

From byte to bedside: Ushering in the era of digital oncology to outsmart cancer

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21 November 2023

Philip Dunne and Mark Lawler from the Patrick G Johnston Centre for Cancer Research talk to us about the emerging field of ‘digital oncology’ and how their approach can truly optimise cancer research and care

Let’s go digital: Harnessing and sharing data to supercharge cancer control efforts

Researchers at Queen’s University Belfast are spearheading a significant novel approach to address one of human health’s greatest challenges. The emerging field of research known as ‘digital oncology’ has brought together scientists from diverse backgrounds to work together on the global cancer research effort.

Using a combination of computer programming, data analytics, digital pathology, and molecular and cellular biology, our team collaborates closely with colleagues from around the world to achieve our goals. While bioinformatics – the intersection between biology and computer science – is a recognised scientific discipline, this new approach goes much further. Patients’ information derived from cancer treatment centres and clinical trial units is combined with diverse laboratory data, including pathology and genomic analyses.

The idea of a global cancer knowledge network, combining diverse multi-modal data to enhance our understanding of cancer, was first proposed by us back in 2018 ⁽¹⁾ but is now becoming an exciting reality.

Digital oncology: Maximising the value of data

Essentially, we are entering an era increasingly about data, its collection, analysis, interpretation, and deployment. Digital oncology approaches are increasingly enabling teams across Europe and globally to maximise the value of existing information from the diverse data collections that exist but that are all too often siloed and sometimes non-compatible. Instigating a more collaborative culture and combining multi-modal data intelligence has helped deliver new insights into the critical drivers involved in cancer development and progression.

Combining diverse data types has revealed several previously overlooked subtle but distinct patterns in molecular and histological information, reinforcing the importance of using multiple tiers of cancer-relevant information that cannot be captured by individual methods alone. For example, our team have recently identified how multi-modal data, involving many individual layers of information including pathology, genomics, and immunology, can identify 'born to be bad' ⁽²⁾ colorectal lesions, uncovering novel opportunities to therapeutically target otherwise hard-to-treat tumours. ⁽³⁾

This multi-modal approach is now being successfully deployed to identify therapeutic options for cancer driver mutations that were once considered undruggable.⁽⁴⁾

Responding to the data tsunami

In collaboration with a wide range of partners worldwide, this new synergistic effort that we have been developing in Belfast is designed to react to the sheer volume and complexity of data now being produced across cancer treatment and research centres. This tsunami of data has resulted in the generation of massive 'data lakes' that rarely realise their full potential to advance cancer research due to issues of data non-compatibility and the specialised computational skills required for data integration and analysis.

What is different about the digital oncology approach is that it maximises the value of how unique combinations of existing information, which were previously being investigated, essentially in isolation, can provide valuable new insights into cancer biology and pathology, with concomitant implications for cancer diagnosis and treatment.

A new breed: The multi-disciplinary digital oncology team

Crucial to the success of the digital oncology paradigm is the growth, nurturing, and long-term support of a cohort of digitally literate cancer researchers. To help achieve the digital oncology revolution that we feel is necessary to deliver 21st-century cancer care and control, we have assembled teams of early career researchers from diverse backgrounds (including computer programming, digital pathology, immunology, and cancer biology) to develop and apply multiple computational approaches that combine and understand the data and deploy the insights garnered to drive advances in cancer diagnosis and care.

We anticipated that through this data-driven approach, we would generate new understanding by assessing multiple tiers of information about the features and ongoing mechanisms within tumour tissue and the associated clinical outcomes from the patients from whom the tissues were sourced.

The current bottleneck that threatens to put a brake on these exciting digital oncology advancements is the retention of this new wave of highly skilled hybrid researchers who can perform experiments and interpret data across many disciplines. This potential impasse has

arisen due to the contrasting prospects of either staying in academic research, with limitations in funding and short-term contracts or availing of the stability and financial reward of working within the industry sector.

While it has taken us by surprise how much our new data-informed findings are plugging so many outstanding gaps in our understanding of tumour biology, there is a real risk that the new leaders in this field will become disillusioned with the perceived lack of support and reward within an academic environment.

Bytes to Bedside: Empowering the digital oncology revolution

The public has been aware for several years of the ‘bench-to-bedside’ approach in cancer research, where results from the laboratory are translated into patient benefit. A critical requirement of the data-driven approach that we are championing is the need to both secure and maintain public trust in the use of data, particularly health-relevant data. ⁽⁵⁾ Crucially, patients and the public must be co-pilots in this digital journey.

We are now entering a data-driven ‘bytes-to-bedside’ era, where digital oncology will be the driver of new diagnostic tools, novel treatment interventions, enhanced quality of life, and active reintegration back into society. For digital oncology to truly achieve breakthroughs in advancing understanding that will enhance human health, we call on government agencies, policymakers and funders to invest strongly in the next generation of cancer researchers with the appropriate data analytics skill set to deliver on the promise of personalised medicine. Capturing and deploying relevant health intelligence to benefit our citizens is key. Data truly can save lives.

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The Patrick G Johnston Centre for Cancer Research: Relieve the human suffering from cancer

Addressing one of the greatest challenges to human health and well-being, the Patrick G Johnston Centre for Cancer Research at Queen's University Belfast (QUB) is recognised internationally as an impactful research centre committed to relieving the human suffering from cancer.

