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Identification of substance use disorders in burn patients using simple diagnostic screening tools (AUDIT/DAST-10)

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ABSTRACT

Introduction and objectives: Substance use is disproportionately high in burn patients and associated with adverse outcomes. Screening methods for substance use disorders may help predict or avoid adverse outcomes.

The University of Utah Burn Center records self-reported Alcohol Use Disorders Identification Tests (AUDIT) and Drug Abuse Screening Tests (DAST-10) for all adult burn admissions. This study assessed for association between AUDIT/DAST-10 scores and burn patient outcomes.

Methods: A retrospective chart review of adult burn patients admitted to the University of Utah from 05/01/2014-06/30/2017. Patient demographics, injury data, and substance use data were collected and analyzed.

Results: 322 patients underwent AUDIT/DAST-10 screening ($n = 322$). 56 (17.4%) had positive AUDIT screens (score ≥ 8). 15/50 with alcohol use at time of injury (TOI) had negative AUDIT screens. Median AUDIT score with TOI alcohol use was 12, without TOI alcohol use was 1. 30/55 patients offered alcohol counseling accepted.

14 patients (4.3%) had positive DAST-10 screens (score ≥ 3). 9/25 with drug use at TOI had negative DAST-10 screens. No patients without TOI drug use had DAST-10 scores >2. 9/11 patients offered drug counseling accepted.

Mean standardized length of stay (LOS) per TBSA burn injury was 1.7 days for positive AUDIT, 1.6 days for negative AUDIT. Median standardized LOS was 1.4 days for positive DAST-10, 1.7 days for negative DAST-10.

Abbreviations: ABA, American Burn Association; AUDIT, Alcohol Use Disorders Identification Test; CBT, cognitive behavioral therapy; DAST, Drug Abuse Screening Tool; EMR, electronic medical record; ICU, intensive care unit; LOS, length of stay; REDCap, research electronic data capture; TBSA, total body surface area; TOI, time of injury.

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Conclusions: AUDIT and DAST-10 screens can identify burn patients with problematic substance use, allowing early intervention. Positive screening scores do not independently predict longer hospital stays, increased wound severity, or treatment noncompliance.

1. Introduction

Alcohol and illicit drug use is disproportionately high in trauma and burn patient populations when compared to the general population [1,2]. In fact, one recent study found that one out of every three trauma patients that met the criteria for a trauma activation had a positive blood alcohol or urine illicit drug test [3]. Another recent study found that of the 20,989 patients who had received a urine drug screen recorded in the National Burn Repository, 11,642 (55%) tested positive for at least one drug of abuse [4].

Problematic alcohol use and illicit drug use have both been shown to adversely affect patient outcomes as well as increase healthcare costs. Beyond difficult to measure factors like provider fatigue and burnout, when matched to groups of non-drug users in community-based setting, illicit drug users have been found to consume more inpatient and emergency care resources [5]. Indeed, problematic drug use has been shown to be one of the most notable predictors of health care utilization [6]. When matched to groups of non-drinkers and non-problematic alcohol users, problematic alcohol users have been found to have higher rates of emergency room visits, inpatient admissions, and outpatient visits [7]. A 2011 study utilizing demographic data, burn features, and a self-reported screening tool (DAST-20) in burn patients indicated that substance abuse itself is a risk factor for burn injury [8].

The Alcohol Use Disorders Identification Test (AUDIT) is a simple self-reported screening tool developed based on results from a cross-national study by the World Health Organization that can be used to identify patients with patterns of harmful or hazardous alcohol consumption [9]. The AUDIT has been found to be both sensitive and specific in discriminating alcoholic patients from non-alcoholic medical patients [10], with a high degree of correlation between AUDIT categories representing alcohol dependence and harmful alcohol use [11]. Patients who score eight or higher on the AUDIT at initial interview have been found to experience a greater amount of alcohol-related medical disorders and hospitalization within 2–3 years of the initial screening, indicating that AUDIT may be useful as a predictive tool, allowing opportunity for early intervention for at-risk patients [12].

The Drug Abuse Screening Test (DAST-10) is a simple self-reported screening tool that assesses patient drug use (including both nonmedical use of drugs and excessive use of prescription drugs) over the 12-month period leading up to the time of the screening, yielding a quantitative index of the degree of consequences of drug use [13]. The DAST-10 has been used to analyze health services utilization and cost for problematic drug use in the community-based setting [6]. Additionally, various studies have employed the DAST-10 (and longer versions of the DAST tool) to assess and detect drug use and misuse in various patient populations [14].

Since 2010, the University of Utah Burn Center has recorded AUDIT and DAST-10 scores for all adult patients admitted with burn injuries. While numerous studies have been conducted examining the associations between alcohol use and burn injury occurrence [1,2], research utilizing AUDIT and DAST-10 data in the burn population is scant. The aim of this study was to utilize the data collected by the Burn Center at the University of Utah to assess for association between AUDIT and DAST-10 scores and specific, measurable risk factors and/or outcomes in burn patient injury, treatment, and recovery in order to provide clinicians with a framework to risk-stratify burn patients, as well as help ensure adequate treatment of co-existing substance use disorders. We hypothesized that patients with higher AUDIT and DAST-10 scores would have longer hospital stays, increased occurrence of unplanned hospital readmission, and increased severity of burn wounds.

2. Material and methods

2.1. Study population

An IRB-exempt retrospective chart review was performed of all patients over the age of 18 admitted to the University of Utah Burn Center within 24 h of burn-related injury between May 1, 2014, and June 30, 2017. All adult patients admitted to the University of Utah Healthcare Burn Center, an American College of Surgeons/American Burn Association-verified regional burn center, are screened for alcohol use disorders with the AUDIT and drug use disorders with the DAST-10. This screening is conducted by a licensed mental health clinician after the patient has been initially stabilized and is able to verbally respond to screening questions. The scores from the AUDIT and DAST-10 screenings are then recorded in the patient's Electronic Medical Record (EMR).

2.2. Diagnostic screening tools

The AUDIT consists of ten questions covering the domains of drinking behavior, alcohol-related problems, and alcohol consumption, with scoring based on patient responses [9]. Each response is scored from 0 to 4, with a maximum possible score of 40. An AUDIT score of 8 or higher is considered highly predictive of hazardous or harmful alcohol use [9]. The construct, concurrent, and discriminant validity of the AUDIT has been validated by multiple studies for use in medical settings [10].

Like the AUDIT, the DAST-10 consists of ten questions and is scored according to patient responses. Responses to the DAST-10 questions are limited to yes or no, and each question is worth one point for a maximum total score of 10 [13]. A DAST-10 score of three or higher is considered highly suggestive of substance use disorder warranting further investigation and/or intensive assessment [15]. The DAST-10

has been validated for the detection and assessment of drug use disorders in the inpatient setting [16].

If a patient has a positive AUDIT or DAST screening upon admission to the University of Utah Burn Center they are given a counseling referral, which provides information on a variety of resources tailored to meet individual patient needs. This includes supportive therapeutic intervention, motivational interviewing, Cognitive Behavioral Therapy (CBT) administered at bedside by a licensed mental health clinician, attendance at an inpatient support group, referral to a trained peer support volunteer in recovery from substance abuse, and participation in Alcoholics Anonymous (AA). Outpatient treatment options are largely based on the patient's insurance funding, with services including Volunteers of America, sober living programs, private mental health therapy, and continuation of therapy initiated in the inpatient setting. It is rare to transition a burn patient at discharge from the burn unit directly to inpatient substance abuse therapy, as the requirements of adequate burn injury follow up care severely limit options for inpatient recovery programs.

2.3. Variables

Data was obtained utilizing patient EMRs and the NATIONAL TRACS®/ABA Burn Registry system. Variables collected included patient demographics (age, gender, marital status, employment status, insurance status), injury related data (date of injury, site of injury occurrence, mechanism of injury, size/type/location of burn wound, wound result of domestic violence incidence), and substance use related data (AUDIT score, DAST-10 score, substance use counseling offered/accepted, urine toxicology screening results, substance use at time of injury). Substance use at time of injury was defined as patient acknowledgement of substance use and/or positive toxicology. As previous studies have suggested a correlation between substance use and larger burn size longer ICU stays, and increased wound severity [4,17], the primary outcome of length of stay standardized for TBSA burn injury was chosen to specifically address these variables. Secondary outcomes included treatment compliance and unplanned readmission, both defined below.

Other miscellaneous variables collected included comorbid conditions, length of stay in burn center, and unplanned readmission to the burn center within studied time frame. Noncompliance with burn treatment was defined as two or more missed follow-up appointments without rescheduling, intentional re-injury, or consistent refusal of physical therapy/wound dressing. Unplanned readmission was defined as a second admission to the burn center in the studied time frame due to wound complications or recurrence.

2.4. Statistical analysis

Study data were collected and managed using Research Electronic Data Capture (REDCap) tools hosted at University of Utah. REDCap is a secure, web-based application designed to support data capture for research studies. Stata 14 (Stata Corp, College Station, TX) was used for data analysis. Inferential statistics (Chi-Squared and t-test) were used for comparisons of gender and age between patients with positive and negative AUDIT and DAST screening. Non-parametric statistics (Wilcoxon rank-sum) were used for comparisons between independent variables with non-normal distribution of data (TBSA, LOS/TBSA). AUDIT and DAST scores were handled as a dichotomous variable based upon positive or negative screening values. A $p < 0.05$ was considered statistically significant.

This study was determined to be exempt by the Institutional Review Board.

3. Results

Between May 1, 2014, and June 30, 2017, 322 patients age 18 or older with acute burn injuries admitted to the University of Utah Health Burn Center underwent AUDIT/DAST-10 screening ($n = 322$).

3.1. Demographics

Patient gender included 58 females (21%) and 215 males (79%). Gender did not differ based upon positive AUDIT or DAST-10. Mean age at time of admission was 47.2 years (S.D. + 17.9). However, patients with a positive AUDIT or DAST-10 were statistically significantly younger than patients with a negative AUDIT or DAST-10. TBSA burn injury had non-normal distribution and a median value of 7% (IQR 3–15) and did not differ based upon positive AUDIT or DAST-10. Length of stay standardized for TBSA also had non-normal distribution and a median value of 1.63 days/ %TBSA (IQR 0.97–3.25). All demographic data is summarized in Table 1.

Table 1 – Patient demographics and standardized length of stay.

	All Patients (N = 322)	AUDIT		DAST-10	
		Positive (n = 56)	Negative (n = 266)	Positive (n = 39)	Negative (n = 283)
Gender[a]	58 Female 215 Male	9 Female 47 Male	66 Female 200 Male	8 Female 31 Male	67 Female 216 Male
Age (yrs)[b] Mean + S.D.	47.2 (+17.9)	41.8 (+16.2)	48.4 (+18.1)	41.2 (+17.9)	48.1 (+17.8)
TBSA (%)[c] Median (IQR)	7 (3–15)	5.5 (3–15)	7 (3–16)	9 (5–19)	7 (3–15)
LOS/TBSA[d] (days/ %) Median (IQR)	1.63 (.97–3.25)	1.70 (1.0–3.56)	1.60 (1.0–3.56)	1.70 (1.0–3.6)	1.4 (0.6–2.6)

[a] χ^2 AUDIT $p = 0.16$; DAST-10 $p = 0.66$.
[b] t-test AUDIT $p = 0.01$; DAST-10 $p = 0.02$.
[c] Wilcoxon rank-sum AUDIT $z = 0.42$ $p = 0.67$; DAST-10 $z = -1.71$ $p = 0.09$.
[d] Wilcoxon rank-sum AUDIT $z = 0.46$ $p = 0.64$; DAST-10 $z = 1.73$ $p = 0.08$.

3.2. Patient substance use and screening information

Of the 322 patients with AUDIT screening data, 56 (17%) had an AUDIT score ≥8, meeting the criteria for a positive screen. Alcohol counseling based upon AUDIT score was offered to 55 patients; of these, 30 patients accepted counseling.

Patient history or screening for illicit drug use at time of admission was positive in 25 patients (7.8%). DAST-10 scores of >3 were used as a threshold for referral, and 14 patients had a DAST-10 that was considered positive based upon this threshold. Drug counseling based upon DAST-10 was offered to 11 patients; of these, 9 patients accepted counseling. Of note, only two patients (0.6%) underwent urine toxicology screening at the time of admission.

Median AUDIT score in the group of patients using alcohol at the time of injury was 12 (IQR 7–20). The median AUDIT score in patients who were negative for alcohol use at the time of injury was 1 (IQR 1–4); the difference in these two groups was statistically significant ($z = -8.31$; $p < 0.001$, Wilcoxon rank-sum). Median DAST-10 in patients with drug use at time of injury was 6 (IQR 3–12); patients who were not using drugs at the time of injury all had a DAST-10 score less than 2. This difference was statistically significant ($z = -6.64$; $p < 0.001$, Wilcoxon rank-sum).

15 of 50 patients who either reported or screened positive for alcohol use at the time of burn injury had a negative AUDIT screen. Nine patients who were positive for drug use at time of admission had a negative DAST-10 screen.

3.3. Patient outcomes

Mean standardized length of stay per TBSA burn injury was 1.7 days for patients with a positive AUDIT (IQR 0.9-3) and 1.6 days for patients with a negative AUDIT (IQR 1–3.56) ($z = 0.46$; $p = 0.64$, Wilcoxon rank-sum). Median standardized length of stay was 1.7 days (IQR 1–3.6) for patients with a negative DAST-10 and 1.4 days (IQR 0.6–2.6) for patients with a positive DAST-10 ($z = 1.73$; $p = 0.08$, Wilcoxon rank-sum).

Only one patient in the study population had an unplanned readmission related to initial injury. This patient had an AUDIT score of 22 during first admission and accepted a counseling referral. At readmission, the patient's AUDIT screening score was 31 and counseling referral was again accepted. A second patient in our review group had a second admission for a new burn injury; this patient had a negative AUDIT and DAST-10 during both admissions.

Not every patient that met criteria for counseling referral was referred; one patient who met AUDIT criteria for referral was not referred (1/56), and three patients who met DAST-10 criteria for referral were not referred (3/14). The reason these patients were not referred was not documented in the medical record. Of the patients who were referred to counseling, all had either a positive AUDIT or DAST-10 screen.

No association was found between positive AUDIT/DAST-10 screening and burn wound size, domestic violence incidence, comorbid conditions, or secondary outcomes of treatment compliance and readmission rates.

4. Discussion

The numerous adverse outcomes, both for patients and for healthcare systems, associated with alcohol and drug use make early identification of and intervention for at-risk patients paramount in providing adequate, cost-effective patient care. However, urine drug screening and serum alcohol screening is not always available or utilized, and further is not necessarily cost-efficient to administer to every patient admitted for a burn injury [18]. Alternative screening methods for identifying patients at risk for the adverse outcomes associated with illicit drug use and alcohol use that are both cost-effective and easily implemented are therefore ideal.

As both the AUDIT and DAST-10 are easily implemented and cost-effective, properly utilizing these screening tools to identify patients at risk for problematic substance provides a useful starting point for early intervention and risk mitigation. In the studied population, utilization of AUDIT and DAST-10 screening tools provided the opportunity for counseling referral for 55 patients with problematic alcohol use and 11 patients with problematic drug use, respectively. These results support the utility of the general implementation of the AUDIT and DAST-10 screening tools in burn centers to help identify patients with problematic substance abuse and provide them with further treatment options, particularly in light of a recent publication elucidating the linkage between substance use and abuse following burns and trauma symptomatology [19].

Notably, previous studies have found that the identification of illicit drug use by urine screening alone rarely results in drug treatment referral [18]. As illicit drug users (specifically females) have been found to be at increased risk for serious injury or trauma and resulting severe medical conditions [1], the identification and referral of patients with a positive DAST-10 screen may serve to help alleviate risk of further severe medical problems in this vulnerable patient population. Underutilization of urine toxicology screening may result in suboptimal patient care, as pre-injury use of cocaine, opiates, barbiturates, amphetamines, PCP, and benzodiazepines have all been shown to have impact on clinical outcomes after trauma that vary by specific drug class (or combination of drug classes) [2]. Therefore, in addition to DAST-10 screening, the use of urine drug screening to identify specific agents can be helpful to assist clinicians in risk-stratifying burn patients who may experience complications from drug use.

The observed urine drug screening rate was 0.6%. However, drug use was reported at the time of burn injury in 8% of study patients (25/322), and 4% of patients (14/322) had positive DAST-10 screens, indicating urine drug screening was underutilized in the study sample. Possible explanations for the low urine drug screening rate observed during this study include an institutional culture that may disfavor screening as well as possible provider reluctance to conduct urine screening due to state-specific laws allowing insurance companies to deny payment for injuries sustained while intoxicated.

The findings that median AUDIT scores were higher in patients with concurrent alcohol use at time of injury and median DAST scores were higher in patients with concurrent

drug use at time of injury suggest that patients with a pattern of hazardous or harmful substance use as identified by positive AUDIT and DAST-10 screening are more likely to engage in behavior that results in burn injury. It further suggests that problematic substance use may directly contribute to the incurrence of burn injury. While additional research into this possibility is warranted to establish statistically significant correlation, current results indicate that patients with hazardous or harmful usage patterns of alcohol and drug use have a higher likelihood of their substance use contributing to burn injury than patients with lower-risk patterns of usage.

Of the 50 patients who either reported or screened positive for alcohol use at the time of burn injury, 15 had a negative AUDIT screen; nine patients who were positive for drug use at time of admission had a negative DAST-10 screen. As injury resulting from alcohol use is one of the factors assessed by the AUDIT tool, it is unlikely that patients who were intoxicated at the time of their burn injury would score a 0 on the AUDIT assessment with accurate self-reporting. Likewise, one of the DAST-10 screening questions specifically asks the patient about their drug use causing a medical problem, making it unlikely that patients using drugs at the time of their burn injury would score a 0 on the DAST-10 with accurate self-reporting. Possible explanations for these discrepancies include conscious omission by the patient, a lack of perceived association between substance use and incurred burn injury in the patient's mind, and the failure of patients to identify a burn injury as a "medical problem" (listed examples on the DAST-10 include more chronic conditions like diabetes and hypertension, and do not specify traumatic injury). Additionally, it is possible that in some instances substance use at the time of injury did not actively contribute to injury occurrence.

These findings raise the possibility of underreporting of substance abuse by the screening instruments. Nevertheless, a 2009 study conducted at the Burn and Shock Trauma Institute of Loyola University Medical Center indicated that formal alcohol screening using the AUDIT identified more patients that were at risk for further alcohol problems than using Blood Alcohol Concentration alone [20]. While the underreporting of alcohol consumption when questioned by a live interviewer versus diary or anonymous reporting has been previously described, more recent studies suggest that alcohol-related problems may no longer be considered sensitive topics in the adult US population [21]. However, these findings fail to account for patients in the ICU (Intensive Care Unit) setting who have been directly injured as a result of alcohol use, where admission of problematic alcohol use may be more difficult.

While commonly held beliefs in the healthcare world label patients with chronic alcohol and drug use problems as a "system drain," tying up essential healthcare resources with both increased utilization and length of hospital stay, this conception is contradicted by our findings that, in the studied population, a positive AUDIT or DAST-10 screen was not associated with increased length of stay. However, the length of hospital stay recorded in this study was for the burn service only and does not account for patients discharged to recovery facilities, inpatient rehabilitation, or inpatient psychiatric units. This may have artificially skewed results toward a shorter than actual lengths of stay. Furthermore, the recorded length of stay analyzed does not account for extenuating circumstances such as possible patient motivation to discharge rapidly to obtain drug of choice or possible provider inclination to discharge patients with substance use issues more quickly. Further studies including length of stay in other healthcare units, long term compliance with outpatient care, and future admissions for non-burn related injuries may show different results.

We initially hypothesized that higher AUDIT/DAST-10 scores would be associated with increased burn wound severity as determined by burn depth and total body surface area (TBSA) injured. However, in the studied population a positive AUDIT or DAST-10 screen was not found to be associated with increased wound severity. This suggests that the comorbid conditions of chronic or problematic substance use in the burn population does not increase the chance of larger burn wounds. However, this finding may be due in part to the more subjective nature of self-reported data, as a recent study using National Burn Registry data found that a positive urine drug screen is correlated with larger average burn size (11.2 vs 9.5% TBSA, $P < .001$) [4].

4.1. *Limitations*

Because both the AUDIT and DAST-10 are self-reporting assessments, accurate scoring is inherently limited by the reliability and accuracy of patient responses. Future studies could continue to assess the effectiveness of combining methods of screening for patient substance abuse not reliant on self-reporting with the AUDIT/DAST-10 tools.

Additionally, because of the chronic nature of burn wounds and the necessarily limited window of the time frame of our study, relationships between outcomes such as noncompliance with chronic therapy, pain medication dependence, unplanned readmission, or future admissions for issues related to substance use but not directly to burn injury may have been missed in the long term.

Our sample size was limited ($n = 322$) due to the study population being limited to one regional burn center. In the future, expanding the sample size by including other ABA-verified regional burn centers with screening programs may make results easier to extrapolate to the burn population as a whole. Additionally, the AUDIT and DAST-10 are validated for use in adult patient populations, so these results may not be generalizable to adolescent patients who receive care at pediatric burn centers.

Data was unavailable as to whether patients who accepted referral to counseling services ultimately utilized counseling resources or substance use treatment, making it difficult to ascertain the effectiveness of counseling referral. Further studies could address this by prospectively assessing long term outcomes in patients referred for counseling, including utilization of counseling and addiction treatment services.

5. Conclusions

The use of the AUDIT and DAST-10 in the burn patient population for diagnostic screening provides a simple, low-cost method of identifying patients with problematic drug or alcohol use, allowing an opportunity for early intervention for

at-risk patients. Patients identified using these screening tools can be provided with substance use counseling and resources which may reduce future medical disorders and hospitalizations associated with problematic substance use. Positive AUDIT or DAST-10 scores do not appear to be independent predictors of longer hospital stays, increased burn wound severity, noncompliance with treatment, or increased occurrence of unplanned readmission. Because both the AUDIT and DAST-10 rely on the accuracy of patient responses and may therefore result in the underreporting of problematic substance use, the concurrent use of non-subjective screening tools such as urine/serum screening should continue to be considered in patients with a high clinical suspicion for problematic substance use.

Declarations of interest

We wish to confirm that there are no known conflicts of interest associated with this publication and that there has been no significant financial support for this work that could have influenced its outcome. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by each of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property. We further confirm that any aspect of the work covered in this manuscript that has involved either experimental animals or human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

We understand that the Corresponding Author (Dr. Cochran) is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). She is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs.

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