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Predictors of Short-Term Functional Decline in Survivors of Nursing Home-Acquired Lower Respiratory Tract Infection

Ellen F. Binder,[1] Robin L. Kruse,[2] Ashley K. Sherman,[3] Richard Madsen,[3] Steven C. Zweig,[2] Ralph D'Agostino,[4] and David R. Mehr[2]

[1]Department of Internal Medicine, Washington University School of Medicine, St. Louis, Missouri.
Departments of [2]Family and Community Medicine and
[3]Statistics, University of Missouri—Columbia School of Medicine, Missouri.
[4]Department of Mathematics and Statistics, Boston University, Massachusetts.

Background. Scant information exists about the risk of functional decline following treatment of acute illness in the nursing home (NH) setting. The aim of this study was to determine the incidence of short-term (30-day) functional decline among survivors of NH-acquired lower respiratory tract infection (LRI) and the factors that predict such decline, including the role of initial hospitalization.

Methods. We used a prospective cohort design to study 781 episodes of LRI in 1044 NH residents in 36 NHs in central Missouri and the St. Louis metropolitan area. Functional decline was defined as a 3-point increase on the Minimum Data Set (MDS) activities of daily living (ADL) long form scale.

Results. Of 781 LRI cases who survived to 30 days, the incidence of ADL decline was 28.8%. In a logistic regression model that used generalized estimating equations to adjust for clustering, variables associated with ADL decline included the following: chronic feeding tube use (AOR = 4.54, 95% confidence interval, or CI, 1.61, 12.80), decubitus ulcer (adjusted odds ratio [AOR] = 2.29, 95% CI 1.35, 3.90), shortness of breath (AOR = 2.18, 95% CI 1.44, 3.30), short-term memory problems (AOR = 2.07, 95% CI 1.33, 3.23), decline in self-performance of toilet use in the 24 hours prior to evaluation (AOR = 1.65, 95% CI 1.29, 2.12), age (AOR = 1.02, 95% CI 1.00, 1.05), and baseline ADL score. Addition of treatment variables to the model showed that initial hospitalization was also associated with ADL decline (AOR = 1.90, 95% CI 1.20, 3.00). Residents with ADL decline at 30 days were less likely to recover to their baseline ADL status at 90 days.

Conclusions. Many NH residents who survive to 30 days following LRI develop new functional limitations, and such individuals are at risk for ADL decline at 90 days. A limited number of clinical variables may predict short-term functional decline. Initial hospitalization for acute treatment of LRI may increase the risk of subsequent ADL decline among individuals who survive to 30 days.

COMPLICATIONS of illness and treatment contribute to functional decline in the ill elderly population. Studies of hospitalized older patients have demonstrated short-term deterioration in mobility and performance of activities of daily living (ADL) that is associated with acute illness episodes (1–4). Predictive models for functional decline associated with hospitalization have been developed to assist clinicians with targeting of high-risk individuals (5–9) and to develop interventions to improve functional outcomes (10).

There is little information regarding the risk of functional decline after acute illness in the nursing home (NH) setting. Because of the high prevalence of cognitive and functional impairments among NH residents, such individuals may be at particularly high risk for further decline (6,7). In addition to survival, elderly patients and their families are concerned about quality of life as a treatment outcome (11). Information about the risk of functional decline may therefore be an important component of treatment decisions for ill NH residents, including choices about location of care.

Pneumonia and the broader category of lower respiratory tract infection (LRI) are a frequent cause of infection, and the leading cause of hospitalization for NH residents (12–14). There is also substantial variability in the rates of hospitalization for LRI (15). Some have suggested that treatment of pneumonia at the NH may reduce the risk of functional decline, particularly for individuals with higher levels of ADL function prior to illness onset (16). There is little research to support this conclusion, and most information has been collected from a single NH facility (16). A study that recruited subjects from several facilities found that individuals with pneumonia or LRI were no more likely to have ADL decline than individuals in whom infection did not develop (17).

The aim of our study was to determine the incidence of short-term (30-day) ADL decline among NH residents with acute LRI, and to determine clinical factors that predict such decline. We also hypothesized that hospitalization for an acute LRI episode would be associated with a higher risk of short-term ADL decline.

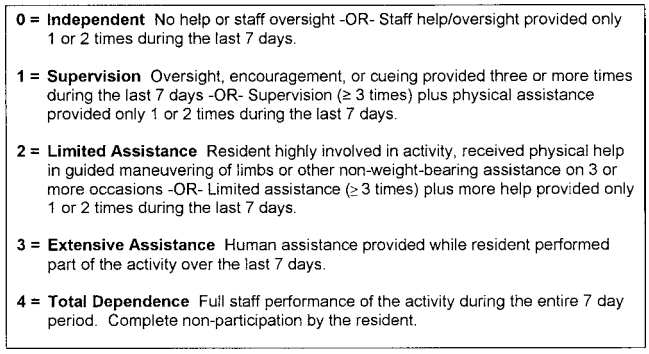

Figure 1. Self-performance scoring for Minimum Data Set activities of daily living items.

METHODS

Subject Identification and Data-Collection Procedures

Subjects for this study were identified from 36 NHs in central Missouri and St. Louis (approximately 4000 beds) between August 15, 1995 and September 30, 1998 as part of the Missouri LRI Study (18). The specific aims of the Missouri LRI Study were to identify clinical factors predictive of 30-day mortality and ADL decline among NH residents with LRI. The Institutional Review Boards (IRBs) of the University of Missouri—Columbia School of Medicine and Washington University School of Medicine approved the project with an exemption for written informed consent. Hospitals with an IRB also granted approval, one of which required informed consent for review of records. NHs and those hospitals without an IRB accepted the university IRB reviews and granted permission to abstract information from medical records.

Methods for LRI case identification have been previously described (18,19). Briefly, trained nurses evaluated residents with signs and symptoms compatible with an LRI. The 2592 evaluations occurred under a physician-authorized protocol in which NH residents with signs and symptoms of an LRI received a standardized history and physical examination by a project nurse under written authorization by the patient's attending physician. Project nurses aimed to perform the evaluation on the day of symptom onset. The evaluation also included a chest radiograph, complete blood count (CBC), and a chemistry panel. Sixty-five percent of cases were evaluated by a project nurse within 24 hours of symptom onset. For 9.2% of the evaluations, the NH resident was transferred to the hospital before an evaluation could be completed, and vital sign and clinical examination data were obtained from hospital records.

When an ill resident met our LRI case definition (see the following subsection), project nurses collected additional data by using the Minimum Data Set (MDS) Version 2.0 instrument (20,21). Project nurses interviewed NH staff familiar with the resident to obtain information about ADL performance during both the previous week and the 24-hour period prior to the evaluation, and recent symptoms of cognitive impairment, delirium, and depression. Information about height and weight, medical diagnoses and conditions, chronic treatments, and immunization status was obtained from the NH chart. On the basis of the evaluation data and chest radiograph reports, we ultimately classified 1406 illness episodes in 1044 residents as LRIs.

For residents whose illnesses met our case definition for LRI (18,19), project nurses returned to the NH facility at 30 and 90 days postbaseline to determine vital status and ADL status. In the few instances in which residents had left the facility, we followed up on their status at their new location and in three instances did a death certificate search.

The baseline and follow-up evaluations were performed on site and information was recorded on standardized forms that were placed in the resident's NH medical record and subsequently abstracted by project research assistants. Research assistants also abstracted information from hospital and NH records about diagnostic studies pertaining to the acute illness episode (e.g., blood or sputum cultures, urinalysis, urine culture), and treatments prescribed (e.g., oxygen therapy, antibiotics, or bronchodilators) during the 30-day period following the baseline evaluation.

Definition of LRI

To meet our LRI definition, the resident had to have pneumonia or at least three of the following six sign or symptom criteria: (a) new or increased cough; (b) new or increased sputum production; (c) fever $\geq 38°C$; (d) pleuritic chest pain, (e) new or increased findings on chest examination (rales, wheezes, etc); or (f) new or increased shortness of breath, or respiratory rate > 25, or worsened cognitive or functional status. We defined pneumonia as (a) at least two sign or symptom criteria just described for LRI and (b) chest x-ray interpretation of probable pneumonia. To be enrolled in the study, individuals with a history of congestive heart failure or chronic obstructive pulmonary disease were required to have a temperature $\geq 38°C$ as part of the LRI criteria or to meet our criteria for pneumonia.

Definition of ADL Decline

Data collected with the MDS instrument were used to calculate a total ADL score using the MDS ADL long form, which has a scale range of 0–28 based on summing scores for seven MDS ADL items (bed mobility, transfer, locomotion on NH unit, dressing, toilet use, personal hygiene, and eating) (22). Each ADL item is scored on the basis of the amount of assistance required for performance (Figure 1), with a higher score indicating greater ADL dependency. We defined ADL decline a priori as a 3-point increase on the MDS ADL scale between baseline and 30 days, because this amount of change had face validity for a substantial increase in staff supervision or assistance with ADLs: at a minimum, such change would require new supervision and cueing for three ADLs or new physical assistance for one ADL. This criterion was also evaluated retrospectively through an analysis of predictive validity for 90-day mortality. In our sample, a 3-point ADL decline is more strongly associated with 90-day mortality than a 2-point decline (6.8% vs 2.0%).

We did not include individuals with baseline scores at or near the "ceiling" of the MDS ADL scale because any further decline could not be reflected in a change of score. Such individuals represent prevalent "cases" of worst ADL

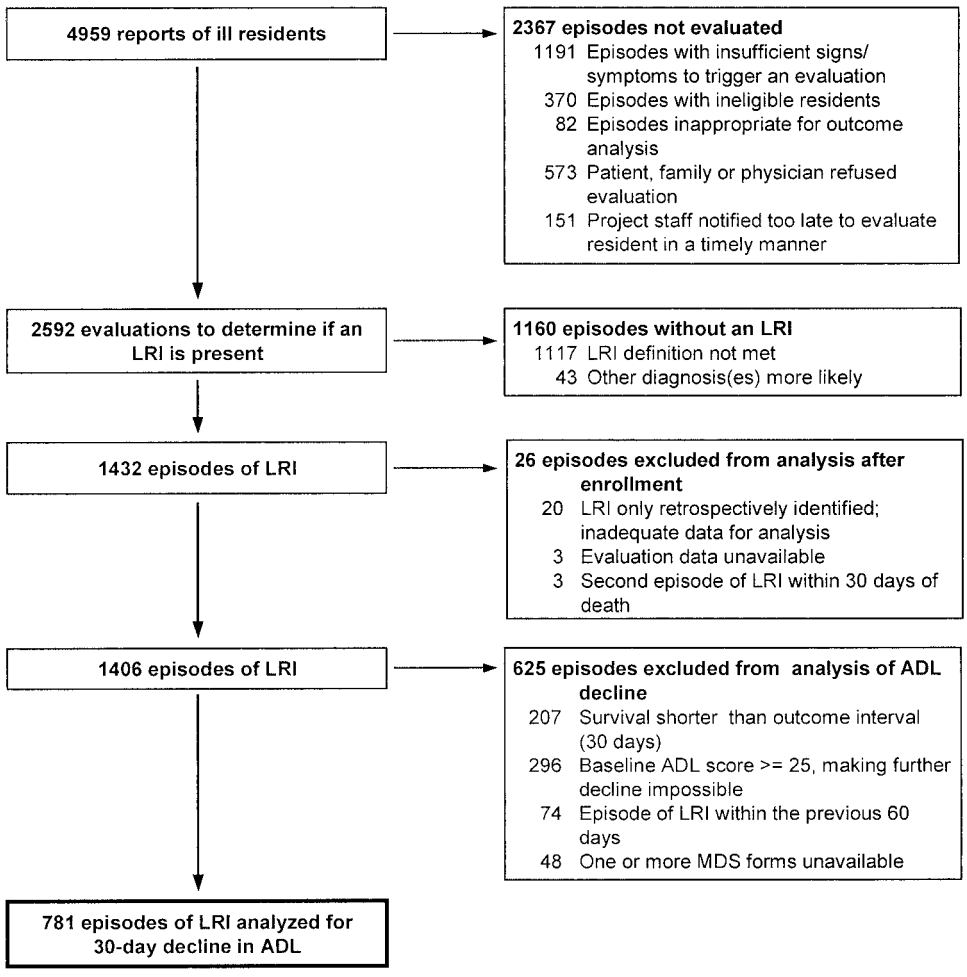

Figure 2. Derivation of study sample population. ADL = activities of daily living; LRI = lower respiratory tract infection; MDS = Minimum Data Set.

function, and their inclusion in our sample would make them falsely appear to have a good prognosis in relation to the outcome of ADL decline. Therefore, we included only those LRI cases in which the baseline MDS ADL score was below 25, which was the 75th percentile for the entire sample.

Statistical Analyses

To be included in this analysis, an individual had to have a baseline ADL score less than 25 and survive to 30 days postbaseline. Additionally, to control for the effects of recurrent LRI within a brief time period, we included only those cases in which the individual had been free of an LRI within 60 days preceding the baseline evaluation. Repeat episodes more than 60 days after a previous episode were, however, allowed.

To avoid the biases that are introduced by dropping cases with incomplete data (23), we imputed the mean for continuous variables with missing values and the mode for missing categorical data, after determining that this procedure was about as efficient as more complicated procedures. Individual variables were initially tested for their relationship to ADL decline using unimputed data. Promising variables with 10% or less missing data were allowed to compete in logistic regression models after data imputation, which was necessary for only a small number of variables.

To develop multivariate models, we first considered a variety of symptoms, physical findings, laboratory studies, and assessment information that, on the basis of published studies and clinical relevance, as judged by the investigators, might relate to ADL decline following an acute illness. A comprehensive list of 25 categories of variables was constructed, including demographics, vital signs, cognitive function, indicators of delirium and depression, nutritional status, medical diagnoses and conditions, laboratory test results, chronic treatments, restraint use, and initial treatments for the LRI episode, including route of antibiotic treatment (oral vs parenteral), oxygen use, and initial location of care (NH or hospital). For cognitive function, we used the MDS cognitive items and also calculated a Cognitive Performance Scale (CPS) total score, which is a validated measure of cognitive impairment that includes four of the six MDS cognitive items (comatose

Table 1. Characteristics of NH Residents Included in or Excluded From a 30-d Analysis of Decline in ADL

Characteristic	Included* (%)	Excluded† (%)	*p* Value
No. of residents	781	625	
Sex			
Female	69.1	65.3	.12
Male	30.9	34.7	
Race			
Black	6.8	9.9	.03
White	93.2	90.1	
Age			
60–69	5.0	5.1	.99
70–79	19.7	20.0	
80–89	43.4	43.8	
90+	31.9	31.0	
ADL status‡			
0–8 none to mild disability	32.5	11.2	<.0001
9–16 moderate disability	33.4	10.1	
17–24 moderate to severe disability	34.1	17.8	
25–28 complete disability		60.9	
Comorbid conditions			
CHF	31.1	32.2	.68
COPD	21.1	18.1	.15
Stroke	27.5	36.3	.004
Dementia	58.9	66.6	.003
Depression	37.1	39.8	.30
Diabetes	21.0	19.0	.36
Decub. ulcers (last 7 d)	9.7	20.8	<.0001
BMI < 20 kg/m^2	23.5	35.6	<.0001
Feeding tube at illness onset	2.4	18.1	<.0001

Notes: NH = nursing home; ADL = activities of daily living; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; BMI = body mass index; LRI = lower respiratory tract infection.

*Residents were in the upper 75th percentile for baseline functional status (lowest 75% of scores), survived to 30 days, and had no other LRI in the preceding 60 days.

†Residents were in the lowest 25th percentile for baseline functional status (highest 25% of scores), died within 30 days of evaluation, or had another LRI in the preceding 60 days.

‡Sum of self-performance ADL scores for bed mobility, transfer, locomotion on unit, dressing, eating, toilet use and grooming from the Minimum Data Set scale completed at the time of evaluation; scores of 8 were converted to 4 (22).

state, short-term memory/5-minute recall, daily decision making skills, and being understood by others), and the MDS item for eating self-performance (24).

We then considered descriptive and bivariate statistics describing the relationship between each candidate variable and 30-day ADL decline. We used the chi-square statistic to test for differences in proportions. On the basis of clinical relevance or a significant bivariable relationship with ADL decline ($p < .10$), we then considered variables for inclusion in a logistic regression model to identify independent predictors of ADL decline. Categories of variables were competed against each other in stepwise regression models. The best predictors from the initial models were then competed against each other to derive the final model. Two potentially relevant variables, cholesterol and albumin, were not considered because of excessive missing data. When large chemistry panels became impermissible under Medicare regulations, most physicians could not justify more than a basic metabolic panel in the context of an LRI. Baseline MDS ADL score was included in the final model because the change in score is related to the individual's baseline. After we developed our best clinical predictive model, we tested the effect of adding treatment variables. Route of administration of antibiotics was highly correlated with site of initial care, and therefore it was dropped from the analysis.

Because individuals could have more than one episode, and each facility could have many individuals with episodes, generalized estimating equations were used to adjust logistic regression estimates for correlations within our data (25). We used generalized estimating equations to examine the effects of the nesting of individuals within NHs and to control for multiple episodes per individual. This matched our primary interest in the relationship of resident characteristics to outcomes. A random effects mixed model would focus more on facility variation, which, in the context of this analysis, was not the main focus. All analyses were performed by using SAS statistical software, Release 8.0 (SAS, Cary, NC).

Results

Of the 1406 illness episodes that were identified as an LRI (19), 781 were included in this analysis. Figure 2 outlines the derivation of the sample used for this analysis. Selected characteristics of the sample are listed in Table 1. The demographic characteristics and comorbid conditions of these LRI cases differed from excluded cases ($n = 625$) for a number of variables, including baseline ADL score, prevalence of stroke, dementia, decubitus ulcers, and chronic feeding tube use, reflecting the exclusion of some of the most severely ill residents from this sample. The incidence of 30-day ADL decline in this sample was 28.8%. In addition, 66.1% of the cases with ADL decline at 30 days either died or did not recover to their baseline ADL status between baseline and 90 days after enrollment, whereas only 23% of those without ADL decline died or declined ($p < .0001$) (Figure 3). Ninety-four (12%) of the 781 cases were hospitalized within 24 hours of enrollment, whereas 147 (19%) were hospitalized within 1 week.

Table 2 shows the bivariable relationships between selected variables and 30-day ADL decline. A large number of variables are associated with ADL decline, including age, short-term memory problems, lethargy, shortness of breath, low lymphocyte count, elevated blood urea nitrogen levels, and the presence of decubitus ulcers or a feeding tube. Treatment variables associated with ADL decline were new oxygen use and hospitalization within 24 hours of the baseline evaluation.

Results of the multivariate logistic regression are presented in Table 3. Variables significantly associated with ADL decline in our initial model were as follows: feeding tube use, presence of a decubitus ulcer, shortness of breath at initial report of illness, short-term memory problems, decline in self-performance for toileting during the 24 hours prior to the evaluation, age, MDS ADL score at baseline, and the square of the MDS ADL score. In the second step of our model construction, we evaluated the

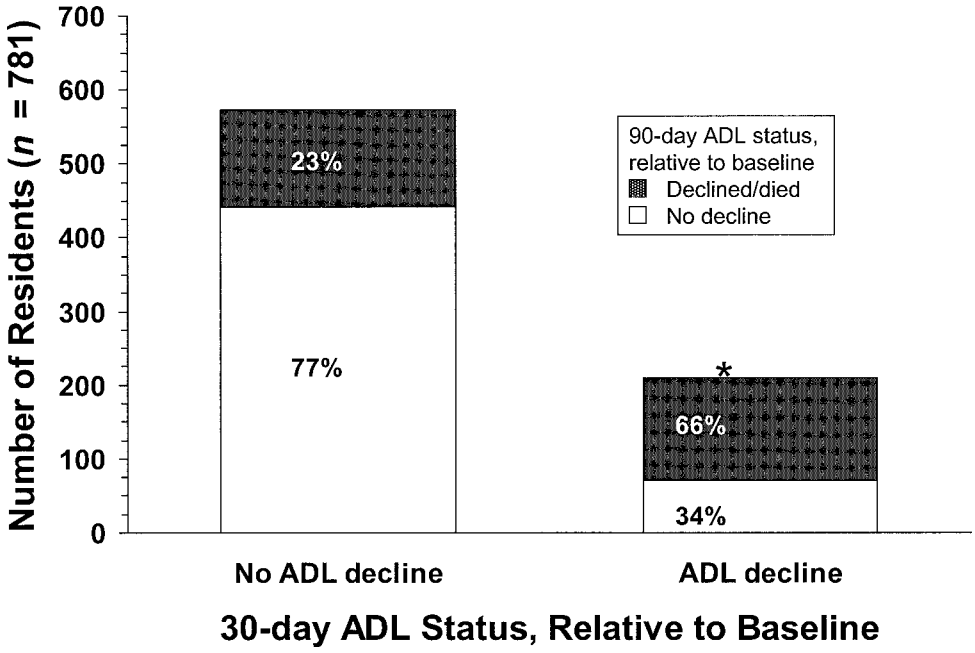

Figure 3. Incidence of activities of daily living (ADL) decline or death at 90 days among 30-day lower respiratory tract infection (LRI) survivors ($n = 781$), relative to baseline. ADL decline is defined as a 3-point increase on the MDS ADL -long form scale. The incidence of LRI decline or death between baseline and 90 days was higher among residents who declined between baseline and 30 days than among residents who did not decline (66% vs 23%, $p < .0001$). $^{*}p < .0001$.

effect of adding each of the treatment variables. Oxygen use was not significant in the model, whereas initial hospitalization (adjusted odds ratio [AOR] 1.90, 95% confidence interval, or CI, 1.20, 3.00) was significantly associated with ADL decline. We performed further analyses to evaluate the relationship between hospitalization, restraint use, and ADL decline, and we found that they were not related.

Discussion

We prospectively studied a large sample of NH residents who resided in multiple facilities to develop a risk prediction model for short-term ADL decline following an acute episode of LRI. We used information that would be easily available to NH clinicians at the time of the initial treatment decisions. The results of this study suggest that measures of chronic illness severity or related disability may have a greater role in predicting short-term ADL decline than clinical measures of acute LRI illness severity at the time of symptom onset. This contrasts with our findings and those of others concerning mortality predictors, in which several measures of acute illness severity (e.g., pulse rate and white blood count) are important mortality predictors (18,26). Similar to studies performed in the hospital setting (4,6,8,9), in this study individuals with moderate baseline ADL impairments, cognitive impairment, and poor nutritional status were at high risk for functional decline.

A single CPS item, presence of short-term memory problems, was predictive of ADL decline, whereas the total CPS score and MDS orientation items were not. The reasons for this are not clear. Among the other CPS items, coma is rare, and residents with dependence in eating were not highly represented in this sample because we excluded those with the worst baseline ADL function. Our results suggest that NH residents with mild to moderate cognitive impairment are independently at risk for ADL decline, and that greater levels of cognitive impairment do not confer greater risk.

The feeding tube and decubitus ulcer variables may indicate risk associated with nutritional deficiency, though they may also be markers for chronic illness. Because of excessive missing data, we were unable to examine the relationship between serum albumin and cholesterol levels, and ADL decline. Other measures of poor nutritional status, such as body mass index and weight loss, were not independently related to ADL decline. Further research is necessary to clarify whether individuals with less severe nutritional deficiencies are at risk for decline. The linear and quadratic terms for ADL function suggest that moderate ADL impairment is the strongest predictor of decline (maximum decline occurs at a baseline ADL score of 10). This may in part reflect more room to decline among those with moderate impairment compared with those who are more severely impaired.

Results from this study are similar to those of Fried and colleagues (16), who studied NH residents at a single urban facility and found that hospitalization for treatment of pneumonia was independently associated with death or ADL decline at 2 months. There were many differences in methodology between the two studies. Fried and colleagues used different criteria to define LRI cases, ADL decline, the time period under study (60 days), and, most importantly, the primary outcome measure (combined death and ADL decline). Functional and cognitive status data were collected retrospectively, and laboratory data were not obtained. Despite these differences, it is notable that the incidence of ADL decline among ''survivors'' in both studies was

Table 2. Relationship of Selected Clinical Variables and LRI Treatments with 30-d Decline in ADL Among LRI Survivors

Variable	Residents with Condition		Relative Risk (95% CI)
	Number	ADL Decline (%)	
Demographics			
Age ⩾ 95	80	40.0	1.58 (1.18–2.13)
Race = black	53	24.5	0.91 (0.56–1.48)
Sex = male	241	23.2	0.82 (0.63–1.17)
ADL status			
Baseline ADL score			
0–8 none to mild	254	27.6	Reference
9–16 moderate	261	31.4	1.14 (0.87–1.49)
17–24 moderate to severe	266	21.4	0.78 (0.57–1.05)
Toileting self-performance decline in prev. 24 h	43	51.2	2.03 (1.48–2.79)
Vital signs			
Pulse ⩾ 100 beats per min	166	28.9	1.10 (0.84–1.45)
Respiratory rate ⩾ 30 per min	187	28.3	1.08 (0.83–1.42)
Temperature			
36.1–38.9°C (97–100.9°F)	580	25.3	Reference
⩾ 38.9°C (101°F)	156	32.7	1.29 (0.99–1.68)
< 36.1°C (97°F)	28	28.6	1.13 (0.62–2.06)
Systolic blood pressure < 95 mm Hg	53	32.1	1.19 (0.79–1.79)
Symptoms			
Cough	690	25.1	0.63 (0.48–0.84)
Lethargy: recent onset or worsening	103	36.9	1.46 (1.10–1.94)
Shortness of breath	130	42.3	1.79 (1.40–2.28)
Somnolent/comatose/restless	135	34.8	1.39 (1.06–1.81)
Laboratory findings			
WBC > 15,000/mm^3	106	32.1	1.24 (0.91–1.69)
Absolute lymphocytes < 800	145	34.5	1.40 (1.07–1.83)
Albumin ⩽ 2.8 g/dl	41	31.7	1.36 (0.84–2.19)
BUN ⩾ 30 mg/dl	187	32.6	1.30 (1.00–1.68)
Hematocrit ⩽ 30%	51	27.4	1.03 (0.64–1.63)
Sodium ⩾ 140 mmol/l	287	26.8	0.98 (0.92–1.11)
Chest x-ray findings			
Possible/probable CHF	164	28.0	1.05 (0.80–1.39)
Possible/probable pneumonia	498	29.5	1.32 (1.02–1.72)
Comorbid illnesses and conditions			
History of COPD	165	25.4	0.94 (0.70–1.26)
History of CHF	243	28.4	1.09 (0.85–1.39)
History of diabetes	164	23.2	0.84 (0.62–1.14)
History of stroke	215	25.1	0.92 (0.70–1.20)
BMI < 20 kg/m^2	183	30.6	1.19 (0.92–1.54)
Decubitus ulcers	76	39.5	1.55 (1.15–2.11)
Feeding tube	19	52.6	2.02 (1.29–3.14)
Foley catheter	37	32.4	1.23 (0.76–1.99)
Weight loss	89	27.0	1.00 (0.69–1.44)
Deterioration in mood, last 90 d	61	29.5	1.12 (0.75–1.13)
Oxygen use at or before evaluation	154	35.1	1.42 (1.10–1.83)
Cognitive function			
Cognitive Performance Score			
0–2	323	22.9	Reference
3–5	443	28.7	1.25 (0.98–1.60)
6	15	53.3	2.33 (1.39–3.89)
Short-term memory problems	589	29.2	1.55 (1.12–2.13)
Treatment after LRI onset			
New oxygen use	130	38.5	1.57 (1.22–2.03)
Initial hospitalization (within 24 h)	94	41.5	1.78 (1.40–2.26)

Notes: LRI = lower respiratory tract infection; ADL = activities of daily living; WBC = white blood cell (count); BUN = blood urea nitrogen (level); CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; BMI = body mass index; CI = confidence interval. Categories shown for continuous variables are for illustration only and do not represent the only form in which they were considered for multivariate modeling; n = 781.

identical, at 28%. It is possible that initial hospitalization is an indicator of greater illness severity. Another possible explanation is that hospitalized individuals experience more restricted mobility with associated muscle atrophy and loss of strength (27,28), which could directly contribute to ADL impairments. This appears to be independent of restraint use. Results from our study and those of Fried's group should be interpreted cautiously, and randomized trials

Table 3. Predictors of 30-d Decline in ADL for Residents: GEE Analysis

Variable	Coefficient	Odds Ratio† (95% CI)	*p* Value
Intercept	−4.2864		
Feeding tube*	1.5126	4.54 (1.61–12.80)	.0043
Decubitus ulcer*	0.8300	2.29 (1.35–3.90)	.0022
Shortness of breath*	0.7787	2.18 (1.44–3.30)	.0002
Short-term memory problems*	0.7266	2.07 (1.33–3.23)	.0014
Toileting self-performance decline in prev. 24 h*	0.5031	1.65 (1.29–2.12)	<.0001
Age*	0.0230	1.02 (1.00–1.05)	.054
MDS ADL long form score	0.1277	NA	.0047
MDS ADL long form score squared	−0.0061	NA	.0009
Hosmer–Lemeshow goodness-of-fit statistic, p = .228; c statistic = .694			

Notes: ADL = activities of daily living; GEE = generalized estimating equations; MDS = Minimum Data Set; CI = confidence interval; NA = not applicable because with both total ADL score and its square in the model, the odds ratio varies for every value of ADL. In the GEE analysis (n = 779), two fourth episodes for two subjects were excluded.

*For dichotomous variables, 1 = yes or present; 0 = no or not present.

†The odds ratio shown is for a 1-y change (e.g., increase in age from 85 to 86).

would be necessary to confirm a causative relationship between hospitalization and ADL decline.

It is notable that a large number of individuals who declined at 30 days following an LRI had persistent ADL decline at 90 days after baseline. Although most NH clinicians are familiar with the downward spiral of function in the context of chronic illness, to the best of our knowledge, this is the first study to quantify the incidence of progressive ADL decline associated with acute illness in this setting.

Our study has limitations, several of which have been discussed previously (18,19). ADL performance was measured by using interviews with NH staff who were familiar with the patient. Although studies have demonstrated the reliability and validity of the MDS instrument (21), it is possible that NH staff were not providing accurate information, particularly for the 24-hour period prior to the LRI evaluation. Because ADL status was measured by using information about assistance over the week prior to each assessment, it is possible that we may have missed some cases of ADL decline if the decline began during the week prior to the baseline evaluation. This would mean that our study provides a conservative estimate of the incidence of ADL decline associated with LRI. Second, we excluded a substantial number of cases because of complete ADL disability, survival less than 30 days, or recurrent episodes of LRI within 60 days preceding the baseline evaluation. The excluded cases were more disabled than those in our sample were, and we may therefore have underestimated the importance of some predictor variables and misspecified the importance of others. Lastly, we were unable to validate our model in another sample of NH residents. Therefore, our model may not be generalizable to all NH residents with LRI and requires further evaluation and validation.

Conclusions

In summary, this study demonstrates that many NH residents develop new functional dependencies at 30 days following an episode of acute LRI. Of those who decline, two thirds did not return to their baseline ADL function at 90 days. A limited number of readily available clinical variables may predict the risk of functional decline following an LRI. Further study will be necessary to validate our findings. In the future, models such as ours could be very useful to clinicians, patients, and family members in providing information that could be incorporated into decisions about treatment for LRI and locations of care.

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Address correspondence to Ellen F. Binder, MD, Washington University School of Medicine, Division of Geriatrics and Gerontology, 4488 Forest Park Blvd., Suite 201, St. Louis, MO 63108. E-mail: ebinder@im.wustl.edu

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