Published in final edited form as:

J Am Pharm Assoc (2003). 2019 ; 59(1): 30–34. doi:10.1016/j.japh.2018.09.007.

Comparisons of Immunization Records between a Community Pharmacy, Regional Registry, and Health System

Jason H. Lam, Pharm.D., CSSBB, FCPA, FCSHP, Serinna Singh, Pharm.D. [Candidate], and UC San Diego SSPPS, La Jolla, CA sms024@ucsd.edu

Grace M. Kuo, Pharm.D., M.P.H., Ph.D., FCCP, FNAP [Professor]

Clinical Pharmacy, Associate Dean for Strategic Planning and Program Development, and Adjunct Professor of Family Medicine and Public Health, UC San Diego SSPPS, La Jolla, CA gmkuo@ucsd.edu

Abstract

Objective: Our study compared the completeness of immunization records for six vaccines between a community pharmacy database, regional immunization information system (IIS), and a health system's electronic health record (EHR).

Methods: In a community pharmacy immunization program, two pharmacists and a community pharmacy resident performed a needs assessment for six vaccines (tetanus-diphtheria-acellular pertussis vaccine for adults or diphtheria-tetanus-acellular pertussis vaccine for child and adolescents, zoster vaccine live, 13-valent pneumococcal conjugate vaccine, 23-valent pneumococcal polysaccharide vaccine, hepatitis B vaccine series, and human papillomavirus vaccine) for over 2,400 patients between August 2016 and March 2017. This is a retrospective study to review immunization records for 243 patients. Inclusion criteria included patients from the community pharmacy immunization program who also had at least one medication prescribed by an academic health system provider. Immunization records for six vaccines were collected from the community pharmacy database, regional IIS, and EHR.

Results: 186 of 243 (77%) patients had additional immunization records in the regional IIS or EHR that were not found in the community pharmacy database. For those 186 patients, 108 (58%) patients had additional immunization records for 2 or more unique vaccines. In total, 378 additional immunization records were identified for the six vaccines. For all six vaccines, the regional IIS and EHR possessed more complete immunization records compared to the community pharmacy database ($p < 0.05$ for HPV and $p < 0.001$ for the remaining 5 vaccines).

First and Corresponding Author Jason H. Lam, Pharm.D., CSSBB, FCPA, FCSHP, Lean Six Sigma Black Belt, Sharp Healthcare, San Diego, CA, Health Sciences Clinical Instructor (Non-Salaried), UC San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences (SSPPS), 8695 Spectrum Center Blvd, San Diego, CA 92123, Jason.H.Lam@gmail.com.

Declarations of interest: none

Previous presentation:

A research poster on our study with preliminary data analysis was presented at the California Pharmacists Association, Western Pharmacy Exchange poster session in San Diego, CA on April 13–14, 2018.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Conclusion: Our study showed that immunization records were more complete in a regional IIS and health system EHR compared to a community pharmacy database. If all three sources were utilized by the pharmacist during the needs assessment, the community pharmacy team would have made fewer vaccine recommendations, which would have reduced the potential for duplicate or inappropriate vaccines.

Background

Immunizations are administered in a variety of settings including clinics, hospitals, and pharmacies. The 2013 update on Standards for Adult Immunization Practice from the National Vaccine Advisory Committee (NVAC) emphasized pharmacists as key providers of immunizations.¹ National and state pharmacy organizations such as the American Pharmacists Association have also recognized immunization administration within the expanded scope of clinical services provided by pharmacists.^{2,3}

Each state has established a database called an immunization information system (IIS), sometimes referred to as an immunization registry. An IIS is a confidential, population-based database that records all immunization doses administered by participating providers.⁴ The IIS in California, the California Immunization Registry (CAIR), promotes the electronic storage of immunization records.⁵ One noted drawback to CAIR is that it does not contain all immunization records because reporting of immunizations is not mandatory in all care settings.⁶ Some states may also have regional IIS databases such as the San Diego Regional Immunization Registry (SDIR).⁷ An IIS website provides online resources on how immunization records can be entered manually or electronically to the IIS.^{5,7}

Another source that contains immunization records is the electronic health record (EHR), which generally includes the patient's medical, prescription, and immunization records. Medical provider offices and hospitals have been implementing EHRs as part of the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, which incentivizes providers and health systems to shift from paper to electronic charts.⁸ The Centers for Medicare & Medicaid Services (CMS) established Meaningful Use criteria for EHRs that included quality measures to promote vaccination screening and administration.^{9–11}

Initial studies to evaluate the utility of sources with immunization records have been conducted. A public health study in Washington described the benefit of using the state's IIS to enhance the completeness of each patient's immunization record.¹² When the PCV13 vaccine was approved for use in 2010, ACIP recommended that all adults 65 years and older who received a prior PPSV23 vaccine should receive PCV13 after 1 year.¹³ The Washington study noted that 30% of patients declined the PCV13 vaccine because they believed they had already received it.¹² It was noted that PCV13 was new and the likelihood of patients who received it was low. Patients likely confused the new PCV13 vaccine with a prior PPSV23 vaccine. Their study recommended the use of a state or regional IIS or EHR to obtain pneumococcal immunization records so clinicians could confirm the patient's history.

In the community pharmacy setting, pharmacists can access an IIS, but the EHR may not be as readily available. Pharmacists often rely on the patient's recollection or calling the provider's office for immunization records. Using multiple sources with immunization records can assist pharmacists when screening patients for vaccine needs. NVAC has recommended that both IIS and EHRs should be referenced for a patient's immunization history.¹ Our study hopes to draw attention to another challenge, access to complete immunization records.

Objectives

Our study compared the completeness of immunization records for six vaccines between a community pharmacy database, regional IIS, and a health system's EHR.

Methods

A pharmacy school affiliated with an academic health system (University of California, San Diego) partnered with a community pharmacy (Ralphs, a division of Kroger) to implement a community pharmacy vaccination program in the summer of 2016. The program consisted of two pharmacists and a community pharmacy resident who screened over 2,400 patients of all ages between August 2016 and March 2017. On Mondays, Wednesdays, and Fridays, the pharmacist or resident ran a prescription report to identify patients with a medication ready for pick up, then performed a needs assessment for six vaccines based on the patient's age, prescription history (which included prior vaccines administered at the pharmacy), and the Advisory Committee on Immunization Practices (ACIP) recommended immunization schedules.¹⁴ The six vaccines were: tetanus-diphtheria-acellular pertussis (Tdap) vaccine for adults or diphtheria-tetanus-acellular pertussis (DTap) vaccine for child and adolescents, zoster vaccine live (ZVL), 13-valent pneumococcal conjugate vaccine (PCV13), 23-valent pneumococcal polysaccharide vaccine (PPSV23), hepatitis B vaccine series (HepB), and human papillomavirus vaccine (HPV).

In our vaccine program, we utilized the community pharmacy standard operating procedures for each vaccine and the ACIP immunization schedules for recommendations. If one or more vaccines were deemed necessary, the team entered a clinical decision support (CDS) alert into the pharmacy database that would prompt the pharmacist on duty to make the recommendation(s) and administer the vaccine during the next patient consultation. If the patient received one or more of the recommended vaccines at the pharmacy or determined the patient already received the vaccine, the CDS alert would be removed. At the time of the screenings, the pharmacy team did not access the IIS or EHR in their assessment.

This is a retrospective study to review immunization records for patients who met two inclusion criteria: 1) vaccine needs assessment was conducted by a pharmacist or resident in the community pharmacy vaccination program, 2) at least one medication was prescribed by an academic health system provider. The list of 17 providers from the nearest academic family and internal medicine clinic was obtained through the health system website. A report in the community pharmacy database was queried, and 243 patients met these inclusion criteria. Upon approval for the quality improvement study from the Office of Human

Research Protections Program at the University of California San Diego, collections and comparisons of data from IIS and EHR began. One pharmacist and the pharmacy resident obtained read only access to the regional IIS through the SDIR website. They accessed and retrieved immunization records through manual record reviews. CAIR was not utilized since most hospitals and clinics in San Diego submitted records to SDIR, and CAIR was transitioning to a new version (CAIR2).¹⁵ Concurrently, a computer programmer at the health system retrieved immunization records from the health system's EHR, Epic. Records included immunizations administered in the health system clinics and hospitals.

The following patient demographic information and immunization history was collected: patient name, age, race, insurance and the month/year of any of the six vaccines administered within the vaccine program. Any additional immunization records found in the regional IIS or EHR compared to the community pharmacy database was also collected. STATA/IC version 15.0 statistical analysis software was used to conduct descriptive and comparative (Fishers Exact and kappa tests) analyses. Fishers exact tests were used to compare aggregate counts of immunization records by vaccine. Kappa tests were used to compare immunization records for individual patients: 1) between community pharmacy database and regional IIS, 2) between community pharmacy database and health system EHR, and 3) between all three sources. Regression analysis was used to evaluate the likelihood of any vaccine records associated with patient's demographic factors. Completeness is defined as a documented immunization record for a patient who is indicated for each of the six vaccines based on the ACIP immunization schedules.

Results

Table 1 shows the analysis for the 243 patients by gender, age, race, and insurance by vaccine indicated. 186 of 243 (77%) patients had additional immunization records in the regional IIS or EHR that were not found in the community pharmacy database. For those 186 patients, 108 (58%) patients had additional immunization records for 2 or more unique vaccines. In total, 378 additional immunization records were identified for the six vaccines (154 for Tdap/DTap, 79 for PPSV23, 65 for ZVL, 54 for PCV13, 20 for HepB, and 6 for HPV).

Table 2 shows immunization record completeness and database agreement. For all six vaccines, the regional IIS and EHR possessed more complete immunization records compared to the community pharmacy database (Fishers exact test, $p < 0.05$ for HPV and $p < 0.001$ for the remaining 5 vaccines). The EHR was the most complete database, with the highest immunization completeness ranging from 50% of patients indicated for HPV to 73% for the HepB vaccine series.

For pneumococcal vaccinations, older age was associated with an increased likelihood of getting PPSV23 (OR 1.12; CI, 1.07 – 1.18) but not with PCV13 (OR 0.99; CI 0.97 – 1.02). Pneumococcal vaccination rates for PPSV23 were 28% for indicated adults 18 to 64 years old and 85% for adults 65 years and older; vaccination rates for PCV13 were 20% for indicated adults 18 to 64 years old and 60% for adults 65 years and older.

In addition, Table 2 shows high percentages of agreement (60–88%) between the community pharmacy database and the regional IIS, and low percentage agreements (27–50%) between the community pharmacy database and the EHR. Kappa coefficients for all comparisons were either negative or less than 0.20 suggesting none or slight agreement.^{16–17}

Discussion

Our results confirmed that a regional IIS and EHR have more complete immunization records compared to the community pharmacy database. PCV13 was the most frequent immunization record in the community pharmacy database, suggesting a higher prevalence of PCV13 given in the community pharmacy compared to the other five vaccines.

If an IIS or EHR was utilized by the pharmacist or resident during the needs assessment, vaccine recommendations would have changed in 77% (186/243) of patients. The two main changes would be to avoiding a duplicate vaccine or recommending a different pneumococcal vaccine. In our community pharmacy vaccine program, the pharmacy team used CDS alerts to recommend one or more vaccines for each patient. Incorporating the regional IIS or EHR would have reduced the number of CDS alerts generated by the pharmacist or resident. When the community pharmacy database was the only source used, the pharmacy team generated alerts to recommend Tdap for over 90% of patients. This caused alert fatigue for pharmacists and technicians as they encountered repeated alerts for Tdap on almost all patients.

Studies on CDS alerts and vaccines have shown inconsistent results. One health system utilized a CDS alert in their clinics to screen and recommend the vaccine for HPV. Providers in that setting provided a range of feedback including ‘if the [CDS alerts] are going to help me do my job, [it] should be welcomed’ to ‘they are often incorrect.’¹⁸ Despite vaccine recommendations in the provider setting, a 2018 study showed that providers assessed and recommended vaccines based on the ACIP immunization schedules, but often did not stock vaccines such as HPV, PCV13, and ZVL as readily as the community pharmacy.¹⁹ Many studies have shown success with vaccine programs in the community pharmacy setting, but the patients were screened using paper forms instead of electronic CDS alerts.^{20–22}

By incorporating immunization records from a regional IIS or EHR, pharmacists could also reduce the potential for duplicate or inappropriate vaccines. The Healthy People 2020 immunization target for pneumococcal disease is 60% for indicated adult patients from 18 to 64 years old, and 90% for all adults 65 years and older.²³ In 2016, the pneumococcal immunization rates for these groups was 33% and 72%, respectively.²⁴ A pharmacist conducting an immunization screening for a 66 year old patient would recommend PCV13 based on ACIP guidelines.²⁵ If that patient has a documented PCV13 over a year ago in the IIS or EHR, the pharmacist would recommend PPSV23 instead of PCV13. Our data revealed that adults ages 65 years and older had a combined immunization rate of PPSV23 (85%) and PCV13 (60%). This shows progress from the 2016 study (72%) towards the Healthy People 2020 goal (90%) in this age group. For adult patients 18 to 64 years old, our data showed combined pneumococcal immunization rates for PPSV23 (28%) and PCV13 (20%) which is a greater gap with the Healthy People 2020 goal (60%).^{23–25} There were two children who

met the inclusion criteria, and since the pharmacy team did not have access to immunization records beyond the community pharmacy, all indicated vaccines were recommended per the ACIP children and adolescent schedule.²⁶ Though the EHR captured more complete immunization records compared to the community pharmacy database and regional IIS, our results showed that EHR-recorded immunization rates were less than optimal for all six vaccines.

State and regional IIS programs continue to expand, but there are still challenges with reporting and connectivity. In a 2014 national survey, the American Immunization Registry Association (AIRA) found that 49% (22 of 45) of pharmacist respondents across the United States were mandated to report immunization records to IIS.²⁷ In 2016, 24% of IIS programs allow unidirectional information exchange from a community pharmacy database or EHR into the IIS. By contrast, 67% of IIS programs offer bidirectional information exchange.²⁷

Our study revealed numerous patients where an immunization record was found in one, but not the other two sources. For example, in the EHR, Tdap immunization records were only found in the IIS after 2012. This suggests that the record exchange may have not transmitted records prior to that year. The high percentages of agreement (60–88%) between the community pharmacy database and the regional IIS suggest the records were most similar, but both sources had less immunization records in these two sources (<15% for community pharmacy database and <40% for regional IIS) compared to the EHR (<75%). The EHR, on the other hand, had the most complete records and resulted in low percentages (27–50%) of agreement with the community pharmacy database.

Until there is more integration, many IIS programs allow community pharmacists to have read-only access to see the records for their patients.²⁷ An immunization project in Washington State provided bidirectional IIS access for 8 community pharmacies. Those pharmacies showed a 41% increase in the number of vaccines administered. In addition, the pharmacists also identified 36 vaccine contraindications and 196 potential duplications.²⁸

Moving forward, future studies could evaluate the presence of immunization records within a health information exchange (HIE). An HIE is a network of hospitals and medical provider offices that connects multiple EHRs. San Diego Health Connect (SDHC) is a regional HIE with 28 participants that connects hospitals and offices across the San Diego and Imperial counties.²⁹ HIEs may allow providers to access immunization histories from multiple sources real-time, which could facilitate a more complete immunization history.³⁰ As pharmacists continue to serve as an access point for patients, we need to partner with immunization registries and provider groups to demonstrate the value in sharing clinical data such as immunization records in our patients' care.

Limitations

The main limitation for our study was that immunization records in the community pharmacy databases were stored in two ways. When a vaccine was administered in the pharmacy, the community pharmacy database would have a prescription transaction. This would facilitate obtaining a list of patients through a prescription report for a vaccine. If the

patient verbally communicated an immunization record, this would often be seen in a free text area on the patient profile. With multiple free text entries on a profile, an immunization record is not codified, and not easily seen or retrievable in a pharmacy report.

Conclusion

Our study showed that immunization records were more complete in a regional IIS and health system EHR compared to a community pharmacy database. If all three databases were utilized by the pharmacist during the needs assessment, the community pharmacy team would have made fewer vaccine recommendations, which would have reduced the potential for duplicate or inappropriate vaccines.

Acknowledgments

We thank Ralph's pharmacy, a Kroger company, the San Diego Immunization Registry, and UC San Diego Health for their collaboration and support.

We thank pharmacists Christina Mnataganian, Pharm.D. and Jarius Mahoe, Pharm.D. who performed the patient screenings in the community pharmacy vaccination program.

We thank the computer programmer Renu Sugathan, M.S. who ran reports in the health system electronic health record.

References

- 1). National Vaccine Advisory Committee. Recommendations from the National Vaccine Advisory Committee: Standards for Adult Immunization Practice. Public Health Reports. 2014;129(2): 115–123. [PubMed: 24587544]
- 2). American Pharmacist Association. Pharmacist Scope of Services. <https://www.pharmacist.com/sites/default/files/files/APhA%20-%20PAPCC%20Scope%20of%20Services.pdf>. Accessed March 30, 2018.
- 3). California Pharmacists Association. Expanding Pharmacist Services. <https://cpha.com/advocacy/provider-status/expanding-pharmacist-services/>. Accessed March 30, 2018.
- 4). Centers for Disease Control and Prevention. Immunization Information Systems (IIS): What is IIS? <https://www.cdc.gov/vaccines/programs/iis/about.html>. Accessed August 13, 2018.
- 5). California Immunization Registry. Parents and General Public. <http://cairweb.org/wheres-my-immunization-record/>. Accessed January 9, 2017.
- 6). Centers for Disease Control and Prevention. Immunization Information Systems (IIS): Survey Results of State Immunization Information System Legislation. <https://www2a.cdc.gov/vaccines/iis/iissurvey/surveyresult.asp?id=28>. Accessed August 23, 2017.
- 7). San Diego Regional Immunization Registry (SDIR). About Us. <https://www.sandiegoimmunizationregistry.org/website/aboutus.htm>. Accessed January 12, 2017 San Diego Regional Immunization Registry (SDIR). SDIR/CAIR Interface Specifications. <http://www.sdiz.org/CAIR-SDIR/Interface-Specs.html>. Accessed June 28, 2018.
- 8). HealthIT.gov. Health IT Legislation and Regulations. <https://www.healthit.gov/policy-researchers-implementers/health-it-legislation>. Accessed January 10, 2017.
- 9). Centers for Medicare and Medicaid Services. New EHR Incentive Program FAQs. https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Downloads/FAQs_2016.pdf. Accessed August 24, 2017.
- 10). HealthIT.gov. Step 5: Achieve Meaningful Use Stage 2. <https://www.healthit.gov/providers-professionals/step-5-achieve-meaningful-use-stage-2>. Accessed August 24, 2017.
- 11). HealthIT.gov. EHR Meaningful Use Stage 2 Specification Sheet for Eligible Professionals – Immunization Registries Data Submission. <https://www.cms.gov/Regulations-and-Guidance/>

Legislation/EHRIncentivePrograms/downloads/Stage2_EPCore_16_ImmunizationRegistriesDataSubmission.pdf. Accessed August 24, 2017.

- 12). Popovich M, Altstadter B, Popovich LH. Observations Illustrating the Use of Health Informatics to Link Public Health Immunization Registries and Pharmacies to Increase Adult Immunization Rates and Improve Population Health Outcomes. *Online Journal of Public Health Informatics*. 2016;8(2):e185 Accessed March 30, 2018. [PubMed: 27752295]
- 13). Immunization Action Coalition. Pneumococcus: Questions and Answers – Information about the Disease and Vaccines. <http://www.immunize.org/catg.d/p4213.pdf>. Accessed January 10, 2017.
- 14). Centers for Disease Control and Prevention. Advisory Committee on Immunization Practices (ACIP): About. <https://www.cdc.gov/vaccines/acip/about.html>. Accessed January 9, 2017.
- 15). California Immunization Registry. CAIR2 Project. <http://cairweb.org/cair-2-project/>. Accessed August 14, 2018.
- 16). Viera AJ, Garrett J. Understanding Interobserver Agreement: The Kappa Statistic. *Family medicine*. 2005;37(5):360–3. [PubMed: 15883903]
- 17). Madewell ZJ, Wester RB, Wang WW, et al. Voluntarily Reported Immunization Registry Data: Reliability and Feasibility to Predict Immunization Rates, San Diego, California, 2013. *Public Health Reports*. 2017;132(3) 357–365. [PubMed: 28379785]
- 18). Dixon BE, Kasting ML, Wilson S, Kulkarni A, Zimet GD, Downs SM. Health care providers' perceptions of use and influence of clinical decision support reminders: qualitative study following a randomized trial to improve HPV vaccination rates. *BMC Medical Informatics and Decision Making*. 2017;17:119. [PubMed: 28797293]
- 19). Lutz CS, Kim DK, Black CL, et al. Clinicians' and Pharmacists' Reported Implementation of Vaccination Practices for Adults. *Am J Prev Med*. 2018 7 23;S0749–3797(18)31888–9.
- 20). Rhodes LA, Branham AR, Dalton EE, Moose JS, Marciniak MW. Implementation of a vaccine screening program at an independent community pharmacy. *J Am Pharm Assoc*. 2017 Mar-Apr; 57(2):222–228.
- 21). Weitzel KW, Goode JV. Implementation of a pharmacy-based immunization program in a supermarket chain. *J Am Pharm Assoc*. 2000 Mar-Apr;40(2):252–6.
- 22). Ernst ME, Chalstrom CV, Currie JD, Sorofman B. Implementation of a community pharmacy-based influenza vaccination program. *J Am Pharm Assoc*. 1997 Sep-Oct; NS37(5):570–80.
- 23). Healthy People 2020 Immunization and Infectious Diseases: Objectives. <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>. Accessed March 30, 2018.
- 24). Centers for Disease Control and Prevention. 2008 through 2016 Adult Vaccination Coverage Trend Report. <https://www.cdc.gov/vaccines/imz-managers/coverage/adultvaxview/data-reports/general-population/trend/index.html>. Accessed June 28, 2018.
- 25). Center for Disease Control, Recommended Immunization Schedule for Adults Aged 19 Years or Older, United States, 2018 <https://www.cdc.gov/vaccines/schedules/hcp/imz/adult.html>. Accessed March 27, 2018.
- 26). Center for Disease Control, Recommended Immunization Schedule Children and Adolescents Aged 18 Years or Younger, United States, 2018 <https://www.cdc.gov/vaccines/schedules/downloads/child/0-18yrs-child-combined-schedule.pdf>. Accessed August 14, 2018.
- 27). American Immunization Registry Association. Survey of Immunization Reporting to Immunization Information Systems by Major U.S. Pharmacies: Pharmacy Vaccination and IIS Reporting by State. AIRA White Paper. January 2014 http://repository.immregistries.org/files/resources/5835adc2a9a72/survey_of_immunization_reporting_to_immunization_information_systems_by_major_u_s_pharmacies_.pdf. Accessed March 20, 2018.
- 28). Bonner L. With proper tools, pharmacists increase adult vaccination rates. *Pharmacy Today*. 9 2017; 23(9):33 [http://www.pharmacytoday.org/article/S1042-0991\(17\)31327-0/fulltext](http://www.pharmacytoday.org/article/S1042-0991(17)31327-0/fulltext). Accessed March 30, 2018.
- 29). San Diego Health Connect. About SD Health Connect: Participants. San Diego, CA: San Diego Healthcare Information Exchange http://sdhealthconnect.org/About_SDRHIE/participants.html. Accessed January 9, 2017.

- 30). San Diego Health Connect [Internet]. About SD Health Connect: Who We Are. San Diego, CA: San Diego Healthcare Information Exchange http://sdhealthconnect.org/About_SDRHIE/who-we-are.html. Accessed January 9, 2017.

Key Points

- Patient immunization records can be found in multiple sources including the community pharmacy database, immunization information system (IIS), and electronic health record (EHR)
- Utilizing multiple sources to obtain the most complete patient immunization history can improve vaccine recommendations in pharmacist-led immunization programs

Table 1:

Demographics for Patients, by Vaccine Indicated

Vaccine	Tdap/DTaP	ZVL	PPSV23	PCV13	HepB	HPV
Total Patients Indicated	243	127	118	109	26	12
Female	156 (64%)	80 (63%)	68 (58%)	67 (61%)	16 (62%)	9 (75%)
Age						
mean, SD range	58 ± 19 (1 – 98)	73 ± 9 (60 – 98)	68 ± 15 (23 – 98)	73 ± 14 (1 – 98)	48 ± 19 (1 – 72)	25 ± 4 (19 – 32)
18 and younger	2 (1%)	0 (0%)	0 (0%)	2 (2%)	2 (8%)	0 (0%)
19 to 34 years	30 (12%)	0 (0%)	2 (1%)	1 (1%)	3 (11%)	12 (100%)
35 to 49 years	54 (22%)	0 (0%)	15 (13%)	1 (1%)	8 (31%)	0 (0%)
50 to 64 years	59 (24%)	30 (24%)	21 (18%)	8 (7%)	7 (27%)	0 (0%)
65 years and older	98 (41%)	97 (76%)	80 (68%)	97 (89%)	6 (23%)	0 (0%)
Race						
White	176 (73%)	100 (78%)	87 (73%)	87 (80%)	15 (58%)	6 (50%)
Black or African American	3 (1%)	2 (2%)	2 (2%)	2 (2%)	2 (8%)	0 (0%)
Asian	25 (10%)	9 (7%)	9 (8%)	8 (7%)	3 (11%)	3 (25%)
Other or Mixed Race	34 (14%)	14 (11%)	18 (15%)	11 (10%)	6 (23%)	3 (25%)
Unknown	5 (2%)	2 (2%)	2 (2%)	1 (1%)	0 (0%)	0 (0%)
Insurance						
Commercial	159 (65%)	58 (46%)	55 (47%)	44 (40%)	22 (84%)	10 (84%)
Medicare	68 (28%)	66 (52%)	57 (48%)	64 (59%)	2 (8%)	1 (8%)
Medicaid	16 (7%)	3 (2%)	6 (5%)	1 (1%)	2 (8%)	1 (8%)

Table 2:

Data Analysis between Three Databases, by Vaccine Indicated

Vaccine	Tdap/DTap	ZVL	PPSV23	PCV13	HepB	HPV
Total Patients Indicated	243	127	118	109	26	12
IMMUNIZATION RECORDS FOUND BY DATABASE						
Community Pharmacy Database	1 (0.4%)	2 (2%)	1 (1%)	13 (12%)	0 (0%)	0 (0%)
Regional IIS	46 (19%)	14 (11%)	13 (11%)	41 (38%)	10 (39%)	3 (25%)
EHR	147 (61%)	65 (51%)	78 (66%)	62 (57%)	19 (73%)	6 (50%)
Fishers Exact	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.05
DATABASE AGREEMENT ANALYSIS						
Community Pharmacy Database	Reference Group	Reference Group	Reference Group	Reference Group	Reference Group	Reference Group
Regional IIS Agreement	81%	87%	88%	60%	62%	75%
Kappa coefficient	k=-0.008	k=-0.028	k=-0.016	k=0.005	k=0.000	k=0.000
p-value	p=0.69	p=0.69	p=0.64	p=0.47	p=n/a	p=n/a
Confidence Interval	-0.024 – 0.008	-0.068 – 0.011	-0.047 – 0.015	-0.141 – 0.151	n/a	n/a
EHR Agreement	39%	47%	33%	48%	27%	50%
Kappa coefficient	k=-0.008	k=-0.032	k=-0.017	k=0.053	k=0.000	k=0.000
p-value	p=0.89	p=0.93	p=0.92	p=0.17	p=n/a	p=n/a
Confidence Interval	-0.024 – 0.008	-0.075 – 0.012	-0.050 – 0.016	-0.053 – 0.159	n/a	n/a
All three databases						
Kappa coefficient	k=-0.089	k=-0.051	k=-0.17	k=0.158	k=-0.098	k=0.11
p-value	p=0.99	p=0.84	p=1.0	P=0.002 *	p=0.81	p=0.25
Confidence Interval	-0.110 – -0.062	-0.094 – -0.019	-0.250 – -0.151	0.153 – 0.199	-0.192 – 0.050	0.000 – 0.200

* Statistically significant, p<0.005