage the development of CCS in the UK, setting the industry back by a decade or more.

Action 2: We urgently need to implement the framework that will enable a second phase of CCS to be developed – in both power and industrial sectors. This second phase will be vital if the UK wishes to have cost-competitive CCS in the 2020s. Importantly, a second phase of CCS must be developed in parallel to the two competition projects – we cannot afford to wait until the first 2 projects have been operating for a few years, as this would mean that second phase projects may not be operational until the back end of the 2020s, preventing the UK from developing a CCS industry at scale by 2030. This would have serious impacts on the ability of the UK to meet its climate change objectives at least cost.

Action 3: To ensure sufficient storage capacity is available to support the deployment of CCS during the 2020s, there is a need for additional funding of



around £100m to bring forward fully appraised and bankable storage sites. Investing in storage appraisal will provide the necessary confidence to power and industrial emitters looking to develop CCS that storage capacity will be available when necessary.

“The Bill has now been through first reading in the Commons and the government has put forward a number of positive amendments regarding CCS, however it remains to be seen whether the Commons will develop CCS further within the Bill.”

It will be interesting to see if and how the UK takes forward these actions. The Energy Bill is due its second reading in the Commons soon, and the onus is now on industry and government to work together to

ensure the Bill can make a meaningful contribution to delivering a thriving CCS industry in the next decade. ■

1 http://www.ccsassociation.org/index.php/download_file/view/918/481/

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Success story on mineral carbonation of CO₂

Pushing academic research towards industrial scale through advanced modelling and piloting

At Aalto University's Department of Energy Technology, Professor Mika Järvinen's Energy Engineering and Environmental Protection research group is conducting pioneering research on biomass combustion, carbon (CO₂) capture and storage (CCS) by mineral carbonation, circulating fluidised bed gasification of waste, and advanced modelling of industrial processes, mainly for energy and metallurgical applications. To foster good industrial collaboration, the group carries out laboratory, pilot and full-scale research to avoid problems in scale-up and provide sustainable and economically feasible solutions for companies.

In 2011 the Aalto University Foundation, together with Abo Akademi University and SSAB (formerly Ruukki) Raahe Works, successfully secured a patent for a technique that produces precipitated calcium carbonate (PCC) from alkaline by-products. This CCS approach aims to reduce CO₂ emissions by using alkaline industrial waste materials and flue gas rich in CO₂ to produce a valuable PCC that is marketable to paper, pharmaceutical or plastics industries, (see the above figure 1). The conventional production of this PCC requires limestone to be mined, transported and subjected to a very energy intensive calcination processes that also emits CO₂. However, by substituting limestone with industrial Ca-rich wastes (e.g. steel slag) our

method reduces waste, saves energy and reduces CO₂ emissions.

Almost 1500 Mt of steel is manufactured globally every year producing 2700 Mt CO₂ corresponding 6.7% of anthropogenic emissions. In addition to the direct and indirect emissions of CO₂, the production of steel also annually generates about 400 Mt of a solid by-product known as slag. Slag is formed from species in pig iron such as Si, Mn, Mg, some Fe and also valuable Cr that are oxidised during steelmaking. One major component in slag formation is CaO that is fed to the top of the slag to remove silicon and sulfur and improve flowability. CaO is produced in the lime kiln by heating the lime stone up to 1100 °C.

There are several different types of slag produced at different stages of the steelmaking process. Basic oxygen steel converter slag is very well suited for a Slag2PCC process as it contains a large amount of free calcium that can be effectively extracted, with annual slag availability being 135 Mt. Steelmaking slag finds applications in road construction as well as the cement industry, however, about 13% is unusable for these purposes and is generally landfilled. Figure 2 presents the simplified principle of our Slag2PCC process implemented to steelmaking.

Steelmaking requires calcium oxide CaO that is produced from CaCO₃. In

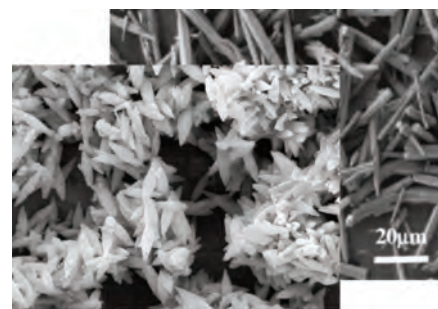


Figure 1

our process, a water solution of an ammonium salt is used to extract calcium from the steelmaking slag. The resulting Ca-rich solution is bubbled with CO₂ gas which reacts to form PCC, precipitated calcium carbonate.

The quality of synthetic PCC generally surpasses that of even the highest quality natural ground PCC as the process can be tailored and controlled to produce a wide variety of PCC products with very high purity and different crystal properties. For this reason PCC can be sold at a higher price. The global consumption of PCC increased from 10 Mt in 2004 to 14 Mt in 2011 and is expected to continue to grow. There are many requirements for the PCC properties including particle size, purity, brightness and crystal morphology, and these vary depending on the application.

Current research challenges and main developments

There could be a significant surplus of PCC available if all steel converter slag production in the world would be utilised by our process. As one exam-

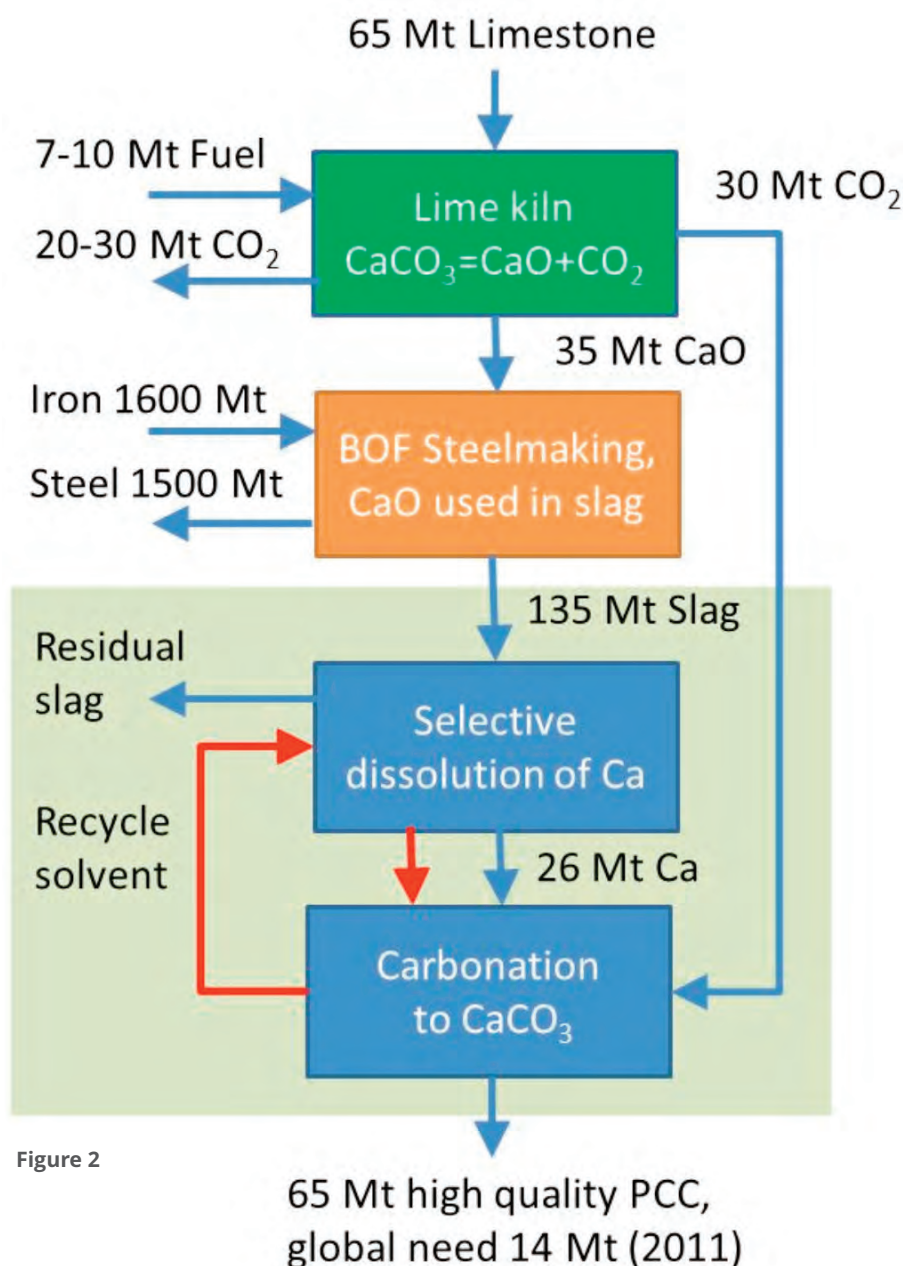


Figure 2

ple, our synthetic PCC could partly replace the limestone used in the production of steel, reducing the need for mining. PCC could be sold at a higher price as a commodity chemical to several other industries. We are also able to bind most CO₂ emissions, 30 Mt, related to calcium treatment in the steel mill. If the lime kiln is heated by biofuels, the process would be mostly CO₂ neutral. The global annual emissions from the blast furnace in

iron making are in the order of 2600 Mt, being far too large for Slag2PCC process to be applicable. The slag from blast furnace is also not suitable for our process and is already mainly used the cement industry. The biggest benefit from our process is in the reduced need of virgin lime stone required for steel converters.

The feasibility of PCC production from steel making slag has been success-

fully demonstrated by our pilot plant, launched in 2014, both on batch and continuous modes. We can successfully produce high quality PCC of rhombohedral calcite and aragonite of various sizes. We have recently published results showing that by applying ultrasonic extraction, extraction efficiency can be significantly increased (Said et al. Enhancement of calcium dissolution from steel slag by ultrasound, Chemical Engineering and Processing 89 (2015) 1–8). We are also currently working on developing alternative PCC products based on the particular advantages of the Slag2PCC process for potential high value niche applications. Recovery of the ammonium salt solvent and effectiveness of the filtering are still critical aspects of the process and how to best achieve this at minimal energy cost is a major challenge.



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A large industrial pipeline, possibly for oil or gas, runs diagonally across the frame from the top left towards the bottom right. The pipeline is covered in a layer of snow. The background shows a snowy landscape with trees and a sunset sky with warm orange and yellow hues. The pipeline is supported by black metal structures.

Fuel the **debate**

Adjacent OIL & GAS is the new quarterly digital publication bringing key intelligence to the international oil and gas industry. As essential reading for senior decision makers, the title places an emphasis on quality content, featuring expert analysis and best practice case studies on projects and developments in the oil and gas sector globally.

We welcome contact from experts interested in making an editorial contribution.

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Engineering a cleaner future for UK fossil fuels

Leadership and clear decisions are needed to drive cleaner energy infrastructure forward, according to the Institution of Mechanical Engineers' Dr Jenifer Baxter...

As we near the UN Climate Change talks in Paris later this month, focus is quite rightly turning to how we reduce the impact of global warming and how the UK will meet its ambitious carbon reduction targets.

Renewables have been hailed by many, particularly by some green NGOs, as the silver-bullet solution, but the reality is that their expense and intermittency mean we cannot meet our targets using current renewables alone.

In terms of the electricity sector, our focus needs to be on winding-down coal-fired power generation and replacing it with lower carbon alternatives such as

gas-fired power, which produces around half the amount of carbon. In the short to medium term, a new 'dash for gas' is the quickest, cheapest and most viable solution to reduce the country's carbon emissions, while meeting the country's energy demands. However it is vital that we reduce the amount of methane emissions from the extraction, storage and transportation of natural gas, ensuring that all greenhouse gas emissions are reduced as far as possible.

Looking further ahead, Carbon Capture and Storage (CCS) could hold much promise, but concerns remain over the affordability of this technology. The £1 billion Government Carbon Capture and Storage (CCS)



reducing carbon emissions. If all new fossil fuel cars were to be solely petrol tomorrow for example, our average carbon emissions would increase by 16%. That cannot be in our interests.

Electric vehicles are also becoming increasingly accessible, with great strides being made to make them more affordable and provide more charging points around the country. However, the ability of our power infrastructure to generate enough electricity to meet demand is critical. The electricity capacity margins are shrinking and the UK's demand is growing across the domestic, commercial and transport sectors. To ensure that the UK can provide security of supply to all users will mean the active use of fossil fuels in the short term as well as additional baseload generation from nuclear, with renewables and energy storage filling the emergency demand gap.

What we need now are clear decisions on large infrastructure projects, combined with leadership in energy policies, which would reduce uncertainty and increase private investments. We need to remove energy infrastructure projects from the political cycle in order to stabilise the sector and create opportunities for skills, investment, innovation and economic growth. ■

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Dr Jenifer Baxter

Head of Energy and Environment

Institution of Mechanical Engineers

www.imeche.org

Commercialisation scheme has been plagued by delays, largely as a result of concerns over costs. We will only be able to properly assess the viability of UK CCS upon the successful delivery of a demonstration project, although with Drax's recent withdrawal from the White Rose coal CCS project, the delivery of any large-scale CCS demonstration project in the UK looks in doubt.

In the transport sector, the Volkswagen crisis has done much damage to the profile of diesel cars. However, while it is vital that a new testing regime that more accurately reflects driver behaviour is introduced quickly, we should not be rushing to scrap these types of cars. Diesel cars make a huge contribution to

Reducing the CBRN risk

Mr Adriaan van der Meer and Tristan Simonart from the Centres of Excellence (CoE) at the European Commission outline the importance of lessening CBRN threats throughout Europe...

“CBRN” stands for chemical, biological, radiological and nuclear (risk mitigation). The origin of these risks can be criminal (proliferation, theft, sabotage and illicit trafficking), accidental (industrial catastrophes, in particular chemical or nuclear, waste treatment and transport) or natural (pandemics but also consequence of natural hazards on CBRN material and facilities).

How important is it to ensure Europe is safe from CBRN risks?

When it relates to security culture and security governance, when one looks at the globalisation of emerging threats, with more than 40 open conflicts in the world, so many destabilised regions and displaced populations, increased biological threats as dramatically evidenced by Ebola crisis, or chemical or radiological contaminations, cross-border trafficking or industrial accidents, time is not for business as usual. CBRN risks in particular are interconnected, complex and ignore frontiers.

The response must therefore be comprehensive and based on a coherent set of actions combining local, regional and international cooperation.

How is the European Commission committed to tackling and reducing the risk of CBRN with an external origin?

On CBRN risk mitigation, as a matter of new international priority, the EU decided in 2010 to launch and fund a new concept called “CBRN Risk Mitigation Centers of Excellence (CoE)”, based on a voluntary, cross border, local ownership and, last but not least, bottom up approach. As of today, 52 partner countries joined the initiative, coordinated around 8 regional secretariats based in Georgia, Jordan, Algeria, Morocco, Kenya, United Arab Emirates, Uzbekistan

and The Philippines. This could not have been achieved without a strong involvement of all partner countries, and all other contributing partners.

What are the CBRN Centres of Excellence, how do they help to minimise risk, and what are their EU added value and uniqueness in the world today?

1. The CoE initiative is a provider of tools and means for increased CBRN governance. It facilitates CBRN governmental officials from partner countries, belonging to all relevant ministries and agencies involved in CBRN governance, to meet regularly at the national level but also twice a year at the regional level. This cross agency cooperation is key to stimulate further networking and has been much appreciated by partner countries.
2. The CoE provides funding for CBRN activities identified and agreed by partner countries during these regional round tables meetings. By implementing these activities, Member States come together and work to create action and provide CBRN governance support. More than 50 CoE projects have been funded in the last 5 years. These activities include a wide variety of formats, such as workshops and trainings, trainers programmes, capacity building or even equipment. Interagency cooperation, team building and support for CBRN administrative reforms are also part of these activities.
3. The CoE provides a funding platform and a sound methodology which are activated only upon request from a partner country – to first assess CBRN needs at the national levels (using NAQs – Needs Assessment Questionnaires with hundreds of supporting questions) and, secondly, to develop CBRN National Action Plans based on the needs assessments. Results are fully



confidential and belong entirely to the country. In the last 2 years, more than 25 partner countries completed their CBRN needs assessments and more than 15 started to develop their own National Action Plan. Some of the first NAPs developed within the initiative were presented this month by their CoE country representatives.

Is there more that will be done to reduce risk?

Yes of course. Beyond funding of new activities, promoting international visibility, political support, local commitment and local ownership are essential. Enhanced coordination between all CBRN stakeholders still needs to be further promoted.

The CBRN Centers of Excellence initiative, although very challenging, has now become mature but still needs to be consolidated, in the respect of the voluntary, local ownership and bottom up approach. This is a clear contribution to build a CBRN security

culture and governance across borders, in closer collaboration with International partners.

The EU will continue to support technically, politically and financially this initiative until at least 2020, as part of its worldwide Instrument contributing to Peace and Stability. ■

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Fighting against CBRNe risks

CBRN threat, which includes Chemical, Biological, Radiological and Nuclear incidents, is a constant concern for which most European countries are preparing. In recent years it has also added the letter "e" to integrate the threat of Explosives, so the acronym CBRN is also called CBRNe. These threats are also known as "Weapons of Mass Destruction" (WMD).

It is in the First World War where it can be said that begins the use of Chemical warfare agents on a large scale, although the use of chemical and biological substances as toxic agents is known since ancient times. Since the battle of Ypres (Belgium), in 1915, where chlorine was used as incapacitating agent for the troops, the whole world is being prepared to detect this threat and best protect it.

Biological warfare is the form of attack in which weapons are used through different microorganisms capable of inflicting devastating damage on people, animals or plants. In 1972, the Convention on Biological and Toxin Weapons Convention, signed by majority of countries, banned the "development, production and accumulation of microbes or their poisonous products except in amounts necessary for peaceful exploration and protection"¹.

Biology has developed enormously in recent years. Biotechnology and genetic engineering can be used to enhance or create biological weapons. By the use of synthetic biology, genetic



Fig. 1: Spanish SIBCRA team at "Regimiento de Defensa NBQ VALENCIA 1" taking a liquid sample

engineering and biotechnology today presents a very real possibility of enhancing the pathogenicity of known microorganisms as well as to revive microorganisms previously eradicated.

Nuclear weapons are considered the paradigm of WMD. The tremendous impact caused by the atomic bombs of uranium and plutonium dropped on the Japanese cities of Hiroshima and Nagasaki during the US attack in 1945 sparked a huge arms race between EEUU and Russia during the Cold War. This degree of danger and tension resulted in numerous treaties, trying to limit their deployment and effects. Foremost among them was the Treaty Partial Nuclear test ban (1963), the Treaty on the Non-Proliferation of Nuclear Weapons (1968), which restricted the availability of nuclear weapons, and the SALT agreements of the 1970s. Nevertheless, today there remain a sufficient nuclear weapons to eliminate all of humanity more than once. However, nowadays

it is considered that the nuclear threat can come in the form of terrorist acts based on homemade bombs with radioactive material of low activity, rather than the use of conventional large-scale nuclear weapons.

The field of Explosives is, unfortunately, the most frequently used in WMD. All too fresh are the memories of the explosive attacks on trains in Madrid (2004), London underground (2005) or bomb attacks in Boston (2013). In addition, car bombs are sadly frequently used in some Middle Eastern countries.

Fortunately, there have been many advances in technology for detection and identification "on site", and especially in remote sensing and early detection of threats, avoiding the possibility of using CBRNe weapons more successfully.

In Chemical defence, although great progress has also been made in the field of "on site" and "stand off" detection and



Fig. 2: Spanish SIBCRA team at “Regimiento de Defensa NBQ VALENCIA 1” searching for radiological sources

protection, remains the challenge of improving the reliability of chemical detectors to avoid false alarms.

In Biological defence, there remains the challenge of developing a “stand off” biological detector, although it is assumed that, given the progress made in recent years, this goal will be soon achieved.

In the Nuclear and Radiological fields, the accuracy in detection of radioactive emission sources and environmental dosimetry has increased considerably. Many countries dispose of highly effective equipment, both portable and fixed in moving vehicles or installed in critical facilities. In the field of explosives, major advances have been made, especially those related to bomb inhibitors for vehicles or fixed in main facilities, as well as improvements on remote sensing systems for explosive identification, like raman, laser or mid-infrared technologies.

Many countries have entrusted CBRNe defence in both civil and military fields, although the Army has usually more operative Units specifically trained in CBRNe.

In Spain, CBRNe Defence is entrusted to Law Enforcement Agencies and Ministry of Defence (Army, UME,

National Police, Civil Guard), and other civilian units, such as Fire Protection and Health Units.

The Ministry of Defence has several well-defined CBRNe Centres:

1. Escuela Militar de Defensa NBQ, located in Madrid, is entrusted with the training of the Armed Forces NBC Defence specialists².

2. Regimiento de Defensa NBQ VALENCIA 1, which has very well-trained operational units able to deploy in national territory or abroad³.

3. Unidad Militar de Emergencias (UME)⁴, joint permanent military force within the Armed Forces, in order to intervene quickly anywhere in the Spanish territory in disaster, serious risk or other public needs.

4. INTA⁵, has at its disposal CBRNe reference laboratories and develops the CBRNe R + D at the CBRNe Department at Instituto Tecnológico La Marañosa (ITM). Spanish CBRNe Department, has participated in numerous projects, funded by national (National Plan for R + D + i) or European entities (EDA, H2020).

At the European Defence Agency (EDA), Spanish CBRNe Department has

participated in many CBRNe EDA related projects, such as TE BIODIM, DATABASE OF BIOLOGICAL AGENTS, BIOTYPE, BIOEDEL, PATCH or QUIXOTE.

Regarding the EU Framework Programme for research and innovation, H2020, CBRNe Department of ITM-INTA has started its participation in Secure Societies 2015 Call, expecting to significantly increase it in the coming years.

In Europe today, it is necessary to join forces between the countries to increase European CBRNe Defence. In this regard, the European Commission is intensifying its efforts to promote joint participation, searching for homogenisation and standardisation of procedures, and fostering interoperability among different CBRNe Units.

We believe that this is the way forward to get a stronger, united and cohesive Europe that addresses this permanent threat effectively.

¹ <http://www.un.org/es/disarmament/wmd/biological/biosec-ondpagebwc.shtml>.

² <http://www.ejercito.mde.es/unidades/Madrid/emdnbq/>

³ <http://www.ejercito.mde.es/unidades/Valencia/rnbq1/>

⁴ <http://www.ume.mde.es/>

⁵ <http://www.inta.es/>



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Cutting to the chase

Antoon Burgers, Program Manager at Holmatro Special Tactics Equipment outlines the advantages of using hydraulics to speed up special tactics operations...

Speed is essential in special tactics operations. You do not want to waste time in getting to your subjects, with the risk of having them destroy evidence, or even escaping. However, SWAT teams and Special Operations Forces these days encounter more and more reinforcements on doors, windows, fences, etc. They find themselves faced with re-bars, padlocks and chains of hardened steel, which cannot be swiftly and easily removed. These materials are not only found when breaching and entering a building, but also when removing objects in the street for security reasons, or when cutting free activists who have chained themselves to an object.

When encountering these obstacles, special tactics teams tend to fall back on conventional tools like grinders, bolt cutters, rams, sledge hammers or hooligan tools, but often not with the desired result. Why? The material is too hard and cannot be broken, it takes too long to open the object or the tools simply make too much noise, warning possible criminals inside. These conventional tools may also endanger the safety of the person that has to be cut loose. You need a tool that is safe and easy to use, can cut through the hardest and toughest materials and offers you the possibility of silent operation.

Hydraulic force

The strength that is required to cut hard and solid materials can be supplied by hydraulics. This technology has been used for years in creating rescue equipment. Now a special materials cutter has been developed for special tactics operations. Because this tool is powered by high pressure hydraulics it can generate a high cutting force (up to 193 kN/19.7 t). Combined with a special blade and jaw design the special materials cutter can cut through extremely tough and hardened material, even up to 60HRC.



Regular cutters can only cut these materials while suffering severe blade damage, if at all. As the blades of the special material cutter are designed with hardened steel inlays they will not damage quickly, but can be easily replaced if needed.

Since the special materials cutter is powered by hydraulics and has a high cutting force it is fast to operate, saving precious time. Another advantage is that it can be used with a hydraulic hand pump, making it suitable for silent operations. The compact design of the special materials cutter allows you to use it in confined spaces. Its adjustable and rotating handle gives you the possibility to cut in various angles when the cutting area is difficult to access.


Ultimately, this special materials cutter allows you to speed up your special tactics operations safely and silently. ■

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Antoon Burgers

Program Manager

Holmatro Special Tactics Equipment

www.holmatro.com/en/special-tactics

A soldier in full tactical gear, including a helmet and night vision goggles, is operating a Holmatro hydraulic tool. The soldier's hands are visible, wearing gloves, and they are holding the tool's handle. The tool is a compact, lightweight device with a hydraulic pump and a cutting head. The background is dark and out of focus, suggesting a night-time or low-light tactical environment.

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spreading distance)

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Tackling our productivity gap requires a shift in thinking

Mark Beatson, Chief Economist at CIPD (the professional body for HR and people development) outlines what needs to be done in order to boost productivity in the UK...

The UK's poor productivity was highlighted by the Chancellor as perhaps the biggest economic problem facing the government during its term of office. In July, the Treasury produced a 15 point plan for tackling the UK's productivity gap. But that's only the start of what will need to be a wide-ranging and sustained campaign across all layers of government if we are to see measurable progress made.

Although it's critical to improving living standards over time, productivity is not a term widely used in day-to-day conversation. We may not always understand 'profit' or 'revenue' in the same way as an accountant does, but we have a pretty good idea what is being measured. When it comes to productivity, the natural definition – output per unit of input – doesn't appear to be widely understood.

Last year, one of CIPD's regular quarterly surveys of employers¹ asked them whether 'productivity' was a term widely used in their business when talking about how to improve performance. Only two thirds said it was and only two thirds – not always the same organisations – said they measured their productivity. We then asked these businesses to describe, in their own words, how they measure productivity. Understanding was mixed, to say the least. Some organisations did talk about measures which looked at value creation per unit of time or labour – such as how many hotel rooms were cleaned in a shift – but many conflated total output or sales with productivity, making no allowance for the time or effort being put into the process. Many talked blandly about KPIs, which is fine if the KPIs make sense in a business context. Some respondents clearly must have wished they had never ticked the box saying they measured productivity, my favourite quote being "I work for a utility company, for goodness' sake."

It's not just businesses either. Health Secretary Jeremy Hunt created a stir at last month's Conservative party conference² when he asked "... are we going to be a country that is prepared to work hard in the way that Asian economies are prepared to work hard, and in the way that Americans are prepared to work hard." Much of the reaction to his remarks centred on the fact that, on average, employees in China and the USA work for more hours each year than British workers do, because of longer working days and less vacation time, with the conclusion being drawn – somewhat lazily – that we can only compete with China and America in the long term if we copy their working hours. Yes, we could become richer as a nation if we work longer each day or each year. But we can also become richer by raising the productivity of each hour worked. This can be done through working harder, or more intensely, although 9 in 10 UK employees already feel their job requires them to work very hard. But the way we will compete long-term with other nations is by working smarter – changing how we work to make the best use of our skills and investing in the technology and systems that give people the tools they need to work more efficiently.

Research published by the CIPD in September³ suggests that some employers lost some of their drive for improvement – for working smarter – during the recession. We found that 21% of UK employers belonged to a group we called 'survivors'. They had been in survival mode for the last few years, focused on the short term, and had struggling to think about, let alone invest in, the long-term. We contrasted them with the 25% of UK employers who we called 'balanced investors'. These had continued to invest in both technology and people throughout and since the recession. Their fortunes could hardly be more different. Many survivors appear stuck in a vicious



circle of falling investment and growth, which means they have fallen further behind over time. In contrast, balanced investors have expanded, creating the opportunities and resources for more investment. Indeed, our research found that differences in what we called 'mind set' were the single biggest factor accounting for productivity differences across employers.

The government's efforts to raise productivity therefore requires a change in mind set in some businesses. This won't be easy. A growing economy helps, as well as access to financial support for investment and training. But it also needs an underlying shift in ambition and an enhanced sense of what is both possible and achievable. This isn't just a question of willpower, of making a different choice. Organisations need both the vision, management and leadership capability to turn vision into reality. It will be a particular challenge for central and local government: our research found that 37% of employers in this sector were survivors and just

2% were balanced investors. How will they improve their productivity if the gains from doing the same with less (and less) start to run out? ■

1 <https://www.cipd.co.uk/publicpolicy/policy-reports/productivity-getting-best-out-of-people.aspx>

2 <http://metro.co.uk/2015/10/06/what-jeremy-hunt-actually-said-about-brits-working-as-hard-as-the-chinese-5423501/>

3 <https://www.cipd.co.uk/publicpolicy/policy-reports/investing-productivity-unlocking-ambition.aspx>

.....
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Winning Support for Continuous Improvement Projects

Your quick step-by-step guide

Gaining support to implement and sustain a continuous improvement program is an oft-voiced concern within organisations. These concerns reflect frustration in both senses of the term – feeling frustrated personally and encountering attitudes that frustrate the effectiveness of the program.

Three sets of skills and methods have shown success in gaining buy-in. They are:

- Using a proven step-by-step process for leading change.
- Recognising and overcoming resistance to change.
- Applying influence principles to engage resistant stakeholders.

Step-by-Step Process for Leading Change

Step 1: Establish a Sense of Urgency – Confronting Reality

People tend to feel comfortable with their current situation and naturally resist change – unless there is a good reason for change. The outcome of Step 1 is, in effect, a compelling business case for change. Why is this change necessary? Articulating that compelling reason – the issues with the current reality that drive an individual, a group or a company to drive others – is a critical first step.

For an individual project, the project charter – approved and supported by key stakeholders – can provide this compelling reason, this urgency. For a

broader initiative, such as implementing an entire Lean Six Sigma (LSS) program, substantial effort might be required to identify major issues holding the organisation back, and thus provide compelling motivation for change.

Step 2: Form a Guiding Coalition – Early Stakeholder Engagement

Implementing change by yourself is not only lonely and frustrating – it is also ineffective. It may be appropriate to combine Steps 1 and 2 to form a guiding coalition that shares your sense of urgency and then brainstorm ways to clearly articulate the “burning platform.”

For an individual project, the team is the obvious coalition – with the addition of a management sponsor or Champion committed to the success of the project. For a LSS program, key stakeholders such as management sponsors or Champions would make a good guiding coalition – especially if the LSS program can be shown to align with achieving their own goals, the organisation’s “must-do’s” going forward. In that sense, the LSS program provides the how for achieving the goals.

Step 3: Define the Vision

Defining the vision for improving a process or developing a new product can be a team-building activity that leads to a vital deliverable: for a smaller-scope project, a compelling



business case for the project; for a larger-scope program, the compelling vision that the stakeholders (the guiding coalition) would share with the larger organisation for how the LSS program aligns with achieving the goals of the organisation.

Team building with the guiding coalition is part of the desired outcome, and the development of the vision should involve the stakeholders so that they feel ownership of that defined vision. The vision could include such concepts as doing things right the first time, dramatically reducing new product development time or ensuring that the voice of the customer (VOC) is heard and heeded.

For a smaller-scope project, the vision can initiate and establish the project charter. For a larger-scope project, an effective set of steps for defining the vision could be:

- The senior manager/executive clearly articulates the burning platform. The stakeholders then brainstorm the issues, starting with the issues from Step 1.

- The stakeholders brainstorm keywords, phrases and terms that seem to capture the direction they would like to take.
- Either the team begins to construct a first-pass vision statement, or a stakeholder or a pair of stakeholders volunteer to work on a first draft of the vision statement for the team to review, amend or replace.
- The team reviews, edits, modifies and finalizes the vision. The vision should be easily remembered, brief, clear and compelling – powerful!

Step 4: Communicate the Vision

If the vision has been polished so that it is brief, clear, compelling and easily remembered, then it has fulfilled the first part of the equation:

Quality x acceptance = effectiveness

This equation explains that the effectiveness of a proposed change within an organisation depends not only on the quality of the change and the preparation for the change, but also on the receptiveness of the organisation to accepting and even embracing the change.

Some key elements required for communicating a vision well include the following¹:

- Simplicity
- Analogies and examples
- A variety of media: meetings, memos, lunches, emails and newsletters. Some of these allow for a two-way communication, which is more powerful than simply talking “at” people and allows messengers to address questions and concerns.
- Repetition
- Leadership by example. Nothing

undercuts a vision like having leaders undercut the message by inconsistent behaviors or snide or counter-message remarks. Even expressions of lukewarm or contingent support undermine the credibility of the message, and subsequently its acceptance. Communicating the vision is a time to show leadership, not hesitancy.

- Addressing of seeming inconsistencies, which otherwise might also undermine the credibility of said vision.

Step 5: Empower Others to Act on the Vision

The term frustration is unusual in that it defines both the symptom and the cause. If people begin to feel frustrated and discouraged, it probably means that something seemingly or actually beyond their control is preventing them – frustrating them – from accomplishing the goals.

The Champion’s role is to help individual project leaders and Lean Six Sigma ‘Belts’ remove roadblocks in their projects.

Step 6: Generate Short-term Wins

Short-term wins help a team in a multitude of ways. They:

- Provide evidence that supports and provides justification for the project or program.
- Deliver a sense of accomplishment.
- Convey helpful feedback for the leadership team.
- Undermine cynics and critics.
- Strengthen support from the managers.
- Help build momentum.

DMAIC (Define, Measure, Analyse, Improve, Control) Lean Six Sigma proj-

ects lend themselves to low-hanging fruit. They find opportunities for quick wins in the Define and Measure phases through process mapping and the identification of non-value-added activities. Beyond that, team-building activities such as brainstorming and fishbone diagramming can achieve visible, if small-scale, success. From small acorns grow...

Steps 7 and 8: Consolidate Gains and Anchor the New Approach in the Culture

People rise to challenges if they trust that:

- Leaders care about the project.
- The team will be supported.
- Individual successes and the full team’s success will be recognized.

People also feel recognised when they are encouraged to share their successes, through presentations to management and elsewhere within their organisations as well as through presentations to other organisations. Media such as staff meetings, newsletters, bulletin boards, posters and banners can be used to recognize people and teams and celebrate success.



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Change management

Why is it difficult to make it part of business as usual?

Change Management is not well understood amongst business leaders plus the skills to perform it do not occur in many businesses as a norm. Sometimes people expect IT solutions to provide the silver bullet to cure this but it does not and ends up transferring the problem from the business to IT.

In many cases resistance to change is under estimated, for example key performance indicators built into the existing systems can be counter-productive to change; businesses do not identify the benefits associated with change and do not monitor whether the change has been implemented and is sustainable.

So how can we change this?
Why should we change this?
 Change is a way of life and the two quotes that underline this:

J F Kennedy said:

"Change is the law of life and that those that look only at the past or the present will miss the future."

Whilst Winston Churchill said:

"To improve is to change, to be perfect is to change often."

So what do we mean by Change Management and who is involved?

This is the transformation of a way a company does business and facilitates

Key features of Change Management



the removal of waste and poor practice. It needs a change of behaviour at all levels from Senior Executives and Departmental Managers, to front line staff.

Why is it so hard?

First of all any change requires a goal and a vision and staff in a business need to be able to see their own benefits as well as the corporate ones

to participate in any change that is required. Change is the movement from the known to the unknown with the resultant fear of it. Change will require clarity and consistency in a person's role, how they will be measured, and decision making skills that they will need. This will identify the gap between their present skills and those required to make the change a success.



So what are the key elements that are required to be understood to make change successful?

The first of these is the development of a vision. There are a number of tools to help companies do this, such as Target Operating Models that enable senior managers to articulate the vision. Done well these define the future state in terms of processes, business rules and job roles; leading to a change agenda covering organisation, roles and processes.

If we get this right then change is not guaranteed to be successful, but it certainly lays the groundwork for it to be.

What are the benefits and what follows on behind a change programme?

A better ability to measure and manage processes, embedding of change skills and the mind-set can ensure that continuous improvement is buried and becomes a part of business as usual.

This avoids the problem that change has not been tackled for such a long time irrespective of many changes in technology, mergers and acquisitions or growth, requiring huge jumps making change painful and quite scary.

A number of quantifiable benefits such as increased business performance, bottom line performance growth and better agility within the market place can be achieved. Increasing the staff contribution by getting them to be enthusiastic about embracing change and moving the business forward. Improving measurements can enable staff to contribute effectively to business performance, they can also potentially reduce external support costs, avoiding handing the change programme to external agencies.

At H3 Partners what we do is provide both the facilitation and mentoring of internal change teams and management teams as well as leaving our customers with the tools, techniques and the

confidence to sustain change going forward. Successful change programmes are fun to be engaged in and leave many of the participants with a real array of new skills and able to make a better contribution to the business.



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“I’ve never been so busy – and yet it not feel busy.” *Chris Evans [Oct. 15] – in Flow*

“Inspiring staff to feel really good about what they’re doing in a given moment? Enabling them to feel so productive and fulfilled that it feels effortless. Having a team that enjoys it so much that they’d probably do it for free (if they didn’t have the bills to pay!). Helping them discover that they’re expert at doing things that others are finding hard to do – yet for them it just come naturally.” *Leadership – in Flow*



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Procurement qualifications: QCF procurement diplomas or exams?

Stefan Thresh, Managing Director of Qube Vocational Development Ltd gives an evaluation of the benefits of procurement vocational qualifications compared with traditional academic forms of study...

The procurement diplomas are competency based qualifications which require learners not only to prove their knowledge and understanding, but also to demonstrate the application of knowledge in the workplace by carrying out the practical activities contained within the units of competence. This is achieved by putting a portfolio together using outputs of the learner's work e.g. tender docs, emails, contract docs, spreadsheets etc. The qualifications are very practical as the learner is expected to demonstrate their procurement skills and their procurement organisation will be effectively benchmarked against the qualifications which represent the latest procurement/supply chain practice. If there are any gaps in systems and procedures, these will be highlighted. These qualifications can also be used as an effective personal development tool i.e. by selecting optional units for activities which may be currently outside the learner's current role with the organisation providing the appropriate opportunities for them to gain the required experience to prove their competency for these units.

Who are these qualifications suitable for?

These work-based qualifications are suitable for procurement/supply chain practitioners at all stages in their career, from trainee buyers to heads of procurement, who wish to prove their competency and demonstrate the application of knowledge and understanding in the workplace instead of perhaps taking knowledge based exams only. These qualifications have the support of major UK employers both in the public and private sector and provide a significant amount of knowledge, understanding and skills development that underpins occupational competence in the procurement and supply chain sector.

How do the QCF Procurement Diplomas compare to exam based qualifications?

The QCF Procurement Diplomas are considered to be much more user-friendly than studying for exams as they facilitate a healthier lifestyle balance as it is about what the learner does in the workplace and they are outcome focussed rather than memorising knowledge which is tested in a written examination.

Qualification Level Comparison Table

Level (QCF)	Level Equivalency	Exam Qualification	Non Exam Qualification
6	Degree	CIPS Professional Diploma in Procurement and Supply	Level 6 Diploma in Procurement (QCF)
5	HND	CIPS Advanced Diploma in Procurement and Supply	Level 5 Diploma in Procurement (QCF)
4	HNC	CIPS Diploma in Procurement and Supply	Level 4 Diploma in Procurement (QCF)
3	A level	CIPS Certificate in Procurement and Supply Operations	Level 3 Diploma in Procurement & Supply (QCF)

Many learners and their employers complain about the difficulties of finding time to attend evening classes at college, attend exam revision courses and the lack of relevance to their current job role or organisation etc.



What about Professional Accreditation?

Levels (NQF) 4 or 5 of the former Supply Chain Management NVQs, together with appropriate experience, used to be accepted for full membership of the Chartered Institute of Procurement and Supply (MCIPS). For over 15 years there has been a competency route to MCIPS available, until now. It is disappointing, therefore, that following a so called mapping exercise to compare their academic qualifications with the QCF Procurement Diplomas, CIPS have decided not to accept these NVQ replacements for membership. Their decision has effectively disenfranchised many procurement practitioners who are unable for various reasons to take their examination route to obtain full membership.

The Chartered Institute of Logistics and Transport (CILT) has confirmed they will accept specific QCF levels for certain grades of membership:

Membership (MILT):

Level 3 or 4 Diploma in Procurement plus 3 years relevant experience.

Level 5 Diploma in Procurement plus 1 year's relevant experience.

Chartered Membership (CMILT):

Levels 5 and 6 Diploma in Procurement plus 5 years experience.

The Institute of Supply Chain Management (IoSCM) will also accept the new QCF Procurement Diplomas for the following grades of membership:

Qualification Title	Membership Grade
Level 4 Diploma in Procurement (QCF)	Associate (ASCM)
Level 5 Diploma in Procurement (QCF)	Professional (PSCM)
Level 6 Diploma in Procurement (QCF)	Expert (ESCM)

The International Institute for Advanced Purchasing & Supply (IIAPS) has confirmed that "after reviewing the comprehensive and extensive materials" submitted to them," someone with the Level 6 Diploma in Procurement (QCF) (assuming they have over 3 years work related experience) will satisfy the IIAPS entry requirements for participation on the International Green Belt in Advanced Purchasing and Supply Programme".

Whilst professional accreditation is desirable it should not be seen as essential as it is the level of qualification achieved that is relevant. A commitment to continuous professional development (CPD) is now the norm for most people contemplating advancement of their career. It is essential, therefore, that both employers and employees alike choose educational pathways that best suit the individual and also the wider training and development objectives of the organisation. For many individuals and employers work based qualifications offer the ideal solution owing to their flexibility and practical nature which not only confirms knowledge and understanding but also the practical application of procurement skills. ■

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Stefan Thresh

Managing Director

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www.qube.uk.com



Becoming a digital services hub

Richard Godfrey, Assistant Director of Digital Peterborough details how Peterborough City Council is addressing key challenges through better use of cloud technology solutions...

As the UK's local authorities continue to battle the ever-present financial, productivity, and modernisation challenges of governing today, many have turned to IT – and cloud computing in particular – as a way to gain an edge. Promising to extend the scale, scope and sophistication of their operations, cloud computing may seem a magic bullet to some, but how many have seen such promised rewards actually materialise?

Peterborough City Council is often heralded as a leading light in digital cities having spent the last 2 years undergoing a dramatic digital evolution – as it shifts everything from HR to customer service into the cloud.

This article will guide you through Peterborough City Council's ongoing journey to implementing a digital services hub, addressing key challenges it set out to solve through smarter use of cloud technology solutions.

A single holistic view

When we started our transformational journey the overarching goal was one of making better connections – of our disparate services, to our community, between issues etc. The council needed a modern streamlined solution which was ready to meet the evolving demands of our communities and allowed us to work as smartly, and efficiently as possible.

To be as responsive as possible, this meant implementing a front-to-back integrated service – where all the products and technologies worked together seamlessly. In an increasingly data-driven world, the service also needed to deliver information in a format which could be cross-matched and used for deep dive analysis.

With the implementation of a core set of cloud applications, including Salesforce, and an XCD HR system, the council now has systems which work

together, giving not only the required front-to-back overview but one that spans left-to-right as well.

For the first time, council employees have been able to see a holistic picture of our services. Three issues that might previously have been viewed and solved in isolation for example, can now be linked to a single underlying factor and solved as one, saving on resources and time. Being able to mine data through the platform is changing the way we deliver services – enabling predictive analysis and early intervention – the ultimate aim is to get so good at spotting the warning signs that people no longer need to come to the council in the first place.

Adding value not fire-fighting

Implementing new systems in the cloud will fundamentally change the way IT works within the council. Having technology systems that update automatically and communicate with each other seamlessly is removing much of the backend fire-fighting and maintenance activity that took up the IT department's time. With such tasks increasingly taken care of, the focus for the team can instead turn to adding value – spending time within departments to help identify and roll out tools to improve their service, or working with the performance team to make sure it is able to best understand and action the captured data. My vision of IT in the council in the future is of it functioning more as a commissioning service, buying in services and acting as advisers to departments rather than having its current executorial role.

Community empowerment

Peterborough has one of the most passionate communities around – something that was a hugely untapped resource until recently. Another goal of our move to the cloud is to find a way to empower local communities, leaning on their strong sense of pride and making it as easy as possible for them to get involved in the day-to-day running of their area.

In the future we hope to push the community's involvement even further – using volunteers perhaps to visit some of our lonely elderly residents. In that way we free up social care to concentrate on those with more immediate needs.

Smarter resourcing through self-service

The final piece of our digital service hub has been the implementation of a central knowledgebase to help with consistent communications and drive more automation and self-service amongst residents.

With approximately 300,000 calls coming in to the council annually from residents, the pressure to manage each enquiry in a timely and consistent manner was rapidly becoming unsustainable.

The Transversal FAQ system now gives our staff access to a vast knowledgebase of information, allowing them to respond to queries quickly and accurately. It has also been integrated into the website, enabling residents to self-serve rather than having to pick up the phone. We've been able to clean up the rest of the website, reducing the number of pages by 75% due to the fact that all the content is being funnelled into the FAQ section.

While the knowledgebase won't stop all calls coming into council, it should ensure our resource is focused more on complex matters, than (day-to-day) questions.

Summary

It has been a long but highly rewarding journey for the council. Despite the various technical challenges along the way, the main stumbling block we've come up against has been the change in mindset needed to go with the new system. Knowing we're leading the way for other authorities has also brought with it some sleepless nights! In the end, the journey continues to be about making the council as efficient as possible – and the process is always evolving. ■

.....
Richard Godfrey

Assistant Director of Digital Peterborough

Peterborough City Council

www.peterborough.gov.uk



ResilienceDirect:

A common information platform
for central and local resilience

OS DATA KEEPS UK CRISIS RESILIENT

Emergency responders need to be ready to deal with crises and disruptive events – ranging from natural disasters to deliberate attacks. Now the emergency response community in the UK have access to a new, fully accredited and secure information-sharing platform called ResilienceDirect™, underpinned by OS location data provided under the Public Sector Mapping Agreement (PSMA).

Cyber Security Top 10

Elaine Munro, BSI's Head of Portfolio Management outlines the cyber security must-dos for business success...

The impact on business for larger organisations, has been well documented in recent times, and a greater understanding of information security has been reached. This is a matter of concern for businesses of all sizes and sectors being targeted by cyber criminals.

The risks to personal data has set off a wave of regulatory compliance with heavier penalties for personal data breaches in the UK. At the same time, there has been increased activity by the Information Commissioners Office (ICO) at a national level, the European Commission is proposing a major reform of EU data protection laws.

What can be done to help businesses to maintain trust, protect their reputations, and improve their bottom line?

Don't be fooled

The first step starts with awareness and not being complacent to the problem, and don't think size can exempt you from a breach, since targeting SME's hackers can gain access to larger companies. Don't leave yourself open and do not assume you are safe.

Know your enemy

Security threats come from a wide range of sources with most data breaches being caused by bad business practices. Poor physical security, lost memory sticks, non-password protected devices, unencrypted laptops and loose talk can contribute to breaches.

Look inwards

All businesses regardless of size must consider the risks to information and understand what they are trying to protect. So, are existing security measures effective? Have controls to mitigate identified risks been determined?

Get an ISMS

After identifying information security risks, the next step is knowing what to do and how to do it. This is where an ISMS or Information Security Management System such as ISO 27001 can help. It provides a framework to help identify and manage information security risks in a cost effective way, putting appropriate controls in place to help reduce the risk of security threats, and help prevent weaknesses in systems from being exploited.

Find your Achilles' Heel

Research has shown that human error is now a leading cause of cyber breaches with trusted insiders playing a key role in many breaches. The most serious breaches are due to multiple failings in people, processes, procedures and technology. ISO 27001 addresses this by requiring organisations to ensure that all relevant personnel have undertaken security awareness training.

Get personal

Encouraging staff to make their personal information security a natural part of their routines, can help businesses to secure corporate information too. Training and awareness activities alert staff of the importance of taking as much care with business information as they would their own personal information. Being vigilant when using devices or carrying paperwork on public transport and avoiding having confidential conversations in public are a couple of ways to protect data.

Be social media savvy

Social media is an inexpensive way of gathering information about people. It enables access to e-mail addresses, telephone numbers, location settings, and details of family and friends, if it is not properly secured. With this information, passwords become



easier to crack as people tend to use things that are easy to remember. ISO 27001 includes controls around password use to ensure they are regularly changed and more difficult to break.

Get to grips with mobile devices

In their haste to adopt new technology and work practices, businesses sometimes overlook the inherent risks and fail to put appropriate security measures in place. Do you allow staff to bring their own devices to work, and access your network? Can you be confident that family members are not also using it? Are you aware of the malicious code being added to free apps downloaded onto mobile devices? If not, you need a policy in place for this. ISO 27001 features controls around authentication for external connections that can help.

Look outwards

Many businesses share sensitive information across and between organisations. If information is shared with a supplier, then the company would be failing in its duty of care if the supplier's handling of that

information was insecure. What information needs to be shared? What safeguards do they have in place to protect confidential data? ISO 27001 features controls around supplier relationships.

Cloud security

Security risks can take a variety of forms, encompassing everything from human error to malicious insiders, data loss or leakage to account or service hijacking. By requiring that, providers of your cloud services are ISO 27001 certified and operating in compliance with the Cloud Security Alliance (CSA) STAR certification requirements, businesses can reassure themselves that their cloud service provider has the appropriate security measures in place to protect customer data. ■

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Elaine Munro

Head of Portfolio Management

BSI Group

www.bsigroup.com



FATTY LIVER DISEASE

AND THE CONSEQUENCES FOR EUROPE

Alterations in our diet over the last decades, combined with a sedentary lifestyle have contributed to the worldwide incidence of overweight and metabolic syndrome, characterised by abdominal obesity, insulin resistance and Type-2 diabetes, hypertonia and dyslipidemia.

This trend is not only observed in industrialised countries in the US and Europe but also gradually now in developed as well as developing countries.

Currently it is believed that approximately 90 million Americans and 40 million Europeans suffer from a fatty liver (also called Non-alcoholic fatty liver disease (NAFLD)).

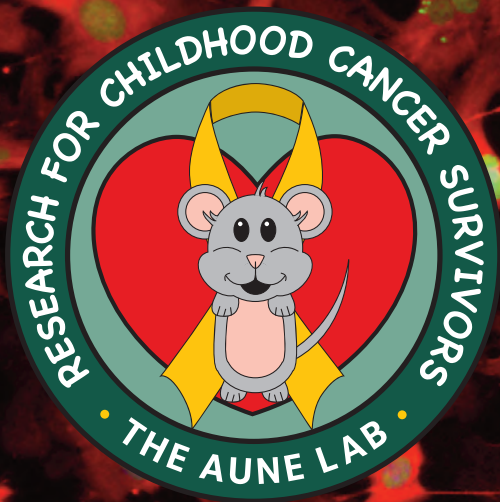


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The Aune Lab: Research for Childhood Cancer Survivors

- In resource-rich countries up to 80% of childhood cancer patients survive longer than 5 years and the numbers of long-term survivors are growing. For example, the United States is expected to have 500,000 long-term survivors of childhood cancer by 2020.
- Long-term survivors are afflicted with numerous health problems caused by their previous therapeutic exposures. A recent study of survivors indicated that the cumulative incidence of death or a life-threatening health condition by age 50 is 50%.
- As modern therapies are made more accessible across the globe, numbers of survivors will rise dramatically.
- Developing preclinical research models to elucidate the mechanisms by which chemotherapy damages normal organs is critical to improving health in the growing population of survivors.
- The Aune Lab is actively developing preclinical mouse models relevant to childhood cancer survivors to understand how chemotherapies damage the heart during early-life exposure.
- Preclinical models can serve as a critical tool to develop a more thorough understanding of how organs such as the heart and vasculature progress through the aging process following early-life exposure to chemotherapy.
- The long-term health problems of childhood cancer survivors will only be solved by combining advocacy to increase awareness and research funding with high quality laboratory research.

More research needs to be conducted which quantifies the cellular responses to chemotherapy in normal tissues. To the left, fibroblasts isolated from murine hearts are grown in tissue cultures, treated with the common chemotherapeutic agent doxorubicin, and then stained for changes in proteins that commonly respond to DNA damage. Systematically identifying the changes induced by chemotherapy in normal organs is critical to understanding how early-life chemotherapy exposure causes late health problems in a majority of childhood cancer survivors.



Increasing global awareness for childhood cancer is critical to decreasing mortality and reducing morbidity. In May 2015, Dr. Gregory J. Aune, MD, PhD spoke at the 68th World Health Assembly in Geneva, Switzerland and called upon the World Health Organization to make a resolution declaring childhood cancer a worldwide problem.

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Making best clinical practices easier to deliver for treatment of anxiety and phobias

