

Safely Increasing the Proportion of Patients With Community-Acquired Pneumonia Treated as Outpatients

An Interventional Trial

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Background: Patients with community-acquired pneumonia who are at low risk for short-term mortality can be identified using a validated prediction rule, the Pneumonia Severity Index. Such patients should be candidates for outpatient treatment, yet many are hospitalized.

Objective: To assess a program to safely increase the proportion of low-risk patients with pneumonia treated at home.

Methods: The intervention provided physicians with the Pneumonia Severity Index score and corresponding mortality risk for eligible patients and offered enhanced visiting nurse services and the antibiotic clarithromycin. Prospectively enrolled, consecutive low-risk patients with pneumonia presenting to an emergency department during the intervention period (n = 166) were compared with consecutive retrospective controls (n = 147) identified during the prior year. A second group of 208 patients from the study hospital who participated in the Pneumonia Patient Outcomes Research Team cohort study served as controls for patient-reported measures of recovery.

Results: There were no significant baseline differences between patients in the intervention and control groups. The percentage initially treated as outpatients increased from 42% in the control period to 57% in the interven-

tion period (36% relative increase; 95% confidence interval, 8%-72%; $P = .01$). However, more outpatients during the intervention period were subsequently admitted to the study hospital (9% vs 0%). When any admission to the study hospital within 4 weeks of presentation was considered, there was a trend toward more patients receiving all their care as outpatients in the intervention group (42% vs 52%; 25% relative increase; 95% confidence interval -2% to 59%; $P = .07$). No patient in the intervention group died in the 4-week follow-up period. Symptom resolution and functional status were not diminished. Satisfaction with overall care was similar, but patients treated in the outpatient setting during the intervention were less frequently satisfied with the initial treatment location than comparable control patients (71% vs 90%; $P = .04$).

Conclusions: Use of a risk-based algorithm coupled with enhanced outpatient services effectively identified low-risk patients with community-acquired pneumonia in the emergency department and safely increased the proportion initially treated as outpatients. Outpatients in the intervention group were more likely to be subsequently admitted than were controls, lessening the net impact of the intervention.

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COMMUNITY-acquired pneumonia is among the most common severe acute infections in adults. It leads to approximately 600 000 hospitalizations each year in the United States, and roughly \$4 billion in direct medical costs.^{1,2} Hospital care for patients with pneumonia is much more expensive than outpatient care. Studies^{3,4} demonstrating large variations in rates of hospital admission for patients with pneumonia across nearby geographic regions suggest that the criteria for hospital admission are uncertain. Surveys indicate that the decision to hospitalize individuals is driven by physicians' assessment of sever-

ity of illness.^{5,6} However, these assessments are not well calibrated, with physicians tending to overestimate the likelihood of death from pneumonia.⁶ A recently validated prediction rule for severity of illness in patients with community-acquired pneumonia, the Pneumonia Severity Index (PSI),⁷ now provides a means to accurately assess risk at patient presentation. The PSI was derived and validated in more than 50 000 patients in the United States and Canada. A PSI score of 90 or lower identifies patients at low risk (<2.8%) for short-term mortality following pneumonia. In a large cohort study,⁷ approximately 50% of hospitalized patients were classified as low risk. These pa-

PATIENTS AND METHODS

STUDY SITE

Massachusetts General Hospital in Boston is a large urban teaching hospital with approximately 700 admissions for pneumonia annually. There are about 63 000 visits to the hospital's emergency department each year. The emergency department is staffed by 22 full- and part-time attending physicians, as well as residents in emergency medicine, internal medicine, and surgery.

STUDY POPULATION

Eligibility

Eligibility for the study included age of 18 to 84 years; pulmonary infiltrate on chest radiograph not known to be old; and symptoms consistent with pneumonia, including cough, dyspnea, change in sputum, pleuritic chest pain, myalgias, or fatigue. Patients with pneumonia were excluded if they were known to be positive for human immunodeficiency virus; chronically immunosuppressed (defined as immunosuppression for solid organ transplantation, postsplenectomy, receiving ≥ 10 mg/d of prednisone or the equivalent for >30 days, or neutropenic, ie, $<1.0 \times 10^9/L$ neutrophils); hospitalized within the past 10 days; residing in a nursing home; recently using illicit injection drugs; diagnosed as having a severe neuromuscular disorder (such as amyotrophic lateral sclerosis); pregnant; homeless, without a telephone, or had other social or psychiatric problem compromising medication adherence or follow-up; unable to take oral medication and nourishment; and receiving long-term oxygen therapy, or were found to have an oxygen saturation lower than 90% or a PO_2 lower than 60 mm Hg on room air. These criteria were intended to restrict the protocol to immunocompetent patients with community-acquired pneumonia who did not have a definite need for hospitalization or barrier to compliance or follow-up. A PSI score was calculated for all patients meeting eligibility criteria. The PSI algorithm assigns a point score to patients based on age, sex, selected comorbid conditions, and patient vital signs and laboratory values at presentation (**Table 1**).⁷ Eligible patients with a PSI score of 90 or lower were enrolled.

Intervention Cohort

During prospective enrollment from April 1, 1996, to February 28, 1997, 826 consecutive emergency department patients met screening criteria for pneumonia. Of these, 576 (70%) were excluded. Many patients had multiple reasons for exclusion, including hypoxia (n = 220), age older than 84 years (n = 123), inability to take oral medications (n = 119), and hospitalization within the preceding 10 days (n = 98). Of the remaining

250 patients, 166 (66%) had PSI scores of 90 or lower, making them low-risk patients eligible for the intervention.

Historical Controls

Retrospective Cohort Controls. Comparable low-risk patients with community-acquired pneumonia presenting to the emergency department in the 12 months (April 1, 1995, to March 31, 1996) immediately preceding the prospective intervention period served as the primary control group. Using the emergency department log, we identified 11 684 patients with presenting symptoms or discharge diagnoses compatible with pneumonia. Of these, 1171 patients had chest radiograph findings at presentation consistent with pneumonia. Records for 15 (1.3%) of these patients could not be located. Of the remaining patients, 147 who met the same eligibility criteria as patients in the intervention cohort and also had a PSI score of 90 or lower were included in the control group. This control group provided the comparison for the proportion treated as outpatients and for those subsequently hospitalized.

Pneumonia Patient Outcomes Research Team (PORT) Cohort Controls. The medical records of the retrospective cohort control patients could not provide adequate information on patient-reported symptoms, functional status, and satisfaction with care. For these outcomes, we used a second control group assembled from patients at Massachusetts General Hospital who were enrolled in the Pneumonia PORT cohort study between October 1991 and March 1994.⁶ The Pneumonia PORT study included about 60% of all eligible patients with community-acquired pneumonia presenting during the study period.⁶ The PSI scores and other eligibility criteria were assessed from the Pneumonia PORT study database supplemented by medical record review. Of 618 patients enrolled in the Pneumonia PORT study through our emergency department, 208 patients (34%) met eligibility criteria for this study.

STUDY INTERVENTION

The study intervention consisted of the following: identifying eligible low-risk patients with community-acquired pneumonia; providing PSI scores and mortality risk information to the emergency department physician; and supporting outpatient management by providing enhanced visiting nurse services, an antibiotic (clarithromycin), and access to a primary care physician. The intervention was provided as an aid to physician decision making, but all aspects of patient management remained under the control of the patient's physician. The study was approved by the Subcommittee on Human Studies of Massachusetts General Hospital. A data monitoring committee

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tients may have been appropriate candidates for outpatient care. Indeed, a majority of such low-risk patients surveyed after hospitalization indicated that they would have preferred treatment at home.⁸

The Low Risk Community-Acquired Pneumonia study assessed the prospective use of an emergency department intervention that identified appropriate low-

risk patients and supported treatment of such patients in the outpatient setting. Comparable patients presenting in the immediately preceding 12 months served as the primary control group. The goal of the intervention was to increase the proportion of patients with community-acquired pneumonia treated as outpatients while preserving comparable levels of safety.

evaluated the safety of the project at 2 and 7 months and recommended at each point that the project continue.

The protocol was developed with participation of members of the emergency department and was presented in detail to staff physicians prior to the start of the study and to resident physicians at the start of their emergency department rotation. A study nurse was present in the emergency department during working hours on weekdays to identify eligible patients. At other times, physicians identified eligible patients without assistance. The patient's PSI score was either calculated by the evaluating physician or provided by study staff. Corresponding mortality risk was presented on the PSI scoring sheet. In general, the site of care decision was made by the evaluating physician in consultation with the patient's primary care physician, if available.

The study made available an antibiotic, at no cost, and enhanced visiting nurse services to facilitate outpatient care. The antibiotic regimen provided in the emergency department was 500 mg of clarithromycin (Biaxin) administered orally twice daily for 10 days, an effective initial agent for empirical outpatient treatment of community-acquired pneumonia.⁹⁻¹² Physicians were not constrained from prescribing alternative antibiotics. By completing a preprinted referral form, the physician could select a rapid visiting nurse home follow-up evaluation. This follow-up consisted of 2 visits, the first within 24 hours of the emergency department visit and the second between 24 and 48 hours. The nurse visit included assessment of vital signs and symptoms, review of medications, and measurement of oxygen saturation by pulse oximetry. If the patient was stable or improving, a standardized form was faxed to the study center that provided a copy to the physician's office. If the visiting nurse thought that the patient's condition was worse, direct contact was made with the patient's physician. A follow-up telephone call from study personnel was made the day after the second nursing visit to confirm stability. Visiting nurse services were ordered for 27% of outpatients.

All patients received written information about their diagnosis of pneumonia and their treatment plan. In addition, they were given a telephone number to contact a study nurse or physician in case they could not reach their own physician. For outpatients without a primary care physician ($n = 54$), the study provided a list of hospital-affiliated primary care physicians who had agreed to accept study patients.

BASELINE AND OUTCOME ASSESSMENTS

Review of medical records provided baseline characteristics as well as the initial site of care (outpatient vs hospital setting). For all patients initially treated as outpatients, subsequent hospital admission within 4 weeks was recorded. For the retrospective cohort controls, comprehensive assessment of late admissions was available only for the study hospital. As a result, comparison of proportions with late

hospital admission was restricted to those admitted to Massachusetts General Hospital. Such delayed hospitalizations were classified as related to the patient's pneumonia or not, as independently assessed by 2 of us (S.J.A. and T.I.B.) with adjudication by a third physician (D.E.S.) for disagreements. For hospitalized patients, length of stay, discharge status, and medical complications were assessed. Length of stay was calculated as the discharge date minus the admission date. Microbiologic cause was assigned using available data according to a previously published protocol.¹³ Death within 4 weeks of presentation was also recorded. Vital status was ascertained for 100% of patients in the intervention group and 80% of retrospective cohort controls. Further ascertainment of vital status for the retrospective cohort was not pursued since the primary concern was the safety of patients in the intervention group, a fact ensured by our results.

Patients in the intervention group were also surveyed in person or by telephone at baseline and at 1-, 2-, and 4-week follow-up. The survey assessed symptoms, functional status, and general health with questions identical to those used in the Pneumonia PORT study.¹⁴ At 4 weeks, patients were also asked about satisfaction with initial treatment location and with overall care. One hundred thirty-four (81%) of the 166 patients in the intervention group consented to the follow-up survey. Of these, only 4 patients (3%) did not complete the 4-week questionnaire. Patients who completed the questionnaire follow-up ($n = 130$) were similar to those who did not ($n = 36$) in terms of baseline characteristics such as PSI scores and comorbid conditions.

STATISTICAL METHODS

Sample size calculations were based on the study's primary outcome, the proportion of patients initially treated as outpatients. The study was designed to detect an absolute increase of 15%, given a historical proportion of 40%. With a 2-sided α level of .05 and a power of .80, approximately 150 patients per group were needed.

Data were entered into a Microsoft Access (Microsoft Corporation, Redmond, Wash) database with statistical analyses performed using UNIX SAS statistical software (SAS Institute Inc, Cary, NC). Baseline patient characteristics and outcomes were compared among patients in the intervention group and each control group using the Fisher exact test for dichotomous outcomes and t tests for continuous variables. For the proportion of patients hospitalized and for 4-week mortality rate, 95% confidence intervals were calculated.¹⁵ Because the length of stay had a skewed distribution, median values were compared using the Wilcoxon rank sum test. Comparisons of patient-reported symptoms and functional status at 4 weeks were analyzed using logistic regression models that controlled for baseline score as well as study group and initial treatment location. There were no significant interactions between study group and other model variables.

RESULTS

BASELINE CHARACTERISTICS

The mean age of patients in the prospective intervention cohort was 53 years; 83 (50%) were women, and 137 (84%) of 164 were white (**Table 2**). Sixty-two (39%) of

158 were employed and 40 (26%) of 153 reported current cigarette smoking. Eighteen (11%) had coexisting chronic obstructive pulmonary disease and 20 (12%) had asthma. These features were not significantly different in patients in the intervention and control groups nor were insurance status or other coexisting conditions, such as coronary artery disease.

Table 1. Modified Pneumonia Severity Index (PSI)*

Category	Points Assigned
Demographics	
Age	No. of years
Sex	If female, -10
Comorbid illnesses	
Known congestive heart failure	If yes, +10
Known active cancer	If yes, +30
Known liver disease	If yes, +20
Known chronic renal insufficiency	If yes, +10
Known cerebrovascular disease	If yes, +10
Physical examination at presentation	
Systolic blood pressure	if <90 mm Hg, +20
Heart rate	If ≥ 125 /min, +10
Spontaneous respiratory rate	If ≥ 30 /min, +20
Oral temperature	If <35°C or 40°C, +15
Altered mental status	If yes, +20
Laboratory values and radiographic findings	
Hematocrit	If <0.3, +10
Glucose	If ≥ 13.8 mmol/L (≥ 250 mg/dL), +10
Sodium	If <130 mmol/L, +20
Blood urea nitrogen	If ≥ 10.7 mmol/L (≥ 30 mg/dL), +20
Arterial pH	If <7.35, +30
Pleural effusion on chest radiograph	If yes, +10
Total PSI score	Sum of assigned points

*In this modified version of the published PSI,⁷ points were not assigned for hypoxia or for residence in a nursing home because these were exclusion criteria for this study. (Reprinted by permission of the New England Journal of Medicine. Copyright 1997.)

The mean PSI score (Table 1) was 55 for patients in the intervention group and 53 for controls (Table 2). Patients were predominantly categorized into the least severe low-risk category, class I.⁷ The percentage of patients having PSI points contributed by each comorbid disease, physical findings, and laboratory variables were similar (data not shown).

Twenty-two patients (13%) in the intervention cohort had multilobar pneumonia compared with 25 (17%) controls ($P = .43$). Sixty-three patients (38%) in the intervention cohort had sputum cultures and 92 (55%) had blood cultures performed. The percentages were similar in the control group (64 [44%] and 89 [61%], respectively; $P > .05$). Twenty-nine patients (17%) in the intervention group and 16 (11%) of retrospective cohort controls had a definitive or presumptive microbiologic cause identified ($P = .11$). The most frequent pathogens were *Streptococcus pneumoniae* (15 patients [9%] in the intervention group and 4 controls [3%]) and *Haemophilus influenzae* (8 patients [5%] in the intervention group and 3 controls [2%]).

Clarithromycin was used in 91 (97%) of 94 outpatients in the intervention group. The predominant antibiotics used by outpatients in the retrospective cohort control group ($n = 61$) were erythromycin (19 [31%]), clarithromycin (17 [28%]), and a combination product of trimethoprim and sulfamethoxazole (7 [11%]). Among patients initially hospitalized, parenteral cefuroxime was the most common antibiotic given (50 [69%] of 72 patients in the intervention group and 58 [67%] of 86 controls).

Table 2. Baseline Characteristics of Intervention Cohort and Retrospective Cohort Controls*

Variable†	Intervention Cohort (n = 166)‡	Retrospective Cohort Controls (n = 147)‡
Mean age, y (median)	53 (55)	52 (53)
Sex, female	50	52
Race, white	84	90
Employed	39	39
Insurance status		
Private	37	48
Medicare	40	40
Medicaid	12	6
Uninsured	11	6
Cigarette smoker	26	36
Coexisting conditions		
Chronic obstructive pulmonary disease	11	15
Asthma	12	9
Coronary artery disease	13	13
Diabetes mellitus	5	10
Alcohol dependence	4	3
Mean PSI score (median)	55 (58)	53 (56)
Class I, ≤ 50	45	45
Class II, 51-70	24	32
Class III, 71-90	31	23

*Values are given in percentages, except where otherwise indicated. PSI indicates Pneumonia Severity Index.

†No P values comparing the intervention cohort with the control group were significant at $P \leq .05$.

‡Actual numbers for an individual variable may vary because of missing data (from 118-147 control patients and from 153-166 intervention patients).

PROPORTION TREATED AS OUTPATIENTS

Ninety-four (57%) of 166 patients were initially treated as outpatients during the intervention period compared with 61 (42%) of 147 retrospective cohort control patients (relative increase, 36%; 95% confidence interval [CI], 8%-72%; $P = .01$; 15% absolute difference) (Table 3). This effect was seen across all 3 of the risk classes eligible for the study. The relative impact was greater in the higher-risk classes II and III.

Among patients initially treated at home, 8 intervention outpatients were admitted to the study hospital within 4 weeks compared with no control outpatients. As a result, the proportion of patients without admission to the study hospital during the 4-week follow-up was 52% for the intervention cohort compared with 42% in the retrospective cohort control group (relative increase, 25%; 95% CI, -2% to 59%; $P = .07$).

OUTPATIENTS WITH SUBSEQUENT ADMISSION

Of the 8 late hospitalizations at the study hospital during the intervention period, 5 were considered related to the original diagnosis of pneumonia (Table 4). One of these admissions was attributable to underlying asthma, 2 resulted from patient and family concerns about outpatient treatment, 1 had a positive blood culture for *S pneumoniae*, and 1 had nausea and vomiting attributed to the oral antibiotic used. These 5 patients were all admitted within 2 days of their initial visit, and all were dis-

Table 3. Proportion of Patients With Low-Risk Pneumonia Treated as Outpatients*

Initial Treatment as Outpatient	Intervention Cohort, No. (%) (n = 166)	Retrospective Cohort Controls, No. (%) (n = 147)	Absolute Difference, %	Relative Change†, %	P
Overall	94 (57)	61 (42)	15	36	.01
Class I (PSI, ≤50)	58 (77)	41 (62)	15	25	...
Class II (PSI, 51-70)	14 (36)	12 (26)	10	41	...
Class III (PSI, 71-90)	22 (42)	8 (24)	19	80	...

*Note that all patients were consecutive eligible patients presenting to the study hospital emergency department (see the "Patients and Methods" section). PSI indicates Pneumonia Severity Index.

†Compared with baseline percentage in controls. For overall comparison, 95% confidence interval was 8% to 72%.

Table 4. Outpatients With a Subsequent Admission to the Study Hospital Within 4 Weeks of Presentation

Age, y	Reason Admitted	Pneumonia Related	No. of Days After Initial Visit	Length of Stay, d
26	Asthma symptoms	Yes	1	5
60	Patient and family request	Yes	1	3
82	Patient and family request	Yes	1	3
63	Blood culture positive for <i>Streptococcus pneumoniae</i>	Yes	1	12
26	Nausea, vomiting	Yes	2	2
41	Ascites	No	26	8
35	Blood culture positive for <i>Staphylococcus aureus</i>	No*	1	40
73	Pulmonary embolus	No†	6	11

*The patient was an injection drug user who denied use at initial presentation (misclassified as eligible).

†Diagnosis was later reclassified as pulmonary embolus.

charged home after an unremarkable hospital stay. The 3 other late admissions included a patient with liver disease admitted with ascites 26 days after presentation, a patient with positive blood cultures diagnosed as having *Staphylococcus aureus* endocarditis from recent injection of an illicit drug (an exclusion criterion for the study that was initially denied by the patient), and another subsequently diagnosed as having had a pulmonary embolus rather than pneumonia.

Comprehensive follow-up of the intervention cohort revealed 2 additional patients admitted to hospitals other than the study hospital after initial outpatient treatment (diagnoses were myocarditis and gastroparesis, admitted 1 and 3 days after presentation, respectively).

FOUR-WEEK MORTALITY

During the 4-week follow-up, no patient in either the intervention group or the retrospective cohort control group was known to have died (95% CI, 0%-2.2% for patients in the intervention group).

PATIENTS INITIALLY HOSPITALIZED

The median length of stay for patients initially hospitalized was similar during the intervention and control periods (4 days in both groups; $P = .72$). Three (4%) of 72 patients in the intervention group had an intensive care unit admission compared with 2 (2%) of 86 controls ($P = .66$). Sixty-three (88%) of 72 patients in the intervention group and 75 (87%) of 86 patients in the control group initially hospitalized were discharged home.

SYMPTOMS, FUNCTIONAL STATUS, AND SATISFACTION AT 4 WEEKS

Measures of symptoms, functional status, and satisfaction with care were compared between patients in the intervention group and controls from the Pneumonia PORT cohort study. There were no significant differences in symptoms at 4 weeks between patients in the intervention cohort and Pneumonia PORT controls after controlling for baseline values and initial location of care (**Table 5**). One hundred twenty (92%) of 130 patients in the intervention cohort had returned to their usual activities by 4 weeks, compared with 138 (85%) of 162 controls.

Patient satisfaction with overall care was high and comparable between patients in the intervention group and Pneumonia PORT controls regardless of their initial treatment location (**Table 6**). However, patients in the intervention group initially treated at home were less frequently satisfied with this site of care than outpatients in the control group (46 [71%] of 65 vs 28 [90%] of 31; $P = .04$). Patients initially hospitalized in both groups had high levels of satisfaction with treatment location.

COMMENT

While most patients with community-acquired pneumonia recover, some will die and others will have a prolonged, complicated course. It is frequently difficult to decide which patients require hospital treatment. The decision to hospitalize also has dramatic financial conse-

Table 5. Symptoms and Functional Status at 4 Weeks After Presentation

Outcomes at 4 wk*	Intervention Cohort†	Pneumonia PORT Controls‡
Symptoms, none or minimal‡		
Cough	49	58
Shortness of breath	68	75
Fatigue	58	65
Functional status		
Return to daily activities§	92	85
General health, excellent or very good¶	35	52

*Values are given in percentage. All P s > .05. P values for symptoms and general health compared intervention cohort and Pneumonia Patient Outcomes Research Team (PORT) controls using logistic regression modeling controlling for initial treatment location and baseline symptoms. The P value for return to daily activities was calculated using the Fisher exact test.

†One hundred thirty patients in the intervention cohort provided baseline and follow-up data. For Pneumonia PORT controls, the number of patients responding varied, reflecting different sampling strategies for these outcomes at different times during the Pneumonia PORT study.

‡Pneumonia PORT control group ($n = 183$ -185).

§Pneumonia PORT control group ($n = 162$).

¶Pneumonia PORT control group ($n = 79$).

quences. Hospital admission results in direct medical costs of several thousand dollars, many times the cost of outpatient care.^{1,2,16} Prediction rules, such as the PSI, provide a more rational basis for deciding which patients with community-acquired pneumonia might safely be treated at home. Low-risk patients (PSI scores ≤ 90 , risk classes I-III) face a 30-day mortality risk of no more than 2.8%.⁷ In the Pneumonia PORT cohort study, 50% of inpatients came from such low-risk classes.⁷ We reasoned that by adding further criteria for safety (eg, ensuring immunocompetence, adequate oxygenation, and a stable outpatient setting), providing an effective antibiotic, and facilitating home care with rapid and expanded visiting nurse services, appropriate low-risk patients with community-acquired pneumonia could be identified and treated effectively as outpatients.

Our results indicate that such a program can safely increase the proportion of patients treated at home. We observed a relative increase of 36% (95% CI, 8%-72%) in the proportion of patients initially treated as outpatients (absolute increase, 15%). The intervention group had more late hospital admissions, thus reducing the relative increase in patients treated solely as outpatients to 25% (95% CI, -2% to 59%; absolute increase, 10%). There were no deaths during the follow-up period and no significant worsening of other indicators of recovery. Overall satisfaction with care was high in the intervention group, comparable with that recorded for Pneumonia PORT controls. There was, however, a decrease in the proportion of outpatients in the intervention group who were satisfied with their initial site of care.

It is difficult to have an impact on the hospitalization decision for patients with community-acquired pneumonia presenting to a busy emergency department. Similar difficulties have been encountered in implementing triage guidelines for other acute conditions.¹⁷ First, patients frequently are sent to the emergency department to be admitted to the hospital. In these cases, it may not

Table 6. Patient Satisfaction With Care for Pneumonia

Outcomes at 4 wk	Intervention Cohort (n = 129)	Pneumonia PORT* Controls (n = 77)	P
Overall care, % satisfied‡			
All patients	93	90	.44
Inpatients	96	91	.40
Outpatients	90	88	.74
Initial treatment location, % satisfied‡			
All patients	84	92	.13
Inpatients	98	93	.32
Outpatients	71	90	.04

*PORT indicates Patient Outcomes Research Team.

‡Question phrased, "How would you rate overall care for this episode of pneumonia?" Response on a scale of 1 to 5 from "very unsatisfactory" to "very satisfactory." Patient considered satisfied if response was 4 or 5.

§Question phrased, "In thinking about the decision to treat your pneumonia initially at home (or the hospital), do you think it was the best place for you?" Response yes, no, not sure. Patient considered satisfied if response was yes.

be possible to change physician and patient expectations. Second, maintaining awareness of the protocol is difficult. Cases of pneumonia constitute only a small fraction of patients treated. Finally, we faced a local problem. Managed care organizations have had a strong influence in the Boston area for years. The Pneumonia PORT study observed shorter lengths of stay for patients hospitalized with pneumonia at our institution than at participating hospitals in other geographic areas.¹⁸ This more parsimonious use of the hospital may extend to the initial hospitalization decision as well, making further reductions in hospitalization difficult. Despite these hurdles, our intervention appeared to have a clear impact on the initial site of care decision. However, we cannot be certain which features of the intervention are responsible for the outcomes observed.

Our study was not a randomized trial. The intervention depended on the collaboration of the emergency department staff. Such a group effect precluded randomization of individual staff members or patients. The use of historical controls raises 2 alternative explanations for our results. First, patients in the intervention period may have been less severely ill. This seems unlikely given the similarity in clinical characteristics, including PSI scores, between patients in the intervention group and the retrospective cohort controls. Second, the reduction in initial hospitalizations may have simply reflected a generally more restrictive use of the hospital during the more recent intervention period. This alternative explanation is harder to refute. A design incorporating alternating intervention and control time periods might have more directly removed this concern. Such a time series study in a single emergency department, however, would need prolonged washout periods to minimize contaminated comparisons. The resulting trial would have taken several years. One indicator that our emergency department did not undergo a wholesale change in its admitting policies is that during the intervention

period 22% of all patients presenting to the emergency department were admitted compared with 23% during the 12 months immediately preceding.¹⁹

Our study highlights several features needed for successful implementation. First, the intervention has to be applied before the hospitalization decision has been made. To that end, physicians have to be repeatedly reminded of the intervention. Second, successful implementation depends on accurate diagnoses and medical history. Our late admissions for individuals with endocarditis and pulmonary embolus remind us that more troubling diagnoses can masquerade as community-acquired pneumonia. Third, patient and family expectations have to be accommodated. Two of our late hospital admissions resulted from patient and family anxiety about care at home. Health care facilities other than acute care hospitals might be the appropriate setting for such patients. Finally, physicians and administrators have to be realistic about the potential for outpatient care for low-risk patients with pneumonia. Increased risk of dying from pneumonia is an important reason for hospitalization, but not the only one. A sizable minority of low-risk patients appear too ill to be treated at home; other patients have active comorbid illnesses requiring hospitalization. For these patients, physicians will frequently choose the hospital setting rather than face the uncertainties inherent in outpatient treatment.

In conclusion, to our knowledge, we conducted the first study of a treatment algorithm using the PSI to identify low-risk patients with community-acquired pneumonia who might be appropriate candidates for outpatient care. Outpatient treatment was supported by provision of clarithromycin and augmented visiting nurse services. The proportion of patients initially hospitalized was decreased, although this led to more late hospital admissions for patients in the intervention group. Patient recovery was not compromised. Our intervention should be implemented only if its impact on patient outcomes can be carefully evaluated. Ideally, the risk-based algorithm should be tested more definitively in randomized multisite trials.

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