Proving Value in Radiology: Experience Developing and Implementing a Shareable Open Source Registry Platform

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Background

The current practice of radiology is such that the core activities of radiology span across multiple clinical departments and providers. With upcoming change in legislation to shift from volume to value based payments, the radiology department will need to generate evidence to prove value on the imaging services provided[1-6]. Data is required to evaluate patient outcomes and study population health. The nature of patient data is such that it is currently stored across various systems. For example, a patient admitted for surgery will have information stored in the administrative scheduling system, the electronic medical record system (EMR), imaging data stored in the PACS (Picture Archiving Communication System) and RIS (Radiology Information System) system, surgical and pathology system. Suggestions for proving value in radiology include demonstration of patient outcomes, ensuring that the patient receives the correct test and using evidence to have the best alternative when a patient requires a procedure. This has led to increased value and quality initiatives working on standardizing structured reporting, terminology systems, data dictionaries and disease registries.

Clinical registries are increasingly utilized in radiology for tracking radiation doses, screening programs like lung cancer screening and CT colonography as well as tracking IV contrast[7]. With increasing need for data to prove value, then there will be a need to set up clinical data registries alongside normal patient care. Small practices and individual departments do not have high levels of information technology (IT) support to set up such large registry systems. Therefore, there is a critical need to develop lightweight registry systems that minimally disrupt patient care and require little support in order to be scalable. Moreover, in future registry initiatives will mostly be generated from interest groups that can be multi stakeholders in a hospital to specialist societies like SIR.

We describe our experience developing and customizing an open source tool as a registry system for patients receiving Y90 treatment at Indiana University for advanced liver tumor therapy.

Case Presentation

We selected OpenMRS[8-10], an open source medical records system in use in over 42 countries to provide HIV and Tuberculosis care. The system has basic functionality including HL7 messaging, patient registration, and localization in multiple languages; form authoring tools in xforms and HTML, basic reporting framework and a customizable REST-ful API. The system has functionality of a terminology system called CIEL (Columbia International eHealth Laboratory)[11, 12] which is mapped to various international terminologies including ICD-10, SNOMED CT, LOINC, RxNORM and CVX.

The Indiana University established the Y90 treatment program by interventional radiology (IR) in 2007. The typical workflow of a patient is such that they are referred by the oncologist group or from an outside facility
or after liver tumor board and are seen in the IR clinic for an initial review. Once a patient is deemed eligible for treatment, approval is requested from the insurance company. After approval of insurance, the patients have a planning MAA (99mTc-macro-aggregated albumin)[13] scan to visualize the hepatic artery system and embolize variants of branches in anticipation for treatment. Patient subsequently receives a second appointment where the Y90 theraspheres are administered. Thereafter, treatment monitoring using labs, imaging and clinical symptoms (ECOG) are used to assess treatment response and to decide on future treatment planning.

We set up an Y90 registry committee that analyzed the patient workflow and the data collected at every visit from the EMR, RIS and PACS system. We developed paper forms that were reviewed by the director of interventional oncology for accuracy and appropriateness. Data elements were derived from actual clinical work at Indiana University, as well as published results of several Y90 papers[1, 14-16]. Once consensus was obtained, the discrete data elements were mapped to the CIEL dictionary with Radlex[17] and SNOMED[18] mappings. There exists no published minimum data set for tracking Y90 or radiology procedures.

The mapped forms were used to generate a form schema that was used to build xforms. A total of 5 forms were developed including an initial encounter form, MAA and Y90 treatment form, return encounter form and an events form that records incidents such as interim admissions between radiology visits. The committee then tested the programmed forms for data completeness. A project to use a cohort of patients diagnosed with cholangiocarcinoma to test for data accuracy and reporting was started. After entry of 15 patient records, reporting functionality was implemented to provide adhoc reports and a reporting dashboard for data discovery. To improve the implementation process, we bundled all the setup scripts into a vagrant /puppet module that allow the user to get started with the registry with one command.

Outcome

We now have a generic registry system distributed as a puppet/vagrant module that is up and running with one command. The system supports form development using HTML and xforms. The reporting framework supports programming of reports using SQL and java from the web framework. The registry system has a playground that allows data discovery and query. For example, one can search different queries:

1. All patients
2. All patients who are dead
3. All patients with a creatinine level of 4

Thereafter you can combine all the 3 queries to get a subset of the data meeting all criteria. We have CIEL terminologies mapped to SNOMED and Radlex.

A total of 20 patients are now entered in the database. To obtain obituary data, we utilized orbituary.com and google.com searches.

Discussion

The design of the database system is such that it serves as a platform that can be used by anyone with access to a HIPAA server. The activities to set up the system involve form development, concept mapping, form design, data entry and reporting configuration. Using the database we are now able to run reports of patients who are alive or dead, the trends in liver enzymes to study occurrence of liver failure after Y90 treatment, as well as treatment outcomes in terms of days alive after Y90 treatment.
The reporting playground helps clinicians understand data on their patients by generating and running their own queries. Pilot implementations have demonstrated the value of structured data collection for such registries. We are therefore working to develop a structured post procedure-reporting template for liver directed therapies with the society of interventional radiology (SIR). The next step is to generate the structured form template in the MRRT (Management of Radiology Reporting Templates) IHE format, which is interchangeable across multiple systems in the healthcare enterprise. We have performed a test implementation of MRRT generated data into OpenMRS using FHIR. We hope that when we transition to use MRRT generated data, we can add a new HL7 listener to pick the relevant reports from our dictation system to populate the registry system automatically. Reporting remains a hurdle for non-technical users, as it requires writing MySQL queries. The reporting playground is however easy to use.

Conclusion

Our vision is to accelerate the quality initiatives that arise from different specialty providers or different societies. We see a role where a society such as SIR brings experts to develop a data dictionary for IR reporting. This data dictionary would be mapped to CIEL, and would be importable to any OpenMRS instance. A batch of sample forms that are customizable by end users would be available for imports for new users who are getting started. Sample report scripts would also be provided into the larger system wide installation/implementation script. Versioning of form, reports and concepts would be automated in a versioning control system that would support subscription to the master registry to get recent registry changes. By providing a generalized registry platform with shared development, we anticipate savings in terms of the time required to set up a new registry system as well as maintain it.

References


**Keywords**

Quality, Registry, Open Source