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Title

The impacts of eHealth upon hospital practice: synthesis of the current literature

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Policy issue

To increase value from health-care expenditures, governments worldwide are increasingly adopting (or planning to adopt) eHealth technologies[1] (e.g. Electronic Medical Records (EMR), Computer Provider Order Entry (CPOE), ePrescribing, and Computerised Decision Support Systems (CDSS)). The US government devoted $34 billion to this effort,[2] and as a result, over 75% of US hospitals have now implemented EMRs.[3] Alternatively, the UK National Health Service suspended their digitization efforts in 2011 after spending approximately £12 billion, but in 2016 dedicated a further £4.2 billion to digitise healthcare.[4] The Queensland Government has budgeted $1.26 billion in an ambitious attempt to digitally transform the state's public hospitals[5] and similar initiatives have also been undertaken by other Australian

states.[6] Investing in eHealth is largely viewed as a means for the healthcare industry to improve financial and clinical outcomes. However, some of these outcomes are yet to be fully realised[7] and effects of digitisation reported in the literature are often conflicting.

While many US hospitals have implemented eHealth technologies, their early experiences are not necessarily generalizable to today's environments because digital systems are rapidly evolving. Because of this, and the heterogeneity of effects reported in past literature, it is important to provide up-to-date assessments of the currently available evidence. The aim of this brief is to provide, for policy-makers, an analysis of current literature relating to the effects to be expected from hospital implementation of eHealth technologies.[2]

What does the evidence say?

An integrated eHealth solution consists of a central EMR that is seamlessly connected to a range of auxiliary systems (e.g. CPOE, CDSS, ePrescribing, etc.). In this brief, we focus on EMR, CPOE, CDSS, and ePrescribing, which are defined below:

- EMR system: "longitudinal collection of patient-centric health care information"[8] used to store, retrieve, and transmit clinical data[2]
- CPOE system: "used by clinicians to enter, modify, review, and communicate orders and return results for laboratory tests, radiological images, and referrals"[8]
- ePrescribing system: "used by clinicians to enter, modify, review, and communicate medication prescriptions"[8]
- CDSS: "clinical information systems that integrate clinical and demographic patient information to provide support for decision making by clinicians"[8]

To provide an up-to-date assessment on the impacts to be expected from eHealth technologies, we extended a previous review of systematic reviews of eHealth impacts[2] that were published between 2010 and 2015. This updated review analysed literature published in 2016 and 2017. We provide a summary of the impacts of eHealth systems reported in literature between 2010 and 2017.

Summary of Impacts experienced by each system:

EMR:

The primary studies in the reviews consistently report that EMRs are more legible and accessible than previous paper-records.[8] However, completeness and integrity of information was compromised due to inappropriate workarounds,[9] which resulted from resistance to changing work practices.[10] Despite this, some studies found the increased availability of information enhanced decision making, which in turn improved patient outcomes,[11] while others reported conflicting findings.[9] Mixed findings were also reported for communication between clinicians and patients,[11] with some highlighting patients' concerns about data security hindered communication.[9] Negative impacts for clinician performance[9] and staff retention[9] were also observed. Overall, the impacts of EMRs are largely mixed.

CPOE:

From 2010-2017 only four reviews examined the impacts of CPOE. Positive impacts were reported for cost savings, individual performance, organizational efficiency, and resource utilisation.[8] Mixed results for communication were apparent, with one study

reporting that CPOE improved proactive communication[9] and another reporting that it resulted in miscommunication.[10] While small time savings were reported, more time was needed to interact with the CPOE than previous paper-based systems.[8] Studies also reported interruptions and inappropriate workarounds.[8] Only one review examined patient outcomes and found no effect.[12]

ePrescribing:

Overall, studies examining the effects of ePrescribing on clinical outcomes yielded mixed results,[9,18] as did studies of cost and time savings.[8] While individual performance was investigated there was no evidence of either a positive or negative impact.[19] However, ePrescribing was consistently associated with improvements in organizational efficiency and safety of prescribing,[8] although communication between clinicians was hindered at times.[10]

CDSS:

Unlike the conflicting impacts reported for EMR, CPOE and ePrescribing, the impacts reported for CDSS were largely consistent throughout the literature. Positive impacts were reported for accessibility,[8] clinical judgement,[14] data integrity,[14] guideline adherence,[15] indicated care,[13] organizational efficiency,[13] patient outcomes,[13-15] resource utilisation[16] and safer prescribing.[15] However, these positive impacts were compromised by the persistence of paper systems[14] and interruptions to workflows.[17] Mixed results were found for clinician performance.[8]

Emerging Impacts:

When comparing the findings of the previous review[2] (2010-2015) to those of the updated review (2016-2017), new findings emerged related to: improved clinical judgement resulting from CDSS which enhanced clinicians' critical thinking skills;[14] unintended consequences of both CDSS and EMR which impacted negatively on changing practice;[10] and decreased staff retention with EMR.[9]

What is the quality of the evidence available?

The quality of currently available evidence is limited, with the majority of reviews being of medium to low quality. This signifies the need for more rigorous systematic reviews to be conducted.

The evidence reported in the systematic reviews was primarily gathered from US hospitals which is not surprising given the sustained focus on hospital digitisation in the US in recent decades compared to other countries. However, each healthcare setting is vastly different and failure to recognise contextual factors that affect successful eHealth implementation can lead to disastrous consequences. The failed eHealth implementation in the UK has been attributed to adopting packaged EMRs that were developed for the US environment.[20] Therefore, while research on eHealth primarily conducted in the US can provide useful insights, it would be unwise to generalise the reported impacts to the Australian context. For this reason, more research on the impacts of eHealth technologies experienced in an Australian context is an urgent priority.

Given the mixed results of eHealth effects reported here, more analysis is needed to better understand why some hospitals experience more positive impacts than others. For instance, are these positive impacts a result of (i) the type (teaching and referral status), casemix, service profile and staffing of the hospital or (ii) governance

structures, strategies, policies or procedures being implemented to promote the effective use of eHealth systems.

Understanding the value that hospitals can attain from eHealth technologies is a challenging task for researchers. As these technologies are becoming increasingly integrated in a seamless manner across different practice settings, it is increasingly difficult to determine the performance of individual technologies and identify where improvements are required.

What does this mean for policymakers?

On aggregate, the evidence implies three issues for policy makers:

1. Implications from evidence of wide-ranging impacts:
The studies show significant impacts from eHealth technologies on different stakeholders (patients, clinicians, hospitals, and health services) and of different outcomes (efficiency, effectiveness, short-term, long-term). This implies the need for policy makers to adopt a comprehensive perspective when assessing success of eHealth implementations and consider both quantitative and qualitative data. Policy-makers also need to take a very inclusive approach when detailing expectations regarding the future success of proposed implementations.

2. Implications from evidence of emerging impacts:
The studies reveal new evidence about specific impacts that have emerged over time (e.g. clinical judgement, changing practices, staff movements). Given that transformation of hospital practice is ongoing and inherently unpredictable, policy-makers need to keep policies open and flexible enough to allow for innovation and which encourage stakeholders to act on opportunities as they emerge rather than being constrained by pre-existing expectations.

3. Implications from evidence of uncertain impacts:
The studies show that success from eHealth is not guaranteed, as implementations vary widely in terms of positive and/or negative outcomes. This suggests that rather than simply supporting eHealth projects per se, policy makers need to identify and support the drivers of successful outcomes. It is not currently clear which particular drivers are most critical, and resolving this uncertainty constitutes a pressing research need.

Synthesis
The wide-ranging, emergent, and uncertain nature of eHealth impacts implies that policy-makers and hospital administrators are unlikely to succeed with eHealth initiatives if they assume that the sole aim is to achieve pre-conceived organisational goals and metrics. Rather, they should consider eHealth implementations to be an opportunity to fundamentally rethink what it means to be a high value hospital and redefine the metrics used to assess their performance. This approach will motivate all stakeholders to leverage new opportunities as they emerge and allow governments to reap the transformational benefits that these technologies have the potential to confer on patient care.

Key Readings

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