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OHDSI on FHIR Platform Development with OMOP CDM mapping to FHIR Resources

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Abstract

Fast Healthcare Interoperability Resources (FHIR)[1] is a rapidly growing health information exchange standard that defines a specification of API based exchange of health information content in a standard, simplified data model to facilitate information sharing between health information systems such as EHRs, PHRs, payer systems, personal medical devices, etc. FHIR allows on-demand access to componentized patient health data along with cross references to other related information. OMOP [2] provides similar capabilities for the sharing of health research data using a common data model for relational databases. Each technology has been developed to serve different needs. By combining the two environments, we create a research and development platform that supports both data science and application deployment research. In this document, we present our mapping of the OMOP CDM to FHIR resources and our construction of a platform to serve end-to-end needs from data science to patient care.

Introduction

We have developed our first version of an OHDSI on FHIR platform as depicted in Figure 1. The OHDSI on FHIR platform consists of three applications/systems: OHDSI environment, OMOP on FHIR, and SMART on FHIR.

OHDSI environment: The OHDSI environment [3] consists of the complete suite of applications developed by the open source OHDSI community. The prerequisite for this environment is the OMOP data repository populated with patient level health data.

OMOP on FHIR: This consists of Tech on FHIR and an OMOP v5 data repository. Tech on FHIR is built using HAPI FHIR [4]. It supports CREATE, READ, UPDATE, and DELETE (CRUD) operations. The data connector in the Tech on FHIR server accesses the OMOP v5 data repository to map CDM formatted patient data to the appropriate FHIR resources. The mapped FHIR resources can be accessed by a client using the DSTU2 version of the FHIR API.

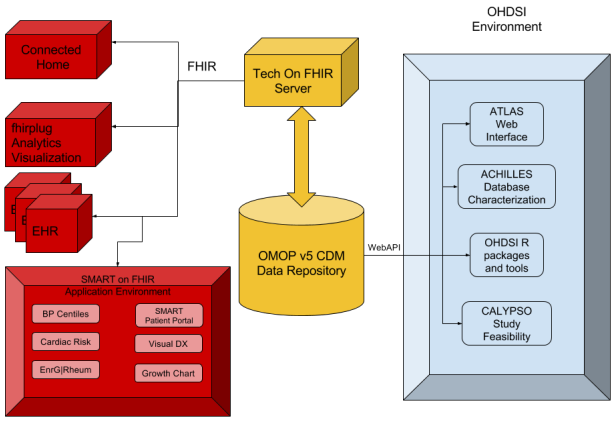

Figure 1: OHDSI on FHIR Platform Architecture

SMART on FHIR applications/systems: We have deployed and integrated necessary components to enable the SMART on FHIR [5] application environment. Some SMART on FHIR apps have been deployed in the application portal (or simulated EHR) and use data stored in the OMOP CDM Data Repository. A FHIR visual analytic tool is being developed using this platform, and health data stored in the OMOP CDM data repository are used for the visualization.

In addition to making OMOP CDM data available for FHIR based tools, supporting the FHIR CREATE API allows live data streams from health devices or applications to be stored in the OMOP data repository providing instant availability of new data to these tools in the OHDSI environment. The OHDSI on FHIR platform allows bidirectional data exchanges enabling researchers access to live data feeds as well as offline loads of large datasets.

Mapping Strategy on Tech on FHIR

FHIR focuses on providing a secure interoperable environment for health service providers to exchange data and for application resources to access it in place while OHDSI and the OMOP CDM create an environment to support data research. Due to these separate aims, some key FHIR data elements, such as patient demographic information, are not available in OMOP. We created a synthetic one-to-one matching table to support these information elements without compromising the existing CDM tables. Other than elements that do not currently exist in the CDM, FHIR data elements are mapped to the OMOP CDM as closely as possible. Data elements that are required in FHIR but do not exist in the CDM are statically assigned with a reasonable value.

OMOP v5 to FHIR

We currently have the following tables mapped to FHIR:

> *care_site, concept, condition_occurrence, drug_exposure, measurement, observation, person, procedure_occurrence, provider, visit_occurrence, device_exposure (in-progress).*

and, the following FHIR resources are mapped from the tables.

> *Location, Medication, Condition, MedicationOrder, MedicationDispense, MedicationAdministration, Observation, Patient, Procedure, Practitioner, Encounter, Device (in-progress).*

Figure 2 depicts examples of how the mapping is performed. Each table's primary keys (or IDs) are used as an ID for the corresponding FHIR resources.

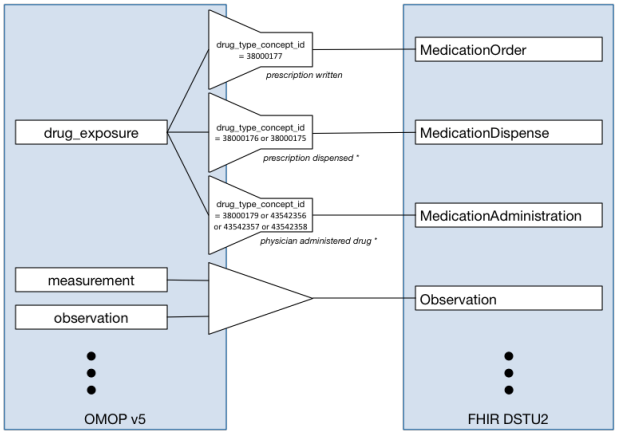

Figure 2: OMOPv5 to FHIR Mapping Example

FHIR to OMOP v5

Mapping from FHIR to OMOP is challenging because FHIR resources can contain more information than the OMOP CDM supports. There are two approaches to address this issue. One is to ignore the elements that cannot be mapped to the OMOP CDM unless these are required by FHIR. This will result in a loss of information that is not currently supported in the CDM. The other approach is to have a generic FHIR table to hold the received FHIR content as is, then later retrieve them using either a JSONb or XML path for any GET or POST operations. For our first version of the platform, we are using the first approach and ignoring those data elements except necessary patient demographic information and required FHIR resource elements. In our next version, we will use the second approach and store the rest of the unmappable FHIR data elements in their original format (JSON or XML).

Conclusion

We could not populate all the FHIR data elements from OMOP v5. However, the data elements that we have mapped from OMOP CDM were sufficient to provide meaningful clinical data to application developers. We have found some vocabulary differences between FHIR and OMOP v5. We believe that we can make more efficient mapping between two if we can further reconcile these differences. One example is vocabulary reference. Some FHIR applications are using system URI in the coding section to recognize which coding system is defined in the FHIR resource. Similar URI information is available in the vocabulary reference.

Our future work is to continuously enhance our mapping strategy and improve the OHDSI on FHIR platform. Furthermore, we will identify any data mapping gaps and work with both working groups to close them.

Reference

1. Fast Healthcare Interoperability Resources (FHIR), https://www.hl7.org/fhir
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