EDITORIAL

Digital health and prescribing: declare the past, diagnose the present, foretell the future

Jodie A Austin
Clinical informatics director[1]

Michael A Barras
Director of pharmacy[2]
Conjoint associate professor[3]

Clair M Sullivan
Program director[1]
Clinical informatics director and Consultant endocrinologist[4]

[1] Queensland Digital Health Centre, Centre for Health Services Research, Faculty of Medicine, The University of Queensland

[2] Pharmacy Department, Princess Alexandra Hospital

[3] School of Pharmacy, The University of Queensland

[4] Metro North Hospital and Health Service, Department of Health, Queensland Government

Brisbane

Keywords
decision-support systems, electronic health records, health informatics

Aust Prescr 2023;46:46–7
https://doi.org/10.18773/austprescr.2023.015

> 'Declare the past, diagnose the present, foretell the future.'
> —**Hippocrates**

The health system in Australia faces a number of challenges, including a growing and ageing population, increased complexity of care, an ongoing pandemic and limited resources. This makes current modes of healthcare delivery unsustainable. Fortunately, these challenges coincide with the rapid expansion of digital health technologies. Digital health is increasingly recognised as the backbone of optimal health care, opening new and efficient ways to deliver care.

The trajectory of digital health transformation has been described across three conceptual 'horizons'.[1] **Horizon 1** lays the foundations and is achieved when an organisation routinely collects and uses data digitally for every patient at every encounter in real time. **Horizon 2** leverages this real-time patient data to create analytics. **Horizon 3** embeds new models of care into clinical workflows using data and digital technology.[1]

Horizon 1 implements digital systems to collect and use data during routine care. This enables computerised ordering and clinical decision-support systems to guide best practice and facilitate safe and effective medicines management. Examples include computerised guidelines, dose-range checking, and alerts for drug interactions, duplicate therapies and inadvertent rechallenge in patients with allergies. Additionally, clinical decision-support systems can assist in identifying cost-effective medicines.[2] In specific conditions, such as cardiovascular disease, the use of decision support in primary care has enhanced physician prescribing performance, and automated SMS reminders sent to patients have improved drug adherence.[3] In our recent study of anticoagulation, hospital-acquired bleeds were analysed 12 months before and after implementing electronic medical records. The number of patients experiencing a bleed decreased significantly (mean 12.1/month versus 7.8/month, p=0.01).[4]

Despite the benefits, digital systems may introduce new types of medication error. For example, selection errors can be made when prescribers choose from a drop-down menu.[5] System design is critical in ensuring that digital strategies enhance patient safety. Clinical decision support needs to be rationalised to limit the rate of false-positive reminders, which can induce alert fatigue. There are reports that 46.2–96.2% of alerts are overridden.[6] More can be done to improve the design, integration and rationalisation of alerts so important warnings are heeded.

Horizon 2 harnesses the data generated by digitally enabled systems to optimise future decisions. Near real-time clinical analytics can capture process measures, for example task completion and patient care outcomes such as adverse drug events. These data can be aggregated, for example in digital dashboards, offering clinicians high-level succinct summaries, with the ability to 'drill down' to data at an individual patient level. An example is an opioid management dashboard that can be used to promote inpatient safety by monitoring for potential adverse drug events or poor pain management.[7]

While descriptive analytics, analysing historical clinical data, is established in Australian health care, there is growing interest in predictive and prescriptive analytics. Sufficient real-time healthcare data are now being generated to enable exploration of the design and implementation of artificial intelligence and machine-learning algorithms. This shifts quality and safety improvement pathways away from the traditional 'break–fix' model to a 'predict–prevent' approach. While still limited in the number of approved clinical applications, there are promising early results. A prospective study evaluated machine-learning–based clinical decision support for an early warning system for sepsis treatment at 5 US hospitals. The system resulted in a 1.85-hour reduction in the median time from an alert to the first antibiotic order and an 18.7% relative risk reduction in sepsis mortality when clinicians evaluated and confirmed the alert within 3 hours, compared to patients whose clinician did not confirm the alert.[8]

The goal of clinical decision support has never been to replace clinicians' judgement, but to provide timely patient-specific assessments and recommendations at the point of care. Digital transformation will never occur through the development and implementation

This article is peer-reviewed

of a clinical analytics product alone. To truly transform practice, clinical decision support must become embedded into clinical workflows and be accepted by busy clinicians. **Horizon 3** therefore builds on foundational data and analytics to transform clinical practice by integrating data and technology into new and innovative models of care. This transformation of health care will drive where and how health services are delivered.

What is hindering digital transformation in health? On a macro scale, the complexity of Australia's health system with disparate digital health platforms within and across health sectors poses a wicked 'interoperability' issue with no simple solution. This problem is compounded further by the varying stages of digital healthcare evolution across the states and territories. Harnessing the full potential of digital health as an aid to seamless information transfer at the transitions of care is yet to be realised.[9] At an organisational level, both technical and human factors are impeding the uptake of clinical analytics. Human factors include clinician resistance and unintended consequences such as increased cognitive load or bias in the way information is displayed.[10] Technical factors include lack of standardised terminology and system complexity requiring bioinformaticians to extract the data. The 'black box' opaqueness of artificial intelligence and machine-learning algorithms provides additional challenges to their uptake in practice.

Much is being done to overcome the barriers to digital health transformation. The Australian National Digital Health Strategy has been established with a 'Framework for Action' to address system-wide issues.[11] This includes the development of a roadmap for implementation of interoperability standards and establishing a digitally enabled workforce.[11] Partnerships are being established between the health sector generating the data, global technology companies and academic institutes. Collaborative research brings academic enquiry to the data, helping to close the feedback loop. Health privacy challenges must be considered—secure methods for data collection, transfer, storage and access need rigorous enforcement through government policy and regulations. This is easier said than done in the current landscape where the regulation of 'software as a medical device' continues to unfold.

Significant progress has been made in digitising the Australian health system. While many healthcare providers are now well versed in computerised ordering and the clinical decision-support systems offered in primary care and hospital settings, Australia is only on the cusp of harnessing the vast quantities of health data being generated. In striving to reach the third horizon of digital health and beyond, Australia's health system can evolve into a learning health system[12] that integrates data and experience into daily practice to continuously drive improvements. Further integration with other services and research facilities creates opportunities to pioneer new models of care. Health systems will become more permeable with the ability to share data beyond the enterprise structure. Examples include integration with new hardware such as wearables, smart devices, drones and robotics. Prescribers will have the ability to 'foretell the future' as Hippocrates prophesised and make informed decisions based on population data but tailored to meet the individual's needs. <

Conflicts of interest: none declared

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