Congressional Testimony

John W. Martyny, Ph.D., C.I.H.
Associate Professor
Department of Medicine
National Jewish Medical and Research Center and
Department of Preventive Medicine and Biometrics,
University of Colorado Denver/Health Sciences Center
1400 Jackson St.
Denver, CO 80206
martynyj@njc.org

My name is John W. Martyny. I am an Associate Professor and an industrial hygienist at the National Jewish Medical and Research Center. I also hold the rank of Associate Professor in the Department of Preventive Medicine at the University of Colorado Denver/Health Sciences Center. I wish to inform you of recent research that we have conducted regarding the chemical exposures associated with the clandestine manufacture of methamphetamine. Our research has indicated that very high levels of toxic chemicals are produced during methamphetamine "cooks"; and that hazardous chemical exposures can be expected to persist in rooms and buildings for an extended period of time.

Prior to discussing our research findings, I wish to acknowledge the contributions made by many groups in conducting this research. The study was initiated due to exposure concerns expressed by local law enforcement officials in Colorado, including the North Metro Task Force in Denver, Colorado. We also obtained enthusiastic help and assistance from local and state law enforcement, fire, and emergency services personnel from Colorado, New Mexico, and Texas. I have attached to this testimony a complete list of participating organizations.

In order to obtain exposure data, we collaborated with agents and chemists working for the U.S. Drug Enforcement Administration who conducted controlled methamphetamine "cooks" while we measured the chemicals being released. Without their help, this information would not have been obtainable. DEA Administrator Karen P. Tandy has been very supportive in this effort. Senator Ben Nighthorse Campbell was also helpful in providing some initial funding for our effort.

We have received financial support from the U.S. Justice Department through Community Action Policing Services, the Centers for Disease Control/National Institute of Occupational Safety and Health (NIOSH), and HealthOne Foundation of Colorado. We gratefully acknowledge the help we have received from the National and the Colorado Drug Endangered Children Coalitions. Full reports of our studies can be obtained from either of their websites (http://www.colodec.org/ and http://www.nationaldec.org/).

Introduction

Our nation faces an unprecedented epidemic of clandestine methamphetamine drug manufacturing. Seizures of methamphetamine drug laboratories continue to rise, putting police and fire first responders at risk for a variety of hazards. For example, the number of seizures in my home state of Colorado has risen dramatically from 31 laboratories in 1998 to 687 laboratories in 2002. First responders and susceptible third parties, especially children, are at risk for exposures to the chemical hazards as well as the fire, explosion, and safety hazards inherent with the clandestine manufacture of methamphetamine.

Unfortunately, very little research has been conducted regarding the specific exposure hazards associated with illegal methamphetamine manufacture. The lack of knowledge has produced four serious problems:

1. Inconsistent medical treatment of chemically exposed individuals:

Because of the lack of information on exposure levels, there has been very poor information on which to establish appropriate medical treatment plans. Healthcare providers providing treatment to individuals exposed at methamphetamine laboratories were forced to provide generic, often expensive, and probably to some extent unnecessary, medical testing.

2. Inconsistent recommendations for protection of emergency service and law enforcement workers:

The use of personal protective equipment (PPE) by emergency services and law enforcement personnel has varied widely by jurisdiction due to the lack of information regarding chemical exposures at the sites. Some jurisdictions utilize self-contained breathing apparatus (masks with air tanks worn on the back) and chemical-protective suits while neighboring jurisdictions use no respiratory protection or chemical-protective suits at all. Other agencies switch from self-contained breathing apparatus to air-purifying respirators (face masks with filters) after the initial assessment, while some agencies remain in the highest levels of protection. These inconsistencies are due to a lack of information from scientifically-based studies of the exposure risks while conducting these operations.

3. Preventable injuries and illness occurring among emergency service and law enforcement workers:

Even though many agencies use some form of PPE, there are increasing reports of emergency service and law enforcement personnel being injured while conducting investigations at clandestine methamphetamine laboratories. The Centers for Disease Control reported 59 events between 1996 and 1999, associated with methamphetamine labs where emergency services personnel were injured during the investigation. The number of injured responders was 155, with the most predominant symptom reported being respiratory irritation.

Studies conducted by Dr. Jeffrey Burgess, while at the University of Washington, investigated the symptoms reported by emergency responders during illegal methamphetamine laboratory seizures. Responders predominately reported general irritant symptoms, but least one case of phosphine gas exposure (a gas that may be lethal at low concentrations) was reported. In a questionnaire study of emergency responders, 53.8% reported at least one illness while conducting laboratory seizures with most symptoms appearing to be related to chemical exposure at the laboratory site. The primary symptoms reported were headache and mucous membrane irritation.

Although the predominant symptoms were irritant symptoms, a number of responders were found to have an accelerated decline in their ability to breathe (determined by a breathing test which measures how fast they can blow air out of their lungs) that may have been related to work in drug laboratories. The majority of symptoms reported by officers occurred during the processing phase of the laboratory seizures but this phase was also the phase in which the most time was spent in the laboratory area. The use of respiratory protection did seem to reduce the incidence of symptoms while investigating these laboratories. There has also been anecdotal evidence of these chemical exposures causing permanent lung damage, but the actual cases have not been reported in the literature.

4. Inadequate hazards training and education of emergency services and law enforcement personnel:

If the exposures encountered in methamphetamine laboratories are not known, then it is difficult to properly educate personnel about the risks they may encounter when entering an illegal laboratory. Although the chemicals used in the production of methamphetamine are well known, first responders do not know which of these chemicals by themselves or in combination may be harmful and what routes of exposure present the most severe risks. Industrial hygienists commonly approach such problems by quantifying the actual exposures using air sampling, modeling, and in some cases teamed with occupational environmental medical specialists using biological markers (chemical traces in urine or blood, for example) to determine what the exposure has been. Major exposure assessment issues include individual chemical characteristics as well as potentially complex interactions of chemicals that might result in unusual and potentially very toxic mixtures.

Summary of our research findings

Our research was designed to determine the potential chemical exposures to law enforcement and emergency services personnel responding to clandestine methamphetamine laboratory seizures. As our research continued, however, we became increasingly concerned, as well, about the potential exposures to third party individuals that were incidentally exposed to these laboratories. Chief among these are concerns was the health and well being of the children associated with these laboratories. Approximately 1/3rd of the methamphetamine laboratories investigated by law

enforcement involve children. In addition, there have been instances of families unknowingly moving into a building that had previously been a methamphetamine laboratory. The occurrence of a clandestine "cook" was only evident after significant lung problems were diagnosed in the children.

Methodologies

Our research has consisted of two phases; a series of controlled "cooks" documenting exposures during differing manufacturing methods and the sampling of conditions present at a number of laboratories being investigated by law enforcement officers. The controlled "cooks" were designed to determine the levels of contamination associated with the "cooks" and the area over which these exposures are spread. The sampling of laboratory investigations was conducted in order to determine residual exposures present after the "cooks" have been conducted.

The controlled methamphetamine "cooks" were conducted in three residences and a hotel that were slated for demolition. These "cooks" were conducted by law enforcement chemists using similar chemicals and equipment, and under similar conditions typically observed in clandestine laboratories. Two of the "cooks" were conducted using the red phosphorous reduction method and two used the Birch method, which uses anhydrous ammonia and lithium metal to produce methamphetamine. Airborne sampling for hydrochloric acid, iodine, phosphine, and anhydrous ammonia was conducted using methods specified in the National Institute of Occupational Safety and Health (NIOSH) Manual of Analytical Methods. Real-time analysis for hydrochloric acid and phosphine were also obtained using an ITX Multi-Gas Monitor. Real-time analysis for anhydrous ammonia was obtained using colorimetric detector tubes. Airborne and surface levels of methamphetamine were determined using a method being developed for NIOSH by Data Chem Laboratories in Salt Lake City, UT. The levels of chemicals observed were compared to the American Conference of Governmental Industrial Hygiene (ACGIH) Threshold Limit Values (TLV) and the NIOSH Immediately Dangerous to Life and Health Levels (IDLH).

Controlled Cook Results

Red Phosphorous "Cooks"

The red phosphorous method of producing methamphetamine involves the use of a number of solvents, iodine, hydrogen chloride gas (frequently manufactured using sulfuric acid and rock salt (NaCl)), red phosphorous, sodium hydroxide, and ephedrine or pseudoephedrine. This method requires heating of the materials as well as a reasonable amount of manipulation (filtering and bubbling hydrogen chloride into the solution) that generally results in significant contamination by the primary chemicals as well as other chemicals produced by the combination and heating of the primary chemicals.

Our analysis of the exposures present during red phosphorous "cooks" has revealed significant exposures to solvents, phosphine, iodine, hydrogen chloride, and

methamphetamine aerosol. Phosphine is a gas produced when the solution of iodine, water, ephedrine, and red phosphorous is heated. It is a gas that may cause severe pulmonary irritation resulting in pulmonary edema and death. At lower levels phosphine may cause nausea, vomiting, headache, and chest tightness, symptoms frequently reported by law enforcement personnel exposed to these laboratories. Unfortunately, there have also been several deaths reported in "cooks" that have possibly been associated with phosphine exposures. Our controlled "cooks" have resulted in measured phosphine levels ranging from not detectable to as high as 2.9 ppm, approximately three times the short-term occupational exposure standard of 1.0 ppm.

Although a seemingly harmless chemical when applied to the skin, iodine can be very toxic when inhaled. The level of iodine considered by NIOSH to be Immediately Dangerous to Life and Health (IDLH) is only 2 ppm and levels lower than 0.1 ppm are required in the workplace. After a red phosphorous cook, iodine contamination can generally be found on many surfaces in the "cook" area and we have measured levels as high as 0.16 ppm in the air during the "cook". The amount present in the air seems to depend upon the amount of water used during the "cook" and the temperature of the "cook" with hotter "cooks" resulting in higher levels of airborne iodine.

Many different types of solvents are utilized during the production of methamphetamine. Methanol and ether are commonly used to extract the pseudoephedrine or ephedrine and Coleman Fuel is commonly used to separate the methamphetamine base prior to acidification. All of these chemicals are extremely flammable; and many clandestine methamphetamine laboratories are found after the explosion and fire. These chemicals may also cause exposures resulting in nervous system damage as well as internal organ damage (liver, kidney, etc.). This is especially true for children with developing nervous systems.

Hydrogen chloride is produced during the acidification phase in all methamphetamine "cooks". It is typically used to precipitate the methamphetamine out of the organic solution. It can be produced by adding aluminum foil to muriatic acid (hydrochloric acid) or by mixing sulfuric acid with rock salt. In either case, large amounts of hydrogen chloride are produced and become airborne in any red phosphorous "cook". We have found levels as high as 155 ppm during the "cook" and average levels of hydrogen chloride are almost always over the occupational level of 2.0 ppm. This chemical can cause severe upper respiratory tract damage and may result in permanent lung damage to adults and especially to children and infants with a growing respiratory system. The current NIOSH IDLH is 50 ppm, which is the level that we frequently encounter during these cooks. The potential for injury due to hydrogen chloride is very high.

While the hydrogen chloride is being used to precipitate the methamphetamine out of solution, a significant amount of methamphetamine itself is bubbled out of the solution and into the air. The methamphetamine can then be found to plate out on surfaces quite distant from the cook, and levels of methamphetamine as high as 16,000 ug/100 cm^2 can be found in houses that were used to produce methamphetamine. These levels can persist and we typically find as much as 300 ug/100 cm^2 in homes that were used for

methamphetamine production, even as long as 6 months after the last use. Airborne levels of methamphetamine may be as high as 5000 ug/m^3 during the cook and almost assures that anyone in the vicinity of the cook will test positive for methamphetamine, even infants. Due to this widespread deposition of methamphetamine throughout the house, virtually all items within the house as well as all people, pets, toys, etc. become contaminated with methamphetamine.

In general, anyone present during the clandestine production of methamphetamine using the red phosphorous method is highly likely to become exposed to toxic levels of phosphine, hydrogen chloride, iodine, solvents, and to high levels of the drug itself. These levels will be exceptionally high for children and infants who, due to their developing physiology and their inquisitive oral habits, will be exposed to high levels of these chemicals at a very sensitive time of their development. The final cost to these children may not be identified for many years to come.

Anhydrous Ammonia "Cooks"

The anhydrous ammonia "cooks" differ from the red phosphorous "cooks" in that they use anhydrous ammonia and a reactive metal (lithium or sodium) instead of red phosphorous and iodine. This method of production still produces significant amounts of solvents, hydrogen chloride and methamphetamine but phosphine and iodine are not produced. The levels of anhydrous ammonia that are produced during these "cooks" are significantly above NIOSH IDLH levels and the likelihood of serious injury to the respiratory system is high. Ammonia levels easily reach 1000 ppm with average levels of 500 ppm common. The current NIOSH IDLH is 300 ppm, well below the levels that we observe during the "cooks". Adults exposed to these levels may be expected to have injury to the respiratory system as well as eye damage. The reactions of children and infants can be expected to be much greater and to persist for longer periods.

Conclusions

Our studies indicate that methamphetamine production and use will have far-reaching effects upon the individuals using this drug, their children, others in the vicinity, and even individuals moving into the "cook" areas well after the cook has moved on to another area. It is unlike the use of many drugs in that there is not only an exposure to the drug itself, but also to the hazardous and toxic chemicals used for the drug's production. It is almost a given that the following will occur:

- The cook and anyone assisting the cook will be exposed to a number of chemicals (phosphine, hydrogen chloride, iodine, anhydrous ammonia, and solvents) at levels that are above those allowed by law in occupational settings and, in some cases, above those levels determined to be "immediately dangerous to life and health".

- Third party bystanders, including children and infants, are likely to be exposed to levels of those same chemicals that may cause severe and long-lasting health

concerns. This is especially true of children and infants who are rapidly growing and more susceptible to chemical exposures in the home environment.

- Law enforcement, fire, and emergency services personnel may be exposed to high levels of these chemicals as they investigate clandestine methamphetamine laboratories. This is especially true if they enter an area where a laboratory is in operation but also may be true if the laboratory is not in operation at the time. Residual chemicals deposited on surfaces of the house as well as boxes of chemicals stored in the house may result in significant exposures to investigating personnel.

- The area used to produce methamphetamine and surrounding areas will be contaminated with a number of chemicals including hydrogen chloride, iodine, solvents, and the methamphetamine itself. Levels of these compounds may remain in the area for an extended period of time (at least 6 months) and may result in exposures to individuals that were not associated with the "cook" and, in fact, never knew of the existence of the methamphetamine production.

What Don't We Know?

What are the long-term health effects for exposed children?

In spite of all we do know about the potential effects of methamphetamine production on the community, there is still much that we don't know. At this time we do not have much information on the long-lasting health effects caused by exposure to clandestine methamphetamine laboratories. This may seem like information that is easily obtainable, but several factors have limited our knowledge in this area. The explosion of these clandestine laboratories has occurred during the last 10 years and has been studied for even a shorter period. This combined with laws limiting the collection of health information from individuals has hampered our ability to track exposed individuals for long periods of time.

Information regarding long-term effects in children is especially needed, since the knowledge of potential physiologic and psychological conditions resulting from these exposures in children may help in our treatment for these individuals. Some physicians and psychologists working with methamphetamine lab exposed children have reported significant concerns that seem to be unique to this exposure. Indeed, since almost all of the children from these laboratories test positive for the drug itself, which we have found on most surfaces of the house, exposure to the other chemicals is also likely. Many of these chemicals can be related to pulmonary problems such as asthma and pulmonary fibrosis as well as liver and nervous system damage. The drug itself is a neurological agent that can result in significant psychological conditions in adults using the drug. Are these same conditions possible in the exposed children? Is it possible that even more severe developmental, psychosocial, and physical effects may occur in children exposed over a long period of time? We know that the brain undergoes significant changes in

early childhood. Does exposure to methamphetamine at this time result in significant effects upon brain development that will not be recognized until later in life?

What are the long-term chemical exposures associated with methamphetamine laboratories?

As part of the process in determining the effect of methamphetamine and its precursor chemicals on children, we need to determine the magnitude of the exposures to children present in a home not only during, but after the "cook" has taken place. To date, we have only conducted controlled cooks in structures that were slated to be demolished within the next few days. This was done to reduce liability for people entering the structure after the "cook". We now need to conduct controlled "cooks" in structures located in a secure location so that we can follow the exposures over time. What chemical exposures exist in the house a day after the cook? What about a month after the cook? Are the exposures associated with the house at a year post-"cook" still dangerous? How do normal activities such as vacuuming, cleaning, cooking and other activities affect these exposures? How do the potential exposures to infants crawling around the house differ from the exposures to adults? All of these questions are important in determining the potential health effects to look for in children as well as other adults residing in the building.

What are the best methodologies to use to control the spread of chemical contamination into the community?

Currently law enforcement agencies that take evidence, suspects, and children out of a suspected methamphetamine laboratory are confronted with decontaminating the individuals and materials. Some agencies conduct the decontamination on site and others transport the individuals to a hospital for decontamination. In some cases, individuals have been transported without decontamination and hospital personnel have become ill from the exposures. What is the best methodology to use for decontamination? Which decontamination methods result in the least amount of trauma for children associated with methamphetamine labs? We have been told that a child able to take his or her favorite toy or object from the house may suffer much less trauma. Are there ways that this can be done? Can we make decontamination child friendly? These are questions that, when answered, may make a drug raid much less traumatic for the children innocently involved.

What are the risks of moving into a house that has been used as a methamphetamine lab?

We currently know that individuals moving into a home that has been used as a methamphetamine laboratory often have respiratory problems. This is especially true of children or adults with asthma or other respiratory problems. At this time we do not know what chemicals cause these symptoms, although many involved in the process affect the respiratory system. We do know that these houses seem to have elevated levels of methamphetamine but we have not tested the homes for other compounds that may cause respiratory symptoms.

What is the best methodology to use in decontaminating a residence that has been used as a clandestine methamphetamine laboratory?

To date a number of states have developed standards and methodologies for the cleanup of methamphetamine labs. These standards vary from state to state although many states have similar standards. Are there specific remediation steps that should be taken in all decontamination efforts? What decontamination procedures result in the lowest residual level of chemicals in the house? At what chemical levels should most people be unaffected? Should we base the decontamination on methamphetamine levels as is currently the practice in most states or should we look for other chemicals? These questions need to be answered in order to determine when the decontamination program is complete and to prevent unnecessarily expensive decontamination.

As these questions get answered, there will undoubtedly be more questions as we begin to understand the complexity of this drug and its manufacture on society.

How will this bill help?

Voluntary guidelines for remediation. The "Methamphetamine Remediation Research Act of 2005" sets into motion several programs. It requires the U.S. EPA to establish voluntary guidelines for the remediation of previous clandestine methamphetamine laboratories. These guidelines will be able to combine the best of all of the existing state guidelines and provide a national guideline that will be available to all states, especially those that are new to the problem. The result will be more uniform remediation guidelines for the states that allow homeowners to more easily understand what is necessary to decontaminate their property. Additionally, a standard could unify potential practices for insurance providers, cleanup, disposal and remediation companies.

Further research. The bill also requires that the EPA support research so that we can begin to answer some of the questions previously mentioned as well as others. At this time, very little funding is being directed at what has become a national problem. Concerns regarding methamphetamine laboratories can be found in the media on a daily basis and many public concerns can't be adequately answered at this time. The bill may also provide funds that will allow us to scientifically determine the serious health effects associated with methamphetamine manufacture that at this time we are only able to identify through anecdotal observations by medical and psychological professionals. Knowledge of the potential effects may help us help the children and infants innocently involved with this drug so that they are not medical or sociological burdens upon society later in their lives. The provision requiring EPA to coordinate research with the National Academy of Science will enable research to move forward in a directed fashion. The emphasis on the biological effect on children and first responders is especially noteworthy.

Better dissemination of better information. The bill requires that the information gathered by the EPA be disseminated to the states on a routine basis. This is extremely

important since the dissemination of current information to all interested individuals is very important in establishing a uniform methodology of combating this national problem. This technology transfer must be accomplished on a regular and frequent basis to assure that the information is well used.

Better detection methods. The development of new testing methods may also be important to the determination of the risks involved in previous methamphetamine labs as well as identifying those laboratories in the field. In order to be effective, however, any new methods that are developed must be validated and standardized to assure that they provide accurate results in a timely fashion.

In closing, I appreciate the opportunity to acquaint you with the results of our research and the belief that we have regarding the importance of reducing this community hazard. Since beginning this work, it has been my privilege to meet many dedicated individuals that have devoted their time and efforts to protecting society and especially children from the potentially devastating effects of these clandestine methamphetamine labs. Much of the work in this area has been conducted by individuals on their own time and at their own expense. This shows the dedication of the many law enforcement, social services, public health, emergency services, and research people working on this problem today. Thank you again for your time.

Individuals and agencies participating in this project:

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North Metro Fire Department
Rich Randall

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National Alliance for Drug Endangered Children
Thornton Police Department
Adams County Sheriff's Department
Broomfield Police Department