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Original Article

Bias in alcohol and drug screening in adult burn patients

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Abstract: Alcohol and illicit drug use are common among burn-injured patients. Urine toxicology and alcohol screens are a part of our admission order sets and automatically ordered for all adult patients. Our objective was to determine the impact of bias in screening compliance and compare those results to patients who test positive. All adult patients admitted between January 1st, 2014 and December 31st, 2018 were eligible for inclusion. Multivariable logistic regression was used to identify potential predictors for compliance in obtaining samples for screens, and patient characteristics associated with testing positive. Four thousand nine hundred ninety-eight patients were included in the study. The biggest predictors for compliance in obtaining samples for screens were inhalation injury, intensive care unit stay, length of stay, burn size, and current smoking status. No differences in compliance with screens were seen across age, race, or ethnicity. Current smokers and patients with a history of major psychiatric illness were more likely to test positive for alcohol and illicit drugs. Non-Hispanic Black patients were more likely to test positive for illicit drugs. Male sex and pre-existing psychiatric conditions were significant predictors for compliance for alcohol screens, and, positive tests. Implicit bias based on age, race, or ethnicity played no predictive role in compliance for either screen, however, non-Hispanic Blacks were more likely to test positive for illicit drugs. More studies are needed to understand the effect of selection bias related to sample collection, and the significance of positive test results.

Keywords: Illicit Drugs, alcohol, bias, burns

Introduction

Alcohol and illicit drug use are common among burn-injured patients [1]. After noting significantly more burn recidivists with drug-seeking behavior [2], urine toxicology and alcohol screens became a standard part of our admission order sets for all adult patients. This information helps health care providers manage expectations about pain tolerance, may explain mental status and physiologic changes during the resuscitative period, and may indicate judgement and circumstances surrounding burn injuries [3-6].

Positive alcohol or illicit drug screens on admission, however, are neither indicative of chronic use, nor have they been able to consistently prognosticate morbidity or mortality [1, 3, 5-10]. Furthermore, unfounded generalizations and prejudices based on race, ethnicity, gender, sexual orientation, and/or socioeconomic status, may bias healthcare providers regarding who should be screened for alcohol or illicit drug use on admission to the hospital [11]. This selection bias, whether explicit (conscious) or implicit (unconscious), may negatively impact patients' care [11]. Thus, our objective was to determine the impact of bias in obtaining samples for alcohol and illicit drug screens of adult patients on admission to our burn center and compare those results to patients who indeed tested positive.

Materials and methods

Inclusion and exclusion criteria

All patients ≥ 18 years of age who were admitted to the burn center for treatment of burn injuries (including inhalational injury alone) between January 1st, 2014 and December 31st, 2018 were eligible for inclusion. Patients were identified using the Burn Center registry. Since 2013, urine toxicology screens and blood alcohol levels have been part of the standard admission orders on all adult patients admitted to our service. The orders for both are pre-checked on the electronic medical record (EMR) system, and simply require the nursing staff to obtain samples. If a patient had more than one admission to the burn center during the study dates, only data from the patient's first hospitalization was included. No other exclusion criteria was applied.

Patient and burn characteristics of interest

Variables of interest included patient age, sex, race/ethnicity, comorbidities, burn mechanism, total burn surface area (TBSA), inhalational injury, whether the patient was admitted to the burn intensive care unit (ICU) during their hospitalization, whether they were on a mechanical ventilator during their hospitalization, length of stay (LOS), inpatient mortality, and year of admission. Age and TBSA were modeled as continuous, linear variables and assessed in 10-unit increments (e.g. the association of a 10-year increase in age on screening). LOS was scaled at 30 days (i.e. patients hospitalized for > 30 days were recategorized as having a 30-day LOS) to minimize the impact of extremely long hospitalizations on the results; only 318 patients (6%) had a LOS > 30 days.

Comorbidities included current smoking, diabetes, hypertension, chronic obstructive pulmonary disease (COPD), coronary artery disease (CAD), congestive heart failure, obesity, psychiatric disorder, and cirrhosis. Our burn center registry identifies any of the following as major psychiatric disorders: major depressive disorder, bipolar disorder, schizophrenia, anxiety/panic disorder, borderline or antisocial personality disorder, adjustment disorder, and/or posttraumatic stress disorder.

Statistical analysis

Trends in alcohol and drug screening were compared using trend tests. A p-value <0.05 was considered statistically significant. Demographics between those screened for alcohol and drugs were reported using descriptive statistics. Due to the large sample size, Chi-square and Wilcoxon tests were only performed to assess differences that appeared clinically meaningful (and reported in the text). Multivariable logistic regression was used to identify potential predictors for whether a patient had an alcohol or drug screening performed. Additionally, for all patients screened, multivariable logistic regression, adjusted for patient demographics and burn characteristics, was performed to identify patients who were more likely to test positive for illicit drugs (marijuana and/or cocaine) and alcohol.

All statistical analyses were performed using SAS version 9.4 (SAS Inc., Cary, NC). The retrospective study was approved by our institutional review board (IRB # 19-1166), which is overseen by the institutional Office of Human Research Ethics, with a waiver of informed consent.

Results

Demographics

Between 2014 and 2018, 4,998 adults were admitted for treatment of a burn injury (including those with only inhalational injury). Of those patients, 70% (n=3,489) were screened for alcohol and 80% (n=4,020) for illicit drugs. Patients who had samples obtained for alcohol screens were more likely to have also had samples obtained for illicit drug screens (89% vs. 60%, P<0.0001), resulting in 62% (n=3,112) of patients being screened for both at admission. Among patients screened, 8% (288/3,489) screened positive for alcohol and 31% (1,261/4,020) for illicit drugs-5% marijuana, 21% cocaine, and 5% tested positive for both. Baseline patient demographics, stratified by alcohol and drug screening status are detailed in **Table 1**.

Temporal compliance rates

Highest compliance rates for obtaining samples occurred in 2018 (alcohol: 77%, illicit

Table 1. Patient demographics and hospital characteristics, stratified by alcohol and drug screening compliance

	Alcohol Screening		Drug Screening	
	Yes	No	Yes	No
	3489 (70%)	1507 (30%)	4020 (80%)	976 (20%)
Age, median (IQR)	43 (30-57)	40 (29-54)	42 (29-55)	42 (29-58)
Male, n (%)	2477 (71)	988 (66)	2821 (70)	643 (66)
Race/ethnicity, n (%)				
Non-Hispanic White	2079 (60)	836 (56)	2378 (60)	537 (55)
Non-Hispanic Black	1016 (29)	476 (32)	1206 (30)	287 (29)
Hispanic	225 (7)	112 (7)	256 (6)	80 (8)
Other[a]	140 (4)	77 (5)	149 (4)	68 (7)
Comorbidities, n (%)				
COPD	281 (8)	94 (6)	307 (8)	69 (7)
Current smoker	1322 (38)	470 (31)	1512 (38)	281 (29)
Diabetes	441 (13)	187 (12)	500 (12)	128 (13)
Hypertension	953 (27)	399 (30)	1077 (27)	274 (28)
Congestive heart failure	80 (2)	31 (2)	79 (2)	32 (3)
Major psychiatric illness[b]	363 (10)	109 (7)	397 (10)	75 (8)
Obesity	216 (6)	84 (6)	245 (6)	55 (6)
Burn etiology, n (%)				
Flame	1726 (50)	621 (41)	1934 (48)	413 (43)
Scald	1178 (34)	622 (41)	1426 (36)	378 (39)
Contact	279 (8)	141 (9)	324 (8)	96 (10)
Chemical	147 (4)	63 (4)	156 (4)	54 (6)
Other	144 (4)	55 (4)	169 (4)	29 (3)
TBSA, %, median (IQR)	2 (1-6)	2 (1-4)	2 (1-5)	2 (1-4)
Inhalation injury, n (%)	159 (5)	15 (1)	157 (4)	17 (2)
ICU stay, n (%)	919 (26)	197 (13)	976 (24)	140 (14)
Ventilator, n (%)	392 (11)	47 (3)	402 (10)	37 (4)
LOS, days, median (IQR)	6 (2-11)	3 (1-8)	6 (2-11)	2 (1-7)
Inpatient mortality, n (%)	100 (3)	26 (2)	93 (2)	33 (3)

Abbreviations: IQR, interquartile range; TBSA, total burn surface area; LOS, length of stay; ICU, intensive care unit. [a]Other races included Asian, Native American/American Indian, Native Hawaiian/Pacific Islander, and 'other' race; race was collapsed for analytical purposes. [b]Documentation of the presence of pre-injury major depressive disorder, bipolar disorder, schizophrenia, anxiety/panic disorder, borderline or antisocial personality disorder, and/or adjustment disorder/post-traumatic stress disorder.

drugs: 84%). Drug screens were consistently more prevalent than alcohol screens, **Figure 1**. After adjusting for patient demographics, burn and hospital characteristics, compliance rates for obtaining alcohol and drug screens were significantly higher in 2018, compared to 2014-2017 (OR 1.63, 95% CI 1.35, 1.97 and OR 1.44, 95% CI 1.16, 1.79, respectively). While the year of admission was not associated with testing positive for alcohol (P=0.80), it was significant for illicit drugs (P=0.006), with patients admitted in 2015 being least likely to test positive for marijuana or cocaine.

Positive impact on compliance

The only variables associated with increased odds of compliance for obtaining both alcohol and illicit drug samples for screenings were current smokers (OR 1.33, 95% CI 1.14, 1.55 and OR 1.36, 95% CI 1.13, 1.64), ICU stay (OR 1.53, 95% CI 1.21, 1.95 and OR 1.36, 95% CI 1.02, 1.81), and overall LOS (for every 1-day increase) (OR 1.04, 95% CI 1.03, 1.05 and OR 1.07, 95% CI 1.05, 1.08) **Table 2**. The presence of inhalation injury also appeared to increase compliance for obtaining both screening sam-

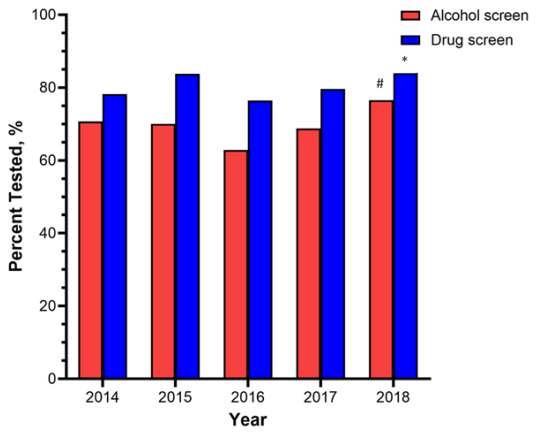

Figure 1. Trends in alcohol and drug screening compliance over time. Compliance rates were significantly higher for alcohol and illicit drug screens in 2018 compared to years 2014-2017. Significance of $P<0.05$ is designated by # for alcohol screens and * for illicit drug screens.

ples, although estimates were not significant for illicit drug use (OR 2.91, 95% CI 1.37, 6.18 and OR 2.06, 95% CI 0.90, 4.71, respectively).

Negative impact on compliance

Interestingly, increased burn size (for every 10% increase in TBSA) decreased the odds of compliance in obtaining samples for both alcohol and illicit drug screens (OR 0.89, 95% CI 0.79, 0.99 and OR 0.83, 95% CI 0.73, 0.94, respectively).

Effect of sex and co-morbid conditions on compliance

Additionally, male sex (OR 1.23, 95% CI 1.04, 1.44) and major psychiatric illness (OR 1.38, 95% CI 1.07, 1.79) increased the odds of compliance for obtaining samples for alcohol screens, but were not predictive of samples being obtained for illicit drug screens. A past medical history of congestive heart failure (CHF) significantly decreased the odds of compliance for obtaining urine samples for illicit drug screens, however had no impact on compliance for obtaining samples for alcohol screens (OR 0.57, 95% CI 0.33, 0.98 and OR 1.07, 95% CI 0.64, 1.8, respectively), **Table 2**. Every 10-year increase in age and the presence of comorbid hypertension and obesity were associated with decreased odds of testing positive for illicit drugs (OR 0.72, 95% CI 0.68, 0.77, and OR 0.72, 95% CI 0.56, 0.92, and OR 0.68, 95% CI 0.46, 0.98, respectively). No differences in obtaining samples, for either screen, was seen across age, race/ethnicity, or other comorbidities, **Table 2**. Among patients successfully screened for alcohol and illicit drugs, those that were more likely to test positive for both were current smokers (OR 1.63, 95% CI 1.20, 2.22 and OR 3.39, 95% CI 2.85, 4.04, respectively) and patients with major psychiatric illness (OR 1.53, 95% CI 1.00, 2.35 and 1.83, 95% CI 1.40, 2.40, respectively). Among patients successfully screened for alcohol, those that were more likely to test positive for alcohol were male (OR 1.85, 95% CI 1.24, 2.75). Among patients successfully screened for illicit drugs, those that were more likely to test positive were non-Hispanic Black patients (OR 2.10, 95% CI 1.73, 2.55) compared to non-Hispanic White patients.

Effect of burn etiology on compliance

Patients with scald and contact burns (OR 0.84, 95% CI 0.71, 0.99 and OR 0.76, 95% CI 0.59, 0.99, respectively) were associated with decreased odds of samples being obtained for alcohol screens, compared to those with flame burns. Patients that sustained chemical burns were least likely to test positive for alcohol (OR 0.20, 95% CI 0.05, 0.82) compared to patients with flame burns. Burn etiology had no impact on illicit drug screen samples being obtained.

Effect of burn characteristics on compliance

Every 10% increase in TBSA was more likely to test positive for alcohol (OR 1.36, 95% CI 1.20, 1.54). Need for mechanical ventilation on admission significantly increased the odds of compliance for obtaining samples for illicit drug screens, but was not significant for alcohol screens (OR 2.00, 95% CI 1.06, 3.77 and OR 1.45, 95% CI 0.90, 2.32, respectively). Inpatient mortality significantly decreased the odds of compliance for obtaining samples for both illicit drug and alcohol screens, although the estimates for alcohol were not significant (OR 0.43, 95% CI 0.20, 0.97 and OR 0.70, 95% CI 0.35, 1.40, respectively).

Figure 2 is a flow diagram summarizing the study findings. When we assumed all patients not screened for alcohol and illicit drugs would have had negative tests, we found similar results to those detailed in **Table 3**, (Supplementary Table 1).

Table 2. Potential predictors of alcohol and drug screens in burn patients

	Alcohol Screen OR (95% CI)	Drug Screen OR (95% CI)
Age, 10-year increase	0.98 (0.93, 1.03)	0.90 (0.85, 0.95)
Male	1.23 (1.04, 1.44)	1.03 (0.86, 1.25)
Race/ethnicity		
Non-Hispanic White	1.0 (ref)	1.0 (ref)
Non-Hispanic Black	0.93 (0.79, 1.10)	0.91 (0.75, 1.11)
Hispanic	0.94 (0.71, 1.25)	0.69 (0.51, 0.95)
Other[a]	0.72 (0.50, 1.04)	0.46 (0.31, 0.67)
Comorbidities		
COPD	0.91 (0.67, 1.24)	1.10 (0.77, 1.58)
Current smoker	1.33 (1.14, 1.55)	1.36 (1.13, 1.64)
Diabetes	0.95 (0.74, 1.21)	1.00 (0.75, 1.58)
Hypertension	0.90 (0.74, 1.10)	0.91 (0.72, 1.14)
Congestive heart failure	1.07 (0.64, 1.80)	0.57 (0.33, 0.98)
Major psychiatric illness[b]	1.38 (1.07, 1.79)	1.17 (0.87, 1.58)
Obesity	1.12 (0.82, 1.52)	1.32 (0.92, 1.88)
Burn etiology		
Flame	1.0 (ref)	1.0 (ref)
Scald	0.84 (0.71, 0.99)	0.93 (0.76, 1.13)
Contact	0.76 (0.59, 0.99)	0.77 (0.57, 1.04)
Chemical	1.02 (0.71, 1.46)	0.72 (0.49, 1.06)
Other	0.91 (0.62, 1.34)	1.34 (0.82, 2.20)
TBSA, 10% increase	0.89 (0.79, 0.99)	0.83 (0.73, 0.94)
Inhalation injury	2.91 (1.37, 6.18)	2.06 (0.90, 4.71)
ICU stay	1.53 (1.21, 1.95)	1.36 (1.02, 1.81)
Ventilator	1.45 (0.90, 2.32)	2.00 (1.06, 3.77)
LOS[c], days	1.04 (1.03, 1.05)	1.07 (1.05, 1.08)
Inpatient mortality	0.70 (0.35, 1.40)	0.43 (0.20, 0.97)

Abbreviations: IQR, interquartile range; TBSA, total burn surface area; LOS, length of stay; ICU, intensive care unit. Adjusted for all potential predictors (above) and year of admission. [a]Other races included Asian, Native American/American Indian, Native Hawaiian/Pacific Islander, and 'other' race; race was collapsed for analytical purposes. [b]Documentation of the presence of pre-injury major depressive disorder, bipolar disorder, schizophrenia, anxiety/panic disorder, borderline or antisocial personality disorder, and/or adjustment disorder/post-traumatic stress disorder. [c]LOS was scaled at 30 days (i.e. patients with LOS > 30 days were recoded as 30 days) due to skew.

Discussion

Over a five-year period, only 70% of alcohol screens and 80% of illicit drug screens were obtained, despite 100% of adult patients having the orders for both at the time of their admission. A significant portion of the trauma patients, including those with burn injuries have been exposed to alcohol and illicit drugs preceding their injuries [12-16]. While exposure is not indicative of chronic use, it may be directly related to their injuries, leading researchers to recommend routine screening for alcohol and illicit drugs on admission [1, 3, 5-10, 13]. Despite automatic admission orders, trends of non-compliance with obtaining screening samples were found related to patient demographics, comorbid conditions, and burn, hospital and treatment characteristics for both screening and testing positive, indicating selection bias may be present.

Male patients were more likely to be screened for alcohol and were more likely to test positive. Male sex has been linked to hazardous drinking in trauma based on blood alcohol screens [14]. In fact, multiple studies have demonstrated an increase incidence in positive screens in males, for both alcohol and illicit drugs [12-17]. Interestingly, we found no difference in illicit drug screening across gender, although males did appear more likely to test positive, suggesting that presumed positive tests may not be the only reason males were more likely to be screened for alcohol. Additionally, urine pregnancy tests are ordered for all female patients between the ages of 16-50 years, on admission, for operative risk assessment. While these women appeared more likely to be screened for illicit drugs (65% vs. 35%), the reason these samples were not also sent for toxicology remains unclear.

We found no differences in screening across age or race/ethnicity; however, the data did indicate that non-Hispanic Black patients were more likely to test positive for illicit drugs. Further study is needed to investigate why non-Hispanic Black patients were more likely to test positive for illicit drugs when compared to non-Hispanic White patients. Generalizations and prejudices based on age, race, ethnicity, or socioeconomic status made by healthcare providers may complicate the delivery of effective medical care. Eliminating age, race or ethnicity as positive or negative predictors of a successful alcohol or

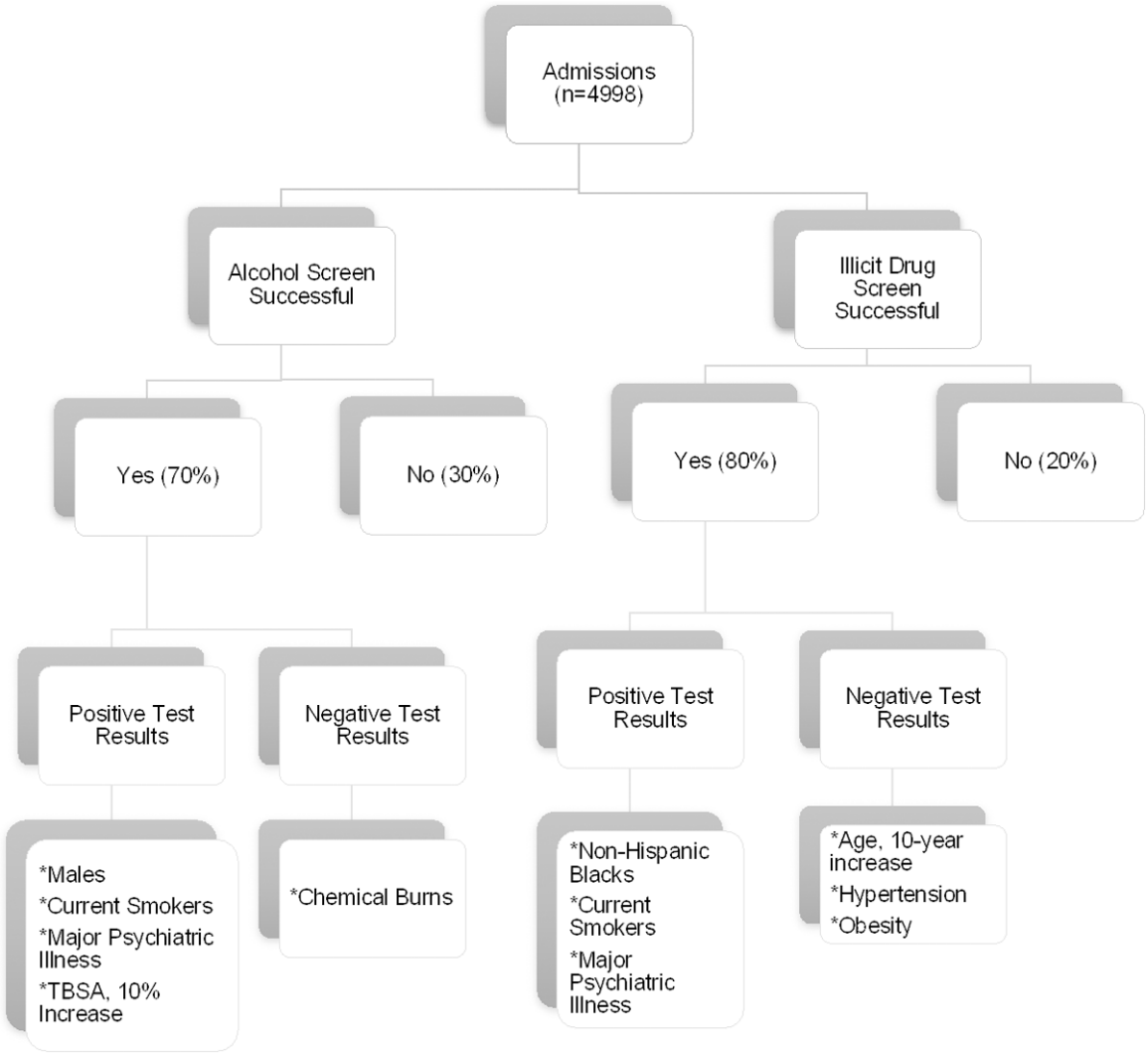

Figure 2. Diagram of successful screens and subsequent study results. Significance of P<0.05 is designated by *.

illicit drug screen is a step closer to delivering equal healthcare across different populations.

Current smokers had increased odds of being successfully screened for both alcohol and illicit drugs. Recent evidence demonstrates that there is a higher prevalence of substance use disorders in people that smoke [18] and we found a similar finding in our study-current smokers were more likely to test positive for both alcohol and illicit drugs.

Major psychiatric illness was also associated with increased odds of alcohol screening, and these patients were more likely to test positive for both alcohol and illicit drugs. The link between alcohol and illicit drug use amongst those with a history of major psychiatric illness has been well-described [19-22]. On the contrary, a known history of CHF significantly decreased the odds of compliance with obtaining urine samples for illicit drug screens but had no impact on compliance with obtaining samples for alcohol screens. While illicit drug and alcohol use may contribute to heart conditions [23, 24], staff did not prioritize sample collection in this patient population, even after adjusting for age. Interestingly, these patients were also less likely to test positive for both alcohol and illicit drugs.

Compared to patients with flame burns, those with scald and contact burns were 16% and 24% less likely to be successfully screened for alcohol, respectively. While these findings were statistically significant, the significance of how

Table 3. Patient and burn characteristics associated with testing positive on admission for alcohol and drugs (marijuana, cocaine) in burn patients

	Alcohol Positive OR (95% CI)	Drug Positive OR (95% CI)
Age, 10-year increase	1.02 (0.92, 1.13)	0.72 (0.68, 0.77)
Male	1.85 (1.24, 2.75)	1.20 (0.99, 1.46)
Race/ethnicity		
Non-Hispanic White	1.0 (ref)	1.0 (ref)
Non-Hispanic Black	0.85 (0.60, 1.21)	2.10 (1.73, 2.55)
Hispanic	0.47 (0.20, 1.10)	0.48 (0.32, 0.73)
Other[a]	0.99 (0.44, 2.26)	1.18 (0.72, 1.91)
Comorbidities		
COPD	0.91 (0.48, 1.70)	1.19 (0.81, 1.74)
Current smoker	1.63 (1.20, 2.22)	3.39 (2.85, 4.04)
Diabetes	0.60 (0.61, 1.14)	0.82 (0.59, 1.16)
Hypertension	0.81 (0.53, 1.24)	0.72 (0.56, 0.92)
Congestive heart failure	0.72 (0.20, 2.54)	1.09 (0.53, 2.21)
Major psychiatric illness[b]	1.53 (1.00, 2.35)	1.83 (1.40, 2.40)
Obesity	0.54 (0.25, 1.22)	0.68 (0.46, 0.98)
Burn etiology		
Flame	1.0 (ref)	1.0 (ref)
Scald	0.72 (0.42, 1.41)	1.17 (0.96, 1.43)
Contact	0.77 (0.42, 1.41)	1.08 (0.78, 1.50)
Chemical	0.20 (0.05, 0.82)	0.62 (0.38, 1.01)
Other	0.53 (0.21, 1.33)	0.67 (0.42, 1.08)
TBSA, 10% increase	1.36 (1.20, 1.54)	1.11 (0.81, 1.39)
Inhalation injury	1.48 (0.76, 2.91)	1.24 (0.73, 2.10)

Abbreviations: IQR, interquartile range; TBSA, total burn surface area; LOS, length of stay; ICU, intensive care unit. Adjusted for all potential predictors (above) and year of admission. [a]Other races included Asian, Native American/American Indian, Native Hawaiian/Pacific Islander, and 'other' race; race was collapsed for analytical purposes. [b]Documentation of the presence of pre-injury major depressive disorder, bipolar disorder, schizophrenia, anxiety/panic disorder, borderline or antisocial personality disorder, and/or adjustment disorder/post-traumatic stress disorder.

the burn injury etiology may or may not impact compliance with obtaining samples for alcohol and drug screens is unknown. Interestingly, patients with non-flame burns appeared to be less likely to test positive for alcohol, even after adjusting for patient characteristics. This finding suggests that unmeasured patient characteristics may exist that are associated with burn etiology and alcohol use.

Unexpectedly, increased burn size was a negative predictor for compliance in obtaining both alcohol and illicit drug screens. While we anticipated patients with larger burns would be more critically-ill and require ICU level care, even after controlling for ICU status, the results persisted. In addition, larger burns appeared to be associated with greater odds of testing positive for alcohol and illicit drugs. This is consistent with at least one other recent study [1]. Alcohol use or intoxication alone is an independent risk factor for death in the resuscitative phase post-burn [25]. Because this information is important for patient outcomes, it is somewhat concerning that we were less likely to test patients with larger burns, yet they were more likely to test positive. Additional research is needed to explore why these patients weren't screened as frequently.

The presence of inhalation injury appeared to increase compliance in obtaining samples for both screens, although results were not significant for illicit drug use. There have been established positive correlations between inhalation injury and positive alcohol and illicit drug screens in the literature [26-28]. Our results also suggest that patients with inhalational injury may be more likely to test positive for alcohol and illicit drugs.

Hospital and treatment characteristics also impacted our findings. Patients admitted to the ICU were more likely to have samples obtained for alcohol and drug screens. Even in the literature, positive screens do not consistently represent severity of trauma [1, 12-14]. This suggests that this this finding may be due to our burn ICU staff being more compliant, and less about those patients being targeted. The need for mechanical ventilation also appeared to significantly increase the odds of compliance for obtaining screening samples. While all mechanically vented patients are admitted to our ICU, even after adjusting for ICU status, these results remained significant. This suggests that patients needing mechanical ventilation on admission are more likely to be screened.

Every 1-day increase in LOS was also associated with increased odds for compliance for

screens for both alcohol and illicit drugs. There are two possible explanations for this finding. First, longer LOS indicates a more ill or complicated patient, even after accounting for burn size and inhalational injury. We may have targeted sicker patients to be screened, as the result may have a bigger impact on their care and outcomes. Alternatively, we may be going back and obtaining initially 'missed' orders on admissions, either to improve compliance or because of abnormal behavior prompting the evaluation. Alcohol and illicit drug screens are ordered on admission to represent a patient's exposure immediately prior to the burn injury and time of sample collection is important. Patients that test positive for alcohol or cocaine for example, many days after admission, may have been using drugs preceding the injury or during their hospital course. Alcohol may be detected in the blood stream for an extended period of time depending upon the level of experience of the drinker, and gender [29-32]. The rate of elimination of alcohol from the blood is increased with increased exposure or experience with drinking [30, 32]. Cocaine, depending upon the dose, can be detected in the urine for up to 5 days [33]. Understanding the pharmacokinetics is important as a timeline for exposure, but if our collection is inconsistent, and not obtained on admission, we would be unable to manage our expectations for their resuscitation or their behavior.

Finally, inpatient mortality significantly decreased the odds of compliance for both illicit drug and alcohol screens, although the estimates for alcohol are not significant. Any exposure to illicit drugs or alcohol may have been a contributing factor, however, the priority for the team shifted to life-saving maneuvers, no to obtaining screening samples.

Our findings demonstrate some degree of selection bias, despite having a standardized approach where drug and alcohol screenings were pre-checked in our admission order sets. Knowing the drug and alcohol exposures of our patients is critical to providing the best care, as screens may indicate risk factors for liver dysfunction, cerebral accidents, cardiovascular disease and other physiologic changes that may complicate the resuscitation [25, 34, 35]. There are many potential reasons that may lead to non-compliance in obtaining samples: patients may be anuric, orders may be randomly missed, patients may refuse to give samples, samples may be lost, or the EMR may fail. It is unlikely, however, that any of these possible reasons would account for the 20-30% of non-compliance in obtaining screening samples that we observed. Arguably, this is where we may have the most impact in managing both the healthcare provider and patient expectations of pain control and factors that may affect their resources, lengths of stay, and recidivism risks [2]. Our failure to educate all members of the team on the importance and potential implications of these tests, appeared to have led to staff using judgement on whom they would prioritize sample collection. By default, this failure led to bias in our practices and a considerable rate of non-compliance. These findings underscore our need for implicit bias training to improve equity in our care.

Our study is not without limitations. First, this was a single institution study and results may not be generalizable. However, we believe that it is important for each center to assess its own implicit and explicit bias testing and treatment paradigms. Additionally, in our database the date of the test was not captured, so we were unable to determine if the screenings were performed on admission or later in the hospitalization. However, there are no medications administered in our burn center that would give false positives for the alcohol or illicit drug substances examined in this study; therefore, if there was any delay in obtaining screening samples, this likely did not impact our results. Lastly, the retrospective nature of our study has inherent limitations.

Conclusion

Male sex and pre-existing psychiatric conditions were significant predictors for compliance with alcohol screens being obtained, and those patients indeed tested positive. While implicit bias based on age, race, or ethnicity played no predictive role in compliance for either screen being obtained, non-Hispanic Black patients were more likely to test positive for illicit drugs. More studies are needed to understand the effect of any selection bias related to our sample collection, and the true significance of positive test results.

Disclosure of conflict of interest

None.

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Supplementary Table 1. Patient and burn characteristics associated with testing positive on admission for alcohol and drugs (marijuana, cocaine) in burn patients, assuming all patients who weren't tested would be negative

	Alcohol Positive OR (95% CI)	Drug Positive OR (95% CI)
Age, 10-year increase	1.01 (0.91, 1.12)	0.72 (0.68, 0.77)
Male	1.97 (1.33, 2.92)	1.17 (0.97, 1.40)
Race/ethnicity		
Non-Hispanic White	1.0 (ref)	1.0 (ref)
Non-Hispanic Black	0.82 (0.58, 1.16)	1.96 (1.63, 2.34)
Hispanic	0.47 (0.20, 1.08)	0.46 (0.31, 0.69)
Other[a]	0.92 (0.41, 2.04)	0.85 (0.54, 1.34)
Comorbidities		
COPD	0.90 (0.48, 1.67)	1.17 (0.81, 1.67)
Current smoker	1.76 (1.30, 2.39)	3.30 (2.80, 3.89)
Diabetes	0.59 (0.31, 1.12)	0.85 (0.61, 1.17)
Hypertension	0.80 (0.52, 1.21)	0.73 (0.57, 0.93)
Congestive heart failure	0.76 (0.22, 2.65)	1.03 (0.53, 2.00)
Major psychiatric illness[b]	1.73 (1.13, 2.62)	1.79 (1.39, 2.31)
Obesity	0.61 (0.28, 1.34)	0.77 (0.54, 1.10)
Burn etiology		
Flame	1.0 (ref)	1.0 (ref)
Scald	0.67 (0.46, 0.96)	1.12 (0.92, 1.35)
Contact	0.69 (0.38, 1.25)	0.97 (0.71, 1.31)
Chemical	0.19 (0.05, 0.79)	0.57 (0.36, 0.90)
Other	0.50 (0.20, 1.25)	0.75 (0.48, 1.19)
TBSA, 10% increase	1.27 (1.14, 1.40)	1.07 (0.98, 1.17)
Inhalation injury	2.20 (1.17, 4.15)	1.42 (0.85, 2.36)

Abbreviations: IQR, interquartile range; TBSA, total burn surface area; LOS, length of stay; ICU, intensive care unit. Adjusted for all potential predictors (above) and year of admission. [a]Other races included Asian, Native American/American Indian, Native Hawaiian/Pacific Islander, and 'other' race; race was collapsed for analytical purposes. [b]Documentation of the presence of pre-injury major depressive disorder, bipolar disorder, schizophrenia, anxiety/panic disorder, borderline or antisocial personality disorder, and/or adjustment disorder/post-traumatic stress disorder.