



Original article

Drug and alcohol use in Tanzanian road traffic collision drivers

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ABSTRACT

Introduction: Road traffic collisions (RTCs) are an important public health problem in low and middle-income countries (LMIC), where 90% of RTC deaths occur. The World Health Organization has suggested strategies to address excess mortality from RTCs including efforts to combat driving after using alcohol or drugs. Data on the impact of drug and alcohol use on RTCs is limited in many low-resource settings including Tanzania. We sought to examine the prevalence of drug and alcohol use in Tanzanian RTC drivers.

Methods: This prospective, observational study was conducted in the emergency centre (EC) of Muhimbili National Hospital (MNH) in Dar es Salaam, Tanzania. We enrolled adult drivers presenting within 24 h of an RTC. We collected a saliva test of blood alcohol content (BAC) and a urine drug screen (UDS) and administered a validated substance use disorder screening tool, the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). Patients were excluded from individual analyses if they could not produce saliva or urine or answer questions. Primary outcomes were rates of positive BAC, UDS and self-reported risky alcohol and drug use patterns.

Results: We screened 5264 trauma patients and enrolled 418, in whom 190 had a BAC, 364 had a UDS, and 410 had a complete ASSIST. 15 of 190 patients (7.9%) had a positive BAC, and 67/361 (18.7%) had a positive UDS for at least one drug. ASSIST scores showed 75/410 (18.3%) patients were at moderate or high risk for alcohol use disorder. Few were at risk for disordered use of other non-tobacco substances.

Discussion: In our population of RTC drivers, positive BAC and UDS tests were rare but many patients were at risk for an alcohol use disorder. Ideal screening for substance use in Tanzanian trauma populations may involve a combination of objective testing and a verbal screening tool.

African relevance

- Mortality from road traffic collisions (RTCs) disproportionately affects African nations, and strategies are needed to both reduce the number and lethality of collisions.
- Screening for substance use disorders among drivers, which increases both the severity and likelihood of a collision, is uncommon in African emergency centres (ECs) and little data is available regarding the ideal screening strategy.
- Here, we present data from a tertiary center in Tanzania on evidence of risky substance use in drivers involved in RTCs, including both

objective testing for recent alcohol and drug use as well as self-reported behaviors.

Introduction

The incidence of RTCs has risen precipitously in the last decade. Data from low- and middle-income countries (LMICs) demonstrate rising morbidity and mortality, particularly in urban areas with rapidly increasing rates of motorisation [1]. The disproportionately high mortality from RTCs in LMICs is thought to be multifactorial including road infrastructure poorly suited for rapid urbanisation, lack of safety standards, and limited enforcement of road safety laws [2]. Driving after

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substance use, particularly alcohol, is a well-established risk factor for RTCs and is associated with increased injury severity, hospital length of stay and mortality [3,4]. The link between substance use and RTCs has largely been documented in high-income countries, however further study within LMICs are required [5].

In high-income countries, the association of alcohol and drug use with trauma has resulted in incorporation of alcohol and drug screening into trauma care algorithms [6]. However, this strategy is expensive and may not be feasible in LMICs. Further studies are needed on the value of laboratory testing, including blood alcohol content (BAC) level and urine drug screen (UDS), relative to lower-cost options such as questionnaires in identifying drug and alcohol use.

In Tanzania, intoxication among drivers has been poorly studied but appears to be common, with some noting, “it is an open secret that drivers drink and drive with impunity.” [7] Preliminary work by *Mundenga* et al. (2019) assessed for objective evidence of drug and alcohol use in trauma patients presenting to the EC of Muhimbili National Hospital (MNH) within 12 h of injury. They found that 49% of patients tested positive for alcohol and 36% of patients tested positive for illicit drugs [8]. While this study included all trauma patients, data on drug and alcohol use in drivers can help inform targeted interventions. Further, injured patients have high rates of ‘risky’ drug and alcohol use [9–11], which contributes to trauma recidivism [12]. Multiple professional organisations in high income countries have recommended screening and brief intervention (SBI) for substance use disorders in trauma patients [10,13]. Once thought to be too resource-intensive for LMICs, SBI has been successfully deployed in South African ECs [14,15]. An improved understanding of rates of risky drug and alcohol use in our population could identify opportunities to incorporate SBI into trauma care in Tanzania.

To address these gaps, we evaluated the prevalence of risky drug and alcohol use in Tanzanian RTC drivers.

Methods

Patients were enrolled at MNH in Dar es Salaam, the most populated city of the East African nation of Tanzania. MNH is Tanzania's largest tertiary care hospital, and the EC receives referrals from district and regional hospitals around the nation. Since 2016, all trauma patients have been prospectively enrolled in a trauma databank by trained research assistants. Additional screening for substance use as detailed below was integrated into enrollment in the trauma databank from December 4th, 2018 until September 1st, 2019.

We conducted a prospective, observational trial of adult RTC drivers presenting to the MNH EC within 24 h of collision. We included drivers of all motorised vehicles including cars, trucks, buses, motorcycles, and *bijajs* (open-air three-wheeled vehicles). Patients were identified by trained research assistants who screened the EC electronic tracking board 24-h per day, seven days per week for chief complaints related to trauma. Patients were enrolled if they were able to complete at least one form of testing (BAC, UDS or ASSIST questionnaire). Patients were excluded from alcohol saliva test results if they were unable to produce a saliva sample, intubated or if copious blood was present in the oral cavity. They were excluded from urine drug testing analysis if they were unable to produce a urine sample, and catheterisation was not indicated for routine care. Patients were excluded from questionnaire testing if they (a) were unable to consent due to being unresponsive or confused, (b) did not speak English or Swahili, or (c) refused to answer questions.

The study was approved by the institutional review board at MNH with a waiver of informed consent, though assent was sought when clinically reasonable and the patients' right to refuse participation was honored.

BAC was measured from saliva samples using qualitative alcohol saliva test strips W53–S (Wondfo, Willowbrook, IL, USA). Urine samples were tested with RapidCheck nine-panel multi-drug test card (Craig Medical, Vista, CA, USA). The length of time for which each substance

can be detected in urine varied based on multiple factors but is typically two to four days for most substances including marijuana (after single use), opiates, cocaine and short-acting benzodiazepines [16].

The time of sample collection and results were recorded. Drug and alcohol tests were interpreted prior to questioning patients about substance use patterns. To validate results, urine and saliva testing cards were reviewed by study authors (PN, AD) to ensure appropriate interpretation of the results.

To assess general substance use patterns, we used the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) version 3.0, a tool developed for the World Health Organization (WHO) to screen for high risk substance use [17]. This tool was validated in seven countries, including one in Sub-Saharan Africa (Zimbabwe), and has been widely used in LMICs [18]. We used an English language source, which was translated by two separate Swahili native-speakers fluent in English. Discrepancies in the two Swahili-language versions were adjudicated by a bilingual author (PN) whose native language is Swahili. Research assistants verbally administered the Swahili or English language ASSIST depending on patient's preferred language.

We calculated our sample size to determine the number of patients needed to report a proportion of positive screens with a 5% margin of error. Based on data from *Mundenga* et al, we assumed a positive screening rate of roughly 50% in our study population [8]. We calculated that assessment of 385 subjects would provide a confidence level of 95% that our point estimate of the positive screening rate would fall within $\pm 5\%$ of the actual value.

The ASSIST consists of seven items assessing the frequency of use, or problems associated with use, of each of ten substances (alcohol, tobacco, cannabis, cocaine, amphetamine-type stimulants, sedatives, hallucinogens, inhalants, opiates, and “other drugs”), for which a Specific Substance Involvement (SSI) score can be calculated. In validation studies of the ASSIST, the authors suggest that for alcohol, SSI scores of 0–10 be considered low risk use, scores of 11–26 be considered moderate risk use, and score of ≥ 27 be considered high-risk use; for all other substances, cut-offs of 0–3, 4–26, and ≥ 27 are used. While these cut-offs have not been validated in Tanzania, psychometric testing in multiple countries including LMICs showed that SSI score at these cutoffs had good discriminative validity to detect non-problematic use (low-risk), disordered use (moderate risk) and dependence (high risk), particularly for alcohol, cannabis, amphetamines, opioids and cocaine [18].

Study data were collected and managed using REDCap electronic data capture tools hosted at MNH [19,20]. The data was analysed in Microsoft Excel (Microsoft Corporation, Redmon, WA, USA) and are summarised with descriptive statistics.

Results

We screened 5264 eligible trauma patients over the study period, of whom 4731 were excluded because they were not an RTC driver (4609 patients), presented >24 h after the collision (117 patients), or were younger than 18 years old (5 patients). An additional 115 patients were excluded because they were unable to respond to questioning, produce samples (15 patients) or declined participation (100 patients). Our final study population was 418 (Fig. 1). Of these, only eight patients (1.9%) were missing a complete ASSIST, of whom all had a UDS but only one had a BAC (12.5%) performed. Among patients with an ASSIST ≥ 1 (indicating lifetime illicit substance use), 41.7% had a UDS and 55.9% had a BAC performed. For patients with an ASSIST of 0 (reporting no lifetime substance use) 84.1% had a UDS and 41.7% had a BAC performed.

The majority of our patients were male ($n = 405$, 96.9%), young (median age 30, IQR 25–36) and drove motorcycles (84.5%) or cars (10.3%) (Table 1). Over two thirds of patients were transferred to our facility from outlying hospitals. The median time between injury and EC arrival was 5.81 h (IQR 3.79–9.38 h) for those referred from another facility versus 4.2 h (IQR 1.94–9.70) for those presenting directly to the

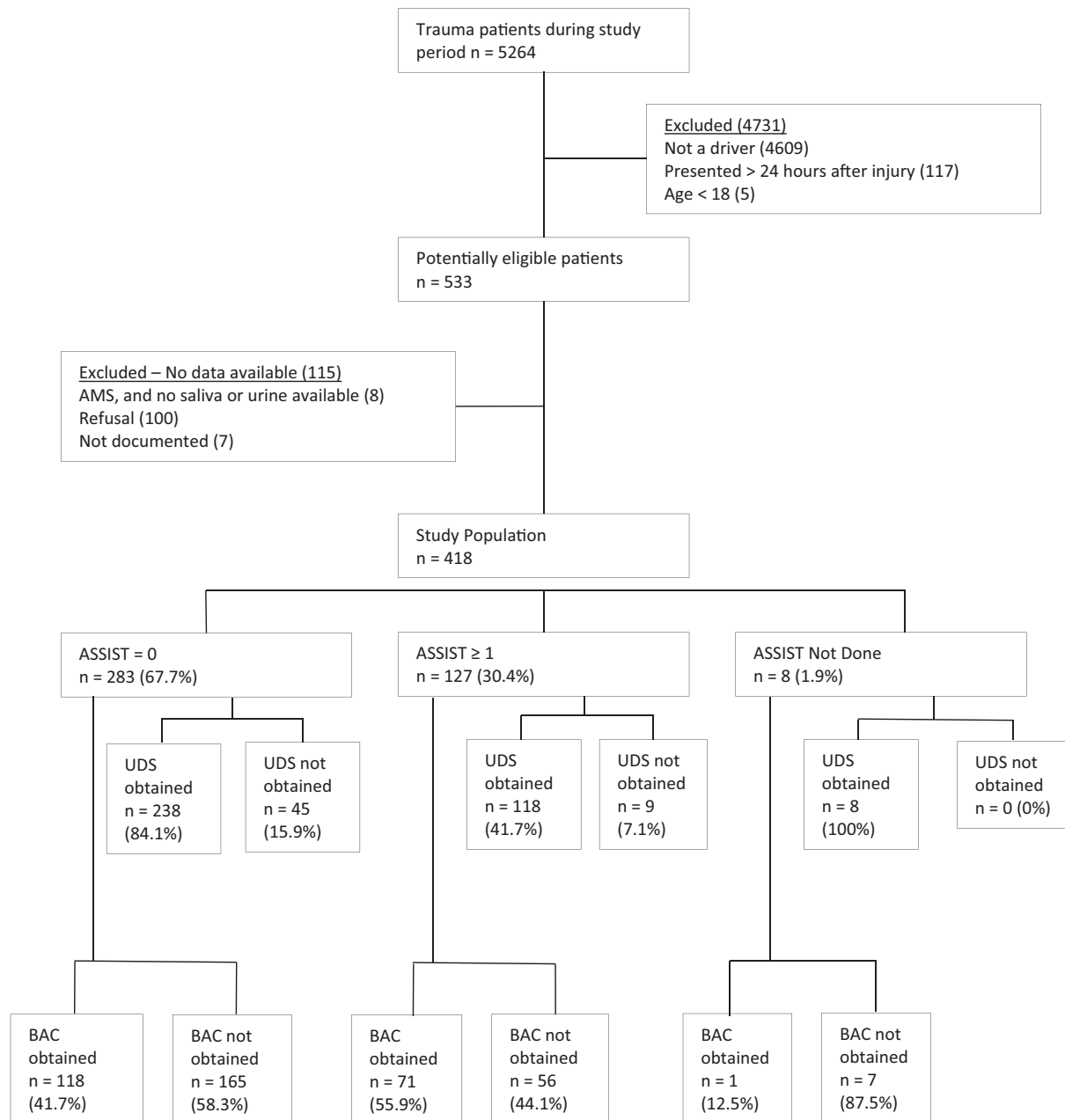


Fig. 1. Study flowchart.

Table 1
Descriptive characteristics of patients enrolled.

Total patients	418
Median age, years (IQR)	30 (25- 36)
Gender, female (%)	13 (3.1%)
Vehicle driven (%)	
Motorcycle	353 (84.5%)
Car	43 (10.3%)
Bus	1 (0.2%)
Bajaj	21 (5.0%)
Referred from other hospitals	
Yes	288 (68.9%)
No	130 (31.1%)

IQR = interquartile range.

MNH EC.

BAC testing was available for 190 patients, or 45.5% of the study population. For those in whom it was unavailable, 103 (45.2% of patients without a BAC) could not produce a saliva sample, 93 (40.8%) met manufacturer-recommended exclusions (including intubation, 6 patients, and copious oral bleeding, 87 patients), and 32 (14%) did not consent. The majority (175, 92.1%) of patients who had BAC testing had levels <20 mg/dL. 14 patients (7.4%) had a BAC of 20-80 mg/dL, and

Table 2
Blood alcohol content levels by saliva testing.

Blood alcohol	N = 190, count (%)
0-20 mg/dL	175 (92.1%)
20-80 mg/dL	14 (7.4%)
80-300 mg/dL	1 (0.5%)
>300 mg/dL	0 (%)

one patient (0.5%) had a BAC of 80-300 mg/dL. No patients had a BAC >300 mg/dL (Table 2).

A UDS was obtained in 361 patients (86.4%). Of the 57 in whom a UDS was not obtained 52 (91.2) had no urine available and the reason was not documented for five patients (8.8%). In patient where a UDS was obtained, 67 (18.6%) had a positive result for at least one illicit substance. The most detected illicit substance was marijuana in the form of tetrahydrocannabinol (THC) (n = 33, 9.1%), followed by benzodiazepines (n = 28, 7.8%), phencyclidine (PCP) (n = 5, 1.4%), non-methadone opiates (n = 4, 1.1%), barbiturates (n = 3, 0.8%), methadone (n = 1, 0.3%), and cocaine (n = 1, 0.3%). (Table 3).

A total of 176 patients had both a UDS and BAC level completed. Of these, three (1.7%) had both a positive UDS and BAC, all of which were positive for THC and one of which was positive for THC and PCP. Nine patients (5.1%) had a positive BAC and a negative UDS, 22 (12.5%) had a positive UDS and a negative BAC and in 142 patients (80.7%) both tests were negative.

The ASSIST tool was completed for 410 patients (98.1%). Of the eight (1.9%) patients who did not have a complete ASSIST tool, seven (87.5%) had an altered level of consciousness and the reason was not documented for one (12.5%). Seventy-five patients (18.3%) were at high (n = 18, 4.4%) or medium risk (n = 57, 13.9%) for an alcohol use disorder. Three patients (0.7%) were at high (n = 1, 0.2%) or medium risk (n = 2, 0.5%) for an opiate use disorder. 13 patients (3.2%) were at medium risk for a cannabis use disorder. One patient (0.2%) each was at medium risk for sedative and hallucinogen use disorders (Table 4).

Among the 15 patients who had a positive BAC, one was at high risk (score 30) and six were at medium risk for an alcohol use disorder. Five of these patients had an ASSIST score of 0 (reporting no lifetime alcohol use), including the sole patient who presented with a BAC of 80-300 mg/dL.

Among patients had who a positive UDS, one patient who was positive for methadone had a very high ASSIST for opiates (score of 31). Six patients who had a positive UDS for THC (17.6%) had positive ASSIST scores for cannabis. The one patient who had a positive UDS for cocaine had an ASSIST score of 0 for cocaine. All three patients who had a UDS positive for non-methadone opiates had an ASSIST score of 0 for opiates. One of the five patients (20%) who tested positive for PCP had a positive ASSIST score for hallucinogens (score of 15); the four others had an ASSIST score of 0 for hallucinogens.

In a post-hoc analysis, we assessed the percentage of patients who presented within 6 h of injury with positive BAC tests. A total of 260 patients arrived within 6 h of injury, including 111 patients who had a BAC test. Of these, twelve patients (10.8%) had a positive BAC (all with a level of 20-80 mg/dL) vs 8% in our overall dataset (p = 0.36).

Discussion

In this study, which is among the first in the region to specifically focus on substance use in RTC drivers, relatively few patients had a

Table 4
ASSIST scores. N = 410.

	Low risk (score 0-3 for drugs, 0-10 for alcohol)	Medium risk (score 4-26 for drugs, score 11-26 for alcohol)	High risk (score >/= 27)
Tobacco	348 (84.9%)	58 (14.1%)	4 (1.0%)
Alcohol	335 (81.7%)	57 (13.9%)	18 (4.4%)
Cannabis	397 (96.8%)	13 (3.2%)	0 (0%)
Cocaine	409 (99.8%)	1 (0.2%)	0 (0%)
Amphetamines	410 (100%)	0 (0%)	0 (0%)
Inhalants	410 (100%)	0 (0%)	0 (0%)
Sedatives	409 (99.8%)	1 (0.2%)	0 (0%)
Hallucinogens	409 (99.8%)	1 (0.2%)	0 (0%)
Opioids	407 (99.3%)	2 (0.5%)	1 (0.2%)
Other drugs	410 (100%)	0 (0%)	0 (0%)

positive BAC test within 24 h of injury, with only one driver having a BAC above the legal limit (80 mg/dL [21]). Using a validated substance use disorder screening tool, over one in six patients were at medium or high risk for an alcohol use disorder. Few other patients (<5%) were at risk for disordered use of illegal drugs. The results of the BAC and UDS testing were often discordant with patient-reported behaviors.

This study builds upon prior work at our center that screened adult trauma patients for substance use within 12 h of injury, which found that 47% of 147 patients had a positive alcohol test. Drug testing was performed in 122, of whom 78 (64%) had a positive UDS with marijuana being the most common drug detected (24.5% of patients). Similarly, in Moshi, northern Tanzania, 30% of all injured patients had a positive breathalyser test, including 29% of patients involved in a RTC. [22] Our study builds upon this work by focusing on RTC drivers, in whom recent psychoactive substance use presents the greatest public health threat. We found fewer patients with positive alcohol and drug screens. One explanation for our lower rates of detection is that injured drivers may be less likely to have used illicit substances than other injured patients. Drivers who used alcohol or drugs may also be less likely to seek care immediately for fear of legal consequences. Other studies, including in Sub-Saharan Africa, have demonstrated that intoxicated patients seeking emergency care are more likely to be injured by assaults and falls than RTCs [23–27]. The lower rates of detection in our study may also be due to the prolonged time between injury and EC presentation. Seven of the fourteen patients with a BAC of 20 mg/dL – 80 mg/dL arrived at our EC more than 4 h after injury time. If these patients metabolised alcohol at a standard rate of 15 mg/dL per hour, their BAC would have been higher than the legal limit at time of injury. This effect was seen in both referred (n = 3) and non-referred patients (n = 4). In a post-hoc analysis, we found a trend toward higher detection of alcohol in those who presented within 6 h of injury (10.8%) relative to the total population (8%), however this was not statistically significant.

Few other studies from the region have assessed alcohol use in RTC drivers. In Maputo, Mozambique, a review of a trauma database did not show a statistically significant increase in odds of alcohol use by RTC drivers [26]. A post-mortem study of fatal RTCs found that 66% of car drivers and 52% of motorcyclists were under the influence of alcohol at the time of the accident [28], which is higher than what we report though is expected given spectrum of disease severity. In Eldoret, Kenya, 60% of adult RTC drivers had evidence of alcohol use, and were eight times more likely to have been drinking than passengers, highlighting the importance of this population as a potential target for interventions [29]. No studies from sub-Saharan Africa have assessed drug use in RTC drivers.

Our study includes several limitations, including prolonged transport times of many of our patients which may have decreased the sensitivity of BAC testing as discussed above. We chose to enroll patients up to 24 h after injury in order to obtain a more representative sample of injured patients presenting to our EC and anticipated this would allow for valid testing by both UDS and ASSIST questionnaire. Future studies may benefit from varying the timing of screening based on the assay. In

Table 3
Urine drug screen.

	N = 361 count (%)
All Negative	294 (81.4%)
At Least One Positive	67 (18.6%)
Benzodiazepines	28 (7.8%)
Barbiturates	3 (0.8%)
Cocaine	1 (0.3)
THC	33 (9.1%)
Methamphetamines	0 (0%)
Opiates	4 (1.1%)
PCP	5 (1.4%)
Amphetamines	0 (0%)
Methadone	1 (0.3%)

THC = tetrahydrocannabinol PCP = phencyclidine.

addition, it is unclear how many patients had a positive UDS due to iatrogenic medication administration, particularly for referred patients. 19 of the 27 patients who had a positive test UDS for benzodiazepines and two of the four patients with a UDS positive for opiates had been referred from another facility, where medication administration is often poorly documented. There were limitations regarding our verbal screening process. While we chose a tool (the ASSIST) that had been validated in neighboring Zimbabwe among other countries, this is has not been validated in Tanzania and our Swahili version has not been validated prospectively. We did not collect data on whether patients took the ASSIST in Swahili versus English. Additionally, due to the lack of single rooms in the EC, patients were enrolled and asked screening questions in treatment rooms containing up to six patients. Curtains were used when available, however this limited privacy may have led to underreporting of substance use. Finally, we excluded many obtunded patients resulted in enrolment of a less severely injured population. Only patients with the ability to converse were able to participate in the ASSIST score and the expectorated saliva assay we used was not recommended for use in patients who were intubated or could not follow instructions. We anticipate that these exclusions biased our study toward lower rates of positive BAC tests.

The findings of this study can help inform the optimal substance use disorder screening strategy to identify patients who would benefit from brief intervention or referral for further treatment. Here, BAC testing identified relatively few patients with positive screens. UDS was positive in a greater number of patients, however due to variable metabolism it is unclear when these drugs were used. In contrast, the ASSIST identified many more patients who could be targeted for interventions on alcohol use than BAC testing but had fewer positive results than the UDS. Relying only on the ASSIST tool for screening would have missed a few patients with concerning laboratory evidence of substance use, including the one patient with a BAC greater than the legal limit and patients with evidence of cocaine and cannabis use. Discrepancies between laboratory evidence of substance use and patient reporting use has been demonstrated in other studies, including in Tanzania [8,22]. The benefit of the ASSIST tool is that it is cost-effective, does not rely on laboratory reagents, and can screen for an array of substances. The ideal strategy may involve collection of a blood or saliva alcohol and urine drug screen paired with a validated survey tool. These results should be weighed in the context of budgetary, human resources, and cultural considerations in the design of local substance use disorder screening programs.

In our study of RTC drivers presenting within 24 h of injury, we found relatively low rates of positive BAC and UDS tests. In contrast, using verbal screening questionnaires, we found that over one in six drivers were at risk for an alcohol use disorder. Optimal methods to identify patients in the ED at risk for driving after alcohol or drug use may include a combination of laboratory and verbal screening.

Dissemination of results

The results of the study were shared with the leadership team of the data collection site. Preliminary results of the study have also been presented at the 2019 Society for Academic Emergency Medicine Annual Meeting and the 2019 Emergency Medicine Society of South Africa International Conference.

Authorship contribution statement

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: AD contributed 45%, PN contributed 25%, MR and HS contributed 10% each, EN and JM contributed 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declared no conflicts of interest.

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