

Grant Final Report

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Flu Alert: Influenza Vaccine Alerts for Providers in the Electronic Health

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Principal Investigator:

Melissa S. Stockwell

Team Members:

David Vawdrey

Marina Catalozzi

Sally Findley

Rita Kukafka

Annika Hofstetter

Rajasekhar Ramakrishnan

Performing Organization:

Trustees of Columbia University

Federal Project Officer:

Vera Rosenthal

Submitted to:

The Agency for Healthcare Research and Quality (AHRQ)

U.S. Department of Health and Human Services

540 Gaither Road

Rockville, MD 20850

www.ahrq.gov

Structured Abstract

Purpose: To implement and determine the impact on vaccination coverage of tailored provider influenza vaccine alerts.

Scope: Missed opportunities contribute to low influenza vaccine coverage. Electronic vaccine alerts can reduce missed opportunities, but prior studies have yielded mixed results.

Methods: FluAlert was designed based on provider and parent input and implemented at 4 urban, academically-affiliated community clinics that serve a primarily low-income, Latino population. When providers began a note in the electronic health record (EHR), FluAlert showed influenza vaccine up-to-date (UTD) status, based on a real-time query of hospital and city immunization registries. For non-UTD children, providers could order a vaccine or document why not ordered; this was not a forced action. The alert was evaluated in a pilot (2010-11), a randomized cluster-crossover trial (2011-12), and then fully implemented (2012-13). We assessed the percent of non-UTD children vaccinated when FluAlert was on vs. off, as well as documentation of why the vaccine was not ordered.

Results: FluAlert fired over 1300 times during the pilot, >14000 during the trial and >35,000 times when implemented at all sites. Providers acted on the alert 72%-82.1% of the time. FluAlert had a significant impact on influenza vaccination of not-UTD children who were seen when the alert was on vs. off. In addition, documentation in the EHR of why the vaccine was not ordered was significantly higher.

We found that a tailored, immunization registry-linked influenza vaccine alert in the EHR was effective in decreasing missed opportunities for vaccination as well as improving documentation.

Key Words: influenza vaccine; clinical decision support; electronic health record, EHR

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Final Report

Purpose

Aims

1. Implement tailored provider influenza vaccine alerts integrated into the electronic health record of urban pediatric community health centers.
2. Evaluate the impact of tailored provider influenza alerts on pediatric influenza vaccine delivery rates.
3. Evaluate the impact of tailored provider influenza alerts on pediatric influenza coverage rates.

Scope

Influenza infection can result in substantial costs, morbidity, and mortality. Vaccinating children 6 months to 18 years of age would significantly reduce the total number of influenza cases in the United States. Therefore, the Advisory Committee on Immunization Practices' current recommendation is that all children 6 months through 18 years old receive the influenza vaccine. However, influenza vaccine coverage nationally remains low; only 56.6% of 6 month to 17 year-olds were vaccinated in the 2012-13 season. Coverage is often lower in low-income populations, who are at higher risk of influenza spread due to crowded living conditions. Childhood influenza coverage rates are also far below rates for the other childhood vaccinations.

Influenza coverage is complicated. The vaccine needs to be given each year but only during certain months such as August through April. There are also missed opportunities for vaccination on the part of the providers. Providers need to remember to recommend it at every opportunity during the influenza season, not just during well child checks. In addition, influenza recommendations have changed four times within six years; which was confusing for providers. Parents' views that lead to a reluctance to be vaccinated also play an important role in influenza vaccination. Even when providers remember to offer the influenza vaccine, they may not know how to best communicate with families who have fears and misinformation.

Clinical decision support in EHRs can help remind providers about adherence to practice guidelines. We took advantage of existing health information technology to tailor, implement and evaluate influenza alerts in the electronic health record (EHR) for pediatric providers to help improve health care decision-making. This study took place in a network of community clinics that are affiliated with New York-Presbyterian Hospital in the Northern Manhattan area of New York City.

Methods and Results

Phase 1: Formative Studies

In this study, we first used qualitative methods in order to develop an electronic influenza vaccine alert tailored to the needs of providers and the specific populations they serve.

Provider Focus Groups and Practice Leader In-depth Interviews. We completed 4 provider focus groups (n = 21) to gain their input into the design of the alert. In addition, in order to further understand the interests of key stakeholders in the four primary care clinics, we also conducted semi-structured interviews with four physician practice leaders at the sites and one pediatrician who was the group liaison to the electronic health record team. A semi-structured topic guide was used that was based on the PRECEDE-PROCEDE model for implementing collaborative health interventions. It included questions about perceived barriers to influenza vaccine delivery, characteristics of an effective alerts, as well as concerns regarding barriers to successful implementation of an alert. The semi-structured interviews also focused on logistics of implementing the alert in their practices, and perceived impact on vaccination rates. The focus groups were audiotaped and transcribed. The transcripts were then analyzed by two researchers using thematic analysis, and categories were generated inductively based on participants' comments, resulting in a codebook. The transcripts were then independently coded by two researchers. Dominant themes were identified using an iterative process in which codes were further refined through coding cycles. There was a coding agreement of 82%, and all disagreements were discussed and resolved.

Three main themes were identified including (1) Current barriers to influenza vaccine delivery; (2) desired characteristic of the alert; (3) Potential concerns regarding the alert. The codes under these themes included Logistical Issues (Stock Issues, Clinic Organization and Resources), Parent Attitudes, Provider Issues, Electronic Health Record (EHR) Issues, and Alert Characteristics.

Participants identified several barriers to influenza vaccine delivery, including remembering to vaccinate during sick visits, the need to review multiple sources of vaccination information, time shortages and inadequate staffing. They felt that an alert could help many of these challenges.

Providers also identified characteristics, which they desired to be included in the alerts. They wanted the alert to occur early in a visit such that they could integrate it into the conversation with the family, and they wanted the alert to be accurate by using multiple sources of vaccination information. They also wanted the alert to both facilitate vaccine ordering, as well as to generate appropriate documentation in the EHR when vaccines were refused or otherwise not given.

There were potential concerns regarding the alert, which were raised. These included accuracy of the alert, interruptions of workflow and forced actions i.e. that a provider could not move on with their work unless the alert was acted on.

Parent Focus Groups. We also completed focus groups (n=22) and in-depth interviews with parents (n=4). A semi-structured topic guide was used which focused on the process a

parent goes through to get an influenza vaccine for their child or adolescent, desired information, communication, and fears/concerns. The focus groups were audiotaped and transcribed. The transcripts were then analyzed by two researchers using thematic analysis, and categories were generated inductively based on participants' comments, resulting in a codebook. The transcripts were then independently coded by two researchers. Dominant themes were identified using an iterative process in which codes were further refined through coding cycles.

Four main themes were identified including (1) Safety of the vaccine; (2) Lack of information; (3) Laws and social norms, (4) Sources of information.

Parents had concerns about vaccine safety were frequently expressed, including the belief that the vaccine can cause influenza, or make children ill with influenza-like symptoms. This was tied to a general feeling of lack of information about the vaccine. However, parents reported that health care providers are one of the most important sources of information for parents regarding the influenza vaccine. Therefore, doctor recommendation played an important role for them, as did any other perceived requirements to vaccinate. Parents also received information from other sources including the media, the Women, Infants and Children (WIC) program, and family and friends.

Phase 2: Alert Design

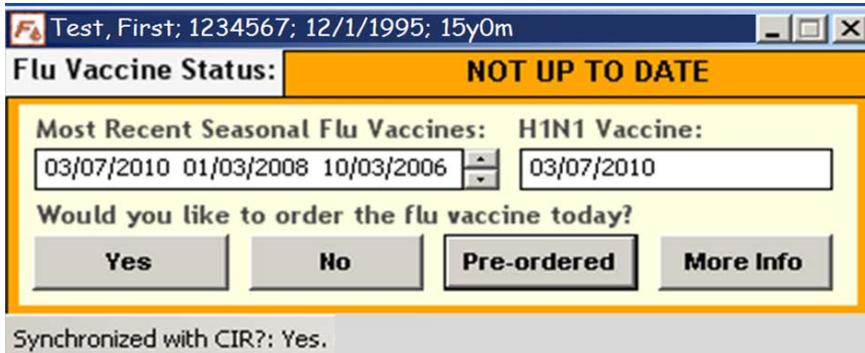
The information learned from the participatory research, in addition to prior studies in the field, was used to develop the tailored alert for the influenza vaccination. Based on parental input, we also designed a set of talking points that have been included in the alert. These include: (1) "Is the flu serious?"; (2) "Does the flu shot cause the flu?"; (3) "Will my child still get sick this winter if s/he gets the shot?"; (4) "What are the side effects of the vaccine?"; (5) "Why does my child need 2 shots?"; (6) "Why does my child need a flu shot every year?"; (7) "Aren't there other ways to protect my child against the flu?"

The FluAlert reminder was designed to act within the Eclipsys SCM Ambulatory application, to retrieve immunization information, via a web service, from the hospital immunization registry, which is synchronized with the New York City's Department of Health Citywide Immunization Registry (CIR). This ensured that the alert was acting on the most up to date influenza vaccine information available for individual patients. FluAlert's graphical user interface (GUI) was then designed, evaluated and revised in order to reflect feedback from our provider's supervisory panel concerning usability, consistency of data display and efficiency in information assimilation, as well as based on pilot testing in users. The alert fired on note opening and the GUI alerts the provider to the patient's influenza immunization status (using up-to-date rules) with both text as well as color code and allows providers to order influenza vaccine or document why a vaccine was not given. In addition, we devised an end-to-end data transfer mechanism between FluAlert and Eclipsys SCM Ambulatory application via Eclipsys' medical logic modules (MLM). This data transfer allowed FluAlert to pass information back to Eclipsys such that the information regarding the vaccination order or reason why vaccine was not ordered as entered in the user interface was automatically pasted into the provider's Eclipsys note, allowing the provider's action to be successfully captured and documented in the patient's chart. There were no forced actions i.e. providers were able to ignore the alert.

There were four types of alerts that were created. The first alert is an alert that fires when a patient is not up to date for influenza vaccine. This alert shows the provider the most recent seasonal influenza vaccine doses as well as any 2009 H1N1 Influenza A vaccine doses since those can contribute to decision-making regarding vaccination for certain children who are less

than 9 years old and may need more than one vaccine in a given season. It also indicates to the provider if the alert synchronized with the city registry. The alert then allowed the provider to take four possible requested actions (1) to order a vaccine; (2) to document why a vaccine was not ordered; (3) to indicate that it was already ordered (but not yet given); or (4) to request more information (Figure 1). At any time, a provider could click to close the alert without penalty.

Figure 1. Orange alert indicating a patient was not up-to-date for influenza vaccine



If a provider wants to order a vaccine and clicks on the associated button, a window with the age-appropriate influenza vaccinations for that child opens (Figure 2). If a provider wants to not order the vaccine and clicks on the associated button, a window with the most common reasons a provider would not order an influenza vaccine. In addition, a free-text box was included. (Figure 3).

Figure 2: Order Vaccine Window

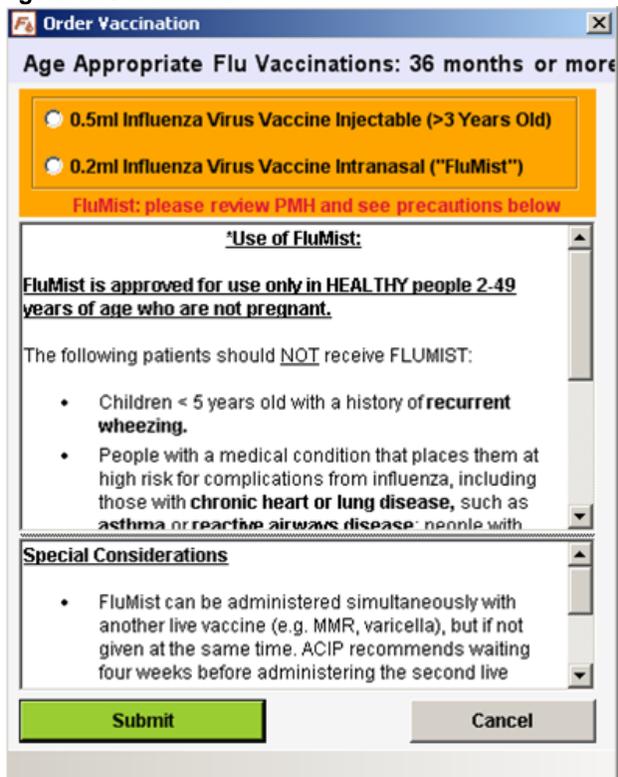


Figure 3: Do Not Order Vaccine Window

Do not order vaccination

Reason for not ordering

Patient: Test, First

MRN: 1234567

Patient Ill

Parent deferred today

Parent refused

Unaccompanied Adolescent

Vaccine not available

Vaccine received or planned for elsewhere
(please update record)

Other

Submit

Once the alert was acted on that information was then pasted back automatically into the Assessment and Plan section of the provider’s note (Figure 4).

Figure 4. Automatic Documentation in Provider Note

Assessment/Plan:
⋮
Plan Flu vaccine was ordered ("Influenza Virus Vaccine Inj >3 Years Old").

Assessment/Plan:
⋮
Plan Flu vaccine not ordered: Patient Ill.

In addition to taking an action on the alert a provider could click on the “more information” button which then displayed additional patient specific information including allergies, past medical history and the complete list of previous seasonal and 2009 H1N1 Influenza A vaccinations (Figure 5).

Figure 5. Influenza Vaccine More Information Window

More Information

FLU VACCINE: NOT UP TO DATE

Patient Info
Name: Test, First2
MRN: 1234568
DOB: 11/1/1995

ALLERGIES:
No Known Allergies

Significant History
* Diabetes Type II
* MYOPIA
* ASTIGMATISM NOS

Seasonal Flu and H1N1 Vaccine History
Influenza: 5/10/2010
Influenza: 4/29/2010
H1N1-09 Inj.: 4/27/2010
Influenza (unspecified): 9/23/2009

Order

Do Not Order

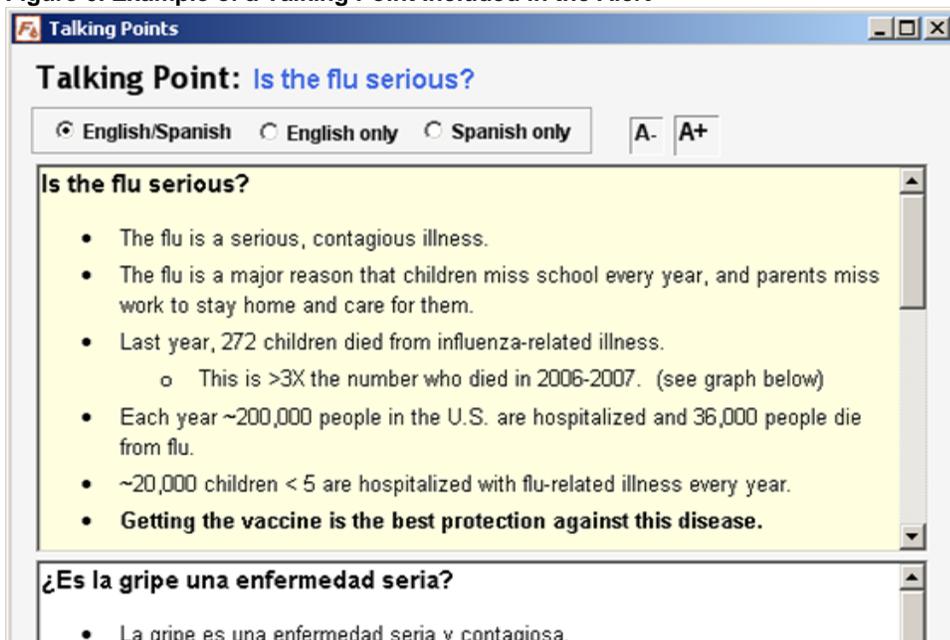
Parent Talking Points

- [Is the flu serious?](#)
- [Does the flu shot cause the flu?](#)
- [Will my child still get sick this Winter if I get the shot?](#)
- [What are the side effects of the vaccine?](#)
- [Why does my child need 2 shots?](#)
- [Why does my child need a flu shot every year?](#)
- [Aren't there other ways to protect my child against the flu?](#)

Close

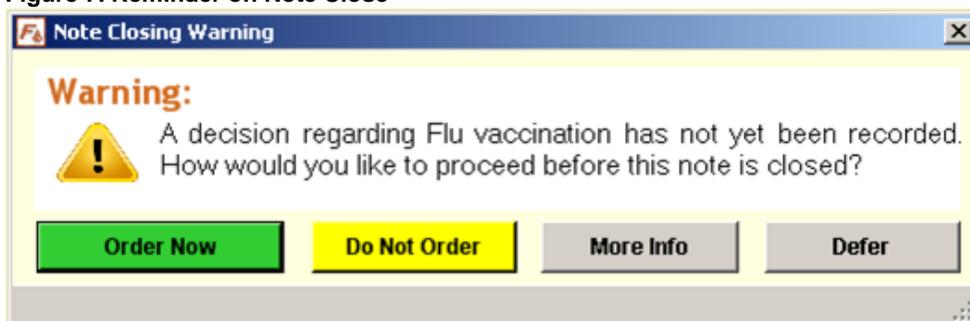
This window also linked to talking points that were based on the information from the focus groups that parents felt they were most likely to want to know from their provider (Figure 6).

Figure 6. Example of a Talking Point Included in the Alert



Finally, if at note close the provider did not order the vaccine, document why it was not being ordered, or indicate that it was already ordered, a final reminder window opened (Figure 7).

Figure 7. Reminder on Note Close



Alerts were also created for when a patient was up-to-date for influenza vaccination (green) (Figure 8), and for when a patient was up-to-date for that visit but still needed another dose that season (yellow) (Figure 9). The latter was for children who were <9 years old who based on previous vaccinations needed to receive two doses that season to be considered fully up-to-date. A final alert type (red) indicated that a patient had a documented egg allergy and therefore the provider could not order vaccine through the alert (Figure 10). They could however, if indicated, order the vaccine through the regular ordering system of the EHR.

Figure 8. Green Alert Indicating a Patient as Up-to-date on Vaccinations

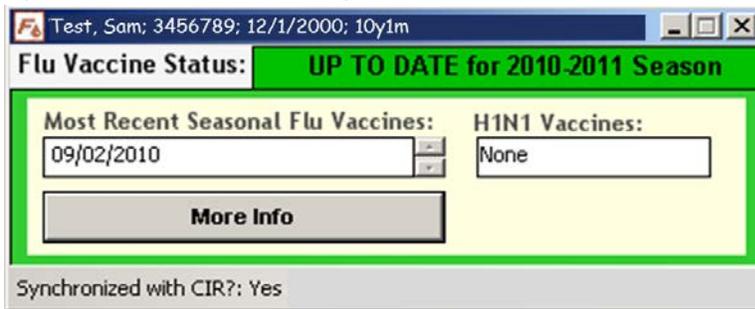


Figure 9. Yellow Alert Indicating a Patient was Up-to-date on Vaccination Currently but Pending Another Dose that Season

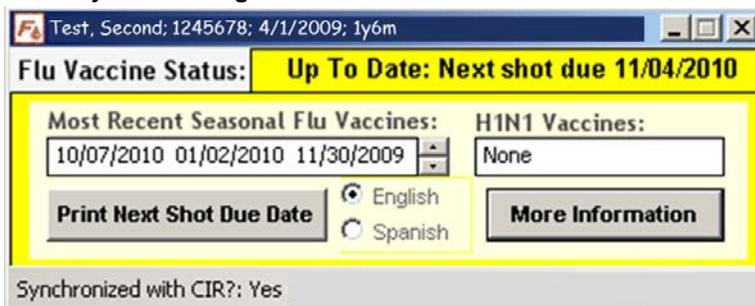
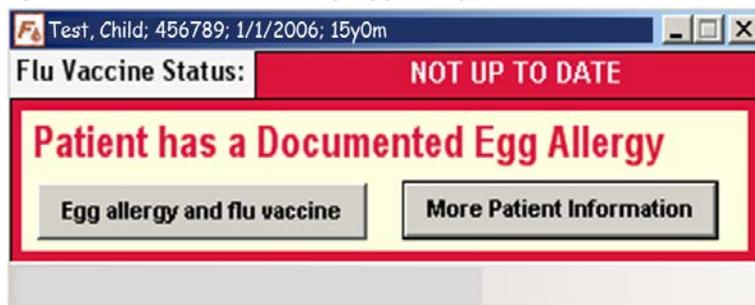


Figure 10. Red Alert Indicating Egg Allergy



Phase 3: Training

We created instructional tools to help providers and nurses familiarize themselves with FluAlert. First, we had a PowerPoint presentation that explained the basic functions of FluAlert for medical providers and nurses. The slides were self-explanatory and provided the user with a working understanding of how to use the core functions of FluAlert. We also developed a comprehensive user's manual, one for providers and one for nurses, to offer users a more detailed explanation of the FluAlert reminders, reviewing all of the features of the alerts. Additionally, we developed a Quick Reference Guide for medical providers and a separate guide for nurses, outlining the basic core functionalities of FluAlert. We conducted live trainings on the use of FluAlert in person at the four clinical sites.

Phase 4: Pilot

The alert was piloted (2010-11 season) for 10 weeks in the late winter at 4 urban, academically-affiliated community clinics that serve a primarily low-income, Latino population. FluAlert fired over 1300 times during the pilot. Providers acted on the alert 72% of the time. During the pilot, children seen when the alert was on had greater odds of receiving an influenza vaccine than those seen when it was off (odds ratio 1.29; 95% confidence interval (1.13-1.48)). Based on the pilot we made minor adjustments to the alert and then implemented it during the 2011-12 season for the full trial.

Phase 5: Cluster-Crossover Trial

During the 2011-2012 influenza season, we implemented a randomized cluster-crossover design at the same sites as the pilot. The season was divided into 2 phases, mid-October to mid-December and January-February, excluding holiday weeks. Using a cluster-crossover design, each clinic had one on and one off period each phase. We conducted three main types of analyses (1) process measures related to provider's actions in response to the alert; (2) impact of alert on receipt of vaccination for children who were not up-to-date for the influenza vaccine; (3) impact of alert on documentation of why a vaccine was not given.

Process Measures for the alert. The alert fired nearly 14,000 times for over 8600 unique visits. In two-thirds (62%) the child or adolescent was not up-to-date for influenza vaccination. In the majority (82%) of the cases where a child was not up to date, the provider acted on the alert by either ordering the vaccine or clicking that they were not ordering the vaccine. In nearly all (98%) of the instances where a provider clicked that they were not ordering the vaccine, the provider went on to mark a reason why they were not ordering the vaccine for that visit.

Vaccination outcomes. We then assessed the children who were not up-to-date when they arrived at a visit, comparing those who left vaccinated when the alert was on vs. off. Analyses accounted for non-UTD children being seen multiple times. There were over 10,000 unique children seen during the analytic periods. Of those, 60% were not up to date for the influenza vaccine. Children seen when the alert was on were more likely to receive a needed influenza vaccine compared with those seen when it was off (75.1% vs. 72.8%; $p=0.042$). The effect of the alert was primarily in the winter (68% vs. 62%), and not in the fall.

Impact of Alert on Documentation. We performed a chart review on a random sample of children who left a visit unvaccinated to assess documentation in the EHR of why the vaccine was not administered. More children seen when the alert was on had documentation of why the vaccine was not given vs. those seen when it was off (68% vs. 42%, $p < 0.0001$). In the majority of cases a reason why the vaccine was not given was documented (83%); in the remaining cases the vaccine was ordered or planned to be ordered but was not given.

Phase 6: Redesign

In the months between the 2011-12 and 2012-13 seasons we made design modifications to the alert based on user feedback. There were two principal changes. First, the green or up-to-

date window stayed opened for a short period but then automatically closed rather than requiring a click to close. We also implemented a “blue” alert, which checked for already placed orders in the EHR and reported to the provider that an order was already present and gave the date of the order. This window also disappeared automatically. This allowed notification that the child was not up to date but that there was an order in place. This order may be from that visit or was a pending return visit order placed previously.

Phase 7: Cross-site Implementation

In the third year of implementation for the study, FluAlert was turned on for all 4 clinics for full-scale implementation. The alert was displayed over 37,000 times. In the nearly 14,000 (63%) of visits where a patient was due for an influenza vaccine, a provider acted on the alert 79% of time. This demonstrated that the impact on provider action was sustained over three years (pilot (72%), cluster cross-over (82%), and full implementation (79%)) despite a lack of a forced action.

Phase 8: Provider Survey

In a survey of 93 health care providers and nurses (all who were eligible) who received the FluAlert reminder, 77% were very satisfied or satisfied with the alert, 15% were a little satisfied and 8% were not at all satisfied. Additionally, 91% found it to be very or somewhat helpful, and none thought it was very unhelpful. Some reported reasons why it was helpful were because it aided compliance, was accurate, and facilitated extra communication with parents. Reported reasons it was less than helpful included perceived interference with workflow, reminding them too many times, and feeling they already knew the patient needed the vaccines.

Nearly all surveyed (96%) thought it was easy to use. The aspects that providers reported they liked the most were that it was quick, color-coded, correctly identified those in need of vaccine, and allowed vaccine ordering. Some reported benefits included that providers did not miss those in need of vaccination, it standardized care, and that it was a good reminder when not thinking about vaccination. It was particularly noted to be useful for children in need of a second dose. Of the various components, of those who remembered seeing that component in the alert, 92% reported having the full influenza vaccine history to be helpful, 90% being able to order the vaccine, 59% documenting why vaccine not ordered, 26% the talking points, 43% the past medical history, and 88% the allergy information. Although the decision to have the alert at note open was based on provider focus groups, only half of those surveyed would leave the alert at note opening (52%), the most common other preferred timing was at the end. Nearly all (92%) were happy with its location in the top right corner.

Over half (56%) of the medical providers reported that the alert did impact their decision to vaccinate. Most (73%) were interested in having provider reminders for other pediatric/adolescent immunizations.

The year after the grant ended, providers requested that the hospital integrate the influenza reminder permanently into the EHR and extend it to the adult population as well. The hospital is implementing the alert as part of regular care.

Conclusions

We found that a tailored, immunization registry-linked influenza vaccine alert in the EHR was effective in decreasing missed opportunities for vaccination as well as improved documentation. Although providers were not forced to act on the alert, they did so the vast majority of the time over three seasons.

Our findings helped to elucidate what providers perceived to be helpful characteristics of a computerized vaccination reminder as well as potential barriers to its implementation. Additionally, the information we gathered from parents helped us understand how alerts can be tailored to our population. Finally, this effective computerized alert model can be used by others as well as modified to apply to other populations in our community.

AHRQ Priority Populations

This study took place in four urban, academically-affiliated community clinics that serve a primarily low-income, Latino population.

List of Publications and Products

Publications

1. Birmingham E, Catalozzi M, Findley SE, Vawdrey DK, Kukafka R, Stockwell MS. characteristics and concerns regarding computerized influenza vaccination alerts. *Prev Med* 2011 Mar-Apr;52(3-4):274-7.
2. FluAlert: A qualitative evaluation of providers' desired

Presentations

1. Stockwell MS, Catalozzi M, Camargo S, Findley S, Kukafka R, Ramakrishnan S, Holleran S, Vawdrey D. FluAlert: Using Tailored, Influenza Vaccine Alerts in the Electronic Health Record to Decrease Missed Opportunities for Vaccination in a Low-Income Pediatric Population. Oral presentation 2013 Pediatric Academic Societies' Annual Meeting (Washington, DC)
2. FluAlert: Using Tailored, Influenza Vaccine Alerts in the Electronic Health Record to Decrease Missed Opportunities for Vaccination in a Low-Income Pediatric Population AHRQ: *A National Web Conference on Using Health IT To Improve Outcomes in Vulnerable and Disadvantaged Populations*
3. Practice Transformation and Meaningful Use of HIT to Improve Health Outcomes: Use of Technology to Promote Vaccination for Low-Income, Minority Populations New Jersey Primary Care Association Annual Meeting 2013