Depressive Symptoms and Hospital Readmission in Older Adults

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Running Title: Depression and Readmission Older Adults

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Abstract

Background: Identifying patients at high risk of hospital readmission may facilitate interventions to improve care. Depressive symptoms are prevalent among hospitalized older adults and may provide a target for these interventions if associated with readmission. The aim of this study was to quantify the risk of 30-day unplanned hospital readmission among adults age ≥65 with depressive symptoms.

Design and Setting: Prospective cohort study of adults aged ≥65 admitted to the University of Maryland Medical Center between 7/1/11 and 8/9/12.

Participants: 750 patients aged ≥65 admitted to the general medical and surgical units and followed for 31 days following hospital discharge.

Measurements: Primary exposure was depressive symptoms at admission, defined as ≥6 on the 15-item Geriatric Depression Scale. Primary outcome was unplanned 30-day hospital readmission, defined as an unscheduled overnight stay at any inpatient facility not occurring in the emergency department.

Results: Prevalence of depressive symptoms was 19% and incidence of 30-day unplanned hospital readmission was 19%. Depressive symptoms were not significantly associated with hospital readmission (Relative Risk (RR)1.20; 95% Confidence Interval(CI) 0.83,1.72). Age, Charlson Comorbidity Index score, and ≥2 hospitalizations within the past 6 months were significant predictors of unplanned 30-day hospital readmission.

Conclusion: Although not associated with hospital readmission in our study, depressive symptoms are associated with other poor outcomes and may be under-diagnosed among hospitalized older adults. Hospitals interested in reducing readmission should focus on older patients with more comorbid illness and recent hospitalizations.

Introduction

Unplanned hospital readmission has been targeted for quality improvement initiatives to reduce healthcare costs and improve patient outcomes. Previous research has suggested that 20% of Medicare beneficiaries are readmitted to the hospital within 30 days of discharge, and 34% are readmitted within 90 days.[1] Hospital readmissions are costly as well, accounting for $15 billion in Medicare spending in 2007.[2] The Medicare Payment Advisory Commission tied 30-day readmission rates to Medicare reimbursements in 2013 with three diagnoses-related groups initially targeted; however the number of targeted diagnoses groups will expand in 2014.[3]

Interventions to reduce hospital readmissions have been observed to be effective; however cost efficiency dictates that they be targeted toward patients at highest risk of readmission.[4-6] Risk factors for readmission include older age, male sex, recent previous hospital admission, longer hospital length of stay and greater comorbidity.[1,7,8] However, these characteristics provide few targets for anything other than broad-based interventions.

Depression may impact hospital readmissions among Medicare beneficiaries.[9-11] Research examining the effect of depressive symptoms on hospital readmission has reported a positive association.[2-16] Nonetheless, a focus on illnesses such as heart failure, age groups that included much younger patients ($\geq$ 18 years old), and variable readmission outcomes limits the generalizability of previous results to an older, more general patient population that may be more in line with current hospital initiatives to reduce readmissions.

This paper reports results from a prospective cohort study on the association between depressive symptoms at baseline and unplanned 30-day hospital readmission among patients aged 65 and older. We hypothesized that depressive symptoms would be associated with

increased risk of 30-day hospital readmission. If this is the case, screening for and treating depression in this patient population may provide an additional means of reducing hospital readmission as well as furnishing a target population for current initiatives.

Methods

Study Design and Study Population

We conducted a prospective cohort study of adults aged 65 and older admitted to the hospital. Study participants were enrolled in their hospital rooms within 72 hours of admission. Following hospital discharge, participants were followed-up by phone at three time points (5, 15, and 31 days) post-discharge to ascertain deaths and unplanned readmission events.

The study population consisted of community-dwelling adults aged 65 and older who were admitted to the general medical and surgical services of the University of Maryland Medical Center (UMMC) between July 1, 2011 and August 9, 2012. UMMC is a 757-bed, tertiary-care hospital in Baltimore, MD. Patients admitted to psychiatric, obstetrical, and intensive care units, residing in a nursing home, unable to speak English, or with a Mini-Mental State Examination (MMSE) score of 15 less or were excluded.[19] This study was approved by the Institutional Review Board at the University of Maryland Baltimore and all participants provided written informed consent prior to participating.

Admission and discharge data on patients meeting our inclusion criteria were collected daily from the UMMC Clinical Data Repository (CDR), a relational database including patients' administrative, demographic, and outcome information.

Necessary sample size was calculated *a priori* based upon the following assumptions: 13% incidence of hospital readmission, 20% prevalence of depressive symptoms, and 10% loss to follow-up. The 13% incidence rate among adults aged 65 and older was obtained from 5 years of data on 30-day hospital readmission to UMMC from the UMMC CDR. Based on these assumptions, a sample size of 750 would allow 80% power to detect a doubling of the risk of 30-day unplanned readmission (i.e. relative risk =2) among study participants with depressive symptoms.

Measures

Study participants were administered a baseline questionnaire. Prevalent clinically-significant depressive symptoms, our primary exposure, were assessed using the 15-item Geriatric Depression Scale (GDS-15), and defined as a score of 6 or greater.[17] This cut-point has been observed to have a sensitivity of 83% and a specificity of 69% to detect depression in elderly inpatients.[18] We also assessed Katz's disabilities in Activities of Daily Living, a scale ranging from 0-5 with 5 indicating the highest level of disability, cognitive impairment with the 30-item MMSE, and social isolation using the 6-item Lubben Social Network Scale (LSNS-6).[17,19-21] The LSNS-6 has been validated as a measure of social isolation risk in community-dwelling adults. A cut-point of less than12 has been suggested to define social isolation, and was utilized in this study.[20] Demographic information on race, sex, and education was self-reported.

In addition to the questionnaire, data on admission and discharge diagnoses (including both the primary diagnosis and up to 15 comorbid medical conditions), number of medications prescribed at discharge, discharge instructions, and hospital readmissions to UMMC were collected from patients' medical charts. Data on the Charlson Comorbidity Index score, a

measure of aggregate comorbidity and medications prescribed at discharge were collected from the CDR.[22]

We created disease categories based on patients' discharge diagnosis International Classification of Diseases, Ninth Revision (ICD-9) codes.[23,24] The following categories were created: cancer (140-208, 230-234), heart disease (391-392.0, 393-398, 402, 404, 410-416, 420-429), diseases of the digestive system (520-579), diseases of the musculoskeletal system (710-739), and complications of surgical and medical care (996-999). The remaining diagnoses were grouped as 'other'.

Study participants were contacted by telephone at 5, 15 and 31 days after discharge from the index hospital admission to determine the incidence of 30-day unplanned hospital readmission. During these telephone calls, data were collected on any hospital readmissions that occurred post discharge, including date, place, reason for readmission, and whether the readmission was planned or unplanned. An unplanned hospital readmission was defined as an overnight stay at any inpatient facility that did not occur in the emergency department and was not previously scheduled. If the patient was unavailable at the follow-up call, outcome information was obtained from the contact person indicated by the patient at enrollment.

Data Analysis

The primary exposure (clinically-significant depressive symptoms) and outcome (unplanned 30-day hospital readmission) were treated as dichotomous variables. Association of both the exposure and outcome variables with covariates was examined using chi-square tests for dichotomous covariates and Student's t-tests for normally distributed continuous covariates to

assess potential confounding. The Wilcoxon rank sum test was used to assess associations of non-normally distributed variables. Statistical significance was defined as p <0.05. Covariates that were significantly associated with the exposure and the outcome, as well as covariates known to be associated with either from the literature were considered for inclusion in the regression model.

A log-binomial regression model was utilized to estimate the relative risk of 30-day unplanned hospital readmission in the study population. The primary log-binomial regression model contained an indicator variable for prevalent depressive symptoms and modeled the log relative risk of 30-day unplanned hospital readmission. Effect modifiers identified using the Breslow-Day test (with a p-value of 0.05 or less) and their main effects were also examined in the model. All data analysis was performed with SAS version 9.2 (SAS Institute Inc., Cary, NC).

Results

During the study period, 3,699 patients aged 65 and older were admitted to the general medical and surgical units at UMMC. Of these, 146 (4%) were not competent to participate and 61(2%) did not speak English. Of the remaining 3,492, 750 (21%) were enrolled into our study. Reasons for non-participation included refusal (21%), already discharged from hospital (16%), already participating in study (6%), and inaccessibility of the patient due to procedures, therapy, or sleep (25%). Patients who enrolled in the study were slightly younger, with a mean age (standard deviation (sd)) of 73.2 (6.5) years vs. 73.9 (6.9) years, p=0.01 and were more likely to be Caucasian (70% vs. 60%, p<0.001). Participants did not differ from non-participants by sex (49% female vs. 52% female, p=0.08) or mean (sd) Charlson Comorbidity Index score (2.5 (2.3) vs. 2.6 (2.4), p=0.7).

Of the 750 participants enrolled into the study, 13 (1.7%) were deceased at discharge, 4 (0.5%) withdrew from the study, and 17 (2.3%) were lost to follow-up at 31-days. This left a total of 716 (95%) patients for whom data on our primary outcome were ascertained.

Mean (sd) age was 73.2 (6.5) years and mean (sd) MMSE score was 27.9 (8.1). (Table 1) Length of hospital stay was skewed, with a median (interquartile range) of 4 (0, 9) days. Nineteen percent of the sample had depressive symptoms (GDS-15 mean (sd) 3.2 (2.8)). The most prevalent discharge diagnosis was heart disease (20%). The 'other' category comprised 35% of discharge diagnoses and included (as a percentage of 'other'): chronic kidney disease (17%), diseases of the respiratory system (11%), stroke/transient ischemic attack (7%), septicemia (3%), fractures (3%), diseases of the nervous system (3%), and 'symptoms' (15%).

One-hundred forty-two (19%) study participants experienced an unplanned 30-day hospital readmission. Among these, 68 (48%) were readmitted to UMMC. Prevalent readmission diagnoses included heart failure (13%), complications (13%), 'symptoms' (13%), and digestive problems (6%). Myocardial infarction and respiratory problems accounted for 3% and 2% of readmission diagnoses, respectively. Thirty-five percent of readmission diagnoses fell into the 'other' category.

Patients with depressive symptoms had greater baseline morbidity compared to other patients. This was reflected by differences in self-rated health of 'good' or better (30% vs. 65%, $p<0.001$), ≥ 1 disability in ADLS (31% vs. 16%, $p<0.001$), ≥ 2 hospital admissions in the past 6 months (36% vs. 22%, $p<0.001$), ≥ 2 falls in the last 6 months (25% vs. 12%, $p<0.001$), number of medications prescribed at discharge (11.2 vs. 10.0, p=0.01), and mean Charlson Comorbidity

Index score (3.1 vs. 2.4, p=0.004). Among patients with depressive symptoms, 48% had been previously told by a doctor that they were depressed.

Based on the bivariate analyses and previous research, the final regression model included terms for age, sex, Charlson Comorbidity Index score, social isolation risk, ≥2 hospital admissions in the past 6 months, and self-rated health of 'good' or better.

In the adjusted model, an association between depressive symptoms and risk of hospital readmission was observed, however it did not achieve statistical significance (Relative Risk (RR) 1.20; 95% Confidence Interval (CI) 0.83, 1.72).(Table 2) Age (3% increase in risk per year of age), Charlson Comorbidity Index score (7% increase in risk for each point) and ≥2 hospital admissions in the past 6 months (53% increase in risk) significantly predicted 30-day unplanned hospital readmission.

Discussion

Depressive symptoms were not significantly associated with increased risk of unplanned 30-day hospital readmission. Increased age, Charlson Comorbidity Index score, and previous hospitalizations within the past six months were all associated with a significantly increased risk of 30-day unplanned hospital readmission among adults aged 65 and older.

These results contrast with previous studies that have reported positive associations between depression and hospital readmission.[12-16] There are a number of possible explanations for this. Although our sample size was larger than in most previous studies, our observed effect size (20% increased risk) was smaller than has been reported. In addition, this study focused on

general medical and surgical patients aged 65 and older and 30-day unplanned readmission, and used the GDS-15, a validated measure in hospitalized elders, to measure depressive symptoms.[18] Our more stringent measures, ability to follow-up with patients who were readmitted to non-UMMC hospitals, and definition of 30-day unplanned hospitalization may have impacted the size of the effect we observed. Previous research examining the effect of depressive symptoms on hospital readmission has primarily focused on patients with specific illnesses such as heart failure, age groups that included much younger patients (> 18 years old), readmission outcomes that varied from 30 days to 1 year, and may have included planned events.[12-16] Furthermore, previous instruments used to measure depressive symptoms have included somatic measures, which can be confused with symptoms of comorbid illness among older adults. This variability in previous studies may have resulted in larger effect sizes than those observed in this study. Finally, a recent systematic review concluded that readmission risk prediction models generally perform poorly due to the multifactorial nature of hospital readmission.[25] Depressive symptoms may interact with facility-level and patient-level characteristics not captured in this study to affect risk.

This study was powered at 80% to detect a doubling of the risk of 30-day unplanned hospital readmission among depressed patients based on a sample size of 750 and the assumptions described in the methods. However, the observed association suggests a smaller population effect than assumed in the sample size calculations, leading to a loss of statistical power. Nevertheless, we assessed our outcome on over 97% of study participants and observed incidence of 30-day unplanned hospital readmission that is consistent with that reported in a national study of Medicare enrollees, lending validity to our results.[1]

Patients with greater depressive symptoms may have been less likely to enroll in the study. Nonetheless, our reported prevalence of depressive symptoms (19%) is consistent with prior research in older hospitalized populations (range 14% - 25%).[26,27] Patients with a MMSE score < 15 and those residing in nursing homes were not eligible to participate in this study. However, we do not believe these exclusions greatly impact generalizability because nursing home residents represent only a small percentage of hospitalized older adults and cognitive impairment has not been reported to be a risk factor for hospital readmission.

This single site study reports incidence of 30-day unplanned hospital readmission and prevalence of depressive symptoms that are consistent with national samples, helping to support its generalizability.[1, 26,27] Furthermore, many previously observed associations, such as those between increasing age and comorbidities as well as prior hospital admissions with unplanned 30-day hospital readmission, were confirmed by this study.[1, 7, 8,13,28-30] It is noteworthy that only 48% of readmissions were to the index facility. This may have led to an underestimation of 30-day hospital readmission rates in our sample size calculations and has implications for institutions attempting to reduce readmissions.

In this large prospective cohort study, a 20% increase in the risk of 30-day unplanned hospital readmission among adults aged 65 and older with depressive symptoms was observed, but was not statistically significant. Hospitals interested in effectively utilizing limited funds to reduce hospital readmission among older adults should focus on older adults with a greater burden of comorbid illness and prior hospital admissions. Nonetheless, the low prevalence of 'doctor-recognized' depression among those exhibiting depressive symptoms presents an opportunity for a public health intervention to increase screening for depression among older

adults. Further research is needed to determine the cost effectiveness of screening for depression

as well as the efficacy of interventions to reduce hospital readmission in this patient population.

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Conflict of Interest Disclosures:

Elements of Financial/Personal Conflicts	*JSA		ALGB		JMH		CHB		RG		JHR		ACC		JPF	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation		x		x		X		X		X		X		X		X
Grants/Funds		x		x		X		X		X		X		X		X
Honoraria		x		x		X		X		X		X		X		X
Speaker Forum		x		x		X		X		X		X		X		X
Consultant		x		x		X		X		X		X		X		X
Stocks		x		x		X		X		X		X		X		X
Royalties		x		x		X		X		X		X		X		X
Expert Testimony		x		x		X		X		X		X		X		X
Board Member		x		x		X		X		X		X		X		X
Patents		x		x		X		X		X		X		X		X
Personal Relationship		x		x		X		X		X		X		X		X

Author Contributions

JSA: study concept and design, acquisition of subjects and/or data, analysis and interpretation of data, and preparation of manuscript. ALG-B: study concept and design, interpretation of data, and preparation of manuscript. JMH: study concept and design, interpretation of data, and preparation of manuscript. CHB: study concept and design, analysis and interpretation of data, and preparation of manuscript. RG: study concept and design, interpretation of data, and preparation of manuscript. JHR: study concept and design, acquisition of subjects and/or data, and preparation of manuscript. ACC: study concept and design, acquisition of subjects and/or data, and preparation of manuscript. JPF: study concept and design, interpretation of data, and preparation of manuscript.

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Table 1. Characteristics of the Study Population of Hospitalized Patients at University of Maryland Medical Center, 2011-2012 by Depressive Symptom Status, n=750

Characteristic	Total N=750	Depressive Symptoms[a] n=140	No Depressive Symptoms n=610	p-value[b]
Age in years, mean (sd)	73.2 (6.5)	72.8 (6.5)	73.4 (6.6)	0.35
MMSE[c] (range 0-30) , mean (sd)	27.7 (2.4)	27.0 (2.7)	27.8 (2.4)	0.002
Length of stay in days, median (IQR[d])	4.0 (5.0)	4.0 (5.5)	4.0 (5.0)	0.20
Female sex, n(%)	366 (49)	74 (53)	292 (48)	0.29
White race, n(%)	540 (72)	101 (72)	439 (72)	0.97
Married, n(%)	433 (58)	72 (51)	361 (59)	0.09
Self-rated health $\geq$ good, n(%)	439 (59)	41 (30)	398 (65)	<0.001
Disabilities in ADLS[e] $\geq$ 1, n(%)	141 (19)	43 (31)	98 (16)	<0.001
$\geq$ High school education, n(%)	636 (85)	110 (79)	526 (86)	0.02
$\geq$2 hospital admissions in last 6 months, n(%)	184 (25)	50 (36)	134 (22)	<0.001
$\geq$ 2 falls in last 6 months, n(%)	108 (14)	35 (25)	73 (12)	<0.001
Lives alone, n(%)	199 (27)	35 (25)	164 (27)	0.62

Social isolation[f], n(%)	89 (12)	34 (24)	55 (9)	<0.001
Medications at discharge, mean (sd)	10.2 (4.7)	11.2 (5.4)	10.0 (4.5)	0.01
Primary Discharge Diagnosis, n(%)				
Cancer	97 (13)	20 (14)	77 (13)	0.60
Heart Disease	151 (20)	27 (19)	124 (20)	0.78
Diseases of the Digestive System	93 (12)	17 (12)	76 (12)	0.92
Complications of Medical Care	83 (11)	19 (14)	64 (10)	0.29
Diseases of the Musculoskeletal System	65 (9)	11 (8)	54 (9)	0.71
Other	261 (35)	46 (33)	215 (35)	0.59
Charlson Co-Morbidity Score (range 0-37), median (IQR[d])	2.0 (3.0)	2.5 (3.5)	2.0 (2.0)	0.001

[a] Geriatric Depression Scale-15 $\geq$ 6, [b]Chi-square for categorical variables, Student's t-test for continuous variables, Wilcoxon for length of stay and Charlson, [c]Mini Mental State Examination range 0-30, [d]Interquartile range [e]Katz's Activities of Daily Living, [f]Lubben Social Network Scale-6 <12

Table 2. Relative Risks (RR) and 95% Confidence Intervals (95% CI) of 30-Day Unplanned Hospital Readmission, n=716

Characteristic	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Depressive Symptoms	1.31 (0.93, 1.84)	1.20 (0.83, 1.72)
Age, per year		**1.03 (1.00, 1.05)**
Female sex		0.88 (0.65, 1.18)
Charlson Comorbidity Index Score		**1.07 (1.01, 1.14)**
≥ 2 admissions/last 6 months		**1.53 (1.12, 2.09)**
Self-rated health ≥ 'good'		0.90 (0.65, 1.24)
Social Isolation		0.72 (0.43, 1.21)