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Alcohol as a Factor in 911 Calls in Denver

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Abstract

Background: Excessive alcohol consumption is associated with a substantial number of emergency department visits annually and is responsible for a significant number of lives lost each year in the United States. However, a minimal amount is known about the impact of alcohol on the EMS system. **Objectives**: The primary objective was to determine the proportion of 9-1-1 calls in Denver, Colorado in which (1) alcohol was a contributing factor or (2) the individual receiving EMS services had recently ingested alcohol. The secondary objectives were to compare the characteristics of EMS calls and to estimate the associated costs. **Methods**: This was a prospective observational cohort study of EMS calls for adults from July 1, 2012, to June 30, 2014. Primary outcomes for the study were alcohol as a contributing factor to the EMS call and recent alcohol consumption by the patient receiving EMS services. Logistic regression was utilized to determine the associations between EMS call characteristics and the outcomes. Cost was estimated using historic data. **Results**: During the study period, 169,642 EMS calls were completed by the Denver Health Paramedic Division. Of these 71% were medical and 29% were trauma-related. The median age was 45 (interquartile range [IQR] 29–59) years, and 55% were male. 50,383 calls (30%) had alcohol consumption, and 49,165 (29%) had alcohol as a contributing factor. Alcohol related calls were associated with male sex, traumatic injuries including head trauma, emergent response, use of airway adjuncts, cardiac monitoring, glucose measurement, use of restraints, use of spinal precautions, and administration

of medications for sedation. Estimated costs to the EMS system due to alcohol intoxication exceeded $14 million dollars over the study period and required in excess of 37 thousand hours of paramedic time.

Conclusions: Compared to 9-1-1 calls that do not involve alcohol, alcohol-related calls are more likely to involve male patients, emergent response, traumatic injuries, advanced monitoring, airway adjuncts, and medications for sedation. This represents a significant burden on the emergency system and society. Further studies are needed to evaluate whether additional interventions such as social services could be used to lessen this burden.

Key words:: emergency medical services, alcohol intoxication, alcohol consumption, emergency responders

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Introduction

Excessive alcohol consumption is associated with more than 2.7 million emergency department (ED) visits annually (□ 1) and an average of 2.3 million years of potential life lost each year in the United States (US) (□ 2). Estimated annual cost in the US alone exceeds 249 billion dollars (□ 3). With increased concern for rising healthcare costs, hospital overcrowding, emergency department boarding, and patient safety, healthcare visits, and utilization secondary to alcohol consumption represents a significant burden to the US healthcare system (□ 4).

The proportion of estimated ED visits associated with alcohol use is significant and is, perhaps, most pronounced when looking at alcohol and trauma. The proportion of ED visits for traumatic injuries in the setting of alcohol use ranges from 30–70%, demonstrating a significant impact of alcohol on emergency services (□ 5–7). Multiple studies have demonstrated that alcohol consumption is associated with significantly worse injury in adult trauma patients (□ 8–11). The impact of alcohol encompasses a variety of age groups. From 2006–2008, an estimated 218,514 visits to US EDs by pediatric patients younger than 18 years were attributed to alcohol, accounting for an estimated cost of more than 850 million dollars (□ 12). Studies have demonstrated adverse outcomes in alcohol related trauma in pediatric patients, both among those who ingested alcohol and among those passively involved in alcohol related traumatic events (□ 13, □ 14). Similar findings were seen when assessing geriatric patients, with higher alcohol consumption leading to increased risk for ED visits (□ 15).

Alcohol use and related injury is an international issue. According to the World Health Organization, alcohol is a direct cause of 1.8 million deaths globally (16). ED visits for injuries related to alcohol use ranged from 6% to 45% of all ED visits worldwide (16, 17).

Alcohol use is a significant issue resulting in injuries, ED visits, and death, and the situation may worsen. Studies have demonstrated increasing numbers of alcohol related injuries and deaths over time, despite interventions (18, 19). McDonald et al. found that from 1992 through 2000, there were an estimated 68.6 million ED visits attributable to alcohol. They also found that over this time period the number of alcohol-related visits increased 18% (18). Hingson et al. studied alcohol related deaths among college students and found a 3% increased incidence from 1998 to 2005 (19). Given this trend, the impact of alcohol in ED presentations and overcrowding is likely to continue to increase over time.

While a significant body of research has been dedicated to alcohol's impact on ED visits, a relative minimal amount is known about the incidence of alcohol as a factor among emergency medical services (EMS) calls for assistance. Understanding the role of alcohol in 9-1-1 call volume and requests for EMS assistance is particularly important in determining the impact of alcohol on the healthcare system as a whole. The few studies that have been done in this area show an increasing incidence of alcohol related EMS calls over time as well a significant burden to local EMS systems (20, 21). However, these studies were performed in relatively small systems outside of the United States. Martin et al retrospectively evaluated the incidence of alcohol related calls to an ambulance service in the United Kingdom (20). The investigators assessed the proportion of ambulance calls in the North East of England [responded to by North East Ambulance Service (NEAS)] from April 2009 to March 2010 that were due to alcohol. Responding paramedics were asked to determine if they felt that calls were “obviously either directly or indirectly related to the consumption of alcohol.” The authors determined that 10% of ambulance-calls were alcohol related, with an estimated total cost of £9 million in a 1-year period. They then extrapolated that nationally this could represent as much as £152 million per year. Holzer et al performed a similar investigation on the effects of alcohol on the EMS system in the city of Zurich, Switzerland (21). The investigators conducted a retrospective longitudinal study from 2001 through 2010 and sought to identify trends in alcohol and drug related calls as well as to identify particularly susceptible groups in order to target future interventions. The study authors identified alcohol or drug use as the cause of transport in 10% of their cases, with 73% of the intoxications involving alcohol, either alone or with other drugs. They

noted an annual increase of alcohol related cases of about 5% per year over this ten-year period. The most at-risk group for increased use in this study, as demonstrated by the greatest increase in cases over the study period, was the population of young patients 25 and under. Middle-aged men comprised the greatest proportion of cases. The investigators did not estimate financial costs of alcohol use on the EMS system or healthcare system as a whole, but rather sought to identify at risk groups for potential future targeted interventions. While both of these studies showed that alcohol had a major impact on these relatively small European EMS systems, to our knowledge our study is the first to look at a large urban EMS system within the US and show the significant impact that alcohol has on resources. McLaughlin evaluated the impact of alcohol on a small US town, but we are not aware of other studies looking at the potentially significant cost alcohol has on large urban pre-hospital services in the US (22). This includes not only direct costs associated with transport and patient care, but also time lost for medical personnel, firefighters, and police first responders.

The primary objective of this study was to report the incidence of alcohol intoxication or alcohol as a contributing factor in 9-1-1 calls necessitating EMS assistance in metropolitan Denver. The secondary objectives of this study were to determine the associations between alcohol consumption and call characteristics and to estimate the potential economic cost of alcohol related calls on the EMS system as a whole.

Methods

Study Design and Setting

This Figure 1 was a prospective cohort study of a consecutive sample of EMS calls from July 1, 2012, through June 30, 2014 who contacted the 9-1-1 system in the city and county of Denver or had another individual contact the 911-system in Denver on their behalf for assistance. The county of Denver has an estimated population of approximately 634,265 people, and encompasses approximately 150 square miles.

The Denver Health Paramedic Division (DHPD) is a division of Denver Health Medical Center, and employs approximately 240 paramedics. It is the sole provider of emergency medical services for the City and County of Denver, Colorado. The DHPD responds to more than 100,000 calls annually for emergency

medical assistance including medical complaints, trauma, and critical care transport. This accounts for more than 95% of all EMS calls in the City and County of Denver. Ambulances are deployed in a dynamic dispersal to maintain coverage 24 hours per day. Between 17 and 23 ambulances are in-service at any one time.

The prehospital care delivery system in Denver is two-tiered. The DHPD provides all Advanced Life Support care and performs all transports. Denver Fire Department (DFD) crews, capable of providing Basic Life Support capabilities, are often co-dispatched to highest priority calls based on dispatch coding. Denver Police Department (DPD) officers may also be co-dispatched depending on the characteristics of the call. Thus, most 9-1-1 calls necessitating emergent response are dispatched one DFD apparatus, one DPD police car, and one DHPD ambulance with additional considerations in place in the event of multiple patients. Institutional review board approval was obtained for the study.

Study Population

The study population included individuals who contacted or had another individual contact 9-1-1 for emergency medical assistance in the City and County of Denver between July 1, 2012, and June 30, 2014. Patients were excluded from the study if they were transported by an EMS provider other than the DHPD.

Data Collection

A mandatory, closed-response data collection field regarding alcohol was included in the electronic paramedic data form to identify calls in which alcohol was a contributing factor in the call for EMS. For each 911-call that required EMS transport, PD transport or a refusal, paramedics completed the closed response data collection instrument outlined in Figure 1. The first question on the data collection instrument was “Is alcohol a contributing factor to this call?” This question was designed to provide information on the scope of alcohol use on the 9-1-1 call system and EMS. The paramedics were uniformly instructed to answer yes to the question regarding alcohol as a contributing factor if they believed anyone's current or recent alcohol use was related to the EMS encounter. The second question on the data collection instrument was “Has this patient been recently drinking alcohol?,” which was intended to identify patients with recent alcohol consumption. We did not provide a fixed definition of “recent” but rather left it to the clinical judgment of the paramedic to determine if the patient was still intoxicated or if the person clearly recently consumed

alcohol. Paramedics were instructed to answer yes if they felt that the patient appeared to have recently consumed alcohol. This was done intentionally instead of using a “is this patient intoxicated” question in order to obtain more data. As an example, a person has two alcoholic drinks at a bar and then falls and strikes his head. He appears sober and is refusing transport, but clearly recently consumed alcohol, which contributed to this call. By asking paramedics to identify if the patient recently consumed alcohol, this allowed us to capture that patient contact and the effect of alcohol on our EMS system. Had we defined it as “is this patient intoxicated,” this patient would have been recorded as a “no” and the impact on the EMS system would not have been identified. We also did not want to confuse alcohol consumption with the decision making capacity questions implied with “intoxication.”

Figure 1. Questions completed by paramedic staff for each emergency medical services call during the study period.

Question	Answer	Example scenarios
Is alcohol a contributing factor to this call?	Yes	• Alcohol intoxication • Alcohol withdrawal • Cirrhosis • Sober patient hit by drunk driver • Assault with any party intoxicated • Intoxicated girlfriend called 911 stating the patient is suicidal • Intoxication caused a substantial delay in calling 911
	No	• An intoxicated person promptly calls for spouse having a stroke • People are drinking at a party and a tree inadvertently falls on them and they sustain injuries from the tree
Has this patient been recently drinking alcohol?	Yes	Intoxicated
	No	Not intoxicated

Abbreviations: EMS; emergency medical services.

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Paramedics received standardized scenario-based training in application of the questions prior to study initiation. The training consisted initially of a division-wide email detailing the proposed changes as well as providing sample cases of how to determine if alcohol contributed to a call and if the patient recently consumed alcohol. This was followed by two division meetings with the paramedics hosted by the medical directors. A slide presentation was given in which the criteria and sample cases were reviewed and all questions were addressed in detail. Finally, the paramedic division lieutenants in supervisor cars followed up with individual providers in the field to ensure the protocol was being followed and to address any

questions in real time.

Paramedics collecting data for the purposes of the study were blinded to the objectives of the study. The paramedics were required to complete the fields regarding the role of alcohol in the EMS call in order to complete and file their electronic EMS report.

All EMS reports for the DHPD are completed using portable laptop computers (Panasonic Toughbook, Panasonic Corporation, Secaucus, NJ) and the data are maintained electronically (HealthWare Solutions EMS Software, HealthWare Solutions, Arcata, CA). All data collected for the purposes of this study were collected prospectively and in real-time by the paramedics who were engaged in the response to the 9-1-1 call.

The following data were collected on study participants: demographics (age, sex, race/ethnicity); EMS call characteristics (paramedic response time, scene time, and transport time); type of concern (medical or trauma), if concern was trauma then type of trauma (blunt or penetrating); chief complaint, clinical characteristics (prehospital vital signs and Glasgow Coma Scale [GCS] score); and EMS interventions.

Outcome Measures

The primary outcome measures for the study included (1) alcohol perceived as a contributing factor for the request for EMS and (2) recent alcohol consumption by the patient receiving EMS services.

Cost Calculations

Cost estimates were used to determine the overall impact of alcohol related calls on the EMS system. To accomplish this, Denver Paramedic Division, Denver Fire, Denver Police, and EMS Dispatch provided historical data based on their budget. They each provided information on the number of units required to complete a call (number of police officers, firefighters, etc.), the cost of each of those units per hour, as well as the average amount of time each unit spent on a call. Of note, this included only hourly wage and did not include public safety employee benefits and pension costs, which are significant. 2014 data was used from all services in order to maintain consistency. This data was used to determine a combined average cost per call for all services and this figure was then used to estimate a total cost over the study period.

Data Management and Statistical Analyses

Data were recorded in an electronic spreadsheet (Microsoft Excel, Microsoft Corporation, Redmond, WA). The data were cleaned and de-identified. All analyses were performed using SAS Version 9.3 (SAS Institute, Inc., Cary, NC). Descriptive statistics were calculated on the study participants and their demographic characteristics. Continuous data are reported as medians with interquartile ranges (IQRs) and categorical data are reported as percentages with 95% confidence intervals (CIs). Logistic regression was utilized to determine the associations between patient and EMS call characteristics and the primary outcomes.

Results

During the study period, 169,642 EMS calls were completed by the DHPD. Of these, 71% were medical and 29% were trauma-related calls for assistance. The median age of patients receiving emergency medical assistance was 45 (interquartile range [IQR] 29–59) years, and 55% were male. The characteristics of the study cohort are described in Table 1.

Table 1. Demographics and characteristics of the study sample (n = 169,642)

CSV Display Table

Among the study cohort, 50,383 calls (30%) had alcohol consumption and 49,165 (29%) had alcohol as a contributing factor to the 9-1-1 call for emergency medical assistance. Information regarding the EMS calls for alcohol consumption and as a contributing factor during the study period is outlined in Table 2.

Table 2. Alcohol as a contributing factor and recent alcohol consumption among 9-1-1 calls in metro Denver 2012–2013

CSV Display Table

The associations between the patient and EMS call characteristics and bivariate associations with recent alcohol consumption or alcohol as a contributing factor are described in Table 3 and Table 4, respectively. EMS calls with recent alcohol consumption or alcohol as a contributing factor were associated with male sex, traumatic injuries including head trauma, emergent response, airway adjuncts, cardiac monitoring, glucose measurement, restraints, spinal precautions, and administration of medications for sedation.

Table 3. Patient characteristics and bivariate associations with recent alcohol consumption in emergency medical services call (n = 169,642)

CSV Display Table

Table 4. Patient characteristics and bivariate associations with alcohol as a contributing factor in emergency medical services call (n = 169,642)

CSV Display Table

The estimated costs associated with alcohol were significant. 49,165 calls over this time period were estimated to have alcohol as a contributing factor. For DHPD, average time on task for a medical response based on 2014 data is 45 minutes and 48 seconds. In 2014, DHPD had an estimated cost per call of $198.10. For Denver Fire, in 2014 a mean of 1.09 vehicles were dispatched to each medical call. Each vehicle carries 5 firefighters. These firefighters cost $33.78 per hour. They spent a mean of 12.23 minutes on each medical call. Total cost for fire per call was thus $37.52. For Denver Police, a mean of 1.91 officers were dispatched to each medical call. They spent a mean of 40.64 minutes on each call and cost $49.06 per hour. Thus, total cost for police per call was $63.47. For EMS dispatch, average cost per call in 2014 was $2.49. In total for all services, cost per call in 2014 was $301.58. Considering there were 49,165 calls over the study period, the approximate total cost to the EMS system was $14,827,180.70. Total paramedic time spent on these calls was approximately 37,537.48 hours. This is a conservative estimate that excludes other significant costs such as fuel, vehicle wear and tear, supervisor time, benefits and pensions, and

other costs that are difficult to quantify such as increased response time due to higher call volumes.

Discussion

To our knowledge, our study is the first of its kind to utilize paramedic assessment of the involvement of alcohol to determine the incidence of alcohol as a factor in 9-1-1 calls in a metropolitan EMS system in the US. Our results demonstrate the significant impact of alcohol on an urban EMS system by showing that alcohol was a major contributing factor to nearly 30% of total calls. This suggests that alcohol has a major financial as well as logistical impact on the EMS system as a whole.

With respect to the patient characteristics associated with EMS calls for trauma that involved alcohol, our findings correlate with previous data on the patient characteristics associated with alcohol intoxication and traumatic injuries. In this study, EMS calls for trauma involving alcohol were associated with male sex, traumatic injuries including head trauma, as well as the need for spinal precautions. Plurad et al., in assessing alcohol use and trauma in patients greater than 10 years old treated in trauma centers in Los Angeles County in 2003, found that alcohol abuse was associated with younger age, male sex, and Hispanic origin. They also found that alcohol intoxication was also associated with higher rates of spinal and head trauma (□ 9). Li et al. analyzed the 1995 National Hospital Ambulatory Medical Care Survey of ED visits in the US and found that rates of visits related to alcohol intoxication peaked in the age group of 25–44 years and were highest among males (□ 23). Kowalenko et al., from an analysis of National Trauma Data Bank cases from 2000 through 2005, reported that in 21 year olds presenting with trauma, 42% tested positive for alcohol (□ 8).

Interventions to aid patients with alcohol intoxication in the prehospital setting have the potential to significantly impact prehospital and healthcare resource utilization and outcomes. Procedures such as field triage by EMS and transport of intoxicated patients to a detoxification facility rather than the ED have proven to be safe and effective (□ 24). In Colorado, field triage by EMS was found to be 99% sensitive, with no significant clinical complications (□ 24). With this intervention, providers successfully triaged about 20% of intoxicated individuals to a detoxification facility rather than to Emergency Departments, likely representing a significant savings in cost and resource allocation (□ 24). In San Diego, an intervention

called the San Diego Serial Inebriate Program has been implemented. According to Dunford et al, in this program, intoxicated patients who are transported by EMS more than 5 times within 30 days are jailed rather than transported to a sobering center (□ 25). In California, public intoxication is a misdemeanor, with penalties of up to 180 days of jail time (□ 25). The Serial Inebriate Program allows judges to offer a 6-month outpatient rehabilitation program as an alternative to incarceration. If these individuals agree and then successfully complete their treatment program, their probation is fulfilled and they are given additional resources. Those individuals who decline treatment or fail to complete the program face jail instead. After this intervention, the authors saw a 50% decrease in use of ED, inpatient, and EMS resources among adult individuals who completed treatment. This resulted in significant cost savings, with an estimated decrease in total monthly average costs per individual of $5,662 for EMS, $12,006 for Emergency Departments, and $55,684 for in-patient hospitalizations. Multiple other studies have documented the efficacy of ED interventions such as providing at risk patients with counseling and access to alcohol cessation programs, with significant reduction in alcohol-related injuries after the intervention (□ 26–□ 28). Our results suggest that further interventions in Colorado could have a significant impact on the EMS system as a whole. This would likely translate to cost savings for the larger health care system as well.

Data from our study may help to facilitate an increased understanding of the role of alcohol in the provision of 9-1-1 services and EMS, which will help to guide policy interventions in the prehospital, outpatient, and ED settings specific to alcohol use. Estimating the costs of alcohol to the emergency care system as a whole helps to quantify the significant impact alcohol has on public health and the potential opportunities for cost savings as a result of timely, effective interventions. The costs identified in this paper, both in terms of financial cost and personnel-hours, while extremely high, likely significantly underestimate the overall burden. As mentioned, our costs exclude vehicle costs, fuel, supervisor time, and so forth, but they also include only the prehospital burden. The Emergency Department and Hospital costs of 49,165 patient presentations due to alcohol is likely tremendous. The hope is that studies such as this will help to clarify the scope of the impact of alcohol in the provision of emergency care services and aid with identification of individuals at risk for alcohol-related EMS needs to help guide interventions to decrease utilization and improve patient outcomes.

Limitations

In this study, the paramedic was asked to indicate whether the patient was intoxicated or whether alcohol was involved as a contributing factor to the EMS call. Since no laboratory testing was conducted on the patients to confirm or refute alcohol consumption as a factor, the primary limitation of the study is that it is possible that there were cases in which the paramedic assessment of alcohol use or alcohol as a contributing factor was incorrect. This approach to our study may have resulted in an under- or over-estimation of the impact of alcohol in EMS calls by the DHPD. However, the paramedics who collected the data on alcohol use or intoxication did undergo standardized training prior to implementation of the questions in the paramedic report. We believe that the estimation of alcohol as a contributing factor by the paramedic helps to provide a more accurate estimate of the contribution of alcohol to 9-1-1 calls and utilization of EMS as compared to using only assessments of alcohol-related ED visits that would not capture individuals who were inadvertently impacted by alcohol but had not consumed alcohol.

Paramedics were allowed to answer “yes” to both questions regarding alcohol consumption and alcohol as a contributing factor if they believed both to be true in the call for EMS. Some patients were likely classified as both having consumed alcohol and having had alcohol as a contributing factor in the call for EMS assistance, thereby resulting in increased emphasis on the role of alcohol as a contributing factor in EMS calls.

Conclusions

In the Denver EMS system, alcohol consumption is a contributing factor in nearly 30% of all patient encounters. Compared to 9-1-1 calls that do not involve alcohol, alcohol-related calls are more likely to involve male patients, emergent response, traumatic injuries, advanced monitoring, use of airway adjuncts, and use of parenteral medications for sedation. The cost to our EMS system as a whole over this period is estimated to be $14,827,180.70. This represents prehospital costs only and does not include emergency department or hospital costs as well as other significant nonpecuniary costs such as increased response times to other calls, decreased ambulance availability, and hospital overcrowding. Alcohol clearly has a significant impact on public health as well as on the EMS system. Further studies are needed to identify the most effective interventions to reduce these effects.

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