Hazards of Illicit Methamphetamine Production and Efforts at Reduction: Data from the Hazardous Substances Emergency Events Surveillance System

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ABSTRACT

Objectives. Methamphetamine (meth) is a highly addictive drug of abuse that can easily be made in small illegal laboratories from household chemicals that are highly toxic and dangerous. Meth labs have been found in locations such as homes, outbuildings, motels, and cars. Its production endangers the "cook," neighbors, responders, and the environment. This article describes surveillance data used to examine the emergence and public health impacts of illicit clandestine meth labs, as well as two states' efforts to thwart lab operations and prevent responder injuries.

Methods. We analyzed data collected from 2001 to 2008 by 18 states participating in the Agency for Toxic Substances and Disease Registry's Hazardous Substances Emergency Events Surveillance (HSEES) Program to examine the occurrence and public health impacts of clandestine meth production.

Results. HSEES data indicate that the majority of clandestine meth lab events occurred in residential areas. About 15% of meth lab events required evacuation. Nearly one-fourth of these events resulted in injuries, with 902 reported victims. Most victims (61%) were official responders, and one-third were members of the general public. Since 2004, with the implementation of local and federal laws and prevention activities, the number of meth lab events has declined. Increased education and training of first responders has led to decreased injuries among police officers, firefighters, and emergency medical personnel.

Conclusions. HSEES data provided a good data source for monitoring the emergence of domestic clandestine meth production, the associated public health effects, and the results of state and federal efforts to promote actions to address the problem.

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Methamphetamine (meth) is a psychostimulant and sympathomimetic drug, with medical uses for the treatment of narcolepsy, attention deficit disorders, and obesity. Long-term meth use has numerous adverse physical and psychological consequences.[1–3] Meth is a very addictive drug with a high potential for abuse. According to the 2007 National Survey on Drug Use and Health, approximately 13 million Americans aged 12 years or older reported using meth at least once during their lifetime.[4]

Unlike drugs such as marijuana or heroin, which are derived from plants, meth can be synthesized in clandestine drug laboratories using a variety of easily bought chemicals that are "cooked" with ephedrine- or pseudoephedrine-containing products. The chemicals vary depending on the process, but can include anhydrous ammonia, drain cleaners, paint thinner, metallic lithium, hydrochloric or sulfuric acids, starter fluid, camping fuel, and others. Chemicals found in meth labs are hazardous and toxic. Exposure to the chemicals or by-products can damage the respiratory tract, mucous membranes, eyes, and skin. It is relatively easy for a cook to acquire the chemicals and recipes necessary to make meth.[5] Labs have been found in fixed locations—homes, outbuildings, and hotel/motel rooms—or in mobile sites, such as trunks of cars, motor homes, or moving vans. The processes used to make meth can result in fires, explosions, spills, or air releases of hazardous chemicals, putting the cook and others nearby, including children and responders, at risk of injury or death.[6–9]

To address the chemical and physical hazards associated with illicit clandestine labs, federal and state governments have passed legislation aimed at decreasing the number of meth labs. In 2004, many states began applying strong restrictions on sales of ephedrine- and pseudoephedrine-containing products, which are the key ingredients in meth production. In September 2006, the Federal Combat Methamphetamine Epidemic Act of 2005 restricted the retail sale of ephedrine and pseudoephedrine products nationwide.[10] However, illegal meth production and abuse continue to be serious concerns within the United States and throughout the world.[11]

This article describes the public health impacts of clandestine meth production in 18 states that collected data on acute releases of hazardous substances. It also provides information on the actions taken in two states to control illicit meth production and prevent injuries to first responders and bystanders during clandestine lab seizures by law enforcement.

METHODS

From 1990 to 2009, the Hazardous Substances Emergency Events Surveillance (HSEES) Program, established by the Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry (ATSDR), collected and analyzed information about acute releases of hazardous substances and threatened releases that resulted in a public health action, such as an evacuation. The goal of the program was to use the collected data to identify prevention strategies that could be implemented to reduce the frequency of these events and the associated morbidity (injury) and mortality (death) experienced by first responders, employees, and the general public. The ATSDR HSEES Program provided funding to a number of state health departments to identify and record information on spill/release events occurring in the funded states. An eligible HSEES event was defined by ATSDR protocol as any uncontrolled or illegal release or threatened release of one or more hazardous substance(s) (excluding releases of petroleum) in a quantity sufficient to require removal, cleanup, or neutralization according to federal, state, or local law. A clandestine drug lab incident was included in the HSEES system if there was an acute release of a hazardous substance (i.e., the lab was in operation ["cooking"] within 72 hours of the lab seizure by law enforcement). Incidents without a known chemical release within the 72-hour period, but with a public health action, such as an evacuation, were also included.

States participating in the HSEES Program identified events from a variety of sources, including state environmental conservation or protection agencies, police and fire departments, poison control centers, federal databases (i.e., U.S. Coast Guard National Response Center and U.S. Department of Transportation Hazardous Material Information Resource System), hospitals, local media, and others. Some states routinely received reports from law enforcement on meth lab seizures. Collected information was entered into a standardized, secure Web-based system maintained by ATSDR. Information recorded included the event location, the responsible party, the types and quantities of chemical(s) involved, primary and secondary causes of the release, the number of individuals injured as a result of the release, the types of injuries, the number of people decontaminated, and the number of people evacuated or sheltered in place.

We analyzed retrospective data, 2001–2008 (the latest complete year of data), from the HSEES system to identify trends in illegal clandestine meth lab events and in the public health consequences (e.g., morbidity,

mortality, and evacuations). The analysis included data collected by the 18 state health departments that participated in the HSEES Program at any time from 2001 to 2008. Eleven states (Colorado, Iowa, Louisiana, Minnesota, New York, North Carolina, Oregon, Texas, Utah, Washington, and Wisconsin) collected information during the entire period. Seven states participated at various times during the period (New Jersey: 2001–2008, excluding 2006; Alabama and Mississippi: 2001–2003; Florida and Michigan: 2005–2008; Missouri: 2001–2005; and Rhode Island: 2001).

RESULTS

Overall, 3.6% (n=2,373) of the total HSEES events (n=66,588) reported from 2001 to 2008 were meth related (Table 1). The highest percentage of meth lab events were reported in 2003 (n=524 events, 5.8% of all 2003 HSEES events) and 2004 (n=442 events, 5.7% of all 2004 HSEES events). The percentage of reported meth events decreased in 2005, when states began applying sales restrictions on ephedrine products. The percentage further decreased in 2006, the year the Federal Combat Methamphetamine Epidemic Act became effective nationwide.[10]

The majority of events (n=2,102, 88.6%) occurred at fixed facilities (e.g., hotels, apartments, or sheds) (Figure 1). The remainder of the events (n=271, 11.4%) were related to transportation (e.g., mobile labs in cars or motor homes, or meth lab chemicals being transported). It is difficult to assign a meaning to the changing percentages over time, because the number of participating states varied from 11 to 18 during this period.

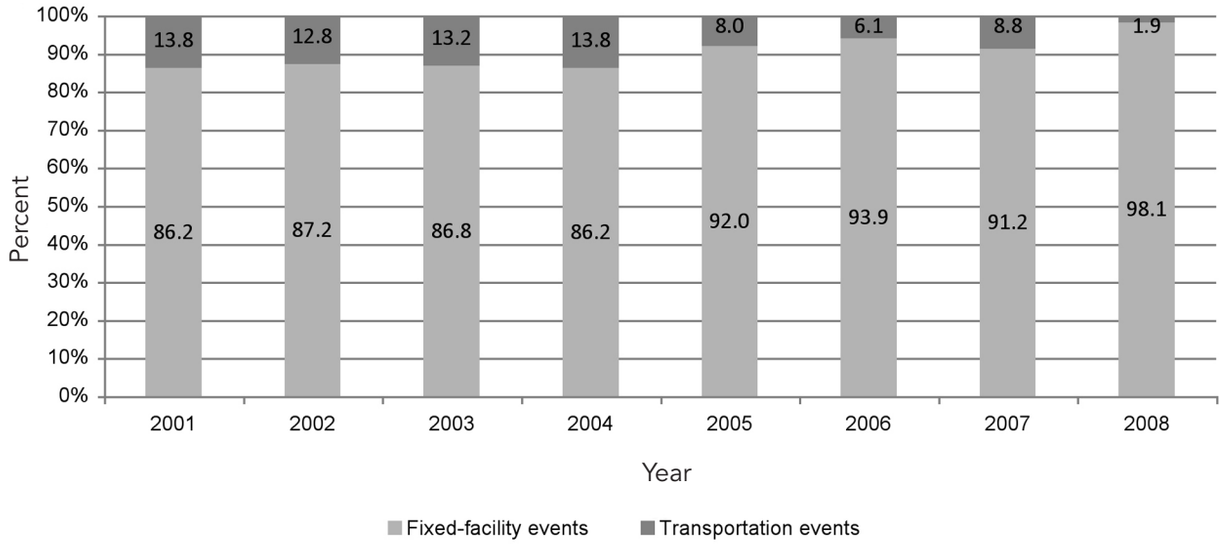
More than 85.6% (n=2,032) of illegal clandestine meth lab events occurred within one-fourth of a mile of a residence. The general land use immediately surrounding an event recorded in the HSEES system can be characterized by as many as two descriptors. The general land use immediately surrounding the reported meth lab locations was identified as residential in 68.3%

Table 1. All HSEES events and clandestine meth lab events, by year: ATSDR HSEES database, 2001–2008

Year	*HSEES events* N	*Meth events* N	*Meth events Percent*
2001	8,978	297	3.3
2002	9,014	423	4.7
2003	9,105	524	5.8
2004	7,744	442	5.7
2005	8,603	300	3.5
2006	7,267	180	2.5
2007	7,947	102	1.3
2008	7,930	105	1.3
Total	66,588	2,373	3.6

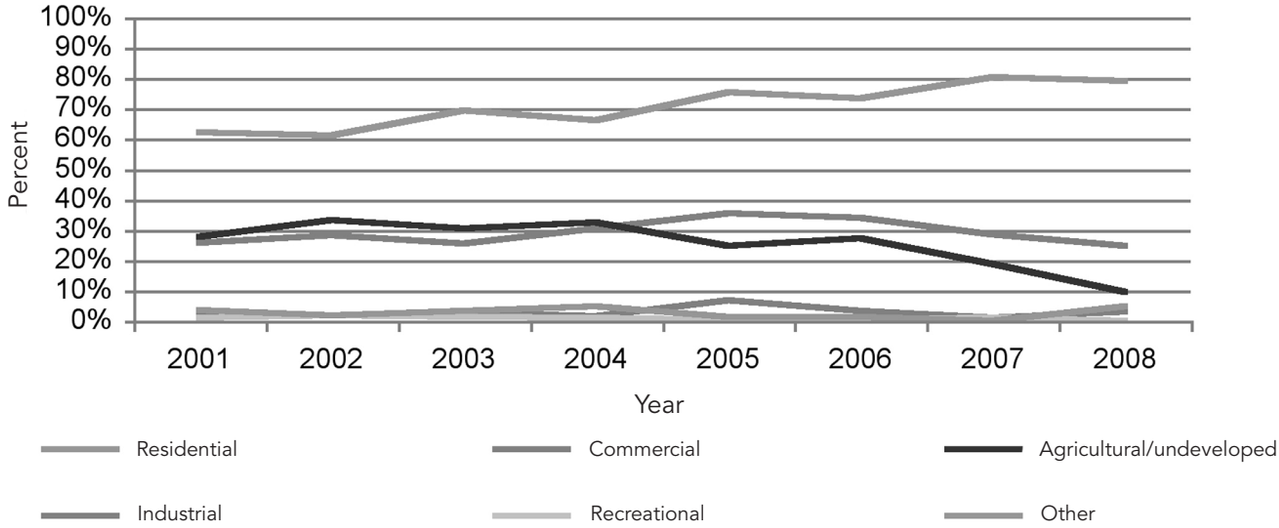
HSEES = Hazardous Substances Emergency Events Surveillance
ATSDR = Agency for Toxic Substances and Disease Registry
meth = methamphetamine

Figure 1. Proportion of fixed-facility and transportation-related methamphetamine lab events, by year: ATSDR HSEES database, 2001–2008



ATSDR = Agency for Toxic Substances and Disease Registry
HSEES = Hazardous Substances Emergency Events Surveillance

Figure 2. Proportion of methamphetamine lab events by type of area in the vicinity of the event, by year: ATSDR HSEES database, 2001–2008



ATSDR = Agency for Toxic Substances and Disease Registry
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of events (n=1,621), commercial in 28.9% of events (n=686), agricultural or undeveloped in 28.5% of events (n=676), industrial in 2.7% of events (n=64), recreational in 1.0% of events (n=24), and other in 2.7% of events (n=64). The total (n=3,135) is greater than the total number of events because more than one area could be reported per event. Meth labs have been most commonly found in residential areas, with an upward and progressive trend in the percentage of events in these areas from 2001 to 2008 (Figure 2). In recent years, a decreasing percentage of meth labs have been discovered in agricultural or undeveloped areas and in commercial areas. Because residential areas can have higher population densities, and chemicals in meth labs can volatilize, explode, or catch fire, people in homes near the vicinity of a meth lab are potentially at risk.

Meth lab events required evacuations more than twice as often as all HSEES events during the 2001–2008 surveillance period (14.5% [n=343] of meth lab events compared with 6.5% [n=4,339] of all HSEES events). In the HSEES data, the highest percentage of evacuations was ordered in response to meth events in 2008 (30.5%, n=32), and the lowest in 2005 (8.3%, n=25), but the actual number of events with an evacuation was relatively stable. The 2001–2008 clandestine meth lab events resulted in the evacuation of 3,596 people. The greatest number of people (n=1,210) evacuated was in 2004, which had the second-highest number of events (n=442). The lowest number of people (n=108) evacuated was in 2008, which had 105 events, the second-lowest number reported.

Analysis of all HSEES events, 2001–2008, showed that 9.0% of the events resulted in reported victims. Analysis of all meth events during the same interval showed that nearly one-fourth (22.8%, n=541, range from 37.0% in 2001 to 10.6% in 2006) resulted in victims. Victims were defined as people who suffered at least one adverse health effect or who died in association with the clandestine drug lab chemical incident. Of the 16,474 HSEES event victims reported from 2001 to 2008, 902 (5.5%) were related to clandestine meth lab events.

Most often, the victims were treated at the scene by emergency medical personnel (6.8%, n=61) or they were observed and reported by an official even though the victim did not seek medical treatment (42.9%, n=387). The percentage of all victims in the HSEES database who did not seek medical treatment when officials observed symptoms was 6.5%, which is significantly different (p=0.001) when compared with victims in meth events. In meth lab events, about one-third of victims (33.9%, n=306) were treated at the hospital and released; 10.8% of victims (n=97) were admitted to a hospital for further treatment; 2.3% of victims (n=21) received treatment from a private physician; and 2% of victims (n=18) died. Thirteen deaths occurred at the scene or upon arrival at the hospital,

three deaths occurred after arrival at the hospital, and two deaths occurred at unknown times. When these data are compared with all victims recorded in the HSEES system, the more severe medical outcomes of being admitted to a hospital or dying are consistent: 11.2% of all victims were admitted to the hospital, and 2.5% of all victims died. The most frequently reported symptoms or health effects were respiratory irritation (53.8%), headache (34.0%), burns (15.4%), and eye irritation (10.5%) (Table 2).

Sixty-one percent (n=552) of victims were official responders to the incident, including police officers (55.1%, n=497), firefighters (5.9%, n=53), emergency medical services (EMS) personnel (0.2%, n=2), and unspecified responders (0.2%, n=2). One-third of victims (33.5%, n=302) were general public, and 5.1% (n=46) were employees.

The percentage of meth lab events with victims in the HSEES system consistently declined from 36.6% (n=110) in 2001 to 11.4% (n=12) in 2008, with no deaths reported in 2008. The percentage of police officers among victims decreased from 49.7% in 2001 to 35.3% in 2008, with a high of 70.9% in 2004 and a low of 24.2% in 2007 (Figure 3). The percentage of firefighters and other official responders among victims declined slightly from 8.9% in 2001 to 5.9% in 2008, and peaked at 11.1% in 2005. During the same period, the percentage of general public among victims increased from 29.1% (n=52) to 47.1% (n=8), with a high of 72.3% (n=24) in 2007.

Table 2. Frequency of injury types reported by victims associated with methamphetamine lab events: ATSDR HSEES database, 2001–2008

	Victims	
Injury type[a]	N	*Percent*
Respiratory irritation	485	53.8
Headache	307	34.0
Chemical burns	139	15.4
Eye irritation	95	10.5
Gastrointestinal problems	75	8.3
Dizziness/CNS effects	67	7.4
Trauma	34	3.8
Skin irritation	32	3.5
Thermal burns	26	2.9
Shortness of breath	18	2.0
Other	16	1.8

[a]The HSEES system allows for as many as seven injury types to be reported for each victim.

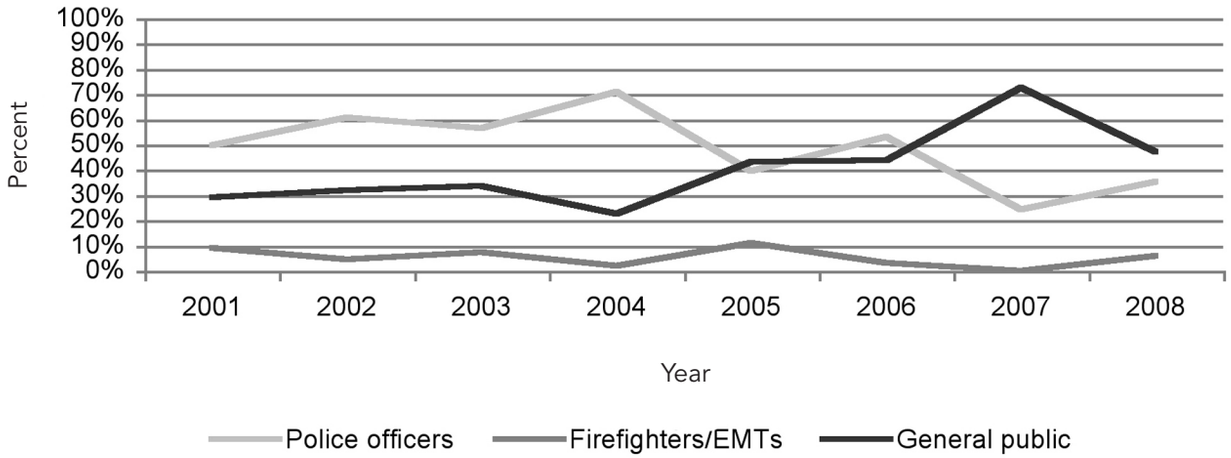
ATSDR = Agency for Toxic Substances and Disease Registry

HSEES = Hazardous Substances Emergency Events Surveillance

CNS = central nervous system

HSEES Program states affected by the meth lab epidemic used their HSEES data to target public health interventions. The outreach activities included creating responder, public, and worker education and awareness; educating santitation workers and law

Figure 3. Proportion of responder and general-public victims associated with methamphetamine lab events, by year: ATSDR HSEES database, 2001–2008



ATSDR = Agency for Toxic Substances and Disease Registry

HSEES = Hazardous Substances Emergency Events Surveillance

EMTs = emergency medical technicians

enforcement personnel about meth lab refuse dangers; and participating in state policy advisory groups. Examples of public health and legislative efforts to fight the meth lab epidemic in two states, Minnesota and New York, follow.

Minnesota

After observing emerging meth lab trends in the state from 1997 to 2000, the Minnesota HSEES Program conferred with HSEES programs in Iowa and Missouri. Data from these programs indicated that meth-related activity was moving north rapidly.[12] Using HSEES data and non-HSEES data in support of action, the Minnesota Department of Health obtained state funds in 2001 for a Meth Lab Program (MLP). The priority focus of the MLP was on education related to public health and safety hazards. As the MLP endeavored to educate responders and the public on meth hazards, meth activity continued to increase, but the number of related victims, especially first responders, declined.

In January 2005, near the beginning of the legislative session, Meth Day at the Capitol was held at the Minnesota State Capitol. Many different groups, such as government agencies, law enforcement agencies, treatment providers, and community organizations, developed presentations, displays, posters, and videos aimed at informing Minnesota lawmakers and the general public about meth activity and the associated community hazards. In conjunction with data from other sources, HSEES data helped to show how meth activity had spread extensively in the state. The event assisted in further increasing public awareness of the issue. A bill that limited access to pseudoephedrine and ammonia was passed by the Minnesota Legislature, signed by Governor Pawlenty in May 2005, and enacted in July 2005.[13] Data analyses showed that, after implementation of the meth lab laws in July 2005, the number of newly discovered meth labs declined almost threefold: from 95 in January–June 2005 to 33 in July–December 2005.

New York

Clandestine drug labs, primarily meth labs, were first identified in New York State (NYS) in the 1980s and then virtually disappeared until 2001. As other states were already dealing with the problems of clandestine meth labs, NYS HSEES Program staff sought to learn from their experiences by conducting extensive research and contacting key personnel in those states. They learned that the response to clandestine meth labs needed to be multi-agency and that awareness training was needed by everyone who might respond to a clandestine meth lab. To address the immediate need and raise awareness about and recognition of clandestine meth labs and the associated hazards, NYS HSEES program staff helped facilitate awareness seminars that targeted all agencies and groups that could be involved in clandestine drug lab identification and response throughout NYS.

During development of the multi-agency presentations, law enforcement identified a need for an easy-to-read reference card. This need led to the development of a visor card with relevant technical (visual indicators of a lab, products commonly found, and potential hazards) and contact information that was distributed to all law enforcement personnel in NYS. To increase awareness among public health officials and decrease their chance of injury, NYS HSEES Program staff developed guidance in 2003 about the physical dangers of responding to odor complaints that may originate from a clandestine meth lab. This odor-guidance document was distributed to all county environmental health officials and to state environmental health staff in regional and district offices.

NYS HSEES Program staff made a presentation at the NYS Department of Health's Environmental Health Directors Fall Conference in 2003 and conducted a video-cast for state and local health department staff. NYS HSEES Program staff also participated in the preparation of a report that focused on the effectiveness of three chemical deterrents that could be added to agricultural anhydrous ammonia to prevent its subsequent use in the production of meth. NYS HSEES Program staff provided data and testimony to the New York State Commission of Investigations that wrote "Methamphetamine Use and Manufacture," released in 2005.[14] NYS HSEES Program staff also provided information to the New York City Attorney General's Office for the report, "New York State Law Enforcement Council—2005 Legislative Priorities."[15] Following release of the reports, a comprehensive bill to combat meth labs was drafted, passed, and enacted into law in 2005.[16] This legislation restricted sales of pseudoephedrine and created and/or increased penalties for crimes associated with the clandestine manufacture of meth. After the law was passed in 2005, the number of identified clandestine meth labs in NYS decreased to fewer than 20 per year in 2007 and 2008.

DISCUSSION

HSEES data show a surge and then a decline of meth labs during the past decade, with fewer new labs reported after the implementation of state and federal laws. Because illegal production of meth often involves use of volatile chemicals and makeshift equipment,

these sites can be extremely dangerous and pose a health threat to the cooks, responders, and the public. Fires, explosions, spills, and volatilized chemicals are hazards at meth lab sites and extremely dangerous for humans and the environment.[12] These hazards are reflected in the type of injuries reported to the HSEES system. More than half of the victims in HSEES events reported respiratory irritation, approximately one-third of the victims reported headaches, and 15.4% reported chemical burns. The HSEES data indicate the danger of these sites: about 14.5% of HSEES-qualifying meth lab incidents required evacuations compared with 6.5% of all HSEES events, and nearly one-fourth (22.9%) of these incidents resulted in injuries compared with about 9.0% of all HSEES incidents.[17]

Meth labs clearly pose a greater threat to responders than to other populations. Of the 902 victims, more than 60% were responders: police officers, firefighters, and EMS personnel. For all HSEES incidents, less than 10% of victims were responders. Many of these labs (68.3%) were found in residential areas. Members of the general public who were at risk in meth lab events included vulnerable populations, such as children and the elderly. About one-third of victims in meth lab events were members of the general public, similar to the percentage of general public victims in all HSEES incidents.[18] These statistics demonstrate the risk that meth labs pose to responders and to the communities in which meth labs are found.

After 2004, the percentage of injuries to responders, especially police officers, generally declined, while the percentage of injuries to the general public continued to rise. This trend in injured-responder data might be related to several factors, such as the implementation of local, state, and federal regulations that helped to reduce the number of labs; increased awareness and training for responders; the development of established protocols that promoted caution and the use of personal protective equipment, such as self-contained breathing apparatuses and chemical-resistant clothing, during a meth lab response; and changes in meth lab composition. First, state and federal laws restricting access to pseudoephedrine and other precursors to meth appear to have been effective in reducing the number of labs overall during the time period. This reduction in meth lab numbers most likely helped to reduce the number of injuries sustained by responders. Second, as described in the information from Minnesota and New York, efforts to educate responders about best practices for responding to meth labs began in 2001, when the meth labs were clearly a growing problem. These efforts involved many agencies and organizations and were initially concentrated on ensuring that the first responders to arrive on scene, often police officers, would recognize the hazard and take precautions. This increase in awareness and knowledge might have contributed to reducing injuries to responders.

Law enforcement officials continue to identify clandestine meth labs on a regular basis. Actions to decrease the number of labs and the resulting morbidity and mortality have been somewhat effective to date, but responders and the public must be aware that these labs still exist and, therefore, the hazards still exist. Meth users will continuously look for "new and improved" methods for making meth. Also, meth is the most common drug manufactured in clandestine labs but is not the only drug manufactured in these clandestine settings. Data on clandestine drug lab incidents will help to identify changes in the drugs being made, in the frequency of these incidents, and in the hazards involved. These data can be used to revise response protocols and training for responders and to educate environmental health and public health professionals who address issues of decontamination and chemical exposure.

Limitations

There are limitations to the data that were collected through the HSEES system. First, reporting to the HSEES system is not mandated, and states rely on other mandated reporting sources. Meth lab details are particularly difficult to obtain because of the confidentiality surrounding pending legal actions. The requirements for reporting clandestine meth labs differed among the participating states, leading to variations in the capture and availability of meth lab data by state. Staff from the participating states also saw that many clandestine meth lab incidents, although reported within the states, did not meet the HSEES case definition because they were not acute events involving a release within the 72-hour period. For these reasons, the HSEES data do not provide a complete characterization of the magnitude of the clandestine meth lab problem in the participating states. It also is not known how well the available data reflect trends in states that did not participate in the HSEES Program. Data from the U.S. Drug Enforcement Administration (DEA) indicate that there are large regional differences in the numbers of clandestine meth labs, with states in the mid- and southeastern sections of the country generally reporting higher meth lab discoveries.[19] These limitations in the data may be compounded by the changing number of participating states during the eight-year data-collection period, which might have affected the trends in meth lab incidents collected by the HSEES system.

CONCLUSIONS

Despite these limitations, HSEES data served a valuable role in initial identification of the surge in clandestine meth labs and continued to be a tool to document meth lab trends and the associated risks in the past decade. As the prevention activities in the states of Minnesota and New York indicate, the HSEES data allowed state health departments to identify an emerging problem relatively early. The recognition of the growing numbers and potential health risks of these clandestine meth labs provided evidence that helped to garner support and secure funds for actions that addressed the problem.

The sustained pressure from law enforcement, public health, citizen groups, and others, along with state- and federal-directed chemical restrictions, has likely contributed to continuing decreases of domestic clandestine meth production and associated injuries in the United States over the past several years. As described in this article, a strong decline in meth lab activities was seen following enactment of meth-related legislation in Minnesota and New York.[12–15] However, DEA data show that this problem has not disappeared and could be on the rise again, with 7,485 labs reportedly seized nationally in 2008 and 10,064 labs seized in 2009.[20] To protect public health, surveillance of clandestine drug labs and other chemical incidents should continue. This surveillance will yield data that can be used to support public health efforts and legislation as trends change.

The Hazardous Substances Emergency Events Surveillance Program represents the collaborative effort of many people whose cooperation is gratefully acknowledged. The authors thank Rita B. Messing, PhD; Noreen Hughes, MS; Jenny K. Ehrlich, MPH; and their other partners in the state health departments who worked hard to collect the data and perform the program activities reported in this article.

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