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Journal

Emergency Medicine Journal, 30(3)

ISSN

1472-0205

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Publication Date

2013-03-01

DOI

10.1136/emmermed-2011-200452

Peer reviewed

Accuracy of the initial diagnosis among patients with an acutely altered mental status

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Accepted 27 January 2012

ABSTRACT

Objectives The objectives of this prospective observational study were to: (1) determine the accuracy of physician diagnosis in patients with an acutely altered mental status (AMS) within the first 20 min of emergency department (ED) presentation; and (2) access if physician confidence in early diagnosis correlates with accuracy of diagnosis.

Methods A prospective observational convenience study was conducted of 112 adult patients who presented to an urban county ED with AMS (Glasgow Coma Scale (GCS) score ≤ 14) between August 2008 and July 2009. Within the first 20 min of patient presentation to the ED, treating physicians were asked to record their best diagnostic guess of the cause of the patient's AMS and their confidence in this diagnosis. Serial hourly GCS was performed and the results of all diagnostic testing were recorded. Blinded investigators determined the final consensus diagnostic cause of the patient's AMS.

Results The final consensus diagnoses for AMS aetiologies were as follows: isolated alcohol intoxication 31%, other (psychotic episodes, underlying dementia) 21%, combination alcohol/other drug intoxications 18%, isolated other drug intoxications 10%, other metabolic derangements 6%, cerebrovascular accident/transient ischaemic attack 4%, seizures/post-ictal states 4%, traumatic brain injuries 3%, isolated opiate intoxications 2%, isolated benzodiazepine intoxication 1% and septic episode 1%. The emergency physician's initial diagnosis of the AMS patient correlated with the accuracy of the final diagnosis ($r^2=0.807$). The quintiles of confidence of diagnosis were: 0–20% degree of confidence had a 33% diagnostic accuracy, 21–40% had 25% accuracy, 41–60% had 43% accuracy, 61–80% had 52% accuracy and those with 81–100% confidence of initial diagnosis had 78% accuracy. Of the 106 patients with an initial diagnosis, 52 (51%) had a head CT performed, with eight (8%) having an acute abnormality.

Discussion Early diagnoses of AMS patients are moderately accurate. Few early misdiagnoses of AMS patients were clinically relevant. Physicians' greater degree of confidence in their diagnosis correlated with greater accuracy.

INTRODUCTION

Altered mental status (AMS) denotes an undifferentiated group of disorders of mentation, characterised by impaired cognition, attention, awareness or level of consciousness.¹ Patients with acute non-traumatic causes of AMS make up 5% of all patients presenting to emergency departments

(ED),² with higher rates (20–25%) among elderly^{3,4} and poisoned patients.^{5–7}

With myriad causes and similar presentations, AMS can be one of the most challenging diagnostic entities for the emergency physician. In different settings and patient populations, investigators have found some of the leading causes of AMS to be drug or alcohol intoxication, hypoglycaemia, ischaemic stroke, intracranial haemorrhage and status epilepticus.^{2, 5–7} These diagnoses often require prompt diagnosis and specific therapies for good outcomes. The objectives of this prospective observational study were to: (1) determine the accuracy of physician diagnosis in AMS patients within the first 20 min of ED presentation; and (2) access if physician confidence in early diagnosis correlates with accuracy of diagnosis.

METHODS

Between August 2008 and July 2009, we conducted this prospective observational study at an urban county hospital with an annual ED census of 58 000 patients. Our ED is fully staffed around the clock by board certified emergency physicians who ultimately oversee all of the patients and who closely supervise all of the residents and interns.

Inclusion criteria were age ≥ 18 years and an initial Glasgow Coma Scale (GCS) score of ≤ 14 . We excluded patients who presented with cardiac or respiratory arrest, multisystem trauma, patients in police custody and patients with a known chronic abnormal level of consciousness. The study protocol was approved by the Committee on Human Research at the University of California, San Francisco.

Research assistants were available approximately 8 h a day on weekdays, mostly covering the evening hours of 15:00 to 23:00. Within the first 20 min of patient presentation to the ED and prior to any laboratory results other than a fingerstick glucose, treating physicians were asked to record their best diagnostic guess of the cause of the patient's AMS and their confidence in this diagnosis within 20% quintiles (0–20%, etc) (figure 1). The only other potential point of care testing that was possibly available in this 20 min included an ECG or arterial blood gas measurement. The physicians were either residents (postgraduate year 1, 2 or 3 from emergency medicine and other specialties) or attending emergency physicians.

The following clinical data were collected by the research assistants: patient demographics, pre-hospital and ED vital signs, initial ED and all available GCS measurements, past medical history and alcohol/substance use history (as recorded by the

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Figure 1 Best guess diagnosis. CVA, cerebrovascular accident TBI, traumatic brain injury; TIA, transient ischaemic attack.

Please circle one

- Isolated alcohol intoxication
- Isolated benzodiazepine intoxication
 - Isolated opiate intoxication
- Isolated other drug intoxication
 - Combination alcohol/other drug intoxication
- Traumatic brain injury
- Combination alcohol with TBI
- CVA/TIA
 - Seizure/post-ictal
 - Hepatic encephalopathy
- Other metabolic derangement
 - Sepsis
- Other: _____

How confident are you of this diagnosis? *Please circle one*

0%–20%	21%–40%	41%–60%	61%–80%	80%–100%
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providers). They recorded all significant ED management and treatment, including administration of dextrose and naloxone, use of physical or chemical restraints, and performance of endotracheal intubation or lumbar puncture. They also recorded results of all diagnostic tests (primarily blood tests, radiological imaging and urine toxicologic screens). Routine urine drug screen testing was conducted at the Clinical Chemistry Laboratory at San Francisco General Hospital using immunoassays (Microgenics Inc, Fremont, California, USA) on the ADVIA Centaur Analyser (Siemens Healthcare Diagnostics, Tarrytown, New York, USA). Ethyl alcohol was tested on the ADVIA 1800 Analyser (Siemens) using the alcohol dehydrogenase method.

Final consensus diagnoses for analysis were established by investigators KS and WW in the following manner: patients who had urine toxicology screens positive for opiates or benzodiazepines were categorised as isolated or combination intoxication. Patients with suspected alcohol intoxication and an abnormal GCS who subsequently had normalisation of their mental state and were discharged from the ED were classified as isolated alcohol intoxication. Patients with an abnormal head CT presumed to be acute were considered to have a positive scan.

Data were entered and stored using Microsoft Excel 2000 Microsoft (Seattle, Washington, USA). After conversion, data were analysed using Stata C 10.0. Accuracy was determined by

Figure 2 Correlation of actual accuracy of diagnosis with the reported physician confidence of diagnosis.

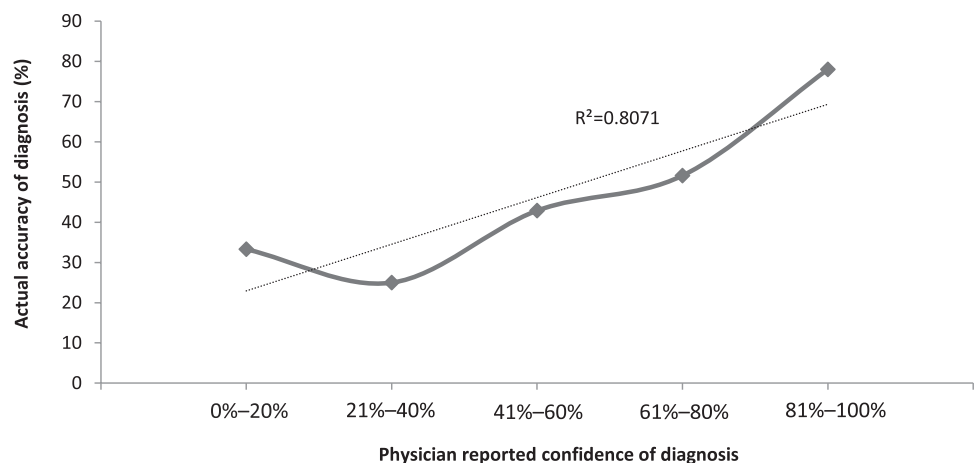
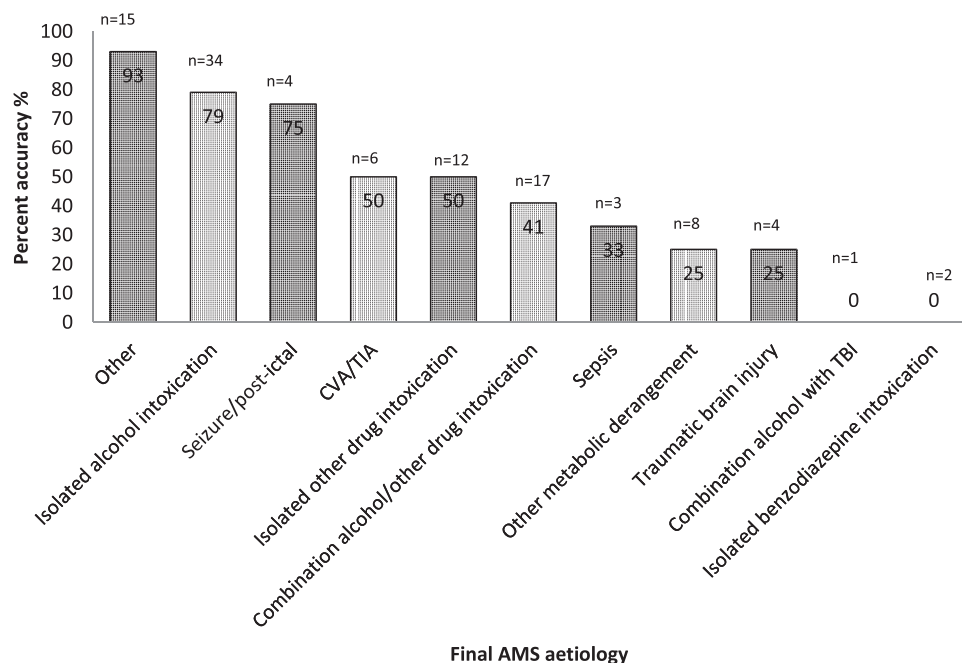


Figure 3 Accuracy of each initial diagnostic category. AMS, altered mental status; CVA, cerebrovascular accident TBI, traumatic brain injury; TIA, transient ischaemic attack.



calculating both the per cent agreement and coefficient of correlation (r^2), with the consensus diagnosis serving as the gold standard. We determined a priori that r^2 values of <0.4, 0.4–0.6, 0.6–0.8 and >0.8 would represent poor, fair, good and excellent accuracy, respectively.

RESULTS

Of the 112 patients with AMS entered into the study, 78 (69%) were men and 96 (86%) arrived via ambulance. Mean age was 52.4 years (SD 15.6; range 21–93 years). Fifty-two (46.4%) patients were transported from the street, 32 (28.6%) from a residence, nine (8.0%) from a clinic and four (3.6%) from a skilled nursing facility. Fifty-six of these patients had toxicological screens performed.

Physician reported confidence of diagnosis correlated with the accuracy of diagnosis ($r^2=0.807$) (figure 2). Those that reported greater confidence in their initial diagnosis had higher rates of diagnostic accuracy. The quintiles of confidence of diagnosis are as follows: those with a 0–20% degree of confidence had a 33% diagnostic accuracy, 21–40% had 25% accuracy, 41–60% had 43% accuracy, 61–80% had 52% accuracy and those with 81–100% confidence of initial diagnosis had 78% accuracy.

The distribution among the initial diagnoses for AMS aetiologies can be seen in figure 3. The final consensus diagnoses for AMS aetiologies are listed in table 1. The initial diagnosis was not recorded for six patients, leaving 106 patients for the final analysis. There was significant variation in diagnostic accuracy among the different initial diagnostic categories (figure 3). In the 35 cases in which the initial diagnosis was isolated alcohol intoxication, physicians were correct 27 (79%) times. Among the other eight incorrectly identified patients, five were ultimately diagnosed with combination drug/alcohol intoxication and three with alcohol and traumatic brain injury.

In patients whose initial diagnosis was intoxication with a combination of alcohol and other drugs, physicians were correct six (50%) times. Most inaccurately assessed patients were ultimately diagnosed with isolated alcohol or other isolated drug intoxication. The 15 patients placed into the initial diagnosis of 'other' were ultimately categorised as psychiatric (n=6),

chronic AMS (n=6) and three as metabolic or septic problems. The 12 patients initially diagnosed as having an isolated other drug intoxication were accurate 55% of the time. The misdiagnosed patients were all diagnosed with multiple drug ingestions.

Of the 106 patients with an initial diagnosis, 52 (51%) had a head CT performed (figure 4). Head CT scans were performed in those with a diagnosis of suspected isolated alcohol intoxication (38%), combination alcohol and other drug intoxication (35%), and suspected isolated drug intoxication (42%).

Of the 52 patients who had a head CT, eight (8% of the total AMS patients) were considered positive. For those patients with a suspected cerebrovascular accident, 67% were considered positive and 25% of those had a suspected traumatic brain injury. The other positive head CTs were scattered among the other initial diagnoses: isolated alcohol intoxication one (3%), combination alcohol and other drug intoxication one (6%), metabolic disease one (13%) and traumatic brain injury one (25%).

DISCUSSION

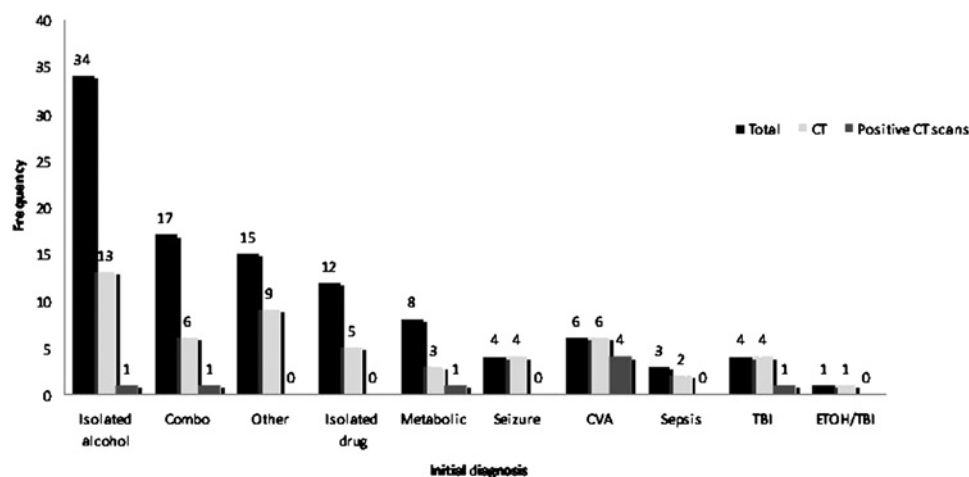
The differential diagnosis of acute AMS encompasses a heterogeneous group of disorders, some of which are associated with

Table 1 Final consensus diagnoses for altered mental status aetiologies

Final diagnosis	No	%
Isolated alcohol intoxication	33	31
Other (psychotic episodes, underlying dementia)	22	21
Combination alcohol/other drug intoxications	19	18
Isolated other drug intoxications	11	10
Other metabolic derangements	6	6
Cerebrovascular accidents/transient ischaemic attacks	4	4
Seizures/post-ictal states	4	4
Traumatic brain injuries	3	3
Isolated opiate intoxications	2	2
Isolated benzodiazepine intoxication	1	1
Septic episode	1	1

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Figure 4 Head CT total rate and abnormal rate by initial diagnosis. CVA, cerebrovascular accident TBI, traumatic brain injury.



major morbidity and mortality. Rapidly distinguishing those patients who need surgical or other acute intervention from those who are merely intoxicated is a critical task for the emergency physician. Given costs, resource constraints and concerns about radiation exposure,⁸ ordering of head CT scans in all such patients is not a viable diagnostic approach. Moreover, drug screening for alcohol, opiates and benzodiazepines may not be available within a reasonable time.

In this study, we found that the emergency physician's initial diagnosis (formed within the first 20 min of patient assessment) for patients with AMS showed good accuracy and that the physician's initial degree of confidence correlated with higher accuracy.

A large portion of our misdiagnoses were the confusing of isolated drug or alcohol intoxication with combination drug or alcohol intoxication. Because all of these patients would be treated with expectant observation and supportive care as needed, this is a clinical error with limited clinical significance. Of those with isolated alcohol intoxication, many were misdiagnosed by our definitions but only one patient had a clinically relevant change in treatment with a positive CT scan.

Because patients who present with AMS are heterogeneous, the development of clinically useful subgroups (suspected alcohol intoxication with an initial GCS of 14–15 or witnessed seizure patients with a GCS <14) with well defined clinical outcomes (absence of a clinically important brain injury) would allow for future studies. These would describe the outcomes and rates of significant pathology among each group and later allow for the development of clinical decision rules to optimise their management.

Limitations

This study is subject to all of the well described limitations of the convenience sample method, and special populations that would occur in the morning or late overnight hours may have been missed. There was incomplete capture of all of the initial diagnoses and only half of the patients had a toxicological screen performed. Patients who were successfully treated for

hypoglycaemia or opiate intoxication would not be included if they were fully awake on ED arrival.

CONCLUSION

The early diagnoses by emergency physicians of patients with an AMS were moderately accurate with few clinically relevant misdiagnoses. Those physicians with a greater degree of confidence in their diagnosis correlated with greater accuracy. Alcohol and drug intoxication made up a large portion of patients with an undifferentiated AMS. A large proportion of AMS patients had a head CT performed.

Acknowledgements The authors thank Julia Wescott for her invaluable help in data collection and organisation.

Funding EJD and WW received support from a UCSF Dean's Summer Fellowship Award. MS received financial support from the Howard Hughes Medical Institute Research Fellowship.

Competing interests KS receives compensation for medical direction from American Health and Safety Training Inc and the San Francisco Fire Department.

Ethics approval The study was approved by the Committee on Human Research, University of California, San Francisco.

Provenance and peer review Not commissioned; externally peer reviewed.

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Emerg Med J published online February 23, 2012
doi: 10.1136/emmermed-2011-200452

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