Implementation of a Targeted Technologic Screening Tool to Increase Pneumococcal Vaccine Uptake in Health-System Retail Pharmacies: A Quality Improvement Initiative

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Abstract

Background/Purpose: Pneumococcal vaccination rates among eligible adults are lower than desired. Recently, pneumococcal vaccination guidelines for adults were updated to include new pneumococcal conjugate vaccines (PCV20), taking into consideration age, underlying risk factors, and previous vaccine status. To respond to PCV under-vaccination and help clarify the new guidelines, this project sought to develop a targeted pneumococcal vaccine screening tool and pop-up alert within retail pharmacies across a large health system with the goal of increasing rates of PCV20 vaccination. *Methods:* A Plan-Do-Study-Act (PDSA) cycle was employed to activate alerts within 24 retail pharmacies for patients indicated to be eligible for PCV20 vaccination. Adult patients who were PCV20 vaccine-naïve, met eligibility requirements, and were due for medication refill were identified through the electronic health record and uploaded to pharmacy software. Pharmacists screened patients for eligibility and inquired about willingness to receive PCV20 vaccine during the upcoming pharmacy visit. Vaccine rates and sociodemographic characteristics were compared before and after the PDSA cycle began, and reasons for patient decline were assessed. *Results:* Between December 2023 and April 2024, 1821 patients were screened for PCV20 vaccines, with 1369 (75%) patients eligible. Ultimately, 130 patients (9%) received PCV20 through the alert process, yet an additional 285 PCV20 vaccines were administered to additional patients, perhaps due to the intervention's success in promoting the tools such that pharmacists were more comfortable in screening patients for PCV20 vaccinations overall. Overall, the study represented a 140% increase in PCV20 vaccination rates compared to the same period of the previous year. The most common reason for declining vaccination was no interest in vaccines (n=231, 51%). *Conclusions:* This PDSA cycle demonstrated a vast increase in PCV20 vaccination rates in retail pharmacies across a large health system, indicating the potential utility of integrated technologic screening tools and alerts to increase administration of other routine immunizations.

Keywords: immunization, pneumococcal vaccines, technology, community pharmacist

Introduction

Streptococcus pneumoniae is the leading bacterial cause of pneumonia worldwide (known as invasive pneumococcal disease), with potential for severe sequelae like meningitis, bacteremia, and endocarditis. Invasive pneumococcal disease may result in significant morbidity, and its case fatality rate may be as high as 30-40% among older patients.[1] In the United States, almost all invasive pneumococcal disease (IPD) infections occur in adults ≥ 65-years or others who have predisposing conditions like chronic obstructive pulmonary disease, asthma, diabetes mellitus, HIV infection, chronic liver or heart disease. Invasive pneumococcal disease is a vaccine-preventable disease with conjugate vaccines (PCVs) indicating efficacy of 75% against vaccine-type IPD.[2] However, pneumococcal vaccination rates remain suboptimal among eligible adults.

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A study of under-vaccinated adults uncovered four main barriers to vaccination: concerns or fears (e.g. of side effects), perception of low susceptibility to disease due to good health status, lack of healthcare professional recommendation (including misinformation potentially spread by some healthcare professionals), and negative experiences from previous vaccines.[3] The Centers for Disease Control and Prevention (CDC) estimates the pneumococcal vaccination rate overall among adults aged 19–64 years at increased risk for pneumococcal disease was only 22.2% in 2021, while estimates of Medicare beneficiaries aged 65-years and older indicated only 12.2% had received an updated pneumococcal conjugate vaccine in 2023.[2]

There have been several formulations and changes in recommendations for the pneumococcal vaccine since its release in the 1980s, which has traditionally made this one of the most complicated vaccine schedules for practitioners and pharmacists to follow.[4,5] In 2021, the Advisory Committee on Immunization Practices (ACIP) introduced two new pneumococcal conjugate vaccines, PCV15 and PCV20, into recommendations that offer broader protection against *S. pneumoniae* serotypes than the previous pneumococcal polysaccharide vaccines (PPSVs).[6] Because eligible patients may have been previously vaccinated with PPSVs or outdated versions of PCVs, recommendations on if and when specific

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patients should receive newer PCV vaccines can be both complex and confusing.[4]

Because pneumococcal vaccines are underutilized by at-risk populations who would benefit from vaccination,[2] methodologies to educate upon and promote pneumococcal vaccinations to patients while they are present at vaccine access points are needed. Retail pharmacies may be the ideal locations to promote pneumococcal vaccine uptake due to their accessibility and convenience.[7] Thus, the current project was initiated within a large health system with more than 20 retail pharmacy locations to promote pneumococcal vaccine uptake among vulnerable adults in the pharmacy during their usual prescription pickup. The project used a technology-based approach to identify retail pharmacy patients eligible for PCV20 vaccination and an educational approach to teach pharmacists and staff on how to approach and counsel patients about pneumococcal vaccinations. This study sought to evaluate the PCV20 alert program to determine its influence in changing pneumococcal vaccination rates, identify groups at the highest risk of being under-vaccinated, and understand reasons for vaccine hesitancy by patients who chose to defer or waive vaccination.

Methods

Study design and setting: This analysis was the result of a Plan-Do-Study-Act (PDSA) cycle to promote PCV20 vaccine uptake across 24 retail pharmacies within a large health system. The academic health system serves urban, suburban, and rural communities within the Upper Midwest, and includes 12 hospitals and 56 primary care clinics. Retail pharmacies are located within hospitals or primary and specialty care clinics throughout the health system and offer 15 common vaccines, including PCV20, under a collaborative practice agreement in accordance with Advisory Committee on Immunization Practices (ACIP) guidelines and Food and Drug Administration (FDA) product labeling. The collaborative practice agreement is written, reviewed, and approved by a committee of pharmacists, nurses and physicians from across the health system. It is signed by physicians from the health system. Additionally, the health system retail pharmacies follow state statues when determining if a patient is eligible for immunization in the pharmacy setting. The study was deemed exempt from local Institutional Review Board review.

Population of interest: Patients were included if they were 19-years and older, seen by a health-system primary care provider in the preceding 12 months, refilled a chronic medication within one of the 24 eligible retail pharmacy locations, and their electronic health record (EHR; Epic Systems; Verona, WI) indicated that they were due for PCV20 vaccination. The PCV20 information was drawn from the health maintenance modifier criteria within the EHR which identifies patients who may be eligible for vaccination based on previous pneumococcal vaccine history, age, predisposing conditions, and relevant risk factors for pneumococcal disease.

Development of retail pharmacy alert and alert selection process: A targeted vaccine alert clinical program was proposed and approved through the retail pharmacy operations team to optimize screening opportunities for pharmacists and replace the non-targeted and underutilized queue that existed. The targeted alert was activated for patients identified in need of PCV20 and identified to have a medication refill coming due within the next month. Lists of patients who were eligible for PCV20 vaccination based on the EHR health maintenance criteria was cross referenced with lists of patients who were due to visit the pharmacy for a prescription refill that month. Patients who were due for both pneumococcal vaccination and to pick up a refill in the coming month were then manually uploaded by pharmacy operations staff into the pharmacy dispensing software into the pneumococcal vaccination program queue. Patients are uploaded using their identification number, their pharmacy store number, and a due date for the alert. The patient upload process was completed once per month. Each retail pharmacy site had a maximum of 20 PCV20 alerts uploaded per month for each pharmacist full-time-equivalent (FTE) to help minimize alert fatigue.

Patients over age 65-years were preferentially chosen to have the alert uploaded as the original pneumococcal collaborative practice agreement only allowed retail pharmacists to provide vaccinations to this age group without a prescription. By month 2 of the intervention, the collaborative practice agreement was updated by the health system to allow retail pharmacists to vaccinate patients aged 19-64 years with certain risk factors, though patients over age 65 years were still prioritized to receive the alert first. If a retail pharmacy site had capacity for additional alerts after all patients aged 65-years and older had the alert uploaded, patients 19-64 years with risk factors were selected at random utilizing a random number generator for pop-up alerts.

Two retail pharmacy sites piloted the alert between November 15, 2023 and December 7, 2023. Following the pilot, patients at the remaining 22 retail pharmacy sites who were due to refill medications between December 1, 2023 and April 30, 2024 were included in the population who could receive the alert. The alert was activated for the first time across all 24 sites on December 7, 2023.

Prior to the implementation date, retail pharmacy site managers were presented an in-person training on the new targeted immunization queue and instructed to disseminate the information to their staff pharmacists. All staff pharmacists were offered clinical resources, guidelines, a self-study presentation, and written instructions about the alert via email and internal resource page. The self-study presentation aimed to explain the purpose and importance of the targeted alert, instruct how to effectively review pneumococcal vaccine recommendations, and train pharmacists to document within the alert on the dispensing software using example test patients. The pop-up alert included a screening grid that helped

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simplify PCV20 vaccine recommendations based on the patient's age, risk factors, medical conditions, and previous pneumococcal vaccine history in line with ACIP recommendations and the CDC PneumoRecs VaxAdvisor mobile app.[8] A link to open the CDC PneumoRecs VaxAdvisor website was available in the alert, but did not have to be used to resolve the alert. In addition to the screening grid, all pharmacy staff were provided example phrases to guide them in offering PCV20 vaccination to patients both on the phone and in-person as part of this intervention. Feedback about the alert program and the associated training was requested from pharmacists via a survey. This feedback was used to optimize the tools available on the resource page.

Additionally, retail pharmacies were provided with bag tags to attach to prescriptions that visually identified patients who were eligible for the PCV20 vaccine so that pharmacy staff could offer the vaccination at prescription pick up. Pharmacy technicians were provided information about the program and how to interact with patients who had a PCV20 bag on their prescription. Lastly, a text message template that offered PCV20 vaccine appointments was created for retail pharmacies to send through the medication dispensing messaging software (EnterpriseRx, McKesson Corp.; Irving, TX). Sites were encouraged to make two outreach attempts via phone, bag tag, and/or text message to each patient before declaring the patient unable to be reached.

Quality improvement cycles: The database of patients who had a PCV20 alert activated was updated monthly with patients who were due for upcoming medication refills. Patients identified as eligible for the PCV20 vaccine within the EHR were updated quarterly. In the second PDSA cycle, alerts were uploaded monthly and the EHR health maintenance modifier criteria was updated each month to capture patients who had received the PCV20 vaccine in the preceding month. The second cycle also filtered out patients who had previously declined vaccination or had been uploaded in a preceding month from being uploaded again. In February 2024, additional focus and resources were allocated towards the pneumococcal immunization program as part of an initiative to bolster immunizations during the month.

General trends in PCV20 administration were reviewed from May 2022 through April 2024. Patients receiving PCV20 vaccines in the 24 retail pharmacy sites from November 15, 2022, through April 30, 2023 were utilized as a comparison population to evaluate trends and differences in vaccine uptake before and after the PDSA cycles began.

Variables of interest: The primary outcome of interest was the total number of PCV20 vaccines given across all retail pharmacy sites. Demographic data gathered for persons vaccinated in the study included age, race, ethnicity, sex, and need for interpreter to help identify groups that may be undervaccinated.

Statistical Analysis: Descriptive statistics summarized patient populations by month. Patient demographics and characteristics were compared among patients eligible for vaccination based on whether they received the PCV20 vaccine; chi-squared tests compared categorical variables with α set *a priori* at 0.05, and p-values between 0.05 and 0.099 were deemed to be borderline significant. Percent difference by month were calculated to determine the rate at which the intervention affected total patient count receiving PCV20 vaccines within the retail pharmacies. Analyses were conducted in SAS, version 9.4 (Cary, NC) and Microsoft Excel for Microsoft 365 (Redmond, WA).

Results

There were 3971 patients who had 5807 PCV20 alerts uploaded to their retail pharmacy profile between November 2023 and April 2024, averaging 1.5 alerts per patient. **Table 1** indicates information on monthly alerts uploaded and associated PCV20 vaccines received. Retail pharmacies targeted 1184 total patient alerts per month based on pharmacist FTEs. In practice, total alerts uploaded each month ranged from 1044 to 1331; however, the actual number of new patients with the alert activated varied month to month from 427 to 1182 (data not shown). Notably, of the 3971 unique patients who had the PCV20 alert activated, 1222 (30.7%) had the alert duplicated across multiple months. Duplicate alerts were most common in January and February before the alert selection process was amended to update the EHR health maintenance criteria every month.

Figure 1 provides additional information on pharmacist screening among patients with activated PCV20 alerts. Of the 3971 patients with an alert activated, 1821 (45.9%) were screened by a pharmacist, and 1369 (75.2%) of them were eligible for vaccination. Of the 452 (24.8%) patients not eligible for vaccination, pharmacists noted that many had already received the PCV20 vaccine and it had not been updated in the EHR (N=82, 18.1%), and 9 (1.9%) were unable to receive it because it was too soon to receive the PCV20 vaccine after a previous dose of pneumococcal vaccine, though 361 (78.8%) patients did not have a documented reason for their ineligibility.

Among patients who were eligible for PCV20 vaccine, a total of 130 (9.5%) received the vaccine within a retail pharmacy location during the study period. There were 1196 (87.4%) patients who were screened and eligible who did not receive a PCV20 vaccine; among them, pharmacists noted reasons for not receiving PCV20 at the visit for 449 (37.5%) patients. The most common reason is that they were not interested in vaccines (N=231, 51.4%), though 90 (20.0%) patients wanted to consult their primary care providers, 86 (19.2%) patients were not present during pharmacy pickup, and 42 (9.4%) patients did not have time for vaccination at that pharmacy visit (data not shown). Interestingly, women were more likely to want to

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consult their primary care provider than men (N=56, 62.2% vs N=34, 37.8%, respectively; p=0.045; data not shown).

Table 2 indicates demographic characteristics and percentages of uploaded patients and compares patients who received PCV20 and those who did not. Patients screened for vaccination differed from screened and eligible patients based on age (p<.0001), interpreter status (p=0.043), and race (p=0.00027) whereby those eligible were slightly older, less likely to need an interpreter, and more likely to be white compared to all patients with alerts uploaded (comparison not shown).

Overall, most patients screened and eligible for PCV20 were white (N=1143, 83.5%), and ≥65-years-old (N=756, 55.2%). Eligible patients who received vaccines had similar demographic distributions to those not receiving vaccines based on sex, interpreter status, and race (p>0.05), however, those opting to receive vaccines were more likely to be older (Age 65-74: N=74, 56.9% vs. N=538, 43.4%; Age 75+: N=19, 14.6% vs. N=125, 10.1%; p=0.0008) compared to those who did not have a PCV20 vaccine administered.

Pharmacists contacted the uploaded and screened patients using phone calls (N=217, 15.9%), text messages (N=677, 49.4%), or tagging the medication bags (N=384, 28.0%) within the pharmacy. **Figure 2** notes differences in vaccination rates based on outreach method and the number of methods of contact. Unexpectedly, a greater proportion of patients without text messages or notes in their bags received the vaccines (Text message: N=95, 73.1% vs. N=35, 26.9%), p<.0001; Note in bag: N=106, 81.5% vs. N=24, 18.5%, p=0.011) compared to patients with those methods of contact. Further, a larger proportion of patients without any methods of outreach received the vaccine (N=72, 55.4%) compared to having 1 or more methods of contact (p<.0001).

Seasonal trends of PCV20 vaccine uptake from May 2022 through April 2024 across the health system's retail pharmacies are depicted in **Figure 3.** Some alerts uploaded in the first cycle were for patients that had already received the PCV20 vaccine. Additional work to refine the inclusion process helped to screen out these patients. More patients receive PCV20 vaccines in August through December compared to January through July. Additionally, **Figure 4** indicates the number of total PCV20 vaccines administered in retail pharmacies by month and compares the 2022-23 season to the current study season (2023-24). Compared to the previous season, rates of PCV20 vaccination began to increase in July 2023 after the distribution of educational resources and fact sheets about vaccine eligibility and a vaccine challenge. Overall, there was a 139.9% increase in PCV20 vaccines during the study period compared to the same months in the year prior to the implementation of the PCV20 alert. Notably, in February 2024, there were 239.4% more PCV20 vaccines administered across all retail pharmacies compared to February 2023. Interestingly, even examining the subset of patients vaccinated for PCV20 in the 2023-24 season who did not have a pop-up alert activated indicates a 64.7% increase over the 2022-23 season, alone. Additionally, in 2023-24, often there were greater numbers of PCV20 vaccines administered to patients without alerts, especially in February when 98 (84.5%) of the 112 vaccines administered were for patients who did not have an activated alert.

Discussion

This was a PDSA cycle project that employed technology and pharmacist education to bolster pneumococcal vaccinations within 24 retail pharmacies in a large health system. The study demonstrated a 140% increase in PCV20 vaccines administered when comparing the study period, November 2023 through April 2024, and the same timeframe during the previous year. Interestingly, approximately two-thirds of patients receiving PCV20 vaccines during the study timeframe were patients without the pop-up alert activated, perhaps due to the intervention's success in promoting educational tools for pharmacy staff such that pharmacists were more comfortable in screening patients for PCV20 vaccinations overall. However, the study was not able to shed light on the best methodology for outreach to patients regarding vaccinations, as patients without documented phone calls, text messages, and notes were more likely to receive PCV20; this was likely due to direct pharmacist outreach to and counseling of patients, which is known to be a successful intervention technique[9–11], though documentation was unavailable for confirmation.

Previous studies on methodologies on how to best promote vaccines in the retail pharmacy show mixed effects on vaccine uptake. Lafleur et al (2022) used technology-based pop-up alerts for COVID-19 vaccine boosters in patients filling immunocompromising medications in community pharmacies and demonstrated low levels of vaccine uptake (2%).[12] The limitation of their automated pop-up was that 4.1% of the automated interventions were clinically appropriate vaccine recommendations and 95.9% of the automated interventions were not clinically appropriate. The study demonstrated a need to target automated alerts with criteria besides medication type to remove clinically inappropriate alerts. Coley et al (2020) used tailored vaccine eligibility messages on paper pharmacy receipts and telephone calls to increase vaccination rates in a regional community pharmacy chain.[13] Eligible patient were identified using age and medication class. However, the change in vaccine rates from baseline varied significantly across different vaccine types, with influenza having an increase of 45%, and pneumococcal increasing by 7%. Additionally, Bacci et al (2019) used proactive technology-based vaccine forecasting to bolster influenza, pneumococcal, and pertussis immunizations in community pharmacy chains, finding vast increases in influenza vaccines administered following their intervention, but a decrease in pneumococcal vaccines administered.[14] While our study did not use proactive technology to forecast vaccine eligibility, it did harness the

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power of the EHR health maintenance criteria in a pop-up alert to integrate pneumococcal vaccine eligibility into the patient's pharmacy dispensing profile. Using the health maintenance criteria allowed identification of patients that were more likely to be eligible than a blanket pop-up alert based on medication class. This simplification allowed pharmacists to efficiently provide recommendations to patients about their vaccine eligibility and increase vaccination rates at upcoming visits to the pharmacy. Our pop-up alert went a step beyond aforementioned interventions to display the screening grid directly in the alert, minimizing the need for the pharmacist to find multiple resources to confirm vaccine eligibility.

These previous interventions also highlighted the need to better tailor outreach techniques and messaging for recommended adult vaccines.[12–14] Patients, pharmacists, and providers alike report confusion surrounding the changing nature of the pneumococcal vaccines.[4,5,15] A 2023 knowledge check of pharmacists and physicians demonstrated that 50% of respondents were unfamiliar with the updated 2021 ACIP pneumococcal vaccine recommendations.[4] The CDC posited that this knowledge gap might lead to lower vaccination rate in adults 65-years and older, especially. The current study's results noted that while only 34% of patients screened by pharmacists were ≥65-years, 55% of the patients who were eligible to receive PCV20 vaccinations were ≥65-years and 72% of those receiving PCV20 were ≥65-years. This indicates a high need and desire for pneumococcal vaccination outreach in that age group. While all patients had been seen by their primary care physician within 12-months, they may not have been previously vaccinated for PCV20 due to ambiguity regarding PCV20 vaccine recommendations, especially in patients with previous PPSV or PCV doses. The use of our streamlined screening tool helped integrate a patient's vaccine eligibility, previous pneumococcal vaccine history, and current pneumococcal vaccine recommendations into one dedicated alert in the dispensing software to efficiently screen patients and offer vaccination at retail pharmacy visits. With greater efficiency in screening processes, ideally more patients eligible for PCV20 vaccines will have future outreach from pharmacists.

In regard to pharmacist education about changing pneumococcal vaccine recommendations, previous studies have indicated that targeted education and training to increase provider knowledge of pneumococcal vaccine recommendations may be effective to increase vaccine uptake,[16–18] though overall understanding of PCV20 recommendations and systematic processes to screen for eligibility may still be lacking.[16,17] While these interventions targeted physicians or advanced practice providers with educational readings or presentations, our combination of pharmacist education with an integrated screening tool support for community pharmacists did provide an overall increase in vaccine uptake of 140% within health system-based retail pharmacy settings.

Community pharmacists can help improve immunization uptake as advocates and immunizers,[10,11] and the retail pharmacy is an ideal location for vaccine promotion. Pharmacists can start a shared clinical decision-making conversation with patients and recommend vaccines, administer immunizations, and combat misinformation.[19] Interestingly, 20% of vaccine-eligible patients in this study who did not receive the vaccine indicated that they wanted to consult with their primary care provider for guidance; an additional 50% of patients indicated they were not interested in vaccines, which highlights the need for collaborative care practices to educate patients about the benefits of vaccination. These reasons for vaccine refusal within community pharmacies align with previously reported literature.[20] Since many physicians may not have a comprehensive understanding of current PCV20 guidelines,[4,5] partnering retail pharmacists with primary care clinics to reduce under-vaccination within high-risk patient populations may be a positive step to further increase gaps in PCV20 coverage.[15,16] The use of a collaborative care model between primary care providers and community pharmacists has been a benefit across numerous chronic disease states, resulting in better inhaler technique and improved medication adherence among COPD patients[21] and significantly reducing blood pressure among hypertensive patients,[22] among many other examples.[23] Thus, finding team-based models that partner primary care with community pharmacy to recommend vaccinations, especially among health system pharmacies where there is a shared EHR, may begin to close the gap in vaccination rates.

There are also mixed findings on effective methods for alerting patients of their vaccine eligibility. An evaluation of pharmacy intervention types on influenza and pneumococcal vaccine rates among patients with asthma or COPD noted higher rates of influenza vaccines among patients who received mailed letters compared to phone calls or those not given any vaccine information.[24] Within the current study, despite all patients with an alert being set to visit the pharmacy sometime throughout the month for a prescription refill, receiving phone calls, text messages, or having tags on their prescription bags did not statistically significantly increase vaccine rates. Further, there were the highest vaccination rates among patients with no reported outreach, which could indicate that the pharmacist directly spoke with a patient about vaccines without recording their direct outreach in the dispensing software. For future outreach attempts in our pharmacies, direct pharmacist to patient counseling may be successful to promote vaccinations, though further investigation is needed. Considering previous literature surrounding this topic, mailed letters could also be considered.[24]

While this study implemented a technology-driven quality improvement process to educate patients about PCV20 vaccines within 24 retail pharmacy locations, it was noted that sociodemographic characteristics differed across who ultimately opted to receive PCV20 vaccines. Demographic

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groups not receiving vaccination at the highest rates in this study were patient in younger age groups. These results parallel information reported in the 1990s indicating lower rates of pneumococcal vaccines within younger adults compared to older adults.[25] Vaccine hesitancy and poor coverage has been more broadly reported among younger adults, also, especially following the COVID-19 pandemic.[26,27] Common barriers to vaccination like fear of side effects, lack of healthcare professional recommendation, the spread of misinformation, and negative experiences from previous vaccines are all potential places for community pharmacists to help provide accurate information about the importance of vaccines, allay concerns about side effects, and provide advice about how to care for any side effects that do arise. [3]

There were four months of study that included duplicated alerts. In practice, this could cause an increase in vaccine hesitancy with patients that have already said declined PCV20 vaccination in previous months. Repeating alerts for patients who had previously declined vaccination also decreased the total number of patients actively being screened for PCV20. The first PDSA cycle in this study aimed to improve the targeted nature of the alert, incorporating previous months' data to remove patients who had received the vaccine as part of the intervention. The second PDSA cycle removed the alert from any patients who had previously declined pneumococcal vaccinations in our pharmacies to help reach additional patients. The final PDSA iteration integrated vaccine eligibility based on the EHR health maintenance criteria with refill data from the dispensing software to have an updated list of eligible patients at the end of each business day in a common clinical dashboard. However, there is still work needed to make the process more efficient and targeted, as each patient had an average of about 1.5 alerts, even in the final month reported. There are still improvements to be made integrating this dashboard with state immunization records, as the EHR health maintenance criteria is not always up to date.

To the best of our knowledge, there is no published literature on simplifying vaccine screening protocols with screening tools following the updated 2021 ACIP recommendations for PCV20, though Rhodes et al (2017) implemented a screening tool for all adult vaccines directly into pharmacy workflow that was successfully used by both pharmacy technicians and pharmacists in a chain of independent community pharmacies.[20] Ultimately, they identified over 500 vaccination recommendations to patients in the course of 1 month, with ~5% immunizations administered at the time of visit. The technology-based screening tool utilized within the current study ultimately reached >9% of patients for PCV20 administration, perhaps because the pop-up alert system allowed screening throughout the course of prescription workflow, allowing multiple opportunities to reach a patient. Future iterations of the PDSA cycles may entail incorporating screening in the data entry process, working to incorporate data from the state's immunization system directly into the patient identification process to minimize work-up on patients who are ineligible for updated vaccines, working collaboratively with primary care physicians as pharmacy alerts are being activated to reach patients that are initially hesitant, and using disease states on a patient's problem list in the EHR to help further filter eligibility for vaccines.

Limitations

Limitations of this study are the result of the PDSA cycles, wherein processes changed throughout the course of the study resulting in slightly differing methodologies to capture and upload patients to receive alerts over the course of the 6-month study period. Presentation of results accounted for this by noting when processes changed to determine the effects. Further, these processes may not be able to be replicated across other systems due to technology and information constraints, thus this study may not be generalizable to other health systems or populations. An additional limitation of our study is that it did not analyze if patients went on to receive the PCV20 vaccine at another pharmacy or in their provider's office after a discussion in the pharmacy, so it is possible that vaccine rates increased more than reported here. This study also did not evaluate the impact of staffing levels at the various pharmacies involved in the intervention.

While almost 4000 patients were uploaded for pop-up alerts to occur within the pharmacy, ultimately <50% of patients were screened for eligibility, likely due to the busy and multifaceted workload of community pharmacists. However, approximately 75% of patients screened were eligible for PCV20 vaccination, which could indicate a barrier in primary care to receive PCV20 vaccinations, potentially due to the changing recommendations and lack of understanding or limited time for screening in clinic workflows. Similarly, while the study showed a vast increase (140%) in PCV20 vaccines administered during the study period compared to 1-year previous, still many patients opted-out of receiving the vaccine, leaving space to collaborate with colleagues around the health system and tailor education surrounding pneumococcal vaccines to be more palatable for patients.

Finally, our methodology does not explain the reason for a rise in vaccination rates outside of patients that had the PCV20 vaccination alert activated. We proposed that providing educational resources to pharmacists prior to the implementation of the alert increased pharmacist comfort in screening for PCV20 vaccinations, however, this study did not objectively assess pharmacist knowledge of vaccination recommendations prior to and following the completion of the trainings. Further study of methodology to improve pharmacist and provider comfort with these updated pneumococcal vaccine recommendations is needed.

Conclusion

This project provides further evidence that the use of technologically integrated vaccine alerts and targeted

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education for pharmacists helps increase pneumococcal vaccination rates. This study implemented a targeted technology-based retail pharmacy alert that used eligibility criteria from the electronic health record to increase PCV20 vaccines administered in retail pharmacies by 140% compared to the same period of the pre-intervention year. The use of a targeted screening tool and pharmacist education successfully increased vaccination rates in patients with a targeted alert and in patients without a targeted alert. There is still room to improve on reaching patients in need of PCV20 vaccination, particularly in younger age groups; updating and tailoring messaging to patients and/or collaborating with primary care physicians may help. Further, continuing to simplify the screening process using integrated technology may provide more efficiency such that pharmacists can screen and reach greater numbers of patients.

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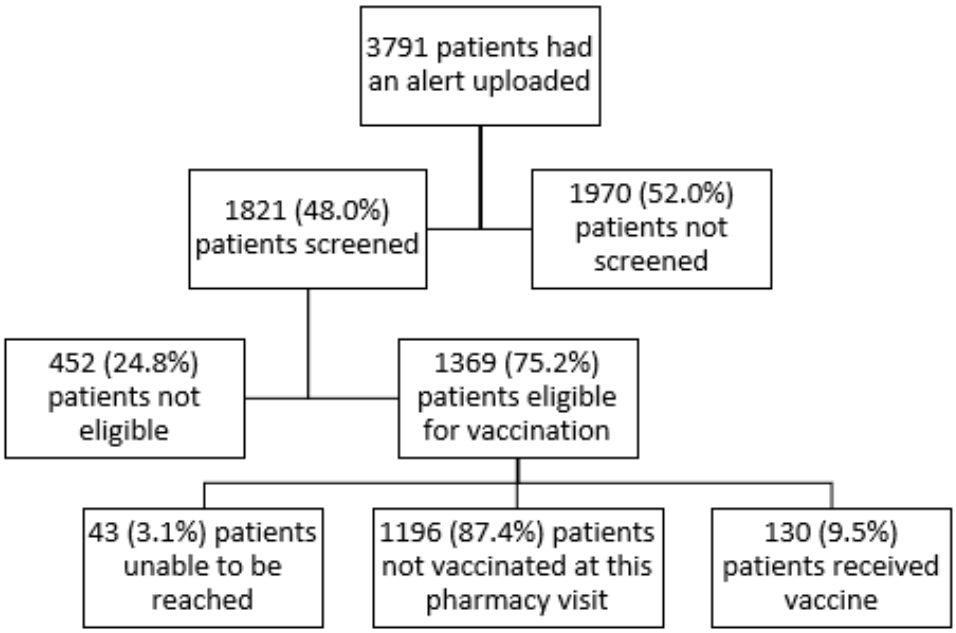
Table 1. Number of PCV20 alerts per month among 24 retail pharmacies compared to number of PCV20 vaccines received

Month	Alerts	Screened and Eligible Alerts	PCV20 Received by patients with screened/eligible alerts, N (%)
Nov 2023 (Pilot)	27	19	6 (31.6%)
Dec 2023	1189	456	54 (11.8%)
Jan 2024	1099	213	25 (11.7%)
Feb 2024	1117	201	14 (7.0%)
Mar 2024	1331	362	22 (6.1%)
Apr 2024	1044	118	9 (7.6%)
Total	**5807**	**1369**	**130 (9.5%)**

Figure 1. Flow diagram of patients uploaded, screened, and vaccinated during the study period (November 15, 2023 – April 30, 2024)



DOI: https://doi.org/10.24926/iip.v15i4.6345

Table 2. Demographic characteristics and percentages of uploaded patients who received the PCV20 vaccine during the study period

		Patients with alerts uploaded N (%)	Patients eligible for PCV20 vaccination N (%)	PCV20 administered N (%)	PCV20 not administered N (%)	p-value
Total Patients		**3971**	**1369**	**130 (9.5)**	**1239 (90.5)**	
Patient age	**18-29 years old**	203 (5.1)	31 (2.3)	1 (0.8)	30 (2.4)	0.0008
	30-49 years old	841 (21.2)	207 (15.1)	7 (5.4)	200 (16.1)	
	50-64 years old	1176 (29.6)	375 (27.4)	29 (22.3)	346 (27.9)	
	65-74 years old	1422 (35.8)	612 (44.7)	74 (56.9)	538 (43.4)	
	75+ years old	329 (8.3)	144 (10.5)	19 (14.6)	125 (10.1)	
Sex	**Female**	2162 (54.4)	707 (51.6)	65 (50.0)	642 (51.8)	0.87
	Male	1805 (45.5)	661 (48.3)	65 (50.0)	596 (48.1)	
	Unknown	4 (0.1)	1 (0.1)	0 (0.0)	1 (0.1)	
English language	**No**	199 (5.0)	56 (4.1)	4 (3.1)	52 (4.2)	0.54
	Yes	3772 (95.0)	1313 (95.9)	126 (96.9)	1187 (95.8)	
Interpreter needed	**No**	3793 (95.5)	1325 (96.8)	128 (98.5)	1197 (96.6)	0.25
	Yes	178 (4.5)	44 (3.2)	2 (1.5)	42 (3.4)	
Race	**American Indian or Alaskan Native**	31 (0.8)	5 (0.4)	0 (0.0)	5 (0.4)	0.36
	Asian	148 (3.7)	59 (4.3)	8 (6.2)	51 (4.1)	
	Black	363 (9.1)	78 (5.7)	6 (4.6)	72 (5.8)	
	Hispanic or Latinx	108 (2.7)	33 (2.4)	0 (0.0)	33 (2.7)	
	White	3119 (78.5)	1143 (83.5)	113 (86.9)	1030 (83.1)	
	More than one race	40 (1.0)	10 (0.7)	1 (0.8)	9 (0.7)	
	Other or unknown	162 (4.1)	41 (3.0)	2 (1.5)	39 (3.1)	

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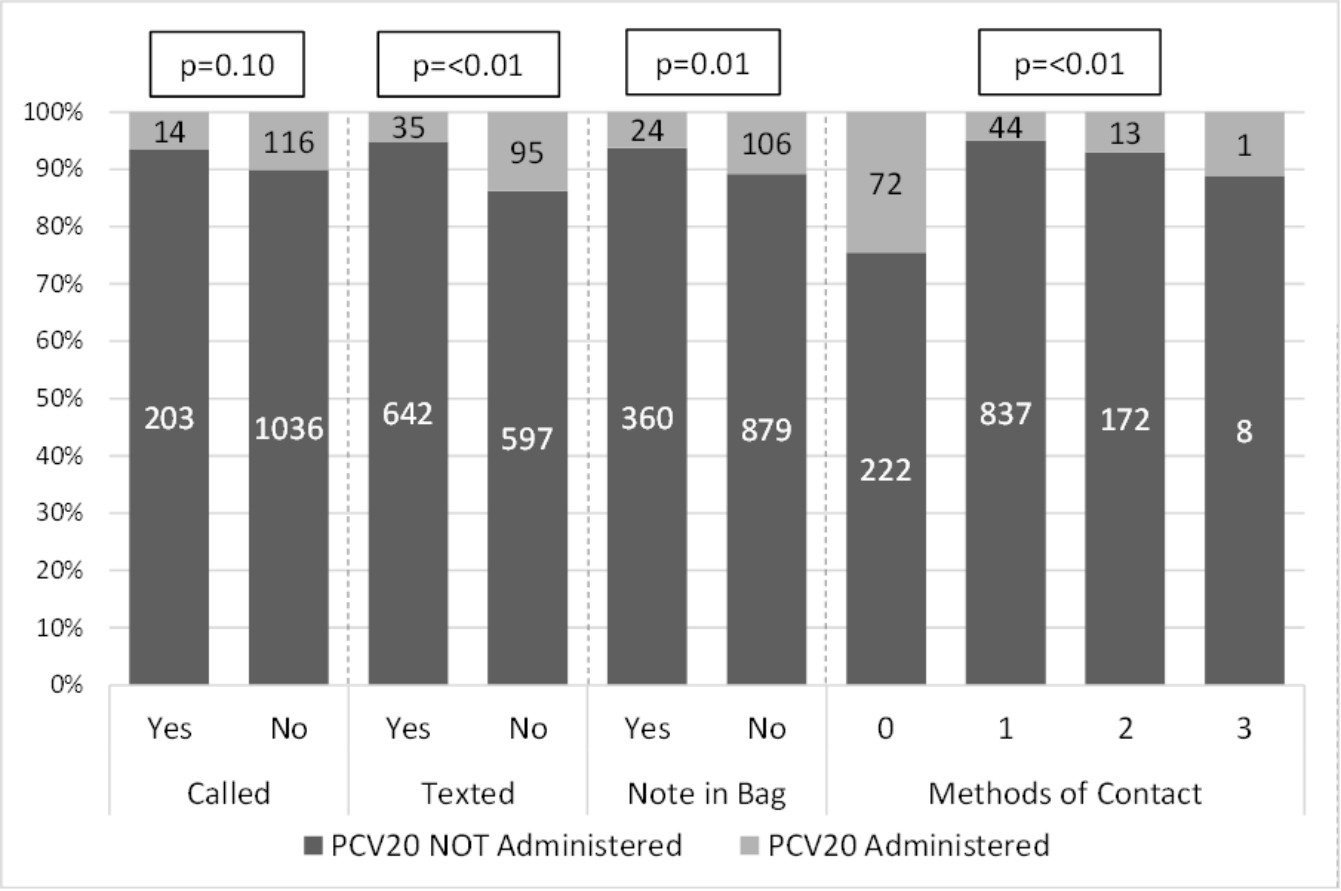
Figure 2. Methods used to contact patients for PCV20 vaccines by whether or not vaccine was administered



DOI: https://doi.org/10.24926/iip.v15i4.6345

Figure 3. Number of PCV20 vaccines administered by month in retail pharmacies

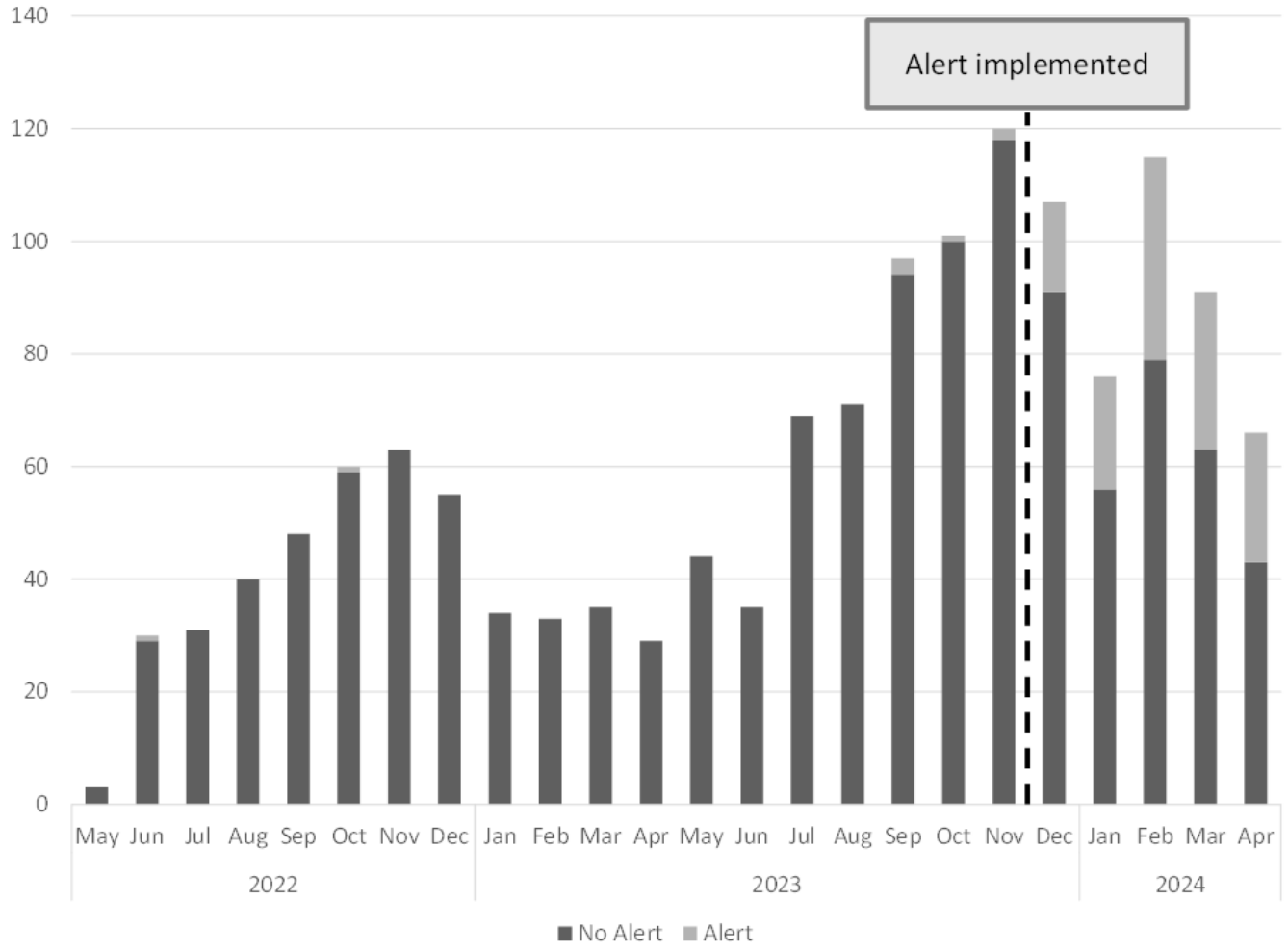


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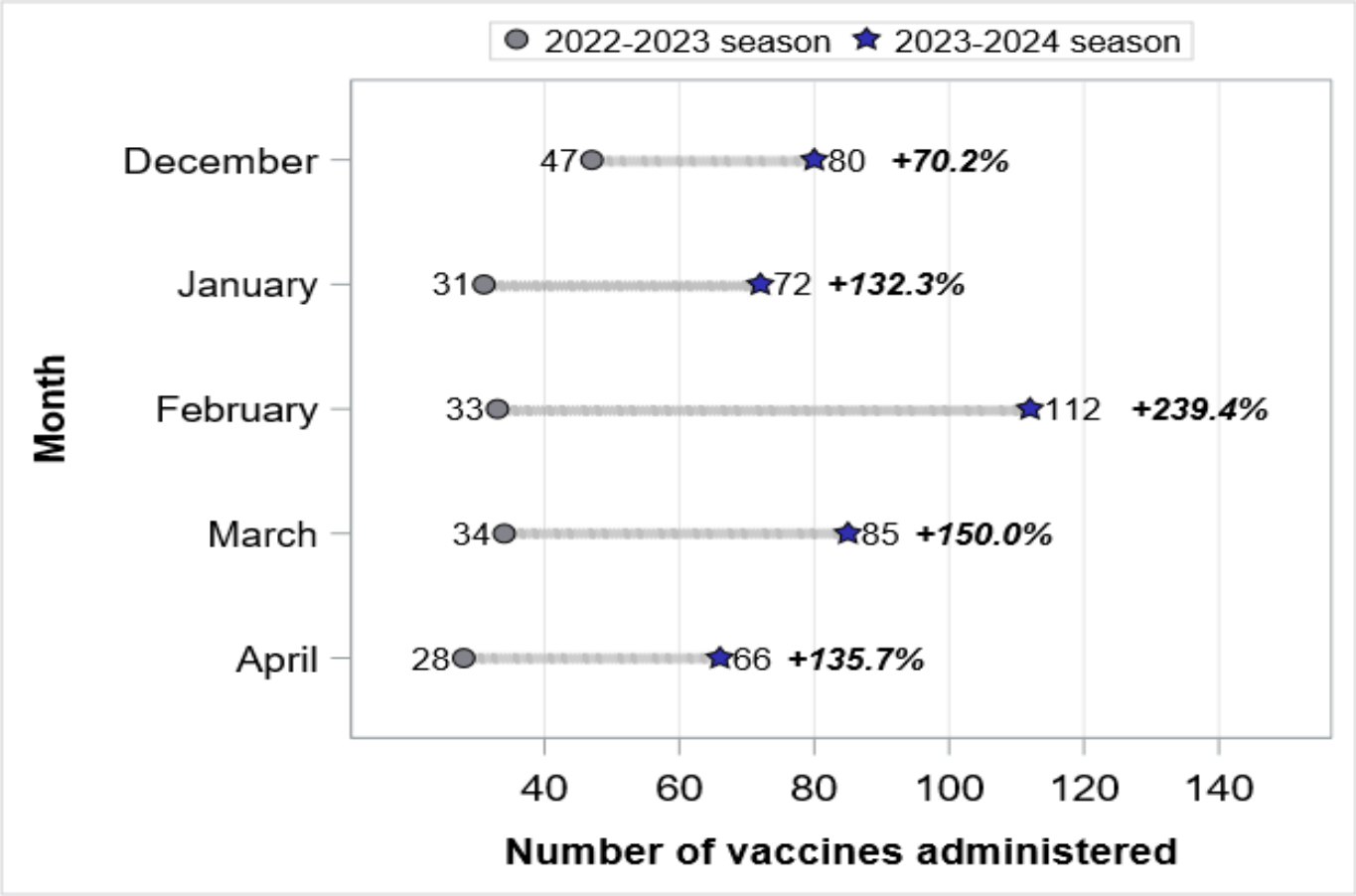
Figure 4. Comparison of PCV20 vaccinations in retail pharmacies within 2023-2024 study season and previous year.



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