

# Health Effects from Reported Exposure to Methamphetamine Labs: A Poison Center-Based Study

Dennis L. Thrasher, MD, MBA, MPH<sup>a</sup>, Katie Von Derau, RN, CPN, CSPI<sup>b</sup>,  
Jefferey L. Burgess, MD, MS, MPH<sup>a</sup>

<sup>a</sup>Mel and Enid Zuckerman College of Public Health, University of Arizona, Tucson, AZ

<sup>b</sup>Washington Poison Center, Seattle, WA

## ABSTRACT

**Introduction:** Illicit methamphetamine laboratories pose a health hazard. However, information on symptoms from exposure is limited, particularly for setup or former laboratories.

**Methods:** A descriptive study was done using case reports provided by the Washington State Poison Control Center for the years 1999 through 2004.

**Results:** Reported exposures occurred mainly in residences, predominantly in setup and suspected former lab sites. For all lab types combined, the most frequent reported symptoms were headache (17%), nausea/vomiting (14%), respiratory (8%), and eye irritation (7%). Healthcare facility utilization was highest for law enforcement personnel (93%) and persons involved in methamphetamine production, or “cooks” (90%). It was lowest for other adults (29%) and children (46%). Hospitalization was most common for cooks (43%), followed by children (8%), law enforcement officers (3%), and other adults (3%).

**Conclusion:** Poison control center data help characterize health outcomes from exposure to suspected illicit methamphetamine labs. Many of the reported symptoms in suspected former labs are consistent with exposure to persistent irritants.

## INTRODUCTION

The hazard posed by clandestine methamphetamine laboratories is a public health concern. In 2004 alone, there were 17,033 methamphetamine lab-related seizures by US law enforcement agencies as reported by the Department of Justice [1]. The Agency for Toxic Substances and Disease Registry (ATSDR) reported that 4% of the Hazardous Substances Emergency Events Surveillance (HSEES) events from January 2000 through June 2004 were associated with illicit methamphetamine production [2]. According to ATSDR reports, 81–97% of all drug lab investigations have involved methamphetamine labs [3]. Methamphetamine laboratories can be found in a wide variety of settings. Although preferred lab locations appear to be rural areas, mobile structures (vans, trailers, storage units), hotels, apartments, and houses [4], 55% of 1544 known methamphetamine labs in one study were found in private households, posing an exposure hazard to their inhabitants [5].

Law enforcement personnel have been the most studied population to date. Police officers exposed to active labs have a 7- to 15-fold greater risk of becoming ill during response activities as compared to exposures to setup, in-transit, and former labs. They are also likely to be exposed to physical hazards such as spills, fires, explosions, and uncontrolled reactions [3]. Study data concerning persons actively involved in the illicit production of methamphetamine, or “cooks,” and the general population are less plenti-

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*Corresponding author:* Jefferey L. Burgess, MD, MS, MPH, Division of Community, Environment and Policy, Mel and Enid Zuckerman College of Public Health, University of Arizona, 1295 N. Martin Ave., Tucson, AZ 85724-5210. Email: [jburgess@u.arizona.edu](mailto:jburgess@u.arizona.edu)

ful. This is despite the finding that 33% of methamphetamine lab event injuries from 2000 to 2004 occurred in the general public, second only to police officers [2]. In addition, children are frequently found at seized methamphetamine lab sites [6,7]. Horton et al. analyzed the HSEES data from 1996 to 2001 and found 519 methamphetamine-related emergency events with release of at least 1 chemical involving children [6]. Eight known events involving 13 injured children with ages ranging from 3 months to 17 years were reported. Of these events, 5 occurred in a private residence: 3 houses, 1 apartment building, and 1 duplex [6]. Besides adverse physical health effects in children, behavioral problems from abuse or neglect are likely [7].

Poison centers are frequently used by both the general public and first responders to obtain information on chemical exposures. Given the limited information currently available regarding adverse health effects from exposure to methamphetamine labs, particularly among the general public, we chose to employ poison center data to improve our understanding of this area. The objective of this descriptive study was to describe the exposures to confirmed and suspected illicit methamphetamine labs and associated symptoms as well as the rates of healthcare facility utilization reported by the Washington Poison Center (WAPC) during the period from January 1, 1999 to December 31, 2004.

## MATERIALS AND METHODS

Information regarding methamphetamine lab exposures was collected and recorded using TOXICALL, a Windows application that was written specifically to document and report exposure and poisoning information. TOXICALL allows data consolidation to a centralized database regionally or nationally [8]. The Washington Poison Center (WAPC) TOXICALL database was searched for the years 1999 through 2004 using the following search criteria: call type = exposure, species = human, narrative notes contained the phrase "meth lab," and patient had a clinical effect coded as either "related" or "unknown if related" to the exposure.

An occupational medicine physician reviewed all cases that met the search criteria. Call reports were provided in a standard TOXICALL format. The format included information fields for patient, caller, exposure, substance, and general information. There was also a scenario/narrative/history field that had been completed by the person at WAPC who handled the call. For calls in which a data classification could not be determined from a specific TOXICALL field or by the reviewer's interpretation of the narrative, the case was retained and the data was categorized as unknown. Callers were classified using the "Relation to Pat" TOXICALL field. In most cases, callers were the patient, a family member, or healthcare provider.

Based on the narrative description of the TOXICALL record, subjects were classified as cooks, law enforcement, residents, or other. For this study, residents and other were assigned to either an "other adults" or "children" classification. These classifications excluded cooks and law enforcement personnel and included subjects that were exposed in residences and public areas such as

parking lots, open areas, or commercial venues. Persons aged 18 years or less were considered children.

Exposure site is a classification within the TOXICALL format and includes own residence, other residence, workplace, health-care facility, school, restaurant/food service, public area, and other. Lab status was determined on the basis of the TOXICALL report narrative as being active, setup, in-transit, or former. This scheme has been used previously by Burgess et al. Active drug laboratories involve active chemical reactions. Setup laboratories are in-place for manufacture but without ongoing chemical reactions. In-transit labs are boxed or otherwise stored for transit, and former labs are so designated after all of the reaction vessels have been removed [3].

In the TOXICALL document symptoms and health effects are entered under the category of "clinical effects" as determined by the WAPC interviewer. Additional symptoms and health effects were extracted from the interviewer's encounter "notes." The symptoms for use in this study were tabulated within the groupings used by HSEES [2]. Data analyses were descriptive in nature and no statistical testing was performed.

## RESULTS

There were 194 calls involving 198 exposed persons during the period 1999 to 2004. Of the 198 persons, 21 (10.6%) were cooks, 31 (15.7%) were law enforcement, 70 (35.4%) were residents, and 76 (38.3%) were classified as other. Combining "resident" and "other" into the other adults and children categories yielded 146 (73.7%) persons, of which 88 (60.3%) were females and 28 (19.2%) were children. A subject's own residence was the predominant site of exposure for cooks (71%), other adults (41%), and children (66%) (Table 1). Almost all law enforcement incidents

**Table 1: Exposure Site and Lab Status by Person Type**

	Cooks n (%)	Law Enforcement n (%)	Other Adults n (%)	Children n (%)
Exposure Site				
Own residence	15 (71)	0	50 (41)	17 (66)
Other residence	3 (14)	1 (3)	30 (25)	4 (15)
Public area	1 (5)	0	14 (12)	4 (15)
Workplace	2 (10)	30 (97)	26 (22)	1 (4)
Lab status				
Active	18 (86)	1 (3)	9 (8)	0
Set-up	1 (5)	19 (61)	37 (31)	13 (50)
Boxed	0	1 (3)	4 (3)	0
Former	0	5 (16)	27 (23)	7 (27)
Unknown	2 (10)	5 (16)	43 (36)	6 (23)
Total	21	31	120	26

were classified as workplace exposures. The laboratory status for events involving cooks was mainly active. Law enforcement officers were primarily exposed in setup labs. Exposures to other adults and children involved mainly setup, former, or unknown lab status.

Information on exposures to specific toxicants was limited. Only 41 calls had toxicant names reported. Methamphetamine (18 cases) and ammonia (4 cases) were the most commonly reported chemical exposures. For all reported toxicants, methamphetamine was the reported toxicant 39% of the time. Excluding methamphetamine, specific chemicals were identified most often in labs that were boxed (40%) and cooking (32%).

The distribution of symptoms reported varied among the exposure groups (Table 2).

There were 425 symptoms reported for 146 persons. Cooks exhibited a high proportion of skin-related manifestations, including chemical and thermal burns. All recorded skin-burn symptoms were in the cook group. On the other hand, they reported no documented cases of nausea, nasal irritation, dizziness, or bad taste. Law enforcement officers generally reported symptoms similar to those of the other adults, including headache and nausea or vomiting, with the exception of a higher frequency of eye and throat irritation. The most common reported symptoms for children were cough and irritation of the throat and skin.

Twenty-seven other adults, ranging in age from 19 to 57 years old, with exposures to suspected former labs reported symptoms. The 6 most reported symptoms were headache (24%), nausea or vomiting (19%), dizziness (8%), breathing difficulty (8%), cough (7%), and eye irritation (7%). The sole reported route of exposure for this group was inhalation (100%).

Given the particular paucity of information on exposures in former labs, more detailed data for children are provided for this category (Table 3). Seven children were identified as having been exposed in suspected former labs. The skin was the primary route of exposure (57%) in these children.

The utilization of healthcare facilities was highest for cooks (91%) and law enforcement personnel (94%) (Table 4). Children experienced a higher percentage of healthcare facility use (46%) than other adults (29%). Cooks had the highest rate of hospital admissions (43%), and children were more likely to be admitted (8%) than other adults (3%). For adults exposed to suspected former labs, 10 (37%) of the calls were from healthcare facilities. None of the children exposed to suspected former labs were treated in healthcare facilities.

## DISCUSSION

Our study demonstrated a difference in lab status, symptoms and healthcare utilization among methamphetamine lab cooks, law enforcement officers, other adults, and children. We are not aware of any other studies directly comparing these groups, although other methamphetamine laboratory studies have reported adverse health effects in specific exposure victim categories [2,3,6].

**Table 2: Frequent Symptoms by Exposure Group (total n = 425).**

Symptom	Cooks n (%)	Law Enforcement n (%)	Other Adults n (%)	Children n (%)
Headache	1 (3)	18 (22)	50 (18)	1 (3)
Nausea or vomiting	0	11 (13)	39 (14)	2 (6)
Throat irritation	1 (3)	14 (17)	24 (9)	1 (3)
Cough	2 (6)	2 (2)	16 (6)	6 (19)
Eye irritation	4 (12)	13 (16)	20 (7)	2 (6)
Nasal irritation	0	0	18 (7)	3 (9)
Dizziness	0	2 (2)	20 (7)	0
Breathing difficulty	3 (9)	9 (9)	21 (8)	3 (9)
Skin irritation	10 (29)*	1 (1)	11 (4)	3 (9)
Bad taste	0	2 (2)	10 (4)	0

\*Seven skin burns: 4 thermal and 3 chemical

**Table 3: Children in Suspected Former Methamphetamine Laboratories**

A 17-year-old female developed nasal irritation after encountering in a wooded public area containers that the fire department told her were from a methamphetamine laboratory.
A 15-year-old male experienced hives after moving into his new residence, a suspected former methamphetamine laboratory.
An 18-year-old male had a burning sensation on his hand while cleaning up after a fire in a methamphetamine laboratory.
A 4-year-old female experienced a persistent cough after a suspected methamphetamine laboratory in her apartment building had been shutdown.
A 15-year-old male came across an abandoned methamphetamine laboratory in the woods. He reported flushing and agitation after some chemical contents spilled onto his skin. He also was a user involved in cooking methamphetamine.
The mother of a 1-year-old female with breathing difficulty reported that their apartment had been a former methamphetamine lab.
The same mother reported a 2-year-old female with swollen eyes after sleeping on the carpet.

**Table 4: Healthcare Utilization and Hospital Admission**

	Cooks n (%)	Law Enforcement n (%)	Other Adults n (%)	Children n (%)
Utilization				
Yes	19 (90)	29 (93)	35 (29)	12 (46)
No	2 (10)	2 (7)	85 (71)	14 (54)
Admission				
Yes	9 (43)	1 (3)	3 (3)	1(4)
No	12 (57)	30 (97)	117 (97)	25 (96)

Our data support previous studies documenting that a large proportion of methamphetamine laboratory exposures occur in private households [2,5]. Thus, the majority of labs have the potential to expose household residents to chemicals used during methamphetamine production. The WAPC scheme assigns most law enforcement exposures to the workplace, although the actual physical location of those exposures, in all likelihood, involved private residences and public areas.

Overall for poison control center calls, specific chemicals were reported infrequently. In particular, specific toxicants were rarely reported (10%) for suspected former labs. However, we believe that most of the methamphetamine laboratories in Washington State during the study time interval used the ephedrine/pseudoephedrine–red phosphorus method, which suggests a certain set of common exposures [9]. In a larger study from January 1 through June 30, 2004 involving 947 persons injured in 558 methamphetamine-associated events, the two most common substances associated with injury were ammonia and hydrochloric acid [5]. Raids by law enforcement on intact, inactive clandestine labs frequently reveal surface contamination with methamphetamine. Environmental sampling during controlled manufacturing of methamphetamine has revealed the presence of phosphine, iodine, anhydrous ammonia, and hydrochloric acid; the latter 2 chemicals were measured at concentrations considered to be immediately dangerous to life and health (IDLH) [10]. Burgess reported a case of cook exposure in which acetone, hydrochloric acid, sodium hydroxide, toluene, and ephedrine were documented [4]. Neighbors and subsequent occupants of former lab sites may be exposed to residual chemicals such as lead, mercury, methamphetamine, and caustic substances [9]. Horton et al. analyzed HSEES data from 1996 to 2000 and found that children in the reported events were exposed to anhydrous ammonia, toluene, lye, solvents, acid, ether, fire, and explosion [6]. In addition to chemical hazards, exposures to methamphetamine labs may be associated with physical hazards. Fires and explosions constitute the main physical hazards that may be present [3]. Of 1544 known methamphetamine event locations reported by Grant, 10% involved explosions [5].

The symptoms reported in this study for law enforcement and other adults are similar to those reported previously, including frequent respiratory irritation, headache, eye irritation, and burns [5,9]. One exception in symptom reporting is the increased frequency of nausea or vomiting in law enforcement, other adults, and children in our study. These symptoms could be evidence of ingestion as a route of exposure or could also be due to anxiety or other manifestations of psychogenic illness [11]. Within our study, the distribution of injuries for cooks appears to be distinct, particularly the relatively higher occurrence of burns and lacerations in cooks. Less dramatic symptoms may be underreported in this setting and cooks may be hesitant to seek medical care for seemingly less serious symptoms for fear of drawing attention to their clandestine activities.

The information in our current study on symptoms in other adults and children from known or suspected former laboratories

demonstrates a variety of symptoms including headache, nausea, dizziness, cough, and breathing difficulty. The latter 2 symptoms are consistent with an irritant exposure. The symptoms reported in calls to the poison center concerning children in suspected former methamphetamine laboratories—including nasal irritation, dermal burning sensation, cough, red painful skin, breathing difficulties, and puffy eyes—also suggest persistent irritant exposure. The continued presence of acids and bases and a number of other chemicals such as iodides in solid forms could help explain these irritant symptoms [4,9,10]. Methamphetamine, which has been documented to persist in former labs [10], may be a source of irritation. Headache and dizziness are consistent with solvent exposure, but given the volatility of solvents, it is less likely that significant solvent exposures would continue to occur in former labs outside of the immediate period of time following the last manufacture of methamphetamine.

The hazard for each exposure to an illicit methamphetamine laboratory is unique. Risk factors for reporting of symptoms by law enforcement personnel involved in methamphetamine lab investigations include involvement in >30 investigations, time duration in the lab, phase of investigation, presence of ongoing chemical processes, and coexistent disease [12]. Exposures may have long-term health consequences. Burgess et al. reported on the long-term health effects in clandestine drug lab investigators in California, including a more rapid decline in forced expiratory volume at 1 second (FEV1) than is seen in the general population [13].

The rate of healthcare facility utilization reported in the current study is not unusual. For methamphetamine laboratory-associated HSEES events from 1996 through 1999, 77.2% of injured first responders were treated at a hospital but did not require admission [14]. For 1791 illicit methamphetamine-related events between January 1, 2000 and June 30, 2004, 274 (29%) victims were treated at hospitals and not admitted. A total of 68 (7%) victims were admitted and 9 (1%) died [2]. Of the 3 cases reviewed, there were 6 victims. Four of these individuals were admitted for burns, and 1 died.

The data in this study are subject to limitations. Since poison center data on suspected chemical exposures rarely include quantitative exposure assessment information and usually lack conclusive identification of individual chemicals, it was not possible to verify that all calls involved actual methamphetamine laboratories. In addition, our results are likely influenced by increased public sensitivity over methamphetamine laboratories. There is likely an underreporting of exposures, with more calls for exposures with symptoms than for exposure without symptoms. Also, more severe exposures have a higher probability of generating a poison center call than less significant exposures. Persons who are closely associated with illicit lab operations may give inaccurate histories due to legal issue concerns. In addition, Bratcher et al. found that physicians displayed a variable index of suspicion for methamphetamine lab exposure and exhibited variable clinical responses for highly suspicious cases [15]. Weir comments on the role of mass hysteria in attributing illness, in particular, to

perceived exposures to infectious agents and unknown environmental toxins [11].

## CONCLUSION

In conclusion, illicit methamphetamine labs are a public health concern. Exposures to other adults and children, as defined in this study, occur mainly in residences and are predominantly from setup and former lab sites. Headaches, nausea/vomiting, airway irritation, and mucus membrane irritation account for the majority of reported symptoms. Symptoms reported from exposure to suspected former methamphetamine laboratories may be due to persistent irritants, supporting the need for laws present in most states requiring appropriate cleanup of these sites prior to their reoccupation. Law enforcement officials and cooks had high healthcare facility utilization rates, while less than half of all exposures to other adults and children resulted in healthcare facility utilization. Hospitalization rates were high for cooks, but hospitalization was a rare occurrence for law enforcement personnel, other adults, and children.

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