Augmentation and Automated Reconciliation of External Immunization Information in an Electronic Health Record

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Introduction

Immunization information systems (IISes, also known as immunization registries) are a uniquely mature resource at the point of care, with origins in the early 1990s and implementations from the early 2000s.[1] Ideally, a health care provider could rely on an IIS to provide a patient's definitive immunization history since birth and forecast upcoming immunization due dates based upon ACIP recommendations.[2] In practice, IISes are insufficient. A clinician may need to consult multiple data sources — an IIS, local electronic health record (EHR), remote EHRs, paper records from other health care systems or carried by the patient, and the patient's or parent/guardian's memory — as well as decision support tools and clinical judgment — to determine which immunizations are due when.

Technical and practical considerations limit the completeness, usefulness and availability of IIS data. IIS participation is now 94% for children under 6 but 44% for adults 19 and older; some IISes do not include adult immunizations.[3] Many states legislate IISes though few mandate reporting of data into them. Inter-IIS — generally interstate — data interchange is blocked by incompatible consent laws while health care providers only have access to their local IISes.[4]

All IISes offer Web-based access. However, usage is limited by awareness[5] and absent or limited EHR integration.[6] EHRs commonly send administered immunizations to IISes in real time, reflecting Meaningful Use Stage 1 and 2 requirements.[7] Bidirectional communication (EHRs querying IISes) is rare, given absent incentives until recently, time-consuming setup, IIS staffing constraints and interoperability issues.[8]

Even with a fully integrated EHR and IIS, challenges remain in ensuring a clinician has up-to-date immunization data available at the point of care with minimal manual reconciliation. We undertook a series of initiatives to integrate additional immunization data into our EHR and automatically reconcile duplicate, conflicting and incorrect data.

Methods

The preexisting environment of our health care system (The MetroHealth System, Cleveland, OH) included locally developed EHR-based clinical decision support rules and alerts reflecting ACIP recommendations. We began EHR-IIS reporting of administered immunizations over a decade ago and bidirectional communication at the end of 2017.

An increasing proportion of immunizations are administered in non-traditional healthcare settings where IIS reporting is less common. In the early 2017–2018 flu season, 17% of adults received an influenza immunization at their workplaces and 28% at pharmacies;[9] Medicare Part D payment incentives cause most zoster immunizations to be pharmacy-administered. Most workplaces have no ability to report to IISes. IIS reporting by pharmacies varies from none to manual to batch to real-time;[10] some determine eligibility via bidirectional interfaces and claims data.[11]

Pharmacies report immunization administration "dispenses" to e-prescribing networks; we receive dispense data from SureScripts as a byproduct of automated prescription eligibility queries at each visit. This is high quality data, as each dispense is of an administered immunization and includes the specific immunization product administered. The CDC maintains mapping tables between products and vaccine code sets (such as CVX codes[12]) with which our local immunizations were already associated. We developed a process to import these dispenses as historical immunization administrations. We also periodically import Medicare claims data for adult immunizations which do not exist locally.

Our EHR (Epic) queries our IIS and external EHRs at each visit. Historical and administered immunizations from these sources are aggregated as "outside" patient information. The EHR can be configured to automatically discard exact duplicates (same CVX code and date). The clinician then reconciles the remainder, discarding or adding to the local record. As we later discuss, a sizeable proportion of received external immunization data remained unreconciled.

Information about the provenance of external immunizations is limited; in many cases, "outside" information is in fact a distorted echo of local information. A local administration may be recorded in the IIS, then received from the IIS or by an external EHR with a different but related CVX code. After reviewing numerous examples, we extended CVX

group mappings to match (and automatically discard) incoming immunizations. For example, seasonal influenza vaccines are mapped to CVX group 88; the specific "flavor" received is not relevant for forecasting. Therefore, we automatically discard an incoming influenza immunization if there is a local immunization on the same date, even if the CVX code differs. CVX group mapping supports more complex scenarios; for example, we discard an incoming MMR-varicella if local MMR and varicella immunizations exist on the same date (the reverse is also true).

Results

Before incorporating any of the above processes (except configuring the EHR to discard exact duplicates) or establishing bidirectional IIS communication, 40% of ~770,000 external immunizations were unreconciled, excluding those older than 10 years which we do not yet process. Afterward, 18% of ~1,500,000 remained unreconciled. In December 2017, of 62558 received immunization dispenses, our processes filed 54242 immunizations (86.7%) as unique and ignored 7843 (12.5%) as duplicates. (The remaining 0.8% were manually reconciled.) In January/February 2018, with bidirectional IIS communication in place, 92% of immunization dispenses were filed, suggesting dispense data continue to be beneficial. Of 1,790,744 non-dispense immunizations received in January 2018, the EHR discarded 67%, our matching process discarded 24% and filed 7.5%, and 1.6% remained unreconciled, requiring manual review.

Discussion

Detailed specifications exist for centralized IIS immunization deduplication.[13] In practice, deduplication responsibility is distributed among local EHRs and clinicians. Some inconsistencies could be more easily resolved given a limited machine-readable form of historical immunization availability; for example, if an immunization was not widely available prior to the reported administration date (e.g., DTaP in 1992, when DTP was then recommended), the data source reporting this administration could be considered of lower quality for deduplication purposes.

Our experience highlights deficiencies of the current CVX groups. Members of a given CVX group do not necessarily contain identical antigens. For example, group 03 includes measles-mumps-rubella (MMR) and measles-rubella. If the local record contained a measles-rubella vaccine and outside information included an MMR on the same date, a strict implementation of CVX group matching would discard the MMR; however, this would result in information loss (i.e., that the patient had been vaccinated against mumps on that date). CDC already places vaccines in multiple CVX groups; we would recommend creating antigen- in addition to vaccine-based groups.

Technical, organizational and legal issues limit IISes' role as "one true source" for historical and forecasted immunizations. A pragmatic approach to improving EHR immunization completeness and accuracy currently necessitates incorporation of immunization data from non-traditional data sources, and reducing manual work through new methods for categorizing immunizations, deduplicating and resolving conflicting immunization information.

References

1. Coyle R. Update and progress in utilizing EMRs and immunization information systems to improve adult immunizations. National Adult and Influenza Immunization Summit; 2017 May 9; Atlanta, Georgia.
2. CDC. Clinical decision support for immunization (CDSi).
3. CDC. Immunization information systems annual report (IISAR).
4. Martin DW, Lowery NE, Brand B, Gold R, Horlick G. Immunization information systems: a decade of progress in law and policy. J Public Health Manag Pract. 2015 Jun;21(3):296.
5. Kempe A, Hurley LP, Cardemil CV, Allison MA, Crane LA, Brtnikova M, et al. Use of immunization information systems in primary care. Am J Prev Med. 2017 Feb;52(2):173–82.
6. Rajamani S, Bieringer A, Sowunmi S, Muscoplat M. Stakeholder use and feedback on vaccination history and clinical decision support for immunizations offered by public health. AMIA Annual Symposium; 2017 Nov 6; Washington, DC.
7. CDC. Meaningful use and immunization information systems.
8. HIMSS Innovation Center. Immunization integration program.
9. CDC. National early-season flu vaccination coverage, United States. 2017.
10. Roszak SE. Reporting to state immunization information systems: community pharmacy perspective. National Adult and Influenza Immunization Summit; 2016 May 10; Atlanta, Georgia.
11. Coleman J. Collaboration and coordination of complementary access points for adult vaccinations. National Adult and Influenza Immunization Summit; 2017 May 9; Atlanta, Georgia.
12. CDC. Immunization information systems: code sets.
13. AIRA Modeling of Immunization Registry Operations Workgroup, editor. Vaccination level deduplication in immunization information systems. American Immunization Registry Association; 2006.