Pharmacist-Driven Pediatric Vaccine Recommendation and Implementation Service

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Abstract

Background: The Advisory Committee on Immunization Practices recommends improving efforts to vaccinate hospitalized children; however, immunizations are oftentimes only administered in primary care settings. We piloted a pharmacist-driven vaccine recommendation service to increase immunization of hospitalized pediatric patients.

Methods: In this prospective cohort study, a pharmacist reviewed the vaccine histories of all immunocompetent patients ages two months to six years hospitalized Monday through Friday in the month of February 2024. If catch-up vaccines were needed, the pharmacist facilitated ordering the immunization(s) to be administered prior to discharge. Intervention data was reported as the number of patients reviewed, percentage of patients who received one or more childhood vaccine(s) in the hospital, and the amount of pharmacist time spent.

Results: A total of 130 patients were included, of which 87 (67%) were determined to be up-to-date on immunizations. Among 43 patients eligible to receive a vaccine, 15 patients (35%) received at least one immunization prior to discharge, and a total of 42 vaccines were administered. The median pharmacist time spent per patient obtaining vaccination history and discussing vaccination with the family was 11 minutes and two minutes, respectively.

Conclusions: The results of this study confirm that under-vaccination in hospitalized pediatric patients is common, with over 30% of patients missing one or more vaccines. In this study, pharmacist intervention resulted in successful administration of 42 immunizations prior to discharge. Including pharmacists in efforts to improve vaccination of hospitalized children could be considered to decrease the burden of review on inpatient providers and to close the gap on missed immunizations.

Keywords: immunization, pediatric, inpatient, hospitalized, pharmacist

Introduction

Routine childhood vaccines remain an essential way to protect children from highly preventable illnesses that can have serious consequences, including debilitating disease and death.[1] Under-vaccination has been associated with increased emergency department visits and increased inpatient admissions.[2] The Advisory Committee on Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC) provides established vaccination guidelines annually; however, single-center studies looking at under-vaccination in hospitalized children reveal that anywhere from 27% to 84% of children are not up-to-date on their vaccines.[3-7] Similar studies show that hospitalized children who are not up-to-date usually require only one to two vaccine doses to be caught up.[3,4] A retrospective cohort study showed that in over 1.5 million pediatric hospitalizations, a vaccine dose was administered in only 12.9% of hospitalizations, with the most common vaccines administered being the birth dose of hepatitis B and the influenza vaccine.[8] Furthermore, less than 2% of these hospitalizations involved a patient receiving a vaccine other than the birth dose of hepatitis B and influenza vaccine.

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ACIP recommends utilizing the inpatient setting to deliver vaccines.[9] Childhood vaccination rates have declined since the start of the COVID-19 pandemic, in part due to a disruption in primary care.[10,11] This highlights the importance of vaccinating children in the inpatient setting when the opportunity exists. The vaccination rate for the measles, mumps, and rubella vaccine for United States kindergarteners fell from 95.2% in 2019–2020 to 92.7% in 2023–2024, below the Healthy People 2030 goal of 95%.[12,13] Since 2019–2020, national vaccine rates for kindergarteners have also remained below 95% for diphtheria, tetanus, and acellular pertussis vaccines, hepatitis B, varicella, and polio.[12] Hospitals across the country have adapted practices to ensure influenza vaccines are given during admission, but not many utilize the same practices for other childhood vaccines.[14]

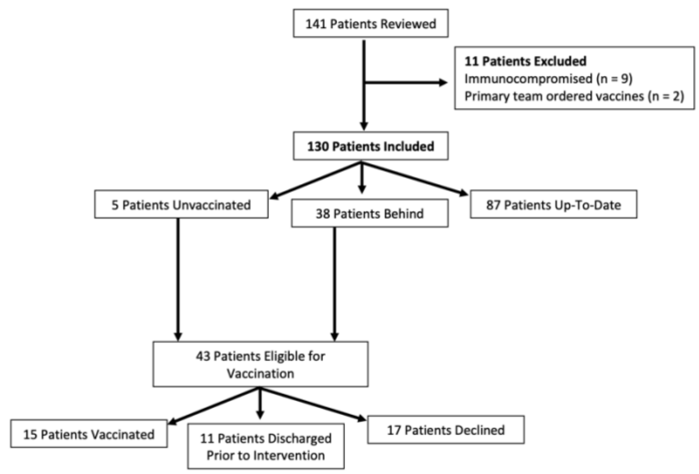
Given their knowledge of the CDC vaccination schedule and of the safety and efficacy of vaccines, an opportunity exists for pharmacists to play a role in developing the same practices for childhood vaccines. Hospital pharmacists are uniquely positioned with access and clinical expertise to identify children who are under-immunized, and to offer catch-up vaccines. The purpose of this study was to describe the impact of a pharmacist-driven vaccine implementation service on identifying patients who are under-immunized and the success rate of catching patients up to CDC recommendations. In this study, we describe the vaccination status of patients ages two months to six years admitted to our institution, and the number of vaccines received following pharmacist-driven recommendations.

Methods:
We performed a one-month, single-center, prospective cohort study evaluating the impact of a pharmacist-led immunization recommendation service at a 148-bed tertiary care pediatric hospital within a multidisciplinary academic medical center in the upper Midwest. The hospital includes 76 general pediatric beds and 12 pediatric intensive care beds. Prior to this pilot, with the exception of the seasonal influenza vaccine, there was no standardized process at our institution for determining vaccination status and offering catch-up vaccines if indicated. At the time of the pilot study, the hospital was not enrolled in Vaccines for Children (VFC), a program that provides vaccines at no cost to eligible children, including patients who are eligible for Medicaid, patients who are uninsured or underinsured, or patients who are American Indian or Alaskan Native. However, payment has not been a barrier to providing routine childhood immunizations in the inpatient setting at our hospital, with the exceptions of the COVID-19 vaccine and nirsevimab, which are only administered in the outpatient setting.

The study included hospitalized patients ages two months to six years — an age range chosen because 80% of all childhood vaccines are indicated during this time period. Patients were excluded if they were immunocompromised, i.e., diagnosed with primary immunodeficiency, receiving chemotherapy during admission, receiving chemotherapy in the past 6 months, or having received a hematopoietic cell transplant or solid organ transplant. Patients were also excluded if the primary team ordered vaccine(s) prior to pharmacist intervention. Vaccine histories were obtained by a pharmacist Monday through Friday from February 5, 2024, to March 1, 2024, using primary care provider visit notes, state immunization registries, outside hospital or clinic information, and parent/caretaker interviews. Immunizations from the North Dakota, Iowa, South Dakota, and Minnesota immunization registries are available via our institution's immunization information system. Status of influenza vaccination was not included in the review because our institution has a pre-existing process for frontline nurses to evaluate influenza vaccination and order seasonal influenza vaccine via a standing order prior to discharge if needed. At the time of the pilot, COVID-19 vaccination and nirsevimab administration were restricted to outpatient administration at our institution due to reimbursement models; COVID-19 vaccination and nirsevimab were therefore not included in our review.

Vaccination status was categorized as unvaccinated (patient had not received any vaccines), behind (patient had received some, but not all, vaccines as recommended by the CDC), or up-to-date (Figure 1). If a patient was up-to-date on all current childhood vaccines but had not received a rotavirus vaccine and was no longer eligible due to age, their vaccination status was marked as up-to-date. If a patient was deemed to be unvaccinated or behind on vaccines after chart review, the pharmacist would conduct a parent/caretaker interview to verify vaccination status and assess willingness to have the patient receive vaccinations prior to discharge. If a patient was deemed as up-to-date after chart review, no patient/caretaker interview was conducted. Patients who were due for a vaccine but were still in the window to receive the vaccine per CDC guidelines (i.e., a 13-month-old child who had not received their 12- to 15-month *Haemophilus influenzae* type B [Hib] booster) were categorized as up-to-date. Any eligible patient who was admitted multiple times throughout the month only had their vaccination status assessed the first time they were admitted.

Figure 1: Inclusion/exclusion of patients during pilot intervention, immunization status of children per ACIP guidelines, and result of pharmacist intervention.



The primary inpatient physician team was contacted via our institution's electronic medical record messaging system or in person by the reviewing pharmacist with the recommendations for catch-up, based on vaccine formulations available on the hospital formulary. If consent was given by both the parent/caretaker and primary team, the pharmacist assisted the primary team in ordering vaccinations to be given by the patient's nurse prior to discharge. If immunizations were ordered the same day as discharge, the pharmacist also coordinated with the patient's care team to ensure vaccinations were administered by the nurse prior to discharge.

Demographic information (age, sex, race, and payor status) and immunization history were collected. Race was necessary for data collection in order to devise immunization recommendations for patients according to ACIP recommendations, specifically as it related to preferential use of the monovalent PRP-OMP formulation of Hib vaccine in American Indian and Alaskan Native infants.[15] At the time of our study, the hexavalent vaccine Vaxelis, which contains diphtheria and tetanus toxoids and acellular pertussis, inactivated poliovirus, Hib conjugate, and hepatitis B (DTaP-IPV-Hib-HepB), was not yet included as a preferred vaccine in this population due to ongoing immunogenicity studies. Race was collected as assigned in the electronic health record.

Information was also collected on the number of patients behind on immunizations (including type of vaccine), the number of catch-up recommendations made, the number of catch-up recommendations accepted by the physician and parent/caretaker, the number of recommendations declined by the parent/caretaker (including reason), and the amount of time spent on chart review and parent/caretaker education.

This study was conducted under the guidance of pharmacy leadership at the institution. This study was categorized as non-human subjects research by the local Institutional Review Board.

The primary outcome was the percentage of patients who received one or more childhood vaccines in the hospital when indicated. Secondary outcomes included the percentage of patients who were up-to-date on vaccines, the number of each childhood vaccine given in the hospital, the percentage of parents/caretakers who accepted and rejected vaccinations after they were recommended, and the time spent reviewing each patient's vaccine history. Other secondary outcomes included vaccination status by race and type of insurance coverage (private versus public). All data were descriptively analyzed. The two-tailed Fisher's Exact Test was used when comparing vaccination status between insurance types (private versus public) and race (Caucasian versus non-Caucasian). The Mann-Whitney U-Test was used when comparing acceptance and rejection of recommendations as related to time spent with the parent/caretaker.

Results

During the study period, 141 patients were reviewed by the pharmacist, 11 of whom were excluded. Nine patients were actively receiving chemotherapy and two had their immunizations ordered by the primary team prior to any pharmacist intervention. Baseline characteristics of the patients included in the study are shown in Table 1.

The majority of patients were 18 months of age or younger (51%) and Caucasian (65%). Of the 130 patients included in the review, 87 patients (67%) were determined to be up-to-date on vaccines by the reviewing pharmacist (Figure 1). A total of 38 patients (29%) were missing one or more of their vaccines, and five patients (4%) were completely unvaccinated.

For the primary outcome, 15 patients (35%) of the 43 eligible patients received one or more childhood vaccines prior to discharge. Parents/caretakers declined vaccine(s) in 17 patients (40%), and 11 patients (25%) discharged prior to pharmacist intervention (Figure 1).

Table 1: Baseline Characteristics (n = 130)

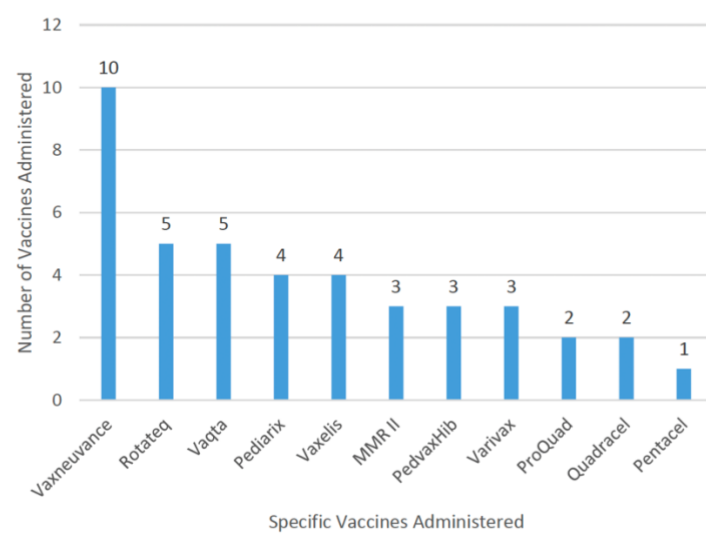
Characteristic	
Female, n (%)	56 (43)
Insurance type	
Private, n (%)	65 (50)
Public, n (%)	64 (49)
Uninsured, n (%)	1 (1)
Admit age, median years (IQR[a])	1.42 (0.75-3.25)
2-18 months, n (%)	67 (51)
19-35 months, n (%)	27 (21)
3-6 years, n (%)	36 (28)
Race	
Caucasian, n (%)	84 (65)
American Indian, n (%)	18 (14)
Hispanic, n (%)	11 (8)
Other race[b], n (%)	17 (13)

[a]IQR = interquartile range

[b]Patients who were not listed as Caucasian, American Indian, or Hispanic

A total of 42 vaccines were administered to 15 patients during the pilot. The most common vaccine administered was the pneumococcal conjugate vaccine (15-valent) (Vaxneuvance; n = 10), followed by the rotavirus vaccine (Rotateq; n = 5) and hepatitis A vaccine (Vaqta; n = 5) (Figure 2.)

Figure 2: Specific Vaccines Administered



Vaxneuvance: pneumococcal conjugate vaccine 15-valent; **Rotateq**: rotavirus; **Vaqta**: hepatitis A; **Pediarix**: diphtheria, tetanus toxoid, and acellular pertussis, inactivated poliovirus, hepatitis B; **Vaxelis**: diphtheria, tetanus toxoid, and acellular pertussis, inactivated poliovirus, hepatitis B, Haemophilus influenzae type B; MMR II: measles, mumps, and rubella; **PedvaxHib**: Haemophilus influenzae type B; **Varivax**: varicella; **ProQuad**: measles, mumps, and rubella, varicella; **Quadracel**: diphtheria, tetanus toxoid, and acellular pertussis, inactivated poliovirus; **Pentacel**: diphtheria, tetanus toxoid, and acellular pertussis, inactivated poliovirus, Haemophilus influenzae type B

Among the 17 patients who declined vaccination in the hospital, 11 parents/caretakers (65%) stated they wanted to wait until their child's next visit with their primary care provider. The parent/caretaker of the same five patients who came into the hospital unvaccinated declined immunizations because they were not interested in having their children receive any immunizations at any time. Finally, one parent/caretaker declined as the family chose a delayed vaccination schedule.

The median time spent obtaining vaccination history was 11 minutes per patient, while the median time spent with each family recommending vaccines was two minutes. Patients with private insurance were more likely to be up-to-date on their vaccines compared to patients with public insurance, although this was not statistically significant (62% vs 44%, $p = 0.06$). Caucasian patients were more likely to be up-to-date on their vaccines than non-Caucasian patients (61% vs 39%, $p = 0.027$). There was no correlation between time spent with family and whether the family accepted or rejected immunizations (three minutes spent with families who accepted versus two minutes spent with families who declined, $p = 0.49$).

Discussion

In this study, 43 patients (33%) were not up-to-date with CDC-recommended immunizations, which corroborates other published data demonstrating that there is a significant number of hospitalized pediatric patients who are behind on childhood vaccinations.[3-7] The one-month pilot intervention of pharmacist-led immunization review and vaccine recommendations to the primary team and caretaker interview resulted in successful vaccine administration prior to discharge in 15 patients (35% of eligible patients). Compared to a previous report by Bryan et al. demonstrating only 12.9% of children receiving vaccines during hospitalization, our study supports pharmacist-led intervention to improve vaccination rates.[8] A total of 42 vaccines were administered during the pilot, demonstrating the capability of a pharmacist in increasing vaccination rates during inpatient stays.

The pharmacist-driven vaccine recommendation service was only conducted during day shift hours Monday through Friday, which unfortunately led to several missed opportunities in offering vaccination to patients. This was demonstrated by the 11 patients who were discharged prior to an intervention being made. In an ideal setting, frontline pharmacist review of immunization history completed on admission would increase feasibility to intervene prior to discharge. The median time spent reviewing immunization histories and discussing immunizations with patients/caretakers (total of 13 minutes/patient) would suggest that a dedicated position for this work would be necessary depending on hospital patient volumes; it may be feasible, however, for frontline pharmacists to tailor their review to patients two months to six years of age, as done in our pilot, to make review more feasible.

It is important to highlight that only two patients were excluded from the study because the primary team ordered vaccinations prior to pharmacist review. Based on information from the Pediatric Health Information System database, only 1.9% of pediatric hospitalizations involved a vaccine administration other than the birth dose of hepatitis B or influenza vaccine.[8] Given that data, it is not surprising that in our pilot only two patients had vaccines ordered prior to pharmacist intervention. Hospital pharmacists are uniquely positioned with access and clinical expertise to identify children who are under-immunized and offer catch-up vaccines, particularly in instances where the primary team may be focused on managing other diagnoses associated with the admission. The 15 patients vaccinated in this study likely would have not been vaccinated prior to discharge without pharmacist intervention.

The finding that children with public insurance were less likely to be up-to-date on vaccinations versus patients with private insurance was similar to that shown by previous data looking into insurance type and vaccination history.[16] Our data showing Caucasian patients being more likely to be up-to-date on their vaccines compared to non-Caucasian patients (61% vs 39%, $p = 0.027$) were also similar to other recently published data showing that vaccination rates are lower among non-Hispanic black or African American children and among Hispanic and American Indian or Alaska Native children.[11] It will be crucial for future vaccination programs to consider these factors when tailoring their programs to specific patient populations.

Pharmacists can play a role by providing information on vaccines to those families interested in having their child caught up in the hospital. Of those caretakers who opted not to have their child vaccinated while in the hospital, the majority (65%) were interested in catching their child up on their vaccines at their next primary care provider appointment, and the conversation with the pharmacist about catch-up was a reminder to some families that their child was due for one or more vaccines. While the time spent with each patient/caretaker was limited to just two to three minutes, it was noted that most families had established views of vaccination and were either quickly amenable to vaccinations or uninterested in further discussion.

A strength of this study was its prospective design. This allowed the pharmacist to review every patient's vaccine history in real-time and make recommendations to the team and the family/caretaker, which would mirror practice if implemented outside of the pilot. To our knowledge, this is also the first study demonstrating a pharmacist's impact on increasing vaccination of under-immunized, hospitalized pediatric patients. While other reviews have included physician-led programs, our results suggest that the primary provider for the patient while hospitalized did not frequently order vaccines (n = 2).

The study included several limitations. It was a single-center study, limiting the external validity. It is also important to note that pharmacist job duties are delineated differently at various institutions. We also limited patients to ages two months to six years to focus on those at highest need of catch-up, as 80% of childhood vaccines are given during this time period. It is unclear if expansion to other age ranges and vaccines would result in similar acceptance rates. The time spent on reviewing vaccine histories and making recommendations on patients older than six years cannot be extrapolated from our results. It would be expected that a greater amount of pharmacist time would be required with more patient review, in addition to likely longer immunization lists as a patient ages. We were also limited by our lack of a comparator group, so these results do not evaluate how much impact was made compared to regular hospital practices/workflows. Additionally, we did not provide families with any type of vaccine hesitancy survey tools (e.g., the Parent Attitudes about Childhood Vaccines tool, the Vaccine Hesitancy Scale, the Vaccination Confidence Scale, or the Vaccination Attitude Examination scale). Utilizing a hesitancy tool in future studies may be beneficial to identify and measure barriers associated with vaccine hesitancy.

Finally, hospitals may face potential payment issues, particularly if they are not enrolled in the VFC program, as vaccine reimbursement can be limited in the inpatient setting. At the time of this pilot, the study hospital was not enrolled in VFC, but the data obtained in this study highlight the potential role that VFC can play in ensuring timely inpatient administration of vaccinations to children without incurring financial barriers. Hospitals should be encouraged to participate in the VFC program to allow inpatient catch-up immunization and increased access to no-cost vaccines.[11]

The results of this pilot study show that pharmacists can make an impact on immunization rates by reviewing vaccination histories and making catch-up vaccination recommendations when warranted. Including pharmacists in efforts to improve vaccination of hospitalized children could be considered to decrease the burden of review on inpatient attending providers and close the gap on missed immunizations.

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Treatment of Human Subjects: IRB determined project was non-human subjects research

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