

Cumulative Benefits of Digital Health Investments in Canada

Calculating quality, access and productivity benefits on a national scale

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Abstract— Capturing the benefits generated from investments in digital health is key towards demonstrating accountability to funders as well as to encouraging widespread adoption by clinicians and other health care professionals. The cumulative benefits calculation, developed by Canada Health Infoway, is a macro-level indicator trended over a period of 10 years. It represents estimated benefits accruing to various health care system stakeholders, as driven by component technologies and their associated adoption across the country. In-depth studies, validated by external experts in relevant fields, have been completed for specific technologies, such as diagnostic imaging systems, ambulatory care Electronic Medical Records (EMR), and telehealth. The financially quantifiable aspects of each study are aggregated, trended over time, and indexed to inflation. From 2007 to 2015 benefits accrued to the Canadian health care system exceeded \$16B.

Keywords—*electronic health record (EHR); adoption; digital health; benefits; telehealth; electronic medical record (EMR).*

I. INTRODUCTION

Efforts to build an interoperable electronic health record (iEHR) have been underway across Canada for many years. While deployment progress and rates of user adoption vary across provinces and territories, the initiative has passed its tipping point and uptake is now increasing rapidly. The potential benefits of the iEHR are substantial – improved quality of care, system efficiencies, improved access to care and use of health data to better manage the health system and facilitate ground-breaking research. An iEHR is a secure, integrated view of a person's medical records from all systems in the network; it provides a comprehensive view of a patient's medical history [1]. Typically, it integrates data from diagnostic imaging systems, laboratory information systems (LIS), as well as drug information systems (DIS), to provide a longitudinal view of a patient's clinical history. As such, it is a similar concept to that of a Health Information Exchange (HIE) [2]. Across Canada, iEHRs are at various stages of implementation and maturity and have evolved according to provincial/territorial strategies and priorities. A growing number of health care professionals in Canada can now access important information about their patients outside of their practice settings through iEHRs [3][4].

The iEHR acts as a complement to point of service systems like electronic medical records (EMR) in physician offices or clinical information systems (CIS) in hospitals. Regular measurement of adoption and maturity for these technologies has made progress easy to follow and manage. For example, in the 2015 Commonwealth Fund Survey, 73% of all family physicians reported they do use electronic records to enter and retrieve clinical notes [5].

In the interest of accountability for the public funds under its management, and optimizing the value accruing from investment of those funds, Canada Health Infoway (Infoway) has developed approaches to evaluate and systematically model the estimated value of outcomes related to select digital health solutions nationally [6]. The cumulative benefits model contains estimates for benefits generated through the use of diagnostic imaging systems, DIS, ambulatory and primary care EMRs, and telehealth.

The rest of this paper is organized as follows. Section II describes the methods used for calculating cumulative benefits. Section III describes the most recent results based on data up to the end of 2015. Section IV addresses the assumptions and limitations of the model. The conclusion, Section V closes the article.

II. METHODS

The cumulative benefits calculation is driven by individual quantitative estimates obtained from pan-Canadian studies commissioned by Infoway for each of the topics mentioned above. The concept of pan-Canadian studies to estimate national value was developed in 2006 to summarize results across diverse data domains, settings, evaluation methods and time periods. The studies aim to generate estimates, which are as comprehensive as possible, validated by experts, and reflecting available evidence. The cumulative benefits cover a subset of digital health solutions, and as such represent a portion of the value from digital health at large. They also provide an assessment of gaps and recommendations for increasing and optimizing the use and spread of technologies in order to increase value over time [6]. Estimates are expressed in Canadian dollars realized on an annual basis and base assumptions to current contexts are applied and documented. Not all outcomes represent direct financial savings, but where possible, a value is expressed

financially to allow comparison of magnitudes. Where the literature does not provide sufficient evidence to quantify the current dollar value of a specific outcome, the value is omitted from quantitative modeling. In instances where a range of estimated benefits is provided, the mid-point value was used as a base estimate. The mid-point estimate for each domain-specific benefit is highlighted in Table 1 and corresponds to the year in which the study was carried out. Simplicity is a core principle of the specification of the quantitative benefits model, with most discrete value estimates derived by multiplying the magnitude of outcome observed per unit x value of outcome x extent of adoption across Canada. Adoption maturity variation (e.g., functionalities used, frequency of use, etc.) is an important driver of value in digital health deployment, so the extent of the adoption used in the model must be matched to the maturity required to achieve the magnitude outcome applied.

Adoption is determined by examining data from surveys of clinicians and patients, usage data from digital health solutions, and operational data sets collected by Infoway’s partners. Specific definitions of adoption are designed to suit distinct kinds of solutions, and trended over time [6]. Adoption is measured differently for each domain or technology. This is both due to the practicality and feasibility of collecting the data and the way in which benefits were initially modelled. For example, telehealth benefits are driven by the number of clinical sessions—defined as consultations involving a clinician and a patient [7] whereas EMR benefits are driven by the number of Canadian physicians who reported using an EMR to document patient information as shown in Figure 1. EMR benefits largely accrue to physicians, and as a result, it is fitting for physician adoption to be a driving factor.

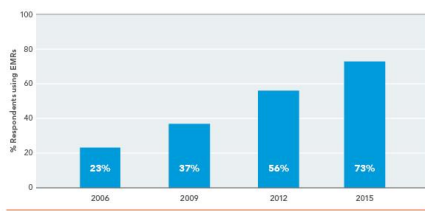


Figure 1. Family physicians in Canada reporting EMR use: Commonwealth Fund Surveys.

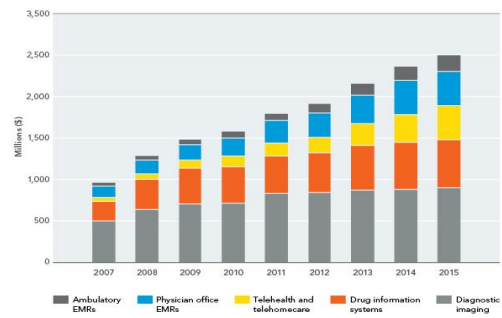
Conversely, telehealth benefits largely accrue to patients and the health care systems that fund patient expenses, such as travel costs. As a result, benefits are driven by patient utilization. Diagnostic imaging benefits are driven by the adoption of picture archiving and communication systems (PACS) by radiologists, physician specialists, and emergency department nurses since they are the professions who would be the most likely to depend on these systems as part of their workflow. While other clinicians and health professionals are likely to benefit, it was preferable to be conservative in the adoption estimate, in line with the organization’s overall reporting principles.

Benefit estimates for previous and subsequent years are dependent on the adoption of each technology by health care professionals in each year as compared to the base years. Each year’s estimate is adjusted for inflation according to the Statistics Canada Consumer Price Index for Health Care [8].

III. RESULTS

Between 2007 and 2015, over \$16 billion in quantifiable benefits have accrued to various parts of the Canadian health care system as shown in Figure 2. These could take the form of productivity gains for clinicians, such as those seen through the introduction of diagnostic imaging systems. Alternatively, they may represent avoided expenses for consumers, such as avoided travel by substituting an in-person visit to an urban centre with a virtual consultation via telehealth. In 2015, the estimated value to the healthcare system exceeded \$2.5B.

Figure 2. Cumulative benefits of investments in digital health across



Canada.

TABLE I. YEARLY BENEFITS BY DOMAIN

	2007	2008	2009	2010	2011	2012	2013	2014	2015
DI	\$511	\$646	\$715	\$724	\$841	\$850	\$878	\$888	\$908
DIS	\$233	\$369	\$436	\$441	\$462	\$487	\$551	\$579	\$593
TH	\$52	\$70	\$95	\$128	\$158	\$187	\$266	\$340	\$407
EMR	\$131	\$162	\$193	\$227	\$270	\$302	\$347	\$414	\$419
AMB-EMR	\$45	\$53	\$59	\$71	\$82	\$106	\$141	\$167	\$196
TOT.	\$973	\$1,300	\$1,498	\$1,590	\$1,812	\$1,932	\$2,183	\$2,387	\$2,523

It is expected that future pan-Canadian studies, examining incremental benefits related to other components of the iEHR such as patient access to health information and/or electronic prescribing will expand the model according to the same overarching methods described above.

IV. ASSUMPTIONS AND LIMITATIONS

While it would be desirable to calculate return on investment (ROI), these benefits accrue to multiple stakeholders and costs are also borne by multiple and sometimes different stakeholders, making these calculations complicated, and best assessed on a stakeholder by stakeholder basis. As an example, productivity gains may increase access but result in additional costs to the health system since more clinical procedures and/or patient visits can be completed with the same inputs. Nonetheless, this is a useful analysis at a macroeconomic level since it can demonstrate the positive effects of investing in digital health.

The pan-Canadian studies completed to date, which drive the cumulative benefits calculation, were completed independently, over a number of years (2008 to 2015). As such, benefits calculated as part of one study, may also be reflected in another. For example, the Generation 2 Drug Information Systems study tracked patient safety benefits related to printing out prescriptions from physician EMRs—this benefit was also included in the EMR pan-Canadian study. These benefits were included only once when aggregating totals in order to eliminate double counting.

V. CONCLUSION

The cumulative benefits calculation has been and continues to be a useful tool for demonstrating the benefits of digital health investments for the purpose of accountability to funders and taxpayers. In addition, it is a useful tool to persuade clinicians and other health care professional to adopt new technologies, and to encourage partners, such as jurisdictions and health care provider organizations to continue to invest in digital health.

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