Automated Identification and Discarding of Low-Quality External Medication Information in an Electronic Health Record

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Description of the Problem or Gap

Ambulatory medication reconciliation involves comparing the local health record's list of medications a patient was at one point taking (or that the patient was intended to take), with those the patient has been recently taking. To aid in this process, EHRs aggregate external medication information for clinical review and potential incorporation in the local record. While debate exists as to the ideal composition of a medication list, e.g. for medications the patient takes infrequently, improving the list's accuracy has clear clinical benefit. This is reflected in a Meaningful Use Stage 3 requirement for external medication reconciliation at transitions of care and referrals.[2]

Our health care system (The MetroHealth System, Cleveland, OH) has exposed external medications as discrete data for reconciliation in its EHR (Epic) for years but did not systematically assess the reconciliation process until early 2018. Most prior studies of electronic medication reconciliation focused on local lists in the context of hospital admission or discharge.[1] External medication reconciliation represents a substantial clinician burden: fully reconciling a long external medication list with our EHR's existing tools can consume half a 15-minute ambulatory encounter.

External medication reconciliation is hindered by issues of data quality (duplicative or irrelevant medications) as well as presentation (e.g., external and local medication lists follow one another in a scrolling page, such that corresponding medications may not be simultaneously visible onscreen). We have addressed both, but focus here on data quality: not all external medication data is equally clinically valuable. We present a system which classifies and filters external medications by their age, provenance and other factors, helping to focus the clinician on unique, accurate and clinically relevant medication information.

Methods

At each visit, our EHR queries external EHRs for patient medication lists and a national e-prescribing network (SureScripts) for dispense data as reported by pharmacy benefit managers (claims history) and pharmacies (fill history). The EHR compiles, matches and attempts to deduplicate the last 90 days of dispense data and all unreconciled external EHR data. During external medication reconciliation, a clinician reviews and acts upon each deduplicated set of medications and dispenses. An external medication may be filed locally as a "historical" medication; attributes available to file vary by source (Table 1). Alternately, the medication may be discarded, if the clinician decides it is duplicative or irrelevant. Inadvertently discarded medications may be filed within 30 days of the discard date. It is also possible to view (though not file) years of historical dispenses and external EHRs' complete medication lists.

Fill history is the highest quality external medication data we receive, as it encodes the dispensed product in standard terminology (NDC[3]). Fill history sigs are free-text without standardized terminology, e.g., "TK 1 C PO QD" or "TAKE 1 CAP BY MOUTH DAILY"; they may also be truncated. Our EHR includes a table mapping free-text sig to discrete dose, route, and frequency, but with limited sensitivity because of the almost unlimited variation afforded by free text.

Discrete medication data received from external EHRs varies from no data at all, to an unsorted, undated list of every medication associated with the patient, to semantically invalid data (e.g. sig = medication name), to essentially all the discrete data fields in our local EHR. Even with discrete data, an external medication may not import seamlessly into the local list: there is no shared terminology for dose, route or frequency, e.g. equating "daily" and "once daily", leaving each health system to develop and maintain its own mappings. When mapping fails, clinicians may manually select corresponding local terminology on import. In practice they usually omit mapping the frequency, creating a partially specified sig (e.g. "take 20 mg by mouth"), with or without a start date.

We developed an EHR-based process which discards external medications or dispenses matching rules, as if the clinician had discarded them manually. Initially, we processed external medication information fetched for the following day's appointments, overnight. This did not account for same-day, urgent or emergent visits. We are now piloting an actionable alert displayed to clinicians, discarding matching external medications and dispenses on request.

Table 1. External medication attributes by source. ●: always present; ○ or (…): optional; †: always present, but may contain encounter date (not clinically useful)

Source	Event/product	Date(s)	Days supply	Quantity	Refills	Sig	Prescriber
Claims history	Medication dispensed	Dispensed	●	●			●
Fill history		Dispensed, written	●	●	●	(Free-text)	●
EHR, historical	Prescribed, generic, free-text medication documented	(Start, end), updated†				(Free-text, discrete)	
EHR, prescription	Medication prescribed	(Start, end), updated†	○	●	●	Free-text, discrete	

We first discard medication information with no conceivable clinical value, such as dispenses of coupons, or medications listed as "other" with no free-text description. We then discard external EHR medications having a start date (or last update date, if the start date was missing) more than 2 years in the past. Most prescriptions are valid for a year; many older medications were intended for short-term use, but had no end dates specified, or represented data from institutions where the patient no longer actively received medical care. Controlled substances are discarded after shorter intervals matching the prescriptions' validity (90 days for schedule II and 180 days for schedule III–V).

External EHR medications are either prescriptions (originating from the source institution) or historical (documented but not prescribed by a clinician at that institution). A historical medication may in turn have been imported from another EHR or provided by the patient. Filing these "second-hand" external medications locally has limited value; for prescriptions, more accurate information is usually available from the prescribing EHR and/or dispense records, and for over-the-counter medications or supplements, from the patient directly. We thus discard this information.

Our actionable alert also compares a patient's local and external medications — if a newer local order exists for the same generic medication and strength, corresponding external medications and dispenses are discarded.

Results

Clinicians were manually reconciling an average of 57,000 external medications per month over the 6 months prior to our interventions. Our batch process first discarded a backlog of ~1,100,000 medications. It now discards an average of 45,000 external medications per month, 87% of these because their dates are too old. Manual reconciliation has continued at a similar pace to prior, thus nearly doubling our overall reconciliation rate. Encounters for which every external medication was reconciled, matching the Meaningful Use requirement, have improved from 45 to 65%.

Our actionable alert pilot data suggest that comparisons between local and external medications offer new discard opportunities. In the first month of our pilot, only 10% of discard opportunities have been medication date-based; 65% resulted from an external medication or dispense being superseded by a newer locally prescribed medication.

Discussion of Results

Overall, medication information exchange suffers from loss of provenance. A prescription identifier could be attached to corresponding dispenses, eliminating the need for matching heuristics. Filing an external medication into an institutional EHR or personal health record could retain the data's provenance, particularly the source institution (or human informant) and individual prescriber where available. This would trivially allow filtering of 2nd or 3rd hand information for which the original source is authoritative. It could also suggest an authoritative source to query for the original prescription (e.g. the prescriber's EHR), as this is not always easily discoverable.

Conclusion

External medication information is inconsistent and could benefit from further standardization and harmonization. However, patient care should not wait for this to occur. Using existing external medication data, we have presented a practical EHR-based strategy for filtering duplicative and irrelevant data from clinician consideration.

References

1. Marien S, Krug B, Spinewine A. Electronic tools to support medication reconciliation: a systematic review. J Am Med Inform Assoc. 2017 Jan 1;24(1):227–40.
2. Centers for Medicare & Medicaid Services. Eligible professional Medicaid EHR incentive program Stage 3 objectives and measures for 2018, objective 7 of 8.
3. U.S. Food and Drug Administration. National drug code directory.