Treatments and Outcomes of Nursing-Home-Acquired Pneumonia

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Background: **Bronchopulmonary infections have been considered the leading cause of hospital admissions and death in the nearly 2 million nursing home residents in the United States. Very little is known about the treatments and outcomes of this entity. The purpose of our study was to document the incidence, treatments, and outcomes of nursing-home-acquired pneumonia in hospitalized and nonhospitalized patients.**

Methods: **We conducted a retrospective chart review during a 24-month period of patients from two community nursing homes in upstate New York with a total average population of 330 residents. The main outcome measure was 6-week mortality.**

Results: **Pneumonia was diagnosed in 129 patients, whose overall 6-week mortality rate was 24.8 percent. Ninety-one patients were cared for in the nursing home, and 38 patients were hospitalized. Six-week mortality rate for the nonhospitalized group was 18.7 percent. The hospitalized group's 6-week mortality rate was significantly higher at 39.5 percent. There were no significant differences between the hospitalized and nonhospitalized groups before their diagnosis that predicted outcome.**

Conclusions: **For many patients nursing-home-acquired pneumonia can be successfully treated in a nursing home with oral antibiotics at a considerable cost savings when compared with hospitalization.**

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By the year 2000 more than 2 million people in the United States will reside in nursing homes.[1] On any given day, there are already more nursing home residents than there are patients in hospitals.[2]

Roughly 1.5 million infections (not limited to pneumonia) are acquired in nursing homes each year in the United States, and infection is the most common reason for hospitalization in this population.[3] A great majority of these infections occur in the three following areas: the respiratory system, the urinary tract, and skin and soft tissues, a grouping easily recalled by the mnemonic PUS (pulmonary, urinary, skin-soft tissue).[4] Among the infections occurring within this group, bronchopulmonary infections have been considered the leading cause of hospital admissions and death in nursing home patients.[5-7]

Pneumonia, depending on the clinical definition and location of the nursing home, causes between 2 and 48 percent of all nursing-home-acquired infections.[8,9] Reported mortality rates of hospitalized patients with nursing-home-acquired pneumonia (NHAP) also fall within a broad range, from 6.5 to 40 percent.[4,6,9-11] A recent meta-analysis of community-acquired pneumonia determined that the highest mortality was reported for those in nursing homes and intensive care units.[12] Much of the variability of this data resulted from the inherent difficulties in diagnosing pneumonia in nursing home patients compared with diagnosing it in younger, independent patients.

The medical literature frequently emphasizes the atypical, nonspecific symptoms and signs of pneumonia in the frail elderly, dating back to Osler's description[13] in the early 1890s: "...in old age, pneumonia may be latent, coming on without chill; the cough and expectoration are slight, the physical signs ill-defined and changeable, and the constitutional symptoms out of all proportion."

A blunted febrile response, decreased immu-

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nity, and limited ability to communicate can further mask the clinical picture in the infected nursing home patient.[14] A change in functional or mental status might be the most prominent sign.[1,6] Tachypnea has been called the most sensitive sign of pneumonia in nursing home patients.[6,15]

Much has been written about the cause of NHAP. Accurate microbiologic data, especially sputum specimens, are often difficult and impractical to obtain from the frail, elderly patient. Still, a general consensus is that aspiration of oropharyngeal flora accounts for the pathogenesis of most cases of NHAP. The responsible organisms are mainly represented by colonizing aerobic or facultative anaerobic gram-negative bacilli and *Streptococcus pneumoniae*. Other organisms include, but are not limited to, *Haemophilus influenzae*, *Staphylococcus aureus*, other streptococcal species, viruses, and *Mycobacterium tuberculosis*. Atypical organisms are rarely implicated.[3,4,6,7,15,16]

As recently as 1990 no study had measured mortality resulting from respiratory tract infections in the nursing home.[6] Review articles through the early 1990s had uniformly recommended that nearly all nursing home residents with pneumonia be hospitalized or at least treated with broad-spectrum parenteral antibiotics. In 1992 Mehr et al[17] reported an overall mortality rate of 28 percent for 92 episodes of NHAP, which included 76 nonhospitalized patients. Chest radiographs were not a required inclusion criterion for their study. In 1995 Degelau et al,[5] who assessed the effectiveness of oral antibiotic treatment in 124 nonhospitalized patients with NHAP, reported a 30-day mortality rate of 13.0 percent, compared with 17.6 percent for 74 hospitalized patients. Houston and colleagues[18] included 112 patients who had a 30 percent mortality rate from NHAP in their study of 421 elderly patients with community-acquired lower respiratory tract infections. Fine et al,[12] in their meta-analysis of more than 33,000 patients with community-acquired pneumonia, reported a mortality rate of 30.8 percent for a subgroup of 556 nursing home patients.

Overall, very few data were available comparing the efficacy of hospitalization with that of treating pneumonia within the nursing home, although more recent literature has suggested the latter strategy is safe and cost-effective in many patients.[18-21]

Empirical broad-spectrum antibiotic therapy has been recommended for acutely deteriorating nursing home patients.[1,2,4,6] One study showed a decreased mortality from NHAP when a broad-spectrum oral antibiotic was used as initial therapy.[17] When we undertook our study, no one had documented the outcome of NHAP treated in the nursing home with oral antibiotics. In 1995 Degalau et al[5] reported the first study that promoted this strategy as safe and cost effective for most nursing home patients.

The purpose of our study was to document the details of treatments and outcomes for patients with NHAP, including comparisons between hospitalized and nonhospitalized cohorts and to show that treating NHAP in the nursing home can be efficacious and safe. We hope to use our results as a pilot project for designing a prospective study to determine the best oral antibiotic treatment for NHAP.

Methods

Cases were selected by retrospective chart review from two nursing homes in upstate New York with a total average population of 330. Infection control records were used to find those patients who had pneumonia diagnosed during the study period, from January 1993 through December 1994.

A standardized data abstraction form was developed to capture the important demographic and study variables for each patient. Three physicians completed all the chart reviews and data abstraction forms. Data were analyzed using SPSS 6.1 for Windows statistical software.[22] Continuous variables were analyzed using the Student t-test, and categorical variables were analyzed using likelihood-ratios, chi-square, or the Fisher exact test when the sample size was small.

To be included in the study, all patients met the same major criterion—a new infiltrate found on a chest radiograph taken within 48 hours of the clinical suspicion of pneumonia—plus at least one of the following minor criteria:

1. Fever (temperature of 101°F or higher or an increase of 2°F from baseline)
2. Leukocytosis
3. Tachypnea (more than 20 breaths per minute)
4. New cough with sputum production
5. Decline in activity or functional status

Table 1. Possible Comorbid Conditions for Each Nursing Home Patient With Pneumonia.

Anemia
Atrial fibrillation
Cerebral vascular accident
Chronic obstructive pulmonary disease
Congestive heart failure
Coronary artery disease
Dementia
Depression
Diabetes
Hypertension
Hypothyroidism
Malignancy (other than skin)
Multiple sclerosis
Parkinson disease
Seizure disorder
Urinary tract infection
Other

The decline in activity or functional status had to reflect a documented, acute, major deterioration in the resident's activity or cognitive status.

Our definition for NHAP is similar to that used by the long-term care committee of the Association for Professionals in Infection Control,[23] except that we added leukocytosis as a minor criterion.

Numerical baseline scores for each patient's activities of daily living (ADLs) were obtained from the standardized Hospital and Community Patient Review Instrument that appears on all charts and is completed regularly by nursing staff as mandated by New York State. Four patient activities were measured: eating, mobility, transferring, and toileting.

Each individual ADL was scored on a scale from 1 to 5. In all categories the numerical score of 1 indicated the highest independent functional status, whereas 5 indicated total dependence. Separate and average ADL scores were recorded for each patient from the four ADL categories.[24] The scores were taken from the Patient Review Instrument most recently completed prior to the 2 weeks preceding the patient's diagnosis of pneumonia.

The comorbid diagnoses found in our study population are shown in Table 1. We recorded the average number of different medications prescribed for each patient per month. We included patients with advanced directives as long as there was no evidence that treatment was limited as a result of these directives. Oxygen was available in the nursing homes.

Table 2. Six-week Outcome of 129 Patients With Nursing-Home-Acquired Pneumonia.

Outcome	Hospitalized	Nonhospitalized
Resolved	23	74
Died	15	17

Patients had to be free of any evidence of respiratory infections for a 6-week period before the entry diagnosis of pneumonia. Cases of pneumonia that occurred in the same patient less than 6 weeks apart were considered to be recurrences of a single case.

The name, duration, and route of antibiotic administration were studied for each episode of pneumonia. To eliminate the possibility of acquired antibiotic resistance, the patient could not have received any antibiotics during the 2-week period before the diagnosis.

Patients were separated by two main treatment strategies: they were either cared for in the nursing home or hospitalized. Subsequently, they had two basic outcomes: they either improved (resolution of entry criteria) or died within 6 weeks (Table 2).

Results

One hundred twenty-nine patients (52 men and 77 women) had pneumonia diagnosed while they were in the nursing home during the study period, yielding an annual incidence of 18.5 percent. Seven cases outside the study period were included in the sample, but not in calculating the incidence. The average age at time of diagnosis was 83.6 years. Patient sex did not predict hospitalization or outcome in our study group.

The overall mortality rate for all patients was 24.8 percent. Ninety-one patients were treated in the nursing home, and 38 were hospitalized. The 6-week mortality rate for the nursing home group (n = 17) was 18.7 percent, whereas the hospitalized group (n = 15) had a mortality rate that was significantly higher at 39.5 percent. The average length of stay for hospitalized patients, 10.6 days, did not differ significantly between survivors and nonsurvivors. The largest group was nonhospitalized survivors (n = 74).

Twenty-four different antibiotics were prescribed 260 separate times, for an overall average

Table 3. Number of Times Specific Antibiotics Were Prescribed and Routes of Administration for Hospitalized and Nonhospitalized Patients With Nursing-Home-Acquired Pneumonia.

Antibiotic	Total	Hospitalized (n = 38)		Nonhospitalized (n = 91)	
		Oral	Parenteral	Oral	Parenteral
Ciprofloxacin	45	6	2	37	0
Ceftriaxone	39	–	18	–	21
Amoxicillin	22	0	–	22	–
Erythromycin	21	3	7	11	0
Clarithromycin	14	0	–	14	0
Penicillin	13	0	0	9	4
Trimethoprim-sulfamethoxazole	11	0	0	11	0
Cefotaxime	8	–	0	–	8
Cefuroxime sodium	7	–	7	–	0
Ampicillin/sulbactam	6	–	6	–	0
Clindamycin	5	2	3	0	0

of almost exactly two antibiotics per episode. The pattern of antibiotic use is shown in Table 3. Only antibiotics prescribed at least three times were included in the table.

The average number of days on antibiotic therapy differed significantly between the hospitalized and nonhospitalized groups. Hospitalized patients were taking antibiotics for an average of 17.8 days, while the nonhospitalized group was taking antibiotics for an average of 13.7 days ($P = 0.03$). Length of antibiotic treatment was not predictive of survival in either group, however.

Not surprisingly, hospitalization was strongly associated with use of intravenous antibiotics. Eighty-one percent of all hospitalized patients received parenteral antibiotics. Intravenous antibiotics were not used in any of the nonhospitalized patients.

Twenty-six of the 91 nonhospitalized patients (28.6 percent) received an average of one intramuscular antibiotic for an average of 6.2 days, either concurrently with or before switching to oral antibiotics alone, and 65 were prescribed oral antibiotics alone. The use of intramuscular antibiotics was not predictive of outcome in this nonhospitalized group, although the sample size of this subset of patients was probably too small for power analysis.

ADL scores for eating, mobility, transferring, and toileting, as measured by the standardized Patient Review Instrument, were not significantly different for any individual activities or for the average of all ADL scores measured among the hospitalized, nonhospitalized, survivor, and nonsurvivor groups. Baseline average number of medications per month (10.85) also did not differ significantly among the four groups.

Fever was the most common minor entry criterion (all patients had chest radiographs with evidence of an acute infiltrate) used to make the diagnosis of pneumonia in all patients. In the nonhospitalized group, 79 percent had fever as a diagnostic criterion. Fever was also the most frequent criterion for diagnosis in the hospitalized group (63 percent) but was not listed significantly more frequently than leukocytosis (58 percent) or tachypnea (58 percent). Percentages do not total 100 because often more than one minor criterion was listed for an episode of pneumonia.

Leukocytosis and tachypnea were the only two signs that predicted hospitalization at the time of diagnosis, but evidence of these signs did not predict outcome in either the hospitalized or nonhospitalized patients. A patient who had a comorbid diagnosis of hypertension, atrial fibrillation, or urinary tract infection was significantly more likely to be hospitalized (Table 4), but again, these comorbid diagnoses were not predictive of outcome.

Not surprisingly, hospitalized patients had more chest radiographs (2.2 compared with 1.1 in the nonhospitalized group). All hospitalized patients were given oxygen, whereas one half of the nursing home group remained on room air.

Of all survivors an additional 47 patients had died from causes not attributable to pneumonia by the time their charts were being reviewed for our study. The average length of time from diag-

Table 4. Signs with Significantly Different Prevalences ($P > 0.05$) Between Hospitalized and Nonhospitalized Patients.

Signs	Percent Hospitalized	Percent Nonhospitalized
Tachypnea	57.9	38.5
Leukocytosis	57.9	25.3
Hypertertension	39.5	22.0
Atrial fibrillation	23.7	8.8
Urinary tract infection	28.9	13.2

nosis of pneumonia to death in this group was 36.9 weeks.

Discussion

The findings of this study offer an important contribution to the scarce data on the incidence, treatment, and outcome of pneumonia in the burgeoning nursing home population. If oral antibiotic treatment in the nursing home is safe and efficacious, great cost savings could be realized when compared with routine hospitalization. One study estimated a savings of $3000 to $4000 per episode of pneumonia for patients treated in the nursing home rather than in the hospital.[19]

Other researchers have also attempted to single out independent predictors of mortality in acutely ill nursing home patients, mostly during hospitalizations. Mehr et al[17] found that increased mortality from NHAP was associated with patients' having a greater number of ADLs score in the dependent category. DeGalau et al[5] described feeding dependence and a need for mechanically altered diet as associated with oral antibiotic treatment failure in NHAP patients.

Our study did not reproduce these findings. In fact, we found no significant differences when comparing patients' baseline abilities to eat, mobilize, transfer, or toilet across all the groups.

A common argument given for hospitalizing the acutely ill nursing home patient is to administer intravenous antibiotics. Our hospitalized patients' baseline ability to take oral antibiotics, as measured by the eating ADL score recorded on the Patient Review Instrument, was not significantly different from that of the nonhospitalized group. We were not able to determine whether an acute change in feeding ability reflected a need for hospitalization.

The choice of antibiotic, route, and dose could be possible predictors of mortality. Most of the hospitalized group received intravenous antibiotics compared with none of the nonhospitalized group. Our study design did not have the power to determine failure rate by class of antibiotic, which will be a main goal of our next study.

Oral ciprofloxacin has been promoted as having tissue penetration equal to its intravenous route. Two review articles and two randomized studies of hospitalized patients with NHAP have specifically suggested oral ciprofloxacin for nursing home patients.[3,8,9,11] Ciprofloxacin was the most frequently prescribed drug for our nonhospitalized group as well as the most frequently prescribed antibiotic overall (Table 3).

Even though oxygen was available in the nursing homes, one half of the nonhospitalized group did not use it. The group cared for in the nursing home was significantly less tachypneic when the diagnosis was made, which might have obviated the need for supplemental oxygen.

We found a few statistically significant differences between the hospitalized and nonhospitalized groups that were associated with the likelihood of the patient being hospitalized, such as the presence of tachypnea, leukocytosis, hypertension, atrial fibrillation, or urinary tract infection. None of these differences carried through to predict outcome, however. Overall, we found the entry data collected on the hospitalized and nonhospitalized groups to be surprisingly similar.

The most striking difference between groups was the significantly higher mortality rate for the hospitalized group compared with that of the nonhospitalized group. The patients in the hospitalized group were not older or on more medications, nor was their baseline functional status decreased compared with their nonhospitalized counterparts. The few differences in signs and comorbidity that appeared at diagnosis did not predict outcome. Yet the hospitalized group was nearly three times more likely to die from their pneumonia (odds ratio 2.84).

We believe the most likely explanation for this difference in outcome is that the group admitted to the hospital had an acute decrease in functional status that was not reflected in our baseline ADL scores, which by design were recorded well before the diagnosis of pneumonia was made.

The hospitalized patients were probably sicker at the time of their admission. Even though an acute change in functional or mental status was

among our minor entry criteria for a patient to be diagnosed with pneumonia, this criterion was the hardest to verify and quantify, because evidence was found only in narrative progress notes. Consequently, acute functional status changes, such as decreased ability to take oral nutrition and medications or to ambulate, which in turn led to hospitalization and poorer outcome, were probably underreported.

Regardless of whether sicker hospitalized patients account in part or whole for the difference in mortality between the hospitalized and nonhospitalized groups, the main point of our study remains clear: it appears to be safe and efficacious to treat pneumonia in most patients with NHAP using oral antibiotics while the patients remain in the nursing home.

Pneumonia is a common event in the final year of a nursing home patient's life. Forty-seven additional patients had died from causes other than pneumonia within an average of 36.9 weeks of their entry into our study, for an overall mortality rate from all causes of 61.2 percent for our study period.

There will always be a subset of acutely ill nursing home patients with pneumonia who require the intensive support of a hospital setting. The question is, are these patients in the majority, as past review literature suggests, or are they a minority?

Along with the results of this study, a small but growing body of evidence suggests that most cases of NHAP can be safely and successfully treated in the nursing home using oral antibiotics for a considerable cost savings when compared with the costs of hospitalization.

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