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Healthcare Utilization in Medical Intensive Care Unit Survivors with Alcohol Withdrawal

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Abstract

Background—Rehospitalization is an important and costly outcome that occurs commonly in several diseases encountered in the medical intensive care unit (ICU). Although alcohol use disorders are present in 40% of ICU survivors and alcohol withdrawal is the most common alcohol-related reason for admission to an ICU, rates and predictors of rehospitalization have not been previously reported in this population.

Methods—We conducted a retrospective cohort study of medical ICU survivors with a primary or secondary discharge diagnosis of alcohol withdrawal using two administrative databases. The primary outcome was time to rehospitalization or death. Secondary outcomes included time to first emergency department or urgent care clinic visit in the subset of ICU survivors who were not rehospitalized. Cox proportional hazard models were adjusted for age, gender, race, homelessness, smoking, and payer source.

Results—Of 1,178 patients discharged from the medical ICU over the study period, 468 (40%) were readmitted to the hospital and 54 (4%) died within 1 year. Schizophrenia (HR 2.23, 95% CI 1.57, 3.34, $p < 0.001$), anxiety disorder (HR 2.04, 95% CI 1.30, 3.32, $p < 0.01$), depression (HR 1.62, 95% CI 1.05, 2.40, $p = 0.03$), and Deyo comorbidity score ≥ 3 (HR 1.43, 95% CI 1.09, 1.1.89, $p = 0.01$) were significant predictors of time to death or first rehospitalization. Bipolar disorder was associated with time to first emergency department or urgent care clinic visit (HR 2.03, 95% CI 1.24, 3.62, $p < 0.01$) in the 656 patients who were alive and not rehospitalized within one year.

Conclusion—The presence of a psychiatric comorbidity is a significant predictor of multiple measures of unplanned healthcare utilization in medical ICU survivors with a primary or

secondary discharge diagnosis of alcohol withdrawal. This finding highlights the potential importance of targeting longitudinal multidisciplinary care to patients with a dual diagnosis.

Keywords

alcohol withdrawal; alcohol use disorder; intensive care unit; rehospitalization; dual diagnosis

INTRODUCTION

Rehospitalizations cost Medicare \$17 billion annually, are potentially avoidable, and a publicly reported statistic (Hospital Quality Alliance, 2012; Jencks et al., 2009; U.S. Department of Health and Human Services, 2012). For non-Medicare patients, rates of rehospitalization for common disorders such as asthma, congestive heart failure, and acute myocardial infarction range from 21-29% one year following the index admission (Berenson et al., 2010; Blais et al., 1998; Philbin and DiSalvo, 1999). A variety of disease-based strategies can reduce the need for rehospitalization. For example, starting inhaled corticosteroids during the index hospitalization for asthma patients is associated with a 40% reduction in rehospitalization. Comprehensive discharge planning in conjunction with the implementation of a post-hospitalization support system reduces rehospitalizations for congestive heart failure by 25% (Blais et al., 1998; Phillips et al., 2004). However, efficacious strategies to reduce rehospitalization rates for inpatients with alcohol-related problems have not been reported.

Consumption of alcohol in excess is associated with many illnesses that require admission to an intensive care unit (ICU). As a result, up to 40% of patients admitted to an ICU have an alcohol use disorder (AUD) (Moss and Burnham, 2006; Mostafa and Murthy, 2002). Alcohol withdrawal syndrome is the most common alcohol-related illness that prompts ICU admission and can be associated with prolonged hospital and ICU lengths of stay (Bard et al., 2006; Lukan et al., 2002; Marik and Mohedin, 1996; Spies et al., 1996). Due to improvements in supportive care, pharmacological therapies, and treatments of co-existing comorbidities, over 90% of patients with alcohol withdrawal survive their hospitalization (Cushman, 1987; Foy et al., 1997; Monte et al., 2010). Despite the high prevalence of alcohol withdrawal in critically ill patients, an increasing emphasis on understanding morbidity after ICU admission, and a focus on preventing rehospitalization, the rates and predictors of rehospitalization in this population remain unknown (Bienvenu et al., 2012; Herridge et al., 2003; 2011; Hopkins and Herridge, 2006).

Unique characteristics of ICU survivors with alcohol withdrawal may increase their risk for rehospitalization. Mood disorders, anxiety disorders, and schizophrenia are commonly present in patients with an alcohol use disorder and in ICU survivors (Chou et al., 2012; Hasin et al., 2007; Hopkins and Herridge, 2006; Jackson et al., 2010). These comorbid psychiatric conditions are associated with poor compliance, worse quality of life, and worse psychiatric outcomes in patients with an alcohol use disorder (Morojele et al., 2012). The presence of a psychiatric condition in the setting of other chronic diseases such as chronic obstructive pulmonary disease and congestive heart failure is independently associated with higher rates of rehospitalization for a medical illness (Coventry et al., 2011; Reese et al.,

2011). However, the association between comorbid psychiatric conditions and rehospitalization in ICU survivors with alcohol withdrawal has not been investigated.

The primary objective of this study was to determine the rate of rehospitalization and urgent/emergent services for medical ICU survivors with alcohol withdrawal syndrome during the first year after hospitalization. Further we sought to identify specific risk factors associated with healthcare utilization among these individuals. We hypothesized that psychiatric comorbidities including schizophrenia, bipolar disorder, anxiety disorder, and depression would be independently associated with higher rates of unplanned healthcare utilization during the first year following hospital discharge.

MATERIALS AND METHODS

Study design, sample, and subjects

We conducted a retrospective cohort study using administrative data from two sources: the Denver Health Medical Center (DHMC) Data Warehouse and the University Health System Consortium (UHC) database. DHMC is an integrated community academic medical center that serves the needs of special populations including the indigent, uninsured, mentally ill, and persons with alcohol and drug-related problems and is one of Colorado's busiest hospitals with over 25,000 admissions each year. The DHMC Data Warehouse pools retrospective data from both administrative and clinical electronic health information applications used in the provision of care to patients. The DHMC Data Warehouse includes demographic data, laboratory data, imaging data, pharmaceutical data, discharge diagnoses, and procedures. Discharge diagnoses were identified using clinical classification software for International Classification of Diseases, 9th Revision, Clinical Modifications (ICD-9 CM) codes. As previously described, ICD-9 CM codes were also used to identify admissions that were alcohol-related (Adams et al., 1993).

The UHC database collects retrospective administrative data from 112 academic medical centers and 256 of their affiliated hospitals with a stated purpose of allowing institutions to benchmark performance (Drachman, 1996). The UHC clinical database includes demographics, imaging and pharmaceutical data, discharge diagnoses, and procedures. In this study, the UHC database was used exclusively to derive a severity of illness measure. Inclusion criteria were date of hospital discharge between 1/1/2005 and 12/31/2010, age between 18 and 89 years, a primary or secondary ICD-9 CM discharge diagnosis code consistent with alcohol withdrawal (291.0, 291.81, or 291.9), and treatment in the medical ICU during their index hospitalization. Alcohol withdrawal did not have to be the principal reason for admission in order for patients to be included in the study. Patients were excluded if they were pregnant, incarcerated at the time of their medical ICU admission, had a repeat medical ICU admission, or died prior to hospital discharge.

Outcome variables

The *primary outcome variable* for this study was time to first rehospitalization to Denver Health Medical Center or death during the year following hospital discharge. Mortality data was obtained from the Centers for Disease Control National Death Index. We considered a

composite outcome, as opposed to rehospitalization alone, because patients who die cannot be rehospitalized. Therefore, death is a competing risk for rehospitalization. At the time of the application to the National Death Index, mortality data was only available for patients through the end of 2009. Patients who had multiple readmissions in the year following the index admission were included only until the time of first readmission. *Secondary outcome variables* included time to first emergency department or urgent care visit in the subgroup of patients who were alive and not rehospitalized, rehospitalization within 30 days, and high healthcare utilization. Emergency department and urgent care visits were considered as a composite endpoint because both are unplanned. There is substantial variability in the definition of high healthcare utilization in prior studies (Lefevre et al., 1999; Pearson et al., 1999; Smits et al., 2009). We chose to identify the patients who accounted for more than half of all rehospitalization events. Therefore, we defined high healthcare utilization as 3 rehospitalizations during the year following discharge for the index hospitalization.

Predictors of rehospitalization or death

Severity of illness quartiles were derived from the UHC database (Graham et al., 2010; O'Brien et al., 2007). Using a proprietary algorithm, the UHC database assigns a severity of illness and risk of mortality score to each patient based on their admission diagnosis and comorbidities. The four scores for severity of illness and risk of mortality in the UCH database correlate to a (1) minor, (2) moderate, (3) severe, or (4) extreme severity of acute illness and risk of mortality. Medical comorbidity was assessed using Deyo's adaptation of the Charlson comorbidity index (Deyo et al., 1992). The Charlson/Deyo index utilizes ICD-9 codes from 12 common illnesses to develop a composite measure of medical comorbidity. Given the minority of scores that were 3 and above, patients were grouped into 0, 1, 2, and 3 or greater (Deyo et al., 1992). The UHC severity of illness quartile provides an estimate of risk based primarily on the presentation of the patient's acute illness while the Charlson/Deyo Index provides an estimate of risk based on underlying medical comorbidities present at the time of admission. Patients were classified as having schizophrenia, bipolar disorder, anxiety disorder, or depression if they had at least two separate encounters with ICD-9 CM codes specific to these diagnoses in the preceding 3 years (see supplementary index for details).

Covariates

Payer source was grouped into Medicaid, Medicare, self-pay, Colorado Indigent Care Program (the state hospital subsidy program for care of the medically indigent), commercial insurance, and other. Smoking status was defined as current smoker (yes or no). Patients were classified as a current smoker if they had an ICD-9 CM code of 305.1, tobacco use documented on their medical screening examination in the emergency department, or had a nicotine replacement therapy in the computerized physician order entry during their hospital stay. Homelessness was identified in the demographics collected during patient admission and abstracted from the Denver Health Data Warehouse. Gender and race (categorized as Caucasian, Hispanic, African American, or other) were also collected.

Statistical Analysis

Differences between patients who were rehospitalized or dead within 1 year and those who were not were analyzed using Student's t-test or the Wilcoxon rank-sum test for continuous variables and chi-square analysis for categorical variables. Descriptive statistics of time to rehospitalization or death and time to emergency department or urgent care visit were generated using Kaplan-Meier curves. To determine the association between our predictors of interest and time to first rehospitalization or death, we used Cox proportional hazards models with UHC severity of illness category, age, gender, race, payer source, homelessness, Charlson/Deyo index scores, and the presence or absence of schizophrenia, anxiety disorder, depression, and bipolar disorder as predictors and time to death or first rehospitalization during the first year following discharge for the index hospitalization as the outcome. A Cox proportional hazards model using the same predictors and covariates was used to examine predictors of time to ED or urgent care visit in the subgroup of patients who were not rehospitalized and were alive. Bootstrap confidence intervals were used to assess significance; the percentile method was used at a significance level of 0.05. For Cox proportional hazards models, we ensured that the assumption of proportionality was not violated for both full models. To ensure that the results of our primary analysis were not disproportionately influenced by patients who died, we constructed an identical Cox proportional hazards model excluding patients who died in the year following hospital discharge.

To determine predictors of high healthcare utilization, a logistic regression model was constructed with Charlson/Deyo score, age, smoking status, UHC severity of illness, schizophrenia, bipolar disorder, depression, and anxiety disorder as predictors of interest and 3 rehospitalization events per year as the outcome variable. We could not include all of the covariates from our main analyses in this logistic regression model because there was not a sufficient number of outcomes of interest. A logistic regression model using the presence of any psychiatric comorbidity (depression, anxiety, bipolar disorder, or schizophrenia), Charlson/Deyo score, and UCH severity of illness category as predictors and rehospitalization within 30 days as the outcome adjusting for age, smoking status, and payer source was also constructed. A two-sided p-value < 0.05 was considered to be significant.

Human subjects protection

This study was approved and a waiver of informed consent was provided by the Colorado Multiple Institutional Review Board. Data for this study was extracted from the Denver Health Data Warehouse and UCH database by a single study investigator (AK) and identifying information was subsequently removed prior to analysis.

RESULTS

Rehospitalization or Death

Of the 4,277 patients admitted to Denver Health Medical Center with alcohol withdrawal over the study period, 1,802 (42%) of the hospital admissions with alcohol withdrawal required care in the medical ICU, and 35% of these patients met one of the exclusion criteria. Reasons for exclusion were: repeat admission (n = 361), prisoner (n = 215), died

prior to discharge ($n = 46$), and pregnancy ($n = 2$). Therefore, 1,178 patients were included in the final analysis. Alcohol withdrawal was the primary discharge diagnosis in 275 (23%) of index admissions while the remaining 903 (77%) of index admissions were for an illness other than alcohol withdrawal. The mean age of patients in the cohort was 47 years [IQR 40, 54] and the median Charlson/Deyo Comorbidity index score was 0 [IQR 0, 1] indicating a low burden of medical comorbidities. Of the 1,178 patients, 403 (34%) saw a healthcare provider for a scheduled visit in the 90 days following hospital discharge.

Within one year of hospital discharge, 468 (40%; 95% CI 37%, 43%) patients were readmitted to the hospital and an additional 54 (4%; 95% CI 3%, 5%) died leading to an overall death or rehospitalization rate of 44% (95% confidence interval 41%, 47%). On univariate analysis, patients who were rehospitalized or died were more likely to be homeless and to have anxiety, depression, bipolar disorder, or schizophrenia (Table 1). For patients who were rehospitalized or died ($n=522$), the median time to event was 67 [IQR 16, 172] days.

Rates of rehospitalization or death increased from 35% in patients without any psychiatric comorbidity to 66% in patients with 1 psychiatric comorbidity, and 78% in patients with 2 or more psychiatric comorbidities ($p < 0.01$). Rates of death or rehospitalization were higher in patients with schizophrenia compared to those without (82% vs 42%, $p < 0.001$), patients with bipolar disorder compared to those without (65% vs 42%, $p < 0.001$), patients with an anxiety disorder compared to those without (81% vs 43%, $p < 0.001$), and patients with depression compared to those without (70% vs 43%, $p < 0.001$). The primary discharge diagnosis on readmission was psychiatric illness in 28%, respiratory illness in 10%, gastrointestinal illness in 10%, cardiovascular illness in 9%, neurologic illness in 7%, and other or unclassified illness in the remaining 36% of patients. In 73 (16%) patients who were rehospitalized, an alcohol-related diagnosis was recorded on second discharge. A Charlson/Deyo score ≥ 3 , schizophrenia, anxiety, and depression were predictors of time to rehospitalization or death, adjusting for age, gender, race, payer source, homelessness, and smoking status (Table 2). When a visit to a healthcare provider within 90 days was added to this full model, it was not associated with death or rehospitalization. When patients who died were excluded from the analysis, the magnitude and the significance of the association between schizophrenia, depression, and anxiety and rehospitalization were unchanged.

Of the 468 rehospitalization events, 165 (35%) occurred within 30 days. In a logistic regression model adjusting for age, gender, race, payer source, smoking status, and homelessness, the presence of any psychiatric comorbidity (depression, anxiety disorder, bipolar disorder, or schizophrenia) was significantly associated with rehospitalization within 30 days (adjusted OR 2.37; 95% CI 1.59, 3.51, $p < 0.01$). Charlson/Deyo comorbidity score and severity of acute illness were not significantly associated with rehospitalization within 30 days of hospital discharge ($p = 0.14$, $p = 0.32$, respectively).

Emergency Department or Urgent Care visits

Amongst the 656 surviving patients who were not rehospitalized in the year following hospital discharge, 251 (38%) had an emergency department or urgent care clinic visit. Among the patients with an ED or adult urgent care visit, the median time to first visit was

61 days [IQR 13, 202]. Adjusting for age, payer source, and homelessness the presence of bipolar disorder was the only significant predictor of time to ED or urgent care visit (adjusted hazard ratio 2.03, 95% CI 1.24, 3.62, $p < 0.01$) (Table 3). Severity of illness and Charlson/Deyo Index score were not significantly associated with time to first ED or urgent care visit.

Predictors of high healthcare utilization

There were 986 total rehospitalization events, an average of 0.84 events per patient-year. Patients who were admitted 3 or more times during the year of follow-up accounted for 522 of the 986 total admissions (53%) despite only comprising 9% ($n = 111$) of the entire cohort. These high healthcare utilizers had at least 3 hospital admissions with a median of 4 and a range of 3 to 14 admissions during the year of follow-up. In this multivariable model, the presence of depression, bipolar disorder, and a Charlson/Deyo score ≥ 3 were associated with high healthcare utilization (Table 4).

DISCUSSION

To our knowledge, this is the first study to assess the long-term outcomes of medical ICU survivors with an alcohol use disorder whose hospitalization was complicated by alcohol withdrawal. Despite a relatively young average age of 47 years and a relative lack of medical comorbidities at the time of the index hospitalization, 44% of patients were rehospitalized or dead within one year of their index hospital discharge. The rate of rehospitalization in this cohort is comparable to other diseases commonly encountered in critical care setting such as congestive heart failure and asthma (Horwitz et al., 2011). Importantly, there are numerous studies regarding systematic approaches to prevent rehospitalization in patients with congestive heart failure, but few studies regarding interventions to prevent rehospitalization in hospitalized patients with alcohol use disorders and no studies on interventions for alcohol use disorders in ICU survivors (Clark and Moss, 2011; Saitz et al., 2007).

As the Affordable Care Act promises to expand access to mental health services, our findings provide a potential avenue to deliver higher quality care at a reduced cost. This cost effective care may be achieved by using a medical ICU admission to ensure longitudinal multidisciplinary care for survivors with an AUD and a psychiatric comorbidity. Initiating such care for ICU survivors could begin with an effective and timely opportunistic intervention (Schuckit, 2009). However, when opportunistic interventions are systematically implemented for medical inpatients with an alcohol use disorder, they do not significantly increase the proportion of patients who enter treatment (Saitz et al., 2007). In contrast to general medical inpatients, medical ICU survivors may be more ready to change their drinking based on surviving a severe acute illness (Clark et al., 2012). Understanding how best to bridge a medical ICU admission to potentially cost effective outpatient care for survivors with an AUD and a psychiatric comorbidity deserves further investigation. Although longitudinal care should reduce morbidity in this population, a visit to a healthcare provider within 90 days of hospital discharge was not associated with lower rates of healthcare utilization in our primary analysis. Future studies should also help define the appropriate location, content and timing of follow-up for this high risk population.

There are limitations to this study. First, we only included patients treated and discharged from a single center in our analysis. In particular, the patients included in our analysis were treated at a medical center whose mission includes caring for patients with psychiatric and alcohol-related problems. This is evidenced by the substantial number of patients (850 per year) admitted to Denver Health Medical Center with alcohol withdrawal. Therefore, our findings may not apply to other hospital systems or geographical locations. However, while it is likely that the prevalence of alcohol withdrawal in ICU patients will vary between hospital systems and location, it is also plausible that the risk factors for healthcare utilization are consistent and generalizable. Second, because this was a single center study, we did not capture rehospitalization events that occurred outside of the Denver Health hospital system. Therefore, we may have underestimated the rates of healthcare utilization in medical ICU survivors with alcohol withdrawal. Third, we chose to only focus on patients with alcohol withdrawal. Whether rates and risks of rehospitalization vary based on the severity of the alcohol use disorder warrants further investigation.

In addition, we relied on administrative data for this study. Using administrative data to identify psychiatric comorbidities may be biased toward identifying a more severe end of the spectrum. Future prospective studies may help delineate how the severity of an alcohol use disorder and comorbid psychiatric conditions relate to rehospitalization and thus help target resources to patients at highest risk of poor outcomes. Because we used administrative data, our definition of alcohol withdrawal was based on ICD-9 CM codes for discharge diagnoses. Therefore, it was the opinion of the treating physician that the patient's delirium was alcohol-related. It is possible that the delirium could have been secondary to another medical illness. However, alcohol-related ICD-9 codes are very specific making this unlikely (Kim et al., 2012). Finally, as indicated by Charlson/Deyo scores, the majority of this cohort lacked an underlying medical comorbidity at the time of index admission which may limit the ability to extrapolate our findings to populations where chronic medical conditions are more prevalent.

In conclusion, medical ICU survivors who were treated for alcohol withdrawal during their hospital course frequently utilized the healthcare system in the first year following hospital discharge, typically within the first few months. The presence of a psychiatric comorbidity was significantly associated with an increase in multiple measures of healthcare utilization. Future studies may seek to validate these findings in other hospital systems, identify opportunistic interventions that may bridge to longitudinal treatment, and determine whether such integrated longitudinal care may improve outcomes in a cost effective manner.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

- Adams WL, Yuan Z, Barboriak JJ, Rimm AA. Alcohol-related hospitalizations of elderly people. Prevalence and geographic variation in the United States. *JAMA*. 1993; 270:1222–1225.
- Bard MR, Goettler CE, Toschlog EA, Sagraves SG, Schenarts PJ, Newell MA, Fugate M, Rotondo MF. Alcohol withdrawal syndrome: Turning minor injuries into a major problem. *J Trauma*. 2006; 61:1441–1445. discussion 1445–1446. [PubMed: 17159688]
- Berenson K, Ogbonnaya A, Casciano R, Makenbaeva D, Mozaffari E, Lamerato L, Corbelli J. Economic consequences of ACS-related rehospitalizations in the US. *Curr Med Res Opin*. 2010; 26:329–336. [PubMed: 19968457]
- Bienvenu OJ, Colantuoni E, Mendez-Tellez PA, Dinglas VD, Shanholtz C, Husain N, Dennison CR, Herridge MS, Pronovost PJ, Needham DM. Depressive symptoms and impaired physical function after acute lung injury: a 2-year longitudinal study. *Am J Respir Crit Care Med*. 2012; 185:517–524. [PubMed: 22161158]
- Blais L, Ernst P, Boivin JF, Suissa S. Inhaled corticosteroids and the prevention of readmission to hospital for asthma. *Am J Respir Crit Care Med*. 1998; 158:126–132. [PubMed: 9655718]
- Chou SP, Lee HK, Cho MJ, Park JI, Dawson DA, Grant BF. Alcohol use disorders, nicotine dependence, and co-occurring mood and anxiety disorders in the United States and South Korea—a cross-national comparison. *Alcohol Clin Exp Res*. 2012; 36:654–662. [PubMed: 21919925]
- Clark BJ, Moss M. Secondary prevention in the intensive care unit: does intensive care unit admission represent a “teachable moment”. *Crit Care Med*. 2011; 39:1500–1506. [PubMed: 21494113]
- Clark BJ, Smart A, House R, Douglas I, Burnham EL, Moss M. Severity of acute illness is associated with baseline readiness to change in medical intensive care unit patients with unhealthy alcohol use. *Alcohol Clin Exp Res*. 2012; 36:544–551. [PubMed: 21950704]
- Coventry PA, Gemmill I, Todd CJ. Psychosocial risk factors for hospital readmission in COPD patients on early discharge services: a cohort study. *BMC Pulm Med*. 2011; 11:49. [PubMed: 22054636]
- Cushman P Jr. Delirium tremens. Update on an old disorder. *Postgrad Med*. 1987; 82:117–122.
- Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992; 45:613–619. [PubMed: 1607900]
- Drachman DA. Benchmarking patient satisfaction at academic health centers. *Jt Comm J Qual Improv*. 1996; 22:359–367. [PubMed: 8724690]
- Foy A, Kay J, Taylor A. The course of alcohol withdrawal in a general hospital. *QJM*. 1997; 90:253–261. [PubMed: 9307759]
- Graham BB, Keniston A, Gajic O, Trillo Alvarez CA, Medvedev S, Douglas IS. Diabetes mellitus does not adversely affect outcomes from a critical illness. *Crit Care Med*. 2010; 38:16–24. [PubMed: 19789450]
- Hasin DS, Stinson FS, Ogburn E, Grant BF. Prevalence, correlates, disability, and comorbidity of DSM-IV alcohol abuse and dependence in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry*. 2007; 64:830–842. [PubMed: 17606817]
- Herridge MS, Cheung AM, Tansey CM, Matte-Martyn A, Diaz-Granados N, Al-Saidi F, Cooper AB, Guest CB, Mazer CD, Mehta S, Stewart TE, Barr A, Cook D, Slutsky AS, Canadian Critical Care Trials Group. One-year outcomes in survivors of the acute respiratory distress syndrome. *N Engl J Med*. 2003; 348:683–693. [PubMed: 12594312]
- Herridge MS, Tansey CM, Matté A, Tomlinson G, Diaz-Granados N, Cooper A, Guest CB, Mazer CD, Mehta S, Stewart TE, Kudlow P, Cook D, Slutsky AS, Cheung AM, Canadian Critical Care Trials Group. Functional disability 5 years after acute respiratory distress syndrome. *N Engl J Med*. 2011; 364:1293–1304. [PubMed: 21470008]
- Hopkins RO, Herridge MS. Quality of life, emotional abnormalities, and cognitive dysfunction in survivors of acute lung injury/acute respiratory distress syndrome. *Clin Chest Med*. 2006; 27:679–689. abstract x. [PubMed: 17085255]
- Horwitz, L.; Partovian, C.; Lin, Z.; Herrin, J.; Grady, J.; Conover, M.; Montague, J.; Dillaway, C.; Bartczak, K.; Ross, J.; Bernheim, S.; Drye, E.; Krumholz, HM. [Accessed August 31, 2012]

Hospital-Wide (All-Condition) 30-Day Risk-Standardized Readmission Measure. 2011. Available at: <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/MMS/downloads/MMSHospital-WideAll-ConditionReadmissionRate.pdf>

Hospital Quality Alliance. [Accessed August 10, 2012] HQA Approved Hospital Inpatient Measures. 2012. Available at: <http://www.hospitalqualityalliance.org/hospitalqualityalliance/qualitymeasures/quality%20measures.html>

- Jackson JC, Girard TD, Gordon SM, Thompson JL, Shintani AK, Thomason JW, Pun BT, Canonico AE, Dunn JG, Bernard GR, Dittus RS, Ely EW. Long-term cognitive and psychological outcomes in the awakening and breathing controlled trial. *Am J Respir Crit Care Med*. 2010; 182:183–191. [PubMed: 20299535]
- Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med*. 2009; 360:1418–1428. [PubMed: 19339721]
- Kim HM, Smith EG, Stano CM, Ganoczy D, Zivin K, Watlers H, Valenstein M. Validation of key behaviourally based mental health diagnoses in administrative data: suicide attempt, alcohol abuse, illicit drug abuse and tobacco use. *BMC Health Serv Res*. 2012; 12:18. [PubMed: 22270080]
- Lefevre F, Reifler D, Lee P, Sbenge M, Nwadiaro N, Verma S, Yarnold PR. Screening for undetected mental disorders in high utilizers of primary care services. *J Gen Intern Med*. 1999; 14:425–431. [PubMed: 10417600]
- Lukan JK, Reed DN Jr, Looney SW, Spain DA, Blondell RD. Risk factors for delirium tremens in trauma patients. *J Trauma*. 2002; 53:901–906. [PubMed: 12435941]
- Marik P, Mohedin B. Alcohol-related admissions to an inner city hospital intensive care unit. *Alcohol Alcohol*. 1996; 31:393–396. [PubMed: 8879288]
- Monte R, Rabuñal R, Casariego E, López-Agreda H, Mateos A, Pértega S. Analysis of the factors determining survival of alcoholic withdrawal syndrome patients in a general hospital. *Alcohol Alcohol*. 2010; 45:151–158. [PubMed: 20075027]
- Morojele NK, Saban A, Seedat S. Clinical presentations and diagnostic issues in dual diagnosis disorders. *Curr Opin Psychiatry*. 2012; 25:181–186. [PubMed: 22449761]
- Moss M, Burnham EL. Alcohol abuse in the critically ill patient. *Lancet*. 2006; 368:2231–2242. [PubMed: 17189035]
- Mostafa SM, Murthy BV. Alcohol-associated admissions to an adult intensive care unit: an audit. *Eur J Anaesthesiol*. 2002; 19:193–196. [PubMed: 12071239]
- O'Brien JM Jr, Lu B, Ali NA, Martin GS, Aberegg SK, Marsh CB, Lemeshow S, Douglas IS. Alcohol dependence is independently associated with sepsis, septic shock, and hospital mortality among adult intensive care unit patients. *Crit Care Med*. 2007; 35:345–350. [PubMed: 17205003]
- Pearson SD, Katzelnick DJ, Simon GE, Manning WG, Helstad CP, Henk HJ. Depression among high utilizers of medical care. *J Gen Intern Med*. 1999; 14:461–468. [PubMed: 10491229]
- Philbin EF, DiSalvo TG. Prediction of hospital readmission for heart failure: development of a simple risk score based on administrative data. *J Am Coll Cardiol*. 1999; 33:1560–1566. [PubMed: 10334424]
- Phillips CO, Wright SM, Kern DE, Singa RM, Shepperd S, Rubin HR. Comprehensive discharge planning with postdischarge support for older patients with congestive heart failure: a meta-analysis. *JAMA*. 2004; 291:1358–1367. [PubMed: 15026403]
- Reese RL, Freedland KE, Steinmeyer BC, Rich MW, Rackley JW, Carney RM. Depression and rehospitalization following acute myocardial infarction. *Circ Cardiovasc Qual Outcomes*. 2011; 4:626–633. [PubMed: 22010201]
- Saitz R, Palfai TP, Cheng DM, Horton NJ, Freedner N, Dukes K, Kraemer KL, Roberts MS, Guerriero RT, Samet JH. Brief intervention for medical inpatients with unhealthy alcohol use: a randomized, controlled trial. *Ann Intern Med*. 2007; 146:167–176. [PubMed: 17283347]
- Schuckit MA. Alcohol-use disorders. *Lancet*. 2009; 373:492–501. [PubMed: 19168210]
- Smits FT, Brouwer HJ, ter Riet G, van Weert HC. Epidemiology of frequent attenders: a 3-year historic cohort study comparing attendance, morbidity and prescriptions of one-year and persistent frequent attenders. *BMC Public Health*. 2009; 9:36. [PubMed: 19166622]
- Spies CD, Nordmann A, Brummer G, Marks C, Conrad C, Berger G, Runkel N, Neumann T, Müller C, Rommelspacher H, Specht M, Hannemann L, Striebel HW, Schaffartzik W. Intensive care unit

stay is prolonged in chronic alcoholic men following tumor resection of the upper digestive tract. *Acta Anaesthesiol Scand.* 1996; 40:649–656. [PubMed: 8836256]

U.S. Department of Health and Human Services. [Accessed August 10, 2012] Hospital Compare. 2012. Available at: <http://www.hospitalcompare.hhs.gov/>

Table 1

Baseline characteristics

	Rehospitalized or Dead (n = 522)	Alive and not Rehospitalized (n = 656)	P-Value
Age	47 [41, 54]	46 [40, 54]	0.18
Gender -no. (% male)	427 (82)	543 (83)	0.66
Race/Ethnicity – no. (%)			0.40
Caucasian	313 (60)	384 (59)	
Hispanic	134 (26)	191 (29)	
African American	42 (8)	46 (7)	
Other	33 (6)	35 (5)	
Reason for Index Admission – no. (%)			< 0.01
Psychiatric Illness	117 (23)	205 (32)	
Neurological	54 (10)	68 (10)	
Gastrointestinal	75 (15)	89 (14)	
Respiratory	60 (12)	48 (7)	
Cardiovascular	26 (5)	39 (6)	
Injury or toxic ingestion	19 (4)	40 (6)	
Other	166 (32)	161 (25)	
Alcohol-Related Admission Diagnosis – no. (%)	105 (20)	197 (30)	< 0.01
ICU Length of Stay (Days)	2.6 [1.4, 5.1]	2.8 [1.6, 5.5]	0.15
Severity of Illness – no. (%)			< 0.01
Minor	17 (3)	22 (3)	
Moderate	81 (16)	144 (22)	
Severe	230 (44)	230 (35)	
Extreme	194 (37)	260 (40)	
Charlson/Deyo Comorbidity Index Score – no. (%)			< 0.01
0	256 (49)	397 (61)	
1	133 (25)	145 (22)	
2	38 (7)	30 (5)	
3	95 (18)	84 (13)	
Anxiety – no. (%)	34 (7)	8 (1)	< 0.01
Bipolar Disorder – no. (%)	79 (15)	42 (6)	< 0.01
Depression - no.(%)	47 (9)	20 (3)	< 0.01
Schizophrenia – no. (%)	41 (8)	9 (1)	< 0.01
At least 1 psychiatric comorbidity – no. (%)	141 (27)	61 (9)	< 0.01
Homeless – no. (%)	168 (32)	156 (24)	< 0.01

Table 2

Predictors of death or rehospitalization in medical intensive care unit survivors with alcohol withdrawal. (n = 1,178)

Variable	Coefficient (β)	Standard Error	Hazard Ratio	95% CI		P Value
Schizophrenia (yes/no)	0.803	0.192	2.231	1.568	3.340	<0.001
Bipolar (yes/no)	0.256	0.158	1.292	0.951	1.789	0.106
Depression (yes/no)	0.481	0.207	1.618	1.046	2.400	0.028
Anxiety (yes/no)	0.711	0.245	2.035	1.304	3.323	0.004
Severity of illness						
Mild			Reference			
Moderate	-0.316	0.293	0.729	0.422	1.331	0.276
Severe	0.029	0.277	1.029	0.618	1.809	0.968
Extreme	-0.296	0.279	0.744	0.440	1.330	0.282
Charlson/Deyo Index Score						
0			Reference			
1	0.195	0.109	1.215	0.969	1.504	0.066
2	0.363	0.214	1.438	0.953	2.272	0.074
>= 3	0.355	0.142	1.426	1.086	1.890	0.012
Age	-0.006	0.005	0.994	0.983	1.004	0.252
Payer Source						
Colorado Indigent Care Program			Reference			
Commercial Insurance	0.069	0.205	1.071	0.708	1.574	0.714
Medicaid	0.634	0.136	1.885	1.427	2.492	<0.001
Medicare	0.396	0.170	1.486	1.048	2.146	0.032
Self-pay	-0.108	0.148	0.898	0.652	1.184	0.452
Other	0.466	0.164	1.594	1.154	2.167	0.012
Current Smoker	0.106	0.095	1.111	0.926	1.360	0.252
Homeless	0.370	0.108	1.448	1.166	1.806	0.000
Race						
Caucasian			Reference			
African American	0.011	0.170	1.012	0.719	1.394	0.982
Hispanic	-0.036	0.109	0.965	0.766	1.175	0.714
Other	0.091	0.213	1.095	0.716	1.646	0.684
Gender (male)	-0.007	0.129	0.993	0.775	1.314	0.950

Table 3

Predictors of an ED or urgent care visit within 1 year of hospital discharge for medical ICU survivors who did not die and were not rehospitalized (n = 656).

Variable	Coefficient (β)	Standard Error	Hazard Ratio	95% CI		P Value
Schizophrenia (yes/no)	0.679	0.478	1.973	0.717	5.313	0.124
Bipolar (yes/no)	0.706	0.267	2.026	1.243	3.623	0.008
Depression (yes/no)	0.186	0.418	1.204	0.478	2.508	0.677
Anxiety (yes/no)	0.710	0.819	2.033	0.767	5.697	0.154
Severity of Illness						
Mild			Reference			
Moderate	0.163	0.387	1.177	0.610	2.786	0.615
Severe	0.473	0.379	1.605	0.838	3.716	0.136
Extreme	0.286	0.390	1.331	0.699	3.237	0.390
CharlsonDeyo Score						
0			Reference			
1	-0.076	0.172	0.927	0.653	1.275	0.613
2	-0.268	0.418	0.765	0.301	1.550	0.462
3	-0.158	0.256	0.854	0.502	1.376	0.539
Age	0.006	0.007	1.006	0.992	1.020	0.436
Payer Source						
Colorado Indigent Care Program			Reference			
Commercial Insurance	-0.954	0.855	0.385	0.138	0.801	0.012
Medicaid	-0.221	0.260	0.802	0.460	1.315	0.338
Medicare	-0.575	0.286	0.563	0.298	0.942	0.018
Self-Pay	0.024	0.179	1.024	0.728	1.445	0.885
Other	-0.598	0.313	0.550	0.272	0.980	0.038
Current Smoker	0.058	0.134	1.059	0.814	1.379	0.653
Homeless	0.629	0.151	1.877	1.435	2.564	0.000
Race						
Caucasian			Reference			
African American	0.720	0.246	2.055	1.269	3.382	0.002
Hispanic	0.348	0.159	1.416	1.056	1.961	0.016
Other	-0.117	0.338	0.890	0.421	1.676	0.709
Gender (male)	-0.216	0.166	0.806	0.601	1.129	0.214

Table 4

Predictors of high healthcare utilization for medical intensive care unit survivors with alcohol withdrawal. High healthcare utilization was defined as 3 or more readmissions to the hospital within the year following initial hospital discharge. (n = 1,178)

Variable	Coefficient (β)	Standard Error	Z value	P Value	Odds Ratio	95% CI	
Schizophrenic (yes/no)	0.476	0.416	1.145	0.252	1.609	0.714	3.628
Bipolar (yes/no)	0.659	0.298	2.212	0.027	1.932	1.079	3.459
Depression (yes/no)	0.985	0.349	2.825	0.005	2.679	1.354	5.299
Anxiety (yes/no)	0.547	0.457	1.199	0.231	1.729	0.708	4.224
Age	0.025	0.011	2.340	0.019	1.025	1.004	1.047
Homeless (yes/no)	0.440	0.219	2.008	0.045	1.553	1.011	2.383
Charlson/Deyo Score							
0			Reference				
1	0.412	0.262	1.571	0.116	1.509	0.904	2.520
2	0.456	0.428	1.065	0.287	1.578	0.683	3.647
≥ 3	1.117	0.283	3.952	0.000	3.056	1.758	5.311
Severity of Illness							
Mild			Reference				
Moderate	0.592	0.780	0.759	0.448	1.807	0.393	8.303
Severe	0.512	0.765	0.669	0.504	1.668	0.374	7.444
Extreme	0.140	0.776	0.181	0.857	1.150	0.252	5.248