Improving Outcomes for Nursing Home Residents with Lower Respiratory Tract Infection

Agency for Healthcare Research and Quality

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Key findings: Two predictive models may help physicians better determine the most appropriate care for nursing home residents by identifying (1) those at risk for pneumonia without obtaining a chest x-ray and (2) nursing home residents at low risk for LRI.

The studies "Clinical Findings Associated with Radiographic Pneumonia in Nursing Home Residents" and "Predicting Mortality in Nursing Home Residents with Lower Respiratory Tract Infection" were conducted in nursing homes in central Missouri and the St. Louis, MO area. Both were funded by the Agency for Healthcare Research and Quality (AHRQ), the Federal Government's lead agency charged with supporting research to improve the quality of health care, reduce its cost, address patient safety and medical errors, and broaden access to essential services. Additional funding was provided by the Robert Wood Johnson Foundation Generalist Physician Faculty Scholars and an Institutional National Research Service Award from the Health Resources and Services Administration.

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Introduction

Lower respiratory tract infection (LRI), which includes pneumonia, bronchitis, and tracheobronchitis, is the leading cause of mortality and hospitalization in nursing home residents. Often, the signs and symptoms of pneumonia, in particular, are not apparent in elderly patients, making diagnosis more complicated. In addition, clinician visits to these residents are few and sporadic and radiological facilities are not readily available. This results in residents being transferred to the hospital just for the purpose of x-ray evaluation. Researchers in Missouri have identified a prediction rule that may help clinicians who care for nursing home residents identify pneumonia without a chest x-ray.

Once an LRI has been diagnosed, clinicians can then determine the most appropriate care. For nursing home residents, many of whom are chronically ill, determining the severity of the illness is a critical step in deciding whether they should be treated in the nursing home or in the hospital. The Missouri researchers have identified patient characteristics predictive of 30-day mortality and used them to distinguish residents at low risk of dying from LRIs. Residents at low risk of dying may be able to receive nursing home care, thereby avoiding the potential complications associated with hospitalization.

Methods

Between August 15, 1995, and September 30, 1998, researchers in Missouri identified participants from 36 nursing homes in central Missouri and the St. Louis, MO area. As part of the Missouri LRI Project, the researchers analyzed 2,334 episodes of illness in 1,474 nursing home residents. Those residents with signs or symptoms of LRI whose chest x-rays showed evidence of pneumonia were evaluated to determine the pattern of symptoms that would indicate a high risk of pneumonia. Researchers developed a simple scoring system (range = -1 to 8) based on eight factors that independently predicted pneumonia without obtaining a chest x-ray: increased pulse, increased respiratory rate (30 or higher), temperature of 38 degrees C or higher, somnolence or decreased alertness, presence of acute confusion, lung crackles on auscultation, absence of wheezing, and elevated white blood cell count (Table 1).

Table 1. Scoring system for estimating 30-day mortality from lower respiratory infection in nursing home residents

Variable	Value	Points assigned	Patient value
BUN (mg/dL)	≤ 16	0	
	> 16 and up to 27	1	
	> 27 and up to 38	2	
	> 38 and up to 49	3	
	> 49 and up to 60	4	
	> 60 and up to 71	5	
	> 71	6	☐
WBC (10^9 cells/L)	≤ 14	0	
	> 14 and up to 24	1	
	> 24	2	☐
Absolute lymphocyte count* (10^9 cells/L)	> .8	0	
	≤ .8	1	☐
Pulse (beats/minute)	≤ 72	0	
	> 72 and up to 102	1	
	> 102 and up to 132	2	
	> 132	3	☐
Gender	Female	0	
	Male	1	☐
Body mass index (kg/m^2) †	> 31	0	
	> 25 and up to 31	1	
	> 19 and up to 25	2	
	> 13 and up to 19	3	
	≤ 13	4	☐
ADL‡	0	0	
	1 or 2	1	
	3 or 4	2	☐
Mood deterioration over last 90 days	No	0	
	Yes	2	☐
			☐

Sum of item scores for patient
To derive risk score, sum the assigned points. Risk of 30-day mortality is as follows:
1-4 points, 2.4%; 5-6 points, 6.9%; 7-8 points, 15.6%; 9-10 points, 34.5%; 11-17 points, 61.6%.

*To calculate absolute lymphocyte count, multiply WBC by percent lymphocytes. For an individual with a WBC of 8 x 10^9/L and percent lymphocytes of 15, (8 x 10^9/L) x .15 = 1.2 x 10^9/L. This value would receive 0 points.

†BMI is calculated as (weight in kg) divided by (height in m)^2. Divide weight in pounds by 2.2 to derive weight in kilograms (145 lb = 66 kg). Multiply height in inches by 2.54 to convert to cm, then divide by 100 to convert to meters (68 in = 1.727 m). BMI = 66/1.727^2 = 22.1.

‡ADL scoring is based on four ADL variables: grooming, toileting, locomotion, and eating. Each is assigned a 0 if the resident is independent, requires supervision, or requires limited assistance; a 1 is assigned if the resident requires extensive assistance or is totally dependent. The four scores are summed to derive an ADL score of 0 to 4 which is assigned points as shown above.

In a separate study of mortality risk due to LRI conducted during the same time period as the pneumonia study, these same researchers evaluated 1,406 episodes of LRI in 1,044 residents of 36 nursing homes in central Missouri and the St. Louis, MO area. Study participants were considered eligible if they were age 60, in the facility at least 14 days, off an antibiotic in the last 7 days for a previous LRI, were expected to live more than 30 days, did not have AIDS, and if they and their physicians and families agreed to participate. Clinical evaluations were recorded for several variables and compared for levels of differentiation and mortality after 30 days. Researchers developed a point system for clinicians specific to nursing home residents based on eight factors: serum urea nitrogen, white blood cell count, body mass index (BMI), pulse rate, activities of daily living (ADLs) status, low total lymphocyte count of less than 800/µl, male sex, and decline in mood over 90 days. The scores derived from the point system are then evaluated to determine the most appropriate care for the resident. A score of 0-4 indicates low risk for death occurring 30 days after diagnosis of LRI, and a score of 5-6, relatively low risk (Table 2).

Table 2. Scoring System* for Projecting Probability of Pneumonia

Factor	Range	Score
White blood cells per mm^3	< 10,000	0
	10,000 – 14,999	1
	≥ 15,000	2
Respiratory rate	< 30 per minute	0
	≥ 30 per minute	1
Somnolence or decreased alertness	Absent	0
	Present	1
Wheezes	Absent	0
	Present	-1
Acute confusion	Absent	0
	Present	1
Temperature	< 38°C	0
	≥ 38°C	1
Crackles	Absent	0
	Present	1
Pulse, beats per minute	< 110	0
	110 – 129	1
	≥ 130	2

*Points for the appropriate range of each factor are summed to derive an overall score. Residents with a score of -1 or 0 had a 24.5% probability of radiographic pneumonia; those with a score of 1, a 37.7% probability; a score of 2, 44.4%; a score of 3, 55.6%; and a score of 4 or more, 69.4% probability of pneumonia.

In developing this new mortality model, the researchers built on the work of earlier research funded by AHRQ and conducted by the Patient Outcomes Research Team (PORT) on Community-Acquired Pneumonia. The PORT developed and validated the Pneumonia Severity Index (PSI), which uses broad categories to identify pneumonia patients living in the community who can be treated safely at home. The LRI tool is more sensitive to residents of nursing facilities, giving more weight to variables such as ADLs, mood decline, and markers of poor nutritional status.

Inclusion criteria for both studies were the same, with the exception that residents in the mortality study had to meet the study definition of an LRI, whereas all those evaluated in the pneumonia diagnosis study were included to determine whether they met the study definition of an LRI.

Findings and Discussion

Researchers' findings confirmed that pneumonia in nursing home residents usually is associated with few symptoms, but a simple clinical tool can identify residents at high risk for pneumonia without the use of a chest x-ray. Among 2,334 episodes of illness in 1,474 nursing home residents, 45 percent of chest x-ray reports suggested possible or definite pneumonia. Yet in 80 percent of pneumonia episodes, patients had three or fewer respiratory or general symptoms. However, only 8 percent of patients had no respiratory symptoms. The 33 percent of residents scoring three or more points had more than a 50-percent probability of pneumonia, and the 24 percent of residents who had a score of 2 points had a 44-percent probability of pneumonia. Study limitations included the caution that residents were from a single state and the possibility of incomplete or missed clinical findings. The researchers note that if their findings are confirmed, doctors should consider treating residents at high risk of pneumonia—those with a score of at least two or three points on the scoring system—without obtaining a chest x-ray. For residents with a score of 1 or less, doctors should obtain an x-ray as a guide to treatment.

In the mortality risk study, researchers developed a new predictive model for 30-day mortality risk in nursing home residents with LRIs. Fifty-two percent of residents had low (score of 0-4) or relatively low (score of 5-6) predicted 30-day mortality, with 2.2 percent and 6.2 percent actual mortality, respectively. Again, researchers cautioned that the residents were from a single state. In addition, they noted limitations of some missing or potentially misclassified data. Still, the results are useful for identifying low-risk residents. If confirmed in other States, the prediction rule can be helpful to clinicians and researchers in deciding between nursing home care and hospitalization for residents with LRI.

For More Information

Study findings are presented in an article in the November 2001 issue of *The Journal of Family Practice:* Mehr DR, Binder EF, Kruse RL, et al. Clinical findings associated with radiographic pneumonia in nursing home residents. *J Fam Pract* 2001 Nov;50(11):931-7; and *The Journal of the American Medical Association:* Mehr DR, Binder EF, Kruse RL, et al. Predicting mortality in nursing home residents with lower respiratory infection: The Missouri LRI Study. *JAMA* 2001 Nov;286(19):2427-36.