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Serious Mental Illness and Acute Hospital Readmission in Diabetic Patients[a]

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Abstract

Patients with serious mental illness (SMI), particularly those with other chronic illnesses, may be vulnerable to unplanned hospital readmission. We hypothesized that SMI would be associated with increased 30-day hospital readmission in a cohort of adult patients with comorbid diabetes admitted to a tertiary-care facility from 2005–2009. SMI was defined by ICD-9 discharge diagnosis codes for schizophrenia, schizo-affective, bipolar, manic, or major depressive disorders, or other psychosis. The primary outcome was 30-day readmission to the index hospital. Among 26,878 eligible admissions, prevalence of SMI was 6% and incidence of 30-day hospital admission was 16%. Among patients aged <35 years, SMI was significantly associated with decreased odds of 30-day hospital readmission (OR 0.39, 95% CI: 0.17, 0.91). However, among patients ≥35 years, SMI was not significantly associated with 30-day hospital readmission (OR

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CONFLICT OF INTEREST DISCLOSURES

Ms. Jennifer Albrecht discloses no conflicts of interest.
Dr. Jon Mark Hirshon discloses no conflicts of interest.
Dr. Richard Goldberg discloses no conflicts of interest.
Dr. Patricia Langenberg discloses no conflicts of interest.
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1.11, 95%CI: 0.86, 1.42). SMI may not be associated with increased odds of 30-day hospital readmission in this population.

Unplanned hospital readmission is a common but potentially preventable healthcare outcome and quality indicator associated with considerable healthcare costs.[1, 2] Furthermore, Medicare Payment Advisory Commission guidelines now recommend reducing reimbursements to hospitals with higher than average 30-day readmission rates.[2] While previous studies have identified patient characteristics (e.g. older age, longer length of hospital stay and higher Charlson Comorbidity Index score) associated with hospital readmission, knowledge of these risk factors has for the most part not translated into successful interventions to reduce the incidence of readmission.[1,3–6]

Serious mental illness (SMI) may represent a better target for intervention if associated with hospital readmission. SMI, which includes schizophrenia and bipolar disorder, is associated with decreased capacity for self-care, lack of access to medical care and poorer quality of care received, all of which may be associated with hospital readmission.[7–9] Furthermore, whereas many previously identified risk factors of hospital readmission are non-modifiable patient factors, patients with SMI could potentially be targeted for readmission-reducing interventions including intensified case management.

We hypothesized that SMI would be associated with increased risk of 30-day hospital readmission. We tested this hypothesis in cohort of adult diabetic patients because these patients often require considerable self-maintenance post-hospital discharge. Previous research has suggested that diabetic patients with SMI may receive lower quality of care for their diabetes than patients without SMI, thereby placing them at increased risk of hospital readmission.[10, 11] To our knowledge, the impact of SMI on hospital readmission has not been assessed in this patient population. As a secondary objective, we aimed to identify other factors associated with 30-day hospital readmissions in this patient population.

METHODS

We conducted a retrospective cohort study including all adult (age ≥ 18 years) admissions with diabetes to the University of Maryland Medical Center (UMMC), between February 1, 2005 and January 31, 2009. UMMC is a 656-bed, urban, tertiary-care referral center in Baltimore, MD. An admission of a patient with diabetes was defined as an admission with International Classification of Disease, Ninth Revision (ICD-9) code 250.xx included as a discharge diagnosis. Patients admitted to UMMC receive a primary diagnosis, designating the primary reason for admission, as well as up to 15 additional codes for contributing or comorbid conditions. Data were collected from UMMC Clinical Data Repository, a relational database including patients administrative, demographic, and outcome data that has been used extensively in published epidemiologic studies.[12, 13] In addition, a random sample of 50 adult admissions with diabetes identified in the Clinical Data Repository was validated against the patients' medical records for this study. This validation study suggested study data had positive and negative predictive values exceeding 90%.

The primary exposure variable of interest was a co-occurring diagnosis of SMI, as defined by the presence of the following ICD-9 codes: schizophrenia and schizo-affective disorders (295.0x – 295.4x, 295.6x, 295.7x, 295.9x); bipolar and manic disorders (296.0x, 296.1x, 296.4x – 296.7x, 296.80, 296.81, 296.89); major depressive disorder (296.24 and 296.34) and other psychosis (297.1x, 298.0x – 298.4x, 298.8x, 298.9x).

Our study outcome was hospital readmission to the index facility, i.e. UMMC, within 30 days of discharge. Therefore, we excluded patients who died during their index

hospitalization because they were no longer at risk of readmission. In addition, we excluded readmissions which occurred less than 24 hours after discharge from the index admission to account for transfer between services within the hospital that may have been registered as separate admission events in the database. Each readmission was listed in the database as a new index admission. As such, a patient could have contributed multiple admission-readmission pairs during the study period.

Demographic and clinical characteristics of the sample were examined using univariate and bivariate analysis. Discrete covariates were analyzed for association with both our exposure and primary outcome using chi-square analysis. Continuous covariates were analyzed for association with both our exposure and primary outcome using the Wilcoxon Rank Sum test and Students t-tests. Distributions of certain continuous covariates, such as length of stay, Charlson Comorbidity Index score (Charlson score), and number of previous admissions in the past 12 months were highly skewed and therefore were dichotomized for our multivariable analysis. The Charlson score was dichotomized at 3, which was slightly over the mean and 1 point over the median. This was to account for the fact that all individuals with diabetes have a Charlson score of at least 1, and may have a score of 2 if they have any complications of diabetes. Previous admissions in the past 12 months and length of stay were dichotomized about the median. Age was examined as both a continuous and a categorical variable. The six age categories were: under 35, 35–<45, 45–<55, 55–<65, 65–<75 and 75 or greater. Discharge location was dichotomized as home or not home.

We used generalized estimating equations (GEE) in a logistic regression model to account for repeated outcomes and model the log odds of 30-day readmission in diabetic individuals with SMI. Variables considered for inclusion in our multivariable models were based upon biological plausibility or were significantly associated ($p<0.05$) with SMI or 30-day hospital readmission in our bivariate analyses. We added individual covariates one at a time. Covariates were kept in the model if their associated p-value was <0.05 or if their inclusion resulted in a greater than 10% change to the parameter estimate of SMI. Following this, we examined interactions with SMI. Interaction terms were kept in the model if their associated two-sided P-values were <0.05. Our final model contained terms for SMI, age categories, SMI-age interactions, Charlson score >3, sex and length of stay >4. Previous admissions in the past year caused other variables in the model to be inestimable, so we were unable to include it. Age was initially modeled as a continuous variable. Non-linearity was examined by both adding an age-squared term and by examining age as a categorical variable. The age squared term, the categorical age terms and each of their interactions were significant and provided a better fit to the data than a continuous age term while not differing significantly from each other. Therefore, we used categorical age terms for ease of interpretation. Odds ratios (ORs) with 95% confidence intervals (CIs) were generated. Contrasts were used to calculate ORs and CIs for the effect-modification of age on the association of SMI with readmission. All analyses were performed with SAS V. 9.2 (SAS Institute, Cary, NC). This study was approved by the University of Maryland, Baltimore Institutional Review Board.

RESULTS

The initial study sample included 27,479 diabetic adults (16% of all adult admissions) who were admitted to the index facility between February 1, 2005 and January 31, 2009. Of these, 601 (2%) died during their index admission and were excluded, leaving a final sample of 26,878 patients. The sample was 51% male and had a mean (standard deviation [SD]) age of 58 (14) years. The mean (SD) Charlson score was 2.6 (1.9). The median (interquartile range [IQR]) hospital length of stay during the index admission was 4 (1,7) days and the median (IQR) number of hospital admissions in the past 12 months was 0 (1).

Approximately 6% (n=1652) patients were identified as having SMI. Of these, 759 (3%) had schizophrenia or schizo-affective disorders, 866 (3%) had bipolar or manic disorders, 96 (0.4%) had major depressive disorder and 311 (1%) had other psychosis. A total of 19,802 (75%) patients were discharged to home and 4,313 (16%) patients were readmitted to the index facility within 30 days of their index admission.

Diabetic patients with SMI differed significantly from diabetic patients without SMI in our study population (Table 1, $p<0.0001$, unless indicated otherwise). Males comprised 46% of diabetics with SMI compared with 52% of patients without SMI. In addition, patients with SMI were younger, with a mean age of 52 years versus 58 years for patients without SMI. In particular, there were much larger percentages of individuals with SMI in the 35–55 age group categories. Diabetic adults with SMI had a lower mean Charlson score; 2.2 versus 2.6 ($P<0.01$). Patients with SMI also spent more time in the hospital during their index admission, with a median length of stay of 5 days compared to 4 days ($P<0.01$). There was little difference between those with and without SMI with regard to discharge to home status ($p=0.15$).

Prior to adjustment for confounding, diabetic adults with SMI were not at increased odds of 30-day hospital readmission OR 0.92, 95% CI: 0.80, 1.05. Rather, male sex was identified as a potential risk factor for 30-day readmission and patients discharged to their homes were less likely to be readmitted within 30 days. (Table 2)

Although the unadjusted analysis suggested that SMI was not associated with 30-day hospital readmission, results of our adjusted model suggested that diabetic adults under 35 with SMI were at significantly decreased risk of 30-day hospital readmission compared to those without SMI OR 0.39, 95% CI: 0.17, 0.91. However, among patients 35 years and older, SMI was not significantly associated with 30-day hospital readmission (OR 1.11, 95%CI: 0.86, 1.42). Table 3 presents the results from our unadjusted and adjusted models. While there was no significant effect of SMI on 30-day hospital readmission in the other age groups, a trend of increasing odds of readmission with increased age was observed. Additionally, male sex, OR 1.21, 95% CI: 1.11, 1.31, Charlson score >3, OR 1.38, 95% CI: 1.20, 1.57, and length of stay >4 days, OR 1.38, 95% CI: 1.22, 1.56, were all significant predictors of 30-day hospital readmission in our study population.

DISCUSSION

In this large cohort of adult patients with comorbid diabetes, we observed varying relationships between SMI and incidence of 30-day hospital readmission. Individuals under the age of 35 with SMI were less likely to be readmitted to the hospital within 30 days; however we did not observe a significant association between SMI and 30-day hospital readmission in any other age group. Despite this lack of association, we observed a non-significant trend of increasing odds of readmission with increased age. We also identified several characteristics which may predict 30-day readmission in this population including male sex, length of stay of index admission greater than 4 days, and a Charlson score of greater than 3.

While to our knowledge no previous studies have assessed the effect of SMI on hospital readmission in diabetic patients, the relationship between SMI and health outcomes in other patient populations has been examined. Our findings are consistent with those of Abrams et al. who observed that comorbid psychiatric conditions identified using hospital inpatient records were not associated with 30-day mortality in Veteran's Health Administration hospital patients admitted for acute myocardial infarction or nonsurgical intensive care.[14, 15]

Furthermore, Blecker et al. (2010) observed no association between SMI and quality of care, including hospital readmission, in disabled Medicaid recipients with heart failure.[16]

The results of this study are consistent with many of the studies conducted on hospital readmission with regard to length of stay, Charlson score, and male sex.[1, 3–6, 17–19] Length of stay for the index admission has been previously identified as a predictor of hospital readmission in Medicare enrollees and adults seen in the emergency department and admitted to general medicine services.[4, 18, 19] Consistent with our results, an elevated Charlson score has been reported to predict hospital readmission in multiple studies.[3–6, 17, 18] Finally, male sex has also been associated with hospital readmissions in previous studies.[1, 6, 19]

Age over 35 was not a significant predictor of hospital readmission among diabetic individuals with SMI. This is in contrast with previous studies that observed an increased risk of hospital readmission in adults aged 65 and older. [3, 5, 6, 19] There are several possible explanations for this observation. Individuals with SMI die, on average, 25 years earlier than people who don't have SMI.[7] Thus, older and potentially sicker patients with SMI who may have been at greater risk of hospital readmission may have already died. Results from Table 1 are consistent with this explanation. Individuals with SMI were younger and had a lower Charlson score compared to those without SMI. Another explanation is that diabetic patients who begin to receive Medicare beginning at age 65 may visit a primary care physician rather than returning to the hospital for care, which could have the effect of decreasing readmissions in those aged 65 and older. This could be especially important in our urban, economically-disadvantaged patient population in which there is high prevalence of lack of healthcare insurance.

Our observation of no association between a diagnosis of SMI and 30-day hospital readmissions in diabetic adults over the age of 35 contrasts with the positive associations reported by Saravay et al. (1996) and Rathore et al. (2008). Saravay et al. examined the association between psychiatric symptoms and four-year hospital readmissions in 273 medical and surgical inpatients.[20] Differences in study population and methods used to ascertain SMI may explain the differences with our results. Rathore et al. (2008) examined a national sample of over 53,000 Medicare beneficiaries, who are generally elderly or disabled, who were hospitalized for heart failure.[21] Our study differed in methods of SMI documentation, as well as differences in demography and lower prevalence of SMI. Finally, Borckardt et al.(2011) reported a positive association between outpatient psychiatric visits and hospital admissions in a retrospective study of a single hospital population.[22] The prevalence of SMI in our study population (6%) was low compared to that of other studies, in which the reported prevalence of SMI ranges from 8.2% – 34%.[8, 15, 16, 23, 24] This may be due to our dependence upon discharge diagnosis codes to verify mental illness diagnoses. As demonstrated by Abrams et al., the method utilized to identify mental illness can have a significant impact on observed results.[14, 15, 25] Using outpatient records resulted in a significant association between SMI and 30-day mortality in Veteran's Health Administration hospital patients, while using inpatient records did not. However, it is also important to note that many previous studies examining outcomes of patients with SMI were conducted in different study populations. Abrams et al. (2009), Frayne et al. (2009) and Kilbourne et al. (2008) relied on Veteran's Administration populations. Blecker et al. (2010) examined the records of disabled Medicare recipients. These populations differ from ours in terms of demographic and comorbidity status.

Although race, socioeconomic status and health insurance may play a role in the association between SMI and 30-day hospital readmission, our use of administrative data hindered our ability to examine these variables due to a large amount of missing data for all of these

variables. Previous studies have been inconclusive on the role of race.[1, 4] However, an association between health insurance and readmission has been observed.[4]

On the other hand, our use of administrative hospital data to identify patients with SMI establishes a benchmark for a tertiary-care facility in an urban setting. Furthermore, as the first to examine 30-day hospital readmission in diabetic adults with SMI, our study adds to the literature on factors influencing hospital readmissions in this population.

The majority of the existing medical literature suggests that patients with SMI experience excess morbidity, mortality, poorer quality of care and increased rates of hospital readmission.[7, 9, 20, 21, 23, 26–30] We have discussed some possible explanations for the lack of support for an increased hospital readmission rate observed in our study. In addition, patients with diabetes may be less likely to be readmitted, regardless of SMI status, because of increased self and physician monitoring. This may be especially true for patients who take atypical antipsychotics, which are known to cause weight gain and are associated with increased risk of obesity and diabetes.[7] In contrast with previous studies of SMI and health services outcomes, we examined a chronic disease that can be well controlled with medication and diet.[21, 23] Well controlled diabetes may be less likely to impact health than previously studied diseases such as acute myocardial infarction or congestive heart failure.

In conclusion, although we did not observe a significant positive association between SMI and hospital readmission, our study highlights the importance of expanding research on the seriously mentally ill into different patient populations and of continued exploration of the relationship between mental illness and health outcomes. Future research should continue to identify opportunities for reducing hospital readmission and other poor outcomes in these high-risk patient populations.

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Table 1

Characteristics of Diabetic Adults by Serious Mental Illness Status, N=26,878

Characteristic	Serious Mental Illness N=1,652	No Serious Mental Illness N = 25,226	Total N= 26,878	P-value*
Male, *N(%)*	766 (46)	13,049 (52)	13,815 (51)	<0.0001
Age, *Mean (SD)*	52 (12)	58 (14)	58 (14)	<0.0001
Age Group Categories, *N(%)*				<0.0001
< 35	117 (7)	1,299 (5)	1,417 (5)	
35–45	338 (21)	2,757 (11)	3,095 (12)	
45–55	554 (34)	5,474 (22)	6,028 (22)	
55–65	387 (23)	6,959 (27)	7,346 (27)	
65–75	172 (10)	5,448 (22)	5,620 (21)	
>75	83 (5)	3,289 (13)	3,372 (13)	
Charlson Comorbidity Index *Mean(SD)*	2.2 (1.7)	2.6 (1.8)	2.6 (1.9)	<0.0001
Previous Admission in Past 12 Months *M(IQR)*	0 (2)	0 (1)	0(1)	<0.0001
Length of Stay, days *M(IQR)*	5 (9)	4 (6)	4(6)	<0.0001
Discharged Home *N(%)*	1,242 (75)	18,560 (74)	19,802 (75)	0.15
Readmission within 30 Days *N(%)*	247 (15)	4,066 (16)	4,313 (16)	0.21

*P-values from chi-square test for proportions, t-test for means and Wilcoxon rank sum test for medians

Table 2

Characteristics of Diabetic Adults by 30 Day Hospital Readmission status, N=26,878

Characteristic	30 Day Readmission N=4,313	No 30 Day Readmission N = 22,565	Total	P-value*
Male *N(%)*	2,382 (55)	11,433 (51)	13,815(51)	<0.0001
Age *Mean (SD)*	57 (13)	58 (14)	58 (14)	<0.0001
Age Group Categories, *N(%)*				<0.0001
< 35	244 (6)	1,173 (5)	1,417 (5)	
35–45	521 (12)	2,574 (12)	3,095 (12)	
45–55	1,022 (24)	5,006 (22)	6,028 (22)	
55–65	1,312 (30)	6,034 (27)	7,346 (27)	
65–75	832 (19)	4,788 (21)	5,620 (21)	
>75	382 (9)	2,990 (13)	3,372 (13)	
Charlson Comorbidity Index *Mean(SD)*	3.0 (1.8)	2.5 (1.8)	2.6 (1.8)	<0.0001
Previous Admission in Past 12 Months *M(IQR)*	1 (3)	0 (1)	0 (1)	<0.0001
Discharged Home *N(%)*	3,070 (71)	16,732 (74)	19,802(74)	<0.0001
Length of Stay, days *M(IQR)*	5 (8)	4 (6)	4 (6)	<0.0001

*P-values from chi-square test for proportions, t-test for means and Wilcoxon rank sum test for medians

Table 3

Adjusted Odds Ratios (OR) and 95% Confidence Intervals (95% CI) of 30-Day Hospital Readmission in Diabetic Patients, N= 26,878

	OR	95% CI
Unadjusted Odds Ratio	0.92	0.80, 1.05
Serious Mental Illness, < 35 years	0.39	0.17, 0.91
Serious Mental Illness, ≥ 35 years	1.11	0.86, 1.42
Serious Mental Illness, 35 – <45 years	0.60	0.31, 1.14
Serious Mental Illness, 45 – <55 years	1.39	0.96, 2.03
Serious Mental Illness, 55 – <65 years	0.84	0.53, 1.36
Serious Mental Illness, 65 – <75 years	1.28	0.69, 2.39
Serious Mental Illness, >75 years	1.59	0.52, 4.89
Male	1.21	1.11, 1.31
Charlson Comorbidity Index >3	1.38	1.20, 1.57
Length of Stay >4 days	1.38	1.22, 1.56