Hospitalization for Community-Acquired Pneumonia*

The Pneumonia Severity Index vs Clinical Judgment

Forest W. Arnold, DO; Julio A. Ramirez, MD; L. Clifford McDonald, MD; and Eric L. Xia, MD, PhD

Study objectives: (1) To define clinical factors that could justify hospital admission among patients with community-acquired pneumonia (CAP) with risk classes of I or II. (2) To determine the positive predictive value of the pneumonia severity index as the sole indicator for detecting inappropriate hospitalizations among patients with CAP.

Design: Retrospective observational study.

Setting: University of Louisville Hospital and the Veterans Affairs Medical Center of Louisville, KY.

Patients: Consecutive adult patients fulfilling the criteria for CAP who were admitted to the hospital between October 1997 and May 2000.

Measurements and results: The medical records of hospitalized patients with CAP having a risk class of I or II were identified and further reviewed to determine whether there existed a clinical basis to justify hospitalization. Of a total of 328 patients, 86 had a risk class of I or II. Among these, 72 had clinical factors that justified their hospital admission. These factors, in frequency of occurrence, included the following: medical conditions other than CAP that required hospitalization, 31 patients (43%); social needs, 13 patients (18%); oral intolerance, 10 patients (14%); failure of outpatient therapy, 10 patients (14%); noncompliance, 6 patients (9%); suspicion of sepsis, 1 patient (1%); and hypoxemia, 1 patient (1%). Among the 86 patients with low risk classes (ie, classes I or II), 14 were found to be inappropriately hospitalized, yielding a positive predictive value of 16%.

Conclusions: The pneumonia severity index, used as the sole indicator for detecting inappropriate hospitalizations, has an unacceptably low positive predictive value. This is due primarily to the severity of comorbid conditions requiring in-hospital care in patients with a nonsevere pneumonia. According to our study, the pneumonia severity index should not be used as the sole indicator with which to define inappropriate hospitalization.

Key words: community-acquired pneumonia; evaluation of hospitalization; pneumonia severity index

Abbreviation: CAP = community-acquired pneumonia

Approximately 1 million patients are hospitalized in the United States for treatment of community-acquired pneumonia (CAP) each year.1,2 The cost of inpatient care exceeds outpatient care by 15 to 20 times and comprises the majority of the $8.4 billion spent annually for the care of patients with all types of pneumonia.3 Due to these costs, it is important to admit only those patients to the hospital who will benefit from hospital care.

In 1997, the pneumonia severity index was developed as a tool to predict the 30-day mortality rate in hospitalized patients with CAP.4 Five groups were identified based on mortality risk. Risk classes I and II were associated with a low mortality risk, with rates of 0.1% and 0.7%, respectively. Risk classes III, IV, and V were associated with a high mortality risk, with rates of 0.9%, 9.3%, and 27%, respectively. National guidelines for the management of patients with CAP from the American Thoracic Society5 and the Infectious Diseases Society of America6 have suggested that patients with the lowest risk classes (I and II) may be considered for outpatient management.
Although use of the pneumonia severity index has not been studied for the purpose of defining hospitalization, local peer review organizations and hospital quality improvement programs use this index to define inappropriate hospital admissions for patients with CAP.\(^4\) However, this approach may be insufficient if clinically justifiable factors for hospital admission are frequently present in hospitalized patients with a risk class of I or II. Therefore, we undertook a study to define the clinical factors that could justify hospital admission among CAP patients with risk classes of I or II. Furthermore, we sought to determine the positive predictive value of the pneumonia severity index as the sole indicator for detecting inappropriate hospitalizations among patients with CAP.

**Materials and Methods**

We conducted a retrospective observational study of patients who had been hospitalized between October 1997 and May 2000 with a diagnosis of CAP at the University of Louisville Hospital and the Veterans Affairs Medical Center of Louisville, KY. CAP was defined by the presence of a new pulmonary infiltrate (according to the radiology report) plus at least one of the following: fever; new or increased cough; leukocytosis; or leukopenia. The pneumonia severity index was calculated as previously reported.\(^4\) Patients with a risk class of I or II were identified as being potentially inappropriate for hospitalization. Each case record was submitted to the clinical judgement of a review committee of five infectious diseases and pulmonary medicine subspecialists. A consensus usually was reached with each case presented to the review committee. In the event that a consensus was not reached, a majority decision was employed. None of the faculty members participating in the review were involved in the initial decision to hospitalize the patient. After discussion, the faculty members determined whether there was any clinical basis for hospital admission. If no clinical basis was determined, the hospital admission was deemed to be inappropriate. If there was a clinical basis for hospital admission, the reasons were categorized as follows: (1) medical conditions other than CAP that required hospitalization; (2) unmet social needs; (3) oral intolerance; (4) failure of outpatient therapy; (5) noncompliance; (6) suspicion of sepsis; and (7) hypoxemia (ie, arterial oxygen saturation < 90% or PaO\(_2\) < 60 mm Hg). The category medical conditions other than CAP that required hospitalization included patients admitted to the hospital for a diagnostic workup (eg, to rule out myocardial infarction or pulmonary embolism) and for treatment of a concomitant medical condition (eg, treatment of congestive heart failure or an exacerbation of COPD). Unmet social needs included any nonmedical reason that prevented adequate outpatient treatment of CAP (eg, homelessness). Failure of outpatient therapy was understood as meaning the patient was having persistent symptoms despite receiving oral antimicrobial treatment at home. Noncompliance was defined in relation to the prescribed oral antimicrobial agents for the treatment of CAP. Suspicion of sepsis was considered when the primary physician included sepsis in the differential diagnosis of the patient on hospital admission and a suspicion of sepsis was considered to be appropriate by the review committee. The positive predictive value of the pneumonia severity index was determined by calculating the proportion of inpatients with a risk class of I or II, in whom we were unable to find any justification for hospitalization, of the total number of inpatients with a risk class of I or II, that is, by dividing the number of unjustified patients who had been admitted to the hospital by the total number of patients in risk classes I or II.

**Results**

A total of 328 patients fulfilled our criteria for CAP. The number of patients in each risk class was as follows: risk class I, 42 patients (12%); risk class II, 44 patients (13%); risk class III, 87 patients (27%); risk class IV, 110 patients (34%); and risk class V, 45 patients (14%). The total number of patients in risk classes I and II was 86 (26%). For patients with a risk class of I, the mean age was 41.1 years, and the average length of hospital stay was 4.6 days. For patients with a risk class of II, the mean age was 50.3 years, and the average length of hospital stay was 7.0 days. The risk factors that led to their pneumonia severity index scores were as follows: neoplasm; cerebrovascular disease; liver disease; altered mental status; tachypnea; tachycardia; hypotension; fever; hyperglycemia; anemia; hypoxemia; and pleural effusion. Seven patients were admitted to the ICU, two of whom died. A patient in risk class I died of respiratory arrest, and the other, in risk class II, died of end-stage AIDS. Seventy-two of the 86 patients with a risk class of I or II had factors that justified their hospital admission (Table 1). The most common factor was a medical condition other than CAP requiring hospitalization. Of these patients, six were immunocompromised, six had a suspected myocardial infarction, four had a severe exacerbation of COPD, two had large pleural effusions, two had new-onset atrial fibrillation, one had severe anemia, one had a possible pulmonary embolus, one had postoperative infection, one had bright red blood per rectum, one had an exacerbation of asthma, one had anoxic brain injury, one had lung contusion, one had abdominal distension with suspected intraabdominal infection, one had suspected meningitis, one had an exacerbation of congestive heart failure, and one had...

### Table 1—Clinical Factors That Justify Hospital Admission Among Patients With Risk Class I or II

<table>
<thead>
<tr>
<th>Clinical Factors</th>
<th>No. (%)</th>
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<tr>
<td>Medical conditions other than CAP that required hospitalization</td>
<td>31 (43)</td>
</tr>
<tr>
<td>Unmet social needs</td>
<td>13 (18)</td>
</tr>
<tr>
<td>Oral intolerance</td>
<td>10 (14)</td>
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<tr>
<td>Failure of outpatient therapy</td>
<td>10 (14)</td>
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<tr>
<td>Noncompliance</td>
<td>6 (8)</td>
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<tr>
<td>Suspicion of sepsis</td>
<td>1 (1.5)</td>
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<tr>
<td>Hypoxemia</td>
<td>1 (1.5)</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>72 (100)</strong></td>
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a seizure. The second most common clinical factor that justified hospital admissions was an unmet social need. This category included seven patients with unstable home situations and six patients with a clinical suspicion of pulmonary tuberculosis that required hospitalization due to the inability to perform adequate home isolation. No clinical justification for hospitalization was identified in 14 patients. The calculated positive predictive value of the pneumonia severity index as a sole indicator for inappropriate hospitalization was 16%.

**Discussion**

We found that the majority of patients who had been admitted to the hospital for CAP with a pneumonia severity index class of I or II had extending clinical circumstances to justify their admission. Disease comorbidities and unmet social needs were the major categories of clinical factors justifying hospital admission for these patients. Used as the sole indicator for inappropriate hospitalization, the pneumonia severity index had a poor positive predictive value of only 16%.

Our findings support the concept expressed by the Infectious Diseases Society of America, the American Thoracic Society, and the American College of Emergency Physicians that the prediction rule should not supersede clinical judgement in determining who should be hospitalized for CAP. This study indicates that there is a subset of patients with a low risk for mortality who are likely to benefit from hospitalization.

When the pneumonia severity index is used to detect inappropriate hospitalizations among patients with CAP, the positive predictive value represents the probability that the hospitalization of a low-risk patient actually is inappropriate. We found two other studies in the literature from which we were able to calculate the positive predictive value of the pneumonia severity index. The calculated positive predictive values from these studies to detect inappropriate hospitalization were 5% and 23%. These values are in the same range as the one calculated in our study (16%).

The proportion of low-risk hospitalized patients who were admitted to our hospitals was similar to the one reported in other areas of the United States. The small size of our study population may limit our ability to determine with certainty the most important clinical factors that justify hospitalization among low-risk CAP patients. In addition, the population of our study was limited to veterans and inner-city, mostly indigent, patients. Such patients may have more comorbidities than the general population, and this may explain the low positive predictive value of the pneumonia severity index calculated in our study. However, our finding that a comorbid condition was the most common reason for admitting a low-risk CAP patient to the hospital is in agreement with the results of at least two other studies. The first study found that among 113 patients admitted to a hospital with a risk class of I or II, 54 (48%) had been admitted due to CAP in the presence of a comorbid condition. The second study found that among 39 low-risk CAP patients, 17 (43%) had been admitted to the hospital due to the presence of a comorbid condition, and another 9 (23%) had been admitted because of psychosocial and economic considerations. Similar to these findings, we found comorbid disease as the basis for hospital admission in 43% of low-risk CAP patients who had been hospitalized. A common example in our population was a 50-year-old patient with COPD and comorbidities, such as cardiovascular disease or diabetes mellitus, who had minimal pulmonary reserve function and in whom a mild case of pneumonia with a pneumonia severity index of class II had led to an exacerbation of COPD requiring hospitalization.

A critical aspect of the activities of peer review organizations and hospital quality improvement programs is their means of collecting data. Although the reviewers for such activities may have special training in abstracting medical records, these personnel usually lack the clinical insight that is necessary to determine whether or not the hospitalization of a low-risk pneumonia patient is clinically justified. The input from practicing physicians will be necessary in any committee that determines the appropriateness of admitting a patient with CAP to the hospital.

Few prediction models have been so well-accepted and have experienced such widespread application as the pneumonia severity index. Although the index was developed to predict patient mortality, it has been suggested that if we can predict mortality, then we can predict the need for hospitalization. The data from our study, as well as those from other studies in the literature, suggest that the majority of hospitalized patients with a low risk for mortality have a clinical reason that justified hospitalization. The use of the pneumonia severity index as the sole tool to define inappropriate hospitalization should be discouraged.

**References**