

Using a Vaccine Manager to Enhance In-hospital Vaccine Administration

Suzanne Landis, MD, MPH, and M. Lynn Scarbrough, MSN, FNP

Asheville and Chapel Hill, North Carolina

Background. Immunizations are effective and safe but underutilized. Inpatient hospitalizations offer an opportunity to update immunizations for both children and adults.

Methods. We tested two strategies for administering vaccines to hospitalized adults: a nurse practitioner vaccine manager, who assessed patient needs and administered vaccines without the attending physician's signature; and enhanced usual care, ie, need assessed by floor nurses and vaccines ordered by attending physicians. Evaluation was based on immunization rates during 2 preintervention months compared with immunization rates during the 3-month intervention period, and on interviews with nurses and physicians regarding their evaluation of the acceptability of the two strategies.

Results. Three percent of patients needing a vaccine received it during hospitalization in the 2-month baseline period before our intervention. During the intervention period, 1252 patients were admitted and available for assessment; 821 were assigned to the "enhanced usual-care" floors and 431 to the "vaccine-manager" floors. Of the patients receiving enhanced usual care, 54% had

either inadequate or no assessment of vaccine need. Seventy-three percent of those who were properly assessed needed at least one vaccine, yet only 4% of those patients received a vaccine. All patients on the vaccine-manager floors were assessed; of these, 47% needed one or more vaccines. Thirty-four percent of patients needing a vaccine received it; however, 47% of patients needing a vaccine refused it. The family nurse practitioner spent an average of 15 minutes per patient in providing this service. Qualitative interviews with staff nurses and physicians demonstrated support for a separate vaccine manager program to immunize patients.

Conclusions. A specially dedicated vaccine manager can be more effective in assessing the need for and in delivering vaccines than can attending physicians working with floor nurses. Using a vaccine manager, these tasks also can be accomplished in a reasonable time. Hospital staff regard this approach as acceptable.

Key words. Vaccination; vaccination utilization; immunization programs; hospitals, community. (*J Fam Pract* 1995; 41:364-369)

The United States Public Health Service's landmark publication entitled *Healthy People 2000* highlights three general public health goals: increasing the span of healthy life for Americans; reducing health disparities among Americans; and achieving access to preventive services for all Americans.¹ All three of these goals would be furthered by

a comprehensive immunization program, one that includes assessment and administration of vaccines during all outpatient and inpatient contacts with the medical system.

Although immunizations have demonstrated efficacy in reducing morbidity and mortality, they are underutilized in both the pediatric and adult populations.²⁻⁷ For example, pneumococcal vaccine, which is used to prevent pneumococcal infection in the elderly and those with chronic medical problems, is safe, relatively inexpensive, and reimbursed by Medicare, yet many of those needing this vaccine are not receiving it. Pneumococcal vaccine is 60% to 81% protective in older, high-risk patients, and is

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From Mountain Area Health Education Center (S.L.), and Memorial Mission Hospital (M.L.S.), Asheville, and the Department of Family Medicine, University of North Carolina, Chapel Hill (S.L.). Requests for reprints should be addressed to Suzanne Landis, MD, MPH, Mountain Area Health Education Center, 118 Weaver Blvd, Asheville, NC 28804.

cost-effective.⁵ Nevertheless, in a study at two teaching hospitals, two thirds of patients with pneumococcal bacteremia had been hospitalized within the previous 5 years and had been appropriate candidates for the pneumococcal vaccine but had not received the vaccine during the hospitalization.⁷ Other institutions report similar findings of missed pneumococcal vaccination opportunities, and provide a rationale for the effectiveness of a hospital-based immunization program.^{6,8} For example, at one university hospital, a predischarge reminder to admitting physicians increased pneumococcal vaccination rates to 45% among hospitalized medical patients with at least one indication for the vaccine, compared with only 3% before the intervention.⁸ Another university hospital-based immunization program increased the pneumococcal vaccination rate to 78% by using a roving infection control nurse who identified predischarge vaccination candidates and dispensed the vaccine.⁹

Thus, a special nurse-managed program appears to enhance the likelihood of vaccinating hospitalized patients more effectively than does a reminder to physicians. However, these methods of managing vaccination rates have not been specifically compared. Both hospitals in the studies cited above were university-based and relied on house staff to provide care to patients; therefore, experiences at these hospitals may not be similar to those in community hospitals with private physicians. We developed, implemented, and evaluated a community hospital-based immunization program to update inadequate immunizations for all adult hospitalized patients before discharge, comparing the effectiveness of a vaccine manager with that of enhanced usual care provided by a floor nurse and attending physician team.

Methods

This study was conducted in a 500-bed regional hospital in Asheville, North Carolina, with 58% of patients from the immediate county (population 183,000) and the remainder from a 15-county area (380,000). For the baseline study (usual care), one nurse approached adult patients admitted to two medical-surgical nursing floors during the months of November and December 1992. Patients were asked to recall when they received the vaccines for tetanus-diphtheria, pneumococcus, influenza, and measles-mumps-rubella (MMR), and if they would agree to receive needed vaccines while in the hospital. After patient discharge, medical records were reviewed to determine sex, race, insurance status, and medical diagnoses as ICD-9 (International Classification of Diseases, 9th Revision) codes.

Subjects for the intervention included patients ad-

mitted to one of six nursing care units chosen to participate: two general medical floors (24 and 20 beds), a 20-bed surgical floor, a 31-bed medicine-urology-respiratory floor, a 27-bed orthopedics floor, and a 40-bed neuroscience unit that also housed eye-surgery and back-surgery patients.

The intervention began on June 21, 1993, and ended September 30, 1993. Vaccines offered through the study included adult tetanus-diphtheria, MMR, and pneumococcal. We did not focus attention on the influenza vaccine because it was not considered in season during the intervention period. The vaccine-manager strategy placed the responsibility for dispensing the vaccines with a family nurse practitioner (FNP), who used a standard protocol form signed by a physician on the medical staff; it did *not* require the signature of the attending physician. Vaccine education, informed consent, documentation, and vaccine administration were accomplished by the nurse without unit staff involvement. Patients were not charged for vaccines. On the advice of legal counsel, the hospital hired a family nurse practitioner who was able to independently assess the need for and then administer vaccines to patients following a pre-designed protocol.

The enhanced usual-care strategy involved integrating immunization history, patient education and consent, and vaccine administration into the daily activities of nurses and physicians without using additional staff. Floor nurses asked patients about their vaccine history, assessed their age and medical problems based on their medical problem list, and indicated on the adult vaccine order form which vaccines were needed. Attending physicians were then asked to complete and sign the vaccine order form. Both strategies adhered to standard indications and contraindications for administration of vaccines.

Assessment of Variables

The outcome variable of interest was receipt of vaccines as defined by a signed, dated notation on the medication administrative record and collected by the vaccine manager during the medical record abstraction after patient discharge. Each patient's vaccine history was collected during hospitalization using standard protocols.

At the conclusion of the 3-month study period, the intervention was discontinued and the vaccine manager completed chart abstractions on patients admitted during the study period. Information collected during audit included age, sex, race (white, black, Hispanic, American Indian, Asian/Pacific Islander, other); insurance status (Medicare, Medicaid, Medicare/Medicaid, Medicare/other, private/other, none); primary medical diagnoses (collected as the ICD-9 discharge diagnoses); patient

mental status (recorded as confused or not, based on impaired mental status and inability to understand and comply with the informed consent for vaccine administration); afebrile status (oral temperature less than 100.4°F within the past 24 hours); length of stay; and documentation of vaccine receipt on patient discharge form. The time assessment for the vaccine-manager strategy included total time required for chart review, for the patient to read the information on and to sign the consent form, and for documentation of vaccines.

The final component of the study included qualitative interviews with nurses and physicians regarding their experiences related to the adult immunization program. We asked them whether vaccine administration should be part of a hospital stay, whether they had experienced more work personally as a result of the study, whether they were aware of any problems with patient care related to receiving vaccines in the hospital, and whether they would be supportive of a routine hospital-based vaccination program. Physician interviews were conducted individually. Nurses were interviewed in groups; each of the six nursing floors were represented by several groups.

Data Analyses

Summary statistics, including means, standard deviations, and ranges for continuous variables and frequency distributions for categorical variables, were used to describe the patient population. We used chi-square statistics for comparisons involving categorical variables and *t* tests for continuous variables. We compared the administration rate of vaccines during the baseline period to that during the intervention period and compared rates of vaccination among patients in the vaccine-manager group with those of patients in the enhanced usual-care group using chi-square statistics. To stabilize the variability of length of stay, the receipt of vaccine in the intervention groups was adjusted for log length of stay using logistic regression.

Power

Our sample size of more than 300 patients in each of the two test strategies provided us with greater than 99% power with an α of 0.01 where P_1 , the approximate proportion of patients vaccinated in enhanced usual care strategy, is 0.05 and P_2 , the approximate proportion of patients vaccinated in the vaccine-manager strategy, is 0.35.¹⁰

Results

Baseline Assessment

During the 2-month baseline (usual care) assessment before the intervention, 58.1% of the 215 randomly approached patients were women, 85.6% were white, 35% had Medicare insurance, 16% had Medicare or other insurance, and the mean age was 58 years. Overall, 44.9% were in need of tetanus-diphtheria vaccine, 57.1% pneumococcal vaccine, 51.9% influenza vaccine, and 1.4% measles vaccine. Seventy-five percent of the patients approached stated that they would accept a vaccine offered during the hospitalization, yet only six (2.8%) of the patients who needed pneumococcal vaccine received it before hospital discharge. This baseline assessment documented the high rate of vaccine need among hospitalized patients, and the low rate of vaccine administration under the current policy of relying on physicians to remember to assess need and order vaccines.

Intervention Period

During the intervention period, 1252 patients were admitted and available for assessment on the six floors of the study hospital: 821 on the enhanced usual-care floors and 431 on the vaccine-manager floors (Figure). All patients admitted to the enhanced usual-care floors had staff nurses and attending physicians capable of assessing vaccine needs; however, some patients on the vaccine-manager floors may not have been assessed since the FNP did not work on weekends or evenings. The vaccine-manager patients were more likely to be men, to be older, to have Medicare insurance, to be hospitalized for injuries and poisonings, infections, and chronic lung diseases, and to have longer lengths of stay as compared with the enhanced usual-care patients (Table 1).

Eight hundred twenty-one patients were admitted to the enhanced usual-care floors. Ten (3.7%) of the 272 who needed one or more vaccines received at least one (Tables 2 and 3). Of the 821 patients, 54.3% had either inadequate or no assessment of their vaccine need by the regular nursing staff; 3.0% were found to be too mentally confused to participate; and 9.5% were assessed and did not need a vaccine, while 33.1% were assessed and did need a vaccine. Of the 272 patients who were assessed as needing a vaccine, only 10 received one. For the 262 patients who needed a vaccine but did not receive one, failure to vaccinate was due to the attending physician not ordering the vaccine (87.4%), fever (11.1%), and patient refusal (1.5%)(Figure).

Of the 431 patients in the vaccine-manager group, 201 (46.6%) needed one or more vaccines, 180 (41.8%)

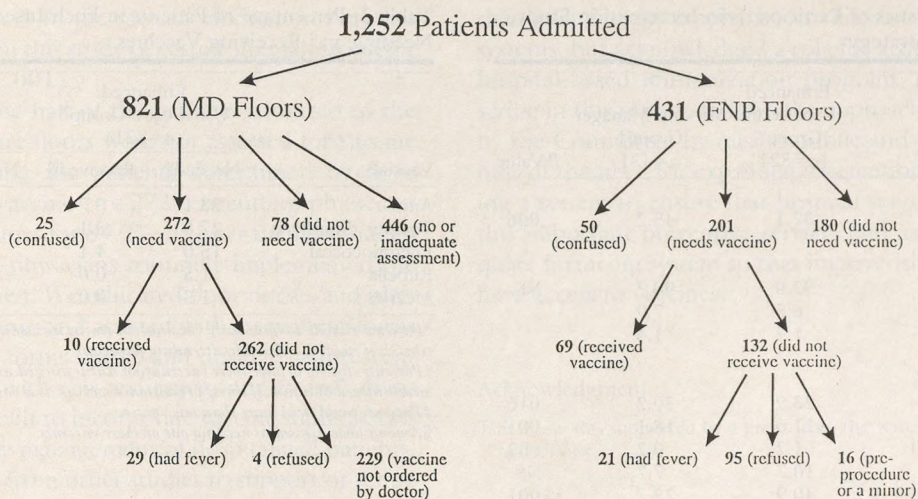


Figure. Flow chart showing the outcome of the Memorial Mission Hospital Adult Immunization Program. “MD Floors” designates the strategy in which vaccination need was assessed by floor nurses and, if needed, vaccine(s) ordered by attending physicians. “FNP Floors” designates the strategy in which a family nurse practitioner, serving as a vaccine manager, assessed the need for vaccination and administered vaccines without physician order. “Confused” denotes confused mental status.

did not need a vaccine, and 50 (11.6%) were found to be too confused to assess. Sixty-nine (34.3%) of the 201 patients who needed one or more vaccines received at least one (Tables 2 and 3). Reasons for nonvaccination among the remaining 132 patients were patient refusal (72.0%), fever (15.9%), and concern about vaccine side effects interfering with a surgical procedure that had not yet been performed (11.4%). One patient did not receive a vaccine because he was under 18 years of age (Figure).

Of the patients needing vaccines, a significantly greater proportion of those on the vaccine manager floors received at least one than did those managed by physician-nurse teams (34.3% vs 3.7%, $P < .001$). There was only a slight difference between baseline and the enhanced usual-care group (2.6% vs 3.7%), but among FNP-managed patients, the vaccination rate during the intervention period was significantly greater than during the baseline period (34.3% vs 2.6%, respectively). Fifteen minutes was the average time the FNP spent per patient providing this service.

Nurses and physicians, who were unaware of the study results, were interviewed to determine how acceptable they considered the program. Nurses on five of six nursing units stated that immunizations were important and should merit a special program to ensure that vaccines were received by patients who needed them. Nurses expressed the opinion that the process of assessing vaccine history, teaching patients about vaccines, obtaining consent, and giving and documenting immunizations added an unacceptable level of extra paperwork and responsibility to the staff nurses' already sizable workload. The staff of the sixth nursing unit was less enthusiastic about the

program. During the study period, they were undergoing substantial changes in personnel and physical structure, which may account for their response. Twenty-six physicians were interviewed regarding their experiences with the immunization program. All of them expressed the opinion that immunizations were important and appropriately provided in hospitals. None of the 26 recalled any patient problems relating to vaccines during the study period. Only one physician expressed a desire that the FNP seek physician approval before immunizing patients.

Discussion

We found a low rate (2.6%) of vaccine administration in-hospital before we implemented the vaccine program. This rate is similar to that found in other published studies that have documented significant missed opportunities for vaccination during hospitalizations.⁷⁻⁹ In the current study, the enhanced usual-care strategy did not substantially improve vaccine delivery from baseline (2.6% to 3.7%), but the rate of vaccinations among vaccine-manager patients increased significantly (34.3%).

Our enhanced usual-care strategy provided vaccinations for 3.7% of patients who were found to need one or more vaccines. A previous study using similar methods at a university medical center with house staff was able to increase vaccination rates to 45%.⁸ The hospital in the present study is a community hospital with attending physicians who are in private practice and provide direct patient care. Thus, our experience, wherein the enhanced usual-care strategy resulted in essentially no improvement

Table 1. Characteristics of Participants in Intervention Study, by Immunization Strategy

Patient Characteristic	Enhanced Usual-Care Group*	Vaccine-Manager Group†	P Value
	(n=821)	(n=431)	
Sex %			
Male	37.1	45.2	.006
Race, %			
White	92.0	90.7	NS
Black	6.5	7.9	
Other	1.2	1.4	
Insurance coverage, %			
Medicare	23.9	30.2	.016
Medicare/Other	11.6	18.1	.001
Medicare/Medicaid	1.2	0.2	.002
Medicaid	10.7	7.7	NS
Private/Other	40.9	23.7	<.001
None	10.8	16.5	.005
Age in years, mean	52.77	57.22	<.001‡
Primary medical diagnosis, %			
Neoplasm	15.6	1.4	<.001
Circulatory disorder	10.4	10.9	NS
Chronic lung disease	2.2	6.0	<.001
Gastrointestinal disorder	16.3	13.7	NS
Infection	3.7	9.1	<.001
Endocrine disorder	3.4	4.4	NS
Musculoskeletal disorder	14.6	6.7	<.001
Injury/Poisoning	9.4	31.6	<.001
Miscellaneous§	24.5	16.2	.001
Length of hospital stay in days, mean	6.21	9.50	<.001‡

*Patients eligible to have their vaccination status assessed by floor nurses, and vaccine(s), if needed, ordered by attending physician.

†Patients eligible to have their vaccination status assessed by, and vaccine(s), if needed, administered by a family nurse practitioner serving as vaccine manager.

‡t-test P value on means for continuous variable.

§Includes nervous system disorder, mental disorder, anemia, kidney disease, diseases of genital organs, and pregnancy.

NOTE: Percentages may not add to 100 because of missing data.

in vaccination rates, might be more representative of average physicians in practice than the rates previously reported. Community hospitals in Minnesota that used standing orders for nursing staffs to administer influenza

Table 2. Percentage of Patients Assessed for Vaccine Status and Percentage of Assessed Patients Needing Vaccination

Vaccine Status	Enhanced Usual-Care Group, %* (n=821)	Vaccine-Manager Group, %† (n=431)
Vaccine status assessed	46	100
Vaccine needed‡	72.5	46.6

*Patients eligible to have their vaccination status assessed by floor nurses, and vaccine(s), if needed, ordered by attending physician.

†Patients eligible to have their vaccination status assessed, and vaccine(s), if needed, administered by a family nurse practitioner serving as a vaccine manager.

‡Those patients whose status was assessed.

Table 3. Percentage of Patients in Each Intervention Group Needing and Receiving Vaccines

Vaccine	Enhanced Usual-Care Group* (n=821)		Vaccine-Manager Group† (n=431)	
	Needed‡	Received§	Needed‡	Received§
Any	33.1	3.7	46.6	34.3
Tetanus-diphtheria	27.8	3.1	32.5	30.0
Pneumococcal	15.0	4.1	31.3	31.9
Rubella	1.5	0.0	0.7	33.3
Measles	1.3	0.0	0.5	50.0

*Patients eligible to have their vaccination status assessed by floor nurses, and vaccine(s), if needed, ordered by attending physician.

†Patients eligible to have their vaccination status assessed and vaccine(s), if needed, administered by a family nurse practitioner serving as a vaccine manager.

‡Patients could need more than one vaccine.

§Among those assessed as needing one or more vaccines.

vaccinations were more likely to vaccinate patients (40.3%) than hospitals attempting to promote vaccination by relying on physician chart reminders (17%) or physician education strategies (9.6%).¹¹ Physician reminders in community hospitals apparently do not substantially improve vaccination rates.

Our 34% vaccination rate among patients in need of vaccine using the vaccine-manager strategy is lower than the 78% figure previously reported in a New York City university hospital, which used an infection control nurse to assess vaccine need for and administer the vaccine.⁹ A large number of our vaccine manager patients (95 of 201 [47%] who needed a vaccine) refused to be vaccinated, claiming they were too tired or had already had too many procedures. We were surprised by this finding, since in our baseline assessment, 75% stated they would accept the opportunity to be vaccinated during hospitalization. This rate of refusals also is greater than the rates of previously reported experiences at two university hospitals that employ house staff for the care of all patients.^{8,9} Refusal rates are probably quite dependent on the characteristics of the vaccine manager seeking permission for vaccine administration as well as on patients' medical conditions and expectations. In this study, the vaccine-manager patients were older and had longer lengths of stay than did the enhanced usual-care patients. The FNP in our study might have been less assertive than the infection control nurse in the other study. Patients in university hospitals may be less likely to question the necessity of procedures offered to them during hospitalization than are private hospital patients.

Certain circumstances might affect the likelihood of vaccination occurring during hospitalizations. For example, the likelihood might decrease because of patient refusal for the reasons listed above, or it might increase because of longer hospital stays that offer a greater opportunity for patients to be assessed and to receive a vaccine.

However, differences in the rate of vaccination between the two strategies in this study persisted after adjusting for length of stay ($P < .001$).

More than one half of the patients admitted to the enhanced usual-care floors were not assessed for vaccine status. Even among the patients determined by floor nurses to need a vaccine ($n=272$), attending physicians did not order vaccines for 84.2%. Neither the floor nurses nor the attending physicians routinely implemented the program as designed. We educated floor nurses and physicians about vaccines and assisted with assessment forms and vaccine order forms before and during the intervention phase. Even with this assistance, nurses and physicians found it difficult to incorporate vaccine status assessment into the daily management of hospitalized patients.

No data exist from other studies to support or refute our assumption that patients would accurately remember their vaccine history when questioned. However, this assumption was necessary for the implementation of a program such as this because, to date, there is no centralized database of patient immunization information. Since pneumococcal vaccine generally is offered only once during a patient's lifetime, we anticipated that patients might be able to recall whether they had received this vaccine, even though they might not remember the date correctly.

Conclusions

It is more labor-intensive and costly to use a specific vaccine manager to assess the need for vaccination and then administer vaccines than it is to integrate these activities into the regular floor nursing care and attending physician roles. However, the vaccine-manager strategy resulted in more patients receiving vaccine education, assessment, and administration, and it was acceptable to nurses and physicians. Even so, the vaccine-manager program demonstrated a higher-than-desired vaccine refusal rate that was also noted in a previous report.¹¹ This refusal rate might be decreased by stressing to patients their physicians' support for in-hospital vaccination and treating vaccinations in a manner similar to that of other ordered treatments or injections. Recently, the National Vaccine Advisory Committee recommended a systematic approach designed to enhance adult immunization rates

that included an emphasis on outpatient primary care systems, but acknowledged a role for acute care sites.¹² A hospital-based immunization program, such as we describe in this report, follows the approach recommended by the Committee by raising public and provider awareness of the need for expanded vaccination rates, identifying a system to ensure that hospital stays are utilized for this important preventive service, and assuring an adequate financing system so that impoverished patients still have access to vaccines.

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