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Commentary

Beyond Influenza Vaccination: Expanding Infrastructure for Hospital-based Pediatric COVID-19 Vaccine Delivery

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ABSTRACT

Controlling the spread of severe acute respiratory syndrome–coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease 2019 (COVID-19), will rely on vaccination at increasing rates and in an equitable manner. The main reasons for under-vaccination are varied among different segments of the population and include vaccine hesitancy and lack of access. While vaccine hesitancy is complicated and requires long-term solutions, access can be enhanced through evidence-based delivery strategies that augment conventional approaches. Hospital-based COVID-19 vaccination programs hold particular promise in reaching populations with decreased vaccine access and those at higher risk for adverse outcomes from SARS-CoV-2 infection. Hospitals have the necessary equipment and storage capabilities to maintain cold chain requirements—a common challenge in the primary care setting—and can serve as a central distribution point for delivering vaccines to patients in diverse hospital locations, including inpatient units, emergency departments, urgent care centers, perioperative areas, and subspecialty clinics. They also have the capacity for mass-vaccination programs and other targeted outreach efforts. Hospital-based programs that have been successful in implementing influenza and other routine vaccinations can leverage existing infrastructure, such as electronic health record–related tools.

With the possibility of COVID-19 becoming endemic, much like seasonal influenza, these programs will require flexibility as well as planning for long-term sustainability. This commentary highlights existing vaccine delivery to children in hospital-based settings, including key advantages and important challenges, and outlines how these systems could be expanded to include the COVID-19 vaccine delivery. (*Clin Ther*. 2022;44:450–456.) © 2022 Elsevier Inc.

Key words: COVID-19 vaccination, hospital-based vaccination programs, influenza vaccination, inpatient vaccination, vaccine delivery.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic continues to be the greatest public health crisis in modern history. At the time of this writing, there have been >390 million cases and >76 million deaths worldwide, including >76 million cases and >900,000

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Abbreviations: COVID-19, Coronavirus Disease 2019; SARS-CoV-2, Severe acute respiratory syndrome coronavirus 2; ED, Emergency department; EHR, electronic health record; mRNA, messenger ribonucleic acid.

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deaths in the United States alone.^{1,2} Also in the United States, >209 million people are fully vaccinated,³ and the pandemic has almost entirely shifted to a pandemic among the unvaccinated. In regions of the country with lower vaccination rates, record numbers of cases, hospitalizations, and deaths have strained health care infrastructure to such extremes that rationing of care is necessary. The reasons for under-vaccination are varied among different segments of the population and include vaccine hesitancy and lack of access, particularly in medically underserved areas. While vaccine hesitancy is complicated and requires long-term solutions, lack of access is one issue for which solutions already exist and are steeped in past experience and success. This commentary highlights existing vaccine delivery to children in hospital-based settings, with focuses on seasonal-influenza vaccination and on the ways in which these systems could be expanded to include the delivery of COVID-19 vaccines.

KEY ELEMENTS OF SUCCESSFUL INFLUENZA VACCINATION PROGRAMS

Each of our institutions has established a highly successful program for promoting influenza vaccination of patients in a variety of inpatient and outpatient settings.⁴⁻⁶ Five key elements crucial for implementing these programs, and examples from our institutions to illustrate these points, are highlighted ([Table 1](#)).

Multidisciplinary team

Because the steps toward successful influenza vaccination involve many different disciplines across an institution, engagement of and cooperation between individuals representing these disciplines is crucial. Our institutions have each convened a team of champions consisting of nurses, advanced practice providers, resident and attending physicians, pharmacists, clinical informaticists, data analysts, and communications specialists. The teams have worked collaboratively toward the shared goal of capturing influenza-vaccination opportunities at all health care visits. In our experience, support from hospital leadership to promote messaging and provide resources when needed is also crucial for program success.

Automated informatics tools

Because health care visits often incorporate different tasks compressed into a limited time frame, automating the identification of vaccine-eligible patients and

ordering the vaccine within the electronic health record (EHR) is highly recommended. In each of our programs, measures have been put into place to: (1) notify providers of vaccine-eligible individuals through the use of best-practices advisories, (2) document influenza-vaccination status, and (3) institute standing orders for nurses and/or pharmacists to independently administer vaccine across all hospital settings. In addition, our EHR has been integrated with the state's immunization-information system in order to facilitate review of patients' vaccine records and to improve communication of vaccine administration across health care settings.

Analytics tools

Accurate and timely data are essential for tracking influenza-vaccine screening, ordering, and administration metrics during the season and for evaluating program growth and optimization between seasons. At our institutions, this information is used to show both real-time progress in the current season and a comparison of data from prior seasons. Prospective audit and feedback are provided regularly by influenza-vaccine champions, nursing managers, and providers on the inpatient and outpatient teams (eg, through weekly e-mail reports and monthly staff presentations).

Education and communication

Efforts to teach and share accurate vaccine-related information are imperative for facilitating evidence-based vaccine-related decision making. Prior to each influenza season, our programs incorporate education/re-education of nurses, providers, and staff to highlight the impact of seasonal influenza on patients and the role that each team member plays in promoting vaccination. We have used varied approaches including in-person and virtual presentations, newsletters, on-line resources, and required training modules. Scripting is integrated into the EHR's best-practice advisories to promote the use of evidence-based vaccine-related communication (eg, offering a strong, presumptive recommendation). Patient- and provider-education materials highlighting the benefits of influenza vaccination and addressing common questions are provided through web-based materials, handouts, and patient-portal messages within the EHR.

Engagement

Each program promotes team member engagement in a variety of ways, such as end-of-season contests

Table 1. Elements of a successful inpatient vaccination program.

Component	Examples
Multidisciplinary team	Team of vaccine champions including nurses, advanced practice providers, resident and attending physicians, pharmacists, clinical informaticists, data analysts, and communications specialists; Regular meetings to share ideas, challenges, opportunities, and to disseminate information
Automated informatics tools	Automated vaccination status screening in EHR; Clinical decision support tools; Vaccine standing orders; Integration with regional or state immunization registries
Analytics tools	Tools to collect, review, and disseminate standardized influenza-vaccination metrics for specific patient groups and hospital settings; Vaccination reports, high-risk patient registry; Vaccination dashboards in EHR; Vaccination status in patient lists; Prospective audit and feedback
Education and communication	Family and patient education through various modalities (eg, care team communication, websites, handouts, videos); Staff and provider education on vaccine-related topics, policies, workflow, and EHR tools through training modules, websites, materials, presentations; Outline informational needs and implement strategies for delivering this information to parents, staff, and providers
Engagement	Solicit hospital leadership support; Foster end-user engagement through incentives like Maintenance of Certification credit, contests

EHR = electronic health record.

for the highest vaccination rates across units and clinics, monthly recognition of nurses with the greatest numbers of vaccination orders and administrations, and offers of education credits or Maintenance of Certification points for trainee, physician, or pharmacy participants.

These examples describe the experience of inpatient-based vaccination at several children’s hospitals, but the lessons learned from these programs apply to other patient populations.

ALTERNATIVE SETTINGS FOR ROUTINE AND SEASONAL INFLUENZA VACCINATION IN CHILDREN

Vaccination in a hospital setting provides a myriad of advantages, including increased access for populations without a primary medical home, increased access for those who face transportation constraints or challenges

with taking time off from work, and targeted delivery to populations with comorbidities that increase the risk for severe outcomes from infection. Hospital-based health systems can serve as a central distribution point for vaccines, have the necessary equipment and storage capabilities to maintain cold chain requirements, and have the capacity for mass-vaccination events. They also can leverage infrastructure that has been established for other vaccination programs such as EHR-embedded tools for vaccine screening, ordering, and tracking. Another advantage is the potential for the entire care team, across roles and disciplines, to provide a strong, consistent vaccine-related message to patients and families. In the hospital, there may be time for prolonged or multiple conversations with a more “captive audience,” with the potential for families to be more open to vaccination with a changing perception of their child’s risk.⁷

Vaccination in Inpatient Settings

In 2010, nearly 2 million children aged <15 years (excluding newborns) in the United States were hospitalized,⁸ the majority of whom had underlying chronic disease⁹ with an increased risk for influenza-related complications.¹⁰ Furthermore, many hospitalized children lack a medical home or usual source of care,¹¹ which may contribute to under-immunization as well as to the risk for adverse outcomes in general.¹²

An estimated 37% to 63% of hospitalized children are eligible for influenza vaccination at the time of admission.^{4,13,14} Of these, only 25% to 50% are vaccinated before hospital discharge.^{4,14,15} The high percentage of missed opportunities is concerning, especially given that influenza vaccination during hospitalization is recommended by the Advisory Committee of Immunization Practices¹⁰ and serves as an important measure of quality of care.¹⁶ Reasons for under-vaccination in the hospital setting have been recently explored. Although many families express interest in receiving vaccines in this setting, evidence suggests that multilevel barriers contribute to missed opportunities.^{7,13,15,17,18} These include difficulty ascertaining accurate vaccine records, perceptions about vaccinating during acute illness, provider apprehension about assuming the task of providing vaccinations, vaccination considered to be the responsibility of the primary care provider,¹³ lack of skills to effectively communicate with hesitant families about vaccines, and billing considerations.

Vaccination in the Emergency Department and Urgent Care Center

The emergency department (ED) is considered a “safety net” for many children and adults without a medical home and can help to overcome many of the aforementioned barriers to accessing vaccines experienced by low-income families.¹⁹ Survey-based data indicate that families demonstrate a willingness to receive vaccines in the ED setting.^{13,19} Several studies have demonstrated that dedicated programs offering influenza vaccine to families in the ED increased overall vaccination rates^{19–21} and that they are cost-effective.^{22,23}

Vaccination in Subspecialty Clinics

A study in children hospitalized due to influenza infection indicated that subspecialty clinics represented the visit type with the highest percentage of missed

opportunities for vaccination, particularly in children with a high-risk medical condition.²⁴ Vaccine reminder-recall is an effective strategy relevant to ambulatory settings that has been implemented using various modalities (eg, letter, telephone, text message, e-mail, EHR-based messages).^{25–28} Several studies have evaluated clinic-based process changes through quality-improvement initiatives, such as previsit planning, vaccine clinics, immunization champions, and nurses designated for vaccine delivery.^{29,30} Multicomponent interventions have been associated with a more substantial increase in vaccination rates compared with single-component interventions.^{26,31}

Vaccination in the Perioperative Period

In the United States, ≈6 million children aged <18 years receive general anesthesia each year, and of those children, >1 million are likely to receive general anesthesia around a vaccine-appropriate age.³² Administering a vaccine with the patient under general anesthesia provides the advantages of patient comfort, convenience, and leveraging existing workflows and processes without sacrificing immunogenicity.^{33,34} For these reasons, the American Academy of Pediatrics states that there are no contraindications to perioperative vaccine administration.³⁵

Vaccination of Family Members During Patient Visits and Hospital Admissions

Vaccinating family members is an effective “cocooning” strategy for protecting patients who are at high risk for disease, who are ineligible for vaccination, or who may mount an insufficient immune response to vaccination.³⁶ These programs are often supported by philanthropic funds to circumvent the need for patient registration and billing. Similar initiatives could be established at adult-care hospitals and nursing homes to allow for family members to receive seasonal-influenza and COVID-19 vaccines during inpatient and outpatient encounters.

COVID-19 VACCINATION IN HOSPITAL-BASED SETTINGS

As COVID-19 vaccines have become available for children, there has been an operational desire for hospital-based health systems to leverage the current influenza-vaccination infrastructure toward vaccination of eligible patients. However, inherent differences between COVID-19 mRNA and seasonal-

influenza vaccines have posed additional challenges that complicate implementation efforts: the need for extreme-cold storage for COVID-19 mRNA vaccines (Pfizer/BioNTech in particular); the need for a second dose of vaccine in all patients; limited vaccine supply from the state, requiring strategic use of every last dose in multidose vials; and additional requirements of reporting/accounting to public health agencies.

CONCLUSIONS

Controlling the spread of COVID-19 depends on vaccination at increasing rates and in an equitable manner, which will require the development of strategies that augment conventional approaches. Hospital-based COVID-19 vaccination programs allow for broader reach to those with decreased vaccine access and provide an opportunity to target other vulnerable populations at higher risk for adverse outcomes from SARS-CoV-2 infection. These efforts can extend across hospital-based settings, including inpatient units, EDs, urgent care centers, perioperative areas, subspecialty clinics, mass-vaccination clinics, and targeted outreach/mobile clinics. Hospital-based vaccination programs can leverage existing infrastructure, including EHR-related tools established for influenza and other routine vaccinations. However, additional challenges specific to COVID-19 vaccination include maintaining cold chain requirements, considerations for access to second and booster doses, and navigating state-managed supply. With the possibility of COVID-19 becoming endemic, much like seasonal influenza, these programs will require flexibility (ie, as new recommendations emerge) and planning for long-term sustainability. Further study into the most effective implementation strategies to increase influenza, COVID-19, and routine vaccine uptake and the impact of hospital-based delivery methods is crucial.

DISCLOSURES

The authors have indicated that they have no conflicts of interest with regard to the content of this article.

AUTHOR CONTRIBUTIONS

All of the authors contributed to the conception and drafting of this commentary. Annika M. Hofstetter and Suchitra Rao contributed equally to this work.

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