Published in final edited form as:

Ann Emerg Med. 2014 November ; 64(5): 516–525. doi:10.1016/j.annemergmed.2014.05.012.

Identifying Patients With Problematic Drug Use in the Emergency Department: Results of a Multisite Study

Wendy L. Macias Konstantopoulos, MD, MPH^{*}, Jessica A. Dreifuss, PhD, Katherine A. McDermott, BA, Blair Alden Parry, BA, CCRC, Melissa L. Howell, BA, BS, Raul N. Mandler, MD, Garrett M. Fitzmaurice, ScD, Michael P. Bogenschutz, MD, and Roger D. Weiss, MD
 Department of Emergency Medicine, Massachusetts General Hospital, Boston, MA (Macias Konstantopoulos, Parry, Howell); the Department of Psychiatry (Dreifuss, Weiss), Harvard Medical School (Macias Konstantopoulos, Dreifuss, Weiss), Boston, MA; the Behavioral Health Partial Program (Dreifuss) and Division of Alcohol and Drug Abuse (McDermott, Weiss), McLean Hospital, Belmont, MA; the Center for the Clinical Trials Network, National Institute on Drug Abuse, National Institutes of Health, Bethesda, MD (Mandler); the Department of Biostatistics, Harvard School of Public Health, Boston, MA (Fitzmaurice); and the Department of Psychiatry, University of New Mexico Health Sciences Center, Albuquerque, NM (Bogenschutz).

Abstract

Study objective—Drug-related emergency department (ED) visits have steadily increased, with substance users relying heavily on the ED for medical care. The present study aims to identify clinical correlates of problematic drug use that would facilitate identification of ED patients in need of substance use treatment.

Methods—Using previously validated tests, 15,224 adult ED patients across 6 academic institutions were prescreened for drug use as part of a large randomized prospective trial. Data for 3,240 participants who reported drug use in the past 30 days were included. Self-reported variables related to demographics, substance use, and ED visit were examined to determine their correlative value for problematic drug use.

Results—Of the 3,240 patients, 2,084 (64.3%) met criteria for problematic drug use (Drug Abuse Screening Test score ≥ 3). Age greater than or equal to 30 years, tobacco smoking, daily or binge alcohol drinking, daily drug use, primary noncannabis drug use, resource-intense ED triage level, and perceived drug-relatedness of ED visit were highly correlated with problematic drug use. Among primary cannabis users, correlates of problematic drug use were age younger than 30 years, tobacco smoking, binge drinking, daily drug use, and perceived relatedness of the ED visit to drug use.

Conclusion—Clinical correlates of drug use problems may assist the identification of ED patients who would benefit from comprehensive screening, intervention, and referral to treatment.

Copyright © 2014 by the American College of Emergency Physicians

^{*}Corresponding Author. wmacias@mgh.harvard.edu.

Author contributions: WLMK, MPB, and RDW developed this secondary analysis. RDW obtained the funding. JAD, KAM, and GMF performed the statistical analyses. WLMK and RDW interpreted the results. WLMK wrote the article, and all authors contributed substantially to its revision. WLMK takes responsibility for the paper as a whole.

A clinical decision rule is proposed. The correlation between problematic drug use and resource-intensive ED triage levels suggests that ED-based efforts to reduce the unmet need for substance use treatment may help decrease overall health care costs.

INTRODUCTION

Background

Of the estimated 22.5 million persons aged 12 years and older who were illicitly using drugs in the United States in 2011, 6.5 million were classified as having a diagnosable (*Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*) drug use disorder or combined drug and alcohol use disorder (3.9 million and 2.6 million, respectively).¹ In addition to the well-documented medical consequences of drug abuse,^{2–5} multiple health outcomes have been linked to drug use, including unintentional injuries, motor vehicle crashes, interpersonal violence injuries because of increased aggression and impulsivity, HIV and other infectious diseases because of high-risk behaviors (eg, risky injection and sexual behaviors), and intentional or accidental overdoses.^{6–8}

Importance

Studies have shown that drug-using individuals are more likely to use the emergency department (ED) for their medical care and are more likely to require hospitalization than their non-drug-using counterparts.^{9–11} The Drug Abuse Warning Network, a public health surveillance system that monitors drug-related morbidity and mortality, estimated that of the 5.1 million drug-related ED visits nationwide in 2011, 2.5 million visits were directly related to use of illicit substances, nonmedical use of pharmaceuticals, or a combination of these.¹² In 2008, the total annual cost of illicit drug use (excluding tobacco and alcohol) was calculated at \$151.4 billion. Not inclusive of substance use treatment, medical care costs alone accounted for \$5.4 billion of the total annual cost.¹³

Substance use-related health events leading to ED visits may constitute opportunistic “teachable moments” for delivering brief but meaningful interventions. In fact, the American College of Emergency Physicians issued a policy statement in 2011 promoting the use of screening, brief intervention, and referral to treatment (SBIRT) in the ED for problematic alcohol use.¹⁴ Although numerous studies have demonstrated the effectiveness of SBIRT in reducing high-risk alcohol use, associated injury recidivism, and driving under the influence,^{15–19} its effectiveness in addressing problematic drug use remains to be definitively demonstrated, though preliminary studies in ED populations show promise.^{20–23}

One significant challenge in addressing drug use disorders in the ED is the difficulty in detecting problematic drug use. Studies have shown that patients tend to deny or underreport illicit drug use.^{24–27} Improving the ability of emergency providers to identify patients with drug use problems is critical to their role in mitigating the health effects of illicit drug use. Determining clinically relevant characteristics that may be indicative of drug use problems may assist emergency providers in identifying patients in most need of comprehensive ED-based screening, intervention, and referral to substance use treatment.

Goals of This Investigation

The present study aims to identify demographic and clinical characteristics associated with problematic drug use in patients who report past 30 day drug use during an ED visit.

MATERIALS AND METHODS

Study Design

As part of a large multicenter randomized prospective trial study, research staff prescreened individuals presenting to the ED during predefined recruitment hours in accordance with local standard operating procedures. Using an approved verbal informed consent script, research staff asked patients to anonymously complete the screening protocol. Using the Brief Information Tool, study staff members recorded basic demographic information (age and sex), chief complaint, ED triage level, and inability or refusal to participate. Study team members then screened participating patients with a composite measure, the Tobacco, Alcohol, Drug questionnaire. The questionnaire captured data on nicotine dependence (the Heavy Smoking Index); heavy drinking or active alcohol abuse or dependence (the Alcohol Use Disorders Identification Test—Consumption); problems such as guilt, blackouts, and withdrawal related to drug use within the last year (the Drug Abuse Screening Test); primary drug of use and number of days of its use in the past 30 days; and perceived relatedness of ED visit to drug use. In the parent trial, prescreened patients who met inclusion criteria and consented for enrollment in the trial were randomized to receive minimal screening only, screening and further assessment, or screening, further assessment, and a 30-minute brief intervention. The parent trial, a 3-group randomized prospective trial, has been previously described,²⁸ was approved by the institutional review board at each participating study site, and is registered at [ClinicalTrials.gov](https://clinicaltrials.gov), number NCT01207791. The Partners Healthcare institutional review board (Boston, MA) approved this secondary analysis during its review of the parent trial.

Setting and Selection of Participants

Patient prescreening and enrollment occurred between October 2010 and February 2012 in the EDs at 6 US academic hospitals. Patients eligible to be prescreened were aged 18 years or older, had adequate English proficiency and literacy, presented to the ED for medical treatment, and were of sound mind to provide informed consent. Study staff did not approach patients with overt exclusions such as life-threatening conditions, psychosis, or intoxication. All prescreened patients provided informed verbal consent to be screened for the study. Participants were considered to have problematic drug use if they scored greater than or equal to 3 on the Drug Abuse Screening Test and reported having used their primary drug of choice within the last 30 days. Participants determined by this self-reporting method to have a drug use problem were considered eligible for enrollment into the parent study trial. Of the 15,224 participants who completed the Brief Information Tool and the Tobacco, Alcohol, Drug questionnaire as part of the prescreening process, 3,240 reported drug use within the last 30 days. This secondary analysis includes prescreening data from all participants who used their primary drug of choice within the last 30 days (N=3,240) whether or not they enrolled in the parent trial. Of the full sample of participants who used drugs within the last 30 days, 2,084 (64.3%) scored greater than or equal to 3 on the Drug

Abuse Screening Test, thus meeting criteria for problematic drug use. The remainder (1,156; 35.7%), who scored less than 3 on the Drug Abuse Screening Test, were considered drug-using individuals who did not meet criteria for problematic drug use.

Data Collection and Processing

Data were directly entered by the participant onto the electronic case report forms with an electronic data capture system on a tablet personal computer or laptop. Research staff directly entered the data if the participant was not comfortable using the computer.

Outcome Measures

The primary outcome for this secondary analysis was drug problem status as it correlated to patient-defined characteristics, including demographics, tobacco, alcohol and drug use behaviors, and characteristics related to the ED visit.

Primary Data Analysis

Bivariate analyses were used to explore the relationships between drug problem status and various patient and ED visit characteristics, including demographics, tobacco, alcohol and drug use behaviors, primary drug of use (ie, drug used with most frequency), ED triage level, and patients' perceived relatedness of the ED visit to drug use. Separate logistic regression analyses were completed for each correlate variable, using drug problem status as the dependent variable, with each analysis also controlling for site. For the purpose of this secondary analysis, ED triage level was categorized as either not resource-intense or resource-intense. Emergency Severity Index triage levels 4 and 5 were considered not resource-intense, whereas Emergency Severity Index triage levels 1 through 3 were considered resource-intense.

Because we found that primary drug of use was strongly associated with drug problem status, with primary cannabis users having substantially lower odds of meeting criteria for problematic drug use than individuals using another drug as their primary drug of use (see "Results"), we performed separate site-controlled bivariate logistic regression analyses exclusively examining the cohort of primary cannabis users among the full sample (n=1,940). To identify characteristics associated with their report of problematic use, these analyses examined the relationships of drug problem status with the same correlate variables used in analyses for the full sample. Continuing to focus specifically on the primary cannabis users, a multivariate logistic regression model examined the relative contribution of each of these independent variables when assessed simultaneously. Because nondrinkers were included in the multivariate model, binge drinking was incorporated into the model by restricting its effect to the drinkers.

RESULTS

Characteristics of Study Subjects

In the full sample of 3,240 participants who reported drug use in the past month, 2,084 (64.3%) were identified as having a drug use problem (ie, received a score of ≥ 3 on the Drug Abuse Screening Test). The mean score on the Drug Abuse Screening Test for all

participants was 4.2 (SD=2.8). Most participants in the full sample were smokers (n=2,393; 73.9%), and the majority reported consuming any alcohol (n=2,753; 85.0%).

Among those participants in the full sample reporting any alcohol use, more than three quarters reported binge drinking in the last year (n=2,139; 77.7%). The mean number of days participants endorsed using their primary drug in the past month was 14.1 (SD=11.6). To determine primary drug of use, study staff asked participants which drug had been used most often in recent months. Most participants reported cannabis (n=1,940; 59.9%), whereas others reported cocaine (n=586; 18.1%), street opioids (n=363; 11.2%), or prescription opioids (n=183; 5.6%). Less frequently reported were methamphetamine (n=71; 2.2%), sedatives or sleeping pills (n=45; 1.4%), hallucinogens (n=26; 0.8%), prescription amphetamines (n=16; 0.5%), inhalants (n=1; 0%), or “other” (n=9; 0.3%). Of the 1,300 patients who reported a substance other than cannabis as their primary drug, 1,179 (90.7%) met the criteria for problematic drug use.

Among participants who reported cannabis as their primary drug, almost half (n=905; 46.6%) met criteria for having a drug problem. The mean score on the Drug Abuse Screening Test for all primary cannabis users was 2.8 (SD=1.9). As were the full sample of drug users, most primary cannabis users were tobacco smokers (n=1,329; 68.5%), and the majority reported consuming any alcohol (n=1,707; 88.0%). Of those primary cannabis users reporting any alcohol use, more than three quarters reported binge drinking in the last year (n=1,311; 76.7%). The mean number of days of primary drug use in the past month among primary cannabis users was 14.2 (SD=11.5), similar to that of the full sample.

Main Results

As shown in Table 1, the characteristic most strongly related to drug problem status in the full sample (N=3,240) was primary drug of use. Relative to those who were primary cannabis users, users of all other drugs had substantially higher odds of meeting criteria for problematic drug use. In fact, 91% of patients reporting a noncannabis primary drug of use (1,179 of 1,300) met criteria for problematic drug use, and the odds of having a drug problem among primary noncannabis users were almost 15 times higher than among primary cannabis users (odds ratio [OR] 14.61; 95% confidence interval [CI] 11.63 to 18.34). This relationship was strongest for the noncannabis illicit drug users (OR 25.54; 95% CI 18.98 to 34.36) who were at highest risk of having problematic drug use compared with users of prescription drugs (OR 4.73; 95% CI 3.41 to 6.55) or other substances (OR 4.60; 95% CI 1.13 to 18.64).

Frequency of past-month drug use was associated with drug problem status, with daily drug users (OR 1.84; 95% CI 1.53 to 2.20) being more likely to have a drug problem than those who used drugs less than daily. Those who were more likely to have a drug problem included tobacco smokers (OR 2.65; 95% CI 2.24 to 3.14) and binge drinkers (ie, those who reported consuming 6 or more drinks on at least 1 occasion in the past year) (n=2,753, excluding nondrinkers; OR 1.79; 95% CI 1.47 to 2.16). The relationship between past-year frequency of alcohol use and drug problem status was more complicated. Individuals who drank less than daily (ie, sometime drinkers) were less likely than nondrinkers to have problematic drug use (OR 0.63; 95% CI 0.51 to 0.78), whereas daily drinkers were more

likely than nondrinkers to have a drug problem (OR 1.50; 95% CI 1.10 to 2.04). In other words, both daily drinkers and nondrinkers were more likely to have a drug use problem than sometime drinkers.

In evaluating the nature of the ED visit itself, participants with a resource-intense ED triage level were more likely to have a drug problem than those who had a non-resource-intense triage level (OR 1.38; 95% CI 1.19 to 1.61). Additionally, individuals who believed that their ED visit was related to substance use were more likely to have a drug problem than those who reported no relation (OR 8.68; 95% CI 6.63 to 11.36). In fact, the perceived relatedness of the ED visit to drug use was the characteristic with the second strongest relationship to drug problem status—primary noncannabis use having the strongest relationship (OR 14.61; 95% CI 11.63 to 18.34), as previously noted—with 91% of participants reporting relatedness (667 of 735) meeting criteria for problematic drug use. Finally, in regard to demographic characteristics, participants aged 30 years and older were more likely to have problematic drug use (OR 1.26; 95% CI 1.08 to 1.47). There was no relationship between sex and drug problem status (OR 1.10; 95% CI 0.93 to 1.30).

Because primary drug of use was so strongly associated with drug problem status, with 91% of primary noncannabis users meeting criteria for problematic drug use compared with only 47% of primary cannabis users, we focused on the primary cannabis users (N=1,940) to determine which characteristics, if any, may correlate with a higher risk for problematic drug use in this seemingly lower-risk group of drug users. As shown in Table 2, the characteristic most strongly related to drug problem status among primary cannabis users was the perceived relatedness of the ED visit to drug use; participants who reported that their drug use played a role in their ED visit were more likely to meet criteria for problematic drug use than those who believed their visit was unrelated (OR 3.25; 95% CI 2.22 to 4.75). This relationship, however, was weaker in the cannabis users than in the full sample (OR 3.25, 95% CI 2.22 to 4.75 versus OR 8.68, 95% CI 6.63 to 11.36, respectively). Unlike in the full sample, there was no relationship between ED triage level and drug problem status among primary cannabis users (OR 1.14; 95% CI 0.94 to 1.39).

The association between age and drug problem status among primary cannabis users was the reverse of that found in the full sample. Among primary cannabis users, participants younger than 30 years were more likely to have a drug problem than those older than 30 years (OR 1.23; 95% CI 1.01 to 1.50). The relationship between past-year frequency of alcohol use and drug problem status was also somewhat different in the cannabis users. Although, as in the full sample, daily drinkers were most likely to have a drug problem (OR 1.94; 95% CI 1.29 to 2.92), there was no difference in drug problem status between nondrinkers and those who drank less than daily (OR 1.00; 95% CI 0.74 to 1.35) in the cannabis users sample. Similar to that in the full sample, tobacco smokers (OR 2.03; 95% CI 1.63 to 2.52), past-year binge drinkers (n=1,707, excluding nondrinkers; OR 1.89; 95% CI 1.47 to 2.44), and past-month daily drug users (OR 2.22; 95% CI 1.77 to 2.78) were more likely to have a drug problem than nonsmokers, non-binge drinkers, and non-daily drug users, respectively.

A multivariate logistic regression analysis controlling for site was performed for primary cannabis users (Table 3) to identify a subgroup of cannabis users at higher risk for

problematic drug use. In this analysis, participants with a drug problem were more likely to be younger than 30 years (OR 1.28; 95% CI 1.04 to 1.59), smoke tobacco (OR 1.94; 95% CI 1.54 to 2.43), binge drink (OR 1.60; 95% CI 1.22 to 2.08), use drugs daily (OR 2.03; 95% CI 1.61 to 2.7), and report their ED visit as related to their drug use (OR 2.74; 95% CI 1.84 to 4.08). The area under the receiver operating characteristic curve for the full multivariate logistic regression model was 0.760.

For the full sample, the correlation between primary drug used and drug problem status was the strongest among the examined characteristics, with primary noncannabis drug users having an almost 15 times higher odds of meeting criteria for problematic drug use than primary cannabis users. Additional multivariate regression analyses of the primary cannabis users identified tobacco smokers, binge drinkers, daily drug users, and those who perceived their ED visit as being related to their drug use as a subgroup of cannabis users at elevated risk of having a drug problem. Further analyses of each of these characteristics suggested the following potential clinical decision rule for identifying ED patients with a high probability of problematic drug use: "If the patient endorses having used drugs in the last 30 days, determine which drug was used most often. If the patient primarily used a noncannabis drug, perform a detailed assessment for a drug problem. If the patient is a primary cannabis user, then determine whether the ED visit is related to the patient's drug use. If the visit is related to the drug use, then determine whether the patient engages in at least 2 of the following 3 substance use behaviors: tobacco smoking, binge drinking, and daily drug use. If yes, then perform a detailed assessment for a drug problem." Overall, this decision rule has a positive predictive value of 89% (Figure 1).

LIMITATIONS

The present analysis includes the full sample of patients (N=3,240) who endorsed drug use within the last 30 days during the prescreening process of the parent trial. This analysis compares the 2,084 patients who met criteria for problematic drug use (Drug Abuse Screening Test score ≥ 3) with the 1,156 patients who did not meet criteria. Enrollment in the parent trial was offered only to patients meeting criteria for problematic drug use.

After study enrollment, biological samples were collected for all enrolled participants, and assessments using validated instruments such as the NIDA Modified Alcohol, Smoking, and Substance Involvement Screening Test were performed in 2 of the 3 randomization arms to further determine the severity of drug use. These detailed data therefore were not collected for individuals in the full sample of this secondary analysis who did not meet study enrollment criteria, declined enrollment, or were enrolled and randomized to the nonassessment group. Our lack of diagnostic data for the full sample in this analysis precludes our ability to identify undeclared drug use, confirm the absence of a drug use problem in patients whose Drug Abuse Screening Test score was less than 3, or perform analyses on graded severity levels of problematic drug use.

Data capture methods in the prescreening process of the parent trial also precluded examination of single versus multiple drug use patterns to determine the effect of polysubstance use on drug problem status, as well as examination of the relationship

between chief complaint and drug problem status. Although the reason for ED visit was recorded in the Brief Information Tool, the accuracy of the triage chief complaint, which covered a wide range of complaints from “influenza-like illness” to “left foot gangrene” to “chest and back pain,” could not be verified and any additional chief complaints that may have surfaced in the course of the ED visit would not have been captured for patients who ultimately were not enrolled in the parent trial study.

Additionally, the sample of prescreened patients was not perfectly representative of the entire ED population because higher-acuity cases were less likely to be included. Similarly, the findings of this secondary analysis may not be applicable to ED patients who present with acute psychiatric emergencies because these patients, although at high risk for addiction, were excluded from prescreening in the parent trial.

Last, although acutely intoxicated patients were not prescreened, patients who initially presented to the ED intoxicated may have been approached for prescreening once sober and able to provide informed consent. It is unclear whether our inability to approach acutely intoxicated patients immediately on arrival disallowed a true representation of this population.

Despite these limitations, the strength of this secondary analysis lies in the large amount of data collected by surveying thousands of patients at multiple enrolling centers, making it more likely that acutely intoxicated patients were eventually approached and prescreened. At least in this secondary analysis of 3,240 participants who reported using their primary drug in the past 30 days, only 487 were nondrinkers (465 drank daily, 2,288 drank sometimes, and, 2,139 of the 2,753 drinkers reported binge drinking).

DISCUSSION

Individuals with problematic drug use routinely receive care in EDs across the nation. The higher prevalence of illicit drug use and drug use problems among ED users compared with ED nonusers²⁹ places emergency providers in a unique position to intervene and mitigate the effects of drug use. Yet despite this, emergency providers are not always equipped with simple, practical, and clinically relevant ways to determine among the chaos of a busy ED which patients may be in most need of substance use intervention. This analysis sought to examine the correlation between problematic drug use and clinically relevant characteristics that may be elicited as part of the history-taking and hence assist emergency providers in identifying patients who may benefit from ED-based screening, intervention, and referral to treatment.

Consistent with the literature, our analysis found that concurrent tobacco or alcohol use is exceedingly likely with illicit drug use.^{30–33} Both primary cannabis and noncannabis users with problematic drug use were more likely to smoke tobacco, drink alcohol daily or binge drink, and use their drug of choice daily. With respect to alcohol, it is not surprising that daily and binge drinking were highly correlated with drug use problems compared with abstinence from drinking. Our analysis of the full sample found that sometime alcohol drinking is negatively correlated with problematic drug use (OR 0.63; 95% CI 0.51 to 0.78)

compared with no alcohol drinking. This relationship may seem counterintuitive in light of the literature on concurrent alcohol and drug use. However, it is possible that individuals who drink alcohol on a less than daily basis have skills necessary to moderate use, circumstances that reinforce moderation, or the genetic or biological characteristics that make moderation the more likely pattern of behavior. When this same relationship was examined among the primary cannabis users, sometime alcohol users were neither less nor more likely to have a drug use problem than those who reported never drinking alcohol.

Finally, as expected, a resource-intense ED triage level (equivalent to Emergency Severity Index levels 1 to 3) was correlated with drug use disorders among all drug users, with the exception of primary cannabis users. This may reflect the fact that primary noncannabis drug users were more commonly older than 30 years, whereas primary cannabis users were frequently younger than 30 years, with possibly better overall health by virtue of age alone. This relationship between ED triage level, primary drug of use, and drug problem status may also reflect the harmful physiologic effects, adverse medical consequences, and hazards of noncannabis illicit drug use compared with cannabis use (eg, cardiotoxic effects of cocaine²).

Although the developmental neurobiological and psychosocial effects of cannabis continue to be subjects of extensive investigation, evidence is mounting to suggest an increased risk of psychotic illness associated with cannabis use that depends on the age at onset of use, frequency and duration of use, and potency of the cannabis used.^{34,35} Given the accelerated proliferation of access to cannabis under current policy reforms and the dose-dependent psychocognitive health effects of cannabis, it is conceivable that facilitating detection of problematic cannabis use and delivery of an early ED-based intervention may reduce the overall incidence of cannabis-induced psychopathology. With almost half of all primary cannabis users meeting criteria for a drug use problem (46.6%), the present analysis may be particularly salient to improving screening among primary cannabis users, given they are more likely to disclose use, as cannabis is more broadly accepted and less likely to be perceived as harmful or problematic.³⁶

Noncannabis drug use itself portends a 15 times higher odds of problematic drug use than does cannabis use. Of the 1,300 noncannabis drug users enrolled across 6 sites, 91% (n=1,179) met criteria for problematic drug use. Because of this, a clinical decision rule with further branches for noncannabis drug users is scarcely needed. However, among primary cannabis users, perceived relatedness of the ED visit to drug use had the strongest correlation to problematic drug use. Indeed, ED visit relatedness had the largest effect on the overall predictive value of the decision rule derived from the multivariate regression analysis, whereas substance use behaviors (tobacco smoking, binge drinking, and daily drug use) had an incremental effect. In fact, if a patient endorses only 1 of the 3, there is no change in the positive predictive value. A patient must endorse 2 of the 3 substance use behaviors to improve the positive predictive value for problematic drug use among primary cannabis users, albeit by only 2%.

Although decision rules derived from logistic regression analyses tend to have higher overall accuracy, regression-derived rules may have lower-than-optimal sensitivity.³⁷ In other

words, the more predictor variables included, the more likely it is that the decision rule will incorrectly screen out or “miss” patients with problematic drug use. As a result, we examined a more simplified rule using “primary drug used” and “perceived ED visit relatedness to drug use” as the sole screening questions, each being the single decisionmaking branch point for noncannabis and cannabis users, respectively (Figure 2). With an overall positive predictive value of 88% for problematic drug use, this decision rule allows a clinician to rapidly determine whether a detailed assessment for a drug problem is indicated in a patient who has used any drug in the past 30 days. Compared with the decision rule derived from our regression analyses, our proposed decision rule is less cumbersome, with a maximum of 2 questions; is less dependent on the accuracy of self-reported substance use behaviors; has a comparable positive predictive value; accounts for the high probability of problematic drug use among individuals who primarily use a noncannabis drug; and identifies a subgroup of patients within the lower-risk primary cannabis user group that has a higher likelihood of problematic drug use. Although use of the regression-derived decision rule yields clinically important information about tobacco use, binge drinking, and frequency of cannabis use, the simpler rule has the advantage of brevity without sacrificing positive predictive value.

In conclusion, the higher ED utilization and hospital admission rates among ED patients with unmet substance abuse treatment needs—which in at least 1 study accounted for an estimated \$777 million (or \$1,568 per ED patient in 2000 dollars) in extra hospital charges³⁸—argue for greater attention to the development of multidisciplinary, cost-effective ways to support ED-based substance use screening, intervention, and referral to treatment. The correlation between problematic drug use and resource-intense ED triage levels in our analysis offers further evidence that ED patients with unmet substance abuse treatment needs incur higher health care costs than their counterparts, and highlights the potential opportunity for decreasing overall health care cost by identifying ED patients who are at highest risk of problematic drug use and referring them to treatment. Our screening and clinical decision rule provides a rapid and simple method of identifying patients on whom more comprehensive ED-based SBIRT should be focused as part of emergency care practice. This research and future cost-effectiveness research could inform policy and resource allocation for the advancement of ED-based drug abuse-mitigating activities.

Acknowledgments

Funding and support: By Annals policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). Dr. Macias Konstantopoulos reports receiving grants from the National Institute on Drug Abuse through McLean Hospital during the conduct of the study. Ms. Parry reports receiving salary support from grants from the National Institute on Drug Abuse (grant #5U10DA015) through McLean Hospital during the conduct of the study. Dr. Mandler, an employee of the National Institute on Drug Abuse, reviewed and approved the article as a part of his authorship role. His role in the project is through the National Institute on Drug Abuse Clinical Trials Network (U10-DA13720). The National Institute on Drug Abuse appointed members and coordinated meetings of the data and safety monitoring board. Dr. Bogenschutz reports receiving grants from the National Institute on Drug Abuse during the conduct of the study. Dr. Weiss reports receiving grants from the National Institute on Drug Abuse during the conduct of the study. This secondary analysis was completed with financial support from the National Institute on Drug Abuse, grants U10 DA01583, K24 DA022288, U10 DA20036, U10 DA13720, U10 DA13035, U10 DA15831, U10 DA13732, and U10 DA15833.

The authors are solely responsible for the content of this article, which does not necessarily represent the official views of the National Institute on Drug Abuse and the National Institutes of Health.

REFERENCES

1. Substance Abuse and Mental Health Services Administration (SAMHSA). Results from the 2011 National Survey on Drug Use and Health: Summary of the National Findings. Rockville, MD: Substance Abuse & Mental Health Services Administration; 2012. NSDUH Series H-44, HHS Publication (SMA) 12-4713; Available at: <http://www.samhsa.gov/data/NSDUH/2k11Results/NSDUHresults2011.pdf>. [Accessed May 3, 2013]
2. Frishman WH, Del Vecchio A, Sanal S, et al. Cardiovascular manifestations of substance abuse part 1: cocaine. *Heart Dis.* 2003; 5:187–201. [PubMed: 12783633]
3. Frishman WH, Del Vecchio A, Sanal S, et al. Cardiovascular manifestations of substance abuse part 2: alcohol, amphetamines, heroin, cannabis, and caffeine. *Heart Dis.* 2003; 5:253–271. [PubMed: 12877759]
4. Enevoldson TP. Recreational drugs and their neurological consequences. *J Neurol Neurosurg Psychiatry.* 2004; 75(suppl III)
5. Brick, J., editor. *Handbook of the Medical Consequences of Alcohol and Drug Abuse*, Second Edition. Binghamton, NY: Haworth Press, Taylor & Francis Group; 2008.
6. Cherpitel CJ, Borges G. Substance use among emergency room patients: an exploratory analysis by ethnicity and acculturation. *Am J Drug Alcohol Abuse.* 2002; 28:287–305. [PubMed: 12014817]
7. Verdejo-Garcia A, Bechara A, Recknor EC, et al. Negative emotion-driven impulsivity predicts substance dependence problems. *Drug Alcohol Depend.* 2007; 91:213–219. [PubMed: 17629632]
8. Santelli JS, Robin L, Brener N, et al. Timing of alcohol and other drug use and sexual risk behaviors among unmarried adolescents and young adults. *Fam Plann Perspect.* 2001; 33:200–205. [PubMed: 11589540]
9. Stein MD, O'Sullivan PS, Ellis P, et al. Utilization of medical services by drug users in detoxification. *J Subst Abuse.* 1993; 5:187–193. [PubMed: 8104569]
10. Palepu A, Tyndall MW, Leon H, et al. Hospital utilization and costs in a cohort of injection drug users. *CMAJ.* 2001; 165:415–420. [PubMed: 11531049]
11. Kerr T, Wood E, Grafstein E, et al. High rates of primary care and emergency department use among injection drug users in Vancouver. *J Public Health.* 2005; 27:62–66.
12. Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. The DAWN Report: Highlights of the 2011 Drug Abuse Warning Network (DAWN) Findings on Drug-Related Emergency Department Visits. Rockville, MD: 2013 Feb 22. Available at: <http://www.samhsa.gov/data/2k13/DAWN127/sr127-DAWN-highlights.pdf>. [Accessed May 3, 2013]
13. Miller, T.; Hendrie, D. Substance Abuse Prevention Dollars and Cents: A Cost-Benefit Analysis. Rockville, MD: Center for Substance Abuse Prevention, Substance Abuse & Mental Health Services Administration; 2008. DHHS Pub. (SMA) 07-4298. Available at: <http://store.samhsa.gov/shin/content/SMA07-4298/SMA07-4298.pdf>. [Accessed May 3, 2013]
14. American College of Emergency Physicians. [Accessed May 3, 2013] Alcohol screening in the emergency department. Available at: <http://www.acep.org/practres.aspx?id=29074>.
15. Longabaugh R, Woolard RE, Nirenberg TD, et al. Evaluating the effects of a brief motivational interventions for injured drinkers in the emergency department. *J Stud Alcohol.* 2001; 62:806–816. [PubMed: 11838918]
16. Mello MJ, Nirenberg TD, Longabaugh R, et al. Emergency department brief motivational interventions for alcohol with motor vehicle crash patients. *Ann Emerg Med.* 2005; 45:620–625. [PubMed: 15940095]
17. D'Onofrio G, Pantalon MV, Degutis LC, et al. Brief intervention for hazardous and harmful drinkers in the emergency department. *Ann Emerg Med.* 2008; 51:742–750. [PubMed: 18436340]
18. Babor TF, McRee BH, Kassebaum PH, et al. Screening, brief intervention, and referral to treatment (SBIRT): toward a public health approach to the management of substance abuse. *Subst Abuse.* 2007; 28:7–30.
19. D'Onofrio G, Fiellin DA, Pantalon MV, et al. A brief intervention reduces hazardous and harmful drinking in emergency department patients. *Ann Emerg Med.* 2012; 60:181–192. [PubMed: 22459448]

20. Madras BK, Compton WM, Avula D, et al. Screening, brief interventions, referral to treatment (SBIRT) for illicit drug and alcohol use at multiple healthcare sites: comparison at intake and 6 months later. *Drug Alcohol Depend.* 2009; 99:280–295. [PubMed: 18929451]
21. Bernstein E, Bernstein J, Levenson S. Project ASSERT: an ED-based intervention to increase access to primary care, preventative services, and the substance abuse treatment system. *Ann Emerg Med.* 1997; 30:181–189. [PubMed: 9250643]
22. Bernstein E, Edwards E, Dorfman D, et al. Screening and brief intervention to reduce marijuana use among youth and young adults in a pediatric emergency department. *Acad Emerg Med.* 2009; 16:1174–1185. [PubMed: 20053238]
23. Estee, S.; He, L.; Yang, S., et al. Six-Month Follow-up Survey of WASBIRT Patients: Use of Alcohol and Other Drugs Declined Among Emergency Department Patients Who Received Brief Interventions for Substance Use Disorders Through WASBIRT. Olympia, WA: Washington State Department of Social & Health Services, Research & Data Analysis Division; 2009. Report 4.60.WA.2009.2.
24. Lee MO, Vivier PM, Diercks DB. Is the self-report of recent cocaine or methamphetamine use reliable in illicit stimulant drug users who present to the emergency department with chest pain? *J Emerg Med.* 2009; 37:237–241. [PubMed: 19081702]
25. Vitale S, van de Mheen D. Illicit drug use and injuries: a review of emergency room studies. *Drug Alcohol Depend.* 2006; 82:1–9. [PubMed: 16183213]
26. Rockett IRH, Putnam SL, Jia H, et al. Declared and undeclared substance use among emergency department patients: a population-based study. *Addiction.* 2006; 101:706–712. [PubMed: 16669904]
27. Schuckman H, Hazelett S, Powell C, et al. A validation of self-reported substance use with biochemical testing among patients presenting to the emergency department seeking treatment for backache, headache, and toothache. *Subst Use Misuse.* 2008; 43:589–595. [PubMed: 18393078]
28. Bogenschutz MP, Donovan DM, Adinoff B, et al. Design of NIDA CTN Protocol 0047: Screening, Motivational Assessment, Referral, and Treatment in Emergency Departments (SMART-ED). *Am J Drug Alcohol Abuse.* 2011; 37:417–425. [PubMed: 21854285]
29. Wu LT, Swartz MS, Wu Z, et al. Alcohol and drug use disorders among adults in emergency department settings in the United States. *Ann Emerg Med.* 2012; 60:172–180. e5. [PubMed: 22424657]
30. Baggio S, Studer J, Mohler-Kuo M, et al. Concurrent and simultaneous polydrug use among Swiss males: use patterns and associations of number of substances used with health issues. *Int J Adolesc Med Health.* 2013; 13:1–8.
31. Olthuis JV, Darredeau C, Barrett SP. Substance use initiation: the role of simultaneous polysubstance use. *Drug Alcohol Rev.* 2013; 32:67–71. [PubMed: 22612987]
32. McCabe SE, Cranford JA, Morales M, et al. Simultaneous and concurrent use of alcohol and prescription drugs: prevalence, correlates, and consequences. *J Stud Alcohol.* 2006; 67:529–537. [PubMed: 16736072]
33. Martin C, Clifford P, Clapper R. Simultaneous and concurrent use of alcohol, tobacco, marijuana, and hallucinogens in first year college students. *J Subst Abuse.* 1992; 4:319–326. [PubMed: 1458048]
34. Di Forti M, Morgan C, Dazzan P, et al. High-potency cannabis and the risk of psychosis. *Br J Psychiatry.* 2009; 195:488–491. [PubMed: 19949195]
35. Moore TH, Zammit S, Lingford-Hugues A, et al. Cannabis use and risk of psychotic or affective mental health outcomes: a systematic review. *Lancet.* 2007; 370:319–328. [PubMed: 17662880]
36. Kilmer JR, Hunt SB, Lee CM, et al. Marijuana use, risk perception, and consequences: is perceived risk congruent with reality? *Addict Behav.* 2007; 32:3026–3033. [PubMed: 17822856]
37. Stiell IG, Wells GA. Methodological standards for the development of clinical decision rules in emergency medicine. *Ann Emerg Med.* 1999; 33:437–447. [PubMed: 10092723]
38. Rockett IRH, Putnam SL, Jia H, et al. Unmet substance abuse treatment, need, health services utilization, and cost: a population-based emergency department study. *Ann Emerg Med.* 2005; 45:118–127. [PubMed: 15671966]

Editor's Capsule Summary

What is already known on this topic

A substantial number of emergency department patients have overt or covert substance use issues.

What question this study addressed

This multicenter study reviewed data from 3,240 patients who used drugs in the past 30 days to determine characteristics associated with problematic drug use as defined by a standardized questionnaire instrument.

What this study adds to our knowledge

Patients who use drugs other than marijuana have a rate of problematic drug use 15 times higher than that of those who report only marijuana use.

How this is relevant to clinical practice

Emergency physicians should consider problematic drug use in anyone who discloses drug use other than marijuana and counsel them about substance abuse treatment.

Figure 1. Regression-derived clinical decision rule for performing detailed assessment for possible problematic drug use (89% positive predictive value).

Figure 2.
Brief clinical decision rule for performing detailed assessment for possible problematic drug use (88% positive predictive value).

Table 1

Bivariate relationships between patient characteristics and drug problem status among the full sample of substance users (N=3,240).

Patient Characteristics		Number With Drug Problem (n[2,084]/ Total With Characteristic (%))	OR*	95% CI
Demographics				
Sex	Male	1,490/2,291 (65.0) [†]	1.10	0.93–1.30
	Female	594/948 (62.7)	–	–
Age, y	18–29	784/1,297 (60.4)	–	–
	30	1,300/1,942 (66.9) [‡]	1.26 [§]	1.08–1.47
Tobacco and alcohol use				
Tobacco use	Nonsmoker	388/847 (45.8)	–	–
	Smoker	1,696/2,393 (70.9)	2.65	2.24–3.14
Frequency of alcohol use in last year				
	Never	338/487 (69.4)	–	–
	Sometimes	1,376/2,288 (60.1)	0.63	0.51–0.78
	Daily	370/465 (79.6)	1.50 [¶]	1.10–2.04
Binge drinking in last year among drinkers, n=2,753				
	No	331/614 (53.9)	–	–
	Yes	1,415/2,139 (66.2)	1.79	1.47–2.16
Drug use				
Frequency of drug use in past 30 days				
	Less than daily	1,479/2,426 (61.0)	–	–
	Daily	605/814 (74.3)	1.84	1.53–2.20
Drug causing most difficulties				
	Cannabis	905/1,940 (46.6)	–	–
	Illicit drugs (noncannabis)	987/1,046 (94.4)	25.54	18.98–34.36
	Prescription drugs	185/244 (75.8)	4.73	3.41–6.55
	Other	7/10 (70.0)	4.60 [¶]	1.13–18.64
	Noncannabis (combined)	1,179/1,300 (90.7)	14.61	11.63–18.34
Medical				
Triage level	Not resource-intense	915/1,543 (59.3) [#]	–	–
	Resource intense	1,166/1,687 (69.1)	1.38	1.19–1.61
ED visit related to substance use				
	No	1,415/2,503 (56.5) ^{**}	–	–
	Yes	667/735 (90.7)	8.68	6.63–11.36

* Adjusted ORs controlling for site effects.

[†] One participant chose not to disclose sex; N=3,239.

[‡] Age data for a participant who answered “3” to years of age was discarded; N=3239.

[§] $P < .01$.

^{//} $P < .001$.

[¶] $P < .05$.

[#] Triage-level data were missing for 10 participants; N=3,230 (3 of whom had a drug problem; N=2,081).

^{**} ED visit relatedness data were missing for 2 participants; N=3,238 (2 of whom had a drug problem; N=2,082).

Table 2

Bivariate relationships between patient characteristics and drug problem status among participants who identified cannabis as their primary substance of use (N=1,940).

Patient Characteristics		Number With Drug Problem (n[905]/ Total With Characteristic (%))	OR*	95% CI
Demographics				
Sex	Male	653/1,385 (47.1) [†]	1.14	0.92–1.41
	Female	252/554 (45.5)	–	
Age, y	18–29	471/950 (49.6) [‡]	1.23 [§]	1.01–1.50
	30	434/989 (43.9)	–	
Tobacco and alcohol use				
Tobacco use	Nonsmoker	198/611 (32.4)	–	
	Smoker	707/1,329 (53.2)	2.03 ^{//}	1.63–2.52
Frequency of alcohol use in last year				
	Never	105/233 (45.1)	–	
	Sometimes	675/1,501 (45.0)	1.00	0.74–1.35
	Daily	125/206 (60.7)	1.94 [¶]	1.29–2.92
Binge drinking in last year among drinkers, n=1,707				
	No	145/396 (36.6)	–	
	Yes	655/1,311 (50.0)	1.89 ^{//}	1.47–2.44
Drug use				
Frequency of drug use in past 30 days				
	Less than daily	604/1,442 (41.9)	–	
	Daily	301/498 (60.4)	2.22 ^{//}	1.77–2.78
Medical				
Triage level	Not resource-intensive	439/1,010 (43.5)	–	
	Resource intense	465/924 (50.3) [#]	1.1	0.93–1.38
ED visit related to substance use				
	No	790/1,780 (44.4)	–	
	Yes	115/160 (71.9)	3.25 ^{//}	2.22–4.75

* Adjusted ORs controlling for site effects.

[†] One participant chose not to disclose sex; N=1,939.

[‡] Age data for a participant who answered “3” to years of age were discarded; N=1,939.

[§] $P < .05$.

^{//} $P < .001$.

[¶] $P < .01$.

[#] Triage-level data were missing for 6 participants; N=1,934 (1 of whom had a drug problem; N=904).

Table 3

Multivariate logistic regression model for correlates of drug problem status among individuals who identified cannabis as their primary substance of use (N=1,932 with complete data on all variables).

Baseline Variables	Adjusted OR*	95% CIs
Male patient	1.03	0.82–1.29
<30 y	1.28	1.04–1.59
Tobacco smoker	1.94	1.54–2.43
Frequency of alcohol use		
Never	–	
Sometimes	0.75	0.52–1.09
Daily	1.05	0.64–1.72
Binge drinking in last year [†]	1.60	1.22–2.08
Daily drug use in past 30 days	2.03	1.61–2.57
Resource-intense triage level	1.18	0.96–1.45
ED visit related to substance use	2.74	1.84–4.08

* Also controlling for site effects (not listed).

[†] Compared with non-binge drinkers.