

FINAL REPORT

Project Title: “DEVISE: Data Exchange of Vaccine Information between an IIS and EHR”

Principal Investigator: Melissa S. Stockwell

Team Members: David Vawdrey, Rajasekhar Ramakrishnan

Organization: Trustees of Columbia University

Project Period: 09/1/2013 – 08/31/2014

Project Officer: Jon White

Agency: This work was supported by the Agency for Healthcare Research and Quality (AHRQ)

Grant Number: R18 HS22667

1. Abstract

Purpose: To assess the impact of immunization information system (IIS) to electronic health record (EHR) vaccine information exchange on under- and over-immunization and immunization record completeness.

Scope: Children receiving care from multiple sources can have scattered records, placing them at risk for under- and over-immunization, and incomplete records. Importing data from IIS into EHRs, a likely meaningful use Stage 3 objective, may help address these problems.

Methods: New York City's IIS allows providers to query electronically for patients' records bringing them directly into EHRs. Five community clinics serving a low-income population piloted this exchange. We retrospectively compared under- and over-immunization for sentinel age groups (19–35 month-olds, 7–10 year-olds, 13–17 year-olds) with visits in a 6-month period pre-implementation of the exchange (2009;n=6,452) vs. post-implementation (2010;n=6,124). We also compared immunization record completeness when IIS data was added to EHR data for 8,548 children with a 2012–13 visit.

Results: Up-to-date status increased from the pre- to post-implementation overall and for each age group($p<0.05$); over-immunization decreased for all age groups combined($p<0.01$). For children seen in 2012-13, immunization record completeness increased when IIS data were added($p<0.001$).

Conclusions: Importing IIS data into an EHR improved under- and over-immunization, and immunization record completeness.

Key Words: Immunization, vaccine, immunization information system, electronic health record, data exchange

2. Purpose

AIM 1: To assess the impact of immunization exchange from a regional IIS to a local EHR on under- and over-immunization of low-income, urban children and adolescents.

Hypothesis 1: *Lower rates of under-immunization will be observed when immunization information is exchanged from a regional IIS to a local EHR*

Hypothesis 2: *Lower rates of over-immunization will be observed when immunization information is exchanged from a regional IIS to a local EHR.*

AIM 2: To assess the impact of immunization exchange from a regional IIS to a local EHR system on completeness of documentation of immunization status in the EHR.

Hypothesis: *More complete documentation of immunization coverage will be observed when immunization information is exchanged between a regional IIS and a local EHR.*

3. Scope:

Immunization is one of the most effective public health interventions,¹ yet despite improvements in childhood immunization coverage over the past 40 years, the most recent National Immunization Survey reports that only 71.9% of young children have completed their primary immunization series.² This percentage falls short of the Healthy People 2010 and 2020 goals of 80% coverage.^{3,4} Coverage for the more recently introduced adolescent immunization recommendations also needs improvement, especially for the human papilloma virus (HPV) vaccine. For example, only 57.3% of adolescent females and 34.6% of adolescent males have received at least one dose of the 3-dose series; only 37.6% of adolescent females and 13.9% of adolescent males have received the whole series.⁵ The resurgence of vaccine-preventable diseases therefore poses a serious threat to public health.⁶⁻⁸

Nearly one-quarter of children in the United States visit more than one immunization provider in their first three years of life, leading to fragmented and incomplete immunization

records⁹⁻¹² Low-income and minority children are especially susceptible to immunization record fragmentation as they are more likely to receive care from multiple clinics and providers.^{9,10,12} Incomplete records can result in under- and over-immunization.^{9,10,13} It may also affect completeness of documentation on an organizational level, which may have a negative impact on the reporting of immunization-related quality measures.¹⁴

This proposal evaluated the impact of implementing the proposed federal meaningful use (MU) Stage 3 objectives related to receiving immunization information from an immunization information system (IIS).

Linking Immunization Information Systems (IIS) and Electronic Health Records (EHR)

An Immunization Information System (IIS), also known as an immunization registry, is a population-based system that collects and centralizes immunization data for children and adolescents from immunization providers at a regional or state level, integrating immunization administration for any given child across all the sources where they may receive immunizations. All 50 states, five cities, and the District of Columbia operated an IIS. Approximately 86% of all U.S. children younger than age six had immunizations recorded in an IIS.¹⁵

The use of electronic health records (EHR) is growing, at least partially as a result of the meaningful use incentives provided through the Health Information Technology for Economic and Clinical Health (HITECH) Act. According to the 2011 Physician Workflow study, 54% of physicians had adopted an EHR system, with 76% reporting that their system met the initial federal MU criteria.¹⁶ The number of adopters among primary care providers was slightly higher at 58%. In the 2012 National Ambulatory Medical Care Survey (NAMCS), 72% of office-based physicians reported having adopted an EHR system.¹⁷

Reporting to an IIS was included in the first two stages of the EHR MU incentive program.¹⁸ Stage 1 of MU included testing and—if successful—establishing a connection from the EHR to an IIS. Stage 2 of MU required “ongoing submission” of production immunization data (as opposed to test data) to an IIS.

Providing IIS Information Directly to Health Care Providers at Point of Care

There are benefits to central reporting of vaccine administrations to an IIS, as is required in Stage 2 of MU,¹⁸ however IIS systems are not being utilized to their full potential. Frontline care providers are most likely to benefit from an IIS when it provides them with up-to-date immunization information at point of patient care through a bidirectional exchange of

immunization information. The exchange of immunization information from an IIS to the EHR is being considered for inclusion in Stage 3 of MU.¹⁸

Currently, a clinician wishing to access information in an IIS must log in to an external website, an impractical option for busy clinicians who do not have time to look outside their EHR.¹⁹ Instead, they rely on the immunization information contained in the EHR, which, for the most part, only includes immunizations administered at that site or within that particular healthcare system. Immunizations provided outside the system are only added to the EHR if the patient or parent provides a paper copy of the record to the clinic staff, and someone takes the extra time to transcribe the information, which may not happen in the busy clinical setting.²⁰ Therefore, healthcare providers often do not have access to a patient's full immunization information when they providing care.

Providing immunization information from an IIS to clinicians directly at point of care within their local EHR system may address challenges of over-immunization, under-immunization and poor documentation of true immunization status. First, making immunization decisions without complete data can lead to over-immunization.^{10,13} Healthcare providers do not want to miss opportunities to immunize, and the CDC recommends to not postpone immunizations if records cannot be found.²¹ Evidence suggests that between 10% and 20% of young children received an unnecessary extra immunization.^{10,13} Lack of bidirectional exchange of immunization information with EHRs can also lead to under-immunization, if a clinician opts to wait for a family to return with a parent-held paper immunization record rather than provide a needed immunization. Finally, using EHR data only can underestimate immunization rates on an organizational level since children may seem to be under-immunized when in reality the missing immunization is documented in the IIS.

4 Methods

This study was conducted at five community health clinics in New York City. These sites serve a predominately Latino, low-income population.

The New York Citywide Immunization Registry (CIR) is a population-based registry, developed in 1997, that includes 62 million immunizations given to 4.8 million individuals. New York City Public Health Law requires documentation for all immunizations administered to children under 19 years-old be submitted to CIR.²² Approximately 94% of facilities that vaccinate children report regularly.²³ Starting in 2009, CIR began providing secure web services allowing immunization data to be queried. The use of these web services allowed EHR systems

to communicate outside of an organization's firewall to retrieve immunization information for its patients from CIR. The web service used standards-based protocols, such as SOAP for message transport and HL7 for message exchange.

Also in 2009, the study sites began collaborating with the CIR to begin testing the new web service. A healthcare provider could click a "synchronize" button, which accessed the CIR web service. Immunization information was then downloaded from CIR into the sites immunization registry, which is linked to the EHR. The imported data were processed using a de-duplication script.

Study Design and Population

In a retrospective study, we assessed the impact of IIS-to-EHR immunization information exchange using two sets of analyses: (1) comparison of coverage and over-immunization in a period pre- and post-implementation of the immunization information exchange and (2) examination of the impact of exchange on documentation of immunization series completion (i.e., up-to-date status) when data from the IIS was added to EHR data. We focused on sentinel age groups: 19-35 months, 7-10 years, and 13-17 years reflecting the completion of the primary immunization series, childhood boosters needed for school entry, and adolescent immunizations. Children were identified through the billing/registration system.

AIM 1: To assess the impact of immunization exchange from a regional IIS to a local EHR on under- and over-immunization of low-income, urban children and adolescents.

In this aim, we assessed under-immunization through an assessment of immunization coverage in children with a visit in a 6-month period prior to implementation of the exchange of immunization information from the IIS to our EHR system vs. the same 6-month period post-implementation. Analysis regarding under-immunization included the entire study population. Analysis regarding over-immunization was limited to those who had an immunization that was documented in the IIS but not in the local EHR but would have contributed to their being up-to-date on their immunizations.

The outcome variable related to under-immunization was up-to-date immunization coverage with age appropriate immunizations as recommended by the CDC's Advisory Committee on Immunization Practices (ACIP). For children in the 19-35 and 7-10 year old age groups, this was based on the 4:3:1:3:3:1 series which includes diphtheria, tetanus, and pertussis (DTaP), polio (IPV), measles-mumps-rubella (MMR), Haemophilus influenza type b

(Hib), hepatitis B, and varicella (chickenpox) vaccines. For adolescents in the 13-17 year old age group, this was based on receipt of the tetanus, diphtheria, and pertussis (Tdap), meningococcal and human papillomavirus (HPV) vaccines. Over-immunization was defined as ever receiving a dose in excess of recommendations by the CDC for an age group as delineated above.

Test of two proportions were used assess the proportion of under-immunized and over-immunized children in the pre-implementation vs. post-implementation groups, overall and stratified by age.

AIM 2: To assess the impact of immunization exchange from a regional IIS to a local EHR system on completeness of documentation of immunization status in the EHR.

In this aim, we assessed the impact of combining immunization records on completeness of documentation of immunization status in children with visits in a recent period post-implementation of the web service by comparing immunization status, with and without inclusion of IIS information. All children in the sentinel age groups with a visit to the sites between March 1, 2012 and February 28, 2013 were included.

The main outcome variable was completeness of documentation of up-to-date vaccine coverage with age appropriate immunization status as recommended by the Center for Disease Control and Prevention (CDC) as above.

Differences in immunization coverage with and without the addition of the IIS data were compared using a binomial test against a null rate of 10%.

5. Results

There were a total of 6,452 children seen in the pre-implementation and 6,214 in the post-implementation period, with no differences in baseline demographic data in terms of age, gender, language or insurance. Most were publicly insured and from Spanish-speaking families.

The proportion of children who were up-to-date who were seen in the pre- to post-implementation increased for the overall sample (79.1% to 85.0%) and for each age group ($p < 0.05$). The proportion of ever over-immunized children decreased from the pre- to post-implementation period for the overall group ($p < 0.01$). For children seen in 2012-13,

immunization record completeness increased when IIS data were added for the overall sample (67.8% to 83.6%) and for each age group ($p < 0.001$).

This study demonstrated the impact of immunization data exchange between an IIS and an EHR on immunization coverage, over-immunization and increased completeness of vaccine records for low-income, urban children and adolescents. It provides important evidence in support of the Stage 3 Meaningful Use requirements related to the exchange of immunization information from an IIS to an EHR system.¹⁸

This study had limitations. First, immunization records could have been incomplete. Second, over-immunization was only assessed in children who were felt to be most at risk for over-immunization because they had an immunization in the IIS that was not in the local EHR. It also measured if the child was ever over-immunized. Finally, the study took place in a single medical system and results may not be generalizable.

However, information gained from this study could be used to help identify the potential impact of including this meaningful use objective for primary care ambulatory offices.

AHRQ priority populations

This study took place in five urban, academically-affiliated community clinics that serve a primarily low-income, Latino population.

6. Publications

Stockwell MS, Natarajan K, Ramakrishnan R, Holleran S, Forney K, Aponte A, Vawdrey D. DEVISE: Data Exchange of Vaccine Information between an IIS and EHR (manuscript is in preparation)

Presentations

1. Stockwell MS, Natarajan K, Holleran S, Ramakrishnan R, Vawdrey D. DEVISE: Data Exchange of Vaccine Information between an IIS and EHR. *Platform presentation* 2014 Pediatric Academic Societies Annual Meeting (Vancouver, BC)

2. Data Exchange of Vaccine Information between an Immunization Information System and Electronic Health Record. Health Partners Research Institute Presentation, 2014 Minneapolis, MN

References

1. Ten great public health achievements--United States, 1900-1999. *MMWR Morb Mortal Wkly Rep.* Apr 2 1999;48(12):241-243.
2. Centers for Disease Control and Prevention. National Immunization Survey. Available at <http://www.cdc.gov/nchs/nis.htm>. Accessed on June 16, 2014.
3. U.S. Department of Health and Human Services. Healthy People 2010 and Healthy People 2020. Available at http://www.cdc.gov/nchs/healthy_people/hp2010.htm and <http://www.healthypeople.gov/>. Accessed on November 18, 2014.
4. U.S. Department of Health and Human Services. Healthy People 2020. Available at <http://healthypeople.gov/2020>. Accessed on November 18, 2014.
5. Elam-Evans LD, Yankey D, Jeyarajah J, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13-17 years--United States, 2013. *MMWR Morb Mortal Wkly Rep.* Jul 25 2014;63(29):625-633.
6. Misegades LK, Winter K, Harriman K, et al. Association of childhood pertussis with receipt of 5 doses of pertussis vaccine by time since last vaccine dose, California, 2010. *JAMA.* Nov 28 2012;308(20):2126-2132.
7. Continued shortage of Haemophilus influenzae Type b (Hib) conjugate vaccines and potential implications for Hib surveillance--United States, 2008. *MMWR Morb Mortal Wkly Rep.* Nov 21 2008;57(46):1252-1255.
8. Measles - United States, 2011. *MMWR Morb Mortal Wkly Rep.* Apr 20 2012;61:253-257.
9. Yusuf H, Adams M, Rodewald L, et al. Fragmentation of immunization history among providers and parents of children in selected underserved areas. *Am J Prev Med.* Aug 2002;23(2):106-112.
10. Feikema SM, Klevens RM, Washington ML, Barker L. Extrimmunization among US children. *JAMA.* Mar 8 2000;283(10):1311-1317.
11. Kolasa MS, Chilkatowsky AP, Clarke KR, Lutz JP. How complete are immunization registries? The Philadelphia story. *Ambul Pediatr.* Jan-Feb 2006;6(1):21-24.
12. Joseph CL, Giblin PT, Kallenbach LR, Jacobsen G, Davis RM. Visiting multiple sites for immunization and vaccine coverage levels of preschool children in 3 urban clinics: potential indicator of record scatter? *Clin Pediatr (Phila).* May 2002;41(4):249-256.
13. Darden PM, Gustafson KK, Nietert PJ, Jacobson RM. Extra-immunization as a clinical indicator for fragmentation of care. *Public Health Rep.* Jul-Aug 2011;126 Suppl 2:48-59.
14. Chien AT, Li Z, Rosenthal MB. Improving timely childhood immunizations through pay for performance in Medicaid-managed care. *Health Serv Res.* Dec 2010;45(6 Pt 2):1934-1947.
15. Progress in immunization information systems - United States, 2012. *MMWR Morb Mortal Wkly Rep.* Dec 13 2013;62(49):1005-1008.
16. Jamoom E BP, Bercovitz A, Woodwell D, Palso K, Rechtsteiner E. Physician Adoption of Electronic Health Record Systems: United States, 2011. NCHS data brief, No 98. Hyattsville, MD; National Center for Health Statistics. 2012.
17. Hsiao CJ, Hing E. Use and characteristics of electronic health record systems among office-based physician practices: United States, 2001-2012 [Internet]. Hyattsville (MD): National Center for Health Statistics; 2012 Dec [cited 2012 Jan 12]. (Data Brief No. 111). Available at <http://www.cdc.gov/nchs/data/databriefs/db111.htm>. Accessed on November 18, 2014.
18. Centers for Disease Control and Prevention. Meaningful Use and Immunization Information Systems. Available at <http://www.cdc.gov/vaccines/programs/iis/meaningful-use/index.html>. Accessed on March 11, 2014.

19. Christakis DA, Stewart L, Bibus D, et al. Providers' perceptions of an immunization registry. *Am J Prev Med.* Aug 1999;17(2):147-150.
20. Clark SJ, Cowan AE, Bartlett DL. Private provider participation in statewide immunization registries. *BMC Public Health.* 2006;6:33.
21. General recommendations on immunization --- recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep.* Jan 28 2011;60(2):1-64.
22. Statewide Immunization Registry, Pub Health Law, Article 21, Title 6, §2168.
23. Immunization Information Systems Annual Report (IISAR) Data Participation Rates and Maps. Center for Disease Control and Prevention website. Available at <http://www.cdc.gov/vaccines/programs/iis/annual-report-IISAR/rates-maps-table.html>. Updated on September 30, 2014. Accessed on November 11, 2014.