Rapid Implementation of a Pneumococcal Vaccine Program in a Multispecialty Teaching Hospital

David H. Lee, MD, MBA, Tony Sun, MD, MBA, Sandra Kemmerly, MD, Freddie Ruddy, RN, BS, Debbie Simonson, PharmD, Lisa Colletti, RN, MN, and Nancy Hennen, RN, MSN

**Streptococcus pneumoniae** infection is a major cause of morbidity and mortality, accounting for 3000 cases of meningitis, 50,000 cases of bacteremia, 500,000 cases of pneumonia, and 40,000 deaths annually in the United States [1]. It has been estimated that use of the pneumococcal vaccine could reduce mortality by half, especially among elderly patients in whom the case fatality rate for pneumococcal bacteremia approaches 30% to 40% [1].

The 23-valent polysaccharide vaccine currently used covers at least 85% to 90% of the serotypes that cause invasive pneumococcal infections and is considered safe based on clinical experience since 1977 [1,2]. The overall efficacy for immunocompetent individuals aged 65 years and older is 75%. Efficacy is 84% among persons with diabetes mellitus, 69% among those with congestive heart failure, and 65% among those with chronic pulmonary diseases [3]. Pneumococcal vaccine is cost-effective in the prevention of pneumococcal bacteremia [4]. One study of patients with chronic lung disease found a 43% reduction in pneumonia hospitalizations and a 29% reduction in death from all causes in patients who received pneumococcal vaccination, translating to health care cost savings of $113 to $512 per person vaccinated [5].

Despite widely disseminated guidelines for use, pneumococcal vaccine remains underutilized. Based on surveillance data from 1997, only 45% of persons aged 65 years or older reported ever receiving pneumococcal vaccine, and only 33% of diabetic patients had received the vaccine [6,7]. The recent profile of medical care delivered to Medicare beneficiaries showed poor compliance with pneumococcal immunization status screening and vaccine administration [8]. The development of antibiotic-resistant **S. pneumoniae** further increases the need to prevent infection among high-risk patients through vaccination.

Hospitalized patients constitute a high-risk population for pneumococcal infections. Hospitalized patients with pneumonia have a 6% to 9% probability of readmission within 5 years for pneumonia if they are unvaccinated at discharge [9]. However, opportunities to provide pneumococcal vaccine in the hospital are missed 80% of the time [10]. Computer reminders to physicians on rounds report or reminder notices in pneumonia care pathways have failed to improve vaccination rates [11,12]. Pharmacy-based chart reminders and the use of a vaccine manager to assess the patient and administer the vaccine have increased vaccination rates, but the employment of extra staff solely for vaccination may not be economically feasible for the hospital [13,14]. Computer reminders to physicians during discharge increased vaccination rates, but the rates were dependent on the number of indications and the subspecialty of the physician [15]. A study that compared different hospital-based strategies to improve vaccination found that standing orders and preprinted orders were associated with higher immunization rates than individualized physician orders [16]. Unfortunately, most vaccination improvement studies involved only nonsurgical patients. It is unknown whether these strategies can be sustained in the long run or applied to surgical patients.

We organized a hospital-based team in collaboration with the state’s Medicare Peer Review Organization (PRO) to examine cultural, medical, and legal barriers to pneumococcal vaccination. We set a goal of implementing a vaccine program for all hospitalized patients within 3 months in order to have a vaccination protocol in place for the upcoming pneumonia season.

**Program Development**

**Setting**

The Ochsner Clinic Foundation is a not-for-profit academic medical center with more than 500 physicians practicing in 25 locations throughout southeast Louisiana. The Foundation’s acute inpatient care facility, located in New Orleans, is a 441-bed, community-based, multispecialty teaching hospital with 20,000 admissions per year.
Evaluation of Current Practices
A committee consisting of key hospital members from inpatient medicine, infection control, hospital pharmacy, nursing, and information systems was organized to examine hospital barriers to vaccination. Upon examination of current physician and nurse practices, the committee concluded that the following would be needed for an effective, sustainable vaccine program:

- A physician-independent vaccine ordering system
- Computerized nurse assessment
- Simplified inclusion criteria
- Full organizational support and staff buy-in

Standing orders. Chart reminders had been used in the past but had failed to change physician behavior. Our previous efforts taught us that innovative approaches were needed to improve vaccination rates. Due to the presence of multiple specialties and residency programs, it was felt that a physician-independent vaccine ordering system was needed. Based on a review of the medical literature, we concluded that a standing order (i.e., a default-system order not requiring a physician’s signature) would be the best approach for our institution.

Standing orders can be implemented in 1 of 3 ways: automatic computer order, preprinted order, and handwritten order without a physician’s signature. In automatic computer order, an order for the vaccine is generated automatically by the computer for patients meeting vaccine eligibility criteria, and the order is directly transmitted to the pharmacy and nursing staff. In preprinted order, a printed form that contains an order for the vaccine by a predetermined physician or vaccine program is inserted into the chart if the patient meets the criteria. In handwritten order, the nurse is authorized by a predetermined physician or vaccine program to write an order for the vaccine if the patient meets the criteria. We decided to use the handwritten standing order because we did not have physician order entry capability and we did not want to increase paperwork with the preprinted orders.

Nurse assessment of vaccine status. We knew that we could not depend on the physicians to consistently assess for vaccine status in every hospitalized patient. Since a member of the nursing staff has to complete a patient assessment for all admitted patients, we decided to modify the nursing assessment to include accessment for vaccination criteria. A computer-assisted algorithm was developed for use in nursing assessment, as we believed that a preprinted algorithm would be too cumbersome.

Simplified vaccination guidelines. We believed that the 1997 Advisory Committee on Immunization Practices (ACIP) guidelines on pneumococcal vaccination were too complex and that modifying the guidelines would decrease vaccination errors and simplify the assessment process. We simplified the ACIP guidelines by focusing on the top 5 qualifiers: age 65 years or older, congestive heart failure, chronic obstructive disease, diabetes mellitus, and cirrhosis. These criteria represented the most common coexisting conditions encountered in the hospital setting, and we felt that using them would increase the likelihood of success for rapid implementation.

Support and buy-in. Strong leadership is needed to change attitudes toward hospital vaccination. Key members of the vaccine committee were instrumental in mobilizing support and dispelling misperceptions about the vaccine’s safety and efficacy. We distributed newsletters that contained information on the pneumococcal vaccine and the committee’s objective of systematic vaccination. We also asked members of the hospital therapeutics committee to disseminate the vaccine information to other members in their respective departments. Informal conferences were held with staff and resident physicians during resident morning reports, with nurses during monthly nursing meetings, and with medical administration. The goal of these meetings was to understand the hospital staff’s current medical practices and perception of the vaccine. We received constructive suggestions (e.g., how to prevent revaccination in demented patients who are readmitted to the hospital) and no objections to systematic vaccination from hospital staff.

Pneumococcal Vaccine Protocol
The vaccine committee developed a standing order protocol based on the information obtained from the medical literature and hospital staff. This protocol was submitted to the hospital therapeutics committee, which assisted in obtaining further buy-in from hospital staff and administration.

Per the protocol, all hospitalized medical and surgical patients were assessed for vaccination status. The following patients were excluded from the protocol: critically ill patients, pregnant women, transplant patients, and patients younger than 18 years of age. Critically ill patients and pregnant women were excluded based on lack of vaccine safety data in these patient populations. Transplant patients were excluded because infectious disease staff routinely assess the vaccine status of these patients. Patients younger than 18 years of age were excluded because they rarely qualify for the pneumococcal vaccine in the hospital setting.

When patients were admitted to the hospital, the responsible nurse performed a computer-assisted patient assessment, including assessment for pneumococcal vaccination status and medical conditions (Figure 1). A computer-based algorithm determined whether the patient qualified for the
vaccine. Qualifying conditions for the vaccine included age 65 years or older, congestive heart failure, chronic obstructive pulmonary disease, diabetes mellitus, and cirrhosis and were derived from the 1997 ACIP guidelines. If the patient had never received the vaccine or did not know about the vaccine status and had any one of the qualifying conditions, the computer generated an online nursing care directive that prompted the nurse to write a standing order. The nurse wrote a standing order in the chart for the pneumococcal vaccine (“Pneumovax 0.5 cc IM per vaccine program”) and entered the order into the computer ordering system. The pharmacy verified and dispensed the vaccine, and the nurse provided the patient with patient education material. If the patient refused the vaccine, the nurse documented the reason for refusal in the record. If the patient agreed, the vaccine was administered immediately by the nurse and its administration was documented in the computer. This information was stored in the patient’s computerized record and could be retrieved into the admit assessment screen if the patient were readmitted to the hospital.

Legality of Standing Orders
A question was raised in the hospital therapeutics committee regarding the legality of a standing order without a physician’s signature. We discovered that the state board of medical examiners generally discourages the use of standing orders without a supervising physician is available for consultation regarding contraindications and adverse reactions. The PRO was also instrumental in assisting and consulting for the design of this quality improvement program.

Results
The vaccine protocol was implemented in the middle of the first quarter in 2001. Data were collected for the first 2 quarters of 2001 and compared to the baseline vaccination rate for each quarter of 2000. The average number of pneumococcal vaccines administered in the hospital per quarter in 2000 was 28 (18 vaccines in the first quarter, 16 in the second, 27 in the third, and 49 in the fourth). After the standing order program was implemented in 2001, the number of vaccines given increased to 144 in the first quarter and 137 in the second quarter of 2001, a relative increase of more than 400% above baseline (Figure 2). This increase in vaccination remained even after adjustment for the total number of patients admitted to the hospital (number of vaccines given per patient admitted per quarter: 0.35%, 0.31%, 0.5%, and 0.94% for the 4 quarters of 2000; 2.8% and 2.8% for the first 2 quarters of 2001). Additional information is provided in Figure 3.

In the first quarter of 2001, 5158 patients were admitted to the hospital, and 2548 were excluded from the protocol per the exclusion criteria. A total of 333 patients met the criteria for new vaccination, but only 202 (61%) had a written standing order. Of this group, 144 received the vaccine and 58 did
not receive the vaccine mainly because of patient refusal. In the second quarter of 2001, 4953 patients were admitted to the hospital and 2196 were excluded from the protocol. A total of 560 patients met the criteria for new vaccination, but only 250 (45%) had a written standing order. Of this group, 137 received the vaccine.

**Discussion**

Hospitalized patients are at high risk for developing future pneumococcal infections due to their underlying medical conditions. However, hospital pneumococcal vaccination rates remain low compared to those of outpatient medical facilities. One reason for the low vaccination rates may be that preventive care measures historically have been implemented in the outpatient setting, whereas hospitals concentrate on managing acute and life-threatening conditions. The results of the vaccine protocol project at Ochsner Foundation hospital indicate that a pneumococcal standing order can be rapidly and successfully implemented in a large, multispecialty, tertiary care hospital, despite layers of administrative obstacles. The protocol we developed and implemented resulted in a 400% increase in pneumococcal vaccination.

Improvement in the pneumococcal vaccination protocol in a number of areas continued to be made after it was implemented. For example, some opportunities were being missed because of the protocol's requirement for an actual written order from the nurse. Three months after the protocol was implemented, we realized that frequent nursing shifts and staff turnover as well as the failure to follow the computer-generated nursing care directive significantly prevented the writing of the order for the vaccine. Thus, written orders were not being generated for some patients who qualified for the vaccine. In addition, some nurses who had not been educated completely about the program were reluctant to write the orders. We improved upon these problems with further education of nurses and additional question-and-answer sessions. To remove this barrier completely, we planned to revise the protocol by removing the written order step and designing an electronic order for the vaccine that would be sent directly to the pharmacy.

In summary, a pneumococcal standing order can be implemented quickly and may lead to significant improvement in vaccination of patients. Selection of key hospital members, physician leadership, involvement of the hospital therapeutics committee, and collaboration with the state's PRO were instrumental in the protocol's success.

**Corresponding author:** David H. Lee, MD, MBA, Ochsner Clinic Foundation, AT-2, 1514 Jefferson Highway, New Orleans, LA 70121, dplee@ochsner.org.

**References**


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**Figure 2.** Number of vaccines given per quarter. The vaccine protocol was implemented in the first quarter of 2001.

**Figure 3.** Detailed breakdown of patients meeting criteria for the vaccine in first half of 2001. *Mainly due to patient refusal.