

A Hospital-Based Pharmacy Intervention Program for Pneumococcal Vaccination

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Background: Current pneumococcal vaccination rates are well below national goals.

Objective: To determine whether pneumococcal vaccination rates could be increased with a hospital pharmacy-based program using simple chart reminders.

Methods: On a daily basis, inpatient records on general medicine and cardiology services at an academic medical center were reviewed to determine which patients were eligible to receive pneumococcal vaccine. Eligible inpatients were interviewed, and the percentage of nonvaccinated inpatients given vaccine during hospitalization was determined. During an intervention period, reminders were placed on charts after the interview requesting a vaccine when indicated.

Results: Of 447 inpatients, 224 (50.1%) had 1 or more indications for receiving pneumococcal vaccine. Only 64 (28.6%) had been previously vaccinated. One hundred

fifty-eight (70.5%) of 224 vaccine-eligible patients had a prior hospitalization within the previous 5 years. Previous hospitalization was not significantly associated with having (48 [30.4%] of 158) or not having (16 [24.2%] of 66; $P = .35$) been vaccinated prior to admission. During the observational period, 0 of 80 vaccine-eligible, nonvaccinated inpatients were vaccinated before discharge. In comparison, 23 (28.8%) of 80 inpatients were vaccinated after a chart reminder ($P < .001$). During the intervention period, vaccination rates were 10-fold higher on general medicine services than on cardiology services.

Conclusions: A hospital-based pharmacy vaccination program that relied on simple chart reminders was significantly associated with increased vaccination rates among inpatients at risk for invasive pneumococcal disease.

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EACH YEAR disease due to *Streptococcus pneumoniae* accounts for 40 000 deaths and more than \$4 billion in treatment costs in the United States.^{1,2} To lessen the impact from these infections, the Advisory Committee on Immunization Practices (ACIP) advocates pneumococcal vaccination for persons 2 years of age or older with chronic illness or immunosuppression and for all persons 65 years of age or older.² Based on these recommendations, at least 20% of the US population needs vaccination: 23 million persons with chronic illness and 33 million persons 65 years of age or older.³ Vaccination rates, however, have remained persistently low. Despite recent gains, the latest surveys indicate that only 28.7% of persons 65 years of age or older and 5% to 7% of younger persons with chronic illnesses or immunosuppression have been vaccinated.^{4,5} These percentages lag well behind the Public Health Ser-

vice-published goal of 60% pneumococcal (and influenza) vaccination rates among vaccine-eligible persons by the year 2000.² Finally, the rapid emergence of drug-resistant *S pneumoniae* organisms presents new therapeutic challenges for physicians and reemphasizes the need for aggressive promotion of pneumococcal vaccination.⁶

Substantive changes in the delivery of pneumococcal vaccines are clearly needed. To this end, many strategies promoting pneumococcal vaccination have been tested, including age-, community-, and provider-based methods.² Organizational strategies, in particular, such as computerized reminders for physicians at the time of hospital discharge, stamped notes in hospital charts, standing orders for vaccine-eligible patients, and pharmacist-coordinated programs in ambulatory care centers, have been evaluated closely.⁷⁻¹⁵ As a primary component of these strategies, hospital-based vaccination has been at-

PATIENTS AND METHODS

The study was conducted at The University Hospital, a 316-bed teaching facility in Oklahoma City, Okla. Phase 1 was observational and designed to establish the percentage of vaccine-eligible, nonvaccinated patients admitted to general medicine and cardiology services who received pneumococcal vaccine prior to discharge. Vaccine eligibility was defined using previously published ACIP recommendations.¹⁹ Charts and medical records of new inpatients were reviewed on a daily basis during weekdays to determine those who had documentation of prior vaccination or who met the criteria for pneumococcal vaccination. Medical and cardiology wards were selected because a significant proportion of the patients admitted to these services were expected to be vaccine eligible owing to chronic illnesses, such as diabetes mellitus, coronary artery disease, congestive heart failure, and chronic obstructive pulmonary disease, or because they were 65 years of age or older.

In the course of a general interview about medications, inpatients who were deemed vaccine eligible by chart review were questioned concerning prior pneumococcal vaccination, hospitalization within the preceding 5 years, and whether outpatient services were provided by a primary care physician. Inpatients were considered vaccinated if a pneumococcal vaccination was recalled during an open-ended interview or if a previous vaccination was documented in the chart. Phase 1 ended after 40 vaccine-eligible, nonvaccinated inpatients were accrued on each service. Forty represented a reasonable upper estimate of the number of inpatients on medical or cardiology services who would be vaccine eligible over a 1-month period. Inpatients were followed up until discharge to determine how often pneumococcal vaccines were administered as part of routine care.

Phase 2 was interventional and similar to phase 1 except that reminders to physicians were placed in charts of vaccine-eligible, nonvaccinated inpatients (**Figure**). In keeping with ACIP recommendations,² vaccinations were requested for vaccine-eligible inpatients who were uncertain about their vaccination status. Beyond reminders, additional interventions were not undertaken. Specifically, no educational efforts were initiated to explain the study to physicians or the rationale behind pneumococcal vaccination of at-risk inpatients. As in phase 1, phase 2 ended when 40 vaccine-eligible, nonvaccinated inpatients were accrued on each service. The same investigator served as chart reviewer and interviewer during both phases. Phase 1 was conducted from April 1, 1996, to April 31, 1996, and phase 2 from May 1, 1996, to June 11, 1996.

The significance of differences in proportions was determined by χ^2 or Fisher exact test. Analysis of variance was determined by the standard least squares method (JMP Version 3.1, SAS Inc, Cary, NC). The study was approved by the Institutional Review Board of the University of Oklahoma Health Sciences Center.

Pneumococcal Vaccination Recommendation The University Hospital Pharmacy Department

Patient _____ Room# _____ Date _____

Dear Doctor _____

Based upon recommendations by the Advisory Committee on Immunization Practices this patient is a possible candidate for the pneumococcal vaccine based upon one or more of the following criteria:

_____ \geq 65 years
_____ Chronic Illness—Cardiovascular disease, pulmonary disease, alcoholism, diabetes mellitus, kidney disease, asplenia, HIV.

The patient has not received the vaccine based upon chart review and patient interview. Would it be possible to consider vaccination in this patient?

The recommended dose is 25 mcg (0.5 ml) IM or SC

Thank you

Pharmacist _____ Beeper# _____

NOT A PERMANENT PART OF MEDICAL RECORD

The reminder that was attached to charts of vaccine-eligible, nonvaccinated inpatients.

tractive because inpatients are often at high risk for pneumococcal disease. For example, up to two thirds of the patients hospitalized for pneumococcal bacteremia will predictably have been hospitalized in the preceding 3 to 5 years.^{8,15-17} Hospital vaccination is also cost-effective. A single dose of pneumococcal vaccine can save \$141 per patient through avoidance of hospital readmission,¹⁸ and benefit-cost ratios are conservatively estimated to exceed 3:1.¹⁵ Thus, hospitalization represents a unique opportunity to vaccinate persons who are at high risk for pneumococcal disease.

This study was undertaken to determine whether hospital staff pharmacists could significantly increase pneumococcal vaccination rates by simply identifying vaccine-eligible inpatients through a brief interview and by placing reminders in the chart to notify physicians of those needing vaccination prior to discharge.

RESULTS

During phases 1 and 2, a total of 529 patients were admitted to the medical and cardiology services at The University Hospital. During phase 1, inpatients were attended by 4 general medicine and 1 cardiology staff physician, typically with 2 resident physicians per team. Since these services changed monthly, phase 2, which lasted 6 weeks, had 2 different sets of staff and resident physicians involved in patient care. Eighty-two inpatients (15.5%) were discharged before evaluation, typically because of short hospital stays. Retrospective chart analyses for these inpatients, however, found no significant differences in age, discharge diagnoses, indications for immunization, or rates of prior pneumococcal vaccination compared with those who were interviewed (data not shown). Among 447 charts reviewed, 224 inpatients (50.1%) had 1 or more indications for pneumococcal vaccination (**Table 1**). No significant differences in pneumococcal vaccine status were found for inpatients as stratified by medicine or cardiology services ($P = .13$) or period of observation ($P = .48$, 1-way analysis of variance).

Table 1. Inpatient Evaluations During Phases 1 and 2*

Pneumococcal Vaccine Status	Phase 1, Observational Period		Phase 2, Interventional Period		Total
	Medicine	Cardiology	Medicine	Cardiology	
Not vaccine eligible	83 (60)	8 (14)	85 (60)	47 (44)	223 (50)
Vaccine eligible and previously vaccinated	16 (12)	11 (19)	17 (12)	20 (19)	64 (29)
Vaccine eligible without prior vaccination	40 (29)	40 (68)	40 (28)	40 (37)	160 (36)
Total	139	59	142	107	447

*All values, other than the totals, are expressed as number (percentage).

Of 224 vaccine-eligible inpatients, 64 (28.6%) had been previously vaccinated. Indications for vaccination of the 160 nonvaccinated, vaccine-eligible inpatients included cardiovascular (105 [66%]) or pulmonary (26 [16%]) disease, diabetes mellitus (36 [23%]), chronic renal failure (20 [13%]), alcoholism (16 [10%]), human immunodeficiency virus infection (4 [3%]), and an age of 65 years or older (17 [11%]). Fifty-four (84%) previous vaccinations were ascertained solely by patient recall. In 10 instances, vaccination was confirmed by chart documentation; however, 5 of the inpatients involved denied ever having been vaccinated. Inpatients with primary care physicians (46 [36%] of 128) were significantly more likely to have been vaccinated (odds ratio, 2.4; 95% confidence interval, 1.8-3.1) than those who did not have primary care physicians (18 [19%] of 96).

Of 224 vaccine-eligible inpatients, 158 (70.5%) had hospitalizations at The University Hospital within the preceding 5 years. Past hospitalization, however, was not significantly associated with having (48 [30.4%] of 158) or not having had (16 [24.2%] of 66) a pneumococcal vaccination ($P = .35$). Only 5 (7.8%) of 64 inpatients with a prior vaccination received it during a previous hospitalization. For the remainder, vaccinations were administered by primary care physicians (36 [56%] of 64) in clinic settings or by other health care providers (23 [36%] of 64).

During phase 1, none of 80 vaccine-eligible, nonvaccinated inpatients received pneumococcal vaccination during hospitalization. In contrast, vaccinations increased to 28.8% (23/80; $P < .001$) during phase 2, when reminders were placed on charts. The rate of vaccination varied significantly by service, with general medicine inpatients having a 10-fold greater chance of pneumococcal vaccination (21 [53%] of 40) than cardiology inpatients (2 [5%] of 40; $P < .001$). During phase 2, the vaccinations administered were evenly distributed among those teams attended by the 8 general medicine staff physicians. No significant adverse reactions to vaccination were reported in patient charts. After completion of the study, the 15 staff physicians on the medical and cardiology services during phases 1 and 2 were asked whether it was their routine to vaccinate eligible inpatients prior to discharge: 1 said yes; 1 quipped, "Whenever I remember"; and 13 responded no.

COMMENT

Interventions to increase the use of pneumococcal vaccine among at-risk populations are clearly needed. Hospital-based vaccination efforts that are simple and consistently applied should help to reduce the burden of

pneumococcal disease, to save lives, and to control health care costs.² In this study, pharmacists at The University Hospital used chart reminders to significantly increase (0% to 53%) pneumococcal vaccination rates among vaccine-eligible, nonvaccinated inpatients on a general medicine service.

Since many decentralized hospital pharmacists routinely review inpatient medication profiles and perform admission medication interviews, inquiries about prior vaccinations, followed by recommendations for vaccination, could easily become a standard pharmacy service. In states in which qualified pharmacists are allowed to administer vaccines (24 states to date), a hospital pharmacist-based vaccination protocol should be a highly effective method with which to increase pneumococcal vaccination rates. Physician involvement might be necessary only to indicate inpatients whom they preferred not to be vaccinated. Hospital-based vaccination programs are more likely to achieve long-term success when standing orders are granted to pharmacists or nurses, thereby making vaccination a routine hospital-based service. Hospital costs for vaccination should be minimal, since many pharmacists routinely perform the tasks required to identify vaccine-eligible patients and Medicare reimburses for pneumococcal vaccination and permits standing orders for its administration to Medicare patients.² Had a pharmacist-based vaccination program been in place at our hospital during phase 1, screening 198 inpatients could have resulted in the administration of as many as 80 pneumococcal vaccine doses, with only a slight increase in pharmacist workload, compared with 0 doses given under the current physician-directed routine.

Many of the findings reported herein are consistent with previous investigations. For example, 28.6% of the vaccine-eligible inpatients had already been given pneumococcal vaccine—a percentage identical to the 28.7% reported for persons 65 years of age or older in a recent national survey.⁵ More than two thirds (70.5%) of vaccine-eligible inpatients had a previous hospitalization in the preceding 5 years—a rate similar to those reported in other descriptive studies.¹⁷ As noted by other investigators, cardiologists appeared disinclined to give pneumococcal vaccinations, even when reminded.⁷ When cardiologists at our institutions were informally asked about this, they typically mentioned vaccination as an activity best performed by primary care providers or in outpatient settings. No attending cardiologist, however, disagreed with the need for, or benefit gained from, pneumococcal vaccination.

Table 2. Intervention Studies to Increase Pneumococcal Vaccination Rates in Hospitalized Patients—1980 to Present*

Source, y	Setting	Method	No. (%)			
			Vaccine Eligible	Vaccine Eligible With Prior Vaccination	Vaccination Among Controls	Vaccination After Intervention
Siebers and Hunt, ¹¹ 1985	Internal medicine clinic	Patient letter reminders, physician education	ND	91/163 (54)	3/39 (8)	20/72 (28)
Klein and Adachi, ⁸ 1983	Teaching hospital	Stamped notes in charts, hospital-wide educational posters	804/1062 (76)	0/804 (0)	4/191 (2)	29/191 (15)
Klein and Adachi, ¹³ 1986	Teaching hospital	Standing orders carried out by nurses, poster advertising	200/258 (77)	11/200 (5)	0/97 (0)	70/90 (78)
Clancy et al, ⁷ 1992	Medical college hospital	Predischarge computer reminders to physicians	ND	ND	167/747 (3)	224/359 (45)
Bloom et al, ¹² 1988	Teaching hospital	Pamphlet, pamphlet and nurse follow-up, pamphlet and volunteer follow-up, nurse interventions	ND	13/85 (15)	No control group	48/64 (75)
Present study	University hospital	Reminders left on charts, no physician education	224/447 (50)	64/224 (29)	0/80 (0)	23/80 (29)

*ND indicates not determined.

According to ACIP criteria, 50.1% of inpatients on general medicine and cardiology services were vaccine eligible, compared with the 74% to 76% that has been noted by other investigators.^{8,13} Slightly more than half the inpatients (56%) with prior vaccinations had received them from a primary care physician, a finding that is consistent with the notion that patients who have a primary care physician are more likely to have been vaccinated than those who do not have a primary care physician.²⁰ The distressing observation during phase I that not a single vaccine-eligible, nonvaccinated inpatient was administered vaccine prior to discharge is unfortunately consistent with the findings of many previous studies.^{7,8,11,13}

The reasons that house staff and attending physicians fail to vaccinate inpatients are multifactorial and include concern for other pressing clinical issues, fear of adverse postvaccination events, lack of knowledge about the efficacy of pneumococcal vaccination, and difficulty in confirming patient vaccination status.²¹ Among general medicine staff physicians at our hospital, underuse appeared to be more a matter of forgetfulness, because vaccination is not a routine part of discharge planning. Cardiologists, however, believed that this intervention was more the responsibility of other providers than themselves. None mentioned a failure to use the vaccine because of concerns about cost, effectiveness, or adverse reactions.

A fear of hypersensitivity reactions to second pneumococcal vaccine doses is largely unwarranted. The major adverse event resulting from a second vaccine dose consists of erythema and induration at the injection site, ie, an arthus-type reaction.² Compared with the reactions after first doses, however, those after second doses occur no more often and are not of increased severity as measured by a need for hospitalization.^{22,23} The inability to confirm the vaccination status of inpatients is a significant problem. For 59 inpatients who recalled prior vaccination in this study, only 10 charts provided confirmatory docu-

mentation. Pneumococcal vaccination, however, is not to be withheld in the absence of an immunization record.² Instead, a patient's verbal history should be relied on. Indeed, a second vaccine dose inadvertently administered because a prior vaccination was forgotten will likely still be effective. Second doses are routinely recommended for persons with chronic diseases and for those 65 years of age or older if the prior vaccination was given at least 5 years previously and if they were younger than 65 years at the time.²

Diverse initiatives to increase pneumococcal vaccination among hospitalized patients have been studied (**Table 2**). Our investigation, however, is the first (to our knowledge) to examine a hospital-based pharmacy program to increase vaccination rates. Previous strategies have used other health care providers (eg, infection control practitioners) or have relied on computer systems that are not available at all institutions. Siebers and Hunt¹¹ and Bloom et al¹² attempted to educate patients to increase vaccination rates, whereas others have reminded physicians to vaccinate eligible inpatients.^{7,8,13} Not surprisingly, studies with dedicated nurses carrying out standing orders had postintervention vaccination rates in excess of 75%.^{12,13} Similar rates should be feasible if existing health care personnel, such as decentralized pharmacists, are used.

It is possible that the low vaccination rates found in this investigation, especially on the cardiology service, reflected the specific prescribing of a few physicians and are not otherwise generalizable to all physicians providing hospitalized care. The control vaccination rates, however, were entirely consistent with those found by other investigators a decade ago.^{8,11-13} Inpatient recall bias is another potential study limitation. We cannot know how many inpatients failed to remember prior vaccination who also had no chart documentation but had actually been vaccinated before. We suspect that this number is small. Pre-

hospitalization vaccination rates among our inpatients were similar to those reported nationally for persons aged 65 years of age or older.²⁴ Practically, though, it is of minor significance, since, in most circumstances, many of these persons should be revaccinated.² Conversely, among those inpatients who were categorized as having a previous pneumococcal vaccination, recall was used solely to make this determination for 54 (84%) of 64 subjects. Some may have erroneously remembered a pneumococcal vaccination that was not administered or gotten this vaccination confused with another (eg, influenza). This bias, though, would only serve to falsely increase the measured rate of vaccination, implying that more inpatients needed pneumococcal vaccine than reported. Finally, during phase 1, inpatients who were not vaccinated prior to discharge may have had a vaccination scheduled at a follow-up clinic. This explanation seems unlikely in most instances, since such plans were never noted in charts.

It has been more than 10 years since Fedson¹⁴ called for an increased emphasis on pneumococcal vaccination. Few institutions have heeded this call. Although our pharmacist-based strategy had little effect on vaccination rates on cardiology compared with general medicine services, we still recommend it as a simple method to promote this important preventive measure. The program can be implemented in hospitals with decentralized pharmacists with little risk or cost to the patient and can potentially achieve better results if coupled with physician and patient education. Implementation should require few additional hospital resources, especially in states where pharmacists are legally allowed to administer vaccines.

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