

# Assessing Pediatric and Young Adult Substance Use Through Analysis of Prehospital Data

Elizabeth L. Seaman, MHS;<sup>1</sup> Mathew J. Levy, DO, MSc;<sup>2</sup> J. Lee Jenkins, MD, MSc;<sup>2</sup>  
Cassandra Chiras Godar, BS;<sup>3</sup> Kevin G. Seaman, MD<sup>3</sup>

1. Department of Behavioral and Community Health, School of Public Health, University of Maryland, College Park, Maryland USA
2. Department of Emergency Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland USA
3. Howard County, Department of Fire and Rescue Services, Columbia, Maryland USA

#### Correspondence:

Elizabeth Seaman, MHS  
Department of Behavioral and Community Health  
School of Public Health  
University of Maryland  
2387 SPH Building, Suite 1224  
College Park, Maryland 20742-2611 USA  
E-mail: eseaman@umd.edu

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#### Abbreviations:

ADHD: attention deficit hyperactivity disorder  
ANOVA: analysis of variance test  
DALYs: disability-adjusted life years  
EMS: Emergency Medical Services  
EMT: emergency medical technician  
HCFR: Howard County Fire and Rescue  
PCR: patient care report  
PTSD: post-traumatic stress disorder

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#### Abstract

**Introduction:** Substance use in young adults is a significant and growing problem. Emergency Medical Services (EMS) personnel often encounter this problem, yet the use of prehospital data to evaluate the prevalence and magnitude of substance abuse has been limited.

**Hypothesis/Problem:** This study evaluated drug and alcohol use through the use of prehospital and EMS data in one suburban county in Maryland (USA). The primary hypothesis was that the type of drug being abused is associated with age. The secondary hypothesis was substance abuse incidence is associated with location. The tertiary hypothesis was that substance abuse is associated with a history of mental illness.

**Methods:** Deidentified patient care reports (PCRs) were obtained during a 24-month period from October 2010 through September 2012 for patients 0 through 25 years of age. Inclusion criteria included chief complaint of alcohol overdose, drug overdose, or the use of naloxone.

**Results:** The primary hypothesis was supported that age was associated with drug category ( $P < .001$ ). Younger adolescents were more likely to use household items, prescription drugs, or over-the-counter drugs, whereas older adolescents were more likely to use illicit drugs. The secondary hypothesis was supported that both alcohol ( $P < .001$ ) and drugs ( $P < .001$ ) were associated with location of call. Calls involving alcohol were more likely to be at a home or business, whereas calls involving drugs were more likely to be at home or at a public venue. The tertiary hypothesis was supported that both alcohol ( $P = .001$ ) and drug use ( $P < .001$ ) were associated with history of mental illness. Older adolescents were more likely to report a history of mental illness. Chi-squared tests indicated there were significant differences between genders and drug category ( $P = .002$ ) and gender and current suicide attempt ( $P = .004$ ). Females were more likely to use prescription drugs, whereas males were more likely to use illicit drugs. Calls involving younger adolescents under 18 were more likely to be at school or the mall, whereas calls involving older adolescents were likely to be at a prison, public venue, or a business.

**Conclusion:** All three hypotheses were supported: the type of substance being abused was associated with both age and location, and substance abuse was associated with a history of mental illness. This research has important implications for understanding how EMS resources are utilized for substance use. This information is valuable in not only the education and training of prehospital care providers, but also for the targeting of future public health interventions.

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#### Introduction

Substance use is one of the largest health problems facing the United States. A 2010 study estimates that 21.8 million Americans age 12 and older have used illegal drugs in the past month.<sup>1</sup> The epidemic of street drug use has been increasing steadily over the past few decades.<sup>2</sup> Other emerging drugs of abuse include prescription drugs.<sup>3</sup> Substance use is often difficult to study for a multitude of reasons, including potential adolescent underreporting or overreporting.<sup>4</sup> Further, since many drugs are illegal, users may be wary of honestly disclosing their use patterns.

Previous studies have analyzed hospital emergency department records to evaluate adolescent substance use cases and proposed prevention strategies.<sup>5</sup> This study focuses on

encounters in the prehospital setting, highlighting the more severe presentations of substance use. Many drug use and overdose cases begin with a 911 call that leads to a public safety or an ambulance response by the Emergency Medical Services (EMS) system. Prehospital care reports offer a unique perspective on drug use in the community, and EMS systems have distinctive and close relationships to the communities they serve. Previous research has used EMS data to carry out public health surveillance of health conditions in the community at large, but this data has yet to include substance use of adolescents and young adults in a suburban community in the United States.<sup>6,7</sup>

Previous studies have analyzed ambulance calls for alcohol-related emergencies.<sup>8</sup> Young people account for many alcohol-related calls, especially on college campuses.<sup>9</sup> Few studies have evaluated the association between activation of the ambulance system and alcohol and drug-related emergencies.

### Background

Recent research has explored the use of prehospital EMS for mental health-related cases, and opportunities for improvements in the emergency medical care of those with mental health-related conditions.<sup>10-12</sup> However, there is a paucity of peer-reviewed literature on use of prehospital data for research on substance use. The research described in this paper analyzed the drug and alcohol-related cases to which Howard County Fire and Rescue (HCFR), responded. Howard County, Maryland (USA) is located between Baltimore (Maryland) and Washington DC. The HCFR provides EMS. The HCFR is located in a suburban county in Maryland, just outside Baltimore, and includes 12 fire stations serving a county population of approximately 299,430 residents.<sup>13,14</sup> In the calendar year 2010, HCFR had 392 career and approximately 600 volunteer emergency services personnel. In 2010, HCFR responded to 68,411 calls, 21,788 of which were EMS responses.

Through the use of data from EMS patient care reports (PCRs), this study aimed to demonstrate an association between patient age and type of substance used, as well as call location, thereby providing a public health examination of prehospital care to determine appropriate future education efforts and interventions. The primary hypothesis was that the type of drug being abused is associated with age. The secondary hypothesis was that substance abuse incidence is associated with location. Additionally, the tertiary hypothesis was that substance abuse is associated with a history of mental illness.

### Methods

This was a retrospective study using deidentified PCRs from prehospital EMS data gathered from Howard County, Maryland. Deidentified PCRs from HCFR were obtained for a 24-month period from October 2010 through September 2012 for patients aged 0 through 25 years of age. The following search criteria were used to search assessment and treatment codes for applicable PCRs: alcohol overdose, drug overdose, and use of naloxone. The initial search by assessment code returned 399 reports which were then reviewed to ensure they met inclusion criteria for this study. Exclusion criteria were patients not within the age range or in the age range but with no evidence of substance use.

Inclusion criteria in this analysis were the following: patients 0 through 25 years of age, and positive assessment for alcohol, drugs, or both. Positive assessment for alcohol, drugs, or both was defined by a patient statement, or a witness statement. In cases

where a patient statement and witness statement were not available or recorded on the report, use of, and positive reaction to, naloxone was used to indicate narcotic drug use. Mental illness was defined as history given by patient or witness or current psychotherapeutic medications reported. For the purpose of this study, substances counted as drugs included: prescription drugs, over-the-counter drugs, street drugs, and use of household substances. The category of prescription drug use was assessed as either a patient taking their prescription drug not as prescribed, usually in much larger quantities or at more frequent intervals, or taking a prescription drug not prescribed to them. The category of over-the-counter drug use was assessed by the patient or witness statement of the amount of drug ingested and analysis of the normal therapeutic range for treatment to determine that the amount taken by the patient was greater than is advised.

This project was approved by the Johns Hopkins School of Public Health Institutional Review Board.

The following variables were included in the analysis: date, time, location type, refusal of services (evaluation, treatment, or transport), race, age, sex, injury type, basic vital signs (Glasgow Coma Scale, blood pressure, pulse, respirations, and oxygen saturation), history of mental illness, history of suicide or harm, and for this study whether the patients stated that they intended to hurt themselves. All of these variables were coded as categorical variables using a standard, discrete number scale.

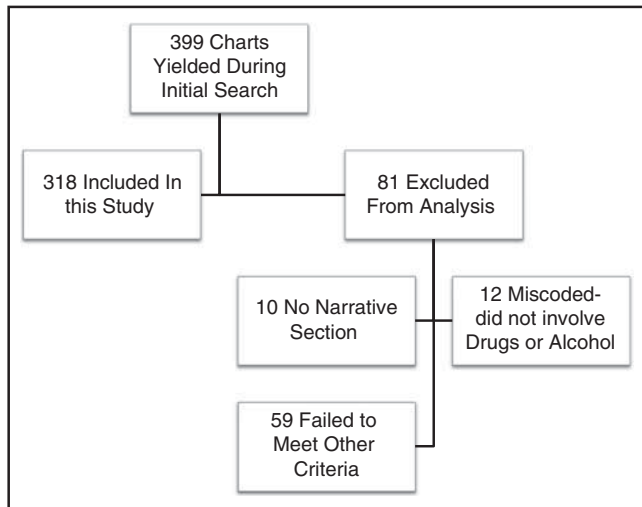
All statistical analyses were carried out in STATA (Version 12, StataCorp., College Station, Texas USA). Descriptive analyses were conducted to examine information contained in the reports (age, race, sex, location of call, refusals, use of alcohol, use of drugs, category of drugs, information on if prescription drugs played a part in the call, history of medical illness, diagnosis of attention deficit hyperactivity disorder (ADHD), history of suicide or harm, and whether cases represented patients' intent to hurt themselves). One-way analysis of variance (ANOVAs) between group tests, chi-squared tests, and Fischer's exact *P* were used to test the associations between variables, as appropriate.

### Results

Of the 399 reports that were initially screened, 81 were excluded because they did not meet study criteria. Of those excluded, 10 of the reports did not contain a "narrative" section and information was insufficient for study purposes; 12 of the reports were miscoded and did not involve drug or alcohol at all. An additional 59 reports failed to meet other criteria, for example, didn't have enough information to consider drug or alcohol involvement in the call. A total of 318 of the 399 total reports were analyzed in this study (Figure 1).

Of the 318 charts included in this study, 160 (50.31%) represented female patients and 158 (49.69%) represented male patients, indicating a relatively equal distribution. The median age was 18. The mean age was 18.49 with a standard deviation of 4.32. Table 1 contains for more information about the demographic breakdown of calls.

In terms of location of EMS incident, 164 (51.57%) calls were at a home. The next most frequent number of calls occurred at a public indoor or outdoor setting (30, 9.43%), at schools (22, 6.92%), and on a street or highway (22, 6.92%). Another setting where calls occurred was an outdoor concert venue in Howard County where 25 (7.86%) of the calls occurred. A total of 18 (5.66%) occurred at a residential location other than the patient's home. The remaining location categories, each of which



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Figure 1. Charts Included in Study

Variables	No. (%)
Age	
0-12	11 (3.46)
13-18	155 (48.74)
19-21	74 (23.27)
22-25	78 (24.53)
Sex	
Male	160 (50.31)
Female	158 (49.69)
Race	
Caucasian	204 (64.15)
Black	69 (21.70)
Asian	15 (4.72)
Hispanic	6 (1.89)
Unknown/Other	24 (7.54)

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Table 1. Descriptive Statistics (N = 318)

contained fewer than 10 calls, were combined to form an “other/unknown” category representing 37 calls (11.64%). The majority of patients (298, 93.71%) received treatment and transport. Only 20 (3.77%) refused transport to a hospital for further evaluation.

For 56 calls (17.61%), the primary cause for symptoms was coded as “overdose-alcohol.” An additional 168 calls (52.83%) were coded as “overdose-drug, medication” and 60 calls (18.87%) “drug/alcohol related illness.” In 260 calls (81.76%), naloxone, the antidote to narcotics overdoses, was not administered or was administered with no response. Naloxone was administered with a positive response, measured by an increase in respiratory rate, an increase in consciousness, or both, in 58 calls (18.24%).

Cases were analyzed independently to see if alcohol and drugs were involved based on patient statement, witness statement, or positive response to naloxone to indicate narcotics involvement. A total of 192 calls (60.38%) did not involve alcohol. For 117 (36.79%) of the calls, alcohol was involved. Finally in the remaining 9 (2.83%) cases, it was unknown if alcohol played a part. For drug cases identified by patient or witness statement, or positive response to naloxone, there were 224 calls (70.44%) determined to involve drugs and 76 (23.90%) cases that did not involve drugs. In 18 (5.66%) of the cases, it could not be determined if drugs were involved. One hundred and eight (33.96%) of the calls were counted as both alcohol and drug cases because witness statements, patient statements, and response to naloxone indicated that both alcohol and drugs were involved.

Of the 224 cases where drugs were involved, 87 (38.84%) involved the use of a prescription drug. In 70 calls (80.46%), the patients were abusing their own prescriptions, and in 11 calls (12.64%), the patients were taking prescriptions written for someone else. In the remaining 6 calls (6.89%), it was not directly stated if the prescription was for the patient or for another person. In 12 calls (3.77%), a mix of prescription drugs and street drugs were involved.

In 54 calls (24.1%), the patient admitted to using an illicit substance. Another 42 calls (18.75%) involved patients abusing over-the-counter medicines. For 18 calls (8.04%), the patient did not admit to narcotics use, but had a positive response to naloxone administration. In 21 calls (9.38%), the patient either refused to name the substance used, or the substance used could not be determined. Finally, the remaining 2 cases (0.63%) represent patients who used a common household item.

In 118 calls (37.11%), the patient reported either a history of a major mental illness, such as depression, bipolar disorder, generalized anxiety disorder, post-traumatic stress disorder (PTSD), or reported taking a medication commonly prescribed to treat a major mental illness.

The primary hypothesis was supported that the drug category being abused was associated with age. The drug category with the youngest mean age was 16.49 (SD = 4.97) for over-the-counter drugs. The drug category with the highest mean age was 21.22 (SD = 2.16) for assumed narcotics use due to positive reaction to naloxone. For the test of age and drug category, the F value was 4.62 ( $P < .001$ ). The Bartlett’s test of equal variances chi-squared value was 85.49 ( $P < .001$ ).

The secondary hypothesis that substance abuse incidence was associated with location was supported by the study data. Separate tests were run to see if an association existed between use of alcohol and location and use of drugs and location. For alcohol, the Pearson’s chi-square value was 51.06 ( $P < .001$ ). For drug use, the chi-square value was 55.32 ( $P < .001$ ). Both alcohol and drug use were associated with location.

The tertiary hypothesis was supported that both alcohol ( $P = .001$ ) and drug use ( $P < .001$ ) were associated with history of mental illness. Additionally, there was a statistically significant difference in age between groups with and without history of mental illness. Those who reported a history of mental illness had a mean age of 19.69 (SD = 3.49) while those who did not report a history of mental illness had a mean age of 17.75 (SD = 4.62). This gave an F value of 15.03 ( $P < .001$ ). Bartlett’s test for equal variances confirmed this association with a chi-squared value of 10.57 ( $P = .001$ ).

There was a statistically significant difference in age based on location of call. Street or highway had the lowest average age for a

call, 15.36 (SD = 1.39). Prison had the highest average age for a call, 23 (SD = 1.41). The test of location and age had an  $F$  value of 3.94 ( $P < .001$ ). The Bartlett's test for equal variances gave a chi-squared value of 68.63 ( $P < .001$ ).

For all categorical values, chi-squared tests and Fisher's exact  $P$  value revealed no statistically significant results for comparing alcohol use and gender, gender and race, gender and a history of harm, gender and history of mental illness, gender and location, or gender and history of ADHD. There was a statistically significant relationship between gender and the primary cause of the call being a suicide attempt. Of the attempted suicide cases, patients were more likely to be a female (33 cases, 10.38%) than a male (17 cases, 5.35%). The Pearson's chi-squared value was 11.13 ( $P = .004$ ). The Fisher's exact  $P$  value was .004 as well.

There was a statistically significant relationship between category of drug used and gender of the patient. Females (45 cases, 14.15%) were more likely than males (30 cases, 9.43%) to use prescription drugs and over-the-counter drugs. Males (32 cases, 10.06%) were more likely than females (22 cases, 6.92%) to use street drugs. In the category of patients who responded positively to naloxone, there were more than three times more male patients (14 cases, 4.40%) than female patients (4 cases, 1.26%). The Pearson's chi-squared value was 21.32 ( $P = .002$ ). The Fisher's exact  $P$  was .001.

## Discussion

To properly understand the scope and magnitude of the epidemic of substance use among the young, research must examine all facets of the problem. Data from prehospital care reports are unique; they report a different perspective on this problem as the patient's first contact is with emergency health services outside of the hospital. Prehospital care reports can be combined with data from hospitals and psychiatric institutions to help researchers learn more about the epidemic.

This study provided information about alcohol and drug use cases in Howard County where patients or bystanders call 911 for emergency assistance. Age was associated with drug category involved. This could be explained by access and peer influence. Younger adolescents may be more likely to use household items or use over-the-counter drugs that they have access to, whereas older teenagers and young adults may have more access to illicit drugs. This may suggest that different preventative efforts should be targeted to different age groups. Alcohol and drugs were associated with location of call. Use of alcohol under the age of 21, or drugs, is illegal, and targeting the most prevalent locations for prevention may have an impact on reducing substance use rates.

This research has public health implications for studying how EMS are being used currently and providing possible improvements. For example, patients who come in contact with EMS for complaints related to alcohol intoxication represent the patients so intoxicated with alcohol or drugs that they could not care for themselves. This subset of patients highlights binge usage of substances; these cases are important as it is in these cases that severe illness, injury, or death occur. In fact, such calls resulted in two cases of death in this dataset. Effective interventions in this subgroup could prevent significant morbidity and mortality. Similar to other public health crises, coordination between agencies can have synergistic effects on prevention.

Additionally, this data can be interpreted with nationwide data about alcohol and drug use and addiction to provide a more complete picture of the epidemic. Interestingly, from an economic prospective, EMS treatment and ambulance transports

to hospitals are often not counted in disability-adjusted life years (DALYs), and costs of the epidemic of addiction. Integrating data from prehospital care reports, emergency room visits, and psychiatrist office visits will provide the most accurate picture of the current mental health care system.

Only eight of the 318 calls studied were for children under 13 years of age. Most of these calls involved a young child accidentally ingesting a large amount of a medicine that had been left out by a family member. These cases might have influenced the average age breakdown, since they were so much younger than the majority of cases. Several associations were proven to be statistically significant. First, both age and sex were associated with category of drug used. Younger adolescents in this study were more likely to use household items, prescription drugs, or over-the-counter drugs, whereas older adolescents are more likely to use illicit drugs or a mix of drugs. Females in this study were more likely to use prescription drugs, whereas males were more likely to use illicit drugs. More research and a larger data set is needed for this trend of age and sex being associated with type of drug being used to further describe this finding and provide information for prevention.

Age was associated with history of mental illness. Experience could be a possible confounder in this relationship. A susceptible adolescent at age 13 may not have had environmental experiences that would lead them to seek treatment for depression, whereas a 20-year-old may have had more environmental stressors that could lead them to seek professional help for depression.

The association of location and age is impacted by law and social norms. Younger adolescents who were not of legal age to drink and would have been refused entry to a bar or club were more likely to be using substances at a home. For late teenagers and 20 to 25 year-olds included in the study, they were more likely to be at another location (business/commercial, concert, etc).

Perhaps the most striking association that warrants more investigation as a public health concern was the association of females being more than twice as likely as men to have 911 called for an attempted suicide. This is consistent with national data that indicates adolescent females are more likely to attempt suicide than adolescent males.<sup>15</sup> This suggests that a suicide intervention could be targeted to female young adults.

## Limitations

There are several limitations to this study. First, the results are from one suburban county in Maryland for a 2-year period. The results may not be generalizable to counties that are different, geographically or socioeconomically. Additionally, data was limited by how much the patients revealed, whether the patients were truthful, and how much information the emergency medical technicians (EMTs) or paramedics recorded on the charts. This data is also limited because charts were not linked to hospital records with confirmatory tests, which are generally considered the gold standard in substance use research.

## Conclusion

The associations demonstrated in this research can be used to help direct prevention and intervention resources. Additionally, this information could be incorporated into training for prehospital emergency care providers to raise awareness and public health implications of these presentations. Further research should employ prevention tactics and study the impact on substance use rates following intervention. A community organization that is directed

towards adolescent substance use may be able to reach this population and deliver a message that resonates with youth. This data sheds a different view on a rising problem. Future research must use data from different perspectives in order to formulate effective prevention strategies.

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