Identification of Low-Risk Hospitalized Patients With Pneumonia*
Implications for Early Conversion to Oral Antimicrobial Therapy

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Purpose: Few available data exist to define either the medically necessary duration of parenteral antimicrobial therapy or length of stay for hospitalized patients with pneumonia. Therefore, we investigated the potential safety and effectiveness of a practice guideline recommending early conversion of low-risk patients with pneumonia from parenteral to oral antimicrobial therapy and early hospital discharge.

Patients and methods: The practice guideline was studied retrospectively in 503 hospitalized patients with pneumonia at a teaching community hospital.

Results: Thirty-three percent of patients with pneumonia were classified as at low risk for complications and potentially suitable for early conversion to oral antimicrobial therapy according to the guideline. Were the guideline to have been used to guide patient discharge decisions, 619 additional bed-days would have been made available to accommodate incoming patients. A consensus among physician reviewers led to the judgment that quality of care would not have worsened for 98.2 percent of low-risk patients had they been switched to oral antimicrobial therapy on the third hospital day, nor would quality of care have been worsened for 93.4 percent of low-risk patients had they been discharged on the fourth hospital day.

Conclusion: The practice guideline that we studied has the potential to safely reduce the duration of parenteral antimicrobial therapy and length of hospital stay for selected low-risk patients with pneumonia. The guideline should be studied in a prospective clinical trial. (Chest 1994; 105:1109-15)

CI = confidence interval

Community-acquired pneumonia is responsible for more than 1 million hospital admissions annually in the United States. In 1985, the overall costs of caring for patients with lower respiratory tract infections exceeded $15 billion, and today's costs are even greater. Moreover, a recent study of 12 hospitals demonstrated that approximately 24 percent of hospitalized patients who died of pneumonia may have suffered potentially preventable deaths. These data demonstrate the tremendous opportunity to improve the quality of care and reduce the cost of hospitalization for pneumonia patients.

Although much has been written about the management of patients with serious community-acquired pneumonia, little information is available to guide physicians regarding the appropriate duration of parenteral antimicrobial therapy or the medically necessary length of stay. Currently, some decisions on the most appropriate timing for converting pneumonia patients from parenteral to oral antimicrobial therapy are made by physicians arbitrarily and with uncertainty. This uncertainty can be illustrated by the wide and unexplainable variations in lengths of stay for hospitalized patients with pneumonia in different communities, in different hospitals, and even in different wards at the same hospital. While some variation in clinical practice is unavoidable, collective clinical information and outcome data could potentially improve clinical decision-making regarding the most appropriate length of stay.

Several recently published clinical trials have shown that some patients with pneumonia can be safely treated with oral antimicrobial therapy early in their hospital stay. In one of these studies, the investigators stated that they had initially "approached the use of an exclusively oral regimen with some trepidation." Criteria for selecting patients who are suitable for early conversion often are implicitly rather than explicitly derived, which could deter physicians from using oral antimicrobials at institutions with little or no experience in this area. The accurate identification of patients with pneumonia whose conditions have stabilized and are at

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very low risk of sustaining complications may facilitate more widespread acceptance of early oral antimicrobial therapy for hospitalized patients with pneumonia, and thereby lead to less costly but still effective medical care.

We studied a practice guideline that identified hospitalized patients with pneumonia who were at low risk for in-hospital medical complications. This guideline could be used to facilitate early conversion from parenteral to oral antimicrobial therapy and early hospital discharge. This guideline, if proven safe and effective in a future controlled trial, could ultimately improve the quality and efficiency of medical care for hospitalized patients with pneumonia.

METHODS

Description of Institution

The study was performed at Cedars-Sinai Medical Center, a large teaching hospital that primarily serves West Los Angeles. The majority of hospitalized patients are cared for by physicians in private practice.

Description of Patients

The inclusionary criteria for pneumonia were the presence of an infiltrate on the chest radiograph and at least one of the major or two of the minor criteria given heretofore: major criteria—cough, sputum production, or history of fever; minor criteria—dyspnea, pleuritic chest pain, pulmonary consolidation on physical examination, or WBC count greater than 12,000/ml. Patients with Mycobacterium tuberculosis infection, human immunodeficiency virus infection, known lung cancer, and those patients less than 18 years of age were excluded from the study.

The etiology of pneumonia was assigned using the method described by Fang and colleagues.

Practice Guideline

The practice guideline was derived from the medical literature and was formalized by the consensus study group that included a pulmonologist, an infectious disease consultant, and two general internists. Patients who did not have (1) obvious reasons for continued hospitalization on the third hospital day, (2) a high-risk pneumonia pathogen (although patients with Gram-negative bacillary pneumonia were included), or (3) a life-threatening complication within the first 3 days of hospitalization were considered as at low risk according to the contents of the practice guideline. Absence of the following criteria implied that the patient was at low risk. The guideline is as follows:

1. Obvious reason for continued hospitalization.
   Systolic blood pressure less than 100 mm Hg; dehydration as documented by hypernatremia (Na >155 mmol/L), blood urea nitrogen to creatinine ratio greater than 20:1, or orthostatic systolic blood pressure changes greater than 20 mm Hg; acute changes in mentation; hypoxia (room air arterial blood gas saturation <90 percent or PaO2 <55 mm Hg); acute respiratory acidosis with pH less than 7.30; observed inability to take medications or fluids orally; metastatic infection sites such as meningitis; or unstable comorbid diseases.

2. High risk pneumonia pathogen.
   Staphylococcus aureus, aspiration pneumonia, postobstructive pneumonia, mycobacterial pneumonia, and fungal pneumonia.

3. Life-threatening complication during hospitalization.
   Acute myocardial infarction, ventricular fibrillation, ventricular tachycardia, asystole, complete heart block, new or unstable atrial fibrillation, new or unstable atrial flutter, supraventricular tachycardia, pneumothorax, congestive heart failure (new onset or worsening of chronic congestive heart failure).

These low-risk patients were considered potentially suitable for conversion to oral antimicrobial agents on the third hospital day and for discharge on the fourth hospital day.

Definition of Need for Hospitalization

The occurrence of a significant medical complication served as a screen for a medically necessary hospitalization. After a complication was identified, the need for hospitalization was based on the physician’s implicit judgment. The physicians who participated in this implicit review process included a pulmonologist (M.B.) and two internalists (M.N. and S.W.). Continued hospitalization was considered necessary if a patient developed a complication that would benefit from hospitalization. Continued hospitalization was considered potentially unnecessary if a patient did not develop a complication and had an uncomplicated hospital course.

Performance of Guideline

For testing the accuracy and validity of the practice guideline, the relative frequencies of life-threatening complications and death were compared between patients hospitalized in the low- and high-risk patient groups. Since patients were classified as at low or high risk according to the guideline 3 days after hospital admission, patients who suffered life-threatening complications within the first 3 days or patients who had a length of stay of 3 days or less were excluded from the analysis. The sensitivity, specificity, positive-predictive value, and negative-predictive value of the practice guideline were measured.

Complications—Explicit Review

Complications of pneumonia (as defined for purposes of the study) included death, septic shock, empyema thoracis, lung abscess, an infection that necessitated prolonged parenteral therapy (e.g., S. aureus), the development of an extrapulmonary infection (e.g., meningitis, endocarditis), the requirement of intravenous fluids for documented gastrointestinal upset, dehydration or hypotension, mental status changes, documented hypoxia requiring supplemental oxygen, acute myocardial infarction, sustained cardiac arrhythmias, or a significant change in preexisting comorbid illnesses, e.g., diabetes mellitus.

Complications—Implicit Review

All complications among low-risk patients that occurred more than 3 days after hospital admission were explicitly and independently reviewed by two board-certified internists. The physicians rated whether (1) conversion of patients from parenteral to oral antibiotic therapy on the third hospital day would have worsened patient outcomes and (2) whether the patient would have been adversely affected by being discharged on the fourth hospital day. Following initial independent review, the physicians discussed cases where there was disagreement and again judged whether compliance with the guideline would have worsened the quality of patient care.

Resource Utilisation—Lengths of Stay

The expected benefit of the guideline as it related to hospital utilization was the projected reduction in hospital bed-days.
Lengths of stay were determined using the midnight census. For each patient who was judged to be at low risk, the hypothetical reduction in the number of hospital days was estimated assuming the guideline had been applied. If the patient was deemed not suitable for discharge by the practice guideline, the reduction in hospital days was not calculated. The number of bed-days saved was defined as the number of actual bed-days less the number of days recommended by the practice guideline.

Severity of Illness

Severity of illness was measured on patients using the methods described by the British Thoracic Society,\(^{25,26}\) by investigators at the University of Pittsburgh,\(^{19,27}\) and by investigators at the University of Rochester.\(^{21}\)

Instability Upon Discharge

Each patient’s clinical instability on the fourth hospital day (which was the anticipated day of hospital discharge) was calculated using the total RAND instability upon hospital discharge criteria.\(^{28}\)

Statistical Analysis

Means are reported with standard deviations. The primary endpoints of the study were the projected impact of early conversion to oral antimicrobial therapy on the third hospital day and discharge on the fourth hospital day on the quality of care and the number of hospital bed-days. The misclassification rate was defined as the number of low-risk patients who suffered complications after the third hospital day. The estimated reduction in length of stay that would have occurred had the guideline been used to discharge patients was calculated. Ninety-five percent confidence intervals were calculated using the software package GB-Stat\(^{29}\) or True Epistat.\(^{30}\) Means are reported with standard deviations. Endpoints were tested using a type 1 error of 0.05.

RESULTS

Demographics

A total of 503 consecutively hospitalized patients between June 1, 1990, and May 30, 1991, with pneumonia were enrolled. Medical records were available for abstraction on 97 percent of patients. The average age of study patients was 72.2 ± 18.1 years old (mean ± SD); 74 percent of patients were 65 years of age or older. Fifty-eight percent of patients were women. The mean length of hospital stay was 9.5 ± 9.8 days and the mean ICU length of stay was 0.9 ± 3.9 days. The infectious etiologies of pneumonia for the study patients are as follows: *Haemophilus influenzae*, 34 (6.7 percent); *Streptococcus pneumoniae*, 25 (5.0 percent); *Pseudomonas aeruginosa*, 25 (5.0 percent); *S aureus*, 21 (4.2 percent); other Gram-negative bacillary pneumonia, 22 (4.4 percent); *Klebsiella pneumoniae*, 14 (2.8 percent); *Mycoplasma pneumoniae*, 12 (2.4 percent); *Legionella pneumophila*, 1 (0.2 percent); *Moraxella catarrhalis*, 5 (1.0 percent); unknown, 324 (64.4 percent); other, 20 (4.0 percent).

Many patients had at least one underlying comorbid disease. Sixty-four percent of patients had serious underlying comorbid diseases, 35 percent of patients had preexisting lung disease, and 19 percent of patients had an underlying malignancy. A total of 31 percent of patients received oral antimicrobial therapy prior to hospital admission. Patients had symptoms of fever in 76 percent of cases, dyspnea in 61 percent of cases, and pleuritic chest pain in 25 percent of cases. The chest radiograph demonstrated multilobar involvement for 36 percent of patients, a pleural effusion in 16 percent of patients, and congestive heart failure in 11 percent of patients.

The discharge disposition of the patients was as follows: 71 percent of patients were discharged to their homes, 14 percent of patients were discharged to a nursing home, 12 percent of patients died, 3 percent of patients were transferred to another hospital, and 1 percent of patients were transferred to a rehabilitation or a chemical dependency center.

Guideline Classification

Thirty-three percent of pneumonia patients were classified as low-risk 3 days after hospital admission according to the guideline (n=166); 39 percent of the population of pneumonia patients were hospitalized more than 3 days. The reasons why patients were judged to be ineligible for classification by the guideline or judged to be at high risk by the guideline included (1) length of hospital stay of 3 days or fewer due to hospital discharge or early death (n=73), (2) life-threatening complication within the first 3 hospital days (n=115), (3) obvious clinical reason for continued hospitalization explicitly defined before the study,\(^{20}\) (n=252), or (4) infection by a high-risk pneumonia pathogen explicitly defined prior to the study,\(^{22}\) (n=129). Many patients had more than one reason that caused them to be ineligible for classification by the guideline or at high risk according to the guideline.

Severity of Illness

The average severity of illness score for patients in the study using the British Thoracic Society criteria was 0.9 ± 0.9, using the University of Pittsburgh criteria was 2.53 ± 2.91, and using the University of Rochester criteria was 3.95 ± 2.53.

Instability Upon Discharge

The mean instability score for low-risk patients was 1.17 ± 0.91 on the fourth hospital day (when patients were suitable for discharge according to the guideline). This instability score compares with a mean score of 1.37 among Medicare patients with pneumonia at the time of hospital discharge.\(^{26}\)

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Table 1—Practice Guideline Recommendations and Life-threatening Complications

<table>
<thead>
<tr>
<th>Practice Guideline</th>
<th>Life-threatening Complications</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>High risk</td>
<td>22</td>
</tr>
<tr>
<td>Low risk</td>
<td>7</td>
</tr>
<tr>
<td>Sensitivity, %</td>
<td>75.9</td>
</tr>
<tr>
<td>Specificity, %</td>
<td>52.5</td>
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<tr>
<td>Negative-predictive value, %</td>
<td>95.8</td>
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<tr>
<td>Positive-predictive value, %</td>
<td>13.3</td>
</tr>
<tr>
<td>Odds ratio</td>
<td>3.5 (95% CI 1.4, 9.2, p=0.007)</td>
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</tbody>
</table>

Validity of the Practice Guideline

The validity of the practice guideline was determined by measuring the ability of the guideline to detect patients who suffered life-threatening complications or died during their hospitalization. One hundred seventy-one patients were excluded because they suffered life-threatening complications within the first 3 days of hospitalization or did not have a length of stay of more than 3 days (inclusion of these patients would have overestimated the discriminatory ability of the guideline). The remaining 332 patients were analyzed. The sensitivity and specificity of the guideline for detecting patients who suffered life-threatening complications were 75.9 and 52.5 percent, respectively (Table 1). Moreover, the negative-predictive value of the guideline for detecting patients at low risk for life-threatening complications was 95.8 percent. Life-threatening complications were 3.5 times more likely (95 percent confidence interval [CI] 1.4, 9.2 p=0.007) if the patient was designated as high risk rather than low risk.

The practice guideline had a sensitivity of 93.3 percent and specificity of 52.6 percent for detecting patients who died during the hospitalization (Table 2). The negative-predictive value of the guidelines for detecting death was 99.4 percent. Death was 15.5 times more likely (95 percent CI 2.1, 73.1, p=0.001) if the patient was designated as high risk rather than if the patient was designated as low risk. The mortality rates for low- and high-risk patients were 0.6 and 8.6 percent, respectively.

Projected Effects of the Guideline if Applied to Low-Risk Patients

Explicit Judgment of Quality of Care: Of those patients who were designated as at low risk, the complications were of relatively minor severity for many patients (Table 3).

Implicit Judgment: Two physicians (from a group of one pulmonologist and two general internists) reviewed the medical records of all low-risk patients who suffered any of the explicitly defined complications (life-threatening or otherwise). The physicians independently judged that 1.8 percent (95 percent CI 0.4 percent, 5.2 percent) of patients may have been adversely affected had they been switched from parenteral to oral antimicrobial therapy, and 6.6 percent (95 percent CI 3.4 percent, 11.6 percent) of patients may have been adversely affected had they been discharged on the fourth hospital day. Descriptions of patient complications are as follows:

Patient 1. This patient's systolic blood pressure transiently decreased below 100 mm Hg without symptoms or treatment.

Patient 2. This patient, who had multiple myeloma, experienced possible congestive heart failure after the third hospital day. The patient was not treated for congestive heart failure and had an uneventful recovery.

Patient 3. This 84-year-old patient required transfer to the ICU for congestive heart failure after the third hospital day. The patient experienced

Table 2—Practice Guideline Recommendations and Inhospital Deaths*

<table>
<thead>
<tr>
<th>Practice Guideline Determination</th>
<th>Inhospital Death</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>High risk</td>
<td>14</td>
</tr>
<tr>
<td>Low risk</td>
<td>1</td>
</tr>
<tr>
<td>Sensitivity, %</td>
<td>93.3</td>
</tr>
<tr>
<td>Specificity, %</td>
<td>52.6</td>
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<tr>
<td>Negative-predictive value, %</td>
<td>99.4</td>
</tr>
<tr>
<td>Positive-predictive value, %</td>
<td>8.6</td>
</tr>
<tr>
<td>Odds Ratio</td>
<td>15.5 (95% CI 2.1, 73.1, p=0.001)</td>
</tr>
</tbody>
</table>

*The analysis excludes patients transferred to other hospitals.

Table 3—Complications Occurring in Patients Designated as Low-Risk by the Practice Guideline*

<table>
<thead>
<tr>
<th>Complication</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in comorbid diseases</td>
<td>5</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>5</td>
</tr>
<tr>
<td>Altered mental status</td>
<td>4</td>
</tr>
<tr>
<td>Hypoxia (Po2 &lt;60 mm Hg)</td>
<td>3</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>2</td>
</tr>
<tr>
<td>Hypercapnia (Pco2 &gt;50 mm Hg)</td>
<td>1</td>
</tr>
<tr>
<td>Death</td>
<td>1</td>
</tr>
<tr>
<td>Required ICU</td>
<td>1</td>
</tr>
<tr>
<td>Lung abscess</td>
<td>1</td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>1</td>
</tr>
<tr>
<td>Unstable atrial fibrillation</td>
<td>1</td>
</tr>
<tr>
<td>Unstable atrial flutter</td>
<td>1</td>
</tr>
</tbody>
</table>

*Some patients had more than one complication. Systolic blood pressure less than 100 mm Hg was used as a screen for implicit review, but when it was not associated with any other complications, it was not considered a complication for the purposes of the study.

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hypoxemia that required treatment with supplemental oxygen and hypotension that necessitated administration of catecholamines intravenously. A pulmonary artery catheter was placed. The patient survived hospitalization.

Patient 4. This patient experienced bronchospasm and possible congestive heart failure after the third hospital day. She was treated with bronchodilators and recovered uneventfully.

Patient 5. This patient had a medical history of intravenous drug use and developed a lung abscess. She was treated with prolonged parenteral antibiotics.

Patient 6. This patient, who had underlying COPD, experienced dyspnea with hypoxemia. The patient had a deep venous thrombosis but no evidence of pulmonary embolism during the hospitalization.

Patient 7. For this patient, a diagnosis of hemolytic anemia secondary to *M. pneumoniae* pneumonia was made after the third hospital day. Although the patient’s hematocrit value decreased to 19 percent, the patient was asymptomatic and was not treated with blood products after the third hospital day.

Patient 8. This patient had a history of COPD, and intermittent hypoxemia was noted before and after the third hospital day. She was thought to have possible congestive heart failure, as evidenced on a chest radiograph. She was not treated.

Patient 9. This 87-year-old patient was admitted to the hospital when he had pneumonia and renal failure. During his hospitalization of 9 weeks' duration, the patient had sepsis, congestive heart failure, acute myocardial infarction, unstable atrial fibrillation, and unstable atrial flutter, and was found to have normal pressure hydrocephalus. He became unresponsive and died after a “do not resuscitate” order was made.

Patient 10. This patient experienced an asymptomatic decline in systolic blood pressure of less than 100 mm Hg. She was not treated. She also had an elective bronchoscopy at the time of admission.

Patient 11. This patient experienced transient hypoxemia after bronchoscopy (percent saturation, 81 percent). She was treated with oxygen and recovered uneventfully.

**Projected Effects of Practice Guideline Utilization**

A total of 33 percent of patients (n=166) with pneumonia admitted to the hospital were suitable for early discharge. The average length of stay for these patients was 7.73±6.12 days. Had these patients been discharged after 4 hospital days, 619 additional hospital bed-days would have been available on an annual basis to accommodate incoming patients.

**Data Quality**

Reproducibility of the guideline classification results was measured. The interrater agreement was 91 percent (kappa 0.80), which demonstrated very good reproducibility of the guideline.

In cases where there were complications, the medical records were implicitly reviewed by two physicians. The physician reviewers independently agreed on whether a patient would have been adversely affected by early conversion to oral antimicrobial therapy for 76 percent of cases (kappa 0.28). Following discussion on this issue, the agreement between reviewers was 100 percent (kappa 1.0). In addition, the physician reviewers independently agreed on whether early discharge would have adversely affected the quality of care for 71 percent of cases (kappa 0.39). Following discussion between the reviewers on this issue, consensus was achieved in 100 percent of cases (kappa 1.0).

**Conclusion**

Patients hospitalized with pneumonia commonly receive parenteral antimicrobial therapy for approximately 7 days and then are converted to oral antimicrobial therapy. There are few published data to support or refute this commonly followed medical practice, nor are there available data to guide physicians’ decisions about the optimal length of parenteral antimicrobial therapy and hospital length of stay. Our present guideline differs from our previous one in that we included patients with Gram-negative bacillary pneumonia, since several recent trials have demonstrated that some patients with Gram-negative bacillary pneumonia can be treated with oral antimicrobial therapy. Our study demonstrated that many hospitalized patients who have pneumonia can potentially be switched from parenteral to oral antimicrobial therapy on the third hospital day, and a significant number of these patients can be safely discharged from the hospital on the fourth hospital day. Since current medical practice significantly differs from our recommendations, use of this guideline has the potential to significantly reduce healthcare costs.

During the first 3 days of hospitalization, an increasing amount of information becomes available to physicians including the pathogen causing the episode of pneumonia (in some cases) and the patient’s initial response to antimicrobial therapy. This information can be used by physicians to make better informed decisions about the optimal duration of parenteral antimicrobial therapy and hospit-
tential length of stay. Objective, valid, and reliable criteria for selecting patients for early conversion can greatly improve the acceptability and safety of this strategy to control healthcare costs while enhancing or maintaining the quality of care at the same time.

The average length of stay for patients with pneumonia is currently 8.3 days. Since length of stay is one of the most important determinants of hospital costs, appropriate reductions in hospital lengths of stay could significantly reduce medical expenditures. The rapid identification of those hospitalized patients who have pneumonia who are suitable for conversion from parenteral to oral antimicrobial therapy may lead to more timely hospital discharge. In our study, we found that low-risk pneumonia patients been discharged on the fourth hospital day, their instability upon discharge (which relates to the probability of postdischarge mortality) would have been lower than that of a large population of Medicare patients in a recently reported study. The low instability score of these low-risk patients further supports the hypothesis that selected patients could potentially be discharged on the fourth hospital day.

Studies have demonstrated that a significant number of hospitalized patients who have pneumonia may have medically unnecessary hospitalizations. Reducing the number of inappropriate hospital admissions is another promising method of safely reducing hospital costs. However, once low-risk patients are hospitalized, which is inevitable in many hospitals, strategies to streamline their care and to appropriately shorten their length of stay can further reduce healthcare costs.

Our study has several limitations. Because patients were enrolled in our study retrospectively, the observation that a patient did not suffer a complication while receiving parenteral antimicrobial therapy does not ensure that patient outcomes would not have been compromised had a patient been switched to oral antimicrobial therapy as recommended by the guideline. However, studies published decades ago and more recent studies have documented that carefully selected patients treated with oral antimicrobial therapy have comparable outcomes to patients treated with parenteral antimicrobial therapy, perhaps because of the improved bioavailability and antibacterial spectrum of these agents. Another limitation of this study was that there was a fair amount of disagreement between the physicians judging the relative benefits of parenteral antimicrobial therapy as compared with early conversion to oral antimicrobial therapy in the relatively few low-risk patients who suffered complications during their hospital stay. Finally, the development of a practice guideline does not necessarily mean that it will be used by physicians in clinical practice, especially since investigators began calling for guidelines for pneumonia patients almost one decade ago, and at the present time, no guidelines are in widespread use. The eventual impact of the guideline reported in our present study can only be determined after it has been tested in a prospective clinical trial.

Practice guidelines hold the promise of reducing healthcare costs and improving quality of care. Many different organizations have actively promoted or are developing guidelines to control escalating healthcare costs, to reduce undesirable variations in care, and to improve quality of care. However, many guidelines are based on "expert" opinion and may not be strongly supported by clinical data. Although retrospectively derived data cannot substitute for randomized clinical trials, pretesting the safety and effectiveness of a guideline that promotes earlier hospital discharge (as was done in our study) may facilitate acceptance of the guideline. As is the case with introducing a new drug into clinical practice, practice guidelines only should be introduced into patient care after supporting evidence is available. Studies such as ours provide that first layer of evidence about the potential benefits and risks of a practice guideline.

In conclusion, some hospitalized patients who have pneumonia may be suitable for early conversion from parenteral to oral antimicrobial therapy, and some of these patients may be safely discharged from the hospital after 4 days. The explicitly defined guideline described in our study identifies those patients potentially suitable for early conversion therapy. If this guideline is validated in a prospective trial, which will be required before it can be recommended for widespread use, it could be used to reduce healthcare costs while maintaining excellent patient outcomes. Furthermore, this study demonstrates the potential benefit of guidelines derived from clinical information for controlling healthcare costs, improving quality of care, and allocating healthcare resources more appropriately.

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