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Age and gender differences in substance screening may underestimate injury severity: a study of 9793 patients at level 1 trauma center from 2006 to 2010

Georgia M. Beasley, MD,[a] *Truls Østbye, MD,*[b] *Lawrence H. Muhlbaier, PhD,*[c] *Carolyn Foley, MS,*[a] *John Scarborough, MD,*[a] *Ryan S. Turley, MD,*[a] *and Mark L. Shapiro, MD*[a,*]

[a] *Department of Surgery, Duke University, Durham, North Carolina*
[b] *Department of Community and Family Medicine, Duke University, Durham, North Carolina*
[c] *Department of Biostatistics and Bioinformatics, Duke University, Durham, North Carolina*

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ABSTRACT

Background: Although the relationship between psychoactive substance use and injury is known, evidence remains conflicting on the impact of substance use on clinical outcomes after injury. We hypothesized that preinjury substance use would negatively impact clinical outcomes.

Methods: National Trauma Registry American College of Surgeons identified patients ($n = 9793$) presenting to Duke Hospital from 2006 to 2010. Logistic regression models assessed potential predictors of receiving substance screening, mortality, length of stay, ventilator requirement, intensive care admission, or emergency department disposition.

Results: Forty-seven percent (4607/9793) of patients received blood alcohol screen (BAS) and 31% (3017/9793) received urine drug screen (UDS). Men were more likely to receive both BASs ($P < 0.001$) and UDSs ($P = 0.001$) than women after controlling for potential confounders. There was no significant difference between men and women over the legal limit for alcohol (OLLA; 27.2%, 95% confidence interval [CI]: 25.7%–28.8% *versus* 24.8%, 95% CI: 22.3%–27.5%). Similarly, younger patients more likely received both BASs ($P < 0.001$) and UDSs ($P < 0.001$) compared with older patients. The proportion of patients aged ≤45 y OLLA (26.5 %, 95% CI: 24.9%–28.2%) was similar to those aged >45 y OLLA (26.8%, 95% CI: 24.5%–29.3%). After controlling for potential confounders neither alcohol, nor tetrahydrocannabinol, nor cocaine was predictive of mortality, ventilator requirement, length of stay, or emergency department disposition, but a higher alcohol level ($P = 0.0174$) predicted intensive care admission.

Conclusions: Females and those aged >45 y are less likely to receive BASs and UDSs. Differential screening that is biased may place patients at risk for receiving inadequate care.

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* *Corresponding author*. Department of Trauma, Surgical Critical Care, and General Surgery, 1557 F Duke South, Blue Zone Box 2837 DUMC 27710, NC. Tel.: +1 919 681 9361; fax +1 919 668 4369.
E-mail address: ml.shapiro@dm.duke.edu (M.L. Shapiro).

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1. Introduction

Traumatic injury is the leading cause of death for Americans aged <45 y and places a major burden on the health care system [1]. The cost of medical care for the approximate 44 million injuries requiring emergency department (ED) admission each year is estimated to be $117 billion dollars [1]. Multiple studies have shown that alcohol and psychoactive substances (illicit and medicinal) are often found in injured patients in emergency rooms [2,3]. Estimates of preinjury substance use, presence of alcohol, and drug use range from 21%–70% [2–7]. Although the strong correlation between substance use and the incidence of injury is well known, fewer studies have examined the impact of substance use on clinical outcomes after injury [8–10]. Alcohol can suppress the release of catecholamines, thereby lowering oxygen delivery to the injured tissue [11–14]. Drug and alcohol use may also impair respiratory and cardiovascular response to injury [11]. One previous study showed that patients using cocaine were more likely to require mechanical ventilation [12]. Those screening positive for substance use may also require a higher level of care that can dramatically increase costs; a day in the intensive care unit (ICU) is approximately 2.5 times higher in cost compared with a day in a regular bed at our institution. Drug and alcohol use may lead to increased morbidity and mortality after trauma, and thus surveillance for preinjury substance use is essential to optimize care delivery and potentially decrease costs.

A recent study using more than 200,000 records from the National Trauma Data Bank found that preinjury drug use was associated with significantly more complications including more infections during hospitalization [3]. Other studies examining clinical outcomes in these patients have been somewhat inconsistent. For example, alcohol use has been reported to have protective effects on mortality and injury severity [15]. Therefore, there is a need to further understand how preinjury drug and alcohol use affect clinical outcomes after trauma. Furthermore, although many studies have focused on the consequences of alcohol use, less is known about other psychoactive agents including tetrahydrocannabinol (THC). Fewer studies have examined the frequency of substance use screening after trauma, which could potentially lead to underestimates of substance use. A further understanding of the extent to which specific psychoactive drugs taken preinjury impact mortality and other clinical outcomes may ultimately aid providers in better management of these patients in an effort to minimize complications and thereby reduce costs. The aims of this study are to (1) identify patients presenting with trauma from 2006 to 2010 at Duke University Medical Center (DUMC) and assess the proportion of those who were screened for blood alcohol and/or urine drugs. (2)Of patients who were screened identify the proportion of those who screened positive for drug and alcohol use, (3) Of those patients screened, compare mortality (both ED mortality and hospital mortality) among those with no drug or alcohol use with the mortality of those who screened positive for drugs or alcohol, and (4) Of those patients screened, assess the effect of drug and alcohol use on ED disposition (EDD; discharged to home or not directly discharged to home), length of stay (LOS), need for ICU, and ventilator requirement (VR).

2. Methods

Data from National Trauma Registry developed by the American College of Surgeons (NTRACS) originally from 2006 to 2010 at DUMC were used for this study. De-identified data extracted for this analysis included the following: age, gender, race (white, black, hispanic, and other), injury severity score (ISS), levels of trauma (0, 1, 2, and 3), types of injuries (blunt and penetrating), primary survey Glasgow coma score (GCS), EDD (discharged to home or not directly discharged to home), length of stay (LOS) and ICU stay (in days), VR, and final disposition (death or discharged). Patients not directly discharged to home included those admitted to a regular care bed, admitted to step down bed, admitted to ED observation unit, admitted to psychiatric unit, detoxification observation unit, ICU, operating room, or jail. Patient disposition was determined by the treating physicians at the time of trauma. The results of drug and alcohol screens when performed were usually available (unless patient went immediately to operating room) to the treating physician before disposition was determined. Data on drug and alcohol screening results were also collected. NTRACS has fields labeled "alcohol present" and "drugs present." The potential entries were "yes," "no," or a blank field. Alcohol and other drug screening were considered performed when the respective fields in the database were coded as either "yes" or "no". When alcohol was "yes," the actual level was recorded and used in the models. Specific drugs are also listed when the screen is positive. We assumed that no screen was performed if the fields were blank. Current protocol at DUMC is for all level 1 and level 2 patients with trauma to receive urine drug screen (UDS) and blood alcohol screen (BAS) with a recommendation for screening in all cases of trauma.

Mean with standard deviation and frequencies were used to summarize continuous variables and categorical variables, respectively. Logistic regression models were used to model the following dichotomous outcomes: screen (BAS and UDS), death, LOS 3 d or more, ICU admission, need for ventilator, and not going home directly from the emergency room. For the analysis of patients who were screened, we excluded those with UDSs only and those with abbreviated injury scale (AIS) head scores of 4, 5, or 6 from further analysis as shown in Figure 2. We chose to exclude patients with severe injuries, as these patients are known to have poor outcomes independent of other factors [16]. Patients who were "dead on arrival" were combined with those who died in the hospital for analysis (again AIS 4, 5, or 6 were excluded). Covariates for all models were chosen *a priori* based on existing literature. C-statistics and odds ratios (ORs) with 95% confidence intervals (CIs) are reported for all models. GCS, ISS, age, and alcohol level were included as continuous variables, whereas trauma type, cocaine use, THC use, race, and trauma alert level were included as categorical variables in the regression models. All statistical analyses were performed using SAS Enterprise Guide version 4.3 (SAS; Cary, NC). This study was approved by the Duke University Institutional Review Board.

3. Results

Data from NTRACS identified 9793 records from 2006 to 2010 among patients aged ≥16 y who presented to DUMC with

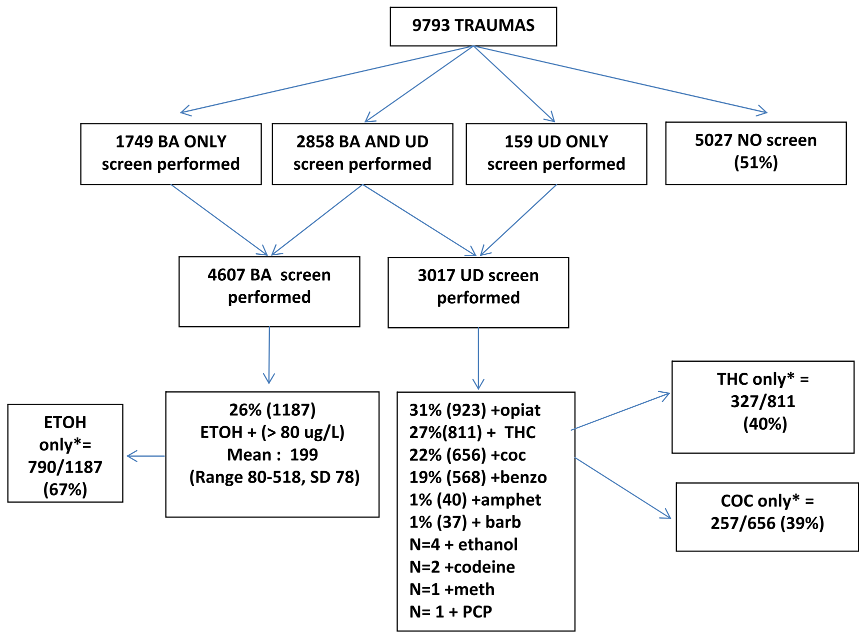

Fig. 1 – Flow diagram of 9793 patients presenting with trauma and the proportions of patients who were screened positive for specific substances. BA = blood alcohol; UD = urine drug; + = screen positive; * = substance plus opiate, Legal limit of blood alcohol (ETOH) = >80 uh/L; Opiat = opiates; THC = tetrahydrocannabinol; COC = cocaine; benzo = benzodiazpene; amphet = amphetamine; barb = barbituate; meth = methadone; PCP = Phencyclidine. (Color version of figure is available online.)

trauma. The most common mechanisms of injury were motor vehicle collisions accounting for 31% (*n* = 3018), falls accounting for 26% (*n* = 2550), and gunshot wounds accounting for 10% (*n* = 1028) of all presentations. Figure 1 shows that 51% (*n* = 5027) of patients with trauma did not get screened for blood alcohol level or urine drug levels. Forty-seven percent (*n* = 4607) of patients with trauma received BAS, whereas 31% (*n* = 3017) received UDS. Of patients who were screened, 26% (*n* = 1187) were over the legal limit for alcohol (OLLA; 80 μg/L), whereas 37% (*n* = 1687) had some level of alcohol detected in the BAS. Twenty-seven percent (*n* = 811) of patients screened positive for THC and 22% (*n* = 656) for cocaine. Figure 1 shows the proportions of patients who were screened positive for other substances in the UDS. The proportion of patients OLLA

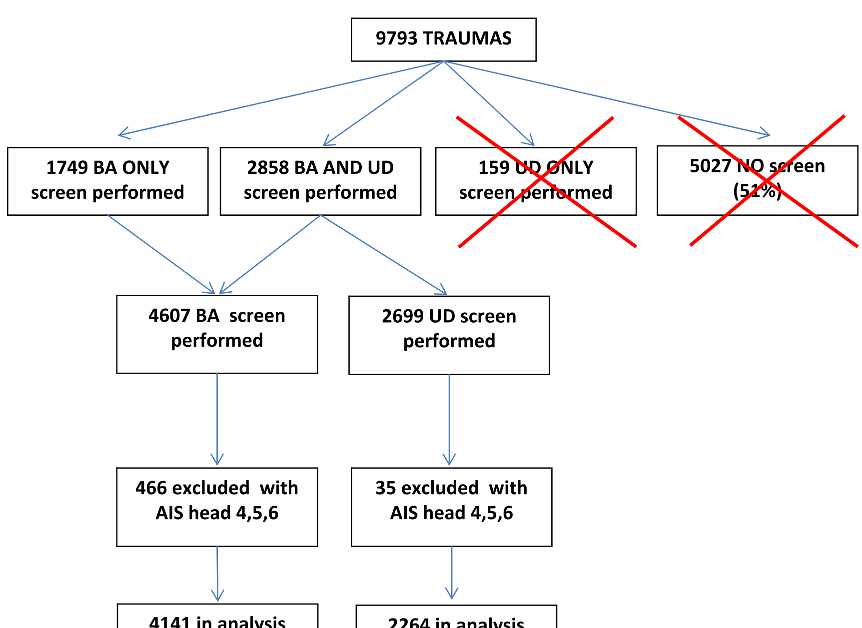

Fig. 2 – Flow diagram of study patients included in clinical outcomes analyses. AIS = abbreviated injury scale; BA = blood alcohol; UD = urine drug. (Color version of figure is available online.)

Table 1 – Predictors of substance screening (multivariate logistic regression).

Total n = 9106	BAS n = 4517		UDS n = 2927	
	OR (95% CI)	P value	OR (95% CI)	P value
Age (y)				
≤45 (*versus*>45)	1.59 (1.43–1.78)	<0.001	1.58 (1.41–1.78)	<0.001
Gender (*versus* F)	1.64 (1.47–1.84)	<0.001	1.16 (1.04–1.30)	0.01
Injury blunt (*versus* pen)	1.67 (1.44–1.94)	<0.001	2.22 (1.92–2.58)	<0.001
ISS	1.01 (1.00–1.01)	0.01	1.00 (1.00–1.01)	0.03
GCS	1.04 (1.01–1.06)	0.03	1.01 (0.98–1.02)	0.85
Race				
Black (*versus* white)	1.20 (1.07–1.35)	0.30	1.12 (1.00–1.26)	0.61
Hisp (*versus* white)	1.13 (0.94–1.36)	0.95	0.99 (0.83–1.18)	0.14
Other (*versus* white)	1.23 (0.92–1.64)	0.48	1.29 (0.99–1.70)	0.11
Trauma level				
2 (*versus* 3)	8.09 (6.84–9.58)	<0.001	3.62 (3.18–4.13)	<0.001
1 (*versus* 3)	7.99 (6.43–9.92)	<0.001	3.06 (2.57–3.66)	<0.001

CI = confidence interval; F = female; GCS = Glasgow coma scale; Hisp = hispanic; ISS = injury severity score; M = male; pen = penetrating; trauma level = trauma alert activation level.

plus opiates only (no other substance) was 67% (n = 790), whereas 40% (n = 327) of THC positive patients and 39% (n = 257) of cocaine positive patients who were screened positive only for the respective substance plus opiates.

Although determining potential biases in screening was not one of our initial objectives for this study, identifying inconsistencies in screening was important for examining our stated aims given that 51% (n = 5027) of patients identified during our specified period had not been screened for substance use. Therefore, we first sought to examine the population of the 9793 (complete data for 9106) patients with trauma to determine if there were any differences between those screened and those not screened. Age, gender, type of injury, race, ISS, GCS, and trauma alert level were chosen *a priori* for model inclusion in a logistic regression model predicting screening status. Table 1 shows that among patients with trauma, those aged ≤45 y were more likely to get BAS than those aged >45 y (95% CI of OR 1.43–1.78, $P < 0.001$) and males were more likely to get BAS than females (95% CI of OR 1.47–1.84, $P < 0.001$) while controlling for ISS, GCS, race, injury type, and trauma alert level (C-statistics for BAS model 0.835 and for UDS model 0.772). Both groups (male *versus* female and age ≤45 y *versus* >45 y) were also more likely to get UDS (male, 95% CI of OR 1.04–1.30, $P = 0.001$ and age ≤45 y, 95% CI of OR 1.41–1.78, $P < 0.001$). Race was not found to be a predictor of being screened. Patients with blunt trauma were more likely to get screened than patients with penetrating trauma for alcohol (95% CI of OR 1.44–1.94, $P < 0.001$) and for drug use (95% CI of OR 1.92–2.58, $P < 0.001$). As expected from policy at DUMC, patients with level 1 and level 2 trauma were more likely to get BAS compared with those with level 3 trauma (95% CI of OR 6.43–9.92, $P < 0.001$ for level 1 *versus* level 3, 95% CI of OR 6.84–9.58, $P < 0.0010$ for level 2 *versus* level 3) with a similar finding for UDS. Specifically, 31% (2100/6685) of patients with level 3 trauma, 87% (1338/1539) of patients with level 1 trauma, and 86% (1357/1569) of patients with level 2 trauma received BAS.

Next, we analyzed patients who were screened again excluding those with AIS head 4, 5, or 6 as detailed in methods. Thus, 4141 patients with BAS and 2264 patients with UDS were included in further analysis. We also chose to examine only alcohol use, cocaine use, or THC use as benzodiazepines and opiates are frequently given therapeutically during trauma and there is no reliable way to distinguish therapeutic use during trauma *versus* recreational or prescribed patient use. In Addition, the use of other substances was very low, (Fig. 1) so we focused on the most common substances in our patient population. Characteristics of this study population are listed in Tables 2 and 3. The GCS and ISS appeared to be similar among patients who were screened positive and those who were screened negative for alcohol, THC, or cocaine (Table 2). Approximately 70% of patients presenting with trauma were men and were aged ≤45 y during the study period (Table 3).

The proportion of patients OLLA aged ≤45 y (n = 762, 26.5%, 95% CI: 24.9%–28.2%) was not different from the proportion of patients OLLA aged >45 y (n = 339, 26.8%, 95% CI: 24.5%–29.3%; Table 3). The proportion of males OLLA (n = 841, 27.2%, 95% CI: 25.7%–28.8%) was not different from the proportion of females OLLA limit (n = 260, 24.8%, 95% CI: 22.3%–27.5%; Table 3). Cocaine use among screened males (23.4%, 95% CI: 21.6%–25.3%) was higher than that among screened females (16.6%, 95% CI: 15.7%–21.1%) as was THC use among screened males (29.9%, 95% CI: 27.9%–32.0%) compared with screened females (20.6%, 95% CI: 17.9%–23.6%). Table 3 also lists proportions of patients who were screened for alcohol and drug use among races and type of injury. Notably, the proportion of patients OLLA was not different between penetrating (23.7, 95% CI: 21.2%–26.5%) and blunt trauma (27.4%, 95% CI: 25.9%–29.0%), although positive screens for THC (46.9%, 95% CI: 42.4%–51.3% *versus* 23.1%, 95% CI: 21.2%–25.0%) and cocaine (30.1%, 95% CI: 26.2%–34.4% *versus* 19.5%, 95% CI: 18.0%–21.4%) were higher in patients presenting with penetrating trauma compared with those presenting with blunt trauma.

We next examined whether drug or alcohol use predicted mortality or predicted any of the selected outcomes measures (ICU admission, VR, LOS 3 d or more, and not going directly home for the ED). Table 4 shows the unadjusted numbers of each event in different subgroups of screen positivity. Each event was modeled with the following covariates chosen *a priori*: age, ISS, GCS, and trauma type. Gender was also

Table 2 – Differences in GCS and ISS between patients who screened positive and those who screened negative for substances.

Variable	ETOH+ 1101/4141 (26.6%)	ETOH− 040/4141 (73.4%)	THC+ 726/2664 (27.2%)	THC− 1938/2664 (72.7%)	COC+ 571/2664 (21.4%)	COC− 2093/2664 (78.6%)
GCS (mean with SD)	13.7 ± 3.31	14 ± 2.91	13.9 ± 3.02	13.9 ± 3.04	13.8 ± 3.12	13.9 ± 3.01
ISS (mean with SD)	8.41 ± 8.37	9.05 ± 8.72	8.8 ± 8.13	9.2 ± 8.73	8.5 ± 7.65	9.3 ± 8.77

COC+ = those who screened positive for cocaine; ETOH+ = those who screened OLLA use; ETOH− = those not screened OLLA; GCS = Glasgow coma scale; ISS = injury severity score; SD = standard deviation; THC+ = those who screened positive for THC.

included because of the differences in screening. While controlling for age, gender, GCS, ISS, and trauma type, neither alcohol level nor screening positive for THC or cocaine was significantly associated with mortality (Table 5, C = 0.938). As expected, older age, higher ISS, and a lower GCS predicted mortality.

There was no association between screening positive for alcohol and/or drugs and need for ventilator (C = 0.924), going home from the emergency room (C = 0.875), or having LOS 3 d or more (C = 0.85). A higher alcohol level was predictive of ICU admission (OR 1.001, 1.000–1.002, $P = 0.0174$). Not screening positive for cocaine use predicted ICU admission (OR 1.46, 95% CI: 1.06–2.02, $P = 0.023$) as shown in Table 6 (C = 0.895). Increasing age ($P < 0.001$), blunt trauma ($P < 0.001$), lower GCS ($P < 0.001$), and higher ISS ($P < 0.001$) predicted ICU admission, whereas gender did not.

4. Discussion

The aims of this study were to determine the prevalence of alcohol and drug use among screened trauma patients at the time of presentation to the ED and to determine if substance use led to increased mortality and worse clinical outcomes. The percentages of patients with any alcohol detected (37%), THC (27%), and cocaine use (22%) were found in this study, and period appear slightly lower but within the range of that in other reports from the late 1980s through present which suggest that 27%–47% of trauma patients have alcohol detected and 30%–40% have drugs detected when routine screening is used [17,18]. Since 51% of patients we examined were not screened, the true prevalence of drug and alcohol use in this population is unknown. We found that drug or alcohol use was not predictive of mortality or other clinical outcomes that we examined in this study. Unfortunately, with 51% of the patients in our study not receiving BAS or UDS, estimating the deleterious effects on clinical outcomes of drug and alcohol use is difficult.

In a study of 996, 225 patients from 258 United States facilities from 1998 to 2003 using NTRACS, only 36.3% of patients admitted with trauma were screened for drug use and half were screened for alcohol use [7]. Thus, although our level of screening (47% for BAS and 31% for UDS) may reflect institutional routines, it is in alignment with the largest published series on screening. Our policy mandates screening for patients with level 1 and level 2 trauma, whereas only a recommendation for patients with level 3 trauma. Patients with level 3 trauma had a statistically significant less incidence of screening and account for a large portion of the missing screens. However, screening was still missed for some patients with level 1 and level 2 trauma. Possible explanations for omitted screens may include physician bias,

Table 3 – Subject characteristics overall and by substance screen positivity.

Variable	BAS		UDS		
	Total ($n = 4141$)	ETOH+ ($n = 1101$)	Total ($n = 2664$)	THC+ ($n = 726$)	COC+ ($n = 571$)
Age (y)					
Mean (range)	38.2 (16–99)	38.4 (16–94)	38.0 (16–99)	29.7 (16–74)	37.2 (17–67)
Age ≤45	2876/4141 (69.5%)	762/2876 (26.5%)	1857/2664 (70%)	654/1857 (35.2%)	425/1857 (23%)
Age >45	1264/4141 (30.5%)	339/1264 (26.8%)	801/2664 (30%)	72/801 (8.9%)	146/801 (18.2%)
Gender					
Male	3093/4141 (74.7%)	841/3093 (27.2%)	1911/2664 (72.8%)	572/1911 (29.9%)	447/1911 (23.4%)
Female	1048/4141 (25.3%)	260/1048 (24.8%)	748/2664 (28.5%)	154/748 (20.6%)	124/748 (16.6%)
Trauma type					
Penetrating	974/4083 (23.9%)	231/974 (23.7%)	478/2616 (18.3%)	224/478 (46.9%)	144/478 (30.1%)
Blunt	3109/4083 (76.1%)	852/3109 (27.4%)	2138/2616 (81.7%)	494/2138 (23.1%)	420/2138 (19.6%)
Race					
White	1853/4128 (44.9%)	482/1853 (26.1%)	1240/2652 (46.8%)	293/1240 (23.6%)	197/1240 (15.9%)
Black	1667/4128 (40.4%)	422/1667 (25.3%)	1027/2652 (38.7%)	377/1027 (36.7%)	296/1027 (28.8%)
Hispanic	474/4128 (11.5%)	165/474 (34.9%)	296/2652 (11.2%)	27/296 (9.1%)	54/296 (18.2%)
Other	167/4128 (4%)	31/167 (18.6%)	89/2652 (2.4%)	27/89 (30.3%)	23/89 (25.8%)

COC+ = those who screened positive for cocaine use; ETOH+ = those who screened OLLA; THC+ = those who screened positive for THC use.

Table 4 – Number of clinical events by substance screen results.

Substance	ED not home	LOS ≥3	Ventilator	ICU	ED dead	Hospital dead
ETOH+ (1101)	336 (33%)	394 (36%)	202 (18%)	255 (24%)	2	11 (1%)
ETOH− (3040)	974 (33%)	1118 (37%)	512 (17%)	634 (21%)	10	60 (2%)
THC+ (726)	235 (33%)	248 (35%)	129 (18%)	149 (21%)	0	4 (0.6%)
THC− (1932)	586 (30%)	763 (40%)	328 (17%)	449 (23%)	12	67 (3.4%)
COC+ (571)	184 (32%)	204 (37%)	93 (17%)	107 (20%)	1	4 (0.7%)
COC− (2087)	637 (31%)	807 (39%)	364 (17%)	491 (24%)	11	67 (3.2%)

COC+ = those who screened positive for cocaine use; ED = emergency department; ED dead = died in ED; ETOH+ = those who screened OLLA use; Hospital dead = died during hospital course; ICU = intensive care unit; LOS = length of stay; THC+ = those who screened positive for THC use.

urgency to the operating room, early discharge, or rapid demise. For example, of 13% (201/1539) of patients with level 1 BAS failures, 25% (51/201) went directly to the operating room, 7% (12/201) were dead on arrival or had rapid demise, and 4% (8/201) were urgently transferred to a burn center (our institution does not have a burn center). We did not examine the incidence of screening by individual physician but this may be important to determine bias. Fewer studies have examined biases in substance screening of trauma patients . Kon *et al.* [19], using NTRACS in patients (n = 79, 246) from 58 institutions, found that trauma patients from racial and ethnic minorities were screened more frequently for alcohol and drugs after adjusting for covariates similar to those included in our analysis. Although we found no differences by race, we did unexpectedly find significantly less screening of older compared with younger patients, women compared with men, and of patients with penetrating trauma compared with those with blunt trauma; the proportions of patients who were screened positive for alcohol and drugs were similar in these subgroups. The reason for these biases is unclear from our study, but certainly these biases could thus overestimate prevalence in these subgroups. However, these biases could also underestimate the prevalence of substance use which may adversely impact at least the following: clinical care during immediate recovery, future occurrence of injuries related to continued alcohol and drug use, and costs related to traumatic injury. A multicenter study of trauma centers with similar demographics could be performed to truly evaluate levels of screening and potential biases in screening.

Alcohol and drug use have known deleterious effects on cardiovascular, respiratory, and immune responses to injury [3,11–14,20]. Preinjury drug and alcohol use have been shown to lead to significantly higher complication rates and mortality [3,21]. Therefore, provider knowledge of drug and alcohol use is important in optimal management of patients, where prophylactic measures may be used in efforts to negate or ameliorate some of the harmful effects of substance use on recovery after traumatic injury. Some studies have reported an increased or no difference in mortality for those screened positive for alcohol, whereas others have reported that elevated blood alcohol level may be protective of trauma patient mortality [21–23]. Our study failed to show a difference in mortality among screened patients between those screened positive and those screened negative for substance use. An additional critical issue is to determine if patients not screened were harmed by the lack of screening. Although this was outside the aims of this study, future studies should examine outcomes of patients not screened compared with those screened.

In addition to mortality, we chose to examine clinical outcomes from data, which are recorded in NTRACS. Although

Table 5 – Predictors of mortality among screened patients (multivariate logistic regression).

Variable	OR (95% CI)	P value
Age	1.06 (1.04–1.07)	<0.001
Gender		
M (*versus* F)	1.07 (0.60–1.91)	0.82
Injury		
Blunt *versus* Pen	0.59 (0.29–1.22)	0.16
ISS	1.08 (1.06–1.11)	<0.001
GCS	0.79 (0.75–0.83)	<0.001
ETOH level	0.99 (0.99–1.00)	0.14
THC		
Neg *versus* Pos	2.27 (0.64–8.80)	0.20
Cocaine		
Neg *versus* Pos	1.74 (0.57–5.32)	0.33

CI = confidence interval; ETOH = alcohol level; F = female; ISS = injury severity score; M = male; Pen = penetrating; GCS = Glasgow coma scale; Neg = screen negative; Pos = screen positive.

Table 6 – Predictors or ICU admission among screened patients (multivariate logistic regression).

Variable	OR (95% CI)	P value
Age	1.02 (1.01–1.02)	<0.001
Gender		
M *versus* F	0.96 (0.76–1.21)	0.71
Injury		
Blunt *versus* Pen	0.45 (0.68–0.73)	<0.001
ISS	1.17 (1.16–1.19)	<0.001
GCS	0.70 (0.68–0.73)	<0.001
ETOH level	1.00 (1.00–1.01)	0.02
THC screen		
Neg *versus* Pos	0.88 (0.65–1.20)	0.42
Cocaine screen		
Neg *versus* Pos	1.46 (1.06–2.02)	0.02

CI = confidence interval; ETOH = alcohol level; F = female; GCS = Glasgow coma scale; ICU = intensive care unit; ISS = injury severity score; M = male; Neg = screen negative; Pos = screen positive; Pen = penetrating.

drug, cocaine, or THC use did not predict many of our chosen outcomes (LOS 3 y or more , VR, and EDD), there were some associations with ICU admission. Particularly, a higher level of alcohol was predictive of ICU admission ($P = 0.0174$). The ICU admission likely reflects a more severely injured patient or higher physician concern. Surprisingly, cocaine use was associated with a lower risk of ICU admission with an OR of 1.46 (95% CI: 1.06–2.02). Cocaine is a known central nervous stimulant and use in the acute setting can increase alertness and energy. However, chronic use of smoked cocaine can be associated with pulmonary infiltrates, renal failure, lethargy, and depression. The half-life in blood ranges from 1 to 30 h, but there is no reliable way to distinguish acute use from chronic use. The findings from this study may be important, but the conclusions we can draw are somewhat limited because we do not know the true level of use in our study population.

Although the cost and preventive measures are somewhat outside the scope of this article, the deficiencies in substance screening do potentially offer an area of focus for improvements. Patients with a positive substance screen can be referred for interventions that may prevent future substance related injuries. A traumatic injury is a "teachable moment" for behavior change [24]. Interventions after alcohol-related injuries have been shown to decrease subsequent alcohol consumption, injuries, and other problems in four randomized controlled trials [25–28]. Preinjury drug and alcohol use have been found to be associated with significantly greater hospital charges for the treatment of trauma patients [3,29] and performing routine screening during presentation to the ED with trauma may ultimately lead to a reduction in overall costs. However, some states still have the Uniform Accident and Sickness Policy Provision Law, which permits insurers to deny coverage to patients who are injured while under the influence of alcohol or drugs, may discourage providers and institutions from performing routine screening as insurers may deny payment to providers who have delivered care under this law. Ultimately, uniform substance screening should be a part of trauma care because of the high frequency of use and potential risks for complications.

Whether routine screening will ultimately lead to the observation of a higher mortality and worse clinical outcomes among those screening positive for cocaine, THC, or alcohol is unknown. We were not able to study the clinical outcomes like return to activities of daily living, infection, and other complications that might ultimately be important. The relationship between substance use and mortality in this study is limited because of the 312 deaths (both ED and hospital) that occurred during the study period, only 27% (83) of the patients were screened for alcohol use and fewer for drug use. We also did not distinguish several admissions by the same individual, although this is relatively rare. In addition, we did not control for comorbidities and a variety of other factors that may contribute to mortality after traumatic injury. We did attempt to control for injury severity with ISS and GCS in addition to age, gender, and trauma type. The characteristics (age, gender, type of trauma, ISS, and GCS) of our population are similar to those in other reports [3]. The strength of our study is the identification of specific drugs; we were able to exclude opiates and benzodiazepines, which are often given therapeutically during trauma. In other published reports, the presence of opiates and benzodiazepines are classified as screen "positive" for drugs, which may explain some of the discrepancies found in the literature related to drug use and mortality [4,8]. Finally, the collective faculty and staff were relatively constant during the chosen period, thus, major changes in screening practices were likely not present. Despite limitations, the findings of this study are important to guide improvements in delivery of care in patients presenting with trauma.

5. Conclusions

Among 9106 trauma patients seen between 2006 and 2010, women, those aged ≥45 y, and those with penetrating trauma were less likely to receive BAS or UDS although among those screened, substance use was as common in the other subgroups. Because substance use may adversely affect clinical outcomes, differential screening that is age, gender, or otherwise biased may place these patients at risk for receiving inadequate or suboptimal care. To get a true estimate of the impact of substance use on outcomes after trauma, substance screening will need to be more broadly applied.

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Beasley: study design, data analysis, statistical analysis, manuscript draft and revisions.

Ostbye: formation of clinical question, research plan, manuscript preparation and revision.

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Foley: data management.

Scarborough: study design, manuscript draft and revisions.

Turley: data analysis, manuscript design.

Shapiro: principal investigator, study design, hypothesis formation, data analysis, manuscript preparation and revision.

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