The Effect of Marital Status on the Presentation and Outcomes of Elderly Male Veterans Hospitalized for Pneumonia

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Background: Although marital status has been shown to affect the outcomes of many conditions, there are limited data on the relationships between marital status and the presentation and outcomes of pneumonia.

Methods: We used Veterans Affairs administrative databases to identify a retrospective cohort of male veterans age ≥ 65 years hospitalized for pneumonia between 2002 and 2007. We assessed unadjusted and adjusted associations between marital status and mortality, hospital length of stay, and readmission to the hospital using generalized linear mixed-effect models with admitting hospital as a random effect and adjusted for baseline patient characteristics.

Results: There were 48,635 patients (26,558 married and 22,077 unmarried) in the study. Married men had a slightly higher Charlson comorbidity score (3.0 vs 2.8, $P < .0001$) but were less likely to require ICU admission, ventilator support, and vasopressor treatment during the first 48 h of hospitalization. Married patients had significantly lower crude and adjusted in-hospital mortality (9.4% vs 10.6%; adjusted OR, 0.87; 95% CI, 0.81-0.93) and mortality during the 90 days after hospital discharge (14.7% vs 16.0%; adjusted OR, 0.92; 95% CI, 0.88-0.98). Their adjusted incidence rate ratio length of stay was also lower (0.92; 95% CI, 0.91-0.92).

Conclusions: Unmarried elderly men admitted to the hospital with pneumonia have a higher risk of in-hospital and postdischarge mortality, despite having a lower degree of comorbidity. Although marital status may be a surrogate marker for other predictors, it is an easily identifiable one. These results should be considered by those responsible for care-transition decisions for patients hospitalized with pneumonia.

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Abbreviations: CAP = community-acquired pneumonia; ICD-9 = *International Classification of Diseases, 9th Revision, Clinical Modification*; VA = Veterans Affairs

Community-acquired pneumonia (CAP) remains a frequent cause of morbidity and is a leading cause of death worldwide.¹ In the United States, approximately 12% of elderly patients admitted to the hospital with pneumonia die within 30 days of admission,²

with men at greater risk than women. Patients who survive the initial hospitalization remain at increased risk of death for many months after discharge.³ In addition to the substantial morbidity and mortality associated with pneumonia is a tremendous societal cost. Pneumonia care is estimated to cost as much as \$17 billion per year in the United States.⁴ Because approximately 18% of elderly patients admitted to the hospital with pneumonia are readmitted within 30 days,⁵ the true cost is much higher.

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The outcomes of patients admitted to the hospital with CAP depend on a variety of factors. Baseline patient factors such as age,⁶ functional status,⁷ and the presence of comorbidities⁶ are important determinants of mortality risk. Demographic characteristics such as race⁸ and socioeconomic status may be predictors of either short-term or longer-term outcomes, such as length of stay and hospital readmission, although the latter has not been a uniform finding.⁹ Acute severity of illness, as reflected by abnormalities in vital signs, gas exchange, and certain laboratory values plays a major role in patient outcomes.⁶ Finally, processes of care, including timing¹⁰ and type of antibiotic therapy¹¹ and ancillary treatments such as statins,¹² have been associated with outcomes, although the degree to which these factors play a causative role remains controversial.

Marital status has also been demonstrated to be a predictor of outcomes in patients hospitalized for a variety of conditions.^{13,14} In one study of all-cause medical and surgical admissions, there were several important differences in the outcomes of unmarried and married patients.¹³ Risk-adjusted hospital mortality was higher in unmarried surgical patients but not medical patients.¹³ Hospital length of stay, hospital costs, and risk of discharge to a nursing facility were all higher in unmarried patients.¹³ Similarly, married patients hospitalized with heart failure had a lower risk of death and hospital readmission than did single patients.¹⁴

There are limited data available regarding the effect of marital status on outcomes of pneumonia. Disparate results have been found in population-based studies in which marital status was examined as a predictor of admission to the hospital with pneumonia.¹⁵ For those patients admitted to the hospital with pneumonia, hospital length of stay is shorter in married patients, with the magnitude of effect being less in elderly patients.¹⁶ However, it is not known whether there is an association between marital status and pneumonia-related mortality or hospital readmission. The primary purpose of this study was to assess the association between marital status and mortality in elderly male patients admitted to the hospital with pneumonia. Secondary outcomes of interest were hospital length of stay and readmission rates.

MATERIALS AND METHODS

As part of a study to assess association of statin use and outcomes of pneumonia, we used the administrative databases of the Department of Veterans Affairs Health Care System to identify a cohort of elderly veterans hospitalized for pneumonia. These databases are the repositories of clinical data from > 150 of the Veterans Affairs (VA) hospitals and 850 outpatient clinics.¹⁷ The institutional review board of the University of Texas Health Science

Center at San Antonio approved the present study using an expedited review (HSC20070783H).

Inclusion and Exclusion Criteria

Subjects included in this study:

1. Were age 65 or older on the date of hospital admission.
2. Had at least one VA outpatient clinic visit in the year preceding the index admission.
3. Received at least one active and filled outpatient medication from a VA pharmacy within 90 days of admission.
4. Were hospitalized during fiscal years 2002 to 2007 (October 2001 to September 2007).
5. Had a previously validated discharge diagnosis of pneumonia/influenza (*International Classification of Diseases, 9th Revision, Clinical Modification* [ICD-9] codes 480.0-483.99 or 485-487)¹⁰ or a secondary discharge diagnosis of pneumonia with a primary diagnosis of respiratory failure (ICD-9 code 518.81) or sepsis (ICD-9 code 038.xx).
6. Received at least one dose of antimicrobial therapy within the first 48 h of admission.

Because there were few women in the cohort, the analyses were restricted to male patients. Patients admitted from a skilled nursing facility were also excluded in order to remove most patients with health-care-associated pneumonia. Patients with immunosuppression were not excluded. If a subject was admitted more than once during the study period, only the first hospitalization was included.

Data Sources

We obtained demographic, utilization, and comorbidity data from the National Patient Care Database and pharmacy data from the VA Decision Support System National Data Extracts and Pharmacy Benefits Management database. We obtained vital status information from VA's Vital Status file, which incorporates data from veterans' death benefits claims, inpatient deaths, Medicare Vital Status files, and the Social Security Administration death master file. We used encrypted patient identifiers to link patient information across these databases.

Baseline patient data included demographic characteristics, comorbidities, and the presence of substance abuse. Demographic information included age, sex, race, and marital status. Priority status was used as a proxy for socioeconomic status. Priority groups include (1) at least 50% disabled by a military service-connected condition (priority group 1); (2) up to 40% service-connected disability or special wartime cohorts; such as Operation Enduring Freedom/Operation Iraqi Freedom (priority groups 2-6); and (3) higher-income patients with no service-connected injuries (priority groups 7-8). Marital status was defined as either currently married or unmarried. Those who were divorced or widowed were considered as unmarried. Race/ethnicity categories included white, black, Hispanic, and other/unknown.

We obtained information on comorbid conditions from both inpatient and outpatient administrative data. Alcohol abuse was defined by ICD-9 codes 291, 303, and 305.0 and illicit drug use by ICD-9 codes 292, 304, and 305 excluding 305.1. To infer current smoking use and/or cessation, we identified ICD-9 codes for tobacco use (305.1, V15.82), smoking cessation clinic use, and/or use of medications for the treatment of nicotine dependence (Zyban, nicotine replacement, or varenicline). We used Charlson comorbidity methodology to classify other preexisting comorbid conditions, both individually and as a composite score.¹⁸ Charlson comorbidity system includes 19 comorbid conditions, which are classified using ICD-9 codes from prior outpatient and inpatient encounters.¹⁹ We also captured the number of ED and primary

care visits during the year prior to admission. Processes of care included use of guideline-concordant antibiotic therapy and admission to an ICU, use of vasopressors, or mechanical ventilation during the first 48 h of the hospital.

Outcomes

The primary outcome of interest in this study was mortality, reported as in-hospital mortality and mortality during the 90 days after discharge. Other outcomes of interest were hospital length of stay and all-cause rehospitalization within 90 days of discharge from the hospital. Mortality was assessed using the VA vital status file. Previous studies have demonstrated that this methodology has a sensitivity of about 98% for veterans' deaths.²⁰

Statistical Analyses

Bivariate statistics were used to test the association of sociodemographic and clinical characteristics with marital status. Categorical variables were analyzed using the χ^2 test, and continuous variables were analyzed using Student *t* test. Separate generalized linear mixed-effect models with admitting hospital as a random effect were used to examine the association between marital status and each of the outcomes. Covariates included: VA priority status, number of primary care or ED visits in the prior year, patient sex, race, Hispanic ethnicity, individual comorbid conditions, tobacco use, alcohol abuse or dependence, and guideline-concordant antibiotic therapy. ICU admission, use of vasopressors, or mechanical ventilation during the first 48 h of the hospital stay were used as covariates only for the postdischarge outcomes. Statistical significance was defined as a two-tailed *P* value of $\leq .05$. All analyses were performed using STATA 11 (StataCorp LP).

RESULTS

Baseline Characteristics

There were 48,635 pneumonia admissions of male veterans included in the analysis. Of these, 26,558 patients (54.6%) were married at the time of admission. Among the unmarried patients, 10,071 were divorced (20.7%), 9,349 were widowed (19.2%), and 2,657 (5.5%) were never married. Table 1 demonstrates the baseline characteristics and requirement for ICU admission, vasopressors, and mechanical ventilation during the first 48 h of admission for each group. Unmarried patients were more likely to be black and less likely to be Hispanic or non-Hispanic whites. Unmarried patients were also more likely to use tobacco products and abuse alcohol or drugs. Married patients were less likely to have a low income. Some comorbidities were more common in married patients, whereas others were more common in unmarried patients. The Charlson comorbidity index was slightly higher in married patients (3.0 vs 2.8, $P < .0001$). Married patients were significantly less likely to require ICU care, mechanical ventilation, or vasopressors during the first 48 h of hospitalization.

Outcomes

Table 2 demonstrates the unadjusted outcomes in the two groups. Married patients had a significantly lower in-hospital mortality rate (9.4% vs 10.6%,

$P < .0001$) and, among those surviving hospitalization, lower mortality during the 90 days after hospital discharge (14.7% vs 16.0%, $P < .0001$). Married patients also had a significantly lower hospital length of stay. The risk of hospital readmission during the 90 days after discharge was nearly identical for the two groups. Figure 1 demonstrates Kaplan-Meier survival curves for the two populations starting at the time of hospital admission. Married men had a significantly higher 90-day survival ($P < .0001$).

Table 3 demonstrates the adjusted risk of requiring ICU admission, vasopressors, or mechanical ventilation during the first 48 h of hospital stay. Married men were less likely to require all three interventions.

Table 4 demonstrates the risk-adjusted outcomes for married and unmarried patients. Married patients had significantly lower adjusted in-hospital mortality (OR, 0.87; 95% CI, 0.81-0.93) and mortality during the 90 days after hospital discharge (OR, 0.92; 95% CI, 0.88-0.98). Their risk-adjusted hospital length of stay was also lower (OR, 0.92; 95% CI, 0.91-0.92). There was no difference in the adjusted 90-day risk of hospital readmission between married and unmarried patients.

DISCUSSION

Among a large cohort of male veterans admitted to the hospital with pneumonia, we found that marital status was a robust independent predictor of several important outcomes. Although married patients were found to have a slightly higher level of baseline comorbidities at the time of admission, they had a lower risk-adjusted rate of admission to the ICU or need for vasopressors or mechanical ventilation within 48 h of hospital admission. Since it is unlikely that marital status or differences in the application of other processes of care directly affect the use of these interventions so early in the hospital stay, these results suggest that married men with pneumonia present to the hospital less acutely ill than unmarried men, despite their higher level of comorbidity. Similarly, married men had a 13% lower adjusted risk of in-hospital mortality and an 8% lower adjusted risk of mortality during the 90 days after discharge. This difference in hospital mortality approaches the magnitude of benefit noted in studies of the timing of initial antibiotics.

What could explain our finding that married men appear to present with less severe acute severity of illness, despite their higher level of comorbidity? Married men had higher socioeconomic status and lower rates of substance abuse, but these factors were adjusted for in the multivariate analysis. A reasonable possibility is that married men are encouraged to seek medical attention by their spouses and, thus, present earlier in the course of their disease than unmarried men. If true, this finding suggests that earlier treatment

Table 1—Baseline Patient Characteristics According to Marital Status

Variable	Marital Status		P Value
	Married (n = 26,558)	Not Married (n = 22,077)	
Age, mean (SD), y	77.3 (6.5)	77.7 (7.0)	< .0001
Race			
White	21,102 (79.5)	16,881 (76.5)	< .0001
Black	2,383 (9.0)	3,118 (14.1)	< .0001
Hispanic	1,939 (7.3)	1,212 (5.5)	< .0001
Other	1,134 (4.3)	866 (3.9)	.05
Preexisting comorbid conditions			
Charlson comorbidity index	3.0 (2.4)	2.8 (2.3)	< .0001
Myocardial infarction	1,934 (7.3)	1,465 (6.6)	.005
Congestive heart failure	6,954 (26.2)	5,562 (25.2)	.013
Peripheral vascular disease	4,118 (15.5)	3,461 (15.7)	.60
Cerebrovascular disease	5,087 (19.2)	3,777 (17.1)	< .0001
Dementia	1,397 (5.3)	1,090 (4.9)	.11
Chronic pulmonary disease	14,013 (52.8)	11,893 (53.9)	.01
Rheumatologic disease	835 (3.1)	517 (2.3)	< .0001
Peptic ulcer disease	900 (3.4)	739 (3.3)	.80
Mild liver disease	185 (0.7)	209 (0.9)	.002
Hepatic failure	87 (0.3)	98 (0.4)	.03
Diabetes	9,217 (34.7)	6,725 (30.5)	< .0001
Diabetes with complications	2,961 (11.1)	1,861 (8.4)	< .0001
Hemiplegia/paraplegia	426 (1.6)	314 (1.4)	.10
Chronic renal disease	3,428 (12.9)	2,699 (12.2)	.02
Cancer	6,443 (24.3)	5,181 (23.5)	.04
Leukemia	784 (3.0)	496 (2.2)	< .0001
Metastatic cancer	1,025 (3.9)	804 (3.6)	.20
AIDS	24 (0.1)	89 (0.4)	< .0001
HIV	9 (0.03)	30 (0.1)	< .0001
Tobacco use	9,327 (35.1)	8,843 (40.0)	< .0001
Alcohol abuse	673 (2.5)	1,334 (6.0)	< .0001
Drug abuse	205 (0.8)	330 (1.5)	< .0001
Other covariates			
Primary care clinic stops, mean (SD)	5.0 (4.2)	4.7 (4.3)	< .0001
ED stops, mean (SD)	1.2 (2.0)	1.2 (2.0)	.82
Guideline-concordant antibiotic use	23,750 (89.4)	19,656 (89.0)	.16
Priority group 1	5,925 (22.3)	3,274 (14.8)	< .0001
Priority groups 2-6	17,707 (66.7)	17,662 (80.0)	< .0001
Priority groups 7-8	2,926 (11.0)	1,141 (5.2)	< .0001
ICU admission ^a	3,560 (13.4)	3,225 (14.6)	.0001
Mechanical ventilation ^a	1,629 (6.1)	1,546 (7.0)	.0001
Vasopressor use ^a	1,135 (4.3)	1,084 (4.9)	.0008

Data are presented as No. (%) unless otherwise noted.

^aDuring the first 48 h of hospitalization.

could explain the lower mortality rate of married men and would be consistent with prior data demonstrating improved mortality associated with more rapid initiation of antibiotic therapy.¹⁰ These results also suggest that lives could be saved by educating patients at risk for pneumonia to seek treatment early when they develop suggestive symptoms, as has been suggested by Ewig and Torres,²¹ similar to campaigns teaching patients to avoid delays in treatment if they develop symptoms suggesting myocardial infarction or stroke.

There are a limited number of prior studies to compare with our results. However, one study found that married patients of both sexes with pneumonia had a lower hospital length of stay.¹⁶ Interestingly, this effect was lower with older patients. In a cohort

study of outcomes of sepsis, in which patients with a pulmonary source composed approximately 45%, single patients had a higher incidence and higher risk-adjusted hospital mortality rate compared with married and widowed patients.²² There have also been several studies on the effect of marital status on the outcomes of conditions such as cardiovascular disease,²³ lung cancer,²⁴ and heart failure.¹⁴ In some studies, all categories of unmarried men did worse,¹⁴ whereas in others only specific subcategories, such as widowed men, did worse.²⁴ In general, although socioeconomic status and substance abuse appeared to play a role in the worsened outcomes of unmarried patients, these factors did not explain all of the differences.^{14,23,24}

Table 2—Unadjusted Outcomes According to Marital Status

Outcomes	Married (n = 26,558)	Not Married (n = 22,077)	P Value
Hospital length of stay, mean (SD)	7.4 (11.2)	8.2 (13.7)	< .0001
Hospital mortality	2,484 (9.4)	2,336 (10.6)	< .0001
Mortality during 90 d after discharge ^a	3,350 (14.7)	3,160 (16.0)	< .0001
All-cause 90-d readmission ^a	6,337 (26.3)	5,222 (26.5)	.760

Data are presented as No. (%) unless otherwise noted.

^aAmong patients surviving until hospital discharge.

Our results have several important implications. First, marital status is a robust predictor of several important outcomes among men hospitalized with pneumonia. Since it is unlikely that marital status would greatly affect the medical treatment or patient response to that treatment, the effect of marital status on hospital mortality is likely related in part to a difference in the acute severity of illness at the time of presentation that was not accounted for in our risk adjustment. However, even after adjustment for the need for ICU care, vasopressors, and mechanical ventilation, unmarried men had a higher adjusted mortality at 90 days after discharge. Whether not being married is merely a marker for the likelihood of more serious illness or whether unmarried men do worse because they have less support once they are discharged, clinicians should be aware that unmarried men are at higher risk of mortality after discharge and consider this issue when determining the need for follow-up and home health-care services.

Because the effect of marital status on hospital mortality was likely in part related to differences in acute severity of illness, the addition of marital status might not improve the performance of predictive

FIGURE 1. Kaplan-Meier curves demonstrating time to death for married and unmarried patients with pneumonia ($P < .0001$).

Table 3—Multivariable Associations Between Marital Status and Treatment Intensity During the First 48 h of Hospitalization

Treatment	OR (for Married Men)	95% CI
ICU admission	0.91	0.86-0.96
Mechanical ventilation	0.85	0.79-0.92
Vasopressor use	0.84	0.77-0.92

models, such as the pneumonia severity index, which rely on clinical data. However, in models that rely on administrative data, the addition of marital status as a predictive variable might improve model performance. The accuracy of such models is assuming increasing importance given the use of 30-day mortality rate and 30-day readmission rate as accountability measures for both public reporting and reimbursement. Because of the expense associated with performing chart review, both of these measures are based on administrative data. Although marital status is not a discrete field in Medicare administrative data, it can be determined with reasonable accuracy.²⁵

Our study has some limitations. We studied an elderly VA population, so the results may not be applicable to the general population. We cannot determine the effect of marital status on the outcomes of women with pneumonia, as there were too few women in the source database to study this issue. Importantly, we used a database that contained very few clinical variables, although several markers of severe CAP were included. Also, we could not analyze subgroups of unmarried men, such as divorced, widowed, and never married. Similarly, we could not analyze the effect of other living arrangements that might provide social support, such as unmarried heterosexual or homosexual couples. Finally, observational studies can only determine association, not causation. It is possible that marital status is a surrogate marker for unmeasured confounders, such as vaccination status, and adherence to medications, such as inhaled corticosteroids for COPD²³ or statins for cardiovascular disease. However, such unmeasured confounders would not alter our primary observation that unmarried men with pneumonia have worse outcomes than married men.

Table 4—Multivariable Associations Between Marital Status and Outcomes

Outcome	OR (for Married Men)	95% CI
Hospital length of stay	0.92 ^a	0.91-0.92
Hospital mortality	0.87	0.81-0.93
Mortality during the 90 d after discharge ^b	0.92	0.88-0.98
All-cause 90-d readmission ^b	0.99	0.95-1.04

^aExpressed as incidence rate ratio.

^bAmong patients surviving until hospital discharge.

In summary, unmarried male veterans admitted to the hospital for pneumonia have a lesser degree of comorbidity than married men. However, during the first 48 h of hospitalization, unmarried men were more likely to require admission to the ICU, vasopressors, and mechanical ventilation. Likely related to these findings, unmarried men had a higher risk of in-hospital death and a higher hospital length of stay. Furthermore, after discharge, unmarried men were at higher risk of mortality during the 90 days after discharge. Physicians and others involved with care transition for men patients hospitalized with pneumonia should be aware of this finding when planning discharge disposition and discharge services.

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Dr Metersky: contributed to study design, analysis, writing, and critical review of the manuscript.

Dr Fine: contributed to study design, writing, and critical review of the manuscript.

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