Improving Treatment Decisions for Patients with Community-Acquired Pneumonia

Community-acquired pneumonia (CAP)—pneumonia contracted outside of a hospital or nursing home environment—affects approximately 4 million Americans each year, accounting for more than 1 million hospital discharges. The cost of treating CAP patients is significant—$10 billion per year—with about 92 percent of this amount spent on hospital care.[1] Among the hospitalized patients are a sizable number of low-risk patients who could be treated safely on an outpatient basis, but these patients must be accurately identified before such treatment is recommended. When low-risk patients are treated at home with the appropriate antibiotic, quality of care can be maintained, patients are more likely to be satisfied, and resources are conserved. When patients requiring hospitalization can have their medical stability more accurately determined, then discharge from the hospital can occur at the appropriate time.

This report describes two tools developed by AHRQ-funded research that help assess the need for hospitalization and determine the medical stability of patients prior to discharge. This report also discusses the importance of early administration of antibiotic therapy and the effectiveness of older, proven, yet inexpensive antibiotics compared with those used in the outpatient treatment of patients with CAP.

The first tool, the Pneumonia Severity Index (PSI), can assist physicians in identifying those low-risk pneumonia patients who can be safely treated at home. Used as part of

Making a Difference

- **The Pneumonia Severity Index (PSI), developed by an AHRQ-funded project, helps physicians make clinical judgments about what care should be provided to patients with CAP…Page 3.**

- **Patients with CAP were more likely to be satisfied with home treatment than hospitalization, according to another study…Page 4.**

- **When the PSI was incorporated into a critical pathway or disease management strategy, one (non-AHRQ-funded) study found that significantly more low-risk patients were treated at home with no negative health effects on patients…Page 5.**

- **VA researchers further validated the PSI. They found that admission of low-risk pneumonia patients could be significantly reduced…Page 5.**

- **Treating CAP with older antibiotics is as medically effective and less costly than using newer antibiotics… Page 6.**

- **Use of a new tool to determine medical stability can lead to better timing of hospital discharge…Page 6.**

a broader management strategy, this decision-support tool has been shown to reduce by up to 18 percent the number of low-risk pneumonia patients who are hospitalized, and to save between $457 and $994 per patient without

diminishing the quality of care.[2,3] The second tool is an instrument that enables clinicians to determine whether a hospitalized pneumonia patient is medically stable before being discharged. Using this instrument, which is based on five vital signs, patients' mental status, and their ability to eat and drink, researchers found that patients who were medically unstable had a 60-percent increased chance of readmission or death, if discharged too soon. In addition, the results of two other studies are described in this report. One study found that elderly patients administered an antibiotic within 8 hours of arriving at the hospital had lower 30-day mortality rates than did other patients. Another study, which compared the outcomes and cost of different antibiotic therapies for patients treated at home, found that an older antibiotic was just as effective and from 3 to 10 times less expensive than newer antibiotics.

Background

Research has shown that wide variations in medical practice may occur between physicians in different geographic regions of the United States. The treatment of patients with CAP is no exception; analyses of hospital admission rates for CAP show marked variation from one region to another. This variation suggests that physicians are using differing standards when deciding which patients with CAP to hospitalize. In actual practice, physicians most often tend to use their impression of the patient's general clinical appearance when deciding whether or not to hospitalize.[4] However, AHRQ-funded research has shown that when making a decision about hospitalization for any CAP patient, physicians also relied on the patient's respiratory status, the presence of other illnesses, lung involvement of more than one lobe, and whether the patient was eating and drinking fluids.[5]

To enhance physicians' decisionmaking, an AHRQ-funded multidisciplinary research team called the Pneumonia Patient Outcomes Research Team (PORT) developed and tested the PSI.[6] This decision-support tool may be used by physicians as a supplement to their clinical judgment when making treatment decisions for pneumonia patients. In studying how patients may be most effectively treated at home and how physicians can know when hospitalized pneumonia patients are stable enough to be discharged, the PORT researchers have also evaluated the effectiveness and cost of different antibiotic medications and developed a tool to determine medical stability.

Facts about Community-Acquired Pneumonia

- 4 million Americans are affected each year.
- Minorities are 3 to 10 times more likely to be affected than whites.
- The elderly are 60 percent more likely to be affected than the general population.
- 1 million hospital discharges per year can be attributed to CAP.
- 90,000 persons die every year from all forms of pneumonia, including CAP.
- The mortality rate for low-risk patients treated at home is less than 1 percent.
- The mortality rate for the more serious cases treated in a hospital each year is between 2 and 30 percent.
- The mortality rate for all cases is about 13 percent each year.
- About $10 billion per year is spent on caring for patients with CAP.
- The average cost for an inpatient case is about $5,700.
- The average cost for an outpatient case is about $300.
- About $100 million per year is spent on antimicrobial therapy for CAP outpatients.

Sources: Infectious Diseases Society of America. Practice guidelines for the management of community-acquired pneumonia for adults. Clin Infect Dis 2000;31:347-82; National Institute of Allergy and Infectious Diseases. Fact Sheet on Pneumococcal Pneumonia. August 2001. Web site: http://www.niaid.nih.gov/factsheets/pneumonia.htm; Lave JR, Lin CJ, Fine MJ, et al. The cost of treating patients with community-acquired pneumonia. Semin Respir Crit Care Med 1999; 20(3):189-97; Gleason PP, Kapoor WN, Stone RA, et al. Medical outcomes and antimicrobial costs with the use of the American Thoracic Society guidelines for outpatients with community-acquired pneumonia. JAMA 1997:278:32-39.

The AHRQ-funded Pneumonia PORT (completed in 1996) was one of a series of PORT projects designed to focus on common clinical conditions that are costly to the Medicare and Medicaid programs. These are conditions for which there is regional variability in patients' outcomes and use of resources and a lack of clear consensus by physicians on the best treatment strategies. The PORTs consisted of multidisciplinary teams of researchers ranging from health economists and clinicians to quality-of-life experts and epidemiologists. PORT investigators were instructed to explore a number of questions, including questions about the variation in the use of treatments and what could be done to reduce inappropriate variation. Providing care in the appropriate setting helps to reduce variations in clinical practice that appear to be due to differing physician practice patterns and not patient-related factors.

Pneumonia Severity Index

PSI separates low-risk from high-risk CAP patients

The PSI, an AHRQ-funded tool developed by researchers at the University of Pittsburgh, helps physicians determine whether CAP patients should be treated at home or in a hospital. The PSI was developed and extensively tested among three groups of over 50,000 patients in 275 U.S. and Canadian hospitals and found to be a reliable decision-support tool.[7]

Using a two-step process, the PSI provides a way for clinicians to measure the severity of a patient's illness and predict the risk of mortality within 30 days of initial diagnosis. The 30-day mortality risk ranges from 1 to 4 percent for the three low-risk categories (Classes I-III), from 4 to 10 percent for Class IV, and from 10 to 30 percent for Class V. Patients classified in risk classes I-III are considered a low enough risk to be eligible either for home treatment or abbreviated inpatient care (a 1-day hospital stay). Patients in risk classes IV and V should be hospitalized.

During the first step of the physician's decision process, an initial history and physical examination are performed. The patient's risk level is evaluated using factors such as age, gender, presence of other illnesses, and abnormal physical examination findings. Patients are asked whether they have a history of tumors, congestive heart failure, cerebrovascular disease, renal disease, and liver disease. The physician then determines whether the patient has any of the following: altered mental status, a pulse rate ≥ 125 beats per minute, a

Figure 1. Algorithm for Prediction Model
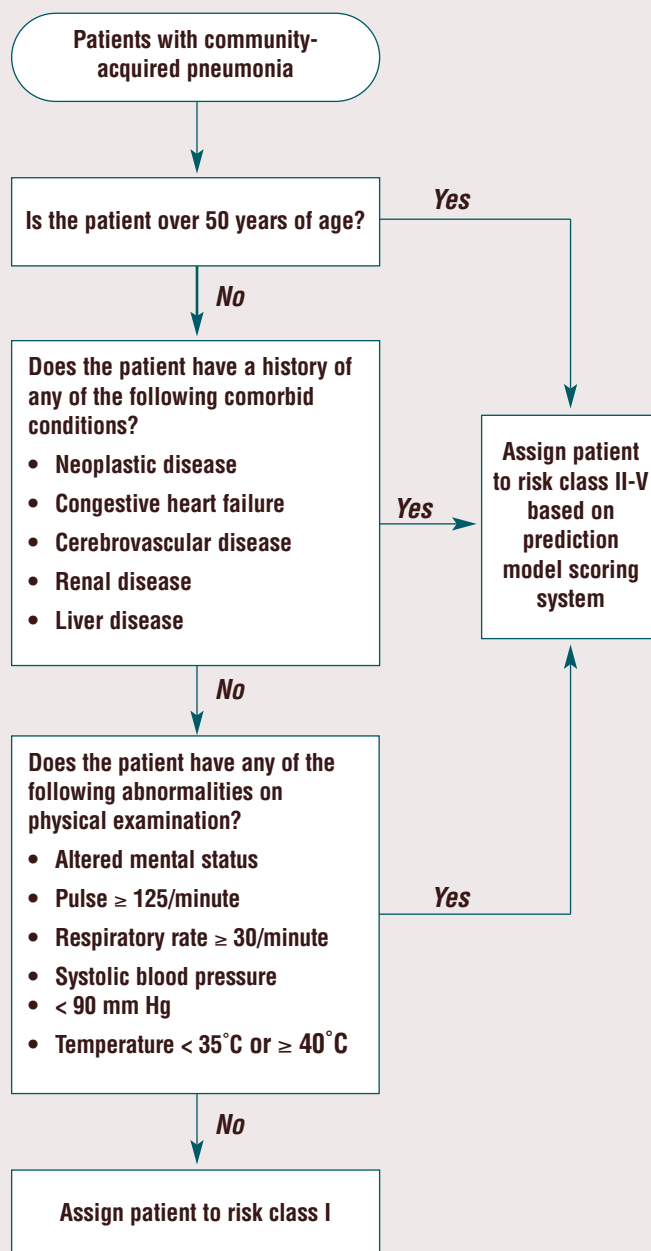
Source: Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med 1997;336(4):243-50.

respiratory rate ≥ 30 breaths per minute, systolic blood pressure < 90 mm Hg, and temperature < 35° C or ≥ 40° C.[7] Patients can be assigned to the lowest risk class (I) based on this initial history and physical examination, observations that do not require expensive lab tests (Figure 1).

For patients not assigned to the lowest risk class (I), the second step is based on diagnostic tests that are used to further determine risk of death or other adverse outcomes. Blood tests determine the extent and effects of pneumonia by measuring blood levels of sodium, glucose, and blood urea nitrogen as well as arterial pH (acidity/alkalinity balance) and the percentage of red blood cells to the whole blood count (hematocrit). An x-ray is used to determine how many lobes are affected and whether there is excessive accumulation of fluid around the lungs (pleural effusion) (Table 1). On the basis of these results, patients are placed in a risk category ranging from II to V (Table 2).

The AHRQ-funded researchers estimated that if outpatient care was used for all class I and II patients, brief inpatient observation for some class III patients, and traditional hospitalization for class IV and V patients, the percentage of patients treated by traditional inpatient care would decrease by 26 to 31 percent.

Outpatient treatment is safe, effective, and preferred by low-risk patients

Three-quarters of all CAP patients are treated in an outpatient setting. The researchers funded through the AHRQ Pneumonia PORT found that outpatient management was safe, associated with substantial improvement in symptoms, and resulted in nearly universal return to work and usual activities within 30 days of being first seen by a physician.[6] Comparisons of low-risk

Table 1. Identifying the level of risk in CAP patients: the risk factors and how they are scored

Patient characteristic	Points assigned*
Demographic factors	
Age:	
Males	Age (in years)
Females	Age (in years) -10
Nursing home residents	+10
Comorbid illnesses	
Neoplastic disease	+30
Liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Renal disease	+10
Physical examination findings	
Altered mental status	+20
Respiratory rate 30 breaths per minute or more	+20
Systolic blood pressure <90 mm Hg	+20
Temperature <35°C or 40°C or more	+15
Pulse 125 beats per minute or more	+10
Laboratory findings	
pH <7.35	+30
BUN >10.7 mmol/L	+20
Sodium <130 mEq/L	+20
Glucose >13.9 mmol/L	+10
Hematocrit <30 percent	+10
Partial pressure of arterial oxygen <60 mm Hg	+10†
Pleural effusion	+10

* A risk score (total point score) for a given patient is obtained by summing the patient age in years (age minus 10 for females) and the points for each applicable patient characteristic.

† Oxygen saturation <90 percent was considered abnormal in the Pneumonia PORT cohort study. The application of the PSI to the initial site of treatment decision (translational research) combines the PSI risk score and in addition considers the status of arterial oxygenation when used to guide the initial site of treatment.

Table 2. How risk levels are scored

Risk Level	30-Day Mortality	Risk Class	Based on:
Low	<0.5 percent	I	Algorithm
Low	≥0.5 and <1.0 percent	II	70 or fewer points
Low	≥1.0 and <4.0 percent	III	71-90 points
Moderate	≥4.0 and <10.0 percent	IV	91-130 points
High	≥10.0 percent	V	> 130 points

Source: Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med 1997;336(4):243-50.

outpatients and inpatients suggest that many of them have similar clinical profiles and similar outcomes.[8]

Another study, also part of AHRQ's Pneumonia PORT, surveyed low-risk CAP patients to determine their treatment preferences. Researchers found that 80 percent of patients with low-risk CAP preferred to be treated at home, including 60 percent of those who had initially been hospitalized; however, only 11 percent of patients recall being asked by their physician if they had a preference for either site. The researchers concluded that most patients with low-risk CAP should be informed of their prognosis and encouraged to participate in the decision for home or hospital care.[9]

PSI can be a critical pathway to reducing resource use and maintaining quality of care

A non-AHRQ-funded study performed in 19 Canadian hospitals examined the use of a "critical pathway" incorporating the PSI.[2] Critical pathways are treatment steps that are essential steps of a complex process. In addition to the PSI, the critical pathway used in this study consisted of treatment with an antibiotic and other practice guidelines to help the physician decide when to switch the patient from intravenous antibiotic administration to oral administration and when to discharge the patient from the hospital. The PSI score was used only as a guide to the admission decision and did not take precedence over the physician's clinical judgment.

Researchers in this study found that fewer low-risk CAP patients were hospitalized in the hospitals incorporating the critical pathway (31 percent) compared with those hospitalized in sites using conventional management (49 percent). In addition, the use of the entire critical pathway combining the PSI, the antibiotic levofloxacin, and guidelines for switching and discharge resulted in a lower median length of hospital stay (5.0 days versus 6.7 days).

The researchers also studied the effects on patient health status of treatment management using the critical pathway. Six weeks after initial treatment, a health status survey (Short Form-36 Physical Component Summary [SF-36 PCS]) was administered to each patient.[a] The survey found that there were no negative effects on patient quality of life, nor were there increases in negative outcomes such as admission to the intensive care unit, readmission to the hospital, complications, or death.

Study of the PSI in Veterans Affairs hospital finds avoidable hospitalization

A recent study of patients with CAP treated in a Veterans Affairs (VA) hospital further confirmed the PSI's value by showing no difference in mortality rates between their patients, grouped by risk class, and those of the original

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[a]The SF-36 is a questionnaire used to measure the general health of populations as well as to compare the health of patients with different medical conditions. It is a general measure that is intended to capture quality of life as well as whether an individual is healthy or not.

PORT study.[10] In examining the hospital records of patients admitted with a diagnosis of pneumonia, the VA researchers found that 20 of 82 low-risk pneumonia patients might have avoided hospitalization if the PSI had been used to make admission decisions. The researchers recommended that the VA incorporate the PSI and current CAP guidelines into an interactive decision-support tool to be made available through the VA's computerized patient record system. This could potentially facilitate physician ability to make real-time application of the PSI.

Health systems and professional societies use the PSI

At least one health care system has adopted the PSI to help improve the quality of care provided in its hospitals. Tenet Health Systems is using the PSI in 30 of its 113 hospitals; however, rather than using it as a tool to guide triage decisions, it is being used to look back at the severity levels of admitted patients as well as the appropriateness of care provided to patients within that severity level. As case managers enter the various risk factors into the database, Tenet's program automatically calculates a patient's severity level and projected mortality. The PSI has been very useful in their process improvement to date, and they are eventually planning to make it part of the system's real-time concurrent case management review at all Tenet hospitals.[11]

The PSI also has been incorporated into the practice guidelines developed by the Infectious Diseases Society of America (IDSA) for the management of adults with CAP. The IDSA believes that the clinical prediction rule provided by the PSI is methodologically sound and "may help physicians make decisions about the initial location and intensity of treatment"[12] for CAP patients. The IDSA represents physicians, scientists, and other health care professionals who specialize in infectious diseases.[12]

Timely and appropriate antibiotic therapy produces better outcomes

In addition to developing the PSI, AHRQ-funded research helped to establish that the early administration of antibiotic therapy (within 8 hours of hospital arrival) was associated with improved survival. In a study of 14,000 elderly patients with pneumonia treated at over 3,500 hospitals,

patients who received early antibiotic therapy had lower 30-day mortality. [b, 13] Another AHRQ-funded study found that for CAP outpatients under age 60 and without additional illnesses, the use of erythromycin was just as medically effective and less than one-third as expensive ($5.43 vs. $18.31) than other antibiotics. For CAP outpatients older than 60 years with one or more other illnesses, the use of erythromycin instead of the new generation antibiotics also resulted in similar medical outcomes and at a cost one-tenth as expensive ($7.50 vs. $73.50).[14] The 30-day outcomes that were assessed included mortality, subsequent hospitalization, medical complications, resolution of symptoms, return to work and usual activities, and health-related quality of life.

Determining medical stability before discharge can reduce mortality

An AHRQ-funded study interviewed physicians who identified aspects of the hospital care of pneumonia patients that could be made more efficient to decrease the patient's length of stay in the hospital.[15] These factors were diagnostic evaluation or treatment of comorbid illness, completion of a standard course of antimicrobial therapy, and delays with arrangement of long-term care. In addition, the researchers concluded that providing more home treatment programs could also reduce the length of the average hospital stay.

Concerned both with unnecessarily prolonged hospital stays and the potential danger of releasing pneumonia patients from the hospital too soon, AHRQ-funded researchers developed a simple measure of how sick patients with pneumonia are that can be used to judge whether it is safe for them to be discharged from the hospital.[16] The measure uses information from the five basic vital signs that are checked several times a day in hospitalized patients—temperature, heart rate, blood pressure, respiratory rate, and oxygen levels in the blood—as well as an assessment of the patient's mental status and ability to eat and drink.

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[b]The article did not state what percentage of the patients studied were CAP patients.

In a followup study, the researchers found that patients who were medically unstable—defined as having problems with at least one of the seven factors in the measure—had a 60-percent increased chance of readmission or death and a 50- percent higher chance of not returning to their usual activities within 30 days.[c] Th e researchers also found that the risk of readmission or death was 5 times greater for the small proportion of patients who were discharged with two or more unstable factors. Among the patients studied, 1 in 5 had been discharged "medically unstable."[17]

The researchers believe that hospital and insurance plan guidelines that shorten the length of hospital stays should build in a safety check to measure clinical stability prior to discharge to ensure that patients are not discharged too soon.

Ongoing AHRQ research

AHRQ's current research related to pneumonia is examining guideline implementation and dissemination, the effects of influenza vaccination on pneumonia and influenza hospitalizations in the elderly, and long-term mortality rates for CAP patients.

- *Guideline to Improve Quality of Initial Pneumonia Care*; Grant No. R01 HS10049. This study is aimed at providing further validation of guideline

recommendations arising from AHRQ's Pneumonia PORT. It assesses the outcomes obtained when the guideline recommendations are used. The researchers compare and evaluate the effectiveness of two strategies to decrease the proportion of low-risk patients treated in the hospital—an experimental guideline implementation strategy and a hospital-designed strategy.

- *Dissemination of Guidelines for Pneumonia Length of Stay*; Grant No. R01 HS08282. This study assesses the effectiveness of a medical practice guideline to reduce length of stay in patients with CAP by using a dissemination strategy implemented through a hospital utilization management program. It considers both patient outcomes and costs of care.

- *The Effectiveness of Influenza Vaccination*; Grant No. R03 HS10154. This study examines the relationship between immunization rates and pneumonia and influenza hospitalizations in the elderly. It takes into account Medicare managed-care selection effects, health care market factors, immunologic factors, and vaccine selection effects.

- *Long-Term Mortality of Community-acquired Pneumonia*; Grant No. F32 HS00135. This study assesses 5-year mortality from CAP to supplement the short-term mortality (30- and 90-day) data from the Pneumonia PORT. This information could potentially help clinicians in managing CAP patients.

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[c]The patients in this study were mostly patients with CAP; only 9 percent were admitted from a nursing home.

Conclusion

Improving the effectiveness and quality of health care is a major part of AHRQ's mission. Two tools developed by AHRQ-funded research help assess the need for hospitalization and determine the medical stability of patients prior to discharge. The first tool, the PSI, has been shown to reduce unnecessary hospitalizations and costs associated with the management of patients with CAP without diminishing quality or patient satisfaction. In fact, most patients favor outpatient care, as it is associated with an earlier return to work and usual activities. Implementation and use of the PSI, as either a stand-alone, decision-support tool for clinicians or as part of a broader set of process improvement tools used by health care organizations, could result in substantial savings without compromising outcomes, safety, or quality of care. Also, the selection of the most cost-effective antibiotic for CAP

patients treated at home and improving the discharge criteria for hospitalized CAP patients can conserve resources without diminishing quality. The second tool uses information from the five basic vital signs as well as an assessment of the patient's mental status and their ability to eat and drink to determine whether it is safe to discharge them from the hospital. AHRQ-funded researchers found that measuring medical stability before discharge can become an indicator of quality of care. It then could be used to compare provider and health plan performance or to stimulate quality improvement activities.

For More Information

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References

1. Lave, JR, Lin CJ, Fine MJ, et al. The cost of treating patients with community-acquired pneumonia. Semin Respir Crit Care Med 1999;20(3):189-97.

2. Marrie TJ, Lau CY, Wheeler SL, et al. A controlled trial of a critical pathway for treatment of community-acquired pneumonia. JAMA 2000;283(6):749-55.

3. Palmer CS, Zhan C, Elixhauser A, et al. Economic assessment of the community-acquired pneumonia intervention trial employing levofloxacin. Clin Ther 2000;22(2):250-64.

*4. Fine MJ, Smith DN, Singer DE. Hospitalization decision in patients with community-acquired pneumonia: a prospective cohort study. Am J Med 1990;89:713-21.

*5. Fine MJ, Hough LJ, Medsger AR, et al. The hospital admission decision for patients with community-acquired pneumonia. Arch Intern Med 1997;157:36-44.

*6. Kapoor WN. Assessment of the Variation and Outcomes of Pneumonia. Pneumonia Patient Outcomes Research Team (PORT). Final Report. June 28, 1996. Web site: <http://www.ahrq.gov/coer/respiratory diseases.html>

*7. Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med 1997;336(4):243-50.

*8. Fine MJ, Singer DE, Marrie TJ, et al. Medical outcomes of ambulatory and hospitalized low risk patients with community-acquired pneumonia. J Gen Intern Med 1994;9(suppl.2):29A.

*9. Coley CM, Li YH, Medsger AR, et al. Preferences for home vs. hospital care among low-risk patients with community-acquired pneumonia. Arch Intern Med 1996;156:1565-71.

10. Ortiz E, Quach CH, and Lenert LA. The Pneumonia Severity Index. Assessing its potential as a triage tool. Federal Practitioner; September 2001:11-25.

11. AHRQ Impact Case Studies Notebook. 2001.

12. Infectious Diseases Society of America. Practice guidelines for the management of community-acquired pneumonia for adults. Clin Infect Dis 2000;31:347-82.

13. Meehan TP, Fine MJ, Krumholz HM, et al. Quality of care, process, and outcomes in elderly patients with pneumonia. JAMA 1997; 278(23):2080-4.

*14. Gleason PP, Kapoor WN, Stone RA, et al. Medical outcomes and antimicrobial costs with the use of the American Thoracic Society guidelines for outpatients with community-acquired pneumonia. JAMA 1997:278:32-39.

*15. Fine MJ, Medsger AR, Stone RA, et al. The hospital discharge decision for patients with community-acquired pneumonia. Arch Intern Med 1997;157:47-56.

*16. Halm EA, Fine MJ, Marrie TJ, et al. Time to clinical stability in patients hospitalized with community-acquired pneumonia. JAMA 1998; 279:1452-7.

*17. Halm EA, Fine MJ, Kapoor WN, et al. Instability on hospital discharge and the risk of adverse outcomes in patients with pneumonia. Arch Intern Med 2002; 162:1278-84.

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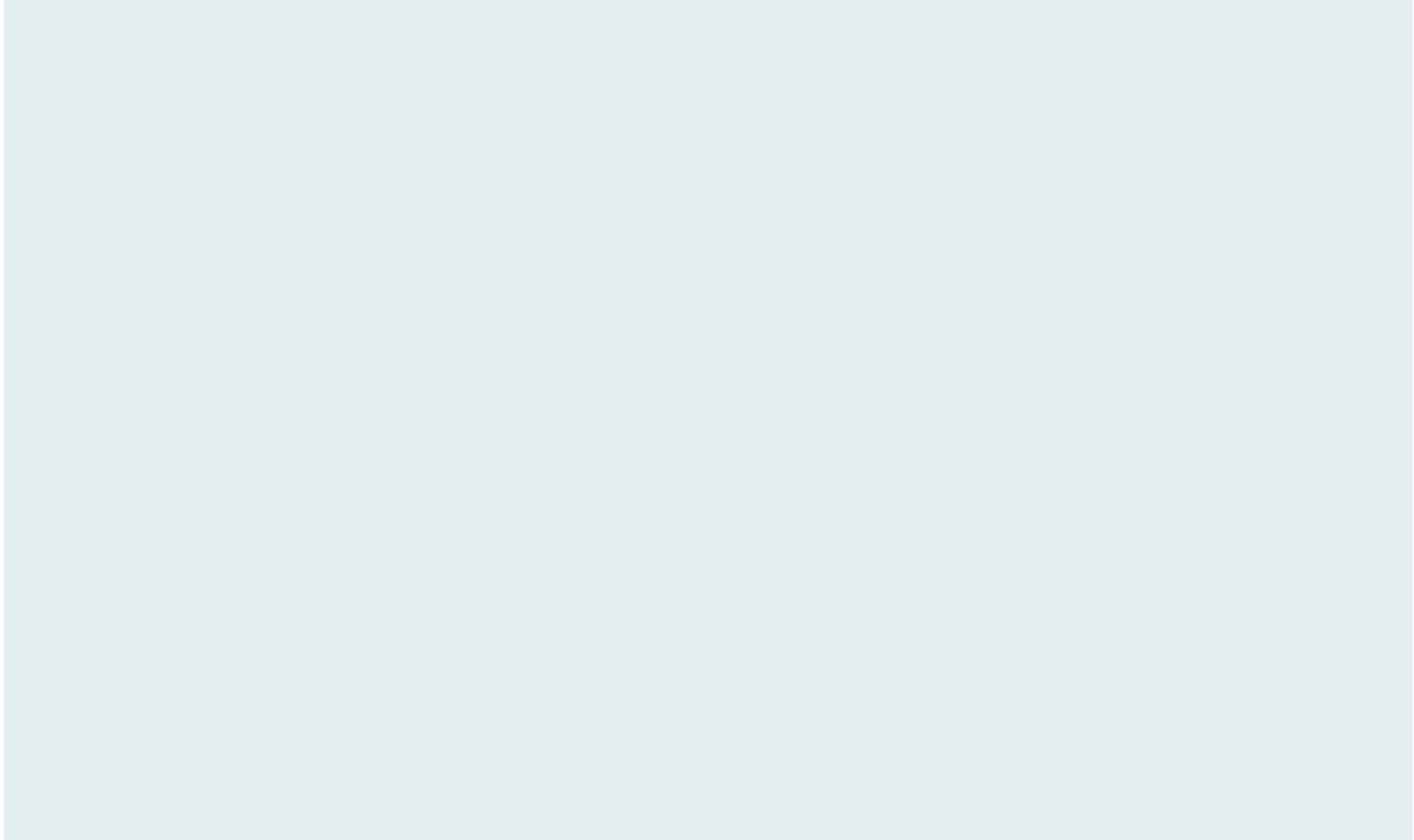
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