Digital innovation in healthcare

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Now is the time for digital innovation, argues Professor Ceire Costelloe at the Institute of Cancer Research, who argues that healthcare is ready to adopt digital transformation

There is currently over £1 billion a year devoted to digital transformation in the NHS. Digital innovation and digitsation of healthcare offer immense opportunities: to improve risk assessment; to speed up diagnoses; and to personalise therapy decisions. Ultimately this will provide better outcomes at reduced costs. The key to realising the potential of digital health is ensuring access to real-time integrated data. The NHS 'move to digital' through the incorporation of electronic patient record systems (EPR) facilitates this translation. Data from EPRs is a vital resource for identifying the need for digital innovation; developing and validating models; and evaluating interventions.

We can use these data to model the risk of disease or deterioration, parameters from these models can then inform the co-design of digital interventions. Working with healthcare stakeholders, interventions can be implemented into practice. Using these integrated data then allows the evaluation of these interventions within real-world clinical settings. This implicitly requires a multi-disciplinary approach including collaboration between healthcare, academia, and industry. Our group leads a programme of work on the early detection of sepsis and the use of EPR for rapid identification in North-West London and nationally.

Can digital innovation help improve the health of sepsis patients?

Sepsis is an international public health problem. Rapid treatment in patients in the early stages of sepsis is associated with improved outcomes and screening for sepsis is widely implemented across countries as an essential approach to facilitate prompt treatment and improve patient outcomes in hospital settings. Digital screening tools have the clear advantage of being able to 'alert' staff to patients who meet eligibility for sepsis screening.

Are hospitals ready for digital innovation?

Whilst GP practices have been using EPRs for many years the same is not true in hospital care. Our survey of NHS Trusts in England suggests that EPR systems have been adopted by 89% of trusts, an increase from 77% in 2018. The introduction of EPR 'paper- less' systems has meant a rapid rise in digital alerts in healthcare, including medication reviews in primary care, DVT assessment, medication clashes and sepsis alerts. Most alerts have shown mixed results. Electronic sepsis screening tools, linked to alerts, have been shown to have low specificity for sepsis and are not always associated with improved patient outcomes. A key factor associated with the effectiveness and specificity of electronic sepsis screening tools and associated alerts is the underlying algorithm used.

Can sepsis alerts improve patient health?

In 2018 we conducted a pilot study to evaluate the impact of the introduction of a digital sepsis alert on patient outcomes associated with sepsis. The alert was embedded within the EPR and was based on a standard algorithm for sepsis detection (the St John's sepsis screening). Our research showed that the introduction of the digital sepsis alert was associated with a reduction in mortality, and an increase in timely treatment with antibiotics. (1) Working with informaticians and clinical stakeholders we were able to access granular EPR data for patients who triggered a sepsis alert and use causal inference approaches, treating the introduction of the alert as a natural experiment. This is the first robust study using EPR data which showed the benefits of digital alerts.

How do we know which alerts to introduce and how?

Our ongoing National Institute of Health Research (NIHR) funded work extends this research to multiple NHS trusts across England and Wales, using different EPR systems, and embedded algorithms for early sepsis detection. We will be able to determine if this variation leads to different clinical outcomes and whether groups of patients benefit equally from digital sepsis interventions. We are investigating the way doctors and nurses use alerts and their attitude towards digital sepsis alerts in the first study to examine the interplay between algorithms, processes, use and attitudes. The key to this research is the sharing of EPR data between Trusts and researchers at separate institutions. The NIHR Health Informatics Collaborative has facilitated this through establishing shared protocols for de-identification of and data sharing agreements.

What's the future for digital alerts?

The nationally recommended guidelines for screening for sepsis and screening tools in common use in English hospitals do not make use of the granular data in electronic patient records; indeed we have found no evidence that 'smart algorithms', machine learning, or AI in the early detection of sepsis, despite many research publications describing the success of prediction models in their data. AI algorithms can be developed which are able to provide personalised recommendations based on individual patient factors and can learn from patient outcomes. EPIC, a major global EPR system has developed the Sepsis Predictive Analysis Model, a proprietary AI-based sepsis prediction model. Whilst AI prediction modes are clearly the vision for the future, a recent publication (2) has demonstrated poor sensitivity and predictive value of the EPIC model, which, has been in use for several years, despite a lack of external validation or evaluation of the AI algorithm in terms of sepsis outcomes. A key challenge for digitisation of health care is how best to validate and evaluate algorithms to ensure that any changes to usual care are effective in improving patient outcomes and do not result in unnecessary treatment, or priorities in healthcare being affected with unintended consequences.

Digital alerts are part of the future – we need to make sure they're safe

After finding the EPIC sepsis alert was associated with poor patient outcomes, Andrew Wong (3) highlighted that 'the ease of integration within the EHR and loose federal regulations' means that hospitals adopt algorithms with ease, without detailed knowledge of real- world performance. This is also the case in England, although the recent MHRA has suggested that software as a medical device should undergo proper scrutiny, 'commensurate with risk.' However, there is not currently a strong methodological library for evaluating digital tools, including determining risk, which is a focus of our research group as we evaluate tools which are currently in use in England.

We are on the brink of a paperless NHS, it is vitally important that we harness the extensive granular data to develop, implement and evaluate the performance of digital tools to support the care of deteriorating patients.

References

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