

# Original Research

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## Methamphetamine Abuse and Emergency Department Utilization

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**Methamphetamine (MAP) abuse continues to increase worldwide, based on morbidity, mortality, drug treatment, and epidemiologic studies and surveys. MAP abuse has become a significant health care, environmental, and law enforcement problem. Acute intoxication often results in agitation, violence, and death. Chronic use may lead to infection, heart failure, malnutrition, and permanent psychiatric illness. MAP users frequently use the emergency department (ED) for their medical care. Over a 6-month period we studied the demographics, type, and frequency of medical and traumatic problems in 461 MAP patients presenting to our ED, which serves an area noted for high levels of MAP production and consumption. Comparison was made to the general ED population to assess use patterns. MAP patients were most commonly Caucasian males who lacked health insurance. Compared to other ED patients during this time, MAP patients used ambulance transport more and were more likely to be admitted to the hospital. There was a significant association between trauma and MAP use in this patient population. Our data suggest MAP users utilize prehospital and hospital resources at levels higher than the average ED population. Based on current trends, we can expect more ED visits by MAP users in the future.**

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**M**ethamphetamine (MAP) is a central nervous system (CNS) stimulant that has an extensive history of abuse since its advent 80 years ago. Illicit MAP use has been increasing steadily in the United States and is rapidly spreading worldwide. MAP is now the most common drug of abuse presenting to emergency departments (ED) in the western United States.<sup>1</sup> Intoxicated MAP patients often present with agitation, violence, and loss of self-control and represent a threat to themselves and caregivers.<sup>2</sup> Chronic MAP users often develop paranoia and lasting psychosis as well as deterioration of judgment and fine motor skills, which may predispose them to injury from moving vehicle accidents.<sup>3,4</sup> Chronic use also results in serious health problems including malnutrition, poor dentition, exhaustion, and systemic or soft-tissue infection from injecting MAP.<sup>5</sup> Criminal and violent behavior associated with MAP may lead to blunt and penetrating traumatic injury.<sup>6,7</sup> Patterns of use vary considerably and include occasional or sporadic use, to “bingeing” over a period of several days. Inevitably, increasing MAP abuse translates into more frequent ED visits by this population. To better appreciate the protean

nature of MAP abuse, we reviewed ED visits by patients with positive toxicology screens for MAP to determine demographics, the relative frequency of associated medical and traumatic problems, and disposition. We also compared these variables with the remaining ED population to assess ED use patterns.

### Materials and Methods

This study was done over a 6-month period from September 1996 through February 1997 at the University of California, Davis Medical Center, a large urban university hospital with an annual ED census of 70,000 visits. This hospital is a level I trauma center and represents the de facto public hospital for its urban geographic area, serving a population of 400,000 within the city limits and 1.5 million in the surrounding area. Our institution provides health care for a high proportion of uninsured patients and for those patients brought in by police from the street or from jail. Retrospective review of all patients presenting to the ED with a urine toxicology screen positive for MAP was performed. Charts were abstracted for

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TABLE 1.—Demographic Differences Between MAP and Non-MAP Patients\*

	MAP n (%)	non-MAP n (%)	OR (95% CI)	P
Age $\pm$ SD (y)	34.9 $\pm$ 8.5	41.2 $\pm$ 13.6		< 0.001
Male	295 (64)	16,721 (52)	1.6 (1.4, 2.0)	< 0.001
Female	166 (36)	15,435 (48)	0.6 (0.5, 0.7)	< 0.001
Race				
Caucasian	341 (74)	16,399 (51)	2.7 (2.2, 3.4)	< 0.001
Hispanic	63 (13)	3,859 (12)	1.2 (0.9, 1.5)	0.3
African American	37 (8)	6,110 (19)	0.4 (0.3, 0.5)	< 0.001
Asian/Pacific Islander	18 (4)	5,576 (17)	0.2 (0.1, 0.3)	< 0.001
Native American	2 (1)	212 (1)	0.6 (0.2, 2.6)	0.7
Insurance				
None	375 (81)	17,685 (55)	3.6 (2.8, 4.5)	< 0.001
MediCal/MediCare	56 (12)	8,360 (26)	0.4 (0.3, 0.5)	< 0.001
HMO/MCO	20 (5)	4,823 (15)	0.3 (0.1, 0.4)	< 0.001
Self-pay	10 (2)	1,288 (4)	0.5 (0.3, 0.9)	0.06

\*All findings significant at  $P < 0.001$ .

SD = standard deviation, HMO/MCO = health maintenance organization/managed care organization

patient demographics, insurance status, chief complaint, mode of arrival, vital signs, laboratory results, smoking habits, procedures, disposition, and outcome. The rapid urine toxicology screen for drugs of abuse, which detects cocaine, opiate derivatives, benzodiazepines, barbiturates, tetrahydrocannabinol, and phencyclidine, was processed on a CX-7 analyzer in the ED (Beckman Industries, Fullerton, California). Univariate statistical analysis was done using chi-square and unpaired Student  $t$  tests. Calculations were done with Stata 5.0. Data are reported as mean  $\pm$  standard deviation (SD) unless otherwise stated. Statistical significance is assumed at a level  $P \leq 0.05$ . This study was approved by the human subjects review committee at our institution.

## Results

A total of 461 patients were identified as having MAP on their urine toxicology screens. During the study period there were 3,102 total urine toxicology screens performed on ED patients and 32,156 total ED visits. Comparison of demographics between patients with positive toxicology screens for MAP and all others are presented in Table 1. The range of age for MAP patients was 3 to 67 years.

Concomitant drug use by MAP patients was also recorded. Tobacco use was documented in 413 MAP patients (90%). Ninety-two patients (20%) coingested ethanol, with an average blood level of  $125 \pm 32$  mg/dl. Other drugs detected included opiates ( $n = 61$ , 13%), cocaine ( $n = 34$ , 7%), benzodiazepines ( $n = 21$ , 5%), tetrahydrocannabinol ( $n = 20$ , 4%), and phencyclidine ( $n = 2$ , 0.4%). With regard to mode of arrival, MAP patients were most likely to use ambulance transport ( $n = 319$ , 69%), followed by: brought in by self, family,

or friend ( $n = 66$ , 14%); brought in by police ( $n = 56$ , 12%); and mental health facility transfer ( $n = 20$ , 4%). During this period there were 7,584 total ambulance transports to our institution. A significant difference in use of ambulance transport existed between MAP and non-MAP patients (69% versus 22%,  $P < 0.001$ ).

Chief complaints and admissions are displayed in Table 2. A total of 268 MAP patients were admitted to the hospital from the ED (58%), followed by 89 who were discharged directly to home (19%). Sixty-three MAP patients were discharged to an inpatient psychiatric facility from the ED (14%), and 41 MAP patients went directly to jail (9%). During this period there were 7,074 admissions to the hospital from the ED. Difference in admission rates for MAP patients and non-MAP patients was significant (58% versus 22%,  $P < 0.001$ ). Average stay for MAP patients was  $2.8 \pm 1.8$  days, and 386 of the 461 MAP patients had two or more ED visits within the past 12 months.

A total of 172 MAP patients (37%) had injuries from trauma (Table 2), of which blunt trauma was most common. Mechanism of injury is demonstrated in Table 3. For the study period there were 6,753 trauma-related ED visits. A significant difference was noted between MAP patients and non-MAP patients for trauma-related complaints (37% versus 21%,  $P < 0.001$ ). Fifty-three of 172 MAP patients (31%) with trauma required sedation for acute agitation.

The next most common presenting complaint for MAP patients was altered level of consciousness (Table 2). In this subgroup, 83 patients were acutely agitated. Sixteen were noted on the ED record to have hallucinations, of which 10 were of the visual and tactile sensation of insects crawling on the patient's body. None of these 10 patients were experiencing ethanol withdrawal at the time. Sixteen

TABLE 2.— Chief Complaints and Hospital Admissions of MAP Patients

Chief Complaint	Total n (%)	Admissions n (%)
<i>n</i>	<i>n</i> = 461	<i>n</i> = 268
Blunt trauma	152 (33)	112 (74)
Altered LOC	108 (23)	52 (48)
Abdomen pain	58 (13)	18 (31)
Suicide attempt	38 (8)	11 (29)
Chest pain	36 (8)	28 (78)
Skin infection	28 (6)	15 (54)
Penetrating trauma	20 (4)	18 (90)
Miscarriage	8 (2)	6 (75)
Ingestion	8 (2)	5 (63)
Headache	5 (1)	3 (60)

LOC = level of consciousness

patients had tonic-clonic seizures, of which 12 were new-onset. The remaining 9 were evaluated for syncope.

Thirty-eight patients were suicidal. The most common attempted mode of suicide was overdose ( $n = 22$ ), followed by slash wounds to extremities ( $n = 10$ ), and jumps from heights ( $n = 5$ ). One patient attempted suicide by striking a brick to his head several times after injecting MAP. A total of 52 patients were brought in or placed on a 72-hour psychiatric hold while in the ED. There were 8 cases of oral ingestion of MAP, 7 of which were for evading police detection of MAP possession. The remaining patient was a 3-year-old boy who ingested some of his parents' MAP, which was lying on the floor.

Twenty-eight patients presented with skin infections from injecting MAP, including 21 with abscesses and 7 with cellulitis. All 21 abscesses required incision and drainage: 12 were performed in the ED under local anesthesia, and the remaining 9 were performed in the operating room. Of note, 18 of the 28 MAP patients with skin infections insisted that a "spider bit them."

## Discussion

The demographics of MAP patients in this study correlate well with previous studies describing defined populations of MAP users. Baberg and colleagues screened inpatient psychiatric consultations at a university medical center and found that MAP use doubled over 6 years in a population with demographics similar to ours.<sup>8</sup> Bailey studied toxicology screens in university hospital patients and reported demographics similar to our data.<sup>9</sup> The typical user in our study was a Caucasian male in his early thirties with no health insurance. Thirty-six percent of MAP patients were female, however, and the use of MAP by females in general has been increasing.<sup>1</sup> Proposed reasons for this trend include the following short-term benefits of MAP use: increased wakefulness allowing for multiple jobs and overtime, weight loss,

and enhanced sexual drive. Anderson and Flynn reported an estimated 7,000 MAP injectors in Sacramento County, of whom most are male, Caucasian, young, and employed.<sup>10</sup> A survey of adolescents by this same team found that MAP was the most commonly used drug after alcohol and marijuana, and 54% admitted using MAP at least once. A 10-year-old study by Derlet et al examined 127 cases of amphetamine toxicity in the ED, and this group found these patients presented with a wide range of complaints, of which altered mental status was foremost.<sup>11</sup> They found less associated trauma compared to our results.

A remarkable association between MAP use and injury from trauma existed in this study. Interpersonal trauma, including gunshot wounds, stabbings, and assaults, was responsible for a large number ( $n = 67$ ) of ED visits (Table 3). The predisposition for violence and suicide from MAP abuse may account for the large proportion of these cases. This association has been investigated in previous studies.<sup>6,7</sup> Kratofil and colleagues described self-injury and mutilation by MAP users.<sup>12</sup> Logan reported a correlation between MAP and violent behavior in drivers arrested for driving under the influence of alcohol.<sup>4</sup> In another series by the same author, 146 deaths involving MAP were reviewed on autopsy, and 27% resulted from homicidal and 15% from suicidal violence.<sup>7</sup> A similar study from Spain also found a high percentage of violent deaths in MAP-positive autopsies.<sup>13</sup> Bailey and coworkers reported MAP presence in almost one-third of homicides and accidental overdoses in San Diego County.<sup>14</sup> In the subculture of MAP users, in which paranoia, poor judgment, predisposition for violence, and access to weapons coexist, any potential misunderstanding or disagreement, however insignificant, may lead to interpersonal violence.

The deleterious effect of MAP on psychomotor and cognitive skills has been well documented. The most notable consequence of this effect is an increased incidence of moving vehicle accidents and falls. In a series of moving vehicle accidents described by Logan et al, poor coordination and judgment was responsible for the majority of crashes, and typical driving behaviors included drifting out of the lane of travel, erratic driving, weaving, speeding, drifting off the road, and high speed collisions.<sup>4</sup> The majority of MAP patients with blunt trauma in our study were involved in car crashes and other moving vehicles, including 2 MAP users who were riding bicycles and crashed into each other (Table 3). Crouch and coworkers investigated fatal truck crashes over a one-year period and found that an alarmingly high percentage tested positive for MAP postmortem.<sup>15</sup> Although MAP does significantly extend periods of wakefulness, this benefit is quickly negated by poor task functioning. Wiegmann and colleagues studied the effect of MAP on cognitive processing, which deteriorated considerably with extended periods of wakefulness induced by MAP.<sup>16</sup>

Chronic MAP use also has been associated with the development of schizophreniform mental illness, which

TABLE 3.—Mechanism of Trauma for Injured MAP Patients

	n (%)
Blunt	n = 152
Auto/truck crash	64 (42)
Assault	47 (31)
Fall	16 (11)
Auto versus pedestrian	10 (7)
Auto versus bike	9 (6)
Motorcycle crash	5 (3)
Bike versus bike	1 (1)
Penetrating	n = 20
Gunshot	11 (55)
Stabbing	9 (45)

may be permanent.<sup>17</sup> The paranoia accompanying MAP use is well documented. In one study only 32% of patients admitted to using MAP when confronted with their positive toxicology results.<sup>2</sup> A large number of MAP injectors in our study ( $n = 18$ ) claimed that their soft-tissue infections were the result of a "spider bite." For 10 patients in this study, note was made in each patient's record that the patient stated someone may have "slipped something in my drink" or "spiked my drink."

The association of MAP use and smoking was profound in our study. This association has been previously described.<sup>10</sup> The combination of nicotine and MAP results in a byproduct, cyanomethylmethamphetamine. In one study by Sekine et al,<sup>18</sup> this compound was demonstrated to have even greater psychostimulant effects than MAP alone.

Our study population also demonstrated a strong propensity for ethanol use. Slawewski and colleagues studied the effect of MAP on ethanol use and found MAP to increase the craving for ethanol and the volume consumed.<sup>19</sup> Concomitant ethanol ingestion further compromises the already impaired coordination and judgment of MAP users who operate moving vehicles.

Users who inject MAP intravenously expose themselves to a large number of serious health problems.<sup>5</sup> Human immunodeficiency virus (HIV), viral hepatitis, endocarditis, and pulmonary abscess may result from MAP injectors using poor needle hygiene.<sup>10</sup> Molitor and colleagues reported that MAP users, especially those who administer MAP by injection, indulge in higher-risk sexual behavior when compared to other users of illicit drugs and are more likely to have a sexually transmitted disease.<sup>20</sup>

The byproducts of clandestine MAP synthesis are extremely hazardous, and there is little or no quality control for the finished product. In Oregon, many injectors developed lead poisoning from a contaminated batch of MAP.<sup>21</sup>

This study had several limitations. The study is a retrospective review. No protocol existed for selection of patients for urine toxicology screening, which may have biased our results. Our institution is located in an area

noted for high levels of MAP production and consumption and provides health care to a large number of uninsured patients. Studies drawn from toxicology results also may underestimate the frequency of drug abuse, because patients who admit to using illicit drugs often are not tested. The urine toxicology test was not followed by more specific gas chromatography confirmation. Although it is possible that some of the toxicology results in this study may have been from false positives or iatrogenic medication, we believe this number to be small and did not measurably affect our results. There were no indications in reviewing patient records that positive toxicology screens resulted from legitimate intake of over-the-counter medications or from prescribed amphetamine derivatives. Definitively linking MAP with the patient's chief complaint was not possible because the amount of time elapsed between last MAP dose and presentation to the ED could not be established.

## Conclusion

Methamphetamine abuse patients presenting to the ED tend to be young Caucasian males, tobacco smokers, and have no health insurance. Compared to the average ED patient, MAP patients use ambulance transport at a much higher rate and are more likely to be admitted to the hospital. A significant association between MAP patients and trauma also existed. Methamphetamine abuse will continue to worsen if current trends prevail. Clinicians must be aware of the variable nature of MAP abuse and its deleterious effect on patients' mental and physical health.

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