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ORIGINAL ARTICLE

Predicting Psychiatric Rehospitalization in Adolescents

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Abstract
Adolescent psychiatric rehospitalizations are common, cause patients and their families severe psychological distress, and use tremendous healthcare resources. This study sought to identify predictors of rehospitalization in 783 adolescents in the 2 year period following psychiatric hospitalization at a major treatment facility in a large urban area. A current diagnosis of posttraumatic stress disorder, greater severity of lifetime suicidal ideation (SI) and stronger treatment alliance prior to hospitalization were associated with a greater likelihood of rehospitalization. Overall, severe lifetime SI was the strongest predictor of rehospitalization; although, within the first 4 months post-discharge, moderate lifetime SI was the strongest predictor. Future research should continue to identify additional factors that may influence rehospitalization, such as the intensity of post-discharge services.

Keywords Rehospitalization · Adolescence or adolescent · Risk factors · Inpatient · Suicidal ideation · Outcomes · Posttraumatic stress

Introduction

Psychiatric hospitalizations account for nearly 15% of all U.S. pediatric hospitalizations (Gay et al. 2018) and cost 3.5 billion dollars annually (Bardach et al. 2014). Self-injurious thoughts and behaviors (SITBs) are the most common presenting reason for adolescent psychiatric hospitalization (Peterson et al. 1996). A study from 49 children's hospitals in the U.S. found that hospital encounters for SITBs have almost doubled from 2008 to 2015, with the greatest increase observed in 15 to 17 year old adolescents. Of these 115,856 encounters for SITBs, 58% were inpatient hospitalizations and 42% were emergency department (ED) visits (Plemmons et al. 2018). Adolescents frequently report continued SITBs in the months following discharge (Czyz and King 2015; Czyz et al. 2016; Yen et al. 2013; Wolff et al. 2018; Prinstein et al. 2008; Czyz et al. 2012), thereby increasing their risk for rehospitalization. Studies report that between 31 and 38% of children and adolescents are rehospitalized in the 12 months post-discharge, with the majority occurring within 90 days

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(Blader 2004; Barker et al. 2010; Fontanella 2008; James et al. 2010). These rehospitalizations are disruptive and cause severe psychological distress for patients and their families (Causey et al. 1998; Roick et al. 2006).

The increase in pediatric psychiatric hospitalizations and high rehospitalization rates demonstrate the importance of identifying predictors of rehospitalization. Over the past two decades, numerous studies have examined psychiatric rehospitalizations; however, many have significant limitations. The majority of these studies have combined children and adolescents in their analyses, despite the differences in clinical presentation of these two cohorts (Fite et al. 2008). As yet, there is no consensus on what factors predict psychiatric rehospitalizations. While psychiatric diagnoses have not been found to predict rehospitalization in most studies (Barker et al. 2010; Romansky et al. 2003; McCarthy et al. 2017; Bobier and Warwick 2005; James et al. 2010), other studies have found the presence of an affective disorder or psychotic disorder (e.g., Arnold et al. 2003) to be predictive. Numerous studies have examined different types of SITBs (e.g., suicide attempt [SA], suicidal ideation [SI], nonsuicidal self-injury) as predictors of rehospitalization and findings have been inconsistent (Czyz et al. 2016; Arnold et al. 2003; Van Alphen et al. 2017; Berona et al. 2017). While SI has been found to better predict rehospitalization (Enns et al. 2003), recent studies (Czyz and King 2015; Czyz et al. 2016; Wolff et al. 2018), have found the chronicity of SI, rather than its recent severity, to be a better predictor of negative post-discharge outcomes, including rehospitalization. Findings regarding whether SITBs predict rehospitalization are limited by small sample sizes and clinically homogeneous populations (e.g., only adolescents with an SA) that do not reflect a general psychiatric inpatient population (e.g., Czyz et al. 2016; Yen et al. 2013; Van Alphen et al. 2017; Berona et al. 2017). Additionally, with the exception of a few studies with sample sizes over 500 (Fontanella 2008; McCarthy et al. 2017), prior studies have generally had sample sizes that have been insufficiently powered to detect small effects. More recently, post-discharge services have been identified as an important factor (James et al. 2010; Trask et al. 2016; Carlisle et al. 2012); however, findings have varied possibly due to methodological differences. It is crucial to identify risk factors for rehospitalization as early in the patient's hospitalization as possible so that inpatient providers can incorporate this risk into both inpatient and discharge care planning.

The inconsistency of this literature demonstrates the need for further evaluation of potential predictors of rehospitalization during the high-risk post-discharge period. The present study used a series of multivariate regression models to examine the association between rehospitalization and a wide range of relevant predictors, including demographic, treatment and clinical variables, in a large, clinically heterogeneous high-risk adolescent inpatient psychiatric population.

Methods

Data Sources

Data were obtained from the electronic medical records of adolescent patients who received treatment on a general pediatric inpatient psychiatric unit in Boston, MA. The study site is the largest provider of child and adolescent inpatient psychiatric care in the state and accepts both private and public-pay insurance. Patients are referred from EDs throughout Massachusetts and surrounding states following a mental health crisis and must meet at least one of the following criteria for admission: acute risk of harm to themselves, acute risk of harm to others, and/or be in a state of significant psychological decline. Former patients are prioritized for rehospitalization so that treatment relationships are maintained, which increases the likelihood of patients returning to this study site if rehospitalized. All study procedures were approved by the study site's Institutional Review Board. Given that data for the study came from secondary sources (i.e., medical record), informed consent was not required.

Study Sample

Patients included in the study were all adolescents ($n = 783$), ages 12–18 ($M = 15.0$, $SD = 1.7$), who were discharged from the inpatient psychiatric unit between January 1, 2012 and December 31, 2013. These patients were primarily Caucasian, female, admitted for acute risk to self, and discharged primarily to home or an acute residential treatment (ART) program. Median length of hospital stay was 10 days. Table 1 summarizes key demographic and treatment characteristics of the study sample.

Variables

Dependent Variable

Time to rehospitalization, defined as the difference between the date of index discharge and date of rehospitalization during the study period, was the primary outcome variable. We determined rehospitalization rates at 30 days, 90 days, 6 months, 1 year, and 2 years post-discharge, as these are common rehospitalization time points reported in the literature. Only the first rehospitalization to the study site within 2 years after a patient's index discharge was captured.

Table 1 Study population and cumulative rehospitalization rates

	Total (%)	Rehospitalized (%)			
	(n = 783)	30 days	90 days	1 year	2 years
Ethnicity (n = 621)					
Caucasian	77.5	8.9	17.1	31.4	36.9
Hispanic	7.2	4.5	4.5	14.1	16.7
African American	5.2	0.0	3.1	9.7	17.3
Asian/Asian American	4.3	11.6	15.7	29.4	29.4
Biracial	2.9	5.6	11.4	17.7	17.7
Other	2.9	0.0	0.0	11.4	11.4
Gender (n = 783)					
Female	70.0	6.6	13.0	24.0	28.6
Male	30.0	6.1	9.3	18.1	20.8
Adoption status (n = 783)					
Not adopted	90.0	5.8	10.9	21.4	25.7
Adopted	10.0	12.1	21.1	29.3	31.1
Reason for admission (n = 783)					
Acute risk of harm to self	79.3	6.3	12.1	23.7	27.5
Significant functional decline	12.6	6.2	10.6	15.2	17.7
Acute risk of harm to others	8.0	8.2	11.7	19	27.3
Discharge location (n = 783)					
Home	36.7	2.5	6.8	16.6	19.6
PHP	17.6	7.5	13.1	19.0	21.8
LT Resi	7.2	9.2	13.1	21.6	28.7
ART	35.2	9.8	16.9	31.1	36.8
IRTP/CC	2.3	0	0	0	0
Other	1.0	12.5	26.8	43.5	43.5

Independent Variables

All independent variables were retrieved from the index hospitalization record. Demographic variables included sex, age, race/ethnicity and adoption status. Treatment variables included length of hospital stay and discharge location. Discharge location categories included: home with outpatient treatment, home with a partial hospitalization program (PHP), longer-term residential or group home (LT Resi), acute residential treatment (ART), and intensive residential treatment program or Continuing Care Unit (IRTP/CCU). Clinical variables included psychiatric diagnoses at discharge, lifetime trauma exposure, the Brief Psychiatric Rating Scale for Children (BPRS-C), and a set of variables that are known to denote patient risk for harm to self or others. DSM-IV-TR diagnoses were converted to DSM-V diagnoses where applicable. The BPRS-C is a reliable, highly validated measure (Gale et al. 1986; Hughes et al. 2001) that consists of 21 symptom areas, each rated for severity (0 = *not present* to 6 = *extremely severe*); it was administered at admission and again at discharge. The risk variables for harm to self (e.g., current SI, recent SA, history of SI [henceforth referred to as lifetime SI]), harm to others (e.g., threatens harm, harms others) and related risk factors (e.g., lack of treatment alliance prior to hospitalization) were each scored (1 = *none* to 4 = *severe*) at time of admission (Table 3, which contains the output of statistical models, also contains all the variables examined). All variables in the current study were assessed and designated by board-certified child psychiatrists.

Data Analysis

To determine the variables that most strongly predicted time to rehospitalization, a series of multivariate Cox proportional hazards regression models were constructed to predict time to rehospitalization. Given that previous research has not consistently identified variables that predict rehospitalization, there was insufficient empirical evidence to justify elimination of available variables from inclusion in the study. Considering the high number of predictors examined, we adopted a sequential model building approach to conservatively reduce probability of type-1 error and identify only the strongest predictors of rehospitalization. Eight domain-specific multivariate preliminary models (e.g., all demographic variables) were constructed to identify the strongest predictors within each domain, using an alpha level of .05. Using multiple preliminary models allowed for

an acceptable sample size to parameter ratio in our preliminary models. The predictors identified in the preliminary models were then fitted in a multivariate cross-domain step 2 model, and then a multivariate final model. As a conservative approach, only statistically significant predictors of rehospitalization in the final model were considered to represent a true effect in the population, and our interpretation was limited to these predictors. A test of the proportional hazards assumption was conducted to ensure that this assumption held for the final model globally and each predictor specifically. All statistical analyses were completed using Stata 14.2.

Results

Baseline Hazard Profile of Rehospitalization

The Nelson–Aalen cumulative hazard ratio of rehospitalization, that is, the percentage of patients rehospitalized at each time point, was 26% at 2 years post-discharge, 22% at 1 year, 18% at 180 days, 12% at 90 days, and 6% at 30 days (Fig. 1).

Step 1 Domain-Specific Models

Table 2 presents results of all significant domain-specific, cross-domain and final model analyses. Results of all domain-specific analyses, regardless of their statistical significance, are provided in Table 3. The following variables were found to significantly predict risk of rehospitalization controlling for variables within their own domain: age, posttraumatic stress disorder (PTSD) diagnosis, severity of lifetime SI, lack of treatment alliance (prior to hospital admission) and the BPRS-C variables sleep difficulties at admission, feelings of inferiority at discharge, and hallucinations at discharge.

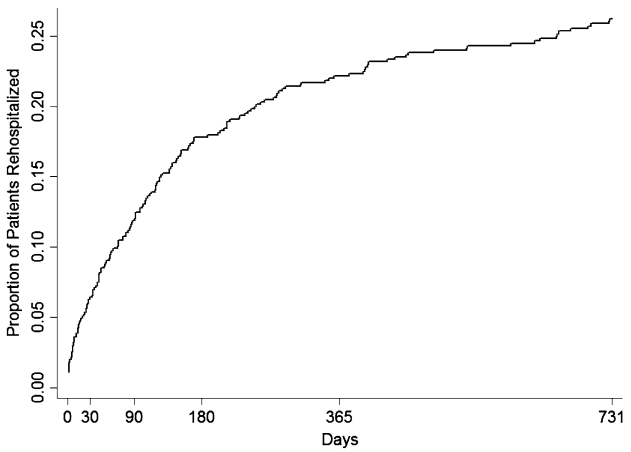

Fig. 1 Proportion of patients rehospitalized within 2 year follow up period (n = 783)

Step 2 Cross-Domain Model

All diagnostic and symptom predictors that were significantly associated with rehospitalization were included in a cross-domain model. In this model, patients diagnosed with PTSD were significantly more likely than patients without PTSD to be rehospitalized. Patients with greater severity of lifetime SI on admission and patients with greater feelings of inferiority at discharge were also more likely to be rehospitalized. Patients with a greater lack of treatment alliance (i.e., weaker treatment alliance) were less likely to be rehospitalized. Older patients were less likely to be rehospitalized. In the cross-domain model, hallucinations at discharge and sleep difficulties were not statistically significant.

Step 3 Final Model

Only predictors that were statistically significant in the step 2 cross-domain model were included in the final model. In this model, patients diagnosed with PTSD were 1.88 times more likely to be rehospitalized during the study period than those without PTSD (Fig. 2).

For every one unit increase in severity of lifetime SI, the likelihood of rehospitalization increased 1.29 times (Fig. 3), and for every one unit increase in lack of treatment alliance, patients were 0.79 times less likely to be rehospitalized during the study period. For every additional year in age, patients were .91 times less likely to be rehospitalized. In the final model, the BPRS-C *feelings of inferiority* variable was not statistically significant.

Finally, a test of the proportional hazards assumption ensured that it held for all individual predictors in our final model and for the final model globally. This test resulted in insufficient evidence to reject the assumption of proportional hazards for PTSD ($X^2 = 1.70$, $df = 1$, $p = .192$), lifetime SI ($X^2 = 1.96$, $df = 1$, $p = .161$), lack of treatment alliance ($X^2 = 2.39$, $df = 1$, $p = .122$), feelings of inferiority ($X^2 = .22$, $df = 1$, $p = .642$), age ($X^2 = 2.88$, $df = 1$, $p = .090$) and for the final model overall ($X^2 = 9.14$, $df = 5$, $p = .104$). Schoenfeld residuals for each predictor revealed a slight trend in PTSD and lack of treatment alliance. However, no concerning violation of the assumption of proportional hazards was apparent.

Despite insufficient evidence to reject the assumption of proportional hazards, Fig. 3 clearly displays a lack of consistent proportionality between the severe and moderate lifetime SI groups. Specifically, in the first 0–118 days post-discharge, patients with severe lifetime SI were less likely to be rehospitalized compared to those with moderate lifetime SI, and more likely to be rehospitalized thereafter. This

Table 2 Cox proportional hazards models of variables predicting rehospitalization by step and domain

Model	Measure	β	(SE)	Wald	P	HR	95% CI			Model measures			
										−2 log likelihood	X^2	*df*	*P*
Step 1: Demographic model (n = 621)										1069.00	20.72	8	.01
	Age	−.10	.05	−2.29	.02	.90	.82	–	.99				
Step 1: Diagnoses model (n = 783)										1157.45	37.73	22	.02
	Trauma/stressor: PTSD	.55	.22	2.44	.02	1.73	1.11	–	2.69				
Step 1: Risk to self model (n = 314)										361.82	30.96	24	.16
	Lifetime history of suicidal ideation	.49	.22	2.23	.03	1.62	1.06	–	2.49				
	Lack of treatment alliance	−.48	.17	−2.83	.01	.62	.44	–	.86				
Step 1: BPRSC admission model (n = 641)										981.81	22.58	21	.37
	Sleep difficulties	.13	.06	2.25	.02	1.14	1.02	–	1.27				
Step 1: BPRSC discharge model (n = 648)										961.61	29.91	21	.09
	Feelings of inferiority	.25	.10	2.51	.01	1.28	1.06	–	1.55				
	Hallucinations	.28	.13	2.27	.02	1.33	1.04	–	1.70				
Step 2: Cross domain model (n = 654)										1002.66	37.77	7	.00
	Trauma/stressor: PTSD	.53	.23	2.30	.02	1.70	1.08	–	2.68				
	Lifetime history of suicidal ideation	.26	.09	2.82	.01	1.29	1.08	–	1.54				
	Lack of treatment alliance	−.24	.09	−2.66	.01	.79	.66	–	.94				
	Sleep difficulties	.08	.05	1.42	.15	1.08	.97	–	1.20				
	Feelings of inferiority	.14	.07	1.97	.05	1.15	1.00	–	1.32				
	Hallucinations	.13	.09	1.44	.15	1.14	.95	–	1.37				
	Age	−.10	.05	−2.05	.04	.91	.83	–	1.00				
Step 3: Final cross domain model (n = 686)										1032.38	33.53	5	.00
	Trauma/stressor: PTSD	.63	.23	2.80	.01	1.88	1.21	–	2.93				
	Lifetime history of suicidal ideation	.25	.09	2.84	.00	1.29	1.08	–	1.54				
	Lack of treatment alliance	−.23	.09	−2.69	.01	.79	.67	–	.94				
	Feelings of inferiority	.12	.07	1.83	.07	1.13	.99	–	1.29				
	Age	−.10	.05	−2.18	.03	.91	.83	–	.99				

Table 3 Cox proportional hazards models of variables predicting rehospitalization by step and domain

Model	Measure	β	(SE)	Wald	P	HR	95% CI			Model measures			
										−2 log likelihood	X^2	*df*	*P*
Step 1: Demographic model (n = 621)										−1069.00	20.72	8	.01
	African American (reference category)	–	–	–	–	–	–	–	–				
	Asian/Asian American	.50	.59	.84	.40	1.64	.52	–	5.21				
	Biracial	.10	.73	.13	.89	1.10	.26	–	4.61				
	Caucasian	.82	.46	1.79	.07	2.27	.93	–	5.54				
	Hispanic	−.01	.59	−.02	.98	.99	.31	–	3.11				
	Other	−.43	.84	−.51	.61	.65	.13	–	3.37				
	Sex	.21	.18	1.20	.23	1.24	.87	–	1.75				
	Adopted	.24	.25	.98	.33	1.27	.78	–	2.07				
	Age	−.10	.05	−2.29	.02	.90	.82	–	.99				
Step 1: Treatment information model (n = 783)										1176.31	.00	1	.96
	Length of stay	.00	.00	−.03	.98	1.00	.99	–	1.01				
Step 1: Diagnoses model (n = 783)										−1157.45	37.73	22	.02
	Mood disorder	.34	.27	1.25	.21	1.40	.83	–	2.36				
	Bipolar disorders	.07	.35	.19	.85	1.07	.54	–	2.12				
	Bipolar disorders with psychotic features	.98	.63	1.56	.12	2.66	.78	–	9.12				
	Depressive disorders with psychotic features	.02	.28	.08	.94	1.02	.59	–	1.75				
	Depressive disorders with psychotic features	.47	.51	.93	.35	1.60	.59	–	4.34				
	Anxiety disorders	.21	.16	1.30	.19	1.23	.90	–	1.68				
	Obsessive-compulsive and related disorders	−.05	.43	−.12	.90	.95	.41	–	2.20				
	Trauma/stressor: PTSD	.55	.22	2.44	.02	1.73	1.11	–	2.69				
	Trauma/stressor: RAD	−.08	.72	−.11	.92	.93	.23	–	3.80				
	Trauma/stressor: adjustment disorder	–	–	–	–	–	–	–	–				
	Trauma/stressor: other	–	–	–	–	–	–	–	–				
	Eating disorders	.24	.25	.94	.35	1.27	.77	–	2.08				
	Schizophrenia spectrum and psychotic disorders	.18	.33	.54	.59	1.19	.63	–	2.26				
	Disruptive, impulse-control, conduct disorders	−.55	.59	−.93	.35	.58	.18	–	1.85				
	Substance-related and addictive disorders	−.56	.30	−1.90	.06	.57	.32	–	1.02				
	Neurodevelopmental: ASD	.12	.25	.49	.63	1.13	.69	–	1.85				
	Neurodevelopmental: ADHD	−.18	.24	−.76	.45	.84	.52	–	1.33				
	Neurodevelopmental: learning disorders	.38	.33	1.16	.24	1.46	.77	–	2.79				
	Neurodevelopmental: tic disorders	.48	.74	.65	.51	1.62	.38	–	6.91				
	Neurodevelopmental: cognitive NOS	.84	.61	1.38	.17	2.31	.70	–	7.59				
	Somatic symptom and related disorders	.06	1.01	.06	.95	1.06	.15	–	7.71				
	Other	.28	1.02	.27	.79	1.32	.18	–	9.72				
		.00	.00	.00	.00	.00	.00	–	.00				

Table 3 (continued)

Model	Measure	β	(SE)	Wald	P	HR	95% CI			Model measures			
										−2 log likelihood	X^2	*df*	*P*
Step 1: Trauma model (n = 587)		.00	.00	.00	.00	.00	.00	–	.00	827.93	6.13	8	.63
	Physical abuse/assault	−.01	.30	−.04	.97	.99	.54	–	1.80				
	Sexual abuse/assault	.04	.28	.15	.88	1.04	.60	–	1.82				
	Witness to violence	.55	.31	1.80	.07	1.73	.95	–	3.16				
	Severe neglect	.02	.40	.05	.96	1.02	.46	–	2.25				
	Bullying	.07	.26	.26	.80	1.07	.64	–	1.80				
	Traumatic loss/grief	.18	.30	.60	.55	1.19	.67	–	2.14				
	Developmental trauma	.48	.33	1.45	.15	1.62	.85	–	3.09				
	Natural disaster	.43	.30	1.46	.15	1.54	.86	–	2.77				
Step 1: Risk to self model (n = 314)										361.82	30.96	24	.16
	Current suicidal ideation	.10	.17	.59	.56	1.10	.79	–	1.53				
	Recent suicide attempt	−.11	.16	−.68	.50	.90	.65	–	1.23				
	Recent self-injury	.18	.14	1.29	.20	1.20	.91	–	1.58				
	Drug/alcohol intoxication	−.17	.24	−.71	.48	.84	.53	–	1.35				
	Drug/alcohol abuse/withdrawal	.05	.26	.20	.84	1.05	.63	–	1.76				
	Severe mood symptoms	.12	.24	.50	.62	1.13	.70	–	1.80				
	Agitation/impulsivity	−.12	.16	−.75	.46	.89	.65	–	1.21				
	Anxiety/panic attacks	.01	.16	.08	.94	1.01	.75	–	1.38				
	Insomnia	.05	.15	.35	.73	1.05	.79	–	1.40				
	Diminished concentration	.02	.16	.14	.89	1.02	.75	–	1.39				
	Confusional state	.41	.24	1.70	.09	1.51	.94	–	2.44				
	Command auditory hallucination	−.11	.25	−.42	.67	.90	.55	–	1.47				
	Delusion that increases risk	−.17	.31	−.56	.58	.84	.46	–	1.54				
	Chronic pain	−.89	.48	−1.85	.06	.41	.16	–	1.05				
	Disabling medical illness	.32	.20	1.61	.11	1.38	.93	–	2.05				
	Lifetime history of suicidal ideation	.49	.22	2.23	.03	1.62	1.06	–	2.49				
	Lifetime history of suicide attempt(s)	−.13	.18	−.73	.46	.88	.62	–	1.24				
	Recent losses	.08	.14	.59	.55	1.09	.83	–	1.43				
	Recent relationship problems	−.01	.16	−.08	.94	.99	.73	–	1.34				
	Lack of family/social support	.06	.18	.31	.75	1.06	.75	–	1.50				
	Lack of treatment alliance	−.48	.17	−2.83	.01	.62	.44	–	.86				
	Family-completed suicide(s)	−.13	.22	−.59	.56	.88	.57	–	1.36				
w	Access to gun?	.69	.77	.89	.37	1.99	.44	–	9.05				
	Mental image?	−.28	.33	−.83	.41	.76	.39	–	1.46				

Table 3 (continued)

Model	Measure	β	(SE)	Wald	P	HR	95% CI			Model measures			
										−2 log likelihood	X^2	*df*	*P*
Step 1: Risk to others model (n = 578)										869.63	.91	24	.91
	Recent threats toward others	.13	.20	.63	.53	1.13	.77	–	1.68				
	Recent harm to others	−.19	.22	−.87	.39	.83	.54	–	1.27				
	Destruction of property—threat	−.06	.31	−.20	.84	.94	.51	–	1.73				
	Destruction of property—action	.23	.33	.71	.48	1.26	.66	–	2.41				
	Fireplay/firesetting/arson	.31	.70	.44	.66	1.36	.34	–	5.36				
	Drug intoxication	−.33	.22	−1.47	.14	.72	.47	–	1.12				
	Drug abuse/withdrawal	.07	.21	.34	.73	1.08	.71	–	1.64				
	Alcohol intoxication	−.06	.25	−.26	.80	.94	.58	–	1.52				
	Alcohol abuse/withdrawal	−.04	.25	−.17	.86	.96	.59	–	1.56				
	Severe mood symptoms	.08	.13	.60	.55	1.08	.84	–	1.40				
	Agitation/impulsivity	.12	.11	1.04	.30	1.12	.90	–	1.39				
	Anxiety/panic attacks	−.11	.10	−1.11	.27	.89	.73	–	1.09				
	Confusional state	.13	.16	.81	.42	1.14	.83	–	1.57				
	Command auditory hallucination	−.13	.18	−.75	.45	.87	.62	–	1.24				
	Delusion that increases risk	.00	.18	−.01	.99	1.00	.70	–	1.42				
	Gang involved	−.89	.97	−.92	.36	.41	.06	–	2.76				
	Fringe of peer group	−.05	.10	−.51	.61	.95	.79	–	1.15				
	Unconcerned w/consequences	−.01	.12	−.08	.94	.99	.78	–	1.26				
	Threatens harm	−.10	.21	−.49	.63	.90	.60	–	1.37				
	Harms others	.24	.25	.97	.33	1.27	.78	–	2.05				
	Threatens property destruction	−.04	.30	−.12	.91	.97	.54	–	1.74				
	Destroys property	−.40	.32	−1.27	.20	.67	.36	–	1.24				
	Rage/explosive outbursts	.01	.13	.05	.96	1.01	.78	–	1.29				
	Past firesetting/fireplay/arson	−.11	.70	−.16	.87	.89	.23	–	3.51				
Step 1: BPRSC admission model (n = 641)										981.81	22.58	21	.37
	Uncooperativeness	−.08	.09	−.83	.41	.93	.78	–	1.11				
	Hostility	.08	.09	.87	.39	1.08	.90	–	1.30				
	Manipulativeness	−.05	.08	−.63	.53	.95	.81	–	1.11				
	Depressive mood	−.03	.09	−.29	.77	.98	.82	–	1.16				
	Feelings of inferiority	.04	.07	.66	.51	1.05	.92	–	1.19				
	Suicidal ideation	.08	.06	1.51	.13	1.09	.98	–	1.21				
	Peculiar fantasies	.07	.11	.64	.53	1.07	.87	–	1.32				
	Delusions	.00	.11	.00	1.00	1.00	.80	–	1.25				
	Hallucinations	.05	.08	.59	.56	1.05	.89	–	1.24				

Table 3 (continued)

Model	Measure	β	(SE)	Wald	P	HR	95% CI			Model measures			
										−2 log likelihood	X^2	*df*	*P*
	Hyperactivity	−.15	.10	−1.52	.13	.86	.71	–	1.04				
	Distractibility	−.01	.07	−.09	.93	.99	.87	–	1.13				
	Speech or voice pressure	.10	.09	1.09	.28	1.11	.92	–	1.33				
	Underproductive speech	.04	.08	.47	.64	1.04	.89	–	1.20				
	Emotional withdrawal	.02	.07	.24	.81	1.02	.88	–	1.18				
	Blunted affect	−.05	.07	−.61	.54	.96	.83	–	1.10				
	Tension	−.05	.07	−.80	.43	.95	.83	–	1.08				
	Anxiety	.02	.07	.32	.75	1.02	.89	–	1.18				
	Sleep difficulties	.13	.06	2.25	.02	1.14	1.02	–	1.27				
	Disorientation	−.21	.18	−1.15	.25	.81	.57	–	1.16				
	Speech deviances	−.04	.13	−.33	.74	.96	.74	–	1.24				
	Stereotypy	.26	.19	1.33	.18	1.29	.89	–	1.89				
Step 1: BPRSC discharge model (n = 648)										961.61	29.91	21	.09
	Uncooperativeness	−.12	.10	−1.14	.25	.89	.72	–	1.09				
	Hostility	.05	.11	.44	.66	1.05	.84	–	1.32				
	Manipulativeness	−.07	.09	−.83	.41	.93	.78	–	1.11				
	Depressive mood	−.05	.11	−.44	.66	.95	.77	–	1.18				
	Feelings of inferiority	.25	.10	2.51	.01	1.28	1.06	–	1.55				
	Suicidal ideation	.05	.09	.60	.55	1.06	.88	–	1.26				
	Peculiar fantasies	.05	.15	.35	.72	1.05	.79	–	1.41				
	Delusions	−.08	.17	−.46	.65	.92	.66	–	1.30				
	Hallucinations	.28	.13	2.27	.02	1.33	1.04	–	1.70				
	Hyperactivity	−.05	.10	−.46	.65	.95	.78	–	1.17				
	Distractibility	.13	.08	1.60	.11	1.13	.97	–	1.32				
	Speech or voice pressure	−.11	.12	−.93	.35	.90	.71	–	1.13				
	Underproductive speech	.07	.11	.62	.53	1.07	.87	–	1.32				
	Emotional withdrawal	.04	.11	.36	.72	1.04	.84	–	1.28				
	Blunted affect	−.17	.12	−1.49	.14	.84	.67	–	1.06				
	Tension	.03	.10	.28	.78	1.03	.85	–	1.24				
	Anxiety	−.06	.11	−.52	.60	.94	.76	–	1.17				
	Sleep difficulties	−.03	.08	−.43	.67	.97	.83	–	1.13				
	Disorientation	−.30	.27	−1.14	.25	.74	.44	–	1.24				
	Speech deviances	−.12	.23	−.52	.60	.89	.57	–	1.38				
	Stereotypy	−.18	.37	−.48	.63	.84	.41	–	1.73				

Table 3 (continued)

Model	Measure	β	(SE)	Wald	P	HR	95% CI			Model measures			
										−2 log likelihood	X^2	*df*	*P*
Step 2: Cross domain model (n = 654)										1002.66	37.77	7	.00
	Trauma/stressor: PTSD	.53	.23	2.30	.02	1.70	1.08	–	2.68				
	Lifetime history of suicidal ideation	.26	.09	2.82	.01	1.29	1.08	–	1.54				
	Lack of treatment alliance	−.24	.09	−2.66	.01	.79	.66	–	.94				
	Sleep difficulties	.08	.05	1.42	.15	1.08	.97	–	1.20				
	Feelings of inferiority	.14	.07	1.97	.05	1.15	1.00	–	1.32				
	Hallucinations	.13	.09	1.44	.15	1.14	.95	–	1.37				
	Age	−.10	.05	−2.05	.04	.91	.83	–	1.00				
Step 3: Final cross domain model (n = 686)										1032.38	33.53	5	.00
	Trauma/stressor: PTSD	.63	.23	2.80	.01	1.88	1.21	–	2.93				
	Lifetime history of suicidal ideation	.25	.09	2.84	.00	1.29	1.08	–	1.54				
	Lack of treatment alliance	−.23	.09	−2.69	.01	.79	.67	–	.94				
	Feelings of inferiority	.12	.07	1.83	.07	1.13	.99	–	1.29				
	Age	−.10	.05	−2.18	.03	.91	.83	–	.99				

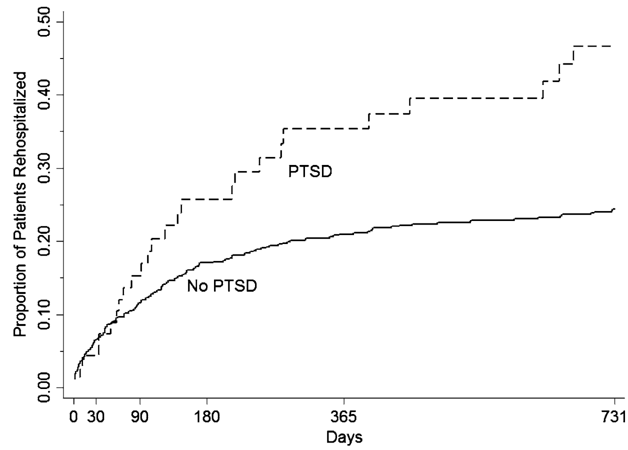

Fig. 2 Proportion of patients rehospitalized within 2 year follow up period, stratified by PTSD diagnosis (n = 783)

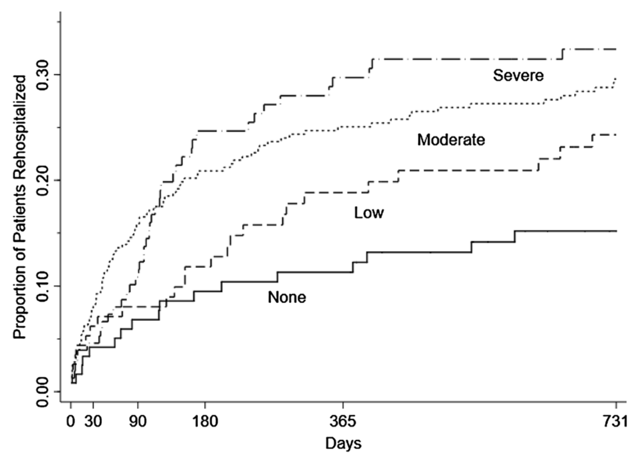

Fig. 3 Proportion of patients rehospitalized within 2 year follow up period, stratified by severity of lifetime suicidal ideation (n = 752)

difference in risk in days 0–118 post-discharge was proportionally largest at days 34–37 when patients with moderate lifetime SI were 2.02 times more likely to be rehospitalized than patients with severe lifetime SI. After day 118, patients with severe lifetime SI were more likely to be rehospitalized than patients with moderate lifetime SI. This difference in risk was proportionally largest at days 404–453.

Secondary Analysis

We hypothesized that patients with severe lifetime SI would be temporarily less likely to be rehospitalized because they were discharged to more intensive levels of care compared to patients with less severe lifetime SI histories. Therefore, we constructed a logistic regression model to determine if patients with severe lifetime SI predicted discharge location ($n = 744$, $X^2 = 21.41$, $df = 4$, $p < .001$). Compared to

being discharged to home with outpatient therapy, patients with severe lifetime SI were 1.99 times more likely to be discharged to PHP ($z = 2.48$, 95% CI [1.15, 3.44], $df = 4$, $p = .013$), 2.19 times more likely to be discharged to LT Resi ($z = 2.09$, 95% CI [1.05, 4.61], $df = 4$, $p = .037$), 2.77 times more likely to be discharged to ART ($z = 4.45$, 95% CI [1.77, 4.33], $df = 4$, $p < .001$), and 3.57 times more likely to be discharged to IRTP/CCU ($z = 2.39$, 95% CI [1.26, 10.15], $df = 4$, $p = .017$). This confirmed that patients with severe lifetime SI were discharged to higher levels of care at higher rates, implicating post-discharge level of care as a possible cause of the temporarily suppressed rehospitalization rate with these patients.

Discussion

Adolescent psychiatric rehospitalizations are common and costly, cause undue emotional and psychological distress to patients and their families and require tremendous healthcare resources (Bardach et al. 2014; Causey et al. 1998; Moses 2011). This retrospective study aimed to identify predictors of rehospitalization in adolescents discharged from an inpatient psychiatric unit. Of the many demographic, treatment and clinical factors examined, only a current diagnosis of PTSD, severe lifetime SI, and lack of treatment alliance were significantly associated with likelihood of rehospitalization in the final model. We address each significant predictor in turn.

Contrary to previous reports of no association between PTSD and adolescent psychiatric rehospitalization (e.g., Arnold et al. 2003; Bobier and Warwick 2005), we found that patients with PTSD were more likely to be rehospitalized than patients without PTSD. A number of factors may contribute to this finding. Patients with PTSD may be more susceptible to rehospitalization due to the overt dysregulation associated with this disorder, making their distress more apparent to caregivers and/or outpatient clinicians, resulting in more ED visits and subsequent rehospitalizations. Alternatively, the predictive findings of PTSD may be reflective of the patient's trauma history, which some studies (Yen et al. 2013; Markota et al. 2018; Van Alphen et al. 2017) have found to predict adolescent rehospitalization. In the present study, no specific trauma exposure category significantly predicted rehospitalization, although witness to violence was trending. This lack of significance may be based on underreporting of trauma in this young, vulnerable population. While the present study distinguished between different forms of trauma, our trauma measure did not assess its frequency, severity or associated symptomatology. Trauma is complex, and a further nuanced examination of the relationship between trauma history, number and types of trauma, post-traumatic stress symptoms, and rehospitalization, is warranted.

Adolescents with a more severe lifetime SI were more likely to be rehospitalized during the two-year follow-up period. This variable is rated by psychiatrists, taking into account the intensity, frequency and duration of lifetime SI, based on interviews with patients, parent and clinical notes. Although other studies have examined recent SI (e.g., the month prior to hospitalization), to our knowledge, no other studies have examined the severity of lifetime SI as a predictor of rehospitalization in adolescents. In the current study, indicators of recent SI severity (e.g., current SI, recent self-injury, recent SA) did not predict rehospitalization. This contrasts with other studies, which found that the severity of past month SI predicted rehospitalization (Czyz and King 2015; Enns et al. 2003). The discrepancy could be due to low variability in the current study (80% of the sample was admitted due to acute risk of harm to self), an issue discussed in other inpatient studies (Yen et al. 2013; Consoli et al. 2015).

However, there is also evidence that compared with acute SI, chronically elevated SI is a better predictor for rehospitalization. For example, several studies have found that although acute SI prior to the index hospitalization and chronically elevated SI in the year following discharge were both predictors of rehospitalization, chronically elevated SI was a much stronger predictor of rehospitalization than acute SI (Czyz and King 2015; Czyz et al. 2016; Wolff et al. 2018). This is because among adolescents that entered with hospital with elevated SI, those whose SI diminished shortly after discharge were at lower risk of rehospitalization. Although no prior studies have examined lifetime SI severity prior to hospitalization, it is possible that adolescents with a longer and more severe history of SI are more likely to experience persistently elevated SI after discharge and therefore require rehospitalization. Future studies should examine this possibility. Overall, our results suggest that having clinicians rate patients' severity of lifetime SI can be useful in understanding which adolescents will likely return to the hospital.

While severe lifetime SI was predictive of rehospitalization within two-years, this pattern did not hold true at all time points. Results show that patients with *moderate* lifetime SI were more likely to be rehospitalized in the first 118 days, compared to all other severity groups, including the severe group. We hypothesized that this counterintuitive result may be related to participation in more intensive discharge services by patients with severe lifetime SI. Further analysis confirmed this hypothesis; compared to all other lifetime SI severity groups, patients with *severe* lifetime SI were more likely to be discharged to more intensive treatment services (e.g., PHP, LT Resi, ART, IRTP/CCU) than to traditional outpatient care. We posit that by extending the episode of intensive treatment, these intensive programs

temporarily manage patients' symptoms in the high-risk period post-discharge, thereby delaying but not preventing rehospitalization. Based on these findings, we recommend that the potentially moderating influence of post-discharge treatment be taken into consideration when evaluating outcomes following treatment across multiple levels of care. Specifically, considering a psychiatric hospitalization followed by intensive post-discharges services as a single episode of care may provide more reliable data on post-discharge outcomes and subsequent need for rehospitalization. Thoughtful titration from intensive to less intensive post-discharge services is an important component of inpatient care and requires closer attention in future studies.

Unexpectedly, adolescents who had a strong treatment alliance prior to hospitalization were more likely to be rehospitalized. This variable, rated by psychiatrists at intake, denotes the strength of the patient's alliance with outpatient mental health providers prior to hospitalization. To our knowledge, this is the first study that has examined pre-hospitalization treatment alliance as a predictor of rehospitalization. One explanation for this finding is that patients with a lower treatment alliance may not attend outpatient psychotherapy after discharge and non-attendance is associated with lower rates of rehospitalization (Blader 2004), perhaps because there is an absence of service providers monitoring suicide risk and recommending rehospitalization. Other potential explanations are that patients who do not attend outpatient therapy either have less access to both outpatient and inpatient care or have reduced help-seeking behaviors and therefore avoid mental health care generally. One additional possibility is that patients with less severe symptoms have engaged in mental health care inconsistently because they do not require regular treatment (e.g., weekly sessions) and therefore have not established a strong alliance with a particular clinician. In contrast, patients with more severe and chronic symptoms may have been attending regular sessions over a long period of time, allowing them to build a strong treatment alliance but also require rehospitalization because of their more severe symptomology.

Consistent with previous literature (Arnold et al. 2003; Bobier and Warwick 2005), we found an association between age and reduced rehospitalization risk. However, we interpret these results cautiously. Although previously admitted patients are prioritized for rehospitalization up to age 20 at this study site, this finding regarding age may be driven by geographic relocation common in this age group, or eligibility for hospitalization at other adult units.

The retrospective design posed several limitations to this study. First, the dataset was limited to available hospital records and did not include post-discharge risk factors, such as response to aftercare services (James et al. 2010; Foster 1999; Trask et al. 2016), medication compliance (Fontanella 2008), and psychosocial factors related to connectedness (Czyz et al. 2012; Lakin et al. 2004). Second, only a patient's first hospitalization during the study period was included; history of prior hospitalizations was unavailable. Third, the predominantly Caucasian and female sample may have influenced study findings. Finally, only patients rehospitalized to the study site could be included in the analysis, which may have caused an underestimation of the true rehospitalization rate. Indeed, the 26% two-year rehospitalization rate in this study is low compared to published rates of 31–38% (Blader 2004; Barker et al. 2010; Fontanella 2008; James et al. 2010). Despite these limitations, the present study's large sample size and the study site's admission practices (i.e., accepting private and public-pay, accepting patients from a large region, and prioritizing adolescents previously hospitalized at the study site) support the generalizability of the study's findings to the adolescent psychiatric population.

Conclusions

Adolescents who require inpatient psychiatric hospitalization are a vulnerable, high-risk population with complex symptomatology that persists post-discharge. Our findings identified three important predictors of adolescent psychiatric rehospitalization: diagnosis of PTSD, severity of lifetime SI and a weak treatment alliance prior to hospitalization. Important areas for further research in adolescents who are in psychiatric crisis should include examination of the role of PTSD, the influence, severity, and trajectory of SITBs, especially SI, and the relationship of adolescent patients with their outpatient mental health providers. Additionally, prospective examination of the critical post-discharge period to better understand the predictors of negative outcomes in this population is warranted and should include longitudinally evaluating patients throughout treatment episodes that span multiple levels of psychiatric care.

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Compliance with Ethical Standards

Conflict of interest Victoria Joyce declares that she has no conflict of interest. Christopher King declares that he has no conflict of interest. Carol Nash declares that she has no conflict of interest. Lauren Lebois declares that she has no conflict of interest. Kerry Ressler is on the scientific advisory boards for Resilience Therapeutics, the Sheppard Pratt-Lieber Research Institute, the Laureate Institute for Brain Research, the Army Study to Assess Risk and Resilience in Service-

members (STARRS) project, the University of California-San Diego VA Center of Excellence for Stress and Mental Health (CESAMH) and the Anxiety and Depression Association of America. He provides fee-for-service consultation for Biogen and Resilience Therapeutics. Ralph Buonopane declares that he has no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent was not required.

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