Improving healthcare with information technology

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As healthcare costs escalate and the public maintains high expectations about health service delivery, the sustainability of our current public system has become untenable. In 2010, health expenditures comprised 11.7% of Canada's GDP and 192 billion dollars were spent on healthcare.[1] Furthermore, Canada's oft-cited aging population—which consumes 44% of all healthcare dollars—continues to grow. In 2005, 13% of Canadians were age 65 or older; by 2036, that figure is expected to reach 24.5%.[2] As policymakers struggle with broad healthcare reform, they are asking hard questions about the marginal returns of further spending on sickness care. For their part, clinical managers and clinician-leaders are working to reorganize the delivery of health services, promote evidence-guided decision-making, and create a culture of inter-professional collaboration and quality improvement.

There is increasing pressure to promote cost-efficiencies in the healthcare system, and health information technology (IT) has enormous potential in that regard. Evidence suggests that such innovations can enhance the efficiency, cost effectiveness, quality, and safety of healthcare delivery.[3] And as the face of health human resources changes, with the adoption of collaborative multi-disciplinary models of care, sharing of health information between providers is all the more crucial.

As of March 2010, an electronic health record is available for 22% of all Canadians, and by early 2011, that proportion is predicted to reach 50%.[4] Canada Health Infoway is an organization charged with managing the development, and promoting the adoption of, electronic health record systems in Canada; its goal is for all Canadians to have an electronic health record by the year 2016. When we compare ourselves to peers in other nations, it is clear that we are not keeping pace. In 2006, Canada ranked last among seven countries based on the use of health IT by primary care physicians.[5] According to a survey of almost 1500 Canadian physicians, only 37% use health information technology. The statistic for our hospitals is more optimistic: approximately 65% have at least one e-health component.[4]

What makes this task so daunting? The complexity of health information technology lies in the amount of data, the sensitivity (and need for privacy) of data, and the high stakes in ensuring the accuracy of data. Banking is an industry with similar information technology needs; according to data from 2004, US financial services spend 5.4% of their total budget on information technology. It is therefore no surprise that we have a long way to go: the average for Canadian healthcare IT spending was only estimated at 1.5-2.0%.[6] In this review article, we will discuss both the potential benefits and challenges to widespread health IT implementation, as well as provide recommendations and future directions for the field.

BENEFITS OF HEALTH IT

Health information technology can deliver a wide range of benefits, including system-level efficiencies (reduced costs and increased productivity), better delivery of care, improved patient safety, more effective communication between providers, and increased access to information. While we have categorized benefits for the sake of discussion in this article, we recognize that these benefits are not truly discrete, and are actually inter-related; for example, when providers communicate more effectively, the resulting decrease in ambiguity leads to improved patient safety, and ultimately, a cost-efficiency through dollars saved treating an adverse event.

Enhanced productivity and long-term cost savings: From an efficiency perspective, upgrades to healthcare IT can help minimize wasted time and resources in a clinical setting. For example, the elimination of paper charts increases the amount of physical space that can be used for patient care. Furthermore, computerization of medical records leads to reduced storage and transcription costs. After a period of training and adjustment, electronic documentation of clinical encounters would be more rapid than handwritten documentation in a paper chart; as such, the amount of time that clinicians spend on administrative tasks is reduced, freeing up valuable time for productive clinical care. A single electronic patient record can result in smoother hand-offs and tighter connections between health providers along the continuum of care, leading to an overall more efficient care process. Furthermore, health information technology can be used to optimize the scheduling of procedures and diagnostic tests, reducing overbooking and bottlenecks, thus allocating resources more accurately.[7]

The costs of implementing a health information strategy are high. However, evidence suggests that the payoff can be equally impressive. In Canada, for example, the estimated productivity gains and savings from a fully implemented electronic health record are estimated at $6 billion.[4] There is a growing body of literature that presents detailed cost-benefit analyses of health IT implementation. One study[8] used US data to demonstrate potential net efficiency and safety savings of $81 billion each year, after widespread and effective e-health adoption. These gains in efficiency will ideally lead to the transfer of labour to more productive activities. The authors analyzed other industries for productivity gains as a result of widespread IT implementation, and estimated potential gains for healthcare between 1.5 and 4%.

Another paper[9] assessed the value of a fully standardized and interoperable nationwide health IT system in the US. Despite the high cost associated with this ambitious task (estimated ten-year rollout costs of $276 billion), the authors projected a net value of $77.8 billion annually after implementation is complete. A third study[10] performed a cost-benefit analysis of an ambulatory care

electronic medical record system, and estimated the net benefit for a 5-year period at $86,400 US per provider. Financial benefits were largely realized from savings in drug and radiology expenditures, and improvements in reimbursement (reduced billing errors and, accordingly, better capture of charges).

Enhancing the delivery of safe, high-quality patient care: The Canadian Adverse Events Study tabulated 70,000 adverse events that occur in our hospitals each year, resulting in as many as 23,000 deaths.[11] British Columbia has implemented a drug information system (DIS), with great success: if these results are used to make projections for all of Canada, we can expect an electronic DIS to reduce inappropriate prescriptions by 55 million, and to identify 20 million drug interactions.[4] This positive impact on patient safety can also translate into cost-savings. In one study, adverse drug events were associated with an increase in costs of $2,262, primarily due to a 1.9-day increase in length of stay.[12] Data cited in another report[7] suggest that drug-related events cost the average 200-bed hospital between $1.6 million and $3 million a year.

The potential for health information technology to reduce errors is three-fold: by preventing the errors upfront, by alerting clinicians and allowing a more rapid correction of the error, and by reporting and generating feedback about the adverse event.[13] In a controlled trial evaluating the effect of computerized medication order entry by physicians, the investigators found a 55 percent reduction in serious medication errors; a follow-up study later evaluated the addition of enhanced levels of clinical decision support to the electronic application, and noted an 83 percent reduction in the overall medication error rate.[14] A fundamental advantage to electronic health records is the elimination of issues that plague written documentation, such as illegible handwriting and incomplete medication orders. Communication breakdowns, most notably during poor "handoffs" between clinical team members, are another common risk factor for adverse events.[13] Health IT can facilitate effective communication among providers, particularly with the use of hand-held wireless devices with access to the electronic patient chart.

The capacity for electronic information systems to facilitate effective clinical decision-making is increasingly being recognized. Order entry systems can limit dosage or route of administration for potentially unsafe medications; for example, in patients with renal dysfunction, computerized calculations of safe drug dosages are particularly beneficial.[13] IT can specifically improve patient monitoring. For example, IT systems can alert clinicians to potentially serious lab abnormalities that may otherwise be overlooked, and promote earlier correction: in one trial, this strategy decreased the duration of dangerous patient conditions by 29 percent.[15] In a related approach, technology-enabled remote monitoring of intensive care lead to a reduction in mortality of up to 68 percent, and a reduction in average length of stay and associated costs of about 33 percent.[16] Finally, health information technology can increase linkage to clinical references and best practice recommendations, allowing clinicians to make evidence-informed decisions.

Increased access to information: Increasing access to information leads to myriad benefits, at the level of patients, providers, and the health system alike. Many of these benefits have already been realized by provincial initiatives.[17] Firstly, providers can develop a common understanding of patient conditions, leading to more seamless care for patients. For example, ONE Mail is an email server that allows for transfer of patient medical records back to the family physician upon discharge from a hospital. Currently, 55,000 Ontario healthcare workers have ONE Mail accounts.[17] Secondly, health information technology can also facilitate communication and collaboration between providers, which is particularly relevant to the enhancement of rural healthcare delivery. One example, Telestroke,

is an emergency telemedicine application that uses two-way communication and digital imaging to connect local physicians with remote neurologists located at large urban centers, to obtain urgent diagnosis and treatment recommendations about their stroke patients. Thus far, 1200 patients have received urgent care that saved their lives.[17] Thirdly, when health information is shared, redundancy and the need for duplicate testing are decreased; this is beneficial to patients, who will no longer have to undergo unnecessary repetition of tests, and as a system-wide cost-efficiency since additional expensive tests can be avoided. A local success story in this arena, the South Western Ontario Digital Imaging Network (SWODIN) provides regional healthcare providers electronic access to a patient's medical imaging results, when taken at any hospital in the network.[17]

Beyond these local success stories, there are other intriguing potential outcomes of increased access to health information. In one scenario, where patients are to receive access to their electronic health record, they could use this information to manage their chronic conditions on a day-to-day basis, identify risk factors, and for self-care. One important benefit that can be felt on both a system- and patient-level is reduced wait times. The use of health IT to co-ordinate and manage wait lists, and to make wait time information accessible to the public in real time, is well documented. In the UK, for example, their national health system reports wait times data that is less than one month old.[18] As such, patients can make an informed decision about where to go for care. A related benefit of health IT is the wealth of data that are made readily available; this is useful both for reporting of health status to the provincial government, and for reporting of performance indicators (e.g. length of stay and mortality rates) to increase hospital accountability.

BARRIERS TO SUCCESS

One review[3] provided a succinct classification of four types of barriers to the implementation of health information technology. Situational barriers include time and financial concerns; cognitive and/or physical barriers include physical disabilities and insufficient computer skills; liability barriers include concerns about confidentiality; and knowledge and attitudinal barriers include apprehension about change or lack of awareness of potential benefits.

With respect to financial concerns, it is no surprise that widespread health information technology implementation comes with a hefty price tag. The costs of implementation include software and hardware, training, workflow process redesign, historical paper chart abstracting, and ongoing maintenance and support. There are also indirect costs as a result of the transition from a paper to electronic system, such as the temporary decrease in provider productivity after implementation, as they adjust to a new system.[10] The creation of an electronic health record for all Canadians is projected to cost $10 billion.[4] In Ontario alone, the estimated total cost of a three-year e-health strategy—which focuses on diabetes management, medications, and wait times—is over $2 billion.[19] Compounding this high cost is the fact that the presumed financial payoff is delayed: one review including 82 studies with cost-benefit analyses showed the time to break-even on health IT investment was between 3 and 13 years.[3] In some cases, the financial payoff may also be uncertain—particularly for physicians operating in a small group or solo practice, where the return on investment is less substantial, and there is no formal organizational support for training and restructuring.[20] Moreover, the task of performing a cost-benefit analysis can itself pose difficulties, given the challenge of assigning dollar values to productivity gains or improvements in patient care.

With respect to attitudinal barriers, Poon et al[21] noted the perception that health information technology could have a negative impact on clinical processes. This speaks to the fact that technology cannot be applied to a clinical area without careful workflow analyses; where necessary, updated protocols should be implemented

that are in sync with the new technology. The authors[21] also noted that product and vendor immaturity was a barrier; many current software offerings were not compatible with hospital needs, and various modifications were necessary to accommodate the hospital's current workflow.

Hersh[22] reported that system and data interoperability was a major concern, noting the "information silos" pervasive in managing healthcare data. Further to this, smaller, pilot projects are often more affordable, and thus, desirable from a management perspective; this becomes a problem when a health system has multiple incompatible electronic medical records, and an expensive standardization process must be undertaken. Hersh[22] also identified the need for a workforce trained sufficiently in clinical informatics to roll-out such a complex implementation process. A related cognitive barrier is the lack of IT knowledge and training in health professional education; this can certainly impede front-line clinicians' acceptance of technological trends in their workplace.

CONCLUSIONS

Recommendations: An electronic health information system has a large impact on the day-to-day work of both clinicians and hospital administrators. As such, there is a clear need to engage, and ensure buy-in from, these stakeholders early in the decision process.[7] Health professionals in particular should be consulted in order to select and build an electronic system that is compatible with clinical needs and patient flow. One approach is to designate key physicians as "champions" of the process, who can then help motivate other clinicians and administrators, and promote acceptance and adoption of the IT system.[7] Often times, there is resistance among front-line staff when a change is seen as coming from administrators who are not familiar with clinical processes; if the process is supported by a respected clinical colleague, however, other clinicians tend to be less wary. It is also important not to underestimate the scale of such an implementation process. The process may include modifications to the software architecture and the establishment of new standards of care or changed medical practices. Change management itself requires resources and time; for example, in one Canadian hospital system, approximately 30 percent of the total project budget was allocated to this stage.[7] Another approach is to implement an information technology system in a succession of phased pilots; the project team can identify lessons learned and apply them to subsequent rollouts. If pilots are successful, other clinical areas will be eager to undergo the same change. Increasing education and awareness about the benefits of health information technology will boost acceptance of change on the part of the general public and health providers alike. Data elucidating these benefits are required for such endeavours; clinical settings where IT systems have been implemented should be encouraged to collect, analyze and publish data on the results. Finally, having diverse applications and software platforms increases complexity, raises costs, and lengthens implementation timeframes.[7] As such, at a time of rapid adoption of health IT, it is crucial to implement a simple, unified system. It will be important to maintain an integrated e-Health Ontario strategy to facilitate this.

The path ahead: Health information technology has created endless opportunities and has enormous potential to transform the delivery of healthcare. The possibilities even surpass the biomedical model: an electronic health record has the capacity to link clinical data to indicators of socioeconomic status, allowing a remarkable understanding of the impact of social determinants of health. However, this changing landscape has also challenged us with important questions.[18] Who will have access to this wealth of information? Will patients be able to view their own electronic record? If data are anonymized, are they then ethical for government reporting and public use? Will health information technology be used

to increase transparency, by providing outcomes data to the general public? Will clinicians feel comfortable operating in such a system, where their post-operative mortality rate is widely published? And perhaps most importantly, will the myriad stakeholders embrace the opportunity to collaborate and use information for the advancement of health? We look forward to learning the answers to such questions, and hope that innovations in health information technology will be embraced across Canada.

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