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Psychiatric Symptoms and Acute Care Service Utilization over the Course of the Year Following Medical-Surgical Intensive Care Unit Admission: A Longitudinal Investigation

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Abstract

Objective—To determine if the presence of in-hospital substantial acute stress symptoms, as well as substantial depressive or posttraumatic stress disorder (PTSD) symptoms at 3-months post-intensive care unit (ICU), are associated with increased acute care service utilization over the course of the year following medical-surgical ICU admission.

Design—Longitudinal cohort study.

Setting—Academic medical center.

Patients—150 patients 18 years old admitted to medical-surgical ICUs for over 24 hours.

Measurements and Main Results—Participants were interviewed in-hospital to ascertain substantial acute stress symptoms using the PTSD Checklist-civilian version (PCL-C). Substantial depressive and PTSD symptoms were assessed using the Patient Health Questionnaire-9 and the PCL-C respectively at 3 months post-ICU. The number of rehospitalizations and emergency room (ER) visits were ascertained at 3 and 12 months post-ICU using the Cornell Services Index. After adjusting for participant and clinical characteristics, in-hospital substantial acute stress symptoms were independently associated with greater risk of an additional hospitalization (Relative Risk [RR]: 3.00, 95% Confidence Interval [CI]: 1.80, 4.99) over the year post-ICU. Substantial PTSD symptoms at 3 months post-ICU were independently associated with greater risk of an additional ER visit during the subsequent 9 months (RR: 2.29, 95% CI: 1.09, 4.84) even after adjusting for both rehospitalizations and ER visits between the index hospitalization and 3 months post-ICU.

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Conclusions—Post-ICU psychiatric morbidity is associated with increased acute care service utilization during the year after a medical-surgical ICU admission. Early interventions for at-risk ICU survivors may improve longer-term outcomes and reduce subsequent acute care utilization.

Keywords

critical care; posttraumatic stress disorder; depression; patient readmission

INTRODUCTION

Critical illnesses and intensive care unit (ICU)-based therapies are a substantial contributor to escalating healthcare costs in the United States (1). Recently, interest has increased in healthcare utilization and associated costs in critical illness survivors (2). A systematic review of healthcare utilization following critical illnesses found that many ICU survivors are rehospitalized during the year post-ICU with considerable associated healthcare costs (2). Yet, potential risk factors for increased acute care service utilization among critical illness survivors remain poorly understood.

A growing body of literature has identified that critical illness survivors have high rates of depression and posttraumatic stress disorder (PTSD) (3–6), with some having clinically apparent PTSD symptoms prior to hospital discharge (7). Depression has been found to be independently associated with increased risk of rehospitalization (8), and both depression and PTSD have been found to be independently associated with increased healthcare costs for medical illnesses (9, 10). However, the role that post-ICU psychiatric morbidity may play in subsequent acute care service utilization has not been established.

The present study is a longitudinal investigation of acute care service utilization in a cohort of medical-surgical ICU survivors over the course of the year following hospital discharge. We sought to ascertain if the presence of in-hospital substantial acute stress symptoms (i.e., clinically important PTSD symptoms present less than one month after exposure to a traumatic stressor) was independently associated with rehospitalization and emergency room (ER) visits during the year post-ICU. We also sought to determine if substantial depressive and PTSD symptoms assessed 3 months post-ICU were independently associated with subsequent rehospitalizations and ER visits.

METHODS

Study Setting, Participants, and Procedures

The present study was conducted at Harborview Medical Center (HMC), a public academic medical center operated by the University of Washington (UW) in Seattle, WA. Between September 2010 and August 2011, we prospectively recruited 150 patients admitted to an ICU at HMC. Exclusion criteria included: 1) admission for traumatic injury; 2) pre-existing cognitive impairment or dementia noted in the medical record; 3) non-English speaking; 4) ICU length of stay (LOS) $\geq$ 24 hours; 5) life-expectancy $<$ 12 months documented in the medical record; and 6) admission for suicide attempt. The study protocol was approved by

the UW Institutional Review Board (IRB), and all participants provided informed consent before enrollment.

Eligible subjects were approached for consent before transfer from the ICU to the general medical-surgical ward. Since the UW IRB did not allow surrogate consent, if the patient was unable to consent, typically due to delirium and/or cognitive impairment, they were re-approached for consent once the delirium and/or cognitive impairment resolved. We assessed cognitive impairment in this context using a cutoff score of ≥ 3 errors on the Six-Item Cognitive Screen (11). The area under the receiver operating characteristic curve for the Six-Item Cognitive Screen is 0.86 for a community-based sample versus the Community Screening Instrument for Dementia and 0.91 for a clinical sample versus a battery including the Mini-Mental State Examination and the Consortium for Establishment of Registry for Alzheimer Disease battery (11).

Participants were interviewed in-person before hospital discharge and again via telephone at 3 and 12 months post-ICU.

Primary Independent Variables

Our primary independent variables included the presence of substantial acute stress symptoms prior to hospital discharge and substantial depressive or PTSD symptoms at 3 months post-ICU.

We assessed in-hospital substantial acute stress symptoms with the PTSD Checklist-civilian version (PCL-C) (12). The PCL-C includes questions regarding 5 intrusive cluster symptoms (e.g., intrusive thoughts, nightmares), 7 avoidant cluster symptoms (e.g., avoidance of thoughts or activities that recall the stressor, emotional numbing), and 5 arousal cluster symptoms (e.g., impaired sleep, hypervigilance). Symptom severity is rated on a 5 point Likert scale (12). Substantial acute stress symptoms was ascertained by following an algorithm that considers a score of ≥ 3 on at least 1 intrusive symptom, 3 avoidant symptoms, and 2 arousal symptoms as consistent with Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV diagnostic criteria (12).

Depression at 3 months post-ICU was ascertained using the Patient Health Questionnaire-9 (PHQ-9) (13). We defined substantial depressive symptoms as a PHQ-9 score ≥ 10 . The PHQ-9 threshold of ≥ 10 has a sensitivity of 88% and a specificity of 88% for major depression diagnosis versus structured psychiatric diagnostic interview (13).

PTSD at 3 months post-ICU was assessed using the PCL-C. We defined substantial PTSD symptoms utilizing the same algorithm used to determine in-hospital substantial acute stress symptoms but required symptoms to continue to be present greater than one month post-ICU.

Covariates of Interest

Medical record-obtained participant and hospitalization-related characteristics included demographics (i.e., age, sex, race), ICU admission diagnosis, baseline medical comorbidity information to compute a Charlson Comorbidity Score (14), ICU admission illness severity

with the Simplified Acute Physiology Score II (SAPS II) (15), ICU LOS, requirement for mechanical ventilation and ventilation duration, requirement for major surgery and number of surgeries, presence of delirium in-ICU per nursing documented assessment using the Confusion Assessment Method-ICU (CAM-ICU) (16), and nursing documented presence of confusion/disorientation/difficulty following commands. We defined probable delirium as a documented positive CAM-ICU or documented presence of confusion/disorientation/difficulty following commands at any point during the hospitalization.

Additional participant characteristics obtained from the baseline interviews included demographics not obtained from medical records (i.e., marital/partner status, education), lifetime history of major depression with the Mini International Neuropsychiatric Interview major depressive episode module (17), and problem alcohol or drug use in the prior year using a score of ≥ 8 on the Alcohol Use Disorders Identification Test or a score of ≥ 3 on the Drug Abuse Screening Test-10 (18, 19).

Outcomes of Interest

Our outcomes of interest were the number of hospitalizations and ER visits that occurred between discharge and 12 months post-ICU. Eligible hospitalizations included those for medical illnesses or surgical procedures; psychiatric hospitalizations or admissions for inpatient chemical dependency treatment were excluded from analyses. An ER visit for any reason was included in our analyses. We also quantified the number of outpatient mental health visits (e.g., visits with a psychiatrist or therapist) between baseline and 12 months post-ICU. This information was obtained at the 3 and 12-month telephone follow-up interviews using the Cornell Services Index, a validated self-report measure of healthcare utilization (20).

Statistical Analysis

We present descriptive data as medians and interquartile ranges (IQRs) or proportions. To ascertain significant differences in baseline characteristics between participants who completed 12-month follow-up and those that did not, we used Mann-Whitney U tests for continuous baseline and clinical variables and χ^2 -tests or Fisher's exact tests for categorical variables. We also determined bivariate associations between in-hospital substantial acute stress symptoms and baseline characteristics, as well as with our outcomes of interest, using Mann-Whitney U tests for continuous baseline and clinical variables and χ^2 -tests or Fisher's exact tests for categorical variables.

We used Poisson regression models to estimate relative risks (RRs) and 95% confidence intervals (CIs) for the associations of our primary independent variables with number of rehospitalizations and ER visits over the course of the year post-ICU. For our analyses of the association of in-hospital substantial acute stress symptoms with number of hospitalizations and ER visits, we initially tested unadjusted associations. We fitted separate models for each outcome. We then sequentially adjusted for our covariates of interest, chosen *a priori* based on their importance in post-ICU outcomes-related research and prior research identifying them as associated with increased acute care service utilization (2, 6, 7, 10, 21), or if they were found to have significant bivariate associations with either outcome. We categorized

all non-normally distributed continuous covariates by their medians. The sequence of adjustments was: 1) baseline participant characteristics (e.g., age categorized by deciles; sex; race categorized as white versus non-white; education categorized as < high school graduate versus high school graduate; marital/partnered status categorized as married/partnered versus single/separated/widowed; lifetime history of major depression; alcohol or drug use problem in the year pre-ICU; Charlson score); and 2) clinical characteristics of the baseline hospitalization (e.g., ICU LOS; SAPS II score; admission for cardiovascular, pulmonary, or infectious disease diagnoses, or for the category of other diagnoses; mechanical ventilation duration; and number of surgeries).

For our analyses of the associations of substantial depressive and PTSD symptoms at 3 months post-ICU with number of hospitalizations and ER visits between 3 and 12 months post-ICU, we fitted separate Poisson regression models for each independent and dependent variable, following the same sequence of adjustments as our models testing in-hospital substantial acute stress symptoms. In a final step, we fitted two separate Poisson regression models for 3-month post-ICU substantial depressive or PTSD symptoms in which we adjusted for the numbers of rehospitalizations and ER visits between discharge from the baseline hospitalization and 3 months post-ICU.

We identified a single participant who was a substantial outlier in post-ICU ER utilization, reporting 100 ER visits between 3 and 12 months post-ICU while the next largest total was 9 ER visits during the entire 12 month period. We fitted our regression models including and excluding this outlier. The results of the analyses including this participant's data were not substantively different though had somewhat larger standard errors and 95% CIs. Therefore, we chose to present the more conservative estimates excluding this participant.

We used two-sided significance tests for all analyses with statistical significance set at $P = 0.05$. Analyses were performed with the STATA 12 statistical software program (Stata Corporation, College Station, TX).

RESULTS

Nearly 1,200 patients were eligible for study inclusion (Figure). Of the 150 participants originally enrolled in the study, 120 (88% of those eligible to complete follow-up, 80% of the original cohort) completed a 12-month telephone follow-up interview. Study participants who developed in-hospital substantial acute stress symptoms were more likely to not complete 12-month follow-up ($P < 0.01$ by χ^2 test).

Baseline interviews were completed a median of 8 days (IQR: 5.0, 15.0) after hospital admission. Participants' median age was 51 years old (IQR: 38, 58), their median ICU LOS was 5 days (IQR: 3, 9), and their median admission SAPS II score was 23 (IQR: 13, 37). The most common ICU admission diagnoses included infectious disease (e.g., severe soft tissue infections [$n = 22$], sepsis [$n = 11$]) and neurologic (e.g., subarachnoid hemorrhage [$n = 13$], intraparenchymal hemorrhage [$n = 6$]) conditions. Nearly half required mechanical ventilation with a median duration of 2 days (IQR: 1, 4). Prior to hospital discharge, 23/150 [15% (95%CI: 10%, 21%)] developed substantial acute stress symptoms. Table 1 presents

the baseline and clinical characteristics of participants who did and did not develop substantial acute stress symptoms. Participants with substantial acute stress symptoms were more likely to have a lifetime history of major depression and alcohol or drug use problems during the year pre-ICU. At 3 months post-ICU, 39/131 [31% (95%CI: 22%, 38%)] study participants had substantial depressive and 21/131 [16% (95%CI: 10%, 22%)] had substantial PTSD symptoms.

Post-ICU Acute Care Service Utilization

Thirty three participants reported 49 rehospitalizations (median: 1, IQR: 1, 2; range: 1, 5) and 48 reported 83 ER visits (median: 1, IQR: 1, 2; range: 1, 7) between baseline hospitalization discharge and 3 months post-ICU. Between 3 and 12 months post-ICU, 39 participants reported 77 rehospitalizations (median: 2, IQR: 1, 2; range: 1, 7) and 49 reported 198 ER visits (median: 1, IQR: 1, 3; range: 1, 100).

Nine participants with in-hospital substantial acute stress symptoms were rehospitalized 29 times (median: 2, IQR: 2, 4; range: 1, 7) over the course of the year post-ICU. Nine participants with in-hospital substantial acute stress symptoms (one without a rehospitalization) reported 152 ER visits (median: 4, IQR: 3, 5; range: 1, 100) during the follow-up period.

Eleven participants with substantial depressive symptoms at 3 months post-ICU were rehospitalized 19 times (median: 1, IQR: 1, 2; range: 1, 5), and 15 (seven without a rehospitalization) reported 124 ER visits (median: 2, IQR: 1, 3; range: 1, 100) between 3 and 12 months post-ICU.

Six participants with substantial PTSD symptoms at 3 months post-ICU were rehospitalized 15 times (median: 2, IQR: 2, 3; range: 1, 5) and 11 (six without a rehospitalization) reported 125 ER visits (median: 2, IQR: 2, 5; range: 1, 100) between 3 and 12 months post-ICU.

Post-ICU Mental Health Care Utilization

Twenty four (20%) participants who completed 12 month follow-up reported at least one outpatient mental health visit over the course of the year post-ICU. Two participants reported inpatient chemical dependency treatment admissions, while none reported inpatient psychiatric hospitalizations.

Only six of the 18 (33%) participants with in-hospital substantial acute stress symptoms who completed follow-up reported an outpatient mental health visit during the year post-ICU. Nine of the 32 (28%) participants with substantial depressive symptoms and eight of the 19 (42%) with substantial PTSD symptoms at 3 months post-ICU reported an outpatient mental health visit during the year post-ICU.

Associations of In-Hospital Substantial Acute Stress Symptoms and Post-ICU Acute Care Utilization

In unadjusted analyses, in-hospital substantial acute stress symptoms were associated with both greater risk of an additional hospitalization (RR: 2.17, 95%CI: 1.09, 4.31) and greater risk of an additional ER visit (RR: 1.94, 95%CI: 1.03, 3.66) over the course of the year post-

ICU. After adjusting for baseline participant characteristics, in-hospital substantial acute stress symptoms remained associated with both greater risk of an additional hospitalization (RR: 2.32, 95%CI: 1.36, 3.95) and ER visits (RR: 1.97, 95%CI: 1.09, 3.55). Table 2 displays the fully adjusted association of in-hospital substantial acute stress symptoms with risk of additional hospitalizations and ER visits. Even after adjusting for initial hospitalization-related clinical characteristics, in-hospital substantial acute stress symptoms remained independently associated with greater risk of additional hospitalizations (RR: 3.00, 95%CI: 1.80, 4.99). The magnitude of the association between in-hospital substantial acute stress symptoms and post-ICU ER visits appeared similar after adjusting for clinical characteristics (RR: 1.94, 95%CI: 0.95, 3.98) though lacked precision.

In addition to in-hospital substantial acute stress symptoms, a baseline Charlson score ≥ 1 (RR: 3.34, 95%CI: 1.31, 8.51) and admission for an infectious disease diagnosis (RR: 1.78, 95%CI: 1.05, 3.01) were independently associated with increased risk of additional hospitalizations over the course of the year post-ICU. A baseline Charlson score ≥ 1 (RR: 2.19, 95%CI: 1.22, 3.95) and admission for a cardiovascular disease diagnosis (RR: 2.07, 95%CI: 1.05, 4.08) were independently associated with increased risk of additional ER visits over the course of the year post-ICU. Conversely, older age (age 55–64 years: RR: 0.44, 95%CI: 0.21, 0.94; age ≥ 65 years: RR: 0.28, 95%CI: 0.08, 0.99) was independently associated with decreased risk of additional ER visits in our cohort.

Associations of Three-month Post-ICU Psychiatric Morbidity with Acute Care Utilization Between Three and Twelve Months Post-ICU

Neither substantial depressive symptoms (RR: 0.70, 95%CI: 0.35, 1.40) nor substantial PTSD symptoms (RR: 0.92, 95%CI: 0.38, 2.24) at 3-month follow-up were associated with risk of additional hospitalizations between 3 and 12 months post-ICU. Also, 3-month substantial depressive symptoms were not associated with additional ER visits between 3 and 12 months post-ICU (RR: 1.16, 95%CI: 0.63, 2.16).

However, 3-month substantial PTSD symptoms (RR: 2.19, 95%CI: 1.14, 4.22) were associated with greater risk of additional ER visits between 3 and 12 months post-ICU. This association persisted after adjusting for participant baseline characteristics (RR: 2.68, 95%CI: 1.42, 5.07) and baseline hospitalization clinical characteristics (RR: 2.52, 95%CI: 1.20, 5.29). After adjusting for both number of hospitalizations and number of ER visits between discharge from the baseline hospitalization and 3 months post-ICU, substantial PTSD symptoms at 3 months post-ICU were independently associated with increased risk of additional ER visits between 3 and 12 months post-ICU (RR: 2.29, 95%CI: 1.09, 4.84) (Table 3).

DISCUSSION

Our investigation of acute care service utilization following medical-surgical ICU admission identified that substantial acute stress symptoms prior to hospital discharge were independently associated with greater risk of rehospitalizations, and 3-month substantial PTSD symptoms were independently associated with additional ER visits, though not rehospitalizations, over the course of the year post-ICU. These findings build on our

previous work identifying that in-hospital substantial acute stress symptoms are independently associated with increased severity of subsequent post-ICU depressive and PTSD symptoms and impaired cognition (7, 22). Since in-hospital substantial acute stress symptoms were associated with loss to follow-up at 12 months, the association with post-ICU acute care service utilization identified here could be a considerable underestimate.

To our knowledge, the present study is only the second to examine psychiatric disorders and risk of rehospitalization among ICU survivors, and the first to examine both pre-ICU and post-ICU psychiatric disorders in this context. Clark and colleagues conducted a retrospective cohort investigation of potential risk factors for death and acute care service utilization among medical ICU survivors admitted with alcohol withdrawal as a primary or secondary diagnosis (23), finding that a wide range of pre-ICU psychiatric diagnoses were independently associated with risk of rehospitalization. However, post-ICU psychiatric symptoms/disorders were not examined. In addition to post-ICU psychiatric morbidity, we examined lifetime history of major depression as a potential predictor of post-ICU acute care service utilization though did not find a significant association.

The present findings are of particular relevance for critical care and other hospital-based clinicians since they could identify patients with substantial acute stress symptoms before discharge and refer them for appropriate treatments. This point is especially important since only one-third of the patients with in-hospital substantial acute stress symptoms, slightly over one quarter with 3-month substantial depressive symptoms, and slightly over two-fifths with 3-month substantial PTSD symptoms in our cohort reported having any mental health follow-up over the course of the subsequent year. While these numbers may partially represent limited access to psychiatric care, interventions that integrate evidence-based mental health care into primary and acute care settings can successfully treat psychiatric disorders, including PTSD, even in settings with limited psychiatric specialty resources (24–27). Our findings suggest that further research is needed to determine if similar interventions could not only improve post-ICU psychiatric outcomes but also decrease healthcare costs through reductions in acute care service utilization. The rationale for trials of similar interventions in critical illness survivors is also bolstered by evidence that related primary care-based interventions have led to reduced inpatient medical care costs among older adults with comorbid depression and chronic medical illnesses (28). These interventions could also have important implications for ICU survivors and their families since rehospitalizations could lead to further functional impairment with resultant caregiver burden (29), and depression in caregivers (30).

Post-ICU substantial acute stress/PTSD symptoms could increase subsequent acute care service utilization for both psychobiological and behavioral reasons. PTSD has been associated with increased systemic inflammation as well as hypothalamic pituitary axis and autonomic nervous system dysregulation (31, 32), potentially leading to additional medical-surgical complications. Furthermore, post-ICU PTSD may lead to non-adherence with treatment for chronic medical conditions and create difficulties with care coordination (31), leading to acute exacerbations of predisposing chronic medical illnesses. Also, PTSD is associated with amplification of pain which could lead to ER visits and further hospitalizations (33).

In addition to post-ICU acute stress/PTSD symptoms, we found that greater baseline medical comorbidity was the only other factor associated with both additional rehospitalizations and ER visits over the year post-ICU. This result is in line with the extensive body of literature identifying medical comorbidity as a risk factor for increased acute care service utilization in a wide range of patient populations (34–36).

Our study has several potential limitations. Since we were unable to enroll patients who were persistently delirious, we could not effectively evaluate whether prolonged delirium was associated with post-ICU acute care service utilization. However, requiring participants to pass a validated cognitive screen before providing consent likely reduced the chances that our assessment of in-hospital acute stress symptoms was confounded by residual hyperactive delirium, and also minimized the possibility that patients with undiagnosed substantial cognitive impairment were recruited into the study. Although we assessed post-ICU acute care service utilization via self-report, potentially introducing recall bias and limiting our ability to determine specific admission diagnoses for rehospitalizations and/or ER visits, the Cornell Services Index has been explicitly validated for this purpose (20). However, we are aware that other acute care medical reports have used statewide hospital admission registries to document readmission patterns (37).

Since functional disability is common among critical illness survivors (29, 38), an added limitation of our study is that we did not ascertain post-ICU disablement and so cannot discern its effect on post-ICU acute care service utilization. As we assessed acute stress/PTSD and depressive symptoms with questionnaires, we could not make clinical diagnoses. Also, although the questionnaires we used to assess PTSD and depressive symptoms have not been specifically validated for use in medical-surgical ICU survivors, they have been used in many relevant populations (39–41). Further, our sample size was small, the study was conducted in a single center serving a safety net population, and a majority of eligible patients were discharged prior to approach. Since we only have data from study participants, we cannot characterize potential differences between our cohort and all eligible ICU survivors from our institution. Additionally, our cohort's severity of acute illness as measured by the SAPS II was lower than in other studies of post-ICU outcomes (42, 43). For these reasons, our results may not be generalizable to the entire population of medical-surgical ICU survivors and warrant replication in larger cohorts. Finally, residual confounding remains a possibility, as in any observational study.

In conclusion, we found that the presence of in-hospital substantial acute stress symptoms was independently associated with increased risk of additional hospitalizations over the course of the year after medical-surgical ICU admission. We also identified that substantial PTSD symptoms at 3 months post-ICU were independently associated with additional ER visits over the next 9 months even after adjusting for the number of rehospitalizations and ER visits between the index ICU admission and 3 months post-ICU. Additional research is needed in order to develop cost-effective interventions for critical illness survivors with psychiatric morbidity that lower healthcare costs through reductions in subsequent acute care service utilization.

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Figure.

Study Flow Diagram

Abbreviations (in alphabetical order): ER = emergency room; HMC = Harborview Medical Center; ICU = intensive care unit.

Table 1

Baseline patient and clinical characteristics and intensive care unit factors by in-hospital substantial acute stress symptom status

Variables	Substantial acute stress symptoms (n = 23)	Without substantial acute stress symptoms (n = 127)	P Value ^a
Patient Baseline Characteristics			
Age			0.31
< 35 years old	5 (22%)	23 (18%)	
35–44 years old	2 (9%)	25 (20%)	
45–54 years old	10 (43%)	32 (25%)	
55–64 years old	5 (22%)	31 (24%)	
65 years old	1 (4%)	16 (13%)	
Female	8 (35%)	53 (42%)	0.51
Non-white	10 (43%)	30 (24%)	0.06
< High school graduate	4 (17%)	17 (13%)	0.62
Married/partnered	9 (39%)	66 (52%)	0.24
Lifetime history of major depression per interview	11 (48%)	32 (25%)	0.03
Alcohol or drug use problem	10 (43%)	24 (19%)	0.01
Charlson Comorbidity score	1 (0, 3)	1 (0, 2)	0.69
Admission Clinical Characteristics			
ICU length of stay (days)	4 (3, 7)	5 (3, 9)	0.69
SAPS II	33 (18, 43)	22 (13, 35)	0.09
Admission diagnostic category ^b			
Cardiovascular	1 (4%)	10 (8%)	1.00
Pulmonary	3 (13%)	16 (13%)	1.00
Infectious Disease	8 (35%)	34 (27%)	0.45
Neurologic	5 (22%)	36 (28%)	0.50
Vascular Surgery	3 (13%)	19 (15%)	1.00
Gastrointestinal	3 (13%)	15 (12%)	1.00
Endocrine/Renal	2 (9%)	5 (4%)	0.30
Orthopedic	1 (4%)	10 (8%)	1.00
Oncologic	1 (4%)	4 (3%)	0.57
Other	1 (4%)	4 (3%)	0.57
Mechanically ventilated	12 (52%)	56 (44%)	0.76
MV duration among ventilated (days)	2 (1, 4)	2 (1, 4)	0.61
Required surgery	12 (52%)	54 (43%)	0.41
Number of surgeries among patients requiring surgery	2 (1, 3)	1 (1, 2)	0.38
Probable delirium	14 (61%)	62 (49%)	0.30

All values are median (IQR) or n (%).

Abbreviations (in alphabetical order): ICU = intensive care unit; MV = mechanical ventilation; SAPS II = Simplified Acute Physiology Score II.

^aResults from Pearson χ^2 test with 1 degree of freedom, Fisher's exact test, or Mann-Whitney U test.

^bSeventeen (11.3%) participants had more than one primary diagnosis at admission to the intensive care unit.

Table 2

Adjusted associations of in-hospital substantial acute stress symptoms with rehospitalizations and emergency room visits over the year following medical-surgical intensive care unit admission

	Associations with number of rehospitalizations		Associations with number of ER visits	
	Adjusted for baseline characteristics	Adjusted for clinical characteristics	Adjusted for baseline characteristics	Adjusted for clinical characteristics
Relative Risk (95% Confidence Interval)				
Substantial acute stress symptoms	2.32 (1.36, 3.95) [†]	3.00 (1.80, 4.99) [‡]	1.97 (1.09, 3.55) [*]	1.94 (0.95, 3.98)
Age				
35–44 years old	1.33 (0.54, 3.28)	1.38 (0.58, 3.30)	0.88 (0.42, 1.82)	0.90 (0.44, 1.83)
45–54 years old	1.21 (0.59, 2.49)	1.18 (0.61, 2.29)	0.75 (0.37, 1.53)	0.84 (0.45, 1.59)
55–64 years old	0.40 (0.17, 0.95) [*]	0.43 (0.18, 1.05)	0.32 (0.15, 0.67) [†]	0.44 (0.21, 0.94) [*]
65 years old	0.87 (0.31, 2.41)	1.06 (0.41, 2.77)	0.20 (0.06, 0.64) [†]	0.28 (0.08, 0.99) [*]
Female	1.15 (0.65, 2.03)	1.07 (0.61, 1.88)	0.71 (0.46, 1.09)	0.62 (0.37, 1.01)
Non-white	1.10 (0.56, 2.15)	1.07 (0.52, 2.19)	1.22 (0.70, 2.14)	1.43 (0.84, 2.44)
< High school graduate	0.75 (0.40, 1.44)	0.77 (0.37, 1.60)	1.15 (0.54, 2.49)	1.71 (0.77, 3.78)
Single/widowed	1.13 (0.64, 2.00)	1.04 (0.67, 1.62)	1.01 (0.61, 1.67)	0.94 (0.58, 1.52)
Lifetime history of major depression	1.35 (0.68, 2.66)	1.35 (0.71, 2.57)	1.26 (0.66, 2.37)	1.06 (0.59, 1.91)
Baseline alcohol or drug use problem	1.04 (0.57, 1.90)	0.93 (0.51, 1.69)	0.83 (0.43, 1.60)	1.08 (0.56, 2.09)
Charlson score 1	3.36 (1.21, 9.35) [*]	3.34 (1.31, 8.51) [*]	2.05 (1.08, 3.90) [*]	2.19 (1.22, 3.95) [†]
ICU LOS 5 days		1.49 (0.72, 3.07)		1.06 (0.66, 1.72)
SAPS II		0.99 (0.97, 1.01)		0.98 (0.96, 1.00)
Cardiovascular diagnosis		1.51 (0.85, 2.67)		2.07 (1.05, 4.08) [*]
Pulmonary diagnosis		0.90 (0.47, 1.75)		0.55 (0.28, 1.10)
Infectious disease diagnosis		1.78 (1.05, 3.01) [*]		0.63 (0.33, 1.21)
Other admission diagnosis		1.61 (0.27, 9.53)		1.58 (0.45, 5.51)
MV duration 2 day		0.93 (0.38, 2.28)		1.88 (0.91, 3.89)
One or more surgeries		0.71 (0.46, 1.09)		0.89 (0.53, 1.48)

Abbreviations (in alphabetical order): ICU = intensive care unit; LOS = length of stay; MV = mechanical ventilation; SAPS II = Simplified Acute Physiology Score II.

^{*} P < 0.05

[†] P < 0.01

[‡] P < 0.001

Table 3

Adjusted associations of substantial posttraumatic stress disorder symptoms at three months post-ICU with emergency room visits between three and twelve months after medical-surgical intensive care unit admission

Associations with number of ER visits between 3 and 12 months post-ICU			
	Adjusted for baseline characteristics	Adjusted for clinical characteristics	Adjusted for 3 month acute care service utilization
	Relative Risk (95% Confidence Interval)		
3-month substantial PTSD symptoms	2.68 (1.42, 5.07) [†]	2.52 (1.20, 5.29) [*]	2.29 (1.09, 4.84) [*]
Age			
35–44 years old	0.79 (0.26, 2.44)	0.78 (0.27, 2.30)	0.90 (0.29, 2.79)
45–54 years old	1.37 (0.44, 4.25)	1.46 (0.51, 4.22)	1.74 (0.50, 6.02)
55–64 years old	0.46 (0.16, 1.31)	0.63 (0.22, 1.83)	0.80 (0.23, 2.80)
65 years old	0.35 (0.10, 1.27)	0.46 (0.11, 1.98)	0.55 (0.11, 2.86)
Female	0.72 (0.42, 1.23)	0.55 (0.31, 0.98) [*]	0.52 (0.30, 0.90) [*]
Non-white	1.88 (0.97, 3.64)	2.27 (1.21, 4.27) [*]	2.12 (1.15, 3.92) [*]
< High school graduate	0.66 (0.10, 4.32)	0.78 (0.12, 5.18)	0.60 (0.08, 4.50)
Single/widowed	0.99 (0.53, 1.85)	0.87 (0.46, 1.64)	0.95 (0.52, 1.71)
Lifetime history of major depression	1.49 (0.67, 3.22)	1.27 (0.62, 2.62)	1.20 (0.61, 2.38)
Baseline alcohol or drug use problem	0.91 (0.36, 2.28)	1.06 (0.41, 2.75)	1.02 (0.32, 3.25)
Charlson score 1	1.79 (0.79, 4.04)	1.97 (0.94, 4.16)	1.80 (0.86, 3.74)
ICU LOS 5 days		1.14 (0.54, 2.39)	1.22 (0.58, 2.57)
SAPS II		0.99 (0.97, 1.02)	1.00 (0.97, 1.02)
Cardiovascular diagnosis		2.52 (1.10, 5.79) [*]	2.75 (1.19, 6.37) [*]
Pulmonary diagnosis		0.44 (0.22, 0.86) [*]	0.45 (0.22, 0.92) [*]
Infectious disease diagnosis		0.88 (0.48, 1.62)	1.01 (0.54, 1.90)
Other admission diagnosis		0.49 (0.15, 1.59)	0.40 (0.17, 1.00)
MV duration 2 days		1.35 (0.53, 3.46)	1.12 (0.46, 2.75)
One or more surgeries		0.91 (0.47, 1.77)	0.88 (0.41, 1.89)
Number of rehospitalizations up to 3 months post-ICU			0.94 (0.64, 1.39)
Number of ER visits up to 3 months post-ICU			1.21 (0.90, 1.63)

Abbreviations (in alphabetical order): ER = emergency room; ICU = intensive care unit; LOS = length of stay; MV = mechanical ventilation; PTSD = posttraumatic stress disorder; SAPS II = Simplified Acute Physiology Score II.

P < 0.05

[†]P < 0.01