

Inclusion of intraocular pressure data into the University of California Health Data Warehouse

William Halfpenny, MB BChir, MEng^{1,2}, Ayan Patel, MS³, Catherine Q. Sun, MD⁴, Kerry Goetz, MS, PhD,⁵ Michelle Hribar, PhD,^{6,7} Sally L. Baxter, MD, MSc^{1,2} * on behalf of the OMOP Eye Care & Vision Research Workgroup

¹ Division of Ophthalmology Informatics and Data Science, Viterbi Family Department of Ophthalmology and Shiley Eye Institute, University of California San Diego, La Jolla, California

² Health Department of Biomedical Informatics, University of California San Diego, La Jolla, California

³ Center for Data-driven Insights & Innovation, University of California Health, Oakland, CA, USA

⁴ Department of Ophthalmology, University of California, San Francisco, California

⁵ National Eye Institute, National Institutes of Health

⁶ Casey Eye Institute Department of Ophthalmology, Oregon Health & Science University

⁷ Department of Medical Informatics and Clinical Epidemiology, Oregon Health & Science University

Corresponding Author/Address for Reprints: Sally L. Baxter, MD, MSc, Shiley Eye Institute and Viterbi Family Department of Ophthalmology, University of California, San Diego, 9415 Campus Point Dr, MC 0946, La Jolla, CA 92093 (s1baxter@health.ucsd.edu).

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ABSTRACT

Background

Efforts to bring ophthalmology data into OMOP have often been behind those of other fields [1]. There is ongoing work by the Eye Care and Vision Working Group to improve this, through vocabulary gap analysis, data transformation design and institutional efforts to implement ETLs [2]. This work documents a cumulation of such efforts, where intraocular pressure, a key ophthalmology datapoint, was loaded into the University of California Health Data Warehouse (UCHDW), an OMOP data warehouse that aggregates data from multiple UC health systems.

Intraocular pressure (IOP) is considered an ophthalmic “vital sign” and is the only modifiable risk factor of glaucoma [3], the world’s leading cause of irreversible blindness. IOP has been frequently used either for cohort identification [4] or outcome evaluation [5] in many landmark clinical trials in ophthalmology. As of now, all glaucoma therapeutic approaches (i.e., hypotensive medications and surgical and laser techniques) aim to lower IOP. Without representation of IOP, it would be impossible to study the outcomes of glaucoma care. Evaluation of IOP is also important for monitoring post-operative or post-procedural outcomes (e.g., after cataract surgery or intravitreal injections) and potential adverse effects related to ocular or systemic medications.

Methods

All patients with IOP measurement records in the UCHDW as of February 2024 were included. The process involved mapping IOP terms from each site’s Epic Kaleidoscope EHR to OMOP standard concepts, transforming data into the OMOP model, and ensuring data quality. The value_as_number field was generated using a text-to-float SAFE_CAST, that cast any non-numeric values to NULL. Analyses included examining sampling characteristics across patients, comparison of the IOP measurement distribution with a reference standard, characterization of outliers, and a review of sampling over time.

Results

95,700 patients had IOP measurements, with a total of 1,255,300 individual measurement events recorded (1,158,200 when null records were excluded). All loaded values were confirmed to be numeric; no string or text values (e.g., “soft”) were present. The mean (SD) IOP after outlier exclusion was 15.27 (3.72) mmHg, which is consistent with previously published population-based studies. There were 1500 (0.13%) measurements that qualified as outliers (IOP>50 mmHg). The study highlighted data quality issues, such as anomalous entries (e.g., non-physiologic values) and significant artifacts in recorded measurement dates. A notable finding was that 35% of records were listed as occurring on a single day, due to EHR system transition (Figure 1).

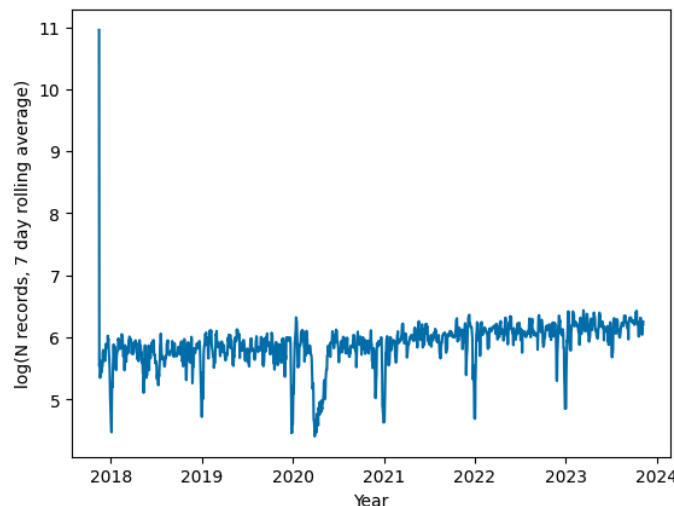


Figure 1: Distribution of IOP records over time, demonstrating an erroneous spike at the beginning of records. Note that y axis is a log scale.

Conclusion: The successful inclusion of IOP data into the UCHDW demonstrates a significant milestone in operationalizing vision data in OMOP. It underscores the importance of close communication between clinical/research teams and IT teams, and the necessity of rigorous data quality checks. The study also identifies areas for improvement in future data transformation efforts, such as handling non-numeric values and validating data against source records. The OHDSI community can use this as a case study for lessons from incorporating new specialty domains, and should be aware of the new influx of previously unavailable vision data, as similar work is being repeated across multiple institutions.

References

- [1] Baxter SL, Lee AY. Gaps in standards for integrating artificial intelligence technologies into ophthalmic practice. *Curr Opin Ophthalmol*. 2021 Sep 1;32(5):431-8. doi: 10.1097/ICU.0000000000000781. PMID: 34231531; PMCID: PMC8373825.
- [2] Eye Care Vision Working Group [Internet]. Available from: <https://ohdsi.github.io/EyeCareVisionWG/>
- [3] Coleman AL, Kodjebacheva G. Risk factors for glaucoma needing more attention. *Open Ophthalmol J*. 2009 Sep 17;3:38-42. doi: 10.2174/1874364100903020038. PMID: 19816585; PMCID: PMC2759104.
- [4] Kass MA, Heuer DK, Higginbotham EJ, Johnson CA, Keltner JL, Miller JP, et al. The Ocular Hypertension Treatment Study: a randomized trial determines that topical ocular hypotensive medication delays or prevents the onset of primary open-angle glaucoma. *Arch Ophthalmol*. 2002 Jun;120(6):701-13; discussion 829-30. doi: 10.1001/archophth.120.6.701. PMID: 12049574.
- [5] Gedde SJ, Schiffman JC, Feuer WJ, Herndon LW, Brandt JD, Budenz DL, et al.; Tube versus Trabeculectomy Study Group. Treatment outcomes in the Tube Versus Trabeculectomy (TVT) study after five years of follow-up. *Am J Ophthalmol*. 2012 May;153(5):789-803.e2. doi: 10.1016/j.ajo.2011.10.026. Epub 2012 Jan 15. PMID: 22245458; PMCID: PMC4460598.