

FHIR-Ontop-OMOP: Querying OMOP clinical databases as FHIR-compliant Clinical Knowledge Graphs

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1. Introduction

The *Observational Medical Outcomes Partnership* (OMOP)¹ is an open community data standard, designed to standardize the structure and content of observational data and to enable efficient analyses that can produce reliable evidence. OMOP relies on relational databases and many datasets are already available in the OMOP format. The *Fast Healthcare Interoperability Resources* (FHIR)² is a more recent effort in the Semantic Web community, which relies on technologies like W3C languages RDF, SPARQL, OWL, and the ShEx language. Interoperability between OMOP and FHIR is an important research topic.

In this demo, we present the FHIR-Ontop-OMOP system for querying clinical OMOP databases as Clinical Knowledge Graphs (CKGs) [1]. To be more precise, the system exposes the OMOP data as a queryable Knowledge Graph compliant with the HL7 *FHIR* standard using the *Ontop*³ Virtual Knowledge Graph engine [2].

FHIR-Ontop-OMOP is an open-source system, published at Github⁴ under Apache 2 license. The system requires a working connection to the OMOP PostgreSQL database. For example, in paper [1], we have used the full MIMIC-III data sets in the OMOP model. The system also comes with a small demo data set from the MIMIC-IV project available in the OMOP Common

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¹<https://www.ohdsi.org/data-standardization/the-common-data-model/>

²<https://www.hl7.org/fhir/>

³<https://ontop-vkg.org/>

⁴<https://github.com/fhircat/FHIROntopOMOP>

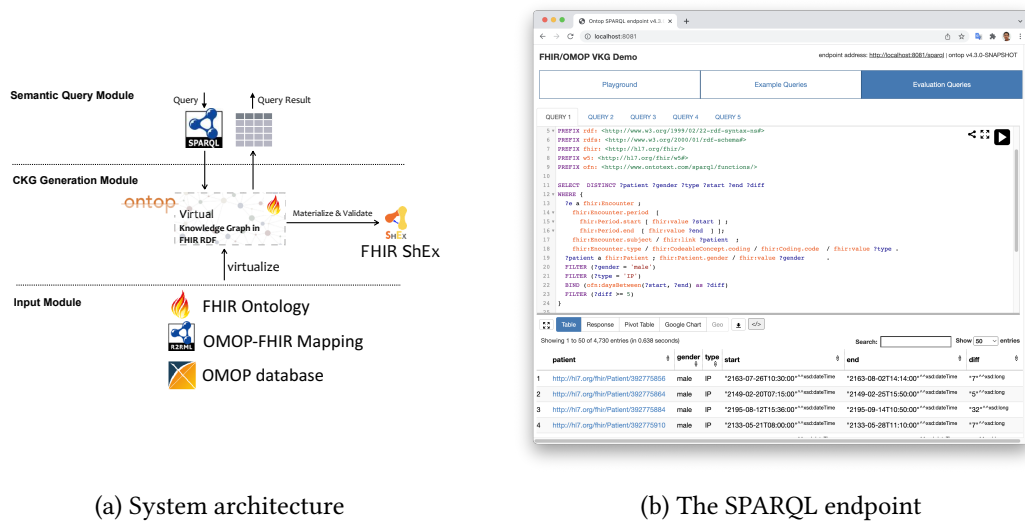


Figure 1: The FHIR-Ontop-OMOP system

Data Model⁵. Instructions on how to use these datasets are described in detail in the README file on Github.

The system architecture is illustrated in Figure 1a. It consists of the following modules (from the bottom to top): (1) an input module that takes input from the FHIR model ontology, the OMOP data repository, and OMOP-FHIR mappings represented by a mapping template; (2) a CKG generation module that relies on the Ontop system to generate a virtual CKG; and (3) a semantic query module that establishes SPARQL endpoints with reasoning capability.

Once the system is running, users can pose SPARQL queries to the virtual Clinical Knowledge Graph following the FHIR data model. The query module relies on the query answering interface of Ontop. The Ontop system translates SPARQL queries over the CKG to SQL queries over the OMOP database, using the FHIR ontology and FHIR-OMOP mapping. Figure 1b shows a SPARQL query example against the MIMIC III OMOP database, and its answers. Further example queries are also provided.

References

- [1] G. Xiao, E. Pfaff, E. Prud’hommeaux, D. Booth, D. K. Sharma, N. Huo, Y. Yu, N. Zong, K. J. Ruddy, C. G. Chute, G. Jiang, FHIR-Ontop-OMOP: Building clinical knowledge graphs in FHIR RDF with the OMOP common data model, *Journal of Biomedical Informatics* 134 (2022) 104201.
- [2] G. Xiao, D. Lanti, R. Kontchakov, S. Komla-Ebri, E. Güzel-Kalayci, L. Ding, J. Corman, B. Cogrel, D. Calvanese, E. Botoeva, The virtual knowledge graph system Ontop, in: *International Semantic Web Conference (ISWC)*, volume 2, 2020, pp. 259–277.

⁵<https://physionet.org/content/mimic-iv-demo-omop/0.9/>