



WORKSHOP

FHIR X OMOP

OHDSI BELGIUM

Tuesday 10 September 2024 - Comet, Brussels

Report

With the financial support of:



Content

<u>Introduction</u>	1
<hr/>	
<u>Key insights & takeaways</u>	2
<hr/>	
<u>Background</u> - Understanding FHIR and OMOP CDM	3-5
<hr/>	
<u>Introduction to FHIR</u>	3
<hr/>	
<u>Introduction to OMOP CDM</u>	4
<hr/>	
<u>Comparative overview of FHIR and OMOP CDM</u>	5
<hr/>	
<u>The case for interoperability</u> - FHIR and OMOP coexistence	6-7
<hr/>	
<u>Complementary roles and synergies</u>	6
<hr/>	
<u>Integrating FHIR and OMOP - Why and how?</u>	7
<hr/>	
<u>Introducing the InterSystems OMOP Platform for FHIR to OMOP conversion</u>	8-10
<hr/>	
<u>Overview of the InterSystems OMOP Platform</u>	8
<hr/>	
<u>Status and development of the ETL Pipeline</u>	9
<hr/>	
<u>Advantages and challenges of the InterSystems OMOP Platform</u>	10
<hr/>	
<u>Conclusion and future directions</u>	10
<hr/>	
<u>Reflections, feedback and recommendations from the workshop</u>	11
<hr/>	
<u>Conclusion and next steps</u>	12
<hr/>	
<u>Annex - About the organizers</u>	13
<hr/>	

Introduction

The "FHIR x OMOP" workshop, held on September 10 - 2024, at Comet in Brussels, was organized under the umbrella of OHDSI Belgium, with significant content and financial support from Tiro.Health and InterSystems. The primary objective was to explore the coexistence and integration of two major healthcare data standards: FHIR (Fast Healthcare Interoperability Resources) and OMOP CDM (Observational Medical Outcomes Partnership Common Data Model).

The workshop was attended by a diverse group of participants, including representatives from academic institutions, healthcare providers, and industry experts, who collaborated to advance the understanding of these standards in the Belgian health data ecosystem.

Special thanks are extended to the OHDSI Belgium team, and all the representatives from InterSystems and Tiro.Health for their invaluable contributions to the workshop's content and logistics.



Over 40 health data enthusiasts participated in this workshop - #DataSavesLives



Key insights & takeaways

Complementary roles of FHIR and OMOP CDM

- **FHIR:** Optimized for real-time data exchange, enabling interoperability across healthcare delivery environments by supporting the integration of various Electronic Health Record (EHR) systems, mobile apps, and health IT solutions.
- **OMOP CDM:** Provides a standardized framework for storing and analyzing observational health data, facilitating long-term data preservation, research, and cross-institutional collaboration.

The integration of these standards offers a holistic approach to data management, balancing clinical needs with research objectives.

Interoperability and data integration strategies

Establishing interoperability between FHIR and OMOP CDM can leverage their complementary strengths:

- **Data translation and transformation:** FHIR resources can be converted into OMOP CDM tables, enabling the repurposing of real-time clinical data for research without redundant data entry. Conversely, research findings stored in OMOP CDM can be accessed by clinical systems through FHIR, bridging the gap between research and clinical practice.
- **ETL pipelines:** An Extract, Transform, Load (ETL) pipeline ensures seamless data integration by converting data formats between FHIR and OMOP CDM, promoting consistent and comprehensive data use.

InterSystems OMOP Platform: A pathway to integration

InterSystems has developed a cloud-based OMOP Platform that features an ETL pipeline to transform healthcare data from FHIR to OMOP CDM format. Key components include:

- **Automated data handling:** Daily conversion and refresh of EHR data into OMOP format, reducing manual effort and errors.
- **Scalability and flexibility:** Supports large-scale data processing for healthcare organizations of various sizes.
- **Enhanced interoperability and compliance:** Facilitates seamless data integration while adhering to regulatory standards and ensuring data security.

This platform's ability to integrate clinical and research data effectively positions it as a valuable tool for advancing both patient care and medical research.

Challenges and areas for improvement

Despite its potential, the ETL pipeline requires further development*:

- **Handling FHIR extensions:** Custom FHIR extensions need tailored mapping strategies to ensure effective data transformation.
- **Performance optimization:** Enhanced processing capabilities are needed to manage large datasets efficiently.
- **Comprehensive documentation:** Additional user-friendly guides and documentation are crucial to support broader adoption and ease of use.

**An updated version of the presented pipeline will be launched at the OHDSI Global Symposium in October 2024, reflecting the feedback and insights gathered during this workshop.*



Background - Understanding FHIR and OMOP CDM

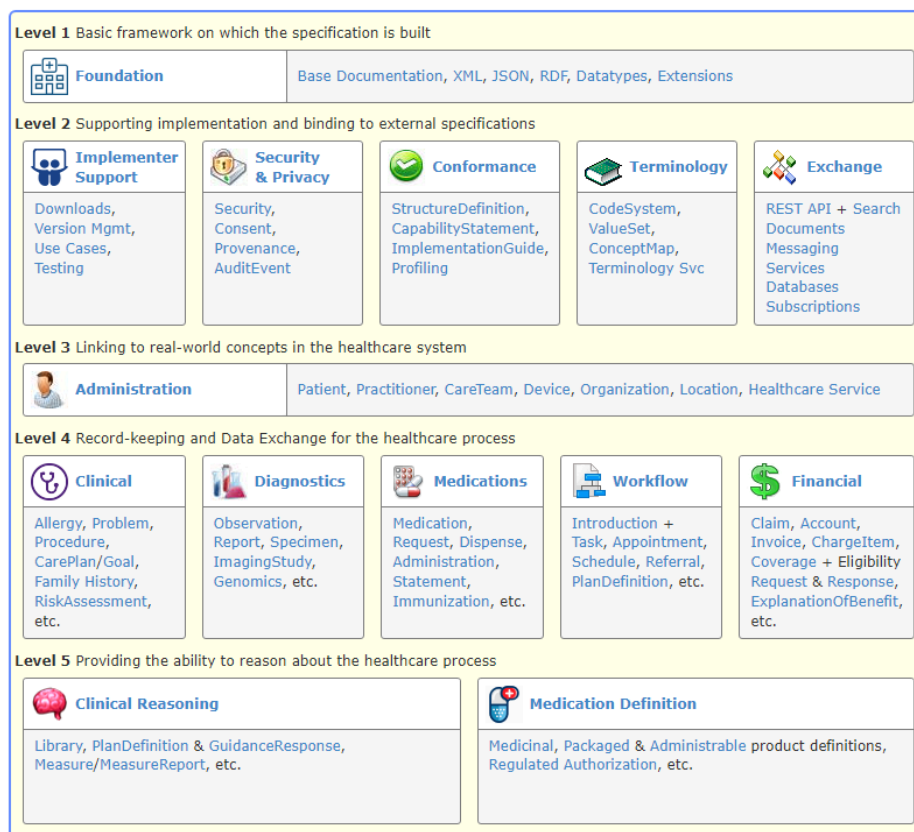
Introduction to FHIR

FHIR is a standard developed by Health Level Seven International (HL7) to enable the exchange and integration of healthcare data across various systems. The FHIR standard facilitates seamless communication between different healthcare applications and platforms, leveraging widely used web technologies.

Core principles of FHIR:

- **Resource-Based Model:** FHIR organizes data into "resources," which represent discrete pieces of healthcare information, such as Patient, Observation, Medication, and Procedure. Each resource has a standardized structure, allowing consistent data exchange.
- **Interoperability and flexibility:** FHIR supports real-time data exchange, enabling different healthcare systems to interact dynamically. Adjustments to the base specification are captured in an implementation guide, which specifies which resources or profiles (adaptations of the base resources) are used to solve a specific use case.
- **Global adoption and implementation:** FHIR has been widely adopted globally due to its compatibility with modern web technologies, making it a popular choice among healthcare IT developers and organizations seeking to integrate various data sources.

To explore FHIR in more detail, including its architecture, data structures, and practical applications, please read the [Tiro.Health white paper on FHIR](#), watch this [high-level overview video](#), or visit the [HL7-FHIR website](#).



An overview of [resources in FHIR v5](#)

Background - Understanding FHIR and OMOP CDM

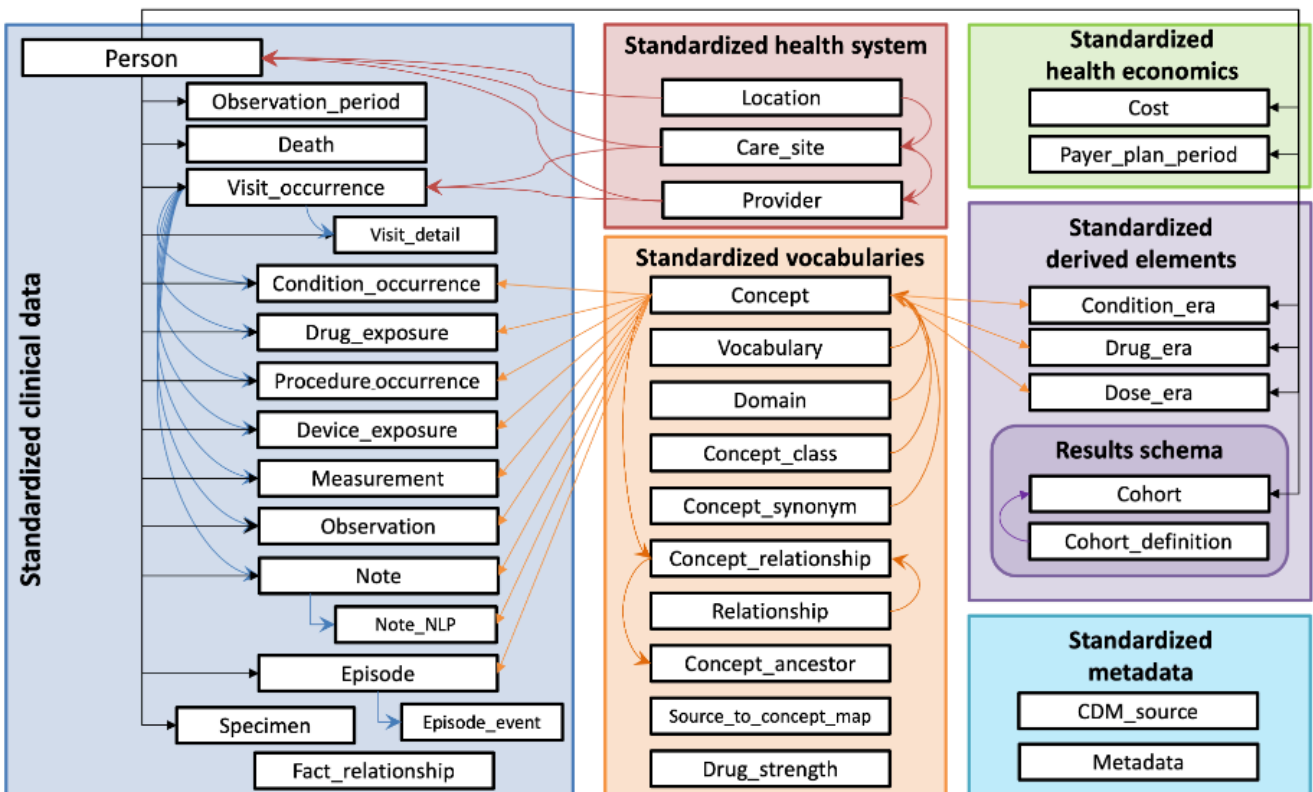
Introduction to OMOP CDM

OMOP CDM is a standardized framework developed by the OHDSI (Observational Health Data Sciences and Informatics) community to support observational healthcare research. Unlike FHIR, which focuses on real-time data exchange, OMOP CDM emphasizes data standardization for research purposes, enabling robust and reproducible data analysis across different healthcare organizations.

Core principles of OMOP CDM:

- **Relational Database Structure:** OMOP CDM organizes healthcare data into a series of interconnected tables, each representing different healthcare concepts, such as patient demographics, clinical conditions, procedures, medications, and observations.
- **Standardized Vocabularies:** It utilizes standardized vocabularies like ICD-10, SNOMED-CT, and RxNorm to ensure uniform data representation, facilitating interoperability across diverse datasets.
- **Federated Data Research:** OMOP CDM supports decentralized data storage models, enabling data to remain within the control of individual organizations while allowing collaborative research across multiple institutions through shared analytical queries.

More detailed insights into OMOP CDM's structure, implementation, and use cases can be found in [Tiro.Health's white paper on OMOP CDM](#) or in the [Book of OHDSI](#).



An overview of the tables in [OMOP CDM v5.4](#)

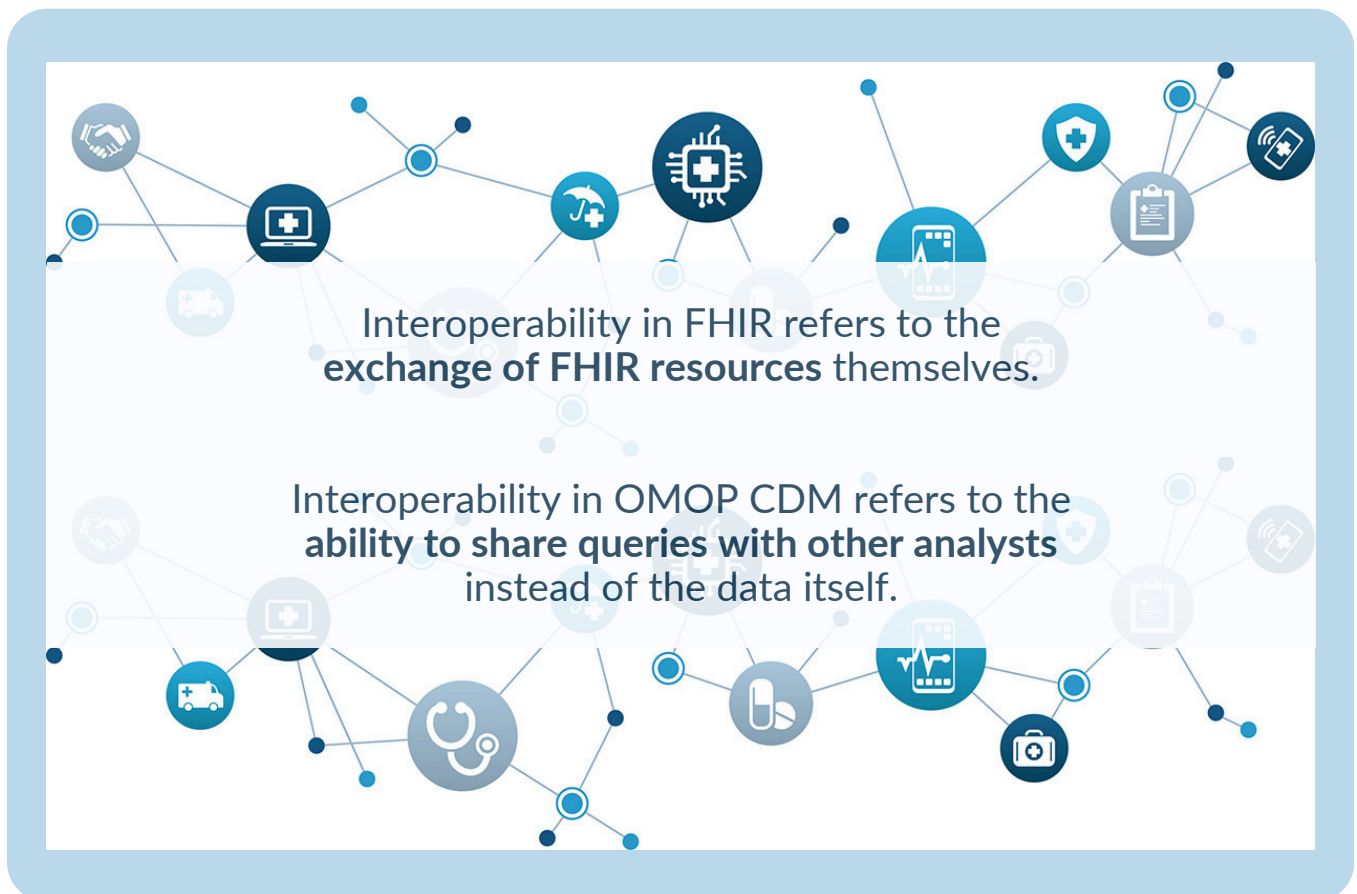


Background - Understanding FHIR and OMOP CDM

Comparative overview of FHIR and OMOP CDM

- **FHIR** is optimized for clinical interoperability and real-time data exchange. It is used primarily within healthcare delivery environments to enable the seamless integration of various EHR systems, mobile apps, and health IT solutions.
- **OMOP CDM**, in contrast, provides a standardized format for observational medical data, supporting large-scale research and analysis efforts. It excels in environments where long-term data storage and cross-institutional collaboration are essential.

While both standards offer unique advantages, their integration within a unified ecosystem can significantly enhance the utility and accessibility of healthcare data for both clinical and research purposes.

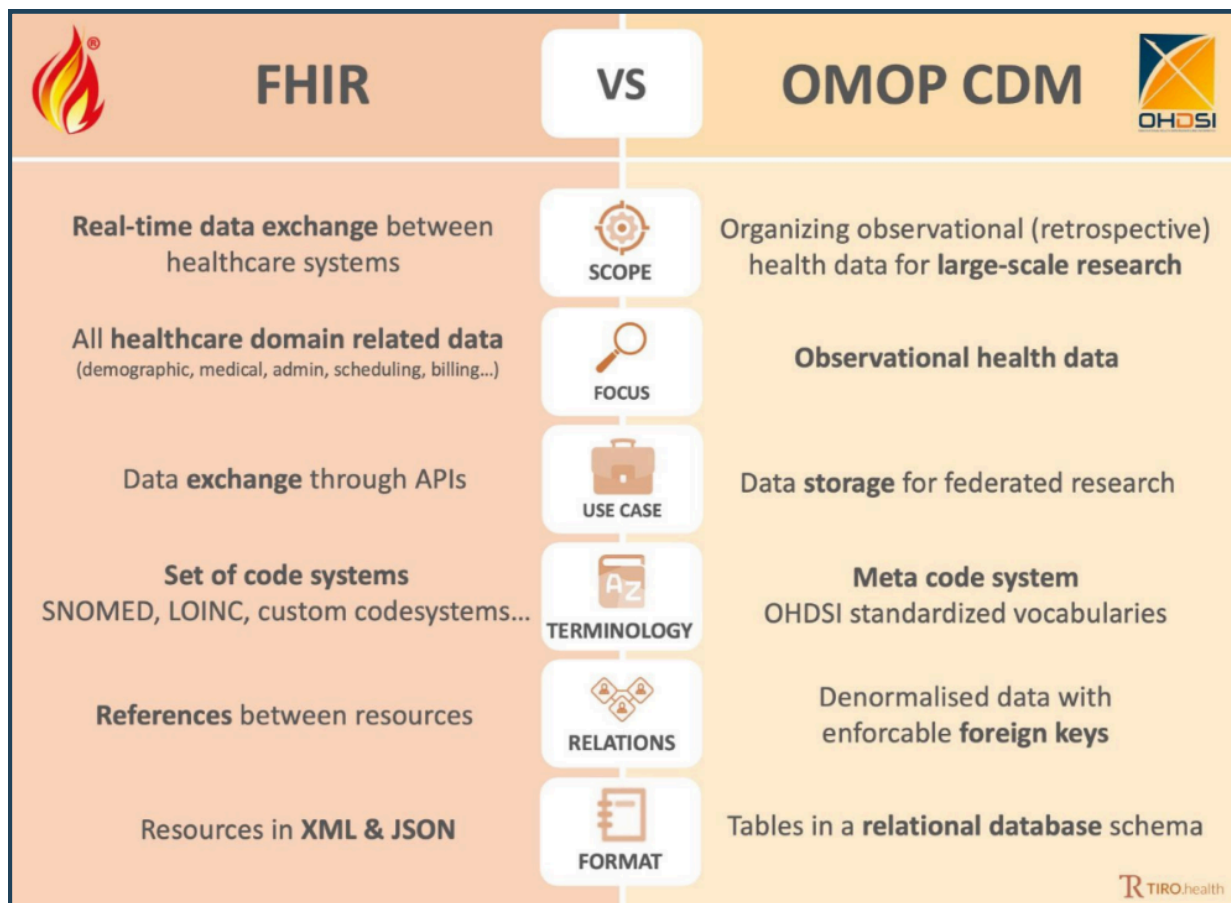


The case for interoperability - FHIR and OMOP coexistence

Complementary roles and synergies

FHIR and OMOP CDM are not competing standards; rather, they serve complementary roles within the healthcare ecosystem:

- **FHIR's role:** Supports dynamic, real-time data exchanges across multiple platforms and systems. It is designed to facilitate the integration of various healthcare applications, allowing data to flow freely between EHRs, healthcare apps, and data repositories.
- **OMOP CDM's role:** Provides a robust data model for storing and analyzing observational health data. It is geared towards long-term data preservation, research, and collaborative studies, allowing consistent data analysis across different datasets and institutions.



An overview of FHIR vs. OMOP CDM (from white paper Tiro.Health)



The case for interoperability - FHIR and OMOP coexistence

Integrating FHIR and OMOP - Why and how?

By establishing interoperability between FHIR and OMOP CDM, healthcare organizations can leverage the strengths of both standards:

- **Data Translation and Transformation:** FHIR resources can be translated into OMOP CDM tables, enabling real-time clinical data to be repurposed for research without redundant data entry. Conversely, research findings and insights stored in OMOP CDM can be made accessible to clinical systems through FHIR, closing the loop between research and clinical practice.
- **ETL Pipelines for Seamless Data Integration:** An Extract, Transform, Load (ETL) pipeline can bridge the two standards, converting data from FHIR to OMOP CDM format and vice versa, ensuring data consistency and completeness. This integration allows healthcare organizations to build a cohesive data ecosystem, enhancing both operational efficiency and research capabilities.

For further details on the compatibility and integration strategies between FHIR and OMOP, please read [Tiro.Health's white paper "FHIR vs. OMOP"](#).

FHIR Resource	OMOP Table
Patient	Person, Location, Death
Encounter	Visit_occurrence
Condition, AllergyIntolerance	Condition_occurrence, Measurement, Observation, Procedure_occurrence
Observation	Observation, Measurement, Condition_occurrence, Procedure_occurrence, Death
Location, Organization	Care_site
Practitioner	Provider, Location
Procedure	Procedure_occurrence, Condition_occurrence, Measurement, Observation
MedicationAdministration, MedicationRequest, Immunization	Drug_exposure

Bridging the gap - semantic mapping [FHIR vs. OMOP CDM](#) (from introduction InterSystems)

Introducing the InterSystems OMOP Platform for FHIR to OMOP conversion

Overview of the InterSystems OMOP Platform

InterSystems has developed a cloud-based OMOP Platform that offers a comprehensive solution for transforming healthcare data from FHIR to the OMOP CDM format. This platform serves both operational and research objectives by facilitating seamless data integration and management. The platform leverages InterSystems IRIS for Health, a scalable, high-performance data platform which now also supports the OMOP CDM and the OHDSI tools.

During the workshop, the cloud portal was used to set up two cloud instances: one instance for the automated ETL pipeline and one instance that hosts the OMOP data after transformation. Additionally, a FHIR sever was configured on a separate IRIS for Health instance, to provide the source FHIR data for the pipeline. The workflow was as follows:

- **FHIR server configuration:** The process begins with setting up a FHIR server, which acts as a central repository for receiving and storing healthcare data in FHIR format.
- **Bulk data export:** The Bulk FHIR Coordinator enables the efficient export of large data volumes from the FHIR server, preparing the data for transformation.
- **Data transformation:** A robust transformation logic maps FHIR resources (such as Patient, Procedure, and Observation) to the corresponding OMOP CDM tables (such as PERSON, PROCEDURE_OCCURRENCE, and OBSERVATION), ensuring data integrity and consistency. The platform supports out-of-the-box mapping for common FHIR resources, reducing the need for extensive manual configuration.
- **Data loading into OMOP CDM:** The transformed data is loaded into an OMOP CDM-compliant database, making it accessible for research and analysis using OHDSI tools like ATLAS and WhiteRabbit.

The InterSystems OMOP Platform offers several key features to support large-scale clinical research and patient data management:

1. **Automatic data conversion:** Converts EHR data into OMOP format daily, without complex ETL development, utilizing the widely adopted Bulk FHIR standard by EHR vendors.
2. **Rapid deployment:** Supports quick deployment of an OHDSI environment with pay-as-you-go pricing, enabling researchers to leverage OHDSI tools effectively.
3. **Timely data for trial recruitment:** Facilitates rapid updates of EHR data to identify and recruit potential trial participants promptly, increasing the likelihood of patient enrollment.
4. **Data quality monitoring:** Offers a data quality dashboard and summary metrics to detect and monitor data quality issues before and after transformation.
5. **Compliance and security:** Ensures security and regulatory compliance by leveraging cloud vendor best practices.
6. **Out-of-the-Box terminology mapping:** Provides pre-mapping to common terminologies and resources, such as SNOMED-CT and RxNorm, enabling efficient data conversion.
7. **Integration with OHDSI tools:** Allows the use of InterSystems IRIS as a new OMOP database option, supporting large-scale research through the OHDSI community tools.



Introducing the InterSystems OMOP Platform for FHIR to OMOP conversion

Status and development of the ETL pipeline

The presented version of the InterSystems ETL pipeline is in a *prototype stage* and requires further development to achieve full maturity. During the workshop, several areas for improvement were identified, including enhanced handling of custom FHIR extensions, performance optimization for large-scale datasets, and the need for more comprehensive user documentation.

The goal is to present an updated version of this pipeline at the upcoming OHDSI Global Symposium in October 2024.



Video - What is the InterSystems OMOP Platform?

Source Data	CONCEPT	CONCEPT_RELATIONSHIP	CONCEPT
Code: W61.51	concept_id: 21222	concept_id_1: 21222	concept_id: 4314097
System: ICD10CM	vocabulary_id: ICD10CM	concept_id_2: 4314097	vocabulary_id: SNOMED
Display: Bitten by goose	concept_code: W61.51	relationship_id: Maps to	concept_code: 217716004
	concept_name: Bitten by goose		concept_name: Peck by bird
	Non-standard		Standard

Example - Automatic mapping of nonstandard terminologies in FHIR data to standard terminologies in OMOP ontology



Introducing the InterSystems OMOP Platform for FHIR to OMOP conversion

Advantages and challenges of the InterSystems OMOP Platform

Advantages:

- **Automated data handling:** Automates complex data handling tasks, reducing manual effort and minimizing errors.
- **Scalability and flexibility:** Supports large-scale data processing, making it suitable for healthcare organizations of various sizes.
- **Enhanced interoperability:** Facilitates seamless data integration across different systems, supporting operational and research needs.
- **Frequent data updates:** Enables incremental data refreshes, only updating records with new data to maintain current and relevant datasets.

Challenges identified:

- **Customizability:** In order to support custom FHIR extensions and code systems, there should be the option to upload custom data transformations and custom code mappings. This last feature will already be included in the updated version.
- **Performance:** Testing of the FHIR to OMOP pipeline in terms of performance needs to take place to validate its use within large healthcare organizations. For that, performance requirements to support initial data load and incremental update for the FHIR to OMOP pipeline need to be identified.
- **Mapping transparency:** The FHIR to OMOP pipeline currently is a kind of black-box. Transparency about the mapping should be provided for auditing and documentation purposes.

Conclusion and future directions

The InterSystems OMOP Platform represents a significant advancement in the integration of FHIR and OMOP CDM standards. By providing a cloud-based, automated solution, the platform enables healthcare organizations to maximize the use of their EHR data for operational and research purposes.

As development continues, efforts will focus on improving performance, handling custom data mappings, and enhancing user documentation to support wider adoption and more effective use of the platform.

Reflections, feedback and recommendations from the workshop

During the workshop, participants provided the following feedback and suggestions for improving the ETL pipeline for FHIR to OMOP conversion:

- **Complexity of implementation:** The whole workflow was challenging to implement given the relatively short amount of time, especially for users who lack familiarity with the technical aspects of FHIR and OMOP CDM.
- **Workflow documentation:** There is a strong need for more comprehensive, step-by-step guides covering all stages of the process, from initial setup to troubleshooting and e.g. the flow from the Bulk FHIR export in the S3 bucket.
- **Performance:** The pipeline requires optimization to handle large datasets more efficiently and reduce processing times.
- **Mapping transparency and consistency:** Improved consistency and reliability in mapping between FHIR and OMOP CDM are needed, particularly for custom FHIR extensions and unique cases.
- **Training and support:** Additional training resources, such as webinars and workshops, would help users better understand and implement the ETL process effectively.

By addressing these areas, the pipeline can become more accessible, efficient, and robust, supporting both operational and research needs more effectively.





Conclusion and next steps

The "FHIR x OMOP" workshop successfully showcased the potential for integrating these two critical healthcare data standards to improve data interoperability and usability. While there are challenges, particularly in terms of technical complexity, documentation, and performance, the collaborative efforts of OHDSI Belgium, Tiro.Health, and InterSystems provide a robust foundation for further developments.

OHDSI Belgium will continue to facilitate discussions, workshops, and collaboration efforts to refine these tools and processes. The InterSystems team is committed to presenting an improved version of their ETL pipeline at the OHDSI Global Symposium in October 2024, reflecting the insights and feedback gathered during this workshop.

Participants are encouraged to engage with the OHDSI Belgium community, share their experiences, and contribute to ongoing efforts to improve the healthcare data ecosystem. Additional resources, including white papers and slide decks, are available for those interested in exploring these topics further.

References & resources

- **White papers Tiro.Health**
 - [FHIR Starter's Guide](#)
 - [OMOP Starter's Guide](#)
 - [FHIR vs. OMOP White Paper](#)
- **Documentation InterSystems**
 - [InterSystems OMOP Platform](#)
- **Workshop slide decks**
 - [Tiro.Health introduction](#)
 - [InterSystems introduction](#)





Annex - About the organizers

OHDSI Belgium

The Belgian OHDSI Node was born spontaneously from the Belgian EHDEN community. After several members expressed their interest to form a Node, we organized a brief poll among Belgian EHDEN data partners, certified SMEs and their networks. This generated a lot of enthusiastic responses, not only from the current community, but also from aspiring data partners and several other stakeholders. In a short time, the Node had been established.

The Node members realize that, in order to leverage health data to improve citizen health, we need an enabling foundation that is trustworthy for citizens and offers FAIR data with a clear governance model. Therefore, besides promoting Belgian participation in OHDSI network studies, the Node aims to contribute to a harmonized Belgian health data ecosystem that is aligned with the European OHDSI chapter and the European Health Data Space and specific national legislations. It takes a hands-on approach, focused on getting things done following the OHDSI open-source and open-science principles.

More information can be found on [OHDSI Belgium's website](#) or [LinkedIn](#) page.

Tiro.Health

Tiro.Health is an SME located in Gent, focusing on transforming data capture for clinicians. Their team is crafting software to save time for clinicians, improve data quality, and drive better patient care.

More information can be found on [Tiro.Health's website](#) or [LinkedIn](#) page.

InterSystems

InterSystems is the leading provider of AI-enabled data management solutions for industries with complex challenges, including healthcare, financial services, and supply chain and logistics. Their health solutions are based on a common set of interoperability services and support virtually every major health standard.

More information can be found on [InterSystem's website](#).



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