



Image Exchange in Canada: Examples from the Province of Ontario

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Abstract

An increased number of healthcare providers across the continuum of care share responsibility for providing treatment and care to the patient. Treatment is often provided at community-based facilities and not necessarily at the hospital that performed the imaging. As a result, there is an increased dependency on readily available access to a patient's longitudinal imaging records. The ways in which diagnostic images and results are exchanged among providers within a patient's circle of care have expanded. This article explores three varieties of image exchange. First, we examine image exchange patterns within a regional Diagnostic Imaging Repository and identify missed sharing opportunities. Secondly, we explore the use of a regional clinical viewer widely used in southwestern Ontario, called ClinicalConnect™, and examine the adoption of the viewer by providers. Finally, the paper provides a high-level look at how patients can leverage patient portals to view their imaging data to empower their healthcare experience.

Keywords Image exchange · DIR · VNA · HIE

Introduction

In 2001, a federal health agency, Canada Health Infoway (CHI), was mandated to facilitate sharing of clinical information and achieve the goal of “One Patient, One Record,” including making diagnostic images and exam results more readily available to health care providers (HCPs). Over the years, CHI has funded a variety of enhancements to ClinicalConnect™, to help fulfill this mandate. Most recently, in Ontario, CHI funded a Provincial Patient Engagement Platform planning project to provide patients' access to their health records, which resulted in the development of the Patient Portal Provincial Service Standards. At the provincial level, in Ontario, a provincial government agency, Ontario Health (formerly eHealth Ontario), originally oversaw the creation and implementation of four regional DIRs and now operates the Diagnostic Imaging Common Service that acts as an access point and consolidates data from the DIRs [1]. Ontario Health also funds the day-to-day onboarding and operation of ClinicalConnect, noting that the DI

Common Service is one of four provincial data repositories integrated with ClinicalConnect. This article covers three approaches for image exchange. First, we examine image exchange patterns within a regional Diagnostic Imaging Repository (DIR) and identify opportunities for improvement. Secondly, we explore the use of a regional clinical viewer widely used in southwestern Ontario, and examine the adoption of the viewer by providers. Finally, the paper provides a high-level look at how patients leverage patient portals to view their imaging data to empower their healthcare experience.

Example 1: Image Exchange Across a Regional Diagnostic Imaging Repository

Ontario

Originally, four regional DIRs were established across the province of Ontario. A DIR can be thought of as a health information exchange, focused on image exchange across a specific region [2]. Every hospital in the province is connected to a DIR. Hospitals publish Diagnostic Imaging (DI) exams to the DIR for the purpose of making the exams available for consumption by other healthcare enterprises via a regional viewer or through foreign exam management. The catchment area defined for each DIR was based on geographic location and clinical referral patterns between

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Table 1 HDIRS by the numbers

Number of PACS feeds	38
Number of HL7 feeds	47
Number of studies stored (as of August 2021)	70,065,106
Number of reports stored (as of August 2021)	72,561,105
Number of exams shared in fiscal 2021–2022	4,923,287

healthcare enterprises. In 2017, two of the DIRs consolidated at a governance level, and technical consolidation occurred in the summer of 2020. This resulted in a total of three remaining regional DIRs in the province of Ontario known as SWODIN (Southwestern Ontario Diagnostic Imaging Network), NEODIN (Northeastern Ontario Diagnostic Imaging Network), and HDIRS (Hospital Diagnostic Imaging Repository Services).

The current HDIRS DIR is the result of an amalgamation of two repositories that covered territories across the central region of Ontario. The information in this section of the paper will focus on details related to the HDIRS DIR. HDIRS serves over $\approx 60\%$ of the population of the province. It is a heterogeneous vendor environment, in which the 38 separate PACS feeds that are connected to HDIRS represent a variety of PACS vendors (Tables 1 and 2).

Design and Implementation

As defined by the Canada Health Infoway Standards Collaborative Working Group 10, a *Foreign Exam* is an image and/or report that was acquired outside of your local healthcare enterprise [3]. *Foreign Exam Management* is the ability for the consuming site to ingest foreign exams directly into their local PACS while treating the study with unique business

Table 2 Contributing PACS vendors

Vendor	Qualification for Transfer to DIR
Agfa	11
Careview	1
Change Healthcare	1
Coral	5
Fuji	2
GE	15
IBM Watson Health	2
Intelerad	23
Phillips	15
Sectra	5
Velox	3
Siemens	3
SIMMS	36

rules appropriate for a foreign exam. At the time that the DIRs were implemented, defined workflows for image exchange, such as the Integrating the Healthcare Enterprise (IHE) profile Import and Display of External Priors (IDEP), was not yet defined.

IHE integration profiles were leveraged to help achieve interoperability and successful image exchange. In the province of Ontario, each DIR publishes to a provincial XDS registry, which is leveraged by provincial viewers as reference point for image and document access. The Import Reconciliation Workflow (IRWF) IHE profile defines the workflow to successfully import patient data from an external source (i.e., CD-ROM, transmitted electronically, delivered from film, etc.). While the IRWF profile does not cover all foreign exam management use-cases, principles from the IRWF profile related to demographics, order, and procedure localization rules were applied and leveraged to effectively execute foreign exam management. In 2018, the CHI Enterprise Imaging Community contributed to the submission and development of the IHE profile, Import and Display External Priors (IDEP) [4]. This profile represents a significant step forward in the advancement of standards-based image exchange and captures the complete requirements for Foreign Exam Management workflow.

IDEP/Foreign Exam Management in Practice

Sites are connected to the DIR over a secure provincially managed private network. The DIRs were implemented in a phased approach. Phase 1 focused on establishing a connection between the sites and the DIR while enabling the ability to publish DI exams to the central repository. Phase 2 focused on enabling participating enterprises' consumption access to outside DI exams stored within the DIR.

PACS systems are typically not designed with the native functionality to effectively discover and manage outside images and reports. As a result, DICOM edge devices were implemented across the HDIRS membership to assist participating enterprises to accomplish IDEP/foreign exam management workflow. In this case, a DICOM edge device is a DICOM node that is designed for the purpose of facilitating seamless access of outside imaging directly in the site's local PACS.

For the exchange of outside imaging to be considered successful, foreign exams must meet the following requirements:

1. Display in the local patient jacket
2. Will not re-archive back to the DIR
3. Will not remain a permanent record in the local PACS

The requirement to create unique purge rules for outside exams was established to mitigate the risk around lack of

data parity for DI exams between the source PACS and the DIR. This can occur if a PACS correction (i.e., exam split, exam merge, image deletion) is applied to the exam at the originating site's PACS, but the correction was not applied at the DIR. As previously mentioned, a PACS does not discriminate between a local and an outside exam; as a result, bullet #3 from the requirements listed above involves customizations at the local PACS to distinguish retention rules for outside exams vs. local exams.

Currently, across the HDIRS membership, only two sites have implemented the IHE profile, Image Object Change Management (IOCM). As participating sites continue to adopt IOCM, manual correction workflow at the DIR will not be required and data consistency between local PACS and DIR will improve.

Patient Identity

The HDIRS membership represents over 40 unique patient-identity groups. To avoid Patient ID collisions, the DICOM tag “Issuer of Patient ID” (0010, 0021) is leveraged to identify the source of the Patient ID and ensure uniqueness. This ensures that if disparate organizations use the same value for Patient ID, data collision will not occur as the DIR distinguishes uniqueness based on a data couplet of Patient ID and Issuer of Patient ID.

HDIRS does not employ an enterprise master patient index (EMPI) to match a patient's longitudinal records. Rather than using an EMPI, the Ontario (province unique) health number (HN) is leveraged to determine a patient match across disparate patient identity pools. The HN is included in all HL7 (Health Level 7) ADT and ORM messages. Data mappings are applied to assign the HN to the DICOM tag, “Other Patient ID Sequence” (0010, 0002) in the VNA, which acts as a global patient identifier in the DIR.

Discovery and Retrieval Flow

Foreign exam retrieval is initiated from an ingesting site by either a manual search from a user, or an automated prefetch triggered by the receipt of an HL7 order message (ORM).

Pre-Fetch Workflow

- The IDEP Server receives an ORM message.
- The IDEP server issues a DICOM C FIND based on Patient ID (in ORM) and Issuer of Patient (associated with the enterprise that placed the ORM).
- Based on the issuance of the C-FIND described above, the VNA provides longitudinal search results based on a patient's matching HN (which is in the DICOM attribute “Other Patient ID Sequence” (0010, 1002)).

Alternatively, a clinical user can perform a manual query directly from the local PACS. The query passes through the FEM edge device first, which structures the C-FIND appropriately (PatientID + Issuer of PatientID) to allow the DIR to return longitudinal results.

Participating sites have had access to the discovery and retrieval of longitudinal records for several years. Table 3 represents the foreign exams ingested volumes across the DIR's membership in fiscal 2021–2022.

This represents the total overall foreign exams that the DIR member sites have retrieved over the past year. Access to outside imaging and results have had a positive impact on the clinical user's experience, with foreign exams leveraged frequently as relevant priors. The availability of outside

Table 3 Breakdown of each retrieval volume of foreign exams across the DIR's membership in fiscal 2021–2022

Site	Total IDEP/foreign exam management ingestion
Hospitals	
Hospital 1	35,079
Hospital 2	53,081
Hospital 3	172,695
Hospital 4	30,568
Hospital 5, 6 (two hospitals share PACS)	371,945
Hospital 7, 8 (two hospitals share PACS)	43,293
Hospital 9	232,823
Hospital 10	502
Hospital 11	232,679
Hospital 12	257,871
Hospital 13	149,634
Hospital 14, 15 (two hospitals share PACS)	82,085
Hospital 16	301,628
Hospital 17, 18, 19 (three hospitals share PACS)	2*
Hospital 20	176,799
Hospital 21	654
Hospital 27, 28 (two hospitals share PACS)	350,204
Hospital 29, 30 (two hospitals share PACS)	108,818
Hospital 31, 32 (two hospitals share PACS)	71,096
Hospital 33	285,304
Hospital 34	15,057
Hospital 35, 36, 37 (three hospitals share PACS)	771,417
Hospital 38	38,021
Hospital 39	148,318
Clinics	
Clinic 1	63,556
Clinic 2	548
Clinic 3	15,057

*Hospitals 17, 18, and 19 have not enabled the IDEP solution

Table 4 A 6-month history of three organizations ingesting exams from enterprises that border the furthest boundaries of the DIR

	Academic center 1	% of total	Academic center 2	% of total	Pediatric hospital	% of total	Group total	% of total
Ingestion of studies from hospitals that border the DIR boundaries	3,287	2.16%	22,767	5.41%	1,916	9.53%	27,970	4.72%
Total FEM	152,333		420,696		20,096		593,125	

images and results have demonstrated the opportunity to reduce repeat imaging and reduce the reliance on physical media [5, 6].

During the implementation of the DIRs, the DIRs were divided based on their geographic region and clinical sharing patterns. This model would allow hospitals and clinics in a particular region to contribute to the most geographically relevant DIR. To explore the nature of regionalized sharing, we analyzed the foreign exam ingestion patterns of three specific healthcare enterprises with high inbound referral patterns. The three healthcare enterprises represent two academic centers and one pediatric hospital. In this analysis, we review the frequency of foreign exams that were imaged at hospitals that border the furthest distances of the DIR.

The three referral sites (academic center 1, academic center 2, pediatric hospital) are in downtown Toronto. The physical distance between the border hospitals and the referral site represents 331 KM (approx. 206 miles). We conducted a 6-month analysis on the three site's ingestion patterns for studies from hospitals that border the DIR boundaries (Table 4).

The results of this analysis demonstrate that despite large geographic distances between healthcare enterprises, a clinical need to access imaging from non-neighboring healthcare enterprises persists.

Opportunities to Improve Sharing

As we review the sharing patterns within a single DIR, we hypothesized that across the HDIRS membership, there are

likely many patients receiving imaging services that live outside of HDIRS catchment area. There are currently 3 DIRs in the province of Ontario; however, IDEP/foreign exam management functionality is not available across DIRs.

As a means of validating this hypothesis, we first reviewed the postal codes within the province of Ontario and categorized each postal code with an appropriate DIR. The Canadian postal code format includes 6 alphanumeric characters. The first 3 characters of the postal code is the forward sortation area (FSA) that defines the general area and district of the address [7]. We employed the FSA code to define a relationship between the postal codes specific to a DIR's geographic coverage and identified postal codes associated with out of province patients (Tables 5 and 6).

Based on the classification of the postal codes per DIR, we analyzed the postal code FSA of registered patients that received imaging from across the DIR's membership. We then assessed how frequently imaging is performed for patients that live at a residence occupied within the geographic boundaries of another DIR. These are patients who live outside of HDIRS territorial boundaries that receive imaging services from the HDIRS membership. These patients will travel back to their community centers, and receive follow-up treatment, and the physician may only see a limited view of the patient's imaging history (Table 7).

The analysis above underscores that there are a high number of patients that receive imaging services across the HDIRS membership that live within the boundaries of another DIR. We can see that the number of out-of-region patients can vary depending on the nature of the enterprise.

Table 5 DIR/postal code categorization

Postal first letter	Non HDIRS postal codes	DIR
N	All	SWO
L	L2, L3B, L3C, L3K, L3M, L8, L9A, L9B, L9C, L9G, L9H, L9K, L0S	NEODIN
K	K1, K2, K4, K6A, K6H, K6J, K6K, K7C, K7S, K7V, K8A, K8B, K8H, K0A, K0B, K0C, K0J	NEODIN
P	P1A, P1B, P1C, P2, P3, P4, P5, P6, P7, P8, P9, P0A, P0G, P0H, P0J, P0K, P0L, P0M	NEODIN

Table 6 Non-Ontario postal code categorization

Postal first letter	Province
A	Newfoundland and Labrador
B	Nova Scotia
C	Prince Edward Island
E	New Brunswick
G	Eastern Quebec
H	Metropolitan Montreal
J	Western Quebec
R	Manitoba
S	Saskatchewan
T	Alberta
V	British Columbia
X	Northwest Territories and Nunavut
Y	Yukon

Hospitals that border a particular DIR tend to see a higher visitation rate from patients that live within the boundaries of the neighboring DIR. Regional Cancer Centers, Teaching Hospitals, and pediatric centers have high visitation rates from patients across each provincial DIR and from outside the province of Ontario.

While it is currently not possible to ingest content from another DIR via IDEP/Foreign Exam Management workflow, provincial viewers provide a more complete picture of a patient’s imaging history.

Table 7 Imaging performed at HDIRS sites, broken down by the DIR that the patient lives within

Site	Total_CA	HDIRS	NEODIN	SWI	Outside Ontario
Hospital 1 (Borders NEODIN)	11,195	10,927	248	5	15
Hospital 2 (Borders NEODIN)	12,362	11,342	959	3	22
Hospital 3 (Borders SWODIN)	17,753	15,840	82	1,809	22
Hospital 4 (Borders SWODIN)	11,338	11,248	27	32	31
Hospital 5 (Pediatric hospital)	57,032	51,772	2,654	2,277	329
Hospital 6 (Borders NEODIN)	21,388	16,926	4,272	133	57
Hospital 7 (Regional cancer center)	72,242	70,633	954	605	50
Hospital 8 (Teaching hospital)	63,342	60,936	944	786	676
Hospital 10 (Regional cancer center)	42,404	41,184	621	528	71
Hospital 11 (Regional cancer center)	188,253	183,736	1,941	2,247	329
Hospital 11 (Teaching hospital)	164,785	153,642	4,970	4,553	1,620

Table 8 Number of sites contributing DI data to ClinicalConnect

Direct integrations	DI-CS integration (provincial) [8]	
Hospital sites in OH West Region	Hospital sites	IHF's
72	184	17

Data is de-duplicated when a hospital has a direct integration between its Hospital Information System, but also contributes data directly to the DI Common Service. Direct Integrations as of September 29, 2021; DI-CS Integrations as of March 2021

Example 2: Image Exchange via a Provincial Viewer

Overview

ClinicalConnect is a secure, web-based provider-facing portal that provides real-time access to patients’ health records, including diagnostic images and reports, generated by acute and community-based healthcare facilities across the province. ClinicalConnect does not operate as a data repository, but rather aggregates all available history from source systems, similar to Google’s search functionality. Acute Care and select Independent Health Facilities’ data are viewable in ClinicalConnect’s Radiology module. From a diagnostic imaging perspective, ClinicalConnect began making radiology images from Hamilton Health Sciences available to all users via Client Outlook’s eUnity Viewer, adding to

radiology reports already available from various regional hospitals. In 2014, ClinicalConnect was integrated with SWODIN (see Table 8), and then in 2016, the portal was integrated with the provincial Diagnostic Imaging (DI) Common Service that consolidates radiology data from the three regional DIRs listed above. Within ClinicalConnect, users use GE Healthcare's Centricity™ Zero Footprint Viewer to view images from SWODIN, and Agfa Healthcare's XERO® Viewer to view images from the DI Common Service, both of which are approved for diagnostic use. Access to these radiology records adds to a wide range of other healthcare data presented in one, consolidated view to provide HCPs with a more complete picture of their patients' health history. ClinicalConnect's Data Integration Chart summarizes the types of data available from healthcare organizations as well as four provincially managed data repositories [8]. Healthcare organizations located in Ontario Health (OH) West Region are approved to access ClinicalConnect and from there authorize their staff to access the data aggregated in ClinicalConnect from otherwise disparate sources to support more efficient delivery of care to their patients (Table 9).

With the formation of Ontario Health Teams (OHTs), their member organizations do not currently share one health information system, creating discrepancies in the data their HCPs have access to. As a result, Ontario's Ministry of Health advises OHTs in its West health region to access ClinicalConnect to help ensure HCPs have electronic, near real-time access to their patients' DI records as part of the patient's integrated health record [9].

Using ClinicalConnect, the concept of images or, more broadly, data exchange should be considered from two perspectives. Radiologists and other DI healthcare professionals access ClinicalConnect to view a patient's DI data when generated at sites outside their own, but also to view non-DI health records that complement their diagnostic work. A DI requisition or referral alone may not include all the patient's data, so using ClinicalConnect, HCPs are able to gain more

insight into their patients' healthcare journey, helping to minimize any "unknowns" that could potentially lead to less optimal recommendations being made. Conversely, non-DI HCPs benefit from being able to view their patients' DI data that they may otherwise not have access to. For example, a family physician whose patient breaks their arm in another city can view the x-ray image and corresponding report to obtain more specifics about the injury, and not have to rely on the patient's recall of what they were told during their hospital encounter.

Privacy and Security

The following describes the framework established for healthcare organizations to be able to contribute and/or view data using ClinicalConnect. Hamilton Health Sciences Corporation is the Health Information Network Provider for ClinicalConnect. Healthcare organizations from across the continuum of care that are located in the OH West Region and are Health Information Custodians of their patients' health records can apply to become Participants in ClinicalConnect, including physicians who operate independent private practices. Organizations must abide by ClinicalConnect's Terms and Conditions which largely mirror the provincial *Personal Health Information Protection Act, 2004*, and include clauses specific to healthcare organizations that in addition to using the portal for viewing purposes contribute data to ClinicalConnect. Participant Organizations have a Local Registration Authority (LRA) who is responsible for creating and managing their users' access to ClinicalConnect, including identity verification per Ontario Health's Assurance Level Standards. ClinicalConnect users must review and accept the ClinicalConnect User Agreement upon first log-in to the portal, annually thereafter and/or when the User Agreement is updated, and all end users are attested by their authorizing organization twice a year. In addition, Hamilton Health Sciences is an Ontario Health Technology and Solution Delivery Partner for the purposes

Table 9 Number of Registered ClinicalConnect Users (as of August 31, 2021)

Sector/HIC type (no. of participant organization sites)	No. of participant organization sites	No. of registered users*	No. of registered users with access to DI-CS via ClinicalConnect
Hospital (sites)	74	35,443	31,191
Primary care organizations (e.g., group practices)	143	1,632	948
Primary care—sole practitioners	1,433	2,450	1,164
Community organizations (e.g., MH&A, CSS)	349	4,173	2,919
Community pharmacies	257	353	332
Public health units	38	848	34
Totals	2,294	44,899	36,558

* All have access to diagnostic images and reports generated by acute care hospitals located in OH West Region

of providing access to Electronic Health Record (repository) data via ClinicalConnect.

All access to data within ClinicalConnect, regardless of the source system/repository, is logged and subject to audit. The ClinicalConnect Program Office at HHS operates ancillary online tools, used by Participant Organizations, to create, manage, and attest ClinicalConnect access, and its Haystack iS surveillance and monitoring system is used by Participant Organization’s Privacy Contact and Privacy Auditor(s) to complete auditing activities.

Privacy Impact Assessments and Threat Risk Assessments were completed with each data-contributing organization at the time of initial integration to their hospital information system/repository.

Retrieving and Viewing Images within ClinicalConnect

ClinicalConnect users are effectively accessing and viewing diagnostic imaging data directly from two main

sources: SWODIN (regional DIR) and the provincial DI Common Service, each with their own viewer. Within the List view of ClinicalConnect’s Radiology module, those reports that have an image associated with them display a camera icon. Clicking on the icon opens a new web browser window and retrieves the image from either SWODIN or the DI Common Service (Fig. 1). After initial launch, the DIR viewer session is independent from the ClinicalConnect application when viewing that patient’s study, and applicable DICOM standards apply at the image viewer level.

Method

We will look at metrics associated with how HCPs leverage ClinicalConnect to view DI data not otherwise accessible within their local health information systems, without having to spend time requesting results from the site that performed the test/procedure, or relying on patients’ recall.

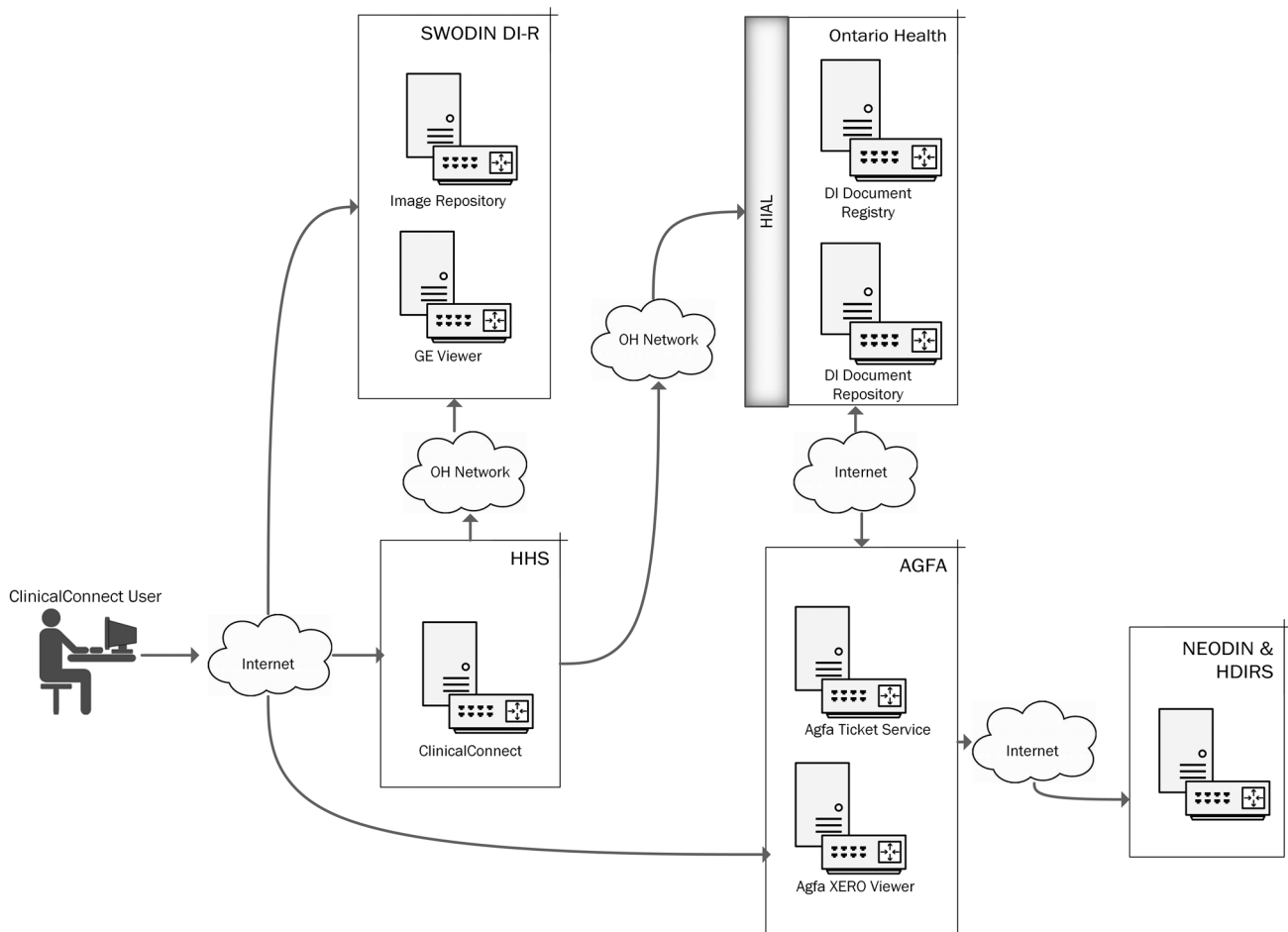


Fig. 1 Opening of a new web browser window upon clicking the icon and retrieval of the image from either SWODIN or the DI Common Service

Results

The following provides information about access and use of ClinicalConnect to exchange diagnostic imaging data between HCPs to improve the patient care journey.

Clinical Sharing Patterns

Using ClinicalConnect, based on queries made by ClinicalConnect users in August 2021, this graph shows the data returned from integrated sources outside the users' local health information system; in other words, the availability of diagnostic imaging data from the DI Common Service, or from regional hospitals' systems, integrated directly with ClinicalConnect, that HCPs may otherwise not have had electronic access to (Fig. 2).

ClinicalConnect in Practice

Wait times for diagnostic imaging tests and procedures across Ontario have increased as evidenced by Health Quality Ontario's Wait Times for Diagnostic Imaging [10]. Patients are increasingly being referred out-of-region for DI services to expedite their care. Results of DI procedures when performed at hospitals and select Independent Health Facilities are aggregated in the DI Common Service, and then available to view by ClinicalConnect users

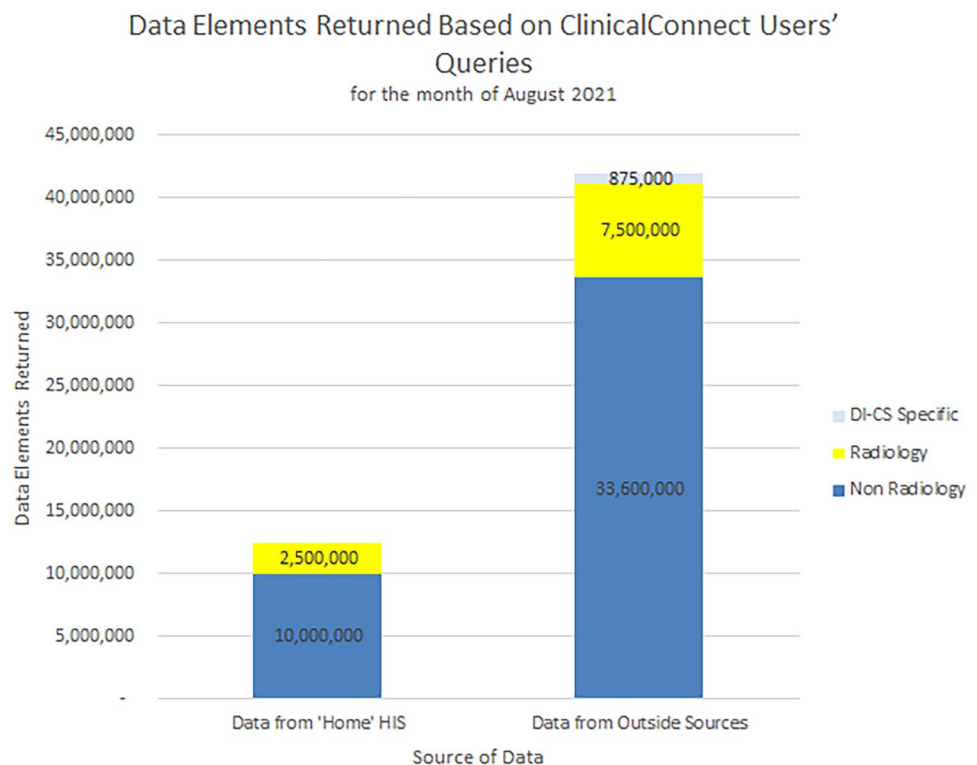
at Participant Organizations that have been authorized to view that repository. It is critical for HCPs on the patient's care team to have ready access to these results, regardless of where in Ontario DI services are performed.

DI procedures can be a pre-requisite to a consultation with a specialist that is conducted electronically known as an eConsult, or for a referral to be made to a specialist electronically, known as an eReferral. ClinicalConnect provides a common access channel to view DI reports and images by aggregating the data from various siloed systems, de-duplicating the information and providing a provincial level view of patient records (i.e., an aggregated longitudinal view of DI records/images).

We see an increased dependency on digital infrastructures where common data access and sharing platforms are foundational enablers as virtual care models evolve and continue to scale up. Virtual care consultations with primary care providers (PCPs) can be much more effective with PCPs' access to the patient's DI report and/or image, supporting an improved understanding of the medical condition. In addition, patients have become more interested in gaining access to their imaging results following their virtual care consultation with their PCP [11].

The DI specialty itself has many sub-specialties, for example for cancer care and interventional radiology. In these cases, the radiologist plays an important role in the patient's ongoing care and benefits from access to their patients' medical records maintained in outside systems.

Fig. 2 Availability of diagnostic imaging data. *Approximately 20% of data elements returned based on ClinicalConnect user queries relate to Diagnostic Imaging data located in ClinicalConnect's Radiology module



This helps support a collaborative approach where all HCPs have access to the same information using ClinicalConnect, and provides the patient with better continuity of care. Furthermore, shared access to electronic medical records helps avoid general inconvenience to the patient when it comes to the time and cost of otherwise unnecessary visits to healthcare facilities and can help reduce unnecessary exposure to radiation created by duplicate testing. Without access to aggregated DI data, HCPs re-order exams as identified in a 2015 study [12]. It found that 45% of physician respondents who encountered clinic patients with inaccessible DI exams reported re-ordering identical DI exams. Within the physician respondents who have re-ordered identical DI exams, 60% reported access issues as a primary reason for re-ordering while 33% identified time constraints for access as a primary reason.

Missed Sharing Opportunity

Since currently not all Independent Health Facilities are contributing their DI data to the DI Common Service, this creates a gap for HCPs seeking to use ClinicalConnect to view their patients' current and complete medical records. During the pandemic, many diagnostic imaging tests and procedures have been moved out of hospital to community-based clinics, yet not all the results cannot be viewed by HCPs (using ClinicalConnect) as part of their patients' consolidated health record.

Example 3: Image Exchange Via Patient Portals

Overview

Patient portals provide secure, online access to their personal health information and can be used by patients to help manage aspects of their own healthcare. They are also becoming a tool for image exchange between healthcare organizations and their patients. In Ontario Health's West Region, currently patients can register for a patient portal account and access their diagnostic imaging reports from acute care hospitals within the region. More recently, a planning project was completed, with a provincial scope in mind, to identify portal solutions to enable patients to view even more of their personal health information, including images themselves maintained within the repositories mentioned above.

Ontario Health recently made its Patient Portal Provincial Service Standards [13] available to OHTs so they may fulfill their mandate to provide patients with access to their online health records. By doing so, a level playing field with a common digital ecosystem can become reality,

bringing providers and patients together to close the gaps and reduce missed opportunities for sharing. One possible approach being considered is to leverage ClinicalConnect, and its existing data integrations with regional hospitals, SWODIN, and provincially managed repositories, to deploy a patient-facing version of the portal. This concept has been initially developed and deployed as part of a Proof of Concept (PoC) project which ran in March 2021 and included patient advisors, where the objective was to provide patients with access to their health records using a portal solution that does not require net new integration work, and employs a user interface that's much like that used by HCPs accessing patients' data, including diagnostic images from a DIR, via ClinicalConnect. This represents a unique alternative to help promote patient access and more empowered healthcare journeys for Ontarians, using a portal that has the potential to be production-ready in relatively short order.

Privacy and Security

For the purposes of this discussion, looking at the patient-facing version of ClinicalConnect as a potential patient portal option, the privacy and security measures related to the provider-facing equivalent apply and are already largely in place as a result of the PoC project. Generally speaking though, as OHTs select patient portal solutions to deploy to their patients, specific privacy and security controls have been mandated or recommended by Ontario Health via its Patient Portal Provincial Service Standards identified above, which align with the Province's *Personal Health Information Protection Act, 2004*. Depending on the patient portal being used and the source system of the diagnostic imaging data, agreements between the various parties will need to be in place.

Standards

Similar to the comments around privacy and security above, a re-skinned version of ClinicalConnect would leverage the same technical standards and protocols as exist today. OHTs will need to ensure the solution they select aligns with Patient Portal Provincial Service Standards.

From a less technical perspective, to provide patients with the best online access to their health records, other factors should be considered including the need for patients to provide proxy/delegate access to their patient portal account, and to "share" their records via a patient portal with their HCPs, specialists, family, and other caregivers.

Method

Feedback from patient advisors was gathered during the evaluation of the abovementioned PoC project and is being

considered part of ongoing collaboration with patient advisors, OHTs, and Ontario Health to advance patient access to their health records.

Results

Through the patient portal PoC, as well as other patient engagement deployments the Health Information Technology Services (HITS) eHealth Office at Hamilton Health Sciences has been involved in, patients expressed a desire for more health information to be available to them, specifically citing access to real-time DI data (vs. delayed results). While patients can access their imaging data upon request, generally on a CD, this approach creates additional work for the patient, time, and cost inefficiencies for the organization having to stock, then burn CDs, and not to mention potential privacy concerns by patients if they misplace their CD. Accessing these images electronically via a patient portal such as the approach described above would mean patients can access their images using the same viewers as those used by their HCP (within ClinicalConnect), safely and securely. Ontario Health is currently working with its stakeholders to facilitate the necessary changes to allow for the release of diagnostic imaging data from sites across the province, including Independent Health Facilities, which contribute to its DI Common Service, to patients as part of a provincial patient portal enablement strategy.

Other Applications

Teleradiology

In its Standards for Teleradiology published in 2008, the Canadian Association of Radiology defines teleradiology as the electronic transmission of diagnostic imaging studies from one location to another for the purposes of interpretation or consultation [14]. Teleradiology was made possible by the large-scale deployment of digital modalities and picture archiving and communication systems (PACS) in our hospitals and clinics. It is increasing bandwidth and improving speed which made teleradiology accessible, and all radiologists perform teleradiology in some form: academic and hospital-based radiologists report within their institutions through their PACS and can serve multiple sites simultaneously. This has allowed easier access to subspecialized expertise in a hospital network.

Numerous hospitals in Canada are relying on teleradiology to cover nights, weekends, and vacations when staffing is difficult in remote locations. Teleradiology has also extended to day-time activities with multiple private independent health facilities covering multiple sites by a single radiologist. The COVID-19 pandemic has acted as a catalyst

for hospitals to start covering shifts by remote reporting from home-based radiologists.

Teleradiology also supports new applications such as peer learning, contributing to quality improvement of the group and breaking the radiologist isolation.

When the concept of DIRs was launched almost twenty years ago, it was anticipated that they would allow load balancing, moving imaging studies from the busiest sites for reporting at sites with more capacity, but this never materialized.

Research

With the increasing penetration of artificial intelligence in Radiology, we see the potential to automatically detect and diagnose increased pathologies. But researchers and software developers need access to large numbers of high quality curated medical images if they want their results to be accurate and reliable. Limited availability of large enough datasets has been identified as one of the major causes of failure. The Diagnostic Imaging Repositories have been designed for clinical use only and did not include a provision for research. There is no mechanism in the DIR to capture patients' consent.

There are currently projects to build imaging libraries for research. Hamilton Health Sciences is engaged in one of these projects and went through a rigorous process to address the privacy and security concerns raised by the Hospital, in its capacity of custodian of the data. The library will provide a substantial number of images giving access to ten years of imaging activity stored on the DI-r, which represents close to seven million studies; data are anonymized, as it is not feasible to acquire consents from patients for the volumes required; appropriate curation ensures the high quality of the data; ideally, images will be labeled by radiologists and residents through existing research projects. Images will be uploaded on a cloud-based solution, and access to the library is granted to researchers and industry as part of research projects approved by Hamilton Health Sciences' Research Ethics Board committee.

Conclusion

The details in this paper highlight the current state of image exchange in Ontario, Canada. There are a different approaches to outside access outside DI exams depending on the use-case. Exchange of outside images and reports can be delivered directly to a site's local PACS via FEM, accessed through a provincial viewer, or sent through a patient portal.

The advancement of the IHE profile import and display of external priors (IDEP) has advanced foreign exam management workflow and the ability for a local PACS to effectively

manage outside imaging and results from a regional DIR. IDEP/foreign exam management allows a clinical user to leverage the existing tools within the local PACS while accessing outside imaging from across the region. While the IDEP/foreign exam management has improved sharing within a single DIR, there are still gaps within this workflow when it comes to sharing imaging across enterprises that belong to disparate DIRs. The provincial viewer used in southwest Ontario provides an alternative view that captures the patient's longitudinal imaging record from otherwise disparate contributing facilities and can be viewed alongside non-radiology health records, supporting a more comprehensive approach to diagnosis and care.

There is an increase in the number and types of patient portals available in Ontario. Providing a single access point for aggregated imaging results would help reduce unnecessary exposure to radiation due to duplicate testing, creating efficiencies for patients and providers alike. Furthermore, enabling patients to share their images and other electronic health records would facilitate greater clinical collaboration that ultimately contributes to more efficient and effective healthcare for patients across the province.

Declarations

Conflict of Interest David Koff is shareholder and board member of RealTime Medical.

Disclaimer The views expressed do not necessarily reflect the views of the Government of Ontario or any of its personnel or entities, including Ontario Health.

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