Pneumococcal infection causes approximately 40,000 deaths in the United States each year, accounting for more deaths than any other vaccine-preventable bacterial disease [1]. The highest mortality rates occur among the elderly, in whom the case-fatality rate for pneumococcal bacteremia is approximately 30% to 40%. It is estimated that approximately half of these deaths could be prevented through vaccination [1]. The Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention (ACIP) recommends that all persons aged 65 years and older be vaccinated against pneumococcal disease [1]. However, it is estimated that less than half of targeted adults in the United States have ever received the vaccine [2].

One strategy for improving pneumococcal immunization rates among the elderly is the implementation of pneumococcal vaccination programs in the acute care inpatient setting [3–7]. Studies have shown that approximately two thirds of persons with serious pneumococcal disease are hospitalized within the 3 to 5 years prior to their pneumococcal illness [3]. The ACIP recommends that hospitalized elderly patients receive pneumococcal vaccine before discharge as a routine standard of care [1]. Pneumococcal vaccination programs targeting high-risk hospitalized patients can lead to improved immunization coverage rates [4] and may reduce the number of cases of pneumococcal infection. This article describes a project designed to improve the immunization rates for hospitalized Medicare beneficiaries in the state of Minnesota.

Project Background
In 1998, all Minnesota hospitals were invited to participate in the Inpatient Pneumococcal Immunization Project. The project was developed and coordinated by Stratis Health as part of its Peer Review Organization (PRO) contract with the Health Care Financing Administration to carry out quality improvement efforts for Medicare beneficiaries in the state. The Inpatient Pneumococcal Immunization Project had 2 primary objectives: (1) to facilitate the implementation of inpatient pneumococcal immunization programs for patients aged 65 years and over in acute care hospitals, and (2) to increase the assessment of pneumococcal immunization status and the subsequent administration of pneumococcal vaccination to eligible patients in the inpatient setting. Twenty-six hospitals, ranging from small rural hospitals to large tertiary care facilities, elected to participate in the project. The number of beds per facility ranged from 10 to 381, with a median of 33.

Baseline Data Collection
For the first phase of the project, Stratis Health reviewed the medical records of a random sample of Medicare patients age 65 years of age or older discharged between 1 March 1997 and 28 February 1998 from the 26 participating hospitals. Twelve records from each hospital were reviewed (if there were fewer than 12, all the records were reviewed). Patients who had died or who were transferred to other facilities were excluded, resulting in a sample of 193. Data were collected from the medical records using a simple data collection tool developed and tested by Stratis Health. Hospitals had the choice to use Stratis Health experienced abstraction staff or to conduct the medical record abstraction on their own. For abstraction conducted by Stratis Health, inter-rater reliability testing was performed on 10% of the cases; for hospital-conducted abstraction, the hospitals sent records to Stratis Health for quality assurance checks. Baseline findings revealed that only 8% of patients had documentation of an assessment for immunization status; of those assessed and found to be eligible for pneumococcal immunization, none had received the vaccine.

Intervention
After baseline data collection, each of the 26 participating hospitals developed and implemented a quality improvement plan designed to increase the assessment of patients for immunization eligibility and immunization of eligible patients aged 65 years and over in acute care hospitals.
inpatients. Improvement efforts were not randomized; rather, each hospital selected quality improvement efforts that were expected to yield high improvement rates for that facility.

For each hospital, the improvement plan included the implementation of a tool to assess patient immunization status and eligibility. Half of hospitals modified an existing form to assess for both influenza and pneumococcal immunization status. Nearly half created a new form to assess for pneumococcal vaccination only. Each hospital individually determined whether assessment would occur during time of admission, time of discharge, or both.

Each hospital improvement plan also included implementation of 1 of 3 medication ordering policies related to the administration of pneumococcal immunization: preprinted physician orders \((n = 5)\), defined as a preprinted order to be signed by the physician delegating authority to a nonphysician provider to immunize based on assessment of need; standing orders \((n = 13)\), defined as a protocol delegating authority to a nonphysician provider to immunize based on assessment of need with no physician signature required; and individual physician orders \((n = 8)\), defined as a traditional physician-initiated order, signed by the physician. Hospitals also implemented educational programs for both hospital staff and patients.

**Remeasurement**

Following implementation of the quality improvement plan, a random sample of medical records was selected from each hospital to determine how many patients were assessed for immunization status and, of those assessed and found eligible, how many were then immunized. All records meeting the inclusion criteria were included. After excluding as with the baseline sample, there was a total of 1868 records. All records were from the time period 1 March 1998 through 28 February 1999. The same data collection tool used for baseline data collection was used for remeasurement.

Project implementation occurred in 3 rounds, with 3 different start dates but identical timelines for project milestones (4 months for baseline data collection, 8 months for implementation, and 4 months for remeasurement). In general, remeasurement took place 8 months following the introduction of the intervention; however, a few hospitals who started out in rounds 1 and 2 ended up having a slightly longer implementation period and their remeasurement took place at the same time as hospitals who started out in later rounds. These hospitals tended to be the larger facilities that faced more delays in terms of team identification, physician approval, and policy and procedure changes.

**Effectiveness of Assessment Practices**

**Figure 1** shows the percentage of patients assessed for immunization status following implementation. Aggregate assessment rates increased from the baseline rate of 8% to 56%, a statistically significant improvement \((P = 0.0245)\). Due to overall low hospital-specific immunization assessment rates prior to this project, only the aggregate baseline measurement is reported. There was a wide range of assessment rates among hospitals. While the majority showed dramatic improvement, with 5 hospitals achieving 100%, 3 hospitals fell at or below the baseline measure.
Effectiveness of Immunization Ordering

Figure 2 shows the percentage of assessed patients found to be eligible for the pneumococcal immunization who were then immunized. Patients were considered eligible to receive the pneumococcal vaccination if they were assessed, had no contraindication to receiving the vaccine, were not immunized at age 65 years or older, and were not previously immunized within the previous 5 years. The aggregate follow-up immunization rate was 28%; the baseline immunization rate was 0%. The difference between baseline and follow-up immunization percentages could not be tested for statistical significance due to the small baseline sample size. Again, there was a wide range of vaccination rates at remeasurement, with several hospitals achieving a rate of 90% or greater.

Figure 3 shows the immunization rates of eligible patients according to the type of medication ordering policy implemented by the hospital. Hospitals using preprinted orders achieved the highest aggregate immunization rate. The use of individual physician orders was associated with a lower immunization rate.

Summary and Implications

In this project, the use of an immunization assessment tool combined with a pneumococcal immunization policy in acute care facilities was found to significantly raise the rate of assessment for immunization need and the rate of patients immunized against pneumococcal infection. Standing orders and preprinted orders for pneumococcal immunization were associated with higher immunization rates than individual physician orders and were more successful in converting eligible patients into immunized patients.

The results from this project concur with results from similar projects demonstrating that standing orders and preprinted orders lead to higher immunization rates [7]. Such orders require fewer steps from assessment to actual immunization, thereby potentially preventing process breakdowns. Individual physician orders may slow or halt the immunization process. This study found no difference between the rate achieved using standing orders and the rate with preprinted orders.

There was a wide variation in the results achieved by the different hospitals; however, the sample size was not large enough to determine which hospital characteristics were associated with success in implementing an improvement plan. Anecdotal information suggests that size of facility may have been a factor, with larger hospitals having greater difficulty in initiating an immunization program. Larger hospitals with complicated systems may need to involve more staff in the process and may benefit from using a rapid-cycle improvement method to test process changes on a small group prior to full implementation.

Although overall improvement rates were high, there is significant room for improvement: almost half of patients in the follow-up sample (44%) were not assessed and nearly three fourths of patients who were assessed and deemed eligible (72%) were not immunized. Some hospitals anecdotaly reported that uncertainty regarding a patient’s previous immunization status often was a barrier to immunization. Hospitals need to establish clear policies regarding action to be taken when previous immunization status is unknown. The ACIP’s current recommendation is to administer the pneumococcal vaccination if previous immunization status
of the individual is unknown and the vaccination is otherwise indicated [1]. The benefits of receiving the vaccine outweigh the risks associated with inadvertent revaccination.

Hospitals also reported situations in which a provider did not want a patient to receive the vaccine during hospitalization. Some providers do not view the hospital as the appropriate site for delivery of preventive care such as vaccination. Others are concerned about vaccine efficacy after acute illness. In such cases, it is important for hospitals to have a plan for immunization of eligible patients after discharge (for example, setting up outpatient or nursing home follow-up for vaccination at discharge).

It is important to capitalize on opportunities to increase pneumococcal immunization among the elderly, including hospitalization. Hospitals need to develop and implement systems to assess elderly patients for pneumococcal immunization status and to administer the pneumococcal immunization to eligible patients. Only with the collective effort of the entire health care system will immunization rates rise, preventing unnecessary illness and mortality due to pneumococcal-related illness.

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References