Analysis of Alcohol Use Clusters among Subcritically Injured Emergency Department Patients

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ABSTRACT

Objectives: 1) To cluster patients according to self-reported drinking patterns using cluster analysis; 2) to externally validate clustered groups on variables related to drinking but not used in the cluster analysis; and 3) to use the clustered patients' responses to alcohol consumption questions to develop a brief screening tool emergency physicians can use to identify patients in need of referral or intervention related to potentially hazardous alcohol consumption.

Methods: A self-report battery was administered to 95 subcritically injured patients. Patients also were saliva alcohol-tested upon arrival to the ED. Using the patients' self-reported quantity, frequency of alcohol consumption, and frequency of having ≥6 drinks on a drinking occasion, patients were categorized into 3 groups using cluster analysis. The 3 clusters were externally validated using injury-related variables, alcohol-related consequences, and the patients' reported readiness to change drinking. A screening tool was developed using cutoff values reported by the patients' answers to drinking pattern questions.

Results: Fifty-nine patients were alcohol-negative, and 36 tested alcohol-positive (i.e., >4 mmol/L [>20 mg/dL]) or had elevated scores on an alcohol problem screening instrument. Three distinct drinking pattern clusters were found. Clusters were validated using discriminant function analysis and multivariate analyses of variance to confirm cluster classifications. Steady and high-intensity drinkers reported more alcohol-related negative consequences, and high-intensity drinkers indicated they would consider changing their drinking. The screening tool correctly classified 97% of the patient sample into their respective clusters.

Conclusions: Using the drinking pattern questions in the clustering procedure was effective for grouping injured patients into clusters that could be differentiated on other drinking-related variables. The resulting screening tool can be used in the ED setting to screen patients for further assessment and intervention. The readiness-to-change results support the assertion that the injury event provides a "teachable moment" for subcritically injured patients whose injury may be related to their alcohol consumption.

Key words: alcohol; screening; injury; emergency department.

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A substantial body of literature exists documenting the frequent presentation of injured patients with positive blood alcohol levels to hospital EDs.[1–3] Alcohol has been found to be a contributory factor in motor vehicle crashes (MVCs),[4–6] and more recently, disproportionate numbers of subcritically injured patients have been found to test positive for alcohol.[7] Injury severity has been found to be related to positive blood alcohol levels at the time of injury,[8] and intoxication appears to affect injury severity assessment, resulting in the increased use of invasive diagnostic procedures and corresponding therapy.[9]

Alcohol-positive injured patients are more likely to report violence-related injuries than are patients with other injuries[10,11]; and a previous history of alcohol-related injuries[12] and alcohol and other drug dependence are more frequently assessed among trauma center patients with positive blood alcohol levels than among trauma patients who test alcohol-negative.[13] Clifford et al.[14] found that a disproportionate number of alcohol-positive subcritically

injured patients report drinking at hazardous and harmful levels. The implications of this literature are twofold. First, emergency physicians (EPs) repeatedly encounter inebriated, injured patients. Second, the rates of frequent, high-intensity drinking and problem drinking among injured emergency patients exceed the rates found for both uninjured emergency patients and the general population.[1]

Due to the constant demand to do more with fewer resources in the ED, it is necessary to identify the most cost-effective tool: one that is reliable and valid, but quick to administer. In order to design and introduce appropriate interventions for injured emergency patients with drinking problems, it is necessary to identify variation in drinking habits and problems from individual to individual and, once identified, to determine whether these differences have implications for the type or types of interventions appropriate for the ED setting. Therefore, it is important to identify variables that can be used to differentiate alcohol-positive patients who have a problem, and who may be in need of intervention, from those who do not have a problem.

One of the goals of the present study was to develop a tool to assess variation in drinking patterns among patients. We examined 3 variables to identify patient drinking patterns: quantity of alcohol consumed on an average drinking day, frequency of consuming alcoholic beverages, and drinking intensity, defined as the frequency of drinking days on which 6 drinks are consumed. Patients were clustered to determine whether there were homogeneous drinking style patterns in the data. Based on previous studies that have clustered alcoholic patients,[15] 3 drinking typologies were expected. It was an aim of this study to determine whether similar drinking patterns could be found among subcritically injured ED patients. On the basis of previous findings among ED patients,[1,7] we expected that the distribution of drinkers in the ED would be different from the distribution of drinkers in the general population.

A second goal of this study was to externally validate the drinking pattern clusters on a set of variables not used in the cluster analysis, as recommended by Aldenderfer and Blashfield.[16] It was hypothesized that by using the clusters as levels of the independent variable, drinking cluster, the groups could be differentiated on variables related to the patients' drinking histories and injury events. Specifically, we hypothesized that patients who have either regular or heavier drinking patterns would: 1) be more likely to test alcohol-positive on the Saliva Alcohol Test (SAT); 2) report higher scores on alcohol dependence measures and more alcohol-related negative consequences; 3) have greater support for alcohol involvement; 4) have a greater number of prior alcohol-related injuries; and 5) report higher scores on our readiness-to-change measure. Readiness to change was of specific interest in this study. Although the relationship between alcohol and injury is well documented, only recently has it been suggested that intervention efforts target hospital EDs.[11,17,18] We know of no other study that has identified patients who might be appropriate for intervention and has assessed patients' simultaneous willingness to consider changing their drinking habits at the time of the injury event.

METHODS

Study Design: We performed a prospective, noninterventional study evaluating a sample of consenting, subcritically injured patients presenting to an urban ED during selected high-yield times to determine whether drinking behavior clusters could be identified and validated. The research protocol was approved by a full review of the hospital's institutional review board, and patients were treated in accordance with the ethical standards of the American Psychological Association.

Setting and Population: Participants for this study were 95 subcritically injured patients presenting for treatment at a large urban Level-1 trauma center in New England. Thirty-six percent of the participants were women, and 64% were men. Patients were approached by a bachelor's degree level research interviewer, who explained that we were conducting a study of alcohol and injury. This took place after triage while patients were waiting for care. Patients were asked whether they would be willing to consent to an assessment interview in a study of alcohol and injury that would take approximately 30 to 40 minutes. All patients signed a form recording their written consent to participate in the study. For consenting patients, the interview commenced at the patient's convenience without interrupting the flow of patient care and was completed prior to his or her release from the ED.

Exclusion Criteria. Critically injured patients were excluded from this study. Patients were classified as critically injured if they required treatment by the trauma team, or if they had a Champion Trauma Score of ≤ 13,[19] a loss of consciousness for >5 minutes, abnormal vital signs, a major anatomic disruption (e.g., open femur fracture, gunshot wound), or any potentially lethal mechanisms of injury (e.g., rollover MVC). Only those patients with lesser injuries who did not meet the major trauma criteria were included in this study. These patients are referred to as *subcritically injured patients.*

Inclusion Criteria. Subcritically injured patients were triaged for routine care in the ED, treated in the ED, and released from the ED to the community. Other inclusion criteria were the following: 1) being present at the time of ED sampling; 2) being judged as not dangerous to clinical or research staff; 3) speaking English; 4) residing within an hour's distance of the hospital; 5) being ≥ 18

years old; and 6) giving informed written consent to study participation.

Experimental Protocol: Patients were approached during preselected periods of observation in the ED. These predesigned periods were either 6:00 PM to 12:00 PM or 8:00 PM to 2:00 AM on preselected days of the week: Wednesday, Friday, Saturday, or Sunday. In any given week, a maximum of 3, 6-hour shifts were sampled. The sample included all available patients who could be interviewed within the predesignated data collection periods.

The interviewers were trained to administer the structured interview and trained in collecting sensitive data from patients. The interviewers initiated the data collection period at the time of the patients' arrival by reviewing the charts of all subcritically injured patients currently in the ED routine treatment area. After explaining the study to the patient and obtaining consent, the patient was interviewed. As soon as all available patients were approached and tested, the interviewer repeated the process for patients arriving after the first check was completed. This iterative procedure continued until the end of the interviewer's shift. Some patients were not approached for the interview due to occasional interviewer overloads, the patient's leaving the ED prior to being approached, or the patient's inaccessibility prior to the end of the interviewer's shift.

Measurements:

Saliva Alcohol Test (SAT). The alcohol reagent strip was developed at the Addiction Research Foundation of Ontario[20] and has a reported sensitivity of 98% and specificity of 99% in detecting the presence of alcohol (as measured by gas chromatography) when used in hospital EDs and a liver clinic with unselected clinical samples.[20] The SAT also has been found to correlate ($r = 0.92$) with blood alcohol values in suspected alcohol abusers.[21] Of the 95 patients in this study, 90 were saliva alcohol-tested as part of the hospital's routine clinical procedure.

Alcohol Use Disorders Identification Test (AUDIT). The AUDIT is a 10-item self-report instrument used to determine whether the patient drinks in either a hazardous or a harmful manner.[22] Drinking patterns and alcohol-related negative consequences are assessed. The total AUDIT score is the sum of the 10 items. The first 2 items assess quantity and frequency of drinking. The third item assesses intensity, indexed by the frequency of high-intensity drinking occasions, i.e., ≥6 standard drinks. Items 4–6 evaluate symptoms of dependence and tolerance, while items 7–10 are inquiries of alcohol-related negative consequences such as experiencing guilt, becoming injured, experiencing an alcohol blackout, and being asked by family, friends, or health professional to cut down. Using the summed score on the AUDIT, a cutoff score of ≥8 is indicative of hazardous drinking, and a score of ≥12 is an indicator of harmful drinking. The AUDIT has established internal consistency ($\alpha = 0.80$) and can reliably distinguish patients with positive and negative alcohol drinking histories.[23,24] Cherpitel[25] recently reported that the AUDIT has an 81% sensitivity rate in detecting patients who are positive for alcohol dependence in an ED population. Our own research has shown that alcohol-positive AUDIT scores are positively related to testing SAT positive at the time of the current ED admission.[14]

The first 3 items on the AUDIT, quantity, frequency, and intensity (frequency of heavy drinking occasions), were used at the item level as clustering variables in this study. The 3 dependence items and the 4 negative consequence items were averaged and used as a composite dependent variable in a multivariate analysis of variance (MANOVA).

The Short Inventory of Problems (SIP). The SIP was used as an additional measure of alcohol-related negative consequences. This questionnaire assesses lifetime experience, i.e., whether the patient has ever experienced the particular consequence. If the answer is affirmative, the patient indicates the frequency with which the consequence has been encountered in the preceding 6 months. The SIP is an abbreviated form of the Drinker Inventory of Consequences (DrInC).[26] Test–retest reliability of the SIP has been established (Pearson $r = 0.89$) in a population of 1,389 patients seeking treatment for alcohol dependence or abuse and ($r = 0.94$) in a population of 60 high-intensity drinkers.[26] Items have a response range on a Likert-type scale from 1, never, meaning the patient has never experienced the consequence, to 6, indicating that the consequence occurs on a near-daily basis. The score is computed by summing across items, with higher scores indicating more occurrences of alcohol-related consequences. Sample items from this scale include "A friendship or close relationship has been damaged by my drinking" and "I have failed to do what is expected of me because of my drinking." This measure was used as a dependent variable.

Important People and Activities Alcohol Support (IPA). Patients who have a network of drinkers who are supportive of alcohol consumption are more likely to be drinkers themselves.[27] The IPA was developed to measure network support for drinking and abstinence.[27] An adaptation of the IPA was used to reduce survey administration time. The condensed instrument measures 2 network support domains: family and friends. Participants are asked to respond to situations in the 2 domains by using a scale from 1, "left, or made you leave when you were drinking" to 5, "encouraged it" (drinking). A "not applicable" response category is for patients without family or friends. The family and friends variables were used as dependent variables in a MANOVA.

Injury Behavior Checklist–Revised (IBC-R). A re-

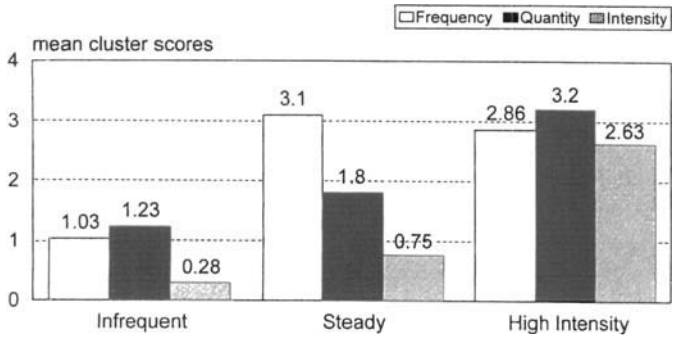

FIGURE 1. ED patient drinking clusters.

vised version of the IBC was used to assess the patient's injury history for the preceding year. The patient reports injuries that have occurred in the preceding year, whether or not they were alcohol-related, and whether or not they necessitated medical attention. The IBC was developed by Starfield[28] as part of a comprehensive interview called the Adolescent Health Status Instrument. Our instrument is the first use of the IBC with adults. We have pilot-tested our adaptation (IBC-R) with the ED population. Our revisions include asking the patient to indicate whether he or she consumed alcohol within the 2 hours prior to an injury and asking the patient to report the number of times different types of injuries occurred. Scores for alcohol-related injures were used as a dependent variable in an ANOVA.

Readiness to Change. The patient's readiness to make a change in his or her drinking behavior was measured using an adaptation from the Beiner and Abrams Readiness to Change Contemplation Ladder.[29] This measure has been found to be predictive of subsequent behaviors that move a person toward reducing smoking, including ≥ 1 attempt to quit in the 6 months after the assessment. The patient is asked to place his or her readiness to change on a rung of a contemplation ladder with response categories ranging from 0, no thought of changing, to 10, taking action to change (e.g., cutting down). For this study, the contemplation ladder was adapted to measure readiness to change alcohol consumption. In another hospital study of the effect of an intervention on inpatients' readiness to change drinking, the contemplation ladder score was found to be predicted by prior negative consequences, consumption, and support for drinking.[30] Readiness to change scores were used as a dependent variable in an ANOVA.

Data Analyses: Four sets of analyses were conducted on the data: 1) cluster analysis using the 3 alcohol consumption measures (frequency, quantity, intensity); 2) analyses of the distribution of patient characteristics across clusters; 3) external validation of clusters using MANOVA and ANOVA with the drinking groups as an independent variable and 6 alcohol-related dependent variables; and 4) sensitivity, specificity, predictive value of a positive test, and predictive value of a negative test were computed to determine how well the 3 screening items identified those cases that potentially required an intervention.

The clustering procedure was the first analysis that was used to classify patients into drinking typologies. An extensive body of literature exists documenting the use of cluster analysis as a classification procedure in the field of alcohol and other drug use research.[15,31-33] We used the SAS cluster analysis program, PROC CLUSTER,[34] to group subjects by their drinking patterns. This analysis was conducted using Ward's linkage method, which is commonly used and tends to yield robust clusters.

The second set of analyses consisted of a series of χ^2 tests of independence. The distribution of patient characteristics (gender, race and ethnicity, type of injury, and SAT status) across the clusters was examined.

The third set of analyses included a series of MANOVAs and ANOVAs. These analyses were chosen to externally validate the clusters on variables that were not used in the cluster analysis.[16] These analyses compared the cluster-formed alcohol use groups on dependent measures of 1) dependence, 2) alcohol-related negative consequences, 3) social support for alcohol involvement and abstinence, and 4) readiness to change drinking habits. Follow-up ANOVAs were conducted on significant MANOVAs. If the ANOVA was significant, a multiple comparison test was conducted on the group means using the Tukey method.

Sensitivity, specificity, and predictive values with their respective confidence intervals were calculated to determine how well the 3 items screened patients in need of further evaluation.

RESULTS

Cluster Analysis: A cluster analysis using Ward's linkage method for clustering was conducted on the 3 variables measuring quantity, frequency, and intensity of alcohol consumption. Based on an examination of the dendogram, a clustering tree that diagrams the participants, 3 distinct clusters were obtained with the cluster analysis. A plot of the means for the clusters is shown in Figure 1. A simple 2-stage decision rule (Fig. 2) was developed that assigned individuals to these 3 clusters with 97% accuracy.

After examining the distribution of patient characteristics, the clusters were externally validated using a set of variables not used in the clustering procedure as recommended by Aldenderfer and Blashfield.[16] The following clusters were identified: a group of infrequent drinkers (n = 40); a group of steady drinkers (n = 20); and a group of high-intensity drinkers (n = 35).

Distribution of Patient Characteristics by Type of Drinker: A number of preliminary analyses were conducted on the clusters to examine whether the distribution of patient characteristics varied across clusters. The distribution of women and men across the 3 clusters was independent ($\chi^2_{(2,95)} = 1.26$, NS). Similar results were found for the distribution of race and ethnicity across the clusters ($\chi^2_{(8,95)} = 7.44$, NS). A significant effect was found for type of injury by cluster ($\chi^2_{(4,94)} = 12.68$, $p < 0.05$). Injury type was categorized as assault, MVC, and other. Participants in the high-intensity drinking group were more frequently found in the assault category, participants in the steady drinking group were most often found in the assault and other group, and participants in the infrequent drinking group were most frequently found in the MVC category. Although the overall χ^2 analysis was significant, no single cell had a significant recurrent injury association.

Test of Hypotheses: MANOVAs were conducted to externally validate the drinking groups identified by the cluster analysis in this sample. In each MANOVA the independent variable was the participants' drinking group, which had 3 levels: infrequent, steady, and high-intensity. The dependent variables for each MANOVA focused on areas related to alcohol consumption such as drinking-related problems, history of alcohol-related injuries, support for alcohol involvement, and readiness to change one's drinking habits.

Hypothesis 1: SAT Results and Drinking Cluster Classification. A test of independence between patient drinking clusters and SAT results was significant ($\chi^2_{(2,90)} = 13.20$, $p < 0.001$). The only significant standardized residual found in the follow-up analysis was for the high-intensity/alcohol-positive cell. The significance of the residual test indicates that more than the expected frequency of alcohol-positive patients was found in the high-intensity drinking cluster. Thus, testing alcohol-positive at the time of the ED visit and being a high-intensity drinker are not independent events.

Hypothesis 2: Dependence and Negative Consequences. The first MANOVA tested the hypothesis that heavier drinkers would score higher on the AUDIT dependence and alcohol-related negative consequence measures. The combined dependent variables were significantly affected by the participants' cluster (Wilks' lambda = 0.74, $F_{(4,180)} = 7.33$, $p < 0.0001$), accounting for 26% of the variance. ANOVAs conducted on the dependent variables that examined dependence symptoms and alcohol-related negative consequences were significant.

The patients were differentiated on their dependence scores by cluster membership ($F_{(2,91)} = 7.33$, $p < 0.001$). In this analysis, the infrequent and high-intensity drinkers were significantly different from each other in their self-reports of dependence symptoms experienced in the preceding 12 months. The high-intensity drinkers had experienced more symptoms with greater frequency than had the infrequent drinkers, who experienced essentially no symptoms of dependence. Means and standard deviations on the dependent measures are listed in Table 1 for all clusters.

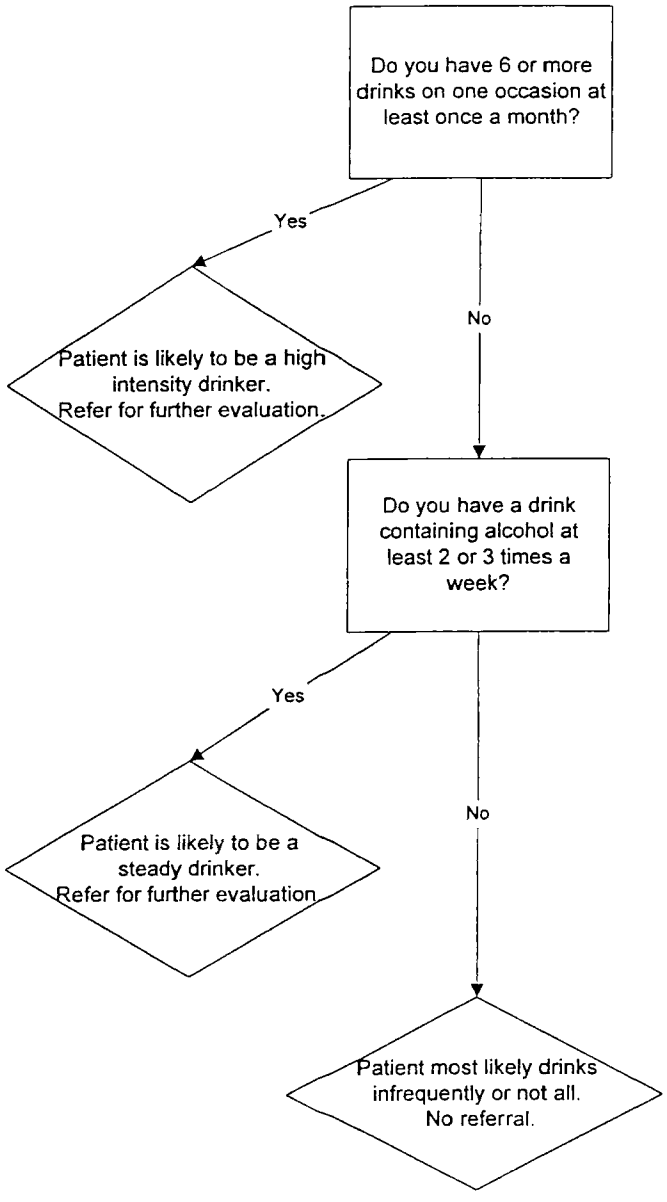

FIGURE 2. Decision tree for identifying potential problem drinkers.

The ANOVA assessing the patients' reports of experiencing alcohol-related negative consequences was significant as well ($F_{(2,91)} = 15.56$, $p < 0.0001$). A multiple comparison test using the Tukey method showed that the high-intensity drinkers reported significantly more alcohol-related negative consequences than did the infrequent and steady drinkers, who did not differ from each other in their reports of consequences (Table 1). When the SIP was used to examine alcohol-related negative consequences, the pattern of group differences remained the

TABLE 1 Means of Dependent Variables Measured for Drinking Clusters among Subcritically Injured ED Patients

	Infrequent	Steady	High-intensity	p-value
Alcohol-related consequences				
Dependence	0.03	0.32	0.67*	0.001
Negative consequences	0.06	0.44*	0.69†	0.0001
SIP‡	15.46	20.80*	22.84†	0.0006
Support for alcohol involvement				
Family	2.49	2.90*	2.83	0.03
Friends	2.83	3.50	3.50*	0.02
Injury behavior history				
Alcohol-related injuries	0.05	0.45	0.26	0.06
Readiness to change				
Change drinking	1.38	3.45	3.26*	0.01

*Significantly different from infrequent drinkers.
†Significantly different from infrequent and steady drinkers.
‡SIP = Short Inventory of Problems.

same: the high-intensity drinkers reported significantly more alcohol-related negative consequences than did the infrequent or steady drinkers ($F_{(2,86)} = 8.04$, $p = 0.0006$). Scores on this instrument indicated that given a larger number of consequences to endorse (16 vs 4); those individuals who endorsed problems on the AUDIT continued to do so when responding to the SIP.

Hypothesis 3: Support for Alcohol Involvement. This MANOVA tested the hypothesis that support for alcohol involvement from family and friends would vary by cluster membership. The overall analysis was significant (Wilks' lambda = 0.86, $F_{(4,152)} = 2.90$, $p < 0.02$), and 14% of the variance in the dependent measures could be explained by the cluster groupings. The univariate analyses indicated that levels of support for alcohol involvement from family members were different among the clusters ($F_{(2,77)} = 3.73$, $p < 0.03$). Family members encouraged the steady drinking patients to continue drinking more than did the infrequent drinkers' family members. The difference between the steady drinkers' and infrequent drinkers' family members did not reach significance. Examination of friends' support for alcohol involvement also was significant ($F_{(2,77)} = 4.03$, $p < 0.02$). In this case, the patients in the high-intensity drinking cluster reported more encouragement from their friends to drink than did the patients in the infrequent drinking cluster. The difference between the steady drinkers and infrequent drinkers did not reach significance.

Hypothesis 4: Injury Behavior History. To test the hypothesis that high-intensity drinkers would have a greater history of alcohol-related injuries, ANOVA was used to assess patients' self-reports on the IBC-R. Only the alcohol-related injury subscale was used in this analysis. The 3 drinking clusters were used as 3 levels of the independent variable. This analysis was nearly significant ($F_{(2,92)} = 2.88$, $p = 0.06$). The individuals in the steady drinking cluster reported more prior alcohol-related injuries than did the participants in the high-intensity drinking cluster, who reported more than those in the infrequent drinking cluster, although the means did not differ significantly (Table 1).

Hypothesis 5: Readiness to Change. To test the hypothesis that there would be variation in readiness to change by cluster, an ANOVA was conducted using the drinking cluster as the independent variable and the participants' score on the contemplation ladder as the dependent variable. This analysis was significant ($F_{(2,88)} = 4.45$, $p = 0.01$). Infrequent drinkers had no thoughts of changing their drinking; however, both the steady and high-intensity drinkers indicated they were contemplating changing their drinking habits.

Sensitivity, Specificity, and Predictive Values of the 3 Screening Items: The sensitivity or the probability of correctly identifying a patient who is either a harmful or hazardous drinker with the 3-item screening tool, was 97% (95% CI = 94%, 100%). The specificity, or the probability of correctly screening out patients who are not hazardous or harmful drinkers, was 65% (95% CI = 55%, 75%). The predictive value of a positive test for the screening questions was 98% (95% CI = 95%, 100%). The predictive value of a negative test for the 3 screening items was 62% (95% CI = 52%, 72%).

DISCUSSION

By using 3 questions regarding the quantity, frequency, and intensity of alcohol consumed, we identified 3 clusters of subcritically injured ED patients, namely, infrequent, steady, and high-intensity drinkers. These 3 clusters can be easily identified using the decision rule shown in Figure 2. The first stage in this process involves identifying the high-intensity drinkers, patients who have 6 drinks at least once monthly. At the next stage, infrequent and steady drinkers can be distinguished by their frequencies of drinking; the steady drinkers are those who drink at least twice weekly. These 3 types differ configurally as well as quantitatively. This approach contrasts with assuming linear drinking patterns among alcohol consumers (often described as light, moderate, and heavy). The clustered patient groups were distinguishable and externally validated on several pertinent alcohol-related variables.

Differentiation of the general ED population of injured patients into these 3 cluster groups can assist clinicians in identifying patients who are appropriate to refer for further evaluation and intervention. For instance, patients categorized in the infrequent drinker cluster essentially had no symptoms of alcohol dependence, had almost no past negative consequences from alcohol, had less social

support for drinking, and had almost no previous alcohol-related injuries. In sum, they did not seem to have a visible problem with alcohol, and they reported that they were not considering changing their alcohol use patterns. Based on these findings, involving these patients in an alcohol intervention probably would not be fruitful. Their lack of interest in changing their drinking habits provides validity for their classification in this cluster. Given their infrequent, nonproblematic drinking, it would not make sense for these patients to report thoughts of quitting or cutting back on their drinking. However, providing primary prevention materials in the ED to lessen the possibility of developing problems even if the patient is not currently a problem drinker might be appropriate.

The patients categorized in the steady drinker cluster reported more negative consequences from drinking than did the patients in the infrequent drinker cluster and reported more alcohol-related injuries in the past than did the patients in both the infrequent and high-intensity drinker clusters. The patients in the steady drinker cluster also indicated a readiness to change their drinking habits. These findings suggest that steady drinking patients may benefit from further assessment and possibly an early intervention program focusing on the relationship between alcohol consumption and injury and responsible drinking limits, for example. These patients indicated motivation to change. It seems as though they may have recognized their alcohol-related negative consequences prior to experiencing significant symptoms of alcohol dependence.

The patients categorized in the high-intensity drinker cluster reported more symptoms of alcohol dependence on the AUDIT than did the patients in the other 2 clusters, endorsed more alcohol-related consequences on the SIP than did both the infrequent and the steady drinkers, and indicated more support by family and friends for their drinking than did the infrequent drinkers. While they reported more alcohol-related injuries than did the infrequent drinkers, they reported fewer alcohol-related injuries than patients in the steady drinker cluster; however, this difference was not significant. Similar to the steady drinkers, they indicated a greater readiness to change their drinking behavior than did the infrequent drinkers. Overall, the patients in the high-intensity drinker cluster reported significant alcohol-related consequences and a readiness to change their drinking behavior. These patients seem to be good candidates for referral and intervention. Since the patients in the high-intensity drinker cluster reported greater symptoms of dependence than the other 2 clusters, the intervention might be more effective if it were to build on the intervention recommended for the steady drinkers and include material that focuses on their harmful drinking and symptoms of dependence.

The patients in the high-intensity and steady drinker clusters, as compared with those in the infrequent drinker cluster, also reported greater social support for their drinking. Since measures of social support for drinking are predictive of drinking,[27,35] these patients may be at significant risk of continued problematic drinking unless the social support for their drinking can be altered. This may be accomplished in 2 ways. First, the interventionist may directly involve the patient's significant others (social support members who seem the most influential) in the intervention. The ED may be quite conducive to this, since patients are frequently accompanied to the ED by a significant other. Helping the patient and significant other to recognize the influence of social pressure to drink and not to drink may be helpful. Second, the interventionist also may attempt to equip the patient with the necessary skills (i.e., drink refusal skills, assertiveness skills, coping skills) to help him or her counteract social cues and pressure to drink in a problematic fashion.

TABLE 2 Screening Items and Response Codes Used to Cluster and Identify Infrequent, Steady, and High-intensity Drinking Patients among Subcritically Injured ED Patients

1. How often do you have a drink containing alcohol?
   0—Never
   1—Monthly or less
   2—2 to 4 times a month
   3—2 to 3 times a week
   4—4 or more times a week

2. How many drinks do you have on a typical day when you are drinking?
   0—None
   1—1 or 2
   2—2 or 3
   3—5 or 6
   4—7 or 9
   5—10 or more

3. How often do you have ≥6 drinks on 1 occasion?
   0—Never
   1—Less than monthly
   2—Monthly
   3—Weekly
   4—Daily or almost daily

LIMITATIONS AND FUTURE QUESTIONS

Although physicians can routinely ask the 2 screening questions of ED patients to assist in making referrals for substance abuse assessment and intervention, it is important to interpret the results of this study with some caution. A potential selection bias may exist in the data given that subjects were recruited during high-volume periods, and the recruited subjects may not be representative of the entire subcritically injured ED population. Replicating these results in future studies with larger samples would strengthen the study findings. Since participation in the study was voluntary, there may be a difference between

those who participated and those who chose not to participate in the study ($n = 6$). While most patients who were approached did participate in the study, it is still possible that our study population may not have been representative of the general ED patient population.

With the exception of the SAT, the measures used in this study relied on self-report, so it is possible that patients either underestimated or overestimated the negative consequences of their alcohol use. However, the validity of self-report in substance use studies is well documented.[36-40]

Because of the potential influence of other drug abuse on injury and other substance-related negative consequences,[41-43] future studies also should examine the concurrent and simultaneous use of alcohol and other drugs, both prescribed and nonprescribed.[44]

The sensitivity and specificity of the screening tool were not validated against a definitive diagnostic test or "criterion standard" but against the AUDIT, which is a screening instrument itself. It is possible that both instruments may be inefficient in correctly identifying patients. The high sensitivity found for our screen indicates that the tool is effective for determining which patients are most likely to be appropriate for referral and intervention. The lower specificity value, on the other hand, indicates the screen is only modestly efficient. Nonetheless, all of the patients positively identified by the screening tool reported drinking frequently and heavily (those classified into the high-intensity cluster) or they reported frequent drinking (those classified into the steady drinker cluster). We argue that being overinclusive reduces the risk of allowing problematic drinkers to fall through the cracks. Alcohol-related injuries are costly, and early identification of problem drinkers can be cost-effective over time if it aids in preventing future alcohol-related injuries and the escalation of problem drinking that necessitates subsequent high-cost treatment. Furthermore, a more sensitive test is usually preferred when the condition has negative consequences.[45] Other researchers have found that the identification of problem drinkers solely on the basis of consumption measures, in the absence of a full diagnostic assessment, tends to underestimate the problem, especially among drinkers in the 18–24-year-old group.[46] Our high sensitivity and low specificity would result in capturing more of the younger patients among whom the majority of alcohol-positive injured patients can be found.[7] Given the inability to conduct a full diagnostic assessment in the ED, the specificity found for the screening tool seems acceptable.

Data were not gathered describing the time lapse between the alcohol consumption and the injury event and the patient's subsequent arrival in the ED. A recent multisite study conducted by Cherpitel[10] found, however, that 80% of the alcohol-positive patients reported drinking within 3 hours of the injury event. Unless there are substantial differences between Cherpitel's 2 study sites and ours, one would expect that the intervals between consumption and the injury event should be similar.

Future studies should also assess the injury type and severity using standardized measures that are widely used in emergency medicine such as E-codes and the Injury Severity Scale (ISS) scores. E-codes were retrospectively gathered in this study, and, unfortunately, complete data were not available due to insufficient chart documentation. Although we did not use the ISS to measure injury severity, our eligibility criteria included only those patients with Champion Trauma Scores ≤ 13. The relationship of these variables to readiness to change and the patient drinking patterns also should be investigated in future studies.

CONCLUSIONS

The hospital ED is frequented by many injured patients who have been drinking prior to the ED visit. It represents an excellent site to identify individuals with varying degrees of alcohol problems. The potential for an immediate connection between a patient's injury and his or her recent alcohol use may establish a "teachable moment," an opportune time during which an individual may be motivated to change his or her drinking style. As noted by Bernstein,[47] faced with significant work demands, EPs would benefit from having an instrument that can be used to identify patients who are amenable to interventions. The brief questions used in the present study differentiated patients into 3 groups, which suggests the possibility for different intervention strategies. The screening tool was effective in this sample for determining patients who need further evaluation and for whom a brief intervention may be appropriate. Future studies will need to determine the efficacy of using this screening tool in conjunction with offering customized intervention in the ED.

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