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Validation of triage criteria for deciding which apparently inebriated persons require emergency department care

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Abstract

Some 620,000 emergency department (ED) visits for acute alcohol intoxication occur annually in the U.S. A half to two-thirds of these appear to be uncomplicated, and might safely be triaged to management in non-ED settings. We hypothesized that consensus criteria would afford sensitive and specific triage. Methods: Paramedics collected data on 99 apparently inebriated persons en route to the ED. We retrospectively reviewed these patients' ED charts to assess who actually required ED care. We then estimated sensitivity and specificity for proposed triage criteria that would have excluded patients from non-ED care: chest or abdominal pain, shortness of breath, suicidal ideation, abnormal vital signs or Glasgow Coma Scale, signs of head trauma, inability to ambulate, seizure, lacerations, fractures, or pregnancy. Results: Subjects were mostly male (89%), homeless (57%), and found on the street (81%); 17 appeared to require ED care, 39 were eligible for non-ED care, but 4 of these would have bounced back to the ED (negative predictive value 90%, sensitivity 76%, 95% CI: 50–93%; specificity 44%, 95% CI: 33–55). Paramedic opinion alone was highly specific (80%) but not very sensitive (41%). Lowering the pulse exclusion threshold from 130 to 83 would increase sensitivity to 100%, but decrease specificity to 22%. A simple post-hoc rule excluding those with age > 55 or pulse > 83 from non-ED care had high sensitivity (94%) and fair specificity (61%). The proposed criteria's sensitivity and specificity varied (65–83% and 44–49%, respectively) depending on which ED services were considered optional (e.g., psychiatric consultation, EKG, IV fluids, etc). Conclusions: Most apparently inebriated individuals in this study did not require ED care, but prospective identification of these persons is a challenge. A low exclusion cutoff for tachycardia may improve sensitivity.

Introduction

The burden on emergency departments (ED) in the United States continues to increase. From 1996 to 2006, the annual number of ED visits increased from 90.3 million to 119.2

million visits (up 32%). While visits to the ED have increased, the number of EDs has decreased from 4,019 to 3,833 (down 4.6% - see Figure 1). The number of visits to the ED in which the patient was transported by ambulance increased about 17 percent from 1997 to 2006.¹ The Institute of Medicine Committee on the Future of Emergency Care in the U.S. Health System has described a national crisis of ED overcrowding.² ED overcrowding has led to decreased quality of care, increased mortality, and decreased access to emergency and specialty services.^{3, 4} Diversion rates of EDs are on the rise, further diminishing patients' access to rapid emergency treatment. As the strain on the ED system increases, so grows the burden to better utilize shrinking ED resources. Identification of non-emergent cases that could be dealt with outside the ED may improve efficiency.

Some 620,000 annual ED visits are made for a primary diagnosis of acute alcohol intoxication. A half to two-thirds appear to be uncomplicated, and might safely be triaged to management in non-ED settings.⁵ Some patients who initially may appear merely inebriated, however, are found to have a life-threatening condition masquerading as or co-occurring with alcohol intoxication.⁶⁻⁹ How often this occurs, and whether or not these patients can be identified prospectively by paramedics, remains unclear.

In several U.S. cities, facilities for caring for inebriated patients with non-acute medical needs have been created – so-called “sobering centers”. One such center is San Francisco’s McMillan Stabilization Pilot Project, a collaborative effort by public and private organizations initiated in 2003. Patients are transported to the McMillan facility by ambulance, the police, or by a Mobile Assistance Patrol (MAP) van that is staffed by non-medical personnel. The McMillan center has 20 beds and is staffed by a multidisciplinary team of nurses, social workers, and caseworkers.

Our aims in this study were to estimate the sensitivity and specificity of triage criteria developed by consensus to identify which apparently inebriated patients might safely be triaged to non-ED care, i.e., a sobering center. We also investigated the sensitivity and specificity of modifications to these criteria.

Methods

We conducted a retrospective records review in an ED in San Francisco, California. Because data was collected only from medical records, we obtained a waiver of consent. The study protocol was approved by the University of California, San Francisco Institutional Review Board. Paramedics completed a paper survey over one month of all patients in which alcohol intoxication appeared to be a primary factor leading to transport (N=172). For each of these patients, paramedics recorded demographic characteristics, location from which the patient was transported, chief complaint, vital signs, Glasgow coma scale score, finger-stick blood glucose level, presence or absence of a number of subjective and objective exclusion criteria, whether or not the patient officially met criteria for triage to the McMillan facility, and whether or not the paramedic thought such triage was appropriate or not. Consensus triage criteria were embedded within the survey form as “exclusion criteria” checkboxes. These patients were all transported to a San Francisco ED per long-standing local emergency medical services (EMS) protocol.

We attempted to locate ED charts on each of these 172 patients, but charts could not be located for 73 and no analysis was conducted on these patients. The retrospective review was conducted using a standardized data collection form to assess which of the subjects transported actually required ED care. Information obtained from this collection process included demographics, tests performed, diagnoses, and disposition of the patient. Data on 99 patients were entered into a computerized database for analysis by San Francisco Department of Public Health quality assurance personnel.

We estimated sensitivity and specificity for four sets of triage criteria that would have excluded patients from non-ED (i.e., sobering center) care:

1. Consensus exclusion criteria (see Table 1). These criteria were generated by consensus of local physicians and EMS personnel.
2. Paramedic opinion, i.e., response to the question, “Do you think transport to the sobering center would be appropriate for this patient?”
3. Subject age > 55 and pulse > 83 only.
4. Consensus exclusion criteria, and also excluding those with pulse > 83.

Sensitivity was further analyzed by varying assumptions about which ED services constituted required services. Sensitivity, specificity, negative and positive predictive values were calculated and reported with 95% confidence intervals.

Results

Subjects were mostly male (89%), homeless (57%), and found on the street (81%). A substantial percentage of these subjects (42%) were identified by paramedics as frequent users of EMS. Table 2 provides a description of demographics of this sample.

Patients who were admitted to the hospital after transport, who received specialty consultation, had positive radiology results, required suturing of a laceration, or got charcoal lavage were considered to have required ED care. Persons who had negative radiologic examinations or who received only non-emergency treatment were not considered to have required ED care (see Table 3). Using this classification scheme, 17 subjects (17%) appeared to require ED care – these included 5 hospitalized subjects, and 12 subjects who received specific ED services but who were not admitted to the hospital (see Figure 2). Forty-three patients were discharged from the ED after negative EKG or radiological studies (N=20), or after non-emergent treatment (N=23). The other 39 patients were observed and then discharged from the ED. Thus, 83% of our sample were deemed not to have required ED care, and 39% did not receive any ED services.

Table 4 summarizes sensitivity and specificity of the four criteria. Consensus criteria were relatively sensitive (76%) but not very specific (44%), while paramedic opinion alone was specific (80%) but not very sensitive (41%). To investigate ways of improving consensus criteria, we generated additional, post-hoc exclusion thresholds from this sample. Lowering the pulse exclusion threshold from 130 to 83 would increase sensitivity to 100%, but

decrease specificity to 22%. A simple rule which merely excludes those with age > 55 or pulse > 83 from non-ED care had high sensitivity (94%) and fair specificity (61%).

For consensus criteria, the sensitivity and specificity varied (65–83% and 44–49%, respectively) depending on which ED services were considered optional (e.g., psychiatric consultation, ECG, IV fluids, etc). Sensitivity was highest (83%, 95% CI 52–98%) if only admission and laceration suturing were required services, while specificity was highest (49%, 95% CI 32–65%) if all services including complete blood count, comprehensive metabolic panel, or other blood tests were deemed to have been required (see Table 5).

Four subjects would have been mistriaged by consensus criteria, and one additional patient would have been mistriaged because of failure to identify or apply consensus criteria properly. These patients would have bounced-back to the ED had they actually been transported to the sobering center. Some characteristics of these five cases are given in Table 6.

Discussion

In our sample, most apparently inebriated individuals did not require defined ED services or admission to the hospital, but prospectively, safely, and efficiently identifying these persons is challenging. Such identification is markedly more difficult because it is done in the field, where decisions are made with limited information. However, the initial encounter with these patients is a time when relatively few resources have yet been devoted, and when appropriate triage has greatest efficacy.

Our consensus criteria's sensitivity of 76% means that out of 100 patients triaged, we could expect 24 to have been undertriaged (i.e., an underestimation of the severity of an illness or injury was made) and sent to a sobering center. What undertriage rate is acceptable in this population? For general medical conditions dealt with by EMS, rates of reported undertriage have varied. Schmidt et al.¹⁰ reported a 9% undertriage rate, and noted that patients with psychiatric complaints were at highest risk for undertriage. In a comparison of triage decisions made by paramedics versus emergency physicians, Pointer et al.¹¹ reported a 9.6% undertriage rate, and called this rate "unacceptably high." However, participants in a symposium convened to assess EMS triage (the Neely Conference) were unable to reach consensus on an acceptable undertriage rate.¹² Asplin, commenting on the study by Pointer cited above, asks:

Although it is easy to agree that undertriaging 10% of patients is unacceptable, when would the sensitivity be high enough for us to consider paramedic triage safe? I do not have the answer to that question, but it seems clear that, if we were finally able to reach an 'acceptable' sensitivity (i.e., an acceptable degree of undertriage), the specificity would be so low that the potential for saving system resources would be marginal at best.¹³

Even after patients are seen and treated in the ED, some bounce-back occurs. The 2006 U.S. National Ambulatory Care Survey¹ reported a 3.6% return rate for patients seen in the same ED within 72 hours, and a study in Taiwan¹⁴ reported a 72-hour return rate of 5.5%. Keith et

al.¹⁵ reported a rate of 2.2% unscheduled return to the ED within 72 hours, whereas another study found a 0.4% unscheduled return visit rate.¹⁶ ED bounce-back may occur more often when patients present with mental illness or problems of drug misuse. In a study looking at risk factors for admission to the hospital within 72 hours after an ED visit, patients with mental health disorders had a higher risk of return than with any other diagnoses, and 71% those cases were alcohol-related.¹⁷ In our study, three of the five patients who would have been mistriaged to non-ED care by consensus criteria required mental health assessment and treatment.

Higher undertriage rates might be more acceptable given an alternative other than simply nontransport to the ED, e.g., transport to alternative medical care. At the McMillan sobering center, patients are cared for by nursing staff following a set of established protocols for monitoring, treatment, referral, or return to the ED. For example, out-of-range vital signs mandate transport to the ED. During a study period August 2003 to January 2004, 5% of patients at the McMillan sobering center were discharged to an ED. Higher undertriage rates place an additional burden on an alternative care center to be able to accurately recognize, possibly perform additional care, and arrange for transport back to an ED.

Given that overtriage is safer than undertriage, modifying our consensus criteria by broadening the range of exclusionary vital signs could provide greater safety. Modification of consensus criteria with a lower exclusion cutoff for tachycardia improved sensitivity, but as noted, this lower exclusion cutoff (pulse > 83) was generated post hoc from the our data and may not be generalizable to other populations. Four subjects who would have bounced back to the ED in our study would have been appropriately initially triaged with the addition of a lower exclusion cutoff for tachycardia (e.g., pulse > 100, rather than the consensus exclusion criteria of pulse > 130).

Use of paramedic opinion alone would have resulted in substantial undertriage (sensitivity = 41%). This finding is in line with other studies that have shown that paramedic opinion alone can be inaccurate in triaging patients.^{18–21} In a meta-analysis of studies reporting U.S. paramedics' ability to determine medical necessity of ambulance transport, Brown et al.²² concluded that insufficient evidence exists to support paramedic determinations of medical necessity for ambulance transport, reporting a likely undertriage rate of 9% but noting that the rate could have been as high as 29%. In our study paramedic opinion would have yielded the least overtriage of any of the four criteria studied, providing relatively high specificity (80%) – of 39 subjects in our study who were discharged after only observation in the ED, paramedic opinion alone would have identified all but three. Accurate triage based on opinion alone appears problematic across skill levels: a study in which an emergency physician and an internal medicine physician reviewed the same 219 cases, the internist indicated 36% of the cases were emergencies, while the emergency physician identified 90% of the cases as emergencies (the two physicians agreed more often when deciding whether patients could be treated in non-ED settings). Another study cites relatively high levels of disagreement among physicians making decisions about necessity of transport to an ED.²³

Complicated triage criteria may place a burden on EMS staff, and our consensus exclusion criteria required accurately determining the presence or absence of a number of conditions.

In one case, the paramedic simply failed to check a box on the exclusion criteria form for “sutureable laceration” in a patient with this condition. Interestingly, we found that simplification via merely cutoffs for age and pulse provided sensitive and fairly specific triage. Nevertheless, these simple rules would still require supplemental criteria (e.g., subjects with cardiac or gastrointestinal disease, cervical spine injuries, etc., might be mistriaged).

Use of any of these criteria is ultimately designed, in part, to increase efficiency and reduce overtriage. The use of consensus criteria over one month would have diverted 71 patients to the sobering center instead of to more expensive care in the ED (and with transport via MAP, would have substantially reduced ambulance costs as well). The cost of ED care for acute alcohol intoxication is significant. In San Francisco, the estimated cost of a single ambulance ride was \$1,458 for 2009–2010 [XXX cite local news or personal communication, DPH], while across the United States, ambulance providers’ average costs for a ground ambulance transport varied widely from \$99 to \$1,218 in 2004 (these national estimates excluded local fire department/EMS systems)²⁴. In 2006 the average cost of an emergency room visit in the U.S. was \$638,²⁵ Thus, the diversion of 71 subjects to non-ED care represents substantial direct savings. Not reflected in these figures, however, are additional indirect savings in the form of reduced ambulance diversion, better EMS response times, and reduced impact on the ED. Nor is the ED the optimal setting for acute intervention in alcohol abuse or dependence, where encounters are characterized by a lack of time and privacy, ignorance about alcohol intervention by the ED staff (e.g., unfamiliarity with screening instruments, unawareness that brief interventions can be beneficial), and limited reimbursement for screening or intervention.²⁶ As few as 15% of ED patients with obvious alcohol problems ever have their drinking behavior addressed while in the ED or through an ED referral for problem drinking.^{27, 28}

There are a number of limitations to our study. Our sample was taken from an urban area, and subjects were mostly male and homeless. Thus, our results may not be generalizable to suburban or rural populations. It is unknown how many subjects, if any, refused transport or care and whether these patients represent an important subgroup. The use of hospitalization and the specific ED services we chose may not be the best standards for determining the necessity of ED care, e.g., some patients who legitimately need transport to the ED do not require hospitalization, but might need diagnostic workup. Some of the consensus criteria are vague and open to some variability in interpretation (e.g., how recent is “recent head trauma?”; what constitutes a “sutureable laceration?”). Paramedics were not blinded to their participation in the study, and this possibly influenced their opinions on the appropriateness of triage to the sobering center (e.g., they may have been more conservative in their opinions, leading to an underestimation of the rate of undertriage for paramedic opinion).

Future research might focus on ways these criteria might be improved by more formal processes of triage development, for example, by the Delphi method, a structured process to elicit expert knowledge using a repeated series of questionnaires to gather and provide information that continues until consensus emerges.²⁹ An examination of whether such criteria might be generalizable for triage of persons who appear to be misusing other drugs of abuse, e.g. opiates or stimulants, might be useful. Are there other tests that could be

administered safely and efficiently by EMS field personnel to assist in triage, e.g., breath ethanol levels or urine toxicology? Should field triage criteria be restricted to use in patients within certain age ranges, and without certain known past diagnoses or symptom categories? Should protocols be tailored to different EMS skill levels (e.g., basic life support versus advanced life support responders)? Would early consultation and communication with physicians by EMS personnel in the field improve triage? From both clinical and public policy perspectives, further analysis of what constitutes reasonable undertriage and overtriage rates would be beneficial.

In conclusion, we found that prospectively identifying inebriated patients who can be diverted to non-ED care is challenging, but potentially provides greater overall efficiency. The use of our consensus criteria would have resulted in substantial undertriage, but this rate may be acceptable given that patients would have been triaged to alternative medical monitoring and care. A lower exclusion cutoff for tachycardia may improve sensitivity.

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Figure 1.

Number of U.S. ED visits and emergency departments, 1991 – 2007

[XXX Need to adapt, get permission for use]

Source: American Hospital Association <http://www.aha.org/aha/trendwatch/chartbook/2009/chart3-7.pdf>

FIGURE 2.

Outcomes for 172 apparently inebriated patients transported to the ED

TABLE 1

Consensus exclusion criteria

Chest pain	Shortness of breath
Abdominal pain	Suicidal ideation or behavior
Systolic blood pressure > 180 or < 100	Diastolic blood pressure > 110
Pulse > 130 or < 60	Respiratory rate > 24 or < 12
O ₂ saturation < 92%	Blood glucose > 250 or < 80
Glasgow Coma Scale < 10	Recent head trauma
Inability to ambulate	Inability to give name
Syncope	Seizure
Suturable laceration	Pregnancy > 20 weeks
Gastrointestinal bleeding	Acute fracture

TABLE 2

Demographics

Characteristic	Study sample N=99*
Age, mean years (+/- SD)	45 ($\pm$ 11)
Sex, n (%) male	88 (89)
Frequent caller per paramedic, n (%)	42 (42)
Homeless, n (%)	52 (57)
Location of patient when ambulance arrived, n (%)	
Street	80 (81)
Shelter	0 (0)
Residence	7 (7)
Other (hotel lobby, park, restaurant, etc)	11 (11)
Unknown	1 (1)
Chief complaint included:	
Alcohol, n (%)	37 (37)
Trouble ambulating or fall, n (%)	20 (20)
Altered level of consciousness, n (%)	16 (16)
Pain, n (%)	11 (11)
No chief complaint noted, n (%)	9 (9)

Table 3

Disposition and level of emergency department care provided among apparently inebriated persons, according to triage criteria

Triage criteria	Level of care required, N (%)					
	Admitted		Required ED care*	EKG/radiology testing*	Non-emergent study or treatment (IVF/meds/blood testing [†])	Observation and discharge
	N	N=5	N=12	N=20	N=23	N=39
Consensus						
ED	59	5	8	12	14	20
Sobering center	40	0	4	8	9	19
Paramedic opinion						
ED	23	2	5	7	6	3
Sobering center	75	3	7	13	17	35
Data-driven: age > 55 & pulse > 83						
ED	48	5	11	11	6	15
Sobering center	51	0	1	9	17	24
Consensus criteria plus pulse > 83						
ED	81	5	12	17	18	29
Sobering center	18	0	0	3	5	10

* Patients receiving specialty consultation, positive radiology results, suturing of a laceration, or charcoal decontamination were considered to require ED care. Persons with negative radiologic examinations were not considered to have required ED care.

[†] Blood testing excludes fingerstick blood glucose and blood alcohol testing.

Table 4

Test characteristics (95% confidence interval) of four triage criteria in predicting who required ED care, or received any ED services

Triage criteria	Required ED care		Received any ED services	
	Sensitivity	Specificity	Sensitivity	Specificity
Consensus	0.76 (0.50–0.93)	0.44 (0.33–0.55)	0.65 (0.52–0.77)	0.49 (0.32–0.65)
Paramedic opinion	0.41 (0.18–0.67)	0.80 (0.70–0.88)	0.33 (0.22–0.47)	0.92 (0.79–0.98)
Age > 55 & pulse > 83	0.94 (0.71–1.00)	0.61 (0.50–0.72)	0.55 (0.42–0.68)	0.62 (0.45–0.77)
Consensus + pulse > 83	1.00 (0.80–1.00)	0.22 (0.14–0.32)	0.87 (0.75–0.94)	0.26 (0.13–0.42)

Table 5

Sensitivity analysis of consensus criteria, varying assumptions about which types of emergency department services are required

Emergency department services required	Sensitivity (95% CI)	Specificity (95% CI)
Base case *	0.76 (0.50–0.93)	0.44 (0.33–0.55)
Base case minus psychiatric consultations	0.80 (0.52–0.96)	0.44 (0.33–0.55)
Base case minus charcoal decontamination	0.76 (0.50–0.93)	0.44 (0.33–0.55)
Only admission and laceration suturing	0.83 (0.52–0.98)	0.44 (0.33–0.55)
Base case plus any CT scan	0.76 (0.55–0.91)	0.46 (0.34–0.58)
Base case plus any radiology test	0.68 (0.49–0.83)	0.45 (0.33–0.57)
Base case plus any radiology test or electrocardiogram (ECG)	0.66 (0.49–0.80)	0.44 (0.32–0.58)
Base case plus any radiology test or ECG or intravenous fluids administered	0.65 (0.49–0.79)	0.45 (0.31–0.59)
Base case plus any radiology test or ECG or intravenous fluids or medications administered	0.65 (0.51–0.77)	0.48 (0.32–0.64)
All services including complete blood count, comprehensive metabolic panel, or other blood tests	0.65 (0.52–0.77)	0.49 (0.32–0.65)

* Assumes that specialty consultation, positive radiology tests, laceration suturing, and charcoal decontamination all require ED services when they occur.

Table 6

Five selected patients requiring ED care who would have been mistriaged to a sobering center by consensus criteria

Description	ED service(s) required
45 year-old man found in his residence, chief complaint of “DTs and depression secondary to alcohol”; SBP 178, P 120, RR 16, O ₂ Sat 99%, GCS 13, and FSG 158. Paramedic comment: “Perfect patient for the sobering center.”	Lorazepam, IV fluids, blood testing, psychiatric consultation, transferred to Psychiatric Emergency Services, diagnosis of “psychoneurosis NOS”
38 year-old woman found on street, chief complaint of “ETOH”; SBP 130, P 100, RR 18, O ₂ Sat 98%, GCS 15, FSG 92. Paramedic comment: “...extremely combative upon arrival to ED”	BAL 0.271; Haloperidol, lorazepam, and psychiatric consult; discharged -diagnoses of alcohol intoxication and “hostile behavior”
49 year-old homeless man found on street with a chief complaint of “ETOH”; SBP 130, P 105, RR 16, O ₂ Sat 99%, GCS 13, and FSG 168	BAL < 0.01; Charcoal lavage, EKG, other blood tests; discharged - diagnoses of alcohol abuse, self-inflicted poisoning with psychotropics
27 year-old man, frequent caller, chief complaint of “laceration to right occiput”; SBP 116, P 106, RR 18, O ₂ Sat 95%, GCS 14, FSG 88; paramedic did not check box for “suturable laceration” - felt sobering center appropriate	IV fluids, C-spine films, laceration sutured; discharged with diagnosis of open scalp wound
47 year-old man found on street complaining of “fall”; SBP 108, P 100, RR 20, GCS 14, FSG 108	Lacerations on forehead and nose dermabonded, tetanus antitoxin; discharged with diagnoses of lacerations and alcohol intoxication

SBP – systolic blood pressure in mm Hg; P – pulse in beats/minute, RR – respiratory rate in breaths/minute; O₂Sat – oxygen saturation; GCS – Glasgow Coma Scale; FSG – fingerstick blood glucose in mg/dl; IV – intravenous fluids; BAL – blood alcohol level in mg/dl