

## Research Article

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## Estimating Risk for 1-Year Readmission at an Academic Acute Inpatient Psychiatric Unit

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### Abstract

**Introduction:** Readmission following psychiatric hospitalization is a common adverse outcome and rates of readmission are a valid indicator for the quality of inpatient care. The goal of this study was to identify risk factors available at the time of discharge associated with a higher risk for 1-year inpatient psychiatric readmission.

**Methods:** Based on review of the literature, candidate risk factors for readmission were selected and abstracted from the discharge summaries of all 849 adult patients admitted to the University of Virginia Health System's general inpatient psychiatric unit in 2013. Multivariate logistic regression was used to identify risk factors and estimate risk for psychiatric readmission within 1 year of index admission

**Results:** 23% of patients were readmitted within 1 year. Risk factors for readmission included diagnoses of thought disorder (odds ratio [OR] = 2.86, p-value [ $p$ ] = 0.004) and substance-induced mood disorder (OR = 3.65,  $p$  = 0.028).

**Conclusions:** This study identified unique risk and protective factors for 1-year psychiatric readmission. Identifying unit-specific risk factors for readmission may inform discharge planning and improve patient outcomes.

**Keywords:** Inpatient psychiatry, Readmission, Rehospitalization, Risk factors

### Introduction

Readmission following psychiatric hospitalization is a common adverse outcome. An analysis of the US National Inpatient Sample estimated that 13% of patients initially admitted for a mood disorder and 19% of patients initially admitted for schizophrenia were readmitted within 30-days with the same condition as a principal or secondary diagnosis [1]. One-year psychiatric readmission rates may be as high as 30-40% in high-risk patient populations [2-4].

The rate of psychiatric readmission is a valid indicator for the quality of inpatient care, particularly the

discharge planning process [5,6]. Multiple studies have demonstrated that targeted interventions during the transition from inpatient to outpatient care can reduce psychiatric readmission rates [7,8]. Readmissions rates must be interpreted cautiously, however, as they also are also influenced by a variety of factors independent of clinical care. Age and historical psychiatric diagnoses are examples of non-modifiable risk factors for psychiatric readmission which have been reported in the literature [9]. Readmission rates can only be meaningfully compared between units and health systems after appropriate risk adjustment. Despite these limitations, readmission rate is a useful benchmark for evaluating quality of care and the effectiveness of interventions for psychiatric patients [10].

The literature on risk factors for psychiatric readmission is inconsistent and often contradictory. For example, one review found that while gender is not associated with psychiatric readmission risk in the majority of published studies, some studies found males to be at higher risk of readmission while others found females to be at higher risk [9]. These discrepancies may reflect underlying differences in patient populations as well as local systemic factors such as inpatient capacity and access to outpatient services [11]. Risk factors for psychiatric readmission can be studied on the level of individual units and institutions to suggest interventions targeted to local patient characteristics and needs.

The purpose of this case-control study was to develop a model to estimate one-year psychiatric readmission risk for patients at the University of Virginia Health System (UVA) using patient data available around the time of discharge. Psychiatric inpatients at highest risk for readmission may benefit the most from intensive discharge planning and other interventions to encourage clinical stability in the community.

## Materials and Methods

This case-control study compared characteristics of patients who were readmitted to UVA's inpatient psychiatry unit within 1 year of index admission to those who were not readmitted. The goal of this study was to develop a multivariable logistic regression model to stratify 1-year readmission risk for psychiatric inpatients using risk factors that could be reliably identified prior to discharge. All 849 patients who were admitted to UVA's adult psychiatric inpatient unit in 2013 were included in the study. There were no exclusion criteria. This study was approved by the University of Virginia Institutional Review Board for Health Sciences Research.

Predefined patient characteristics were abstracted from the discharge summary of the index admission by three individuals using a common procedure and electronic form. Data missing from the discharge summary were collected from admission and progress notes from the index admission when possible. Psychiatric readmission status was determined by identifying subsequent admission notes in the electronic health record. Patient data was de-identified prior to electronic storage and analysis. General patient characteristics such as demographic, diagnostic, and discharge information were reported using descriptive statistics.

10 candidate risk factors for psychiatric readmission

were prospectively selected based on the results of a literature review. Seven candidate risk factors were discharge diagnoses: bipolar disorder, major depressive disorder, substance-induced mood disorder, thought disorder (schizophrenia or schizoaffective disorder), anxiety disorder, any Axis II disorder, and substance abuse disorder. Two risk factors, homelessness and active romantic relationship, attempted to capture degree of social support. Length of stay was the final risk factor. Since discharge planning often occurs shortly after admission in an acute psychiatric unit, risk factors were selected based on feasibility and availability around the time of admission. For example, the diagnoses of schizophrenia and schizoaffective disorder were combined into a single category of thought disorder since these diagnoses may be difficult to reliably differentiate during a brief initial inpatient presentation.

A multivariable logistic regression model was created with 1-year readmission as the binary dependent variable and candidate risk factors as independent variables. The model was calibrated using a randomly-selected training dataset representing 70% of all records. Candidate risk factors with a  $p$ -value  $< 0.05$  on univariate regression were included in a multivariate regression reduced via backwards stepwise elimination with a cutoff of  $p < 0.05$ . The final calibrated model was then evaluated against a testing dataset containing the remaining 30% of records to assess discriminatory power and evaluate for over fitting. Risk factors were reported using odds ratios and associated  $p$ -values. Discriminatory power was measured by the C-statistic, defined as the area under the receiver operating characteristic (ROC) curve. Data analyses were performed using IBM SPSS for Windows, version 24 (IBM Corp, Armonk, NY).

## Results

849 adults were admitted to UVA's inpatient psychiatric unit in 2013. Slightly more than half of the patients were female ( $N = 438$ , 52%). The mean age was 43 years old ( $SD = 17$ ). 81% ( $N = 685$ ) of patients were white, 16% ( $N = 134$ ) were black, 1% ( $N = 10$ ) were Hispanic,  $< 1\%$  ( $N = 5$ ) were Asian, and the remaining patients were of "other" or unknown racial background. The average length of admission was 7 days ( $SD = 8.6$ ). The most common Axis I diagnoses were Major Depressive Disorder ( $N = 260$ , 31%), Bipolar Disorder ( $N = 175$ , 21%), Anxiety Disorders excluding Panic Disorder ( $N = 156$ , 18%), Mood Disorder NOS ( $N = 92$ , 11%), Posttraumatic Stress Disorder ( $N = 86$ , 10%) Substance-Induced Mood Disorder ( $N = 67$ , 8%), Schizoaffective Disorder ( $N = 64$ , 5%), and Schizophrenia

(N = 46, 5%). 34% (N = 285) of patients had at least one Axis II diagnosis. 190 patients (22.4%) were readmitted at least once within one year of index admission. 22 patients (2.6%) were readmitted multiple times during this period.

Three of the ten candidate risk factors were included in the final multivariable logistic regression model used to predict one year readmission risk. The diagnoses of thought disorder (schizophrenia or schizoaffective disorder) (odds ratio [OR] = 2.86, *p*-value [*p*] = 0.004) and substance-induced mood disorder (OR = 3.65, *p* = 0.028) were associated with increased readmission risk in both training and testing datasets. Active romantic relationship was a protective factor in the training dataset (OR = 0.62, *p* = 0.030), but not the testing dataset (OR = 1.09, CI = 0.794). The model had similar performance against the training (C = 0.62, 95% confidence interval [CI] = 0.56-0.68) and testing (C = 0.62, CI = 0.54-0.71) datasets. Table 1 summarizes the odds ratio and associated *p*-value for each risk factor and the performance of the model against training and testing datasets.

## Discussion

22.4% of all psychiatric inpatients in this study were readmitted to the same unit within one year. This is consistent with high 1-year readmission rates reported in the literature for other acute inpatient psychiatric units in the United States. Specifically, Clements and colleagues report a 33% rate of readmission [12] and D'Ercole and colleagues a 44.5% rate. These consistent elevations underscore the severity of this challenge.

Our model had limited power to discriminate which psychiatric inpatients would be readmitted within 1-year, as indicated by C-statistic = 0.62 against the testing dataset. Other studies using multivariable logistic regression to predict psychiatric readmission have reported similar model performance with C-statistics between 0.63 and 0.76 [13-15]. In our population, discharge diagnoses of thought disorder and substance-induced mood disorder were statistically-significant risk factors for one-year readmission. Patients with these diagnoses may benefit the most from discharge planning and community follow up matched to their specific needs. There were no significant protective factors across both the testing and training data sets. These findings are consistent with other studies which find unique risk and protective factors for psychiatric readmission. Specific risk factors include being uninsured, having three or more psychiatric hospitalizations [3], a lack of follow up within 7 days of discharge, medication side effects and a lack of psychotic symptom remission in patients with schizophrenia, and a personality disorder diagnosis [13-15]. Protective factors include assertive community treatment, receipt of aftercare, pre and post-discharge patient psychoeducation [4,7].

This study has several limitations. This study did not capture admission to other inpatient psychiatric units outside of UVA and therefore underestimates overall readmission rates for our patient population. History of prior psychiatric readmissions, a significant risk factor in many other studies, was not included as a candidate risk factor since this information was not reliably available in

**Table 1:** Multivariable Logistic Regression Model to Predict Readmission Risk.

Candidate Risk Factor	Univariate Regression (Full Dataset)		Multivariate Regression (Training Dataset)		Multivariate Regression (Testing Dataset)	
			AUC=0.623 (0.566-0.679)		AUC=0.621 (.536-.707)	
	AOR	p-value	AOR	p-value	AOR	p-value
Thought Disorder	2.383	<0.001	2.352	<0.001	2.856	0.004
Substance-Induced Mood Disorder	2.051	0.018	2.651	0.002	3.649	0.028
Active Romantic Relationship	0.568	0.008	0.616	0.03	1.088	0.794
Major Depressive Disorder	0.532	0.01	—	—	—	—
Substance Abuse Disorder	1.323	0.036	—	—	—	—
Any Axis II Diagnosis	1.374	0.123	—	—	—	—
Anxiety Disorder	1.448	0.126	—	—	—	—
Length of Admission	1.011	0.251	—	—	—	—
Homelessness	1.221	0.445	—	—	—	—
Bipolar Disorder	1.121	0.629	—	—	—	—

discharge documentation.

## Conclusions

This study sought to identify patients at highest risk for 1-year psychiatric readmission to a general academic inpatient unit using patient data available at the time of discharge. Our model had limited predictive power and identified discharge diagnoses of substance-induced mood disorder and thought disorder (schizophrenia or schizoaffective disorder) as significant risk factors for 1-year readmission. Overall, this study suggests that risk factors vary between local patient populations. Future research should continue to explore methods to match modifiable local risk factors for psychiatric readmission with evidence-based and cost-effective community services.

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### Previous presentation

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### Potential conflicts of interest

The authors report no financial or other relationship relevant to the subject of this article.

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