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Volume 7 - Issue 3, 2007 - Cover Story The New Virtual Radiology Department:Managing a Multisite Network

Canada Health Infoway Programme - How Europe Can Learn

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Canada is currently implementing a national, interoperable Electronic Health Record (EHR) solution supporting seamless sharing of diagnostic imaging results to authorised healthcare providers. Through this programme, Canada will realise significant quality of care and financial benefits, with 95% of its exam volume accessible through the EHR by 2010.This will allow healthcare providers and patients electronic access to a secure and private lifetime health record. Integrating imaging records into an interoperable EHR solution is a key requirement for successful adoption. However, how does one achieve this integration? What clinical and financial benefits can one expect? The Canadian experience offers some insights into these questions.

60% of Canadian healthcare facilities are rurally located and have less than 100 beds. Though these facilities offer diagnostic imaging (DI) services, most do not have radiologists on-site and specialty services are concentrated in regional and tertiary healthcare facilities located in urban centres. Canada performs approximately 40 million radiology procedures per annum, with an expected growth rate of 5% annually. Currently Canada has 1,967 certified radiologists implying an average workload of ~20,000 exams annually per radiologist. With an average age of fifty, many radiologists are expected to retire within the next ten years, placing a significant pressure on the healthcare system.

Also, because physicians do not have ready access to DI records in other facilities, patient referral and transfer often results in repeated DI procedures at an estimated $170M - $480M annually. Thus the motivation for integrating imaging into the EHR is to provide timely report turnaround time and radiologist coverage to 60% of healthcare facilities, balance workloads across regional settings to maximise limited resources, and to eliminate unnecessary repeat procedures and reduce costs.

Challenges in Integrating DI Results

The goal is to share all data seamlessly, so that healthcare providers can access any study, report, key image note and supporting document from any PACS or other clinical systems within five seconds. Achieving these requirements in a cost-effective manner brought a number of challenges.

When Canada embarked on the EHR in 2002, about 35% of DI procedures were captured electronically. It was determined that deploying PACS into every facility would cost about CDN$1B and would require an unattainable level of resources to complete the project within 10 years. Also, as Canada does not have a national person identifier, every hospital and healthcare facility uses a different patient numbering scheme.

Another challenge is to facilitate access to all DI results available for a patient. Canada has many RIS and PACS from a multitude of vendors. Performance aside, there is no common standard for clinical systems to query a RIS or PACS. DICOM is a clear candidate, but only PACS are DICOM-capable. Also, not all systems support DICOM. This presents a challenge for displaying DICOM images. Finally, whereas clinical systems may have internal mechanisms to satisfy privacy requirements, configuring all systems to be aware of all consumer and patient consent directives is impractical.

Context for Sharing DI Data

The Canadian EHR is based on an enterprise architecture that defines “the enterprise” as the entire healthcare delivery system in Canada. It addresses the problem of consolidating disparate data by integrating information in a set of shared data repositories, namely:

• Public health service delivery and surveillance repository;

• Lab services repository;

• Diagnostic imaging repository;

• Drug utilisation and e-prescribing repository; and,

• Clinical notes and other health record information repository.

In order to organise the information in these repositories, a series of identifier registries are used to identify and manage the characteristics of 'clients' of the health system, 'providers' of health services, and the locations where services are provided. Clinical "point of service" (PoS) applications publish appropriate subsets of data to the shared data repositories in near real-time. A sequential list of all EHR data related to a patient is maintained in an EHR index. Publishing, discovery and retrieval of clinical data are performed through an Enterprise Service Bus (ESB) and a common set of standards-based interfaces. The collection of common and reusable components that support these repositories is called an EHR "Infostructure" (EHRi).

The Technical Solution for Sharing DI Data within Canada

The technical solution for seamless sharing of results across Canada is a network of Diagnostic Imaging repositories (DI-r) that consolidate results data as well as provide shared PACS application for hospitals that do not have a PACS.

These DI-r leverage common components of the EHRi through standard interfaces based on the Integrating Healthcare Enterprise (IHE) Cross-Enterprise Document Sharing for Imaging (XDS-I) integration profile. In practice a DI-r is a centralised storage and server infrastructure that supports:

• Long-term storage of DI results for the lifetime of a patient;

• Integration with existing RIS and PACS via DICOM and HL7;

• Interoperability with EHR components through IHE XDS-I transactions;

• Information access to EHR consumers via IHE XDS-I transactions, DICOM and WADO.

A total of 21 DI-r are planned for Canada with 5 already deployed, 12 in implementation and the remaining 4 in planning, as shown in Fig. 1.

Solving Key Challenges

As of the end of 2006, 60% of DI procedures are captured and shared electronically, connecting 120 hospitals, 250 radiologists and 55 systems in a three-year period with a limited pool of resources. The challenge of identifying patients within an EHRi across Canada is solved through the use of an Enterprise Master Patient Index (EMPI) solution in each EHRi. In particular, Canada has negotiated an agreement with Initiate Systems that favours the use of the Initiate Hub™ as the defacto EMPI across the country.

With respect to privacy and security, Canada has developed a 'Privacy and Security Conceptual Architecture' that allows PoS to access a set of common services within the EHRi. Leveraging common services ensures consistency across all domain systems and reduces the cost of implementation and operation.

To ensure information access and display within five seconds, jurisdictions have embraced a combination of solutions. Each DI-r has an image distribution capability that leverages Internet friendly protocols and streaming technology. This allows any user to access the full patient history directly from the centralised storage infrastructure. Currently, the solutions deployed are all proprietary in nature and, thereby, do not allow cross-vendor access. The DICOM JPIP standard is being considered as a pan-Canadian standard to solve this issue.

Also, network constraints such as peering problems and backbone delays make on-demand access to multiple image sets challenging using internet friendly protocols and streaming technology. To overcome this challenge, jurisdictions are evaluating content delivery concepts where application services and data are distributed across the network and "closer" to the end user viewing clients. Essentially, these solutions leverage "edge appliances" to host cached data and provide image distribution services. Workflow engines manage the staging of relevant data at the edge appliance using a variety of triggers such as ADT and Order messages.

Financial Considerations

The first DI-r implementations were initiated in 2003. At that time, the capital cost for PACS hardware, software and professional services equated to approximately CDN$30 for every exam completed in the year of purchase. For example, a DI-r and shared PACS that supported 1 million exams annually cost CDN$30 million. In 2006, a similar project, including EHR interoperability and standards compliance, cost approximately CDN$10 million. This dramatic shift in price is the result of leveraging economy of scale and aggressive negotiation.

The cost of “useable” spinning disk storage dropped by a factor of four, partly due to time and technology, but predominantly through large-scale purchasing and negotiating multi-year contracts. Software costs dropped by a factor of five. This was partly due to “web pricing expectations”, but predominantly through large scale purchasing, aggressive negotiation and a shift from concurrent to enterprise licensing.

Sharing Health Data

The sharing of DI data in the context of an EHR has demonstrated many clinical and financial benefits. Qualitative surveys have shown improvements in access to radiologist coverage and specialist consultation has resulted in better medical management and quality of care. Projects across Canada has seen productivity gains for radiologists (~30%), technologists (~25%) and physicians. The latter is interesting in that physicians are able to regain 1.75 hours a week lost due to lost or inaccessible films. Although not fully proven out, preliminary estimates indicate that regional systems will reduce unnecessary patient transfer and generate a saving of CDN$0.87/exam.

Data gathering is still underway to quantify the number of avoidable retakes that can be eliminated. However, preliminary research in Ontario indicates an annual saving of approximately CDN$120 million. To summaris the financial benefits, an investment strategy report determined that Canada would deliver CDN$9.1 billion in healthcare benefits over 10 years as a result of sharing DI results in the context of the EHR.

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