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OMOP on FHIR for Data Analytic Application Platform

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Abstract

Fast Healthcare Interoperability Resources (FHIR)[1] has been growing rapidly as a service for health information exchange between health systems. On the other hand, there is a machine learning that has greatly advanced, and the performance of predictive models in healthcare has been improved. Integrating these two technologies with OMOP CDM [3] as a backend data models enables the delivery of analytics at the point of care. In this document, we present how OMOP-based predictive models are connected to the clinical decision support systems via FHIR. This application platform is being built on our previous studies, OMOP on FHIR mapping and GT-FHIR Release 2 architecture, which are now the part of Georgia Tech's Health Data Analytics Platform.

Introduction

Application platform requires number of different components interconnected together to provide integrated solutions for deployed applications. The OMOP on FHIR for Data Analytics Application Platform has the following three critical components.

- Big Data in common model for training and developing analytic models
- Interoperability and communication component for system interfaces and content exchanges
- Data mapping for semantic interoperability

The platform implements these three components with OMOP CDM, FHIR, and OMOP on FHIR. Both OMOP CDM and FHIR are designed to store meaning of data. While they both have similar capability, their goals are different, which make some of data mapping in OMOP on FHIR obscure. In the following section, we describe how we architecturally address while providing a platform for analytic applications.

OMOP on FHIR Architecture

The OMOP on FHIR architecture is presented in [2]. As shown in Figure 1, it provides mappings and workflow for reading and writing between FHIR and OMOP CDM. Main concept of this architecture is to decouple reading and writing transaction flows to improve the data integrity and quality. For writing, staging tables are used. FHRI data will be mapped to the staging table, which will then trigger the ETL to execute processes for transforming these staging tables to OMOP CDM. You can think of this approach as progressive mapping strategy (or multi-step data transformation.) Often, we receive datasets in different format from multiple sources. At the first stage, we map them into the staging table. We would need to be customized to handle those raw data. However, once they are mapped to the staging table. We use our standard ETL to map them to workable data in OMOP CDM. Details on the ETL will be

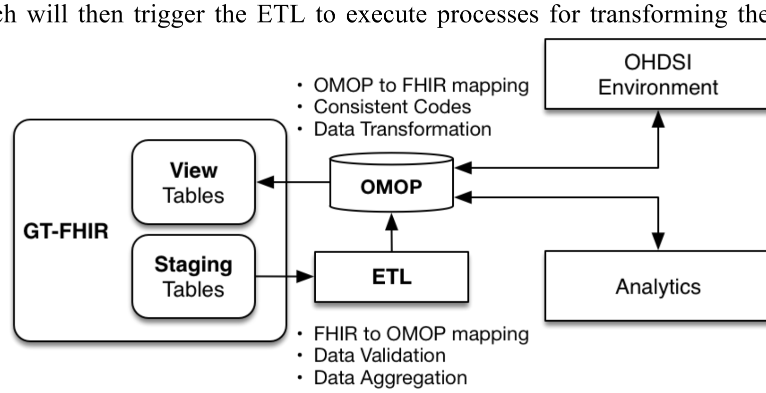

***Figure 1**:OMOP on FHIR Architecture*

presented separately.

Furthermore, with this architecture design, the ETL processes provide the auditing and quality control steps to ensure data are persisted into the proper locations and mapped appropriately to OMOP CDM. Once data are persisted into the OMOP CDM, we gain access to the Observational Health Data Sciences and Informatics (OHDSI) resources [4] that can perform data aggregations and packages for cohort creation and various population level data analytics. As we are mapping the FHIR contents to OMOP CDM, any EHRs that can understand this data model can take advantage of our platform.

Some of data elements in FHIR cannot be one-to-one mapped from OMOP CDM. SQL views are used to map the OMOP CDM tables to the appropriate FHIR resources for read requests. By constructing FHIR-friendly schema views, the FHIR API layer can be implemented relatively easily and is more robust to changes in the OMOP model. We would also maintain FHIR specific tables to support FHIR resources that OMOP cannot handle. We call them f_* tables or views.

Analytics Application Platform

The OHDSI software provides various analytic tools that minimize the overhead for data scientists. These tools provide robust analytics capabilities but are limited in their real-world impact on clinical care. With OMOP on FHIR, any data analytics process can be turned into application services for delivery at the point-of-care. Figure 2 depicts the logical process flow of data analytics with OMOP on FHIR. Note that GT-FHIR supports SMART on FHIR [5]. With this feature, applications in the platform can utilize the analytic services via APIs and patient EHR data.

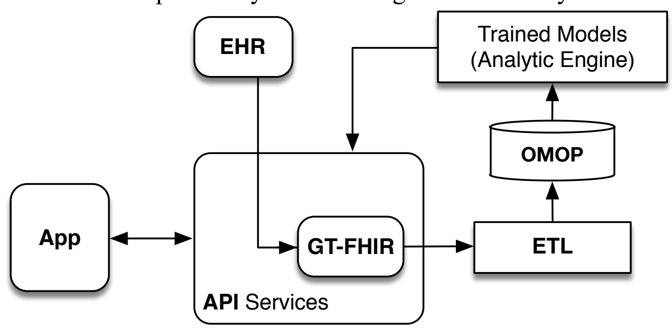

***Figure 2**: Analytics Application Platform*

As a test case, we deployed a predictive model for assessing risk of C. Difficile colitis infection based on individual patient characteristics. We set up an API gateway that received test patient data via FHIR, transformed to OMOP, called the C. Diff predictive model, and returned the personalized risk prediction. Total transit time for ingestion, mapping, and result generation averages 5-6 seconds with mid-end virtual machines.

Conclusion

OMOP on FHIR is an open-source platform that provides bidirectional mapping processes between OMOP and FHIR as well as a framework for API-based analytics as a service using OMOP-based predictive models. Our future work includes expanding mappings and evaluating several OMOP-based predictive models for impact on clinical decision-making. We hope that tools such as OMOP on FHIR, which connect research analytics to the point-of-care, will advance the goals of precision medicine while allowing innovation in analytics.

Reference

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