ABSTRACT

BACKGROUND: Pneumococcal vaccination in eligible patients is recommended by the Infectious Disease Society of America and the Centers for Disease Control (CDC) Advisory Committee on Immunization Practices. Because hospitalization provides an opportunity to vaccinate patients at high risk for developing serious pneumonia complications, eligibility screening and administration of the pneumococcal vaccine prior to discharge in qualified patients are evaluated by the Joint Commission and the Centers for Medicare & Medicaid Services (CMS) as part of pneumococcal vaccination core quality measures. Among patients with an inpatient diagnosis of pneumonia in 2008, 56% in our 580-bed tertiary care teaching hospital, compared with 84% nationwide, received pneumococcal vaccination. To improve pneumococcal vaccination rates for all patients in the study facility and not just those with pneumonia, a multifaceted intervention including a revised nurse screening tool, rescheduling of the vaccine order, storage of the vaccine in automated dispensing cabinets on the nursing unit, and creation of a vaccine tracking system was developed and implemented between August 2009 and October 2009.

OBJECTIVE: To determine the impact of a multifaceted intervention on pneumococcal vaccine screening and administration rates in eligible patients according to the CDC recommendations who were admitted to an internal medicine unit of a tertiary care teaching hospital.

METHODS: All patients aged 18 years or older from 2 internal medicine units were identified during 4-month time intervals before (pre-intervention, April through July 2009) and after (post-intervention, November 2009 through February 2010) implementation of the multifaceted pneumococcal vaccine protocol. Of these, 150 patients from each 4-month period were randomly selected for electronic medical record review. Eligibility for pneumococcal vaccination was derived from the CDC recommendations and consensus of the vaccine steering committee at the study institution; the criteria included aged 65 years or older, admitting diagnosis of pneumonia, at least 1 of several chronic diseases, immunocompromising condition, cochlear implant, cerebrospinal fluid leak, current tobacco smoking, pregnancy or having a child in the home less than aged 6 months, or awaiting solid organ transplantation. Patients who had vaccine contraindications/precautions or had been vaccinated in the previous 5 years were ineligible. Data on demographics, presence of vaccine screening, indication, administration, rescheduling, and refusal were collected. The primary endpoint was the rate of pneumococcal vaccine administration in eligible medicine patients. Secondary endpoints included changes in screening rates, vaccine refusal, and order rescheduling. Descriptive statistics and Student’s t-test were used to evaluate patient demographic data. Pearson chi-square tool, a scheduled vaccine order on the second day of the hospital stay, storage of the vaccine in automated dispensing cabinets on the nursing unit, and creation of a vaccine tracking system was associated with significant improvement in pneumococcal vaccine administration in eligible medicine patients (74.2% vs. 19.1%, P<0.001).

CONCLUSIONS: Implementation of vaccine protocol changes was associated with improved pneumococcal vaccination rates in eligible medicine patients. Protocol changes were relatively easy to implement in a large institution, and a similar approach may be implemented at other institutions as an effective way to improve pneumococcal vaccination rates.

What is already known about this subject

- Pneumococcal vaccination is important for reducing pneumococcal-related morbidity and mortality. Pneumococcal vaccination for adults is recommended by the Centers for Disease Control and Prevention, Centers for Medicare and Medicaid Services, the Healthy People Initiative 2020, the Joint Commission, and the Infectious Disease Society of America.
- In a randomized, controlled study by Dexter et al. (2004), computerized standing orders for pneumococcal and influenza vaccines increased the rate of pneumococcal and influenza vaccine administration in eligible medicine patients compared with electronic physician reminders (pneumococcal: 51% vs. 31%, respectively, P<0.001; influenza: 42% vs. 30%, respectively, P<0.001).
- Robke and Woods (2010) found that implementation of protocol-driven orders written by pharmacists was associated with an increase from 71.2% to 88.3% in pneumococcal vaccination rates in patients with a diagnosis of community-acquired pneumonia during a 6-year period from 2003 to 2008.
- Yancey et al. (2010) found that a comprehensive initiative including a paper vaccine screening form, paper standing order form, and storage of the vaccine on the nursing unit was associated with improvement in pneumococcal vaccination rates in patients with a diagnosis of pneumonia (34.7% to 92.0%).

What this study adds

- Implementation of a multifaceted vaccination protocol that used electronic technologies including a revised nursing screening tool, a scheduled vaccine order on the second day of the hospital stay, storage of the vaccine in automated dispensing cabinets on the nursing unit, and creation of a vaccine tracking system was associated with significant improvement in pneumococcal vaccine administration in eligible medicine patients (74.2% vs. 19.1%, P<0.001).
- The process for designing and implementing the multifaceted vaccination protocol described in this study may be applied by other hospitals to improve pneumococcal vaccine ordering and administration.
Streptococcus pneumoniae (pneumococcus) remains a significant bacterial pathogen resulting in significant morbidity and mortality in the United States. Streptococcus pneumoniae causes various upper and lower respiratory tract infections, including pneumonia. Annually 175,000 hospitalizations and up to 12,500 deaths are attributed to serious pneumococcal infection.

Pneumococcal infections are often preventable with the pneumococcal polysaccharide vaccine, which is “up to 75% effective in preventing pneumococcal bacteremia and meningitis.” Based on this information, the Infectious Disease Society of America (IDSA) and the Centers for Disease Control (CDC) Advisory Committee on Immunization Practices recommend pneumococcal polysaccharide vaccination for patients aged 65 years or older or those with high-risk comorbidities. In addition, IDSA recommends that vaccination status be assessed upon admission and that vaccine be administered at hospital discharge or during outpatient treatment. Furthermore, the Joint Commission and the Centers for Medicare and Medicaid Services (CMS) evaluate hospitals’ performance on pneumonia core quality measures, which include assessment of vaccine screening and administration in eligible patients. The Healthy People initiatives for 2010 and 2020 also address the importance of vaccination by including an objective to “increase the proportion of adults who are vaccinated annually against influenza and ever vaccinated against pneumococcal disease.”

Quantifying the overall pneumococcal vaccination rate is difficult because institutions do not routinely abstract and analyze that data; however, in 2008, CMS reported that the average rate for pneumococcal vaccination in U.S. hospitals was 84% for patients with pneumonia. At the study institution, a 580-bed adult tertiary care facility, the average pneumococcal vaccination rate for patients with pneumonia was 56% in 2008; no data on overall pneumococcal vaccination rates were available.

Events Prior to the Present Study Intervention

To improve pneumococcal vaccination rates for all patients, an electronic screening tool was developed and implemented for the pneumococcal vaccine in October 2007. The screening tool included a list of vaccine indications derived from the CDC criteria and, by a consensus of the study institution’s vaccine steering committee, a question establishing if the vaccine had been administered in the last 5 years, a list of vaccine contraindications/precautions, and a place to document vaccine refusal. Nurses administered the vaccine screening tool to patients upon hospital admission. Patients were deemed eligible for pneumococcal vaccination if they had an indication, were not vaccinated in the past 5 years, and had no contraindications/precautions. For eligible patients, an unscheduled order was entered per protocol by the pharmacist for the vaccine to be administered upon discharge. An unscheduled order appears on the medication administration record but does not have a specific time designated for administration and can be given at any time based on the discretion of the nurse. Although the majority of patients were appropriately screened and had the vaccine ordered, many patients were not vaccinated, likely because the unscheduled order did not generate a charting task to remind nurses to administer the vaccine and because of the number of other tasks required prior to patient discharge.

Present Study Intervention

Between August 2009 and October 2009, the study institution developed and implemented a hospital-wide initiative to further improve pneumococcal and influenza vaccination and screening. The electronic screening tool was revised (Figures 1a and 1b), intensive nursing education was provided, the electronic vaccine orders were changed from unscheduled to scheduled, vaccines were stored in automated dispensing cabinets on the nursing unit, and an electronic vaccine “dashboard” that identified patients who did not have documented vaccination or vaccine screening (Figure 2) was created. The electronic screening tool was revised to automatically populate the patient’s vaccination history if the data were available in the study institution’s records. The tool was also simplified by creating a second screen with contraindications specific to each vaccine, and an option was included to note whether vaccination was refused at the time of screening. If the patient had a vaccine indication and did not refuse vaccination, an electronic order was automatically scheduled for 9:00 a.m. on the second day of hospital stay.

Nursing Education. In October 2009, nursing education was provided by the clinical nurse specialist on the units; one 30-minute inservice was conducted for staff nurses on each shift. The education reviewed the revised screening tool, scheduling of vaccine orders, and emphasized the importance of vaccination in preventing illness. Using the vaccine dashboard, the clinical nurse specialists met with individual nurses to discuss why the screening or vaccine had been withheld or not documented and reinforced the importance of inpatient vaccination.

Dispensing Cabinets. Automated dispensing cabinets were installed on the nursing units at approximately the same time that the vaccine initiative began. Pneumococcal and influenza vaccines were stored in the refrigerated portion of the cabinets with the intent of decreasing the time from the vaccine order to vaccine administration. This change was also expected to decrease the workload for pharmacists and technicians as vaccines did not have to be delivered to the floor for individual patients, and the number of unused vaccines returned to the pharmacy decreased.

Dashboard. The vaccine dashboard is an electronic tool available to all health care providers at the study institution and available to all health care providers at the study institution and...
Evaluation of Pneumococcal Vaccination Rates After Vaccine Protocol Changes and Nurse Education in a Tertiary Care Teaching Hospital

**FIGURE 1a** Vaccine Protocol Screening Form—Part 1: Indications

<table>
<thead>
<tr>
<th>Vaccine Indications Present?</th>
<th>Vaccine Indications (Pneumococcal and Influenza)</th>
<th>Pneumovax Within Last 5 Years?</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ Yes</td>
<td>❑ Age ≥65 years</td>
<td>❑ Yes</td>
</tr>
<tr>
<td>❑ No</td>
<td>❑ Admitted with diagnosis of pneumonia</td>
<td>❑ No</td>
</tr>
<tr>
<td></td>
<td>❑ Chronic lung disease (e.g., COPD, interstitial disease, asthma)</td>
<td>❑ Unknown</td>
</tr>
<tr>
<td></td>
<td>❑ Chronic renal failure or nephrotic syndrome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Diabetes mellitus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Chronic heart disease (e.g., CHF, cardiomyopathy, CAD, valvular heart disease)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Chronic immunosuppression from any cause (e.g., cancer, chronic steroid use, HIV infection)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Sickle Cell Disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Chronic liver disease (cirrhosis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Awaiting solid organ transplant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Pregnant or lives with a child &lt;6 months of age</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Chronic cerebrospinal fluid leakage due to congenital lesions, skull fractures, or neurosurgical procedures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Cochlear implants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Prior splenectomy or splenectomy planned in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Current tobacco smoker</td>
<td></td>
</tr>
<tr>
<td></td>
<td>❑ Vascular disease: CAD, PVD, Stroke</td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 1b** Vaccine Protocol Screening Form—Part 2: Contraindications and Precautions

**Pneumococcal Vaccine Contraindication/Precautions**

- ❑ No contraindications present
- ❑ Pt received pneumococcal vaccine after age 65
- ❑ Allergy to pneumococcal vaccine
- ❑ Patient reports AIDS with CD4 count <200 cells/cubic cm
- ❑ Pt undergoing chemotherapy, biotherapy, or radiation therapy this admission
- ❑ HSCT and acute leukemia patient w/ platelet count <50,000
- ❑ Solid organ transplant <3 months
- ❑ Active Graft vs. Host Disease
- ❑ Hematopoietic Stem Cell Transplant <12 months
- ❑ Neutropenia and/or acute febrile illness

**Pneumococcal Vaccine Refused By:**

- ❑ Not refused
- ❑ Family
- ❑ Patient
- ❑ Other

**Pneumococcal Vaccine was not refused = Vaccine has been ordered**

*To be considered eligible for pneumococcal vaccination, patients had to have at least 1 indication, not have received the vaccine in the past 5 years, and have no contraindications or precautions. Vaccine indications and contraindications/precautions were derived from the Centers for Disease Control recommendations,9 vaccine product labeling,9 and by consensus of the vaccine steering committee at the study institution. Indications based on committee consensus included pregnancy or having a child in the home less than 6 months, PVD, and awaiting solid organ transplantation.

AIDS = acquired immune deficiency syndrome; CAD = coronary artery disease; CD4 = cluster of differentiation 4; CHF = congestive heart failure; cm = centimeters; COPD = chronic obstructive pulmonary disease; HIV = human immunodeficiency virus; HSCT = hematopoietic stem cell transplantation; MD = physician; Pt = patient; PVD = peripheral vascular disease.
provides a real-time view, sorted by nursing unit and room number, of whether vaccine screening is complete and whether the vaccine is administered for each patient. It is also color-coded to provide a quick reference for nursing managers, pharmacists, or other health care professionals to evaluate vaccine screening and administration status (Figure 2).

**Study Objective**

Since pneumococcal disease causes significant morbidity and mortality, hospitalization represents an important opportunity for pneumococcal vaccination. The purpose of this study was to determine whether the implementation of a multifaceted vaccine protocol improved pneumococcal vaccine screening and administration in eligible medicine patients. Patients were considered eligible for pneumococcal vaccination if they had at least 1 indication, had not received the vaccine in the past 5 years, and had no contraindications or precautions (Figures 1a and 1b). Vaccine indications and contraindications/precautions were derived from the CDC recommendations,4 vaccine product labeling,9 and by consensus of the vaccine steering committee at the study institution. Indications included aged 65 years or older, admitting diagnosis of pneumonia, pregnancy, having a child in the home aged younger than 6 months, or any of a list of chronic conditions that would put a patient at high risk for pneumonia (Figure 1a).

The project was conducted in compliance with Institutional Review Board (IRB) requirements, and as a quality improvement project was determined to be exempt from review by the Emory University IRB and the Mercer University IRB.

**Methods**

**Definition of the Quality Measure**

Our primary quality measure compared pneumococcal vaccine administration in eligible patients admitted to 2 internal medicine units before and after implementation of the vaccine initiative. The numerator included the number of eligible medicine patients who received the pneumococcal vaccine during the study time periods, and the denominator was the number of patients eligible for pneumococcal vaccination during the study time periods.

Our secondary quality measures were changes in vaccine screening rates, the number of vaccine orders, and the number of patients who refused vaccination. We also evaluated the number of patients who had the vaccine rescheduled to determine if the timing of the automatic electronic scheduled order was appropriate. Vaccine refusal was assessed to determine if revisions to the screening tool or the scheduled order resulted in increased refusal.
Design
A pre-test/post-test study using electronic medical record review was conducted retrospectively for randomly selected adult patients admitted to 2 internal medicine units at the study institution during the specified study periods. These study periods occurred before and after vaccine protocol changes were implemented. The pre-implementation group included patients admitted from April 2009 to July 2009. Changes to the vaccination protocol were developed and implemented from August 2009 to October 2009. The post-implementation group included patients admitted from November 2009 to February 2010. Data collected included patient’s age, date of admission, primary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code for admission, screening date, whether vaccine was indicated, whether the vaccine was ordered appropriately, whether vaccine was administered, whether the vaccine was refused, and whether the vaccine was rescheduled.

Patient Selection
Adult patients aged 18 years or older admitted to 2 internal medicine units during the pre-specified time periods were identified. Using a random number generator, 150 patients from each 4-month period were selected for inclusion (n = 300). Patients were defined as eligible for pneumococcal vaccination based on results of their vaccine screening (Figures 1a and 1b). If the nurse determined that the patient had at least 1 indication, had not been vaccinated in the past 5 years, and had no contraindications/precautions, then the patient was considered to be eligible for pneumococcal vaccination.

Statistical Analysis
Sample size was calculated based on the study institution’s pneumonia core measures data for pneumococcal vaccination, reported in 2008 as 56%. We used the pneumonia core measures data to estimate the sample size because the study institution does not abstract data on vaccine administration for all eligible patients. We determined that a 15 percentage-point increase in vaccination rates would represent a clinically meaningful change. Using a 1-sided Student’s t-test with a type 1 error rate (alpha) of 0.05 and a power of 80%, 145 patients were needed per group. Descriptive statistics and Student’s t-test were used to evaluate continuous patient demographic data. Pearson chi-square tests were used to compare categorical data between the pre-implementation and post-implementation periods. Analyses were conducted using SPSS version 15.0 (SPSS Inc., Chicago, IL) and Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA) and an a priori statistical significance level of 0.05.

Results
Patient Characteristics
A total of 1,156 patients were identified for the pre-implementation group, and 894 were identified for the post-implementation group (Figure 3). After random selection of 150 patients from each group, the total N was 300 patients. After excluding 7 patients without screening data, patients were then further stratified into those eligible for pneumococcal vaccination (n = 78, n = 47 pre-implementation and n = 31 post-implementation) and those who were not (n = 215, n = 97...
The overall screening rate was similar between the groups Vaccine Screening and Administration and between groups (Table 1). Among eligible patients, there was no significant between-group difference in mean [SD] age (54 [20] years vs. 58 [19] years for pre- and post-implementation, respectively; \( P=0.319 \)). The primary diagnosis identified at admission varied greatly both within and between groups (Table 1).

### Vaccine Screening and Administration

The overall screening rate was similar between the groups (pre-implementation 96.0% vs. post-implementation 99.3%; \( P=0.056 \); Figure 3). Of the patients screened, more patients were eligible for the pneumococcal vaccine in the pre-implementation group than in the post-implementation group (32.6% vs. 20.8%, \( P=0.022 \); Table 2). A smaller proportion of patients eligible for pneumococcal vaccination had the vaccine ordered in the pre-implementation group compared with the post-implementation group (80.9% vs. 96.8%, \( P=0.040 \)). The rate of vaccine administration increased significantly from pre- to post-implementation (19.1% vs. 74.2%, respectively, \( P<0.001 \)). There was no significant between-group difference in the rates of vaccine refusal among patients who were eligible for vaccination (\( P=0.203 \)) or in the percentages of patients who had the vaccine rescheduled (0.0% vs. 6.5%, \( P=0.250 \)).

#### Discussion

Immunizing patients against vaccine-preventable illnesses during hospitalization represents a significant opportunity for inpatient providers to improve public health. Hospitalized patients are a captive population who have time to be screened for vaccine eligibility and can have the vaccine easily administered. Although there has been increased emphasis on inpatient vaccination with national quality improvement initiatives, many hospitals still struggle to meet the recommended targets.

Dexter et al. (2004) described a prospective, randomized, controlled study comparing use of computerized standing orders with electronic physician reminders for pneumococcal and influenza vaccination orders in eligible hospitalized medicine patients.30 Fifty percent of the hospitalized patients were eligible for the influenza vaccination and 22% for pneumococcal vaccination. Significantly more patients in the computerized standing order group than in the electronic reminder group received influenza and/or pneumococcal vaccinations (influenza 42% vs. 30%, respectively, \( P<0.001 \); pneumococcal 51% vs. 31%, respectively, \( P<0.001 \)). The authors concluded that implementation of standing computerized orders was more effective than physician reminders in improving administration of influenza and pneumococcal vaccines.30

Similar to the study by Dexter et al., the present study included a sample of all medicine patients eligible for pneumococcal vaccination. We also utilized a computerized standing order for pneumococcal vaccine to be scheduled for 9:00 a.m. on the second day of the hospital stay. Scheduling the order for the second day of hospitalization allows providers to decide if there are any relative contraindications to vaccinating the patient and gives them ample time to discontinue or reschedule

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**TABLE 1** Most Common Primary Diagnoses at Admission

<table>
<thead>
<tr>
<th>ICD-9-CM Code</th>
<th>Diagnosis</th>
<th>Number of Patients</th>
<th>ICD-9-CM Code</th>
<th>Diagnosis</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>277.02</td>
<td>Cystic fibrosis with pulmonary manifestations</td>
<td>7</td>
<td>038.9</td>
<td>Unspecified sepsisemia</td>
<td>11</td>
</tr>
<tr>
<td>584.9</td>
<td>Acute renal failure, unspecified</td>
<td>6</td>
<td>518.81</td>
<td>Acute respiratory failure</td>
<td>5</td>
</tr>
<tr>
<td>038.9</td>
<td>Unspecified sepsisemia</td>
<td>5</td>
<td>577.0</td>
<td>Acute pancreatitis</td>
<td>4</td>
</tr>
<tr>
<td>415.19</td>
<td>Pulmonary embolism and infarction</td>
<td>4</td>
<td>491.21</td>
<td>COPD with acute exacerbation</td>
<td>4</td>
</tr>
<tr>
<td>482.1</td>
<td>Pseudomonal pneumonia</td>
<td>4</td>
<td>486</td>
<td>Pneumonia, organism unspecified</td>
<td>4</td>
</tr>
<tr>
<td>491.21</td>
<td>COPD with acute exacerbation</td>
<td>4</td>
<td>584.9</td>
<td>Acute renal failure, unspecified</td>
<td>3</td>
</tr>
<tr>
<td>578.1</td>
<td>Blood in stool</td>
<td>3</td>
<td>578.1</td>
<td>Blood in stool</td>
<td>3</td>
</tr>
<tr>
<td>780.60</td>
<td>Fever, unspecified</td>
<td>3</td>
<td>578.9</td>
<td>Gastrointestinal hemorrhage, unspecified</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>999.31</td>
<td>Infection due to central venous catheter</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>415.19</td>
<td>Pulmonary embolism and infarction</td>
<td>3</td>
</tr>
</tbody>
</table>

*The pre- and post-implementation periods were April 2009 through July 2009 and November 2009 through February 2010, respectively.

**TABLE 2** Results for Patients Eligible for Pneumococcal Vaccination

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Pre-Implementation (n = 47)</th>
<th>Post-Implementation (n = 31)</th>
<th>P Valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine ordered</td>
<td>80.9 (38)</td>
<td>96.8 (30)</td>
<td>0.040</td>
</tr>
<tr>
<td>Vaccine administered</td>
<td>19.1 (9)</td>
<td>74.2 (23)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Vaccine refused</td>
<td>10.6 (5)</td>
<td>22.6 (7)</td>
<td>0.203</td>
</tr>
<tr>
<td>Vaccine rescheduled</td>
<td>0.0 (0)</td>
<td>6.5 (2)</td>
<td>0.250</td>
</tr>
</tbody>
</table>

\*P values for Pearson chi-square tests.
the order. Although we could not differentiate which intervention produced the biggest influence on vaccine administration, changing the schedule of the order was likely a key element because it generated a reminder for nurses to administer the vaccine, and the change in order timing from discharge to the second day of the inpatient stay allowed the vaccine to be given during a less hectic time.

Robke and Woods (2010) described 10 years of pharmacist involvement in pneumococcal vaccinations in a large tertiary care hospital. The hospital initially found that pharmacists could improve pneumococcal vaccination rates by screening and educating eligible patients and contacting physicians to authorize vaccination; however, this process was time consuming. The hospital subsequently adapted its program to allow pharmacists to write protocol-driven orders for pneumococcal and influenza vaccinations. Although the authors did not report overall vaccination rates for their institution, they did report an increased proportion of patients with community-acquired pneumonia (CAP) who received pneumococcal vaccination (71.2% vs. 88.3%) between 2003 and 2008 and an increase in the total number of pneumococcal vaccines dispensed during the same time period.1

In the present study, vaccine interventions did not rely solely on pharmacists to screen and order vaccines; instead, we used a multidisciplinary approach to improve vaccine screening and administration. Nurses, pharmacists, physicians, and information technology personnel were involved in the development and implementation of vaccine initiatives. In addition, we report vaccination rates for all eligible patients, not only those with a CAP diagnosis. Similar to Robke and Woods, we utilized a protocol-driven pneumococcal vaccine order to ensure that patients were not missed. Any patient determined to be eligible for vaccination received a computerized, protocol-driven pneumococcal vaccine order.

Yancey et al. (2010) reported implementing quality initiatives that significantly improved pneumococcal vaccination rates.11 The initiatives included a paper, nurse-driven vaccination assessment form, standing vaccine orders for eligible patients, and changes in vaccination administration scheduling. Implementation of these changes increased pneumococcal vaccination rates for patients with pneumonia from 35% in the first quarter of 2005 to 92% in the last quarter of 2007. In addition, the total number of pneumococcal vaccines dispensed by the pharmacy increased from 154 vaccines in 2004 to 1,206 vaccines in 2007. Key areas for success identified by the authors included a streamlined process, education and training, real-time intervention, and a multidisciplinary approach.11

We report an initiative similar to that of Yancey et al., but we utilized electronic information technology for our nurse-initiated screening tool, automatic scheduled vaccine order, vaccine storage, and real-time tracking (vaccine dashboard). These changes, in addition to nursing education, were associated with significant improvement in our pneumococcal vaccination rates in eligible medicine patients. Our results also suggest a trend toward increased screening following the protocol changes; however, this difference was not statistically significant. There was a significant decrease in the number of patients with an indication for the vaccine in the post-implementation period; however, the study was not designed to determine factors influencing this difference.

We assessed the rate of rescheduled vaccine orders in the post-implementation group to evaluate the appropriateness of the automatically scheduled order and to identify any potential trends that resulted in vaccine rescheduling. The timing of the automatic order appears appropriate because only 6.5% of patients had their vaccine order rescheduled during the study.

The methods used in this study could be extrapolated to other institutions as an effective and efficient way to increase vaccination rates in hospitalized patients. The information technology department was relied upon to implement the protocol changes in the hospital’s electronic medical record and computerized provider order entry system. The process could also be adapted for hospitals that require the use of paper order forms.

Further research, including assessment of the appropriateness of screening, would be helpful to determine the true impact of these changes and allow for further improvement of the screening tool and vaccine screening protocol.

Limitations

First, the improved vaccination rates cannot be attributed to any specific change in the vaccine initiative. Multiple changes in the screening process and vaccine protocol were made at the same time and a combination of these changes likely resulted in improved vaccination rates. Second, the accuracy of the vaccine screening was not assessed. As a result, there may have been patients who were determined to be ineligible but may have qualified for vaccination, and there may have been patients who could not remember whether they had been vaccinated previously who received an additional dose. Intensive nursing education and revision of the screening tool were implemented to minimize inappropriate screening.

A third limitation of this study was the selection of 2 different time periods for comparison. The time periods were selected in order to minimize confounders, such as changes in nursing staff and differences in the priority of vaccinations as a significant health system initiative; however, by selecting 2 different seasons other confounders were introduced. Seasonal differences could have contributed to significant variation in baseline characteristics between patient groups, such as a higher number of patients admitted with influenza or other viral upper respiratory infections that are commonly seen during the winter months.
Conclusions
Implementation of a multifaceted, electronic vaccine protocol was associated with improved pneumococcal vaccination rates in eligible medicine patients. Protocol changes were relatively easy to implement in a large institution and were associated with a significant improvement in pneumococcal vaccination rates. A similar approach may be implemented at other institutions as an effective way to improve pneumococcal vaccination rates.

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