Severity of Acute Illness is Associated with Baseline Readiness to Change in Medical Intensive Care Unit Patients with Unhealthy Alcohol Use

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Background: Unhealthy alcohol use predisposes to multiple conditions that frequently result in critical illness and is present in up to one-third of patients admitted to a medical intensive care unit (ICU). We sought to determine the baseline readiness to change in medical ICU patients with unhealthy alcohol use and hypothesized that the severity of acute illness would be independently associated with higher scores on readiness to change scales. We further sought to determine whether this effect is modified by the severity of unhealthy alcohol use.

Methods: We performed a cross-sectional observational study of current regular drinkers in 3 medical ICUs. The Alcohol Use Disorders Identification Test was used to differentiate low-risk and unhealthy alcohol use and further categorize patients into risky alcohol use or an alcohol use disorder. The severity of a patient's acute illness was assessed by calculating the Acute Physiologic and Chronic Health Evaluation II (APACHE II) score at the time of admission to the medical ICU. Readiness to change was assessed using standardized questionnaires.

Results: Of 101 medical ICU patients who were enrolled, 65 met the criteria for unhealthy alcohol use. The association between the severity of acute illness and readiness to change depended on the instrument used. A higher severity of illness measured by APACHE II score was an independent predictor of readiness to change as assessed by the Stages of Change Readiness and Treatment Eagerness Scale (Taking Action scale; $p < 0.01$). When a visual analog scale was used to assess readiness to change, there was a significant association with severity of acute illness ($p < 0.01$) that was modified by the severity of unhealthy alcohol use ($p = 0.04$ for interaction term).

Conclusions: Medical ICU patients represent a population where brief interventions require further study. Studies of brief intervention should account for the severity of acute illness and the severity of unhealthy alcohol use as potential effect modifiers.

Key Words: Alcohol Use Disorder, Unhealthy Alcohol Use, Intensive Care Unit, Readiness to Change, Severity of Illness.

THE SPECTRUM OF unhealthy alcohol use ranges from consumption in excess of recommended limits (risky alcohol use) to alcohol abuse and dependence (alcohol use disorders [AUDs]; Saitz, 2005). Unhealthy alcohol use is associated with the development of multiple conditions that frequently require care in a medical intensive care unit (ICU), including the acute respiratory distress syndrome (Moss et al., 1996), severe sepsis (O'Brien et al., 2007), and nosocomial infection (Gacouin et al., 2008). Therefore, unhealthy alcohol use is commonly present in medical ICU patients, with point estimates ranging from a low of 12% when ICD-9 codes are used to establish a diagnosis to 34% when systematic screening is implemented (Moss et al., 2003; O'Brien et al., 2007).

Despite improving outcomes and the high prevalence of unhealthy alcohol use among medical ICU patients, no studies have specifically addressed the efficacy of alcohol screening and interventions in this setting (Esteban et al., 2002). Importantly, studies of brief intervention in other hospitalized patient populations have reported mixed results (Havard et al., 2008). For example, in trauma patients, brief intervention led to a reduction in alcohol consumption and a 47% reduction in trauma recidivism (Gentilello et al., 1999). In contrast, brief interventions in general medical inpatients were no better than the standard of care in reducing alcohol consumption or receipt of alcohol treatment following discharge (Emmen et al., 2004; Saitz et al., 2007).

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Several potential reasons may contribute to these disparate results, although a failure to properly account for specific moderators could represent 1 explanation (Field et al., 2010). While the hospital setting itself may serve as one such moderator, the severity of unhealthy alcohol use could also be important (Vasilaki et al., 2006). To support this contention, in the aforementioned study of hospitalized trauma patients, brief interventions were most efficacious in patients with nondependent risky alcohol use (Gentilello et al., 1999), a diagnosis found on the milder end of the unhealthy alcohol use spectrum. In contrast, more than 75% of patients enrolled in the study assessing the efficacy of brief intervention in general medical inpatients had alcohol dependence, a diagnosis on the more severe end of the unhealthy alcohol use spectrum (Saitz et al., 2007). This high rate of alcohol dependence may explain the lack of benefit in the overall population. In support of this hypothesis, a secondary analysis of this randomized, controlled trial reported that brief interventions did reduce alcohol consumption in general medicine patients with nondependent risky alcohol use (Saitz et al., 2009).

The severity of unhealthy alcohol use is unlikely to be the sole explanation for the mixed effects of brief intervention in hospitalized patients. Although most studies of brief interventions exclude patients on the more severe end of the unhealthy alcohol use spectrum, a recent study in trauma patients demonstrated that the effect of a brief intervention in hospitalized trauma patients was dependent on whether alcohol dependence was present (Field and Caetano, 2010). Injured patients with alcohol dependence had a larger decrease in alcohol consumption compared with patients without alcohol dependence. A study of brief interventions in injured emergency department patients had similar findings (Blow et al., 2009).

One potential explanation for the disparate findings in trauma and general medicine inpatients may be the severity of the acute illness. The severity of acute illness has been proposed to moderate the effectiveness of a brief intervention but has not been specifically addressed in the literature. Alternatively, the effect of the severity of the acute illness on receptiveness to a brief intervention may depend on the severity of a patient's unhealthy alcohol use. For example, patients with nondependent risky alcohol use may stop drinking on their own while patients with alcohol dependence may be receptive to a brief intervention if their acute illness is sufficiently severe to increase the salience of the moment.

As an initial step in designing interventions to address unhealthy alcohol use in medical ICU patients, we sought to define the spectrum of unhealthy alcohol use in this population. We further sought to determine whether patients with unhealthy alcohol use would be amenable to interventions by assessing their baseline readiness to change, hypothesizing that the severity of a patient's acute illness would be independently associated with a higher baseline readiness to change. Finally, we sought to determine whether the interaction between the severity of the acute medical illness and the severity of unhealthy acute use influences the readiness to change of the patient.

MATERIALS AND METHODS

Between December 2009 and January 2011, we conducted a cross-sectional observational study in the medical ICUs of 3 hospitals. These 3 hospitals represent diverse healthcare settings and include a tertiary urban academic medical center with a 17-bed medical ICU, a county hospital with a 25-bed medical ICU, and a community hospital with a 12-bed medical ICU. Each of the participating hospitals has separate medical and trauma/surgical ICUs. Because screening and brief intervention is required for level 1 trauma designation and is already in place for trauma/surgical patients in 2 of the hospitals and because our primary interest is the care of medical ICU patients with unhealthy alcohol use, we focused only on patients with non-trauma/surgical diagnoses who were admitted to the medical ICUs in the 3 participating hospitals. Patients who were 18 years of age or older, admitted to a medical ICU, met the definition of a current regular drinker (>12 standard alcoholic drinks in the past year; Sondik et al., 2010), spoke English as a first language, were not a prisoner, and did not have preexisting or acquired cognitive dysfunction that precluded the ability to obtain informed consent were eligible for participation in the study. Patients who were not able to answer questions coherently at the time of ICU admission because of sedation or delirium were followed until the resolution of their critical illness. If necessary, patients were followed after they were transferred out of the medical ICU to the general medicine ward. Patients were excluded if they refused to participate or were enrolled during a previous admission. If patients agreed to participate, informed consent was obtained prior to enrollment. After enrollment, demographic information was collected. By self-report, we additionally assessed patients for a history of depression, generalized anxiety disorder, prior psychiatric hospitalization, or treatment for a psychiatric disorder or substance abuse. Unhealthy alcohol use was assessed using the Alcohol Use Disorders Identification Test (AUDIT). Readiness to change was assessed using 3 different instruments: a visual analog scale (VAS), the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES), and the Readiness to Change Questionnaire (RCQ; Bertholet et al., 2009a; Miller and Tonigan, 1996; Rollnick et al., 1992). Alcohol-related consequences were assessed using the Short Inventory of Problems (SIP) questionnaire (Feinn et al., 2003; Miller et al., 1995). This study protocol was reviewed and approved by the institutional review boards at all participating hospitals prior to commencement of the study. All data were abstracted from the charts by a single investigator (BJC) and was double-checked at the time of entry. Range limitations were used to further ensure the accuracy of data entry.

Definition of Independent Variables

Unhealthy Alcohol Use. For men, we defined low-risk drinking as an AUDIT score of 1 to 7, risky alcohol use as an AUDIT score of 8 to 15, and the presence of an AUD as an AUDIT score of 16 or more. For women, the respective scores were 1 to 4, 5 to 15, and 16 or more (Neumann et al., 2004). Although the AUDIT cutoff of 16 for an AUD can lead to misclassification, it is highly specific for an AUD. Posttest probabilities for an AUD with an AUDIT score ≥ 16 are 87% for men and $>94\%$ for women (Rubinsky et al., 2010).

Severity of Acute Illness. Acute Physiologic and Chronic Health Evaluation II (APACHE II) score calculated on medical ICU admission was used to estimate the severity of illness (Ho et al., 2006). The APACHE II scoring system requires the input of 12 physiologic measurements including patient characteristics, comorbidities, and laboratory values. Scores can range from 0 to 71 with higher scores indicating more severe illness (Knaus et al., 1985). The APACHE II is widely used in the United States to estimate severity of illness for critically ill patients (Cowen and Kelley, 1994). A cutoff

of ≥8 was used to designate a high severity of illness. This is a generally accepted cutoff used to predict a complicated hospital course for medical inpatients (Pavlidis et al., 2010).

Alcohol-Related Consequences. Alcohol-related consequences are independently associated with baseline readiness to change in trauma patients and may confound the relationship between severity of illness and readiness to change in medical inpatients (Apodaca and Schermer, 2003). We, therefore, assessed alcohol-related consequences with the SIP, a short form of the Drinker Inventory of Consequences (Miller et al., 1995). The SIP also assesses 5 domains of alcohol-related consequences but only contains 15 questions. The SIP has good internal consistency, concurrent validity, and stability (Feinn et al., 2003).

Admission Diagnosis. An alcohol-attributable diagnosis at hospital admission is also associated with an increased readiness to change in medical inpatients and may confound the relationship between severity of illness and readiness to change (Lau et al., 2010). We determined whether admission diagnoses were attributable to alcohol by review of the patient's chart including the history and physical, consultant's notes, and progress notes (Rehm et al., 2006; Saitz et al., 2007). Examples of admission diagnoses that were attributed to alcohol included diseases such as alcoholic cirrhosis, alcoholic hepatitis, and alcohol withdrawal. Other diagnoses that the treating physician or the author felt were solely related to alcohol, such as alcoholic ketoacidosis or hyponatremia owing to low solute intake, were also included as alcohol-attributable, as described by Saitz and colleagues (2007).

Outcome Variables

Readiness to Change. There is no single gold standard for measuring readiness to change. Prior studies assessing readiness to change in general medicine patients have validated the SOCRATES as well as the VAS while studies assessing readiness to change in trauma patients used the RCQ. Although these 3 questionnaires likely measure different constructs, all of them were included in our analysis to thoroughly assess potential causes for the disparate findings between studies in general medicine patients and studies in trauma patients.

1. The SOCRATES was originally developed in a treatment-seeking population to capture the stages of change described by the Transtheoretical Model (Miller and Tonigan, 1996). Its original format used a 3-factor structure that assessed recognition (7 questions), ambivalence (4 questions), and taking steps (8 questions). When assessed in a non-treatment-seeking medical inpatient population, a 2-component structure was found to be more appropriate (Bertholet et al., 2009b). The first component, perception of problems (PP), contains 10 items with scores ranging from 10 to 50. Higher scores indicate a perception not only of a problem, but also of a need for help. The second component, taking action (TA), contains 6 items with scores ranging from 6 to 30. Higher scores indicate that a person is already taking steps to cut down their drinking and is committed to change. Both scales have good internal consistency (Crohnbach's alpha 0.94 and 0.88, respectively). Higher scores on the PP scale are correlated with increased alcohol consumption and are likely a measure of disease severity while higher scores on the TA scale correlate with decreased alcohol consumption at 3 months (Bertholet et al., 2009a). Because the SOCRATES PP scale is likely a measure of disease severity, a priori, we focused our analysis only on the SOCRATES TA scale. To confirm this, a multiple linear regression model using the SOCRATES PP as the outcome variable demonstrated that it was significantly correlated with total SIP score ($p < 0.001$) and higher AUDIT category ($p = 0.03$).
2. The RCQ is a 12-item questionnaire, also based on the stages of change model, that contains 4 questions assessing precontemplation, 4 assessing contemplation, and 4 assessing action (Rollnick et al., 1992). It was specifically developed to assess readiness to change in patients who are not seeking treatment. The reported internal consistency (assessed by calculating Cronbach's alpha coefficient) for the scales are 0.73, 0.80, and 0.85, respectively. The RCQ has been used to assess readiness to change in several inpatient populations (Lau et al., 2010). Each question asks the patient to rate their response on a 5-point Likert scale from −2 (strongly disagree) to +2 (strongly agree). For the purposes of analysis, we used a summary score of readiness to change obtained by adding the contemplation and action scores then subtracting the precontemplation score, as previously described (Bombardier et al., 1997).
3. A VAS asked patients, "How ready are you to change your drinking habits?" with 0 being not ready to change and 10 being ready to change. Although the VAS has not been as extensively validated as other RCQs, it may be more applicable to the clinical setting because of its brevity. Higher scores on the VAS correlate with decreased alcohol consumption 3 months following hospital discharge (Bertholet et al., 2009a).

Statistical Analysis

Means and standard deviation are reported for normally distributed continuous variables. Medians and interquartile ranges (IQRs) are reported for continuous variables that are not normally distributed. Differences between patients with low-risk alcohol use, risky alcohol use, and an AUD were evaluated using the *t*-test for normally distributed continuous variables, the Wilcoxon Rank-Sum test for continuous variables that were not normally distributed, and the chi-square test for categorical variables. A Bonferroni adjustment was used to account for multiple comparisons in these univariate analyses.

To determine predictors of readiness to change in the group with unhealthy alcohol use, stepwise linear regression was performed using severity of illness measured by APACHE II score, alcohol-related consequences measured by SIP score, and severity of unhealthy alcohol use determined by the AUDIT as predictors of readiness to change. Age, gender, race, unemployment, and homelessness were not significantly associated with any of our outcome variables, thus not meeting the definition of a confounding variable. Therefore, these were not included in the multivariate models. To address whether the effect of severity of illness depends on the severity of unhealthy alcohol use, we included a first-order interaction term for severity of illness (APACHE II category) and severity of unhealthy alcohol use (AUDIT category) in each model. Starting with full models, a partial *F*-test was performed for each individual predictor in the model. Predictors with the highest *p*-value for the partial *F*-test were removed from the model if the *p*-value was >0.15. This process was continued until no variables could be removed (Kleinbaum et al., 2008). Separate models were constructed using the VAS, SOCRATES TA, and RCQ scores as the outcome variable. As a post hoc analysis, we performed a multiple linear regression model using the same methods with the RCQ action subscale as the outcome variable. APACHE II scores were dichotomized into a high severity of illness and a low severity of illness, and AUDIT scores were used to dichotomize patients into risky alcohol use and AUD, as described in the sections above. A 2-sided *p*-value of <0.05 was considered to be significant in the final reduced models.

RESULTS

Of the 731 medical ICU admissions, 161 patients met our inclusion criteria (Fig. 1). Overall, 49 patients were excluded

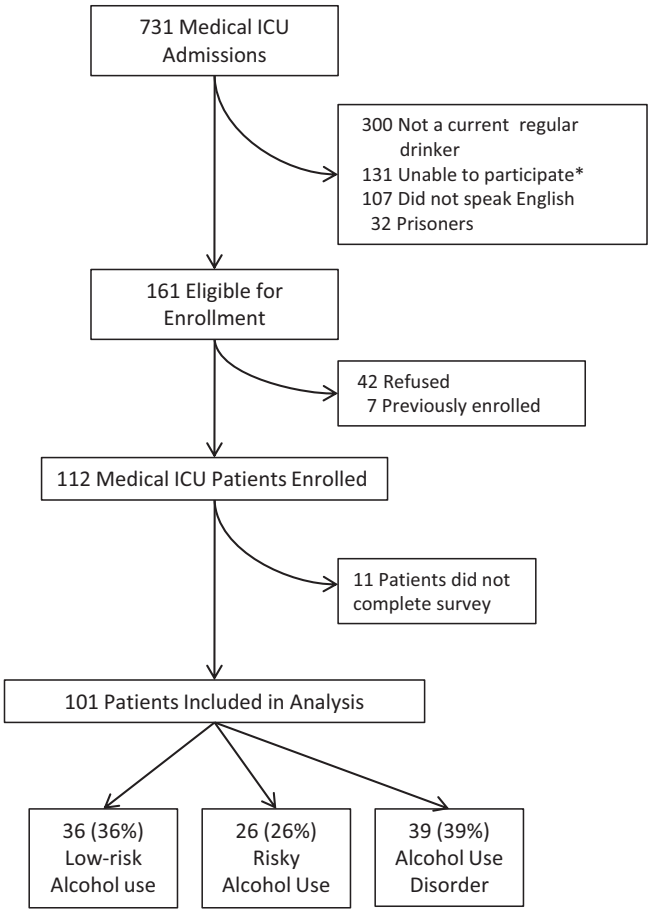

Fig. 1. Screening and enrollment of patients admitted to the medical intensive care unit (ICU). *Patients were unable to participate due to baseline or acquired cognitive dysfunction that did not resolve prior to hospital discharge and precluded the ability to provide informed consent.

from the study. Refusal to participate was the most common reason for exclusion. Of 112 patients enrolled, 101 (90%) completed their questionnaire and had sufficient data available for analysis. There was no difference in alcohol-attributable diagnoses, the percentage of patients with a high severity of acute illness, the need for mechanical ventilation, or the need for vasopressors between those patients who completed the survey and those who did not.

Nearly two-thirds (65/101) of patients who were current regular drinkers met the criteria for unhealthy alcohol use. More patients who met the criteria for unhealthy alcohol use had an AUD (61%; 95% CI: 49 to 73) than risky alcohol use (39%; 95% CI: 27 to 51). Admission diagnoses were more commonly related to cardiac disease in low-risk drinkers (43%) than in patients with risky alcohol use (27%) or an AUD (10%; $p = 0.005$). Conversely, admission diagnoses were more commonly related to gastrointestinal disease in both patients with risky alcohol use (38%) and those with an AUD (21%) compared with those with low-risk alcohol use (6%; $p = 0.005$). The need for mechanical ventilation (11% in the low-risk alcohol use group, 4% in unhealthy alcohol use, 13% in AUD group, $p = 0.41$) and the median ICU length of stay (2 [IQR: 1 to 4] days in low-risk alcohol use group, 2 [IQR: 1 to 3] days in risky alcohol use group, 2 [IQR: 1 to 4] days in AUD group, $p = 0.75$) did not differ significantly between the 3 groups.

Patients with risky alcohol use or an AUD were more likely to be male, unemployed, and homeless (Table 1). Self-reported mood disorders were common, occurring in one-third of patients with risky alcohol use and nearly one-half of patients with an AUD, although this did not differ significantly between groups ($p = 0.35$). Alcohol-attributable

Table 1. Baseline Characteristics of MICU Patients with Low-Risk Alcohol Use, Risky Alcohol Use, and an Alcohol Use Disorder

	Low-risk alcohol use ($n = 36$)	Risky alcohol use ($n = 26$)	Alcohol use disorder ($n = 39$)	p-Value
Age	51 ± 16	50 ± 11	47 ± 11	0.38
Gender (n, % male)	23/36 (64)	23/26 (88)	34/39 (87)	0.02
Race/ethnicity (%)				
Caucasian	17/36 (47)	18/26 (69)	17/39 (44)	0.10
African American	10/36 (28)	1/26 (4)	6/39 (15)	0.03
Hispanic	6/36 (17)	7/26 (27)	12/39 (31)	0.34
Other	3/36 (8)	0/26 (0)	4/39 (8)	0.11
Alcohol-attributable admission diagnosis (%)	3/32 (9)	7/26 (26)	17/39 (44)	<0.01
APACHE II score	8 [3 to 12]	6 [4 to 9]	10 [5 to 12]	0.38
Unemployed (%)	12/36 (33)	18/26 (69)	32/39 (82)	<0.01
Homeless (%)	4/36 (11)	3/26 (11)	12/38 (32)	0.05
Mood disorder (%)[a]	6/36 (17)	9/26 (35)	18/39 (46)	0.02
Current smoker (%)	10/34 (29)	12/25 (48)	29/39 (74)	<0.01
Drinks per week	3 [1 to 6]	15 [6 to 35]	35 [15 to 60]	<0.01
Binge drinking days[b]	0 [0 to 2]	4 [2 to 25]	17.5 [5.5 to 30]	<0.01
AUDIT score	3 [2 to 4]	10 [9 to 13]	24 [21 to 30]	<0.01
SIP score	0 [0 to 5]	12 [2 to 19]	28 [20 to 37]	<0.01

[a]By patient self-report.
[b]Number of days out of the last 30 with 5 or more drinks on 1 occasion for men, 4 or more drinks on 1 occasion for women.
MICU, medical intensive care unit; APACHE II, Acute Physiologic and Chronic Health Evaluation II; AUDIT, Alcohol Use Disorders Identification Test; SIP, Short Inventory of Problems.

Table 2. Readiness to Change in Medical ICU Patients, as Measured by Validated Questionnaires

	Low-risk alcohol use	Risky alcohol use	Alcohol use disorder
SOCRATES perception of problems[a,b,c]	11 [10 to 20]	28 [20 to 35]	43 [38 to 46]
SOCRATES taking action[a,b]	14 [6 to 20]	22 [14 to 26]	22 [18 to 25]
Visual analog scale[a,b]	1 [0.1 to 7.3]	7.8 [0.8 to 9.3]	8.7 [5.5 to 9.5]
Readiness to Change Questionnaire[a,b,c]	−7.5 [−13 to 4]	7.5 [−2.5 to 12]	12 [6 to 16]

[a]Wilcoxon Rank-Sum test $p < 0.001$ for comparison of alcohol use disorder to low-risk alcohol use.
[b]Wilcoxon Rank-Sum test $p < 0.05$ for comparison of risky alcohol use to low-risk alcohol use.
[c]Wilcoxon Rank-Sum test $p < 0.05$ for comparison for alcohol use disorder to risky alcohol use.
ICU, intensive care unit; SOCRATES, Stages of Change Readiness and Treatment Eagerness Scale.

admission diagnoses were common in patients with risky alcohol use (26%) and patients with an AUD (44%). However, the proportion of patients with an alcohol-attributable diagnosis at admission did not significantly differ between those with risky alcohol use and those with an AUD ($p = 0.17$). Patients with risky alcohol use consumed a median of 15 (IQR: 6 to 35) drinks per week, significantly fewer drinks per week than patients with an AUD (median: 35; IQR: 15 to 60; $p < 0.01$). Patients with risky alcohol use also scored significantly lower on the SIP (median: 12; IQR: 2 to 19) than those with an AUD (median: 28; IQR: 20 to 37; $p < 0.01$).

Patients with risky alcohol use and those with an AUD scored significantly higher on all scales of readiness to change when compared with patients with low-risk alcohol use (Table 2). On average, patients with risky alcohol use had SOCRATES TA scores (median: 22; IQR: 14 to 26) that were significantly higher than patients with low-risk alcohol use (median 14; IQR: 6 to 20; $p < 0.01$). Similarly, scores on the RCQ were significantly higher for patients with risky alcohol use (median: 7.5; IQR: −2.5 to 12) than those with low-risk alcohol use (median: −7.5; IQR: −13 to 4; $p < 0.01$). Median scores on the VAS were also higher in patients with risky alcohol use than patients with low-risk alcohol use, although this did not reach statistical significance after adjustment for multiple comparisons ($p = 0.04$). Patients with an AUD scored significantly higher than patients with risky alcohol use on the SOCRATES PP scale (43 vs. 28, $p < 0.001$) as well as the RCQ (12 vs. 7.5, $p = 0.029$), but not on the VAS (8.7 vs. 7.8, $p = 0.11$) or the SOCRATES TA scale (22 vs. 22, $p = 0.44$).

In the subset of patients who met criteria for risky alcohol use or an AUD, those with a more severe acute illness scored higher on the SOCRATES TA scale and the VAS than patients with APACHE II scores below the median, suggesting that they are more ready to change their drinking behaviors (Table 3). There was no statistical difference in median scores on the RCQ for those with low and high severity of illness scores ($p = 0.08$). Greater preadmission alcohol-related consequences, as measured by the SIP scores, were associated with readiness to change as measured by the VAS ($\beta = 0.09$; 95% CI: 0.01 to 0.13; $p = 0.01$) but not the RCQ or the SOCRATES TA scale. An alcohol-attributable admission diagnosis was not associated with higher scores on any of the RCQs. In multiple linear regression models, an APACHE II score above the median was the only independent predictor of readiness to change, as measured by the SOCRATES TA scale (Table 4). When the VAS was used as the outcome variable, the effect of the severity of acute illness on baseline readiness to change depended on the severity of unhealthy alcohol use. On average, patients with a high severity of illness and an

Table 3. (a) Univariate Analysis of Severity of Illness and Admission Diagnosis as Predictors of Readiness to Change. (b) Results of Simple Linear Regression Using Alcohol-Related Consequences Measured by the SIP Score as the Predictor and the 3 Measures of Readiness to Change as the Outcome Variable

	Severity of illness			Admission diagnosis		
	Low APACHE II	High APACHE II	*p*-Value	Attributed to alcohol	Not attributed to alcohol	*p*-Value
(a)						
SOCRATES taking action scale	21 [14 to 25]	24 [21 to 28]	0.02	22 [18 to 26]	22 [15 to 25]	0.88
Visual analog scale	7.1 [0.9 to 9.0]	9 [7.6 to 9.8]	<0.01	8 [3.2 to 9.5]	8.7 [6 to 9.5]	0.49
Readiness to Change Questionnaire (Action scale)	7 [−3 to 13]	12 [8 to 15]	0.08	8 [3 to 14]	12 [6 to 13]	0.51

	β	Standard error	*p*-Value
(b)			
SOCRATES taking action scale	0.06	0.06	0.28
Visual analog scale	0.09	0.04	0.01
Readiness to Change Questionnaire (Action scale)	0.03	0.04	0.45

SIP, Short Inventory of Problems; APACHE II, Acute Physiologic and Chronic Health Evaluation II; SOCRATES, Stages of Change Readiness and Treatment Eagerness Scale.

Table 4. Multivariate Linear Regression Models to Predict Readiness to Change Using 3 Different Validated Questionnaires as the Outcome Variable

	β	Standard error	*t* Ratio	*p*-Value
SOCRATES taking action scale				
Original full model				
AUD	−0.864	0.998	−0.87	0.39
Alcohol-related consequences	0.107	0.081	1.33	0.19
High severity of illness score	1.668	0.855	1.95	0.06
Alcohol-attributable diagnosis	1.449	0.878	1.65	0.11
High severity of illness * AUD	−0.681	0.849	−0.80	0.43
Full-reduced model				
High severity of illness score	2.00	0.73	2.76	<0.01
Visual analog scale				
Original full model				
AUD	−0.4016	0.5759	−0.70	0.49
Alcohol-related consequences	0.1025	0.0498	2.06	0.04
High severity of illness score	1.0969	0.5177	2.12	0.04
Alcohol-attributable diagnosis	0.6872	0.5285	1.30	0.20
High severity of illness * AUD	−1.2758	0.5064	−2.52	0.02
Full-reduced model				
High severity of illness score	1.4558	0.4874	2.99	<0.01
AUD	0.2541	0.4874	0.52	0.60
High severity of illness * AUD	−1.0483	0.4874	−2.15	0.04
Readiness to Change Questionnaire				
Original full model				
AUD	0.2984	1.4381	0.21	0.84
Alcohol-related consequences	0.2705	0.1169	2.31	0.02
High severity of illness score	1.1133	1.2133	0.92	0.36
Alcohol-attributable diagnosis	0.9610	1.2480	0.77	0.45
High severity of illness * AUD	−0.3565	1.1989	−0.30	0.77
Full reduced model				
Alcohol-related consequences	0.2578	0.0849	3.04	<0.01
High severity of illness score	1.1725	1.1161	1.05	0.30

SOCRATES, Stages of Change Readiness and Treatment Eagerness Scale; AUD, alcohol use disorder.

AUD scored 1.05 (95% CI: 0.09 to 2.01) points lower on the VAS than patients with a high severity of illness and risky alcohol use ($p = 0.04$). When scores on the RCQ were used as the outcome variable, the SIP score was the only independent predictor of readiness to change ($p < 0.01$). In a post hoc analysis, a multiple linear regression model did not identify any predictors of readiness to change using the RCQ action scale, but there was a strong trend toward an association with the severity of acute illness ($p = 0.06$).

DISCUSSION

In our study of current regular drinkers admitted to 3 medical ICUs, we determined that a substantial population of medical ICU patients with unhealthy alcohol use appeared ready to change their drinking behaviors based on the RCQ, the SOCRATES TA scale, and a VAS. We were able to recruit and enroll this population despite the ubiquitous use of analgesics and anxiolytics, as well as ICU-associated delirium, which have been reported to create difficulties in meaningful patient–caregiver interactions (Salluh et al., 2010). The majority of MICU patients with unhealthy alcohol use had an AUD (61%); however, a significant proportion had nondependent risky alcohol use (41%). Moreover, we were able to demonstrate for the first time that the severity of a patient's acute illness is an independent predictor of baseline readiness to change as measured by the SOCRATES TA scale. Additionally, when using the VAS to measure readiness to change, the effect of the severity of acute illness on baseline readiness to change was dependent on the severity of unhealthy alcohol use. This significant interaction suggested that, for patients with a high severity of acute illness, those patients with an AUD were not as ready to change their alcohol use at baseline.

Prior studies reported that premorbid alcohol-related consequences independently predicted readiness to change in trauma patients, while an alcohol-related admission diagnosis predicted readiness to change in medical inpatients (Apodaca and Schermer, 2003; Lau et al., 2010). Neither of these studies evaluated the effect of severity of the acute illness on readiness to change of a hospitalized patient. Severity of illness independently predicted readiness to change in our study only as measured by the VAS and SOCRATES TA scales. When we used the same measure as Apodaca and and Schermer (2003), we similarly found that premorbid alcohol-related consequences independently predict baseline readiness to change. This may be because the SOCRATES TA scale and VAS are more reflective of the action stage of readiness to change while the RCQ incorporates some measure of the severity of unhealthy alcohol use (Bertholet et al., 2009a; Williams et al., 2006). Supporting this, our post hoc analysis measuring only the action subscale of the RCQ demonstrated a strong trend toward an association with severity of acute illness ($p = 0.06$). Regardless, the finding that the severity of acute illness impacts baseline readiness to change suggests that there may be an enriched population of patients in the medical ICU who will be receptive to an intervention.

The findings in our study can be used to design trials that assess the efficacy of brief intervention in medical ICU patients. While prior studies of brief intervention in general medical inpatients failed to demonstrate efficacy, these studies did not account for the severity of a patient's acute illness as a potential moderator. In contrast, studies in trauma patients frequently account for injury severity in adjusted analyses (Gentilello et al., 1999; Sommers et al., 2006) and have reported that the type of injury modifies the effect of brief interventions (Mello et al., 2005). Our findings suggest that the acute severity of illness may be important and should be accounted for in the analysis of future studies of brief intervention in medical ICU patients. While brief interventions may suffice for medical ICU patients with risky alcohol use, the majority of patients in our study had an AUD. Different interventions may be necessary depending on the severity of the patient's AUD. However, the recent studies in trauma patients suggest that brief interventions may be more efficacious in patients with an AUD (Blow et al., 2009; Field and Caetano, 2010) and that patients with an AUD should be included in a study assessing the efficacy of brief intervention in the medical ICU.

There are limitations to our study. It is likely that there is a selection bias as the patients with the highest severity of illness in the medical ICU either die or are transferred to a long-term acute care facility. This is reflected in the median APACHE II score, which reflects a predicted mortality of 8% that is well below the average actual mortality for a medical ICU. However, patients who die or are transferred to long-term acute care facilities for care would not be eligible to receive alcohol-related interventions in the hospital. Therefore, this selection bias is unlikely to alter the interpretation of our findings. It is not clear that baseline readiness to change is an important mediator of the efficacy of brief interventions in hospitalized patients (Barnett et al., 2010; Walton et al., 2008). However, a recent study in emergency department, patients suggested that the efficacy of brief intervention may be mediated through maintaining the motivation to change in those already inclined to alter their drinking behaviors at baseline, suggesting that assessing readiness to change may help to target resources (Stein et al., 2009). Because readiness to change does not accurately predict the response to a brief intervention, the results of our study do not suggest that the severity of acute illness moderates the effect of a brief intervention or that brief interventions should be implemented in the medical ICU. The uncertainty regarding how baseline readiness to change mediates the response to a brief intervention highlights the difficulty in interpreting our finding that the effect of the severity of acute illness on readiness to change measured by VAS depends on the severity of unhealthy alcohol use. It is possible that patients with risky alcohol use and a severe acute illness would stop drinking without an intervention, while patients with an AUD and a severe acute illness would most benefit from a brief intervention targeted at increasing their readiness to change. Future randomized, controlled trials should address the efficacy of brief interventions in the medical ICU population, while specifically accounting for the severity of acute illness and the severity of unhealthy alcohol use as potential moderators. Finally, there may be other unmeasured factors that could explain readiness to change in the medical ICU population. For example, it may be more important that a patient attributes their illness to alcohol (Barnett et al., 2010; Walton et al., 2008) while we only assessed whether a physician felt that the diagnosis was attributed to alcohol.

In conclusion, medical ICU patients who are recovering from their critical illness represent a population of hospitalized patients where the efficacy of brief interventions should be further studied. Potential interventions should account for the spectrum of unhealthy alcohol use that includes a substantial proportion of patients with both nondependent risky alcohol use and an AUD. Prospective studies will be needed to determine whether severity of illness serves as a moderator of brief intervention.

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REFERENCES

Apodaca TR, Schermer CR (2003) Readiness to change alcohol use after trauma. J Trauma 54:990–994.

Barnett NP, Apodaca TR, Magill M, Colby SM, Gwaltney C, Rohsenow DJ, Monti PM (2010) Moderators and mediators of two brief interventions for alcohol in the emergency department. Addiction 105:452–465.

Bertholet N, Cheng DM, Palfai TP, Samet JH, Saitz R (2009a) Does readiness to change predict subsequent alcohol consumption in medical inpatients with unhealthy alcohol use? Addict Behav 34:636–640.

Bertholet N, Dukes K, Horton NJ, Palfai TP, Pedley A, Saitz R (2009b) Factor structure of the SOCRATES questionnaire in hospitalized medical patients. Addict Behav 34:568–572.

Blow FC, Ilgen MA, Walton MA, Czyz EK, Mccammon R, Chermack ST, Cunningham RM, Barry KL (2009) Severity of baseline alcohol use as a moderator of brief interventions in the emergency department. Alcohol Alcohol 44:486–490.

Bombardier CH, Ehde D, Kilmer J (1997) Readiness to change alcohol drinking habits after traumatic brain injury. Arch Phys Med Rehabil 78:592–596.

Cowen JS, Kelley MA (1994) Errors and bias in using predictive scoring systems. Crit Care Clin 10:53–72.

Emmen MJ, Schippers GM, Bleijenberg G, Wollersheim H (2004) Effectiveness of opportunistic brief interventions for problem drinking in a general hospital setting: systematic review. BMJ 328:318.

Esteban A, Anzueto A, Frutos F, Alia I, Brochard L, Stewart TE, Benito S, Epstein SK, Apezteguia C, Nightingale P, Arroliga AC, Tobin MJ (2002) Characteristics and outcomes in adult patients receiving mechanical ventilation: a 28-day international study. JAMA 287:345–355.

Feinn R, Tennen H, Kranzler HR (2003) Psychometric properties of the short index of problems as a measure of recent alcohol-related problems. Alcohol Clin Exp Res 27:1436–1441.

Field CA, Baird J, Saitz R, Caetano R, Monti PM (2010) The mixed evidence for brief intervention in emergency departments, trauma care centers, and inpatient hospital settings: what should we do? Alcohol Clin Exp Res 34:2004–2010.

Field CA, Caetano R (2010) The effectiveness of brief intervention among injured patients with alcohol dependence: who benefits from brief interventions? Drug Alcohol Depend 111:13–20.

Gacouin A, Legay F, Camus C, Volatron AC, Barbarot N, Donnio PY, Thomas R, Le Tulzo Y (2008) At-risk drinkers are at higher risk to acquire a bacterial infection during an intensive care unit stay than abstinent or moderate drinkers. Crit Care Med 36:1735–1741.

Gentilello LM, Rivara FP, Donovan DM, Jurkovich GJ, Daranciang E, Dunn CW, Villaveces A, Copass M, Ries RR (1999) Alcohol interventions in a trauma center as a means of reducing the risk of injury recurrence. Ann Surg 230:473–480; discussion 480–483.

Havard A, Shakeshaft A, Sanson-Fisher R (2008) Systematic review and meta-analyses of strategies targeting alcohol problems in emergency departments: interventions reduce alcohol-related injuries. Addiction 103:368–376; discussion 377–378.

Ho KM, Dobb GJ, Knuiman M, Finn J, Lee KY, Webb SA (2006) A comparison of admission and worst 24-hour Acute Physiology and Chronic Health Evaluation II scores in predicting hospital mortality: a retrospective cohort study. Crit Care 10:R4.

Kleinbaum D, Kupper L, Nizam A, Muller K (2008) Applied Regression Analysis and Other Multivariable Methods. Thomson Brooks/Cole, Belmont, CA.

Knaus WA, Draper EA, Wagner DP, Zimmerman JE (1985) APACHE II: a severity of disease classification system. Crit Care Med 13:818–829.

Lau K, Freyer-Adam J, Gaertner B, Rumpf HJ, John U, Hapke U (2010) Motivation to change risky drinking and motivation to seek help for alcohol risk drinking among general hospital inpatients with problem drinking and alcohol-related diseases. Gen Hosp Psychiatry 32:86–93.

Mello MJ, Nirenberg TD, Longabaugh R, Woolard R, Minugh A, Becker B, Baird J, Stein L (2005) Emergency department brief motivational interventions for alcohol with motor vehicle crash patients. Ann Emerg Med 45:620–625.

Miller WR, Tonigan JS (1996) Assessing drinkers' motivation for change: the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES). Psychol Addict Behav 10:81–89.

Miller WR, Tonigan JS, Longabaugh R, National Institute on Alcohol Abuse and Alcoholism (U.S.) (1995) The Drinker Inventory of Consequences (DrInC): An Instrument for Assessing Adverse Consequences of Alcohol Abuse: Test Manual. U.S. Dept. of Health and Human Services, Public Health Service, National Institutes of Health, National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Moss M, Bucher B, Moore FA, Moore EE, Parsons PE (1996) The role of chronic alcohol abuse in the development of acute respiratory distress syndrome in adults. JAMA 275:50–54.

Moss M, Parsons PE, Steinberg KP, Hudson LD, Guidot DM, Burnham EL, Eaton S, Cotsonis GA (2003) Chronic alcohol abuse is associated with an increased incidence of acute respiratory distress syndrome and severity of multiple organ dysfunction in patients with septic shock. Crit Care Med 31:869–877.

Neumann T, Neuner B, Gentilello LM, Weiss-Gerlach E, Mentz H, Rettig JS, Schroder T, Wauer H, Muller C, Schutz M, Mann K, Siebert G, Dettling M, Muller JM, Kox WJ, Spies CD (2004) Gender differences in the performance of a computerized version of the alcohol use disorders identification test in subcritically injured patients who are admitted to the emergency department. Alcohol Clin Exp Res 28:1693–1701.

O'Brien JM Jr, Lu B, Ali NA, Martin GS, Aberegg SK, Marsh CB, Lemeshow S, Douglas IS (2007) Alcohol dependence is independently associated with sepsis, septic shock, and hospital mortality among adult intensive care unit patients. Crit Care Med 35:345–350.

Pavlidis TE, Pavlidis ET, Sakantamis AK (2010) Advances in prognostic factors in acute pancreatitis: a mini-review. Hepatobiliary Pancreat Dis Int 9:482–486.

Rehm J, Patra J, Popova S (2006) Alcohol-attributable mortality and potential years of life lost in Canada 2001: implications for prevention and policy. Addiction 101:373–384.

Rollnick S, Heather N, Gold R, Hall W (1992) Development of a short 'readiness to change' questionnaire for use in brief, opportunistic interventions among excessive drinkers. Br J Addict 87:743–754.

Rubinsky AD, Kivlahan DR, Volk RJ, Maynard C, Bradley KA (2010) Estimating risk of alcohol dependence using alcohol screening scores. Drug Alcohol Depend 108:29–36.

Saitz R (2005) Clinical practice. Unhealthy alcohol use. N Engl J Med 352:596–607.

Saitz R, Palfai TP, Cheng DM, Horton NJ, Dukes K, Kraemer KL, Roberts MS, Guerriero RT, Samet JH (2009) Some medical inpatients with unhealthy alcohol use may benefit from brief intervention. J Stud Alcohol Drugs 70:426–435.

Saitz R, Palfai TP, Cheng DM, Horton NJ, Freedner N, Dukes K, Kraemer KL, Roberts MS, Guerriero RT, Samet JH (2007) Brief intervention for medical inpatients with unhealthy alcohol use: a randomized, controlled trial. Ann Intern Med 146:167–176.

Salluh JI, Soares M, Teles JM, Ceraso D, Raimondi N, Nava VS, Blasquez P, Ugarte S, Ibanez-Guzman C, Centeno JV, Laca M, Grecco G, Jimenez E, Arias-Rivera S, Duenas C, Rocha MG (2010) Delirium epidemiology in critical care (DECCA): an international study. Crit Care 14:R210.

Sommers MS, Dyehouse JM, Howe SR, Fleming M, Fargo JD, Schafer JC (2006) Effectiveness of brief interventions after alcohol-related vehicular injury: a randomized controlled trial. J Trauma 61:523–531; discussion 532–533.

Sondik EJ, Madans JH, Gentleman JF (2010) Vital and Health Statistics [Online]. Hyattsville, MD. Available: http://www.cdc.gov/nchs/data/series/sr_10/sr10_249.pdf. Accessed January 21, 2011.

Stein LA, Minugh PA, Longabaugh R, Wirtz P, Baird J, Nirenberg TD, Woolard RF, Carty K, Lee C, Mello M, Becker B, Gogineni A (2009) Readiness to change as a mediator of the effect of a brief motivational intervention on posttreatment alcohol-related consequences of injured emergency department hazardous drinkers. Psychol Addict Behav 23:185–195.

Vasilaki EI, Hosier SG, Cox WM (2006) The efficacy of motivational interviewing as a brief intervention for excessive drinking: a meta-analytic review. Alcohol Alcohol 41:328–335.

Walton MA, Goldstein AL, Chermack ST, McCammon RJ, Cunningham RM, Barry KL, Blow FC (2008) Brief alcohol intervention in the emergency department: moderators of effectiveness. J Stud Alcohol Drugs 69:550–560.

Williams EC, Kivlahan DR, Saitz R, Merrill JO, Achtmeyer CE, McCormick KA, Bradley KA (2006) Readiness to change in primary care patients who screened positive for alcohol misuse. Ann Fam Med 4:213–220.