



Discrepancies in Ophthalmic Medication Documentation for Glaucoma Patients



Manual chart review of 150 glaucoma outpatient visits found discrepancies in ophthalmic medications documented in medication lists and progress notes for 32% of the medications, or a median of 1 (interquartile range, 0-2) medication per patient.

Medication list accuracy in the electronic health record (EHR) is crucial for clinical decision making and patient safety. This is especially true for glaucoma patients, who often take multiple medications that change over time because of adverse effects or inefficacy. Previous work in microbial keratitis has shown that medication lists are often inaccurate because of discrepancies between the medication lists and the unstructured progress notes.¹ These discrepancies can occur for several reasons, most notably due to the variable quality and process of medication documentation.² Although a few studies have evaluated the accuracy of medications documented in medication lists and progress notes in ophthalmology^{1,3} and other specialties,^{4,5} to our knowledge no work has quantified the extent of medication documentation discrepancies between the medication list and the progress notes in glaucoma. Our study aimed to address this gap in knowledge by analyzing the frequency and reasons for discrepancies between EHR medication documentation in medication lists and progress notes for glaucoma patients.

This study was approved by Oregon Health & Science University's Institutional Review Board and adhered to the tenants of the Declaration of Helsinki. Informed consent was waived for this cross-sectional study. We randomly selected 150 unique patients who saw a comprehensive or glaucoma ophthalmologist at Oregon Health & Science University between January 1, 2019, and December 31, 2020. For each patient, we identified the most recent encounter with a primary billing diagnosis related to glaucoma. Three reviewers (J.S.C., J.V.K., W-C.L.) manually extracted current medications prescribed for any ophthalmic diagnosis from each progress note and the medication list at the time of the visit from our EHR (Epic). To determine inter-rater reliability, we selected a subset of 20 encounters that all reviewers evaluated; disagreements were resolved by discussion. Each reviewer then reviewed medication lists and progress notes for 40 to 45 additional patients each for a total of 150 patients. Ophthalmic medications were labeled if they appeared only in the progress note, the medication list, or in both locations. Medications were also labeled according to their indications, summarized in 3 categories: a prescribed glaucoma medication (i.e., timolol), an ophthalmic medication prescribed not directly for glaucoma management (i.e., prednisolone, erythromycin), or an over-the-counter (OTC) ophthalmic medication (i.e., artificial tears, oral eye supplements).

Data analysis was performed using R (version 4.0.3; The R Foundation). Inter-rater agreement, defined as the percentage of

medications extracted by all 3 reviewers, was calculated for medications from the progress note and medication list for the subset of 20 visits. Manual review of patient encounters with mismatched medications was performed, and reasons for mismatch (i.e., only appearing in one source, discontinued medications) were also assessed. For ophthalmic medications in the medication lists, the number of duplicate medications per patient was also calculated.

In the 20 visit subset, 51 and 49 ophthalmic medications were extracted from the progress note and medication list, respectively, and inter-rater agreement for each data source was 92.2% and 98.0%, respectively. On review, human error and discrepant medication naming (i.e., timolol, "timoptic") were identified as important reasons for reviewer disagreement. In the study dataset (n = 150 encounters), 428 total medications were extracted; 269 were prescribed for glaucoma management, 64 were for other ophthalmic indications, and 95 were OTC ophthalmic medications (Table S1 available at www.ophtalmologyscience.org). Overall, 290 (68%) extracted medications were documented in both the progress note and the medication lists. Of these, 226 (83%) glaucoma medications, 37 (58%) other ophthalmic medications, and 27 (28%) OTC medications were correctly documented in both data sources (Fig 1). The median number of mismatches per patient was 1 (interquartile range, 0-2) medication; 81 patients (54%) had ≥ 1 mismatches for all medications and 33 patients (22%) had ≥ 1 mismatches for glaucoma medications (Fig S1, available at www.ophtalmologyscience.org). Of all extracted medications, 12 medications (3%) were duplicated in the medication list. On manual review, 35 (8%) ophthalmic medications only documented in the medication list were found to be discontinued but persisted in the medication list. Furthermore, 49 (11%) OTC medications were reported in the progress note as current medications but never documented in the medication lists.

There is a need for studies quantifying medication documentation accuracy for glaucoma patients. Our results demonstrate that 68% of medications were accurately documented between the progress note and the medication list. Agreement in glaucoma medication documentation (84%) between both data sources was higher than for other medication types (28%–58%). These results are consistent with prior studies examining medication documentation in ambulatory clinics, with accuracies ranging from 77% to 79%.^{1,4} Because glaucoma patients are often taking multiple eyedrops with different side effects, these results are concerning for the quality of EHR data used in patient care, research, and billing. Several reasons exist for medication documentation discrepancies. First, physicians do not routinely manually update the medication list, likely because it is time-consuming and often out of date, which makes clinicians less inclined to use it in the future. This is especially true for OTC medications, which are usually recommended by clinicians rather than formally prescribed. Another reason is that physicians used to documenting in paper charts may prefer documenting in progress notes. Ultimately, inconsistent medication

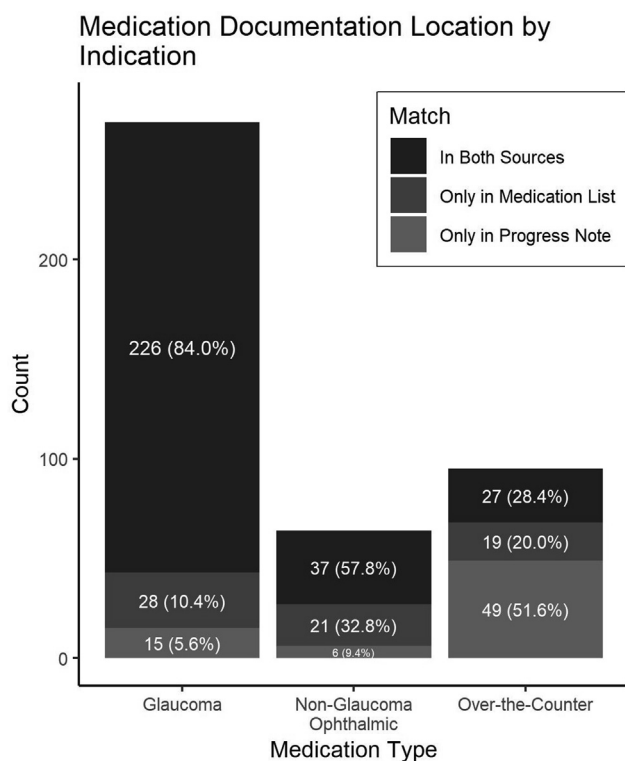


Figure 1. Medication appearances in the progress note and medication list by class. Overall, 150 encounters from 150 patients were reviewed and 428 current ophthalmic medications were extracted. A total of 226 (84%) glaucoma medications were documented in both the progress note and medication list, and 37 (58%) and 27 (28%) nonglaucoma ophthalmic medications and over-the-counter (OTC) medications, respectively, were documented in both data sources. The majority of ophthalmic medications that only appeared in the progress note were OTC medications, whereas the majority of medications that only appeared in the medication list were glaucoma medications.

documentation may inadvertently lead to unsafe treatment plans and adverse events to patients.⁶ These inconsistencies would also limit the use of medication data and any conclusions drawn from such data in research; as is, these data would require time-consuming manual correction before use in any study. Therefore, creating a “gold standard” active medication list remains an unmet need for physicians and researchers using EHRs.^{1,4} Natural language processing algorithms, which extract progress note text to update medication lists, represent promising avenues to automate medication reconciliation.⁷ However, these algorithms will require validation on complete medication data including dosage, frequency, and duration to be clinically useful.

Future work is needed to rigorously evaluate the impact of medication documentation discrepancies on patient safety. Moreover, the extent of medication discrepancy in this study may be underestimated when studied in other specialties that manage a vast number of medications. Although caution should be exercised when interpreting medication data in the EHR, there are opportunities to improve EHR design and medication documentation practices.

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Report

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