

From HEYEX to OMOP: Lessons Learned Connecting a Retinal OCT Repository to the EHR at an Academic Medical Center

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Background and Motivation

Ophthalmology relies heavily on imaging to support accurate diagnosis and treatment. Consequently, addressing critical research questions requires the integrated analysis of structured electronic health record (EHR) data alongside high-dimensional ocular imaging. However, at most academic medical centers, these data sources remain siloed: clinical data reside within the EHR, while ocular images are stored locally on acquisition devices or distributed across non-interoperable PACS systems. This fragmentation represents a major barrier to both single-site retrospective studies and multicenter collaborations.

Objectives

We describe the infrastructure development process at the Vanderbilt Eye Institute (VEI) to create a linked optical coherence tomography (OCT) imaging repository integrated with clinical exam data from the Vanderbilt University Medical Center (VUMC) EHR. We present this work as an implementation of a reproducible model for institutions seeking to participate in OHDSI-based ocular imaging network studies. Additionally, we outline our approach and roadmap for mapping this repository to the OMOP Common Data Model (CDM) as a foundation for scalable multicenter observational research.

Methods and Infrastructure Development

Developing this repository required addressing several interdependent technical and institutional challenges:

1. EHR Data Extraction

This effort required extensive collaboration with VUMC's Department of Biomedical Informatics (DBMI), Clinical Informatics Core, and the Vanderbilt Institute for Clinical and Translational Research. Key considerations included defining data governance and storage; establishing automated, operationally-transparent extraction workflows; and determining appropriate update frequencies. We describe a structured framework for navigating these discussions and operationalizing data access.

2. Image and Metadata Extraction

OCT images at VEI are acquired using multiple Heidelberg imaging devices which then send images to the HEYEX PACS. The latest HEYEX version stores images in DICOM format. We detail the conversion workflow and the resulting storage architecture.

3. Linkage and Repository Construction

Imaging data were linked to corresponding EHR records using medical record number (MRN) and date of service, and stored within a VUMC IT-approved, HIPAA-compliant environment (Databricks). We describe the governance structure, storage, and access control strategies necessary to operationalize this repository for research use.

4. Toward OMOP Integration

We outline our current approach and outstanding challenges in representing ocular imaging metadata and associated clinical variables within the OMOP CDM. This includes mapping to relevant concept domains (Condition, Measurement, Procedure, Observation) and identifying limitations in existing OMOP vocabularies for ophthalmic imaging that require extension through custom concepts.

Conclusions and Future Directions

The challenges encountered at VUMC—including fragmented imaging storage, proprietary file formats, heterogeneous PACS environments, and limited standardized vocabularies for ocular imaging in OMOP—are common across ophthalmology practices. These barriers constrain the generation of real-world evidence in ophthalmology at scale. By documenting our approach and progressing toward OMOP standardization, we position VEI to participate in OHDSI-enabled multicenter studies of ocular disease. We anticipate that standardized, OHDSI components will enable the construction of federated ophthalmic imaging research networks.