

# Vaccinating in the Emergency Department, a Model to Overcome Influenza Vaccine Hesitancy

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## Abstract

**Introduction:** Vaccine hesitancy and delays in vaccine administration time have limited the success of prior influenza vaccination initiatives in the pediatric emergency department (ED). In 2018–2019, season 1, this ED implemented mandatory vaccine screening and offered the vaccine to all eligible patients; however, only 9% of the eligible population received the vaccine. In 2019–2020, season 2, the team sought to improve influenza vaccination rates from 9% to 15% and administer over 2,000 vaccines to eligible ED patients.

**Methods:** Key drivers included: identifying vaccine hesitancy, providing counseling, reducing administration delays, and developing reminders for vaccine administration. We tested interventions using plan-do-study-act cycles. We included discharged ED patients, age 6 months–18 years old, emergency severity index score 2–5, and no prior vaccine this season. Process measures included percent of patients screened, eligible, accepting the vaccine, and leaving before vaccination. Outcome measures were the percent of eligible patients vaccinated and the total number of vaccines administered. Vaccination time was the balancing measure. **Results:** We included 57,804 children in this study. Comparing season 1 to 2, screening rates (84%) and eligibility rates (58%) were similar. Vaccine acceptance rates improved from 13% to 22%, the proportion of patients leaving before vaccination decreased from 32% to 17%, and vaccination rates improved from 9% to 20%. Total vaccines administered increased from 1,309 to 3,180, and vaccination time was 5 minutes faster in season 2. **Conclusions:** This ED influenza vaccination process provides a model to overcome vaccine hesitancy and can be adapted and replicated for any vaccine-preventable illness. (*Pediatr Qual Saf* 2021;6:e430; doi: 10.1097/pq9.000000000000430; Published online 7 April, 2021.)

## INTRODUCTION

In 2019, the WHO named vaccine hesitancy as one of the top 10 global health threats.<sup>1</sup> Vaccine hesitancy is defined as

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a reluctance or refusal to vaccinate. It continues today as only 58% of US children were vaccinated annually against the influenza virus in 2018.<sup>1–3</sup> To surmount vaccine hesitancy, the WHO recommends addressing missed opportunities for vaccination, tailoring immunization programs to high-risk populations, and supporting healthcare workers.<sup>4</sup>

The pediatric ED offers a novel strategy to overcome influenza vaccine hesitancy. Hart et al<sup>5</sup> identified a “gap population,” where 85% of ED parents intend to vaccinate their child against influenza each season; however, only 50% of these patients received the vaccine on follow-up. Vaccination programs in the pediatric ED bridge this gap. As a safety net for children without a medical home, the ED provides an opportunity to improve vaccination rates in classically undervaccinated populations and patients at high risk for influenza.<sup>5–8</sup> The ED also breaks down barriers such as transportation, difficulty making an appointment, and insurance problems.<sup>5</sup> Most patients report a willingness to be vaccinated in the ED.<sup>5,9</sup> Finally, prior studies have demonstrated how the electronic health record (EHR) can support ED healthcare workers to promote vaccination.<sup>8,10</sup>

Despite the obvious benefits and parental support, past influenza vaccination efforts have demonstrated only modest success in the pediatric ED.<sup>8,10</sup> During the prior season, this ED implemented mandatory influenza vaccine screening and found 58% of children were eligible for vaccination. However, influenza vaccine acceptance rates were only 13%, and many patients left before vaccination. Consequently, vaccination rates improved from 0% to only 9% (n = 1,235).<sup>8</sup> Therefore, our team aimed to develop a process to overcome vaccine hesitancy and improve administration rates in the pediatric ED.

Prior studies have sought to understand the barriers and facilitators of influenza vaccination. This study team found that parents decline vaccines due to uncertainty about the vaccine, a concern the child was too sick to receive the vaccine, or are unable/unwilling to wait for vaccination.<sup>8</sup> Similar barriers were identified during interviews with ED parents.<sup>5</sup> Focus groups with parents, teens, and healthcare workers characterized facilitators of vaccination. These included: a recommendation to receive the vaccine by a trusted source, access to better information regarding the severity of influenza disease and vaccine safety and efficacy, and making it convenient to get the vaccine.<sup>11</sup> Strelitz et al<sup>12</sup> demonstrated the feasibility of using a survey to identify vaccine hesitancy in ED triage, thus improving provider awareness and prompting ED providers to discuss the parents' vaccine choice before discharge.

Armed with a deeper understanding of vaccine hesitancy and vaccine facilitators, this team sought to optimize the ED vaccination process by improving influenza vaccine acceptance rates and ensuring that every patient requesting the vaccine received it. Specifically, we aimed to increase the influenza vaccination rates in eligible patients from 9% during the 2018–2019 season (season 1) to 15% during the 2019–2020 season (season 2) and administer over 2,000 vaccines.

## METHODS

### *Context*

This tertiary care, pediatric academic center located in Milwaukee, Wis., has a level 1 pediatric trauma center and ED with over 71,000 ED visits and 8,000 admissions in 2019. The ED serves as a referral site for surrounding urban and rural areas of Wisconsin, Illinois, and Michigan. In the summer of 2018, a multidisciplinary “flu team,” including ED nurses, providers, pharmacists, hospital leadership, and EHR analysts, formed to initiate an ED influenza vaccination initiative. EHR enhancements and process improvements were made to facilitate vaccine administration. An automated, electronic, weekly data report was built to monitor process, outcome, and balancing measures in this refined population and was available for continuous review throughout seasons 1 and 2.

### *Interventions*

To improve upon this work, the “flu team” interviewed stakeholders and performed failure modes and effects analysis to develop four key drivers of success: identifying families with vaccine hesitancy, involving providers in counseling, reducing delays in administration, and developing electronic reminders to administer the vaccine. The team defined the season 2 target population as ED patients age 6 months–18 years, with Emergency Severity Index levels 2–5, discharged September 1, 2019, through March 21, 2020. The team excluded patients if they had a prior influenza vaccine this season or if they were admitted. Vaccines were deferred until hospital discharge in admitted patients due to concerns that vaccine side effects, especially fever, may misinform medical decision-making for inpatients. Four intervention categories were identified, and multiple iterations of each were tested using plan-do-study-act cycles (Fig. 1). These interventions included: EHR enhancements, nursing and provider education, nursing and provider recognition, and a pharmacy workflow facilitating vaccine storage in the ED.

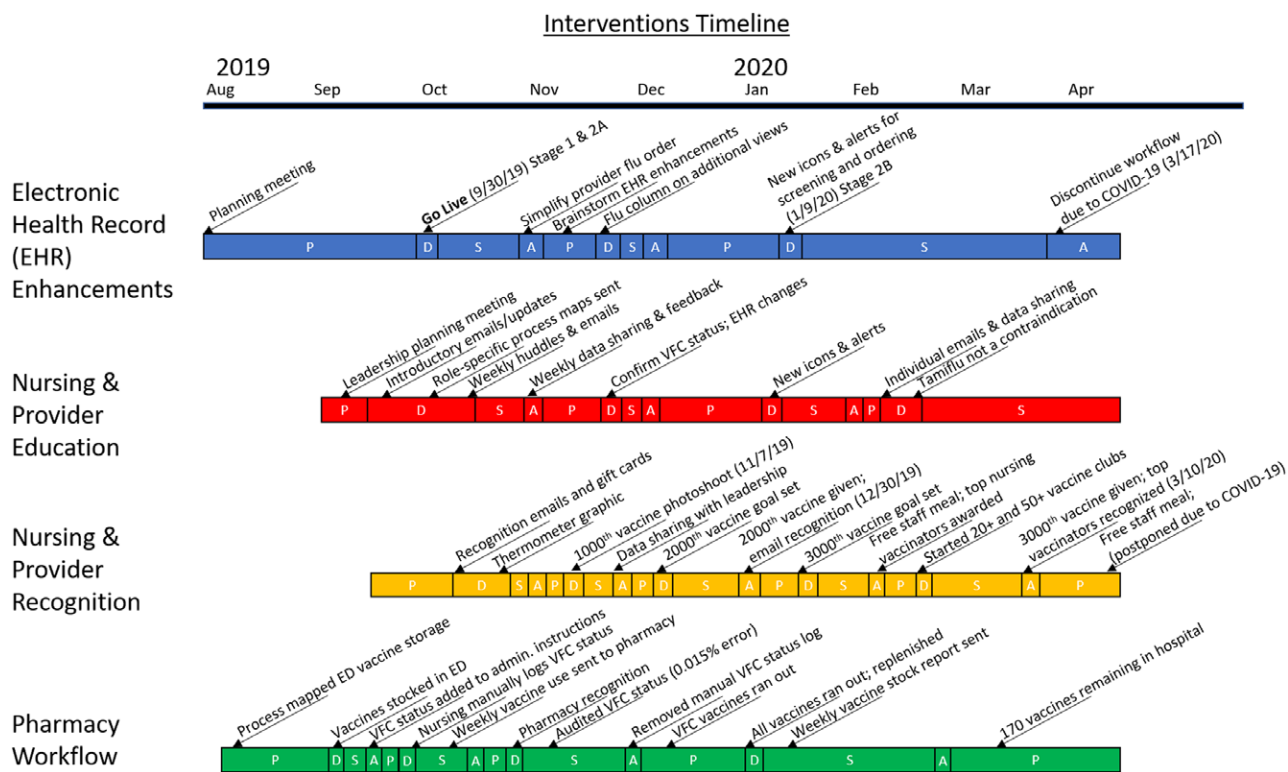
### *EHR Enhancements*

Figure 2 outlines the influenza vaccination process after season 2. Shading is used to identify different stages of the process. Stage 1 represents season 1 enhancements.<sup>8</sup> Season 2, stage 2A and 2B enhancements focused on facilitating communication, identifying vaccine hesitancy, reminding nurses to administer the vaccine, and adding redundancy. To facilitate communication, a “flu column” was added to the universal ED track-board. Icons in this column represented the patient's screening response (syringe = requests vaccine, blank = declines vaccine, and checkmark = vaccine administered). To identify vaccine hesitancy, a fourth screening option, “needs more information,” was added, and if selected, a question mark icon appeared in the flu column. Reminders to complete vaccination were added to the nursing discharge checklist and provider discharge narrator.

Yellow banners appeared in provider EHR workflows to identify unscreened patients and those needing more information (Fig. 2, stage 2B). Clicking either banner led to the screening questionnaire with a hyperlink containing answers to common influenza vaccine questions. Clicking “no, requests vaccine” triggered a provider Best Practice Advisory facilitating the vaccine order. Medical scribes also received similar yellow banners, which recommended notifying the provider of a patient needing more information or an unscreened patient. EHR workflows were turned off prematurely on March 21, 2020 due to the competing needs of Coronavirus Disease 2019 (COVID-19) for nursing and provider time.

### *Nursing and Provider Education*

Emails, huddles, and staff meetings were used to educate nurses and providers regarding the flu column, added screening response, and storing vaccines in the ED. We



**Fig. 1.** Timeline depicting 4 critical interventions (EHR enhancements, nursing and provider education, nursing and provider recognition, and pharmacy workflow) and significant changes over time. Stages of the interventions: (P) planning, (D) doing, (S) studying, and (A) acting.

distributed the handout on commonly asked vaccine questions and a PowerPoint on “tips and tricks to encourage vaccines” to nursing staff and providers to address vaccine hesitancy. Throughout season 2, weekly nursing and provider-specific emails were initiated, including data sharing, recognition, and EHR or workflow updates. Weekly data sharing included vaccine count, screening rate, acceptance rate, and the number of patients leaving before vaccination. Feedback was gathered at leadership meetings and “flu team” huddles. Revised workflows were shared with staff in huddles, newsletters, and emails.

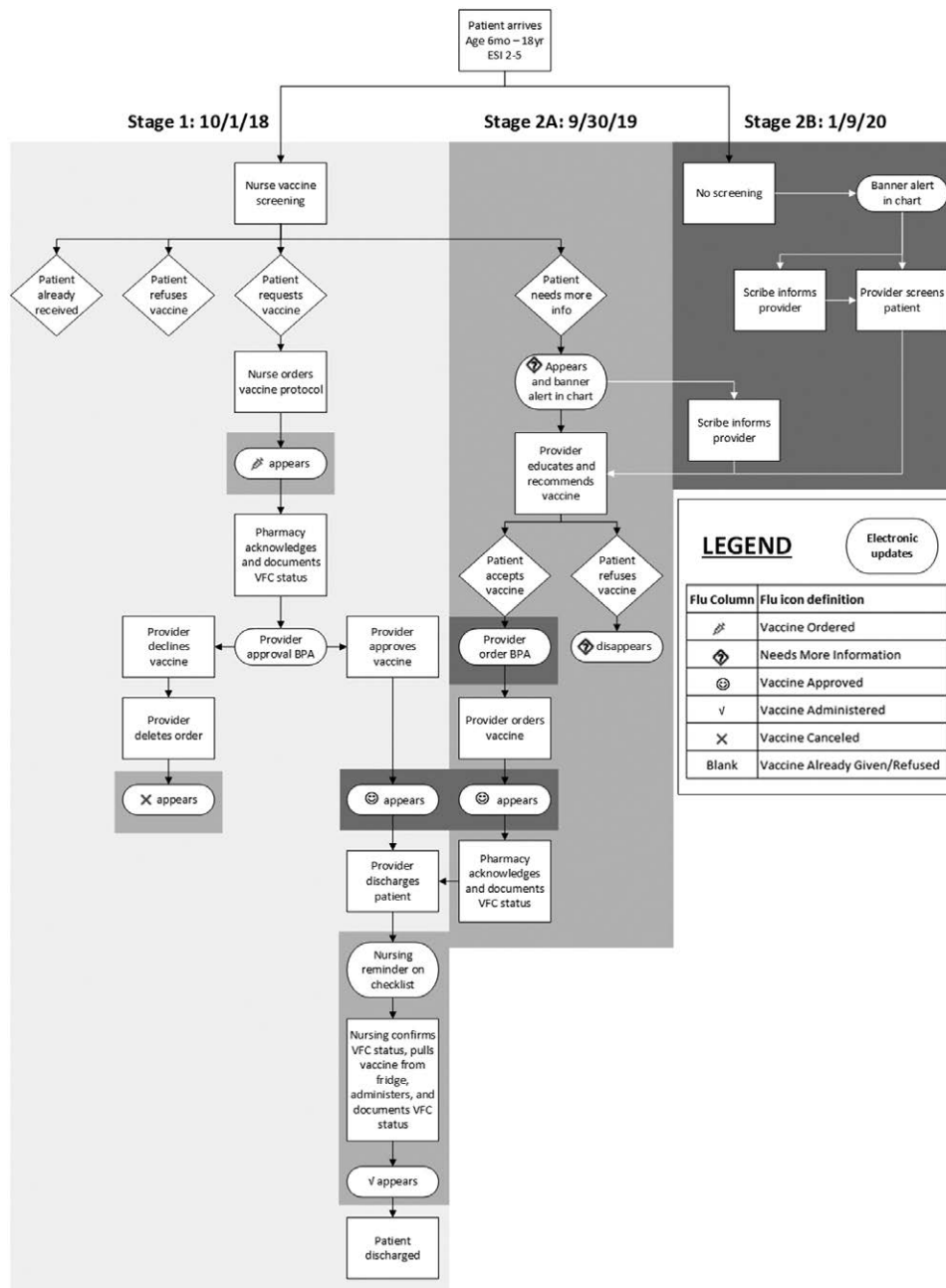
**Goal Setting and Recognition**

Motivating nurses and providers by setting attainable goals and providing recognition was a priority. A “thermometer graphic,” displayed in the nursing lounge, depicted weekly progress with a goal of 2,000 vaccines. The top 5 nurses administering the most doses each week were recognized with a \$5 gift card and in weekly emails throughout season 2. A photoshoot, announcements on social media, staff treats, and a \$25 gift card for the administering nurse were used to celebrate the 1,000th vaccine. The team initially aimed to administer 2,000 vaccines by March 31, 2020; however, the 2,000 vaccine goal appeared attainable by the end of December due to higher than expected vaccination rates. Therefore, the flu team challenged the nursing staff to a new deadline to administer 2,000 vaccines by December 31, 2019. To celebrate

the 2,000th vaccine, the “flu team” provided a free meal to all staff and 2 \$50 gift cards to the top vaccinating nurses in December. Then, the “flu team” set a new vaccination goal to administer 3,000 vaccines by March 31, 2020, and if achieved, a second staff meal and recognition of top vaccinators were promised. The 20+ and 50+ clubs provided weekly recognition to all nurses vaccinating 20% of their patients, and all providers approving at least 50 vaccines. The celebration of the 3,000th vaccine was postponed due to COVID-19 and the need for social distancing.

**Pharmacy Workflow**

To reduce delays in vaccine administration time, we stored influenza vaccines in an unlocked refrigerator, in the ED medication room, under 24-hour surveillance. Due to identical barcodes, 2 separate labeled bins were used to differentiate the suppliers (commercial or Vaccine for Children Program [VFC]). VFC is a federally funded program providing vaccines free of charge to qualified patients.<sup>13</sup> To reduce vaccines’ misallocation, the pharmacy documented VFC status in the medication administration instructions, and nursing reviewed VFC status and documented it in the medication administration record before administration. Initially, nurses also manually logged VFC status; however, after an audit demonstrated rare misallocation of vaccines, manual documentation was replaced with an electronic audit. Due to high



**Fig. 2.** Process map summarizing the emergency department (ED) influenza vaccine administration process at the end of season 2. Shading represents the different stages of the project. Stage 1 represents the baseline process, and stages 2A and 2B represent process improvements made to the workflow throughout season 2.

demand, all vaccines were depleted January 13, 2020; however, weekly communication with pharmacy and hospital leadership led to acquiring additional vaccines from the hospital’s outpatient primary care group.

**Studying the Intervention**

Despite improved vaccination rates, patients continued to leave before vaccination. To address this concern, in January 2020, we added 2 icons to the flu column on the track-board: a smiley-face indicating vaccine approval and a gray syringe indicating not appropriate for vaccination

(Fig. 2, stage 2B). The flu column icon changed to a smiley-face after a provider approved a nurse-ordered vaccine and after a provider independently placed a vaccine order. Despite these EHR enhancements, the number of patients leaving before vaccination increased in late January. Therefore, the team sought email feedback from nurses and providers caring for these patients and found that the administration of Tamiflu was a perceived contraindication to influenza vaccination. The team clarified that the inactivated influenza vaccine was safe to administer with Tamiflu; however, this misperception remained

a barrier to vaccinating in confirmed or suspected influenza cases.<sup>14</sup>

**Measures**

Process measures included the percent of total patients screened for influenza vaccine status, percent of eligible patients accepting the vaccine (responded “no, requests vaccine”), and percent of accepting patients that left before vaccination. The outcome measures were the percent of eligible patients vaccinated and the total number of vaccines administered. Balancing measures included vaccine administration time, ED length of stay, and the financial impact of the vaccination program to the hospital. Per nursing guidelines, all vaccines were administered at discharge; therefore, the difference in discharge time between vaccinated and unvaccinated patients represented the vaccine administration time.

**Analysis**

We used descriptive statistics to define the total vaccine eligible population and chi-square analysis to compare each demographic category in seasons 1 and 2. Statistical process control charts were utilized to measure the impact of the interventions in real-time. The control limits were set at 3 sigmas. The centerline and control limits were revised when special cause was noted as defined by 8 consecutive points above or below the mean or a single data point above or below the upper or lower confidence interval. The formal cost analysis compared the patient’s insurance company’s actual payments to the direct variable costs for these charges. Although all payers were charged the same amount for their services, payments varied based on the insurance company’s contracted fee schedule. Direct variable costs included vaccine charge, determined by the actual invoice cost, and an administration charge, determined by an internal cost accounting system.<sup>8</sup> Any patients covered under the VFC program had a vaccine cost of zero.<sup>13</sup>

**Ethics**

The institutional review board determined the project to be quality improvement and thus exempt from informed consent. There were no identified conflicts of interest.

**RESULTS**

We reviewed 57,804 patient charts over 2 influenza seasons, September 30, 2018, through March 31, 2019 (season 1), and September 29, 2019, through March 21, 2020 (season 2). Mandatory screening for vaccine status led to similar sustained screening rates during seasons 1 and 2, 84% (n = 23,603) and 84% (n = 25,119). Most ED patients were unvaccinated against influenza and thus vaccine eligible, 58% (n = 13,740) season 1 and 57% (n = 14,338) season 2. As expected, eligibility peaked in September and declined throughout each season, correlating with community vaccination efforts.

Characteristics for vaccine eligible patients were compared over the two seasons, and although age and acuity were statistically different, there were no clinically meaningful differences identified (Table 1). Vaccine acceptance rates in the eligible population improved from 13% (n = 1,747) to 22% (n = 3,177) seasons 1 and 2 (Fig. 3A). We did not shift the baseline for acceptance rates because the timing of special cause did not correlate with our interventions. Instead, the timing of these special cause events likely represents seasonal variation in vaccine acceptance where vaccination rates peak in early fall with high demand and decline throughout the season.<sup>8</sup> Documented reasons to decline vaccine were similar across seasons, including a plan to get or follow up with pediatrician, unsure, allergy, too sick, refused, or parent not available to consent.<sup>8</sup> Of those accepting vaccination, the proportion of patients, leaving before vaccination improved from 32% (n = 582) to 17% (n = 596) in season 1 versus 2; however, special cause was noted in the late January of each season, corresponding with the seasonal variation seen in vaccine acceptance rates (Fig. 3B).

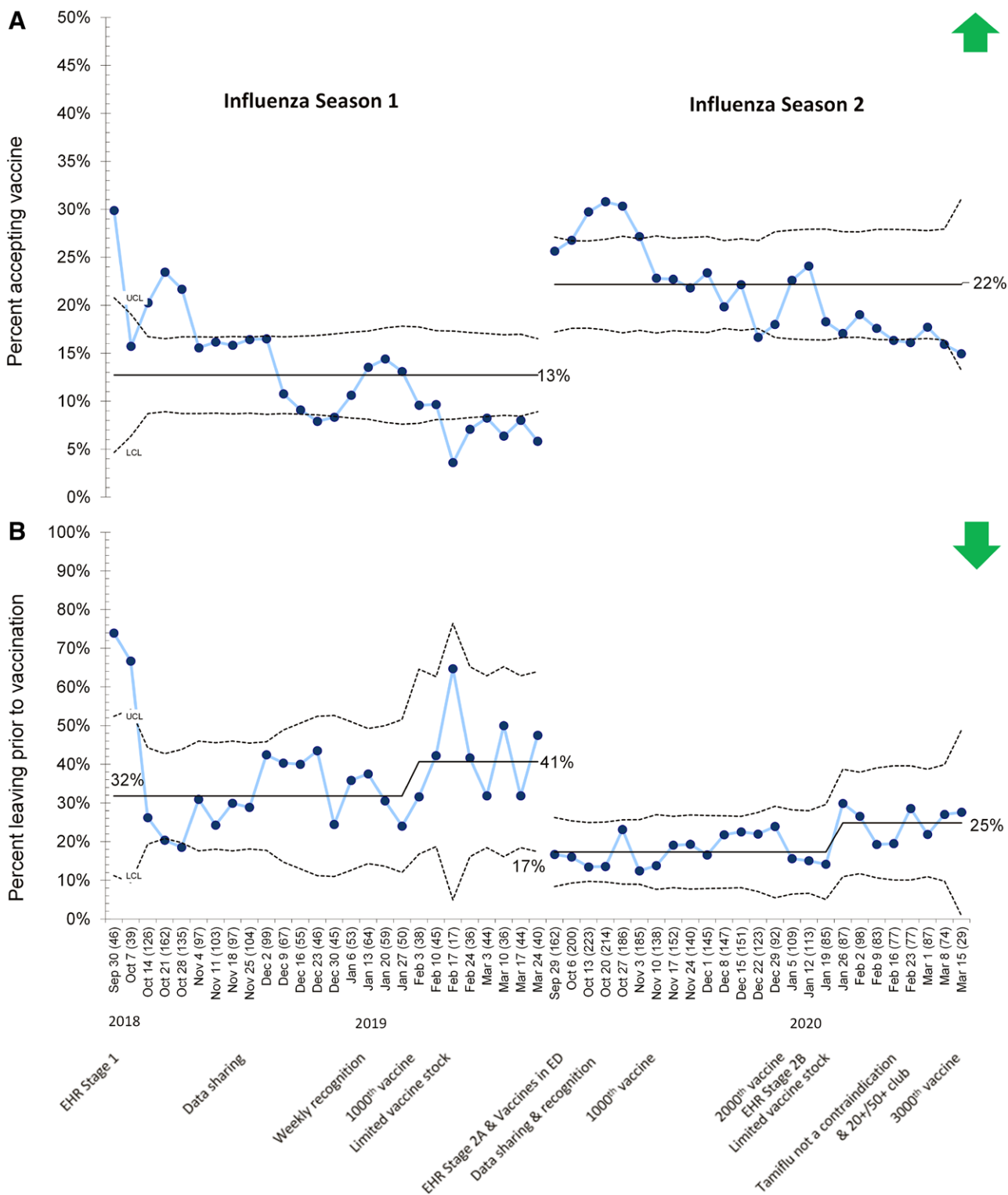
The team quickly surpassed the goal to vaccinate 2,000 patients by December 2019 and sought to maintain vaccination efforts throughout the season. Of the eligible vaccinated patients in season 2, 90% (n = 2,581) accepted and received the vaccine, 4% (n = 124) initially declined but later accepted the vaccine after provider counseling,

**Table 1. Demographics Table Comparing Patient Characteristics for Eligible Patients in Season 1 to Eligible Patients in Season 2**

Eligible Population	Season 1, n = 13,740 (%)	Season 2, n = 14,338 (%)	P
Age*, y			0.006
0–4	7,037 (51.2)	7,155 (49.9)	
5–17	6,598 (48.0)	7,103 (49.5)	
18+	105 (0.8)	80 (0.6)	
Race			0.16
American Indian or Alaska Native	72 (0.5)	63 (0.4)	
Asian	367 (2.7)	395 (2.8)	
Black or African American	6,816 (49.6)	7,330 (51.1)	
Native Hawaiian or Pacific Islander	46 (0.3)	48 (0.3)	
White	5,797 (42.2)	5,862 (40.9)	
Unknown	642 (4.7)	640 (4.5)	
Ethnicity			0.51
Hispanic or Latino	3,254 (23.7)	3,480 (24.3)	
Not Hispanic or Latino	10,360 (75.4)	10,727 (74.8)	
Unknown	126 (0.9)	131 (0.9)	
Insurance			0.83
Commercial	3,229 (23.5)	3,363 (23.5)	
Medicaid	10,008 (72.8)	10,421 (72.7)	
Medicare/other government	78 (0.6)	82 (0.6)	
Self-pay	425 (3.1)	472 (3.2)	
Acuity*			< 0.001
2-Emergent	809 (5.9)	869 (6.1)	
3-Urgent	3,940 (28.7)	4,088 (28.5)	
4-Less urgent	6,482 (47.2)	7,075 (49.3)	
5-Nonurgent	2,509 (18.2)	2,306 (16.1)	

Patients were vaccine eligible if they were screened and answered, “no, declines vaccine,” “no, requests vaccine,” or “needs more information.”

\*Significance at P < 0.05.



**Fig. 3.** Improving influenza vaccination rates by increasing the percent accepting vaccines and decreasing the percent leaving without vaccination over seasons 1 & 2. A, P chart comparing vaccine acceptance rates in eligible patients between seasons 1 and 2. B, P chart comparing the percent of accepting patients leaving before vaccination in seasons 1 and 2. Critical interventions are documented. LCL, lower control limit; UCL, upper control limit.

and 6% (n = 157) needed more information, received counseling, and were vaccinated. Therefore, the percent of eligible patients receiving vaccines improved from 9% (n = 1,235) to 20% (n = 2,862) between seasons 1 and 2.

Figure 4 demonstrates that the vaccination rates in eligible patients in season 2 surpassed season 1 throughout each phase of the flu season. The special cause seen in Figure 4 did not correlate with our interventions and was

attributed to seasonal variation; therefore, we did not shift the baseline.

Furthermore, building redundancy into the system facilitated the administration of 318 additional vaccines in season 2. One hundred seventy-five patients bypassed initial screening, but a provider later ordered the vaccine. One hundred forty-three patients required and received a second vaccine of the season per Centers for Disease Control and Prevention recommendations. Three thousand one hundred eighty (3,180) vaccines were administered by March 21, 2020 when the project was prematurely cut short due to preparation for COVID-19. This result is more than double the total number of vaccines given the previous season (n = 1,309).

To balance these interventions, vaccine administration time improved from 9 to 4 min between seasons 1 and 2. There was no change in ED length of stay for unvaccinated patients. A formal cost analysis comparing hospital reimbursement and direct cost of vaccine administration revealed approximately \$89,500 net revenue to the hospital after 2 influenza seasons (Table 2).

## DISCUSSION

### Summary

This quality improvement team optimized an ED influenza vaccination initiative via implementing a strategic

plan to overcome vaccine hesitancy. By improving vaccine acceptance rates and reducing the number of patients leaving before vaccination, ED vaccination rates improved from 9% to 20% in eligible patients. Three thousand one hundred eighty children received an influenza vaccine, more than twice the number administered the prior season. Additionally, vaccine administration time by nursing staff improved by 5 min. Within 2 flu seasons, the project resulted in over \$89,500 in increased net revenue to the hospital.

### Interpretation

Although interviews of ED parents suggest that 85% would be willing to receive the vaccine in the ED, 2 prior studies have incorporated screening and offering the vaccine to all eligible ED children, and only 9% of the eligible populations received vaccines.<sup>5,8,10</sup> Vaccination success was also reported to be limited in 14%–32% by patients leaving before vaccination each year.<sup>8,10</sup> Our study is novel as targeted interventions to overcome vaccine hesitancy and delays in vaccine administration significantly improved pediatric ED vaccination rates from 9% to 20% and reduced the number of children leaving before vaccination from 32% to 17%. Furthermore, this study supports findings from Hart et al that universal influenza vaccine screening and offering the vaccine in the ED is cost effective.<sup>15</sup>

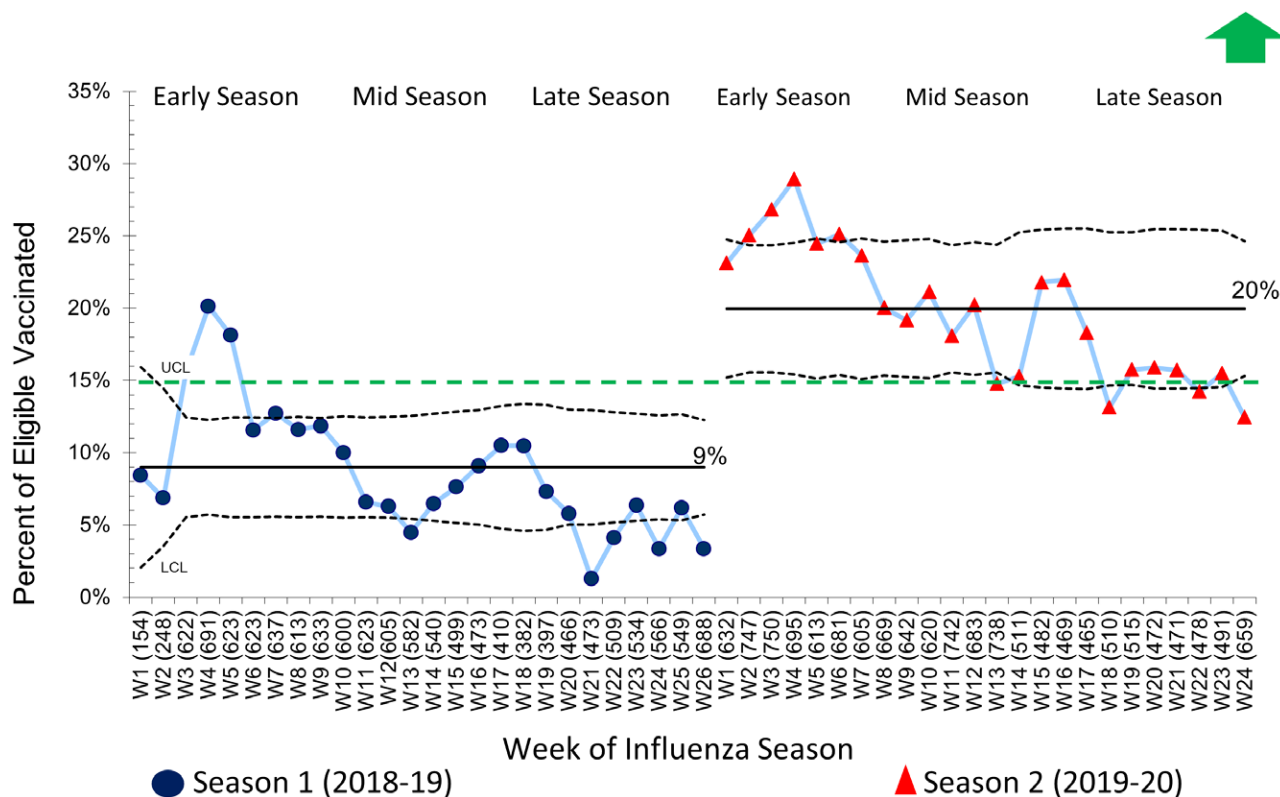


Fig. 4. P chart comparing vaccination rates in eligible patients across season 1 (blue diamonds) and season 2 (red triangles). Special cause seen in this figure did not correlate with our interventions and was attributed to seasonal variation: therefore, we did not shift the baseline. LCL, lower control limit; UCL, upper control limit.

**Table 2. Cost Analysis Table Comparing Actual Reimbursement to Direct Cost for All Influenza Vaccines Administered in the ED based on the Primary Payer Financial Class and Vaccine for Children Status**

Primary Payer Financial Class	No. Vaccines, n (%)
Medicaid—Vaccine for children eligible	3,287 (73.2%)
Medicaid—Vaccine for children noneligible	163 (3.6%)
Medicare	17 (0.4%)
Commercial	892 (19.9%)
Self-pay	130 (2.9%)
Total No. vaccines given in emergency department	4,489
<b>Total cost analysis</b>	
Total No. vaccines given in emergency department	4,489
Actual reimbursement	\$112,317.78
Direct cost	\$22,765.01
Margin	\$89,552.77

Dates of service September 30, 2018–March 31, 2019 and September 29, 2019–March 21, 2020.

The success of this project was multifactorial. Nursing buy-in was integral to improving vaccine acceptance and was influenced by weekly feedback and frequent nursing recognition. Storing vaccines in the ED improved nursing and pharmacy satisfaction and workflow efficiency, as it eliminated 3,180 nursing calls to pharmacy to request vaccine delivery before administration. Additionally, utilizing the EHR to identify vaccine hesitancy and build redundancy into the system led to almost double the number of provider-initiated vaccines. Patients leaving before vaccination decreased by almost 50% due to the reduction in vaccine administration times, nursing reminders to vaccinate, and improved nurse-provider communication. A testament to the system's strength was demonstrated when extrinsic factors, including nursing shortages and peak ED volumes, occurred throughout December 2019, and vaccination rates remained well above season 1.

Challenges to this process included identifying why patients were leaving before vaccination and ensuring vaccine administration accuracy. The special cause noted in patients leaving before vaccination was likely due to the peak in suspected influenza cases during the late January 2020. Despite clarifying that antiviral medications were not contraindications to vaccinations, the perceived danger remained a barrier to vaccination. Due to the government-sponsored VFC program, the misallocation of vaccines was a concern. Therefore, the process of storing vaccines in the ED was audited to ensure appropriate distribution, and further concerns for accuracy were relieved.

### Limitations

We performed this vaccination effort at a single tertiary care center that valued influenza vaccine administration. We utilized an established EHR and worked closely with EHR analysts to facilitate enhancements; therefore, these interventions may not be generalizable to institutions without these capabilities. Although revenue generation was not a primary aim of this project, participation in the VFC program contributed to the net positive revenue seen

in our cost analysis. Therefore, the cost analysis may not be relevant to institutions that do not qualify for the VFC program. Improved familiarity with the vaccination process during season 2 may have impacted vaccine administration times; however, we could not measure this impact. Finally, due to contrasting systems used by other health systems and retail pharmacies, we were unable to determine the final seasonal vaccination status and the number of influenza vaccine doses received by ED patients at the conclusion of this season.

### Future Directions

In the COVID-19 pandemic era, there is a critical need for EDs to prepare for and implement the infrastructure necessary to facilitate massive vaccine administration beginning today. Planning for rapid vaccine distribution takes time and must include a methodology to overcome vaccine hesitancy and distribute vaccines to underserved and high-risk populations.<sup>16</sup> The pediatric ED is a critical location to launch a vaccination campaign as it overcomes barriers to vaccine access for underserved communities and high-risk patients. It capitalizes on the provider-patient relationship as an opportunity to overcome vaccine hesitancy.<sup>8</sup> Although we successfully administered the influenza vaccine in our study, this model can be replicated for any vaccine-preventable illness. With simple adjustments to the EHR, pharmacy workflow, and storage plan, our institution has the means to provide immediate access to coronavirus vaccines when they become available. COVID-19 is not the first viral pandemic to threaten us globally and will certainly not be the last.

### Conclusions

We optimized an ED influenza vaccination process by improving vaccine acceptance rates and reducing the number of patients leaving before vaccination. Within two years, vaccination rates in eligible patients improved from 0% to 20%, and over 4,400 children were vaccinated. Although we used the pediatric influenza vaccination process as a model, we believe we have developed the process and infrastructure necessary to implement an immediate vaccination program in both the adult and pediatric EDs in the setting of a COVID-19 pandemic or any future pandemics. Future efforts are needed to expand this vaccination program to other EDs. The time to act is now.

### DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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