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Ralph Weisheit
Illinois State University

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MAKING METHAMPHETAMINE*

RALPH WEISHEIT

ILLINOIS STATE UNIVERSITY

ABSTRACT

In many parts of the U.S. methamphetamine production remains a serious problem despite efforts to restrict access to precursor chemicals. Methamphetamine laboratories are a particular issue in rural areas, where many essential chemicals are available and where a lower population density means that noxious fumes are less likely to be noticed. This paper shows how the problem emerged and changed over time and includes: Early production in the U.S., the spread of meth production, the process of making meth, precursor control efforts, superlabs versus small local operations, health risks, contaminated lab sites, and children found in methamphetamine lab sites.

While methamphetamine has been around for nearly a century, the rise of domestic methamphetamine laboratories has added a sense of urgency to responding to the problem, particularly in rural areas where much of the domestic methamphetamine production takes place. Methamphetamine laboratories pose environmental and health risks that transcend the effects of the drug on the user. Apartment residents may be killed or injured by a meth lab explosion in the adjoining apartment, children in homes where meth is cooked may be exposed to toxic chemicals and to meth itself, hotel guests may be injured by toxic chemical residue from the previous tenant's meth lab, and emergency responders may be sickened when they enter a lab site. Thus, meth labs pose a type of threat to innocent citizens that simple drug use does not. This article will describe the problems created by methamphetamine laboratories and the manner in which states and the federal government have responded.

For the drug manufacturer methamphetamine production has several advantages over the production of such plant-based drugs as cocaine and heroin. Producing methamphetamine in domestic labs means that production can be very close to the point of sale (Klee 1997). The domestic methamphetamine producer does not have to worry about crossing borders or losing shipments at sea. A short distance between the producer and consumer also dramatically reduces the number

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of hands through which the product must pass before it reaches the consumer, substantially reducing the cost to the final consumer. Cocaine, for example, is very cheap in South America, but must pass through many hands before it reaches the final consumer in America. As Peter Reuter notes, “Fully 99 percent of the price of the drug, when sold on the streets in the United States, is accounted for by payments to people who distribute it (Reuter 1990:18).” This, in turn, requires an exceptional level of organization and the ability to be a good manager/CEO (Klee 1997).

The building blocks of plant-based drugs are often plants that are indigenous to specific regions, have particular growing seasons, require a substantial amount of physical space in which to grow, and are subject to the vagaries of weather. Further, plants simply require time to grow. This not only limits the amount that can be produced in a given year, but means that the grower is exposed to risk of eradication by law enforcement, insects, thieves, and weather for the duration of the growing season. In contrast, the meth cook can produce the final product in any weather, in a few hours, in a limited space and, if they suspect imminent arrest, they can quickly dispose of their equipment and materials.

Finally, those who would manufacture methamphetamine can start with very small operations and grow (or shrink) their business as the market allows. What may start as a “hobby” may easily be turned into a business. Startup costs and technical expertise required for small operations are minor, but the successful small-time meth cook can easily grow the business, both in size and in complexity. Thus, in the United States, synthetically manufacturing methamphetamine gives the drug a host of distinct business advantages over cocaine or heroin.

METHAMPHETAMINE: A BRIEF INTRODUCTION TO THE DRUG

Methamphetamine is the most potent member of a class of drugs known as central nervous system stimulants (CNS). Other drugs in this category include amphetamine, cocaine, ephedrine, and methylphenidate. As a central nervous system stimulant, methamphetamine elevates mood, raises blood pressure and relaxes bronchial muscles. The users experiences increased self-confidence as though they could accomplish anything. It also increases the ability to focus on otherwise dull or repetitive tasks. The drug increases wakefulness and alertness and decreases fatigue. The drug also suppresses appetite, although this effect diminishes as the drug is used over time. The drug also disrupts the body’s ability to regulate its temperature, making it potentially dangerous when used during physically

demanding activities. Heat stroke is a possibility, and this sometimes proves fatal. Larger doses may cause apprehension, impulsiveness and aggression. Very high doses may lead to psychotic episodes that are nearly identical to paranoid schizophrenia. Tolerance to methamphetamine develops quickly and abstinence following periods of abuse generally lead to depression and fatigue. Craving for the drug may persist long after its use has stopped (Weisheit and White, forthcoming).

Some begin their using careers because the drug's effects are seen as helpful. Women who wish to lose weight may be drawn to the appetite suppressing effects. The boost in energy may be helpful to those working two jobs or to long-haul truckers who wish to stay awake for extended periods. Increased concentration may be seen as beneficial for those with repetitive or boring tasks. How many users begin their using careers through purely recreational use and how many begin trying to work longer hours, lose weight, or other socially desirable objectives is unknown. Nevertheless, for some initial use to achieve desirable social goals clearly leads to abuse.

Current estimates suggest that more than 700,000 people have used methamphetamine in the past month, a number slightly greater than the number of crack cocaine users and more than double the number of heroin users (SAMSHA, 2007a). While the media has focused on rural white users, rates of use for methamphetamine are highest for American Indians and are high for both Whites and Hispanics (SAMSHA 2007b). Blacks in the U.S. have by far the lowest rates of methamphetamine use, a rate one-fourth that of whites. Although the press has made much of the drug's appeal to women, men are twice as likely as women to report using meth. No data describe the characteristics of people who manufacture methamphetamine.

Unlike many other drugs methamphetamine can be taken in a variety of ways. It can be smoked, eaten, snorted, injected (into the blood, muscle, or skin), or even taken in suppository form. The method of administration influences "The timing and intensity of the 'rush' that accompanies the use of MA [methamphetamine], . . . The effects are almost instantaneous when MA is smoked or injected; they occur approximately five minutes after snorting or 20 minutes after oral ingestion (Anglin et al. 2000:139)." Injecting the drug produces the shortest time from first use to abuse and from abuse to treatment. Injection also places the user at risk for HIV and for hepatitis C.

Methamphetamine cases place a burden on the criminal justice system, and this is particularly true for local sheriffs who not only investigate these cases, but must

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house methamphetamine offenders in their local jail. While there are no estimates of the cost to sheriffs across the nation, one survey found nearly half reported meth as their biggest drug problem, more than the combined percent reporting cocaine marijuana, and heroin (NACO 2006). When the effects of the drug wear off the appetite is no longer suppressed and the meth inmate has a ravenous appetite, increasing food budgets. Further, developing “meth mouth” is not unusual for long-term methamphetamine users. Meth mouth is characterized by extensive and often grotesque levels of tooth decay caused by a variety of factors, including poor dental hygiene and excessive grinding of the teeth (Weisheit and White forthcoming). Treating meth mouth often requires a lengthy regimen of expensive antibiotics followed by extensive dental reconstruction. While the costs of such dental work are substantial, no systematic account describes the costs for the nation as a whole. In addition, sheriffs are housing users who have neglected their overall health and who are depressed, agitated, and irritable when coming down from the drug. By any standard, methamphetamine inmates are a demanding and expensive population group.

As with many drugs, the use of methamphetamine creates a host of problems for the user and for society. What distinguishes methamphetamine from other illicit drugs is the variety of problems created by its domestic illicit manufacture. It is to those problems to which we now turn our attention.

ILLICIT PRODUCTION IN THE UNITED STATES

Amphetamine was first synthesized in 1887 and methamphetamine in 1919, but for many years these drugs were readily available through legal channels or through diversion from legal channels, and there were few incentives for illicit manufacturing. The history of illicit manufacturing worldwide is unknown, but in the United States it is thought to have begun in California in the early 1960s. Amid concerns about over-prescribing by doctors and diversion to the illegal market, Abbot laboratories withdrew injectable Desoxyn (the trade name for legally manufactured methamphetamine) and Burroughs Wellcome withdrew injectable Methedrine (another trade name for legally manufactured methamphetamine), leaving “intravenous methamphetamine users without a product that could be readily injected. Demand was created for an inexpensive water-soluble powder product (Miller 1997:116).” Because of this unmet demand, the first illicit methamphetamine laboratories emerged in San Francisco in 1962 or 1963, perhaps with the help of some legitimate chemists (Brecher 1972; Miller 1997; Smith, 1969).

By 1967 San Francisco became a center for the manufacture of methamphetamine. Small labs proliferated and a crack down by police pushed larger labs from the city to surrounding rural areas (Smith 1969). The 1970s and early 1980s witnessed the publication of several manuals providing instruction in the manufacture of methamphetamine (cited in Puder, Kagan and Morgan 1988). During the 1980s substances sold on the street as amphetamines virtually all contained methamphetamine and nearly all of the methamphetamine sold on the street was illicitly manufactured, rather than diverted from legitimate pharmaceutical production (Puder, Kagan and Morgan 1988). Eventually, methamphetamine production made it way along the entire west coast from San Diego to Washington State. From there production moved eastward so that today methamphetamine labs have been found in every state.

While hundreds, perhaps thousands, of recipes for methamphetamine can be found on the internet, most meth cooks learn their skills from other meth cooks. The internet and books with technical descriptions of the cooking process may be useful for cooks who wish to hone their skills, but that is probably not how most of the cooks begin. Thus, knowledge about cooking meth spreads in much the same way that communicable diseases are spread—through social networks. This is particularly true of smaller operations—known by such street names as “mom and pop,” “Beavis and Butthead,” or “kitchen” labs. In rural areas it is not unusual for one rural county to have many meth labs while an adjoining rural county has few or none. The county with many labs is often one in which a knowledgeable cook moves into the community and teaches others in exchange for their help with such things as providing the necessary chemicals. Thus, small methamphetamine labs are often based on friendship networks in which a cook works with others, eventually teaching them and they, in turn, eventually teach others in their friendship network. In this way knowledge about cooking meth can spread geometrically.

For many (though not all), cooking meth has some features of an art, in that cooks may endlessly experiment to find the perfect recipe. Such cooks have often been arrested with detailed records of their experiments and take pride in the quality of their product. As Frank Owen (2007:24) has observed:

Different from regular drug dealers who express their status through ostentatious displays of guns, cars, and jewelry, a meth cook’s standing is determined solely by his ability to produce Grade A dope. Like a chef in a

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four-star restaurant, meth cooks often employ helpers who, in exchange for meth, do the menial preparatory work. One person's job might be to buy the cold pills. Another is sent out to get the batteries. Yet others rub their fingers raw punching pills from blister packs.

Many cooks find satisfaction in the very process of cooking. As one author has described it (Owen 2007:23):

Talk to practically any meth cook in the Ozarks and they'll tell you pretty much the same thing: The ritual of gathering the ingredients and cooking the drug gets them just as excited as the drug itself. "I got higher off the cooking than I did off the dope," says Stanley Harris.

Arrested cooks who are obsessed with the details of manufacturing meth present an interesting dilemma. Does putting them in jail or prison give them a "classroom" full of "students" eager to learn the trade, and thus serve to spread knowledge about cooking meth? Does it put them in contact with others with whom they can swap recipes? Does it give them contacts that enable their local operation to expand to other communities in their region? If they are not imprisoned, how can they be kept from spreading their knowledge in a society that values free speech?

Similar questions can be asked about putting those enamored by the process of cooking with methamphetamine users in group treatment settings:

The other thing that came up frequently was how the meth addicts spend much of their time in treatment learning new techniques to manufacture the drug. Proponents of self-help groups and 12-step programs often cite the sense of comradeship that such programs engender among drug users. . . . But community isn't necessarily a good thing when it comes to kicking meth. Self-help groups can easily turn into chemistry classes (Owen 2007:53).

Those who wish to control methamphetamine production are thus confronted with a host of issues beyond those related to simple distribution.

THE PROCESS OF MAKING METHAMPHETAMINE

There are a variety of ways to manufacture methamphetamine. Some methods require several days of round-the-clock work by a team of cooks while others require only a few hours and a single cook. Some labs are suited for large scale production, what the DEA describe as “super labs” capable of producing 10 pounds or more of methamphetamine in a 24-hour period. Other recipes are best suited for small-scale production. There are two general methods for manufacturing methamphetamine, with several variations available for each method. The amalgam or P2P (also known as phenylacetone or phenyl-2-propanone) method uses P2P and methylamine (a derivative of ammonia) as the primary precursor chemicals (Skeers 1992) and produces a telltale odor similar to that of stale cat urine. This method may also utilize hydrochloric acid, formic acid, and/or mercury, among other chemicals. In February of 1980, P2P became a Schedule II controlled substance and methylamine is now on the DEA’s watch list. As P2P became more difficult to obtain a second method, the ephedrine/pseudoephedrine reduction method became more popular, first appearing in clandestine laboratories in 1982, although the technique was understood well before that (Skinner 1990). The National Drug Intelligence Center (2007) reports that the ephedrine/pseudoephedrine reduction method is now the predominate method for manufacturing meth in both large and small labs. Not only is the method easier than the P2P method, but the final product is more potent (National Drug Intelligence Center 2003).

Although restrictions on P2P made it difficult to purchase the compound in the United States legally, with some effort it can be synthesized (Uncle Fester 2005). The P2P method of methamphetamine manufacture is by far the more time consuming and demanding of the two. For example, one recipe involves a cooking process that requires special laboratory equipment, spans three days (after one has manufactured their own P2P), requires constant monitoring and modulation of the mixture’s temperature, and must be stirred every 30 minutes. The very complexity of this process may make it appealing to trained chemists and others who relish the process of making meth as much as the effects of the final product, but will have comparatively little appeal to the untrained methamphetamine cook eager to get his final product quickly.

The ephedrine/pseudoephedrine reduction method, which is simple to do and is based on relatively inexpensive household products, has become the predominant method of methamphetamine production in the United States. It is called a

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reduction method because it involves removing an oxygen molecule, as can be seen by comparing the formula for ephedrine with that for methamphetamine:



The only thing that differentiates ephedrine from methamphetamine is a single oxygen molecule. Within this general method there are two primary ways of converting ephedrine or pseudoephedrine to methamphetamine (along with several other less familiar ways): the red phosphorous or Red-P method and the Nazi or Birch method.

The Red-P method utilizes ephedrine/pseudoephedrine and red phosphorous, as is found in the striking pads of match books and in road flares. Depending on the recipe, red phosphorous is combined with iodine and/or hydriodic acid. Replacing red phosphorous, which is a restricted chemical, with hydrophosphorous acid, another restricted substance is also possible. However, those who have difficulty locating hydrophosphorous acid can find instructions for several ways of making it themselves. The Red-P method yields relatively high quality methamphetamine.

Another ephedrine/pseudoephedrine reduction method utilizes anhydrous ammonia, lithium (typically extracted from lithium batteries), sodium hydroxide (lye), and touline (paint thinner or Coleman fuel). Some believe this so-called Nazi method got its name because it was used by the Nazis during World War II, but others dispute this, suggesting the name came from one of the first cooks who had Nazi symbols on the letterhead of the paper on which the recipe was written (*Drug Identification Bible* 2001). The method is also called the Birch Reduction method, after the Australian chemist Arthur John Birch who first published his discovery of this method in 1944. Whatever the source of the name, the Nazi/Birch method has become particularly popular because of its simplicity, requiring substantially less technical knowledge than the P2P method, and because of the potency of the final product.

It has often been said that trying to stop the production and trafficking in illicit drugs is like trying to grab a balloon—squeeze in one place and it bulges out in another. One solution sometimes leads to new problems. Methamphetamine production is no different. As already noted, illicit methamphetamine production in California was triggered by the decision of drug manufacturers to withdraw legally manufactured methamphetamine voluntarily. What followed were a series of efforts

by the federal government to end methamphetamine production. These efforts have had an impact, but have also generated unintended consequences. Four federal laws provide good illustrations of these efforts and of the consequences that followed:

1. The Drug Abuse Control Amendments of 1965 [Public Law 89-74]
2. The Controlled Substances Act of 1970 [Public Law 91-513]
3. The Chemical Control and Diversion Act of 1988 [Public Law 100-690]
4. The Combat Methamphetamine Epidemic Act of 2005 [Public Law 109-177].

The Drug Abuse Control Amendments of 1965 modified the Federal Food, Drug, and Cosmetic Act to include barbiturates and amphetamines, including methamphetamine. The act limited the frequency with which prescriptions for methamphetamine could be renewed and required manufacturers to keep detailed records. The intent was to limit the diversion of these drugs away from legitimate therapeutic uses. The practical impact of the law was to limit the availability of legally manufactured methamphetamine tablets (and the eventual ban on injectable methamphetamine) for recreational purposes, spawning the rise of illicit production, as well as smuggling the restricted drugs from Mexico (Owen 2007).

The Controlled Substances Act of 1970 made it illegal to possess methamphetamine without a prescription and gave the DEA the authority to regulate legal production and distribution. The law had the effect of further reducing legal access to methamphetamine and, as might be expected, the effect was to increase illicit production substantially.

The Chemical Diversion and Trafficking Act of 1988 (CDTA) regulated bulk shipments of ephedrine and pseudoephedrine, but did not apply to over-the-counter medicines containing these substances. "Within a month following enactment of the CDTA the first encounter in the United States with ephedrine tablets at a clandestine methamphetamine laboratory seizure occurred. Non-controlled ephedrine tablets could be purchased easily in large quantities for subsequent conversion to methamphetamine (DEA n.d.a)." Unfortunately, Mexico had no such controls on bulk shipments of powdered ephedrine and during the 1990s methamphetamine production in Mexico flourished. Mexican traffickers imported hundreds of tons of ephedrine powder from India, China, Pakistan and the Czech Republic. In an 18-month period beginning in 1994, more than 200 tons of powdered ephedrine destined for Mexico were seized, enough to make 140 tons of

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methamphetamine (DEA n.d.a; Owen 2007). In all likelihood this was only a fraction of the amount actually sent to Mexico.

The Combat Methamphetamine Epidemic Act of 2005 sought to end domestic methamphetamine production via the Nazi method by restricting access to over-the-counter medications containing ephedrine and pseudoephedrine. The long-term consequences of this act are as yet unknown, but the short-term effects seem clear. By limiting the amount of these medications that can be purchased (no more than nine grams per month) there has been a reduction in the number of seized methamphetamine labs. However, while the number of seized labs went down, they were not eliminated.

In many ways, precursor regulation is a good example of states serving as laboratories for drug policy. The much touted success of regulating ephedrine in Oklahoma was quickly followed by other states and eventually by the federal government (Harvard Law Review 2006). In 2005 alone 35 states enacted legislation to restrict the sale of ephedrine and pseudoephedrine, with another six states enacting legislation in 2006 (National Alliance for Model State Drug Laws 2006a).

States also have adopted tough penalties for the illegal possession and transportation of anhydrous ammonia. In 21 states it is a felony to possess anhydrous ammonia to make methamphetamine and in 15 states it is a felony to possess or transport anhydrous ammonia in unapproved containers. In some states possession and transportation are separate felonies (National Alliance for Model State Drug Laws 2006b).

Of greater concern than the issue of small domestic laboratories, is the apparent rise of methamphetamine produced and distributed by large trafficking organizations, primarily operating out of Mexico, with some large labs in the United States operated by Mexican nationals. While Mexico had been a major supplier to methamphetamine to consumers in the U.S. since the 1990s, the demise of small independent methamphetamine labs has the potential to enable Mexican drug traffickers to dominate the U.S. methamphetamine market. There are some signs of this happening. According to a report by the National Drug Intelligence Center (2007):

As methamphetamine production in small-scale laboratories has decreased nationally since 2004, Mexican criminal groups have expanded direct distribution of methamphetamine, even in many smaller communities.

These groups pose an increased challenge to local law enforcement because they are often Mexico-based, well-organized, and experienced drug distributors that have been successful in blending into somewhat insular Hispanic communities or among Hispanic workers employed in the agricultural, landscaping, construction, and meatpacking industries.

The concern is that the small-scale operators, who mainly cooked for themselves and for friends and for whom small amounts of cash changed hands, are being replaced by large-scale operation in which profit is the driving motive, the money involved is substantial, and the potential for violence is considerable. As recently as 1994, Philip Jenkins could state with some confidence *there is no such thing as a national market in methamphetamine* (emphasis added) (1994:10). By 2003 a national market was emerging with the DEA estimating that “Mexico-based groups control 70-90% of methamphetamine production and distribution in the United States . . . (Brouwer et al. 2006:712).” Mom-and-pop laboratory operations primarily shared their product with family and friends, and while such operations may have allowed young people access to methamphetamine, there were no strong financial incentives for aggressively marketing their product to youth. In contrast, when methamphetamine production becomes a business run by people with no stake in the well-being of the local community, there are strong incentives for expanding the customer base. The young are a particularly appealing target (just as they are for many legal industries, including alcohol and tobacco) in that they have the potential to be customers for years to come.

The effect of precursor regulation on overall levels of methamphetamine consumption are much debated. Cunningham and Liu (2003) have argued for the effectiveness of these measures, noting that methamphetamine-related hospital admissions have gone down following legal restrictions to access to precursors. Reuter and Caulkins (2003) doubt these claims, noting that other measures suggest no effect of these regulations. For example, following precursor regulation the price of methamphetamine went down, when there should have been shortages of the drug that drove prices up. Similarly, there were no sharp reductions in the reported use of methamphetamine by newly admitted jail inmates.

In what is perhaps the most detailed study to date, Dobkin and Nicosia (2007) considered the impact of a major disruption in the supply of precursors on a variety of methamphetamine-related indicators. In the months immediately following this disruption the price of methamphetamine rose from 30 dollars to 100 dollars a

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gram, purity dropped from 90 percent to less than 20 percent, hospital admissions declined by 50 percent, treatment admissions declined by 35 percent, felony arrests for methamphetamine possession fell by 50 percent, misdemeanor arrests for methamphetamine possession fell by 25 percent, and the percent of arrestees testing positive for methamphetamine declined by 55 percent. All these changes occurred with no evidence that users were switching to other drugs. Unfortunately, the impact of this major precursor disruption was short lived as new sources of precursors were identified. "Price returned to pre-intervention levels within four months while purity, hospital admissions, drug treatment admissions and drug arrests recovered to near pre-intervention levels over eighteen months (Dobkin and Nicosia 2007:3)."

If precursor regulation has had an unclear effect on overall levels of methamphetamine consumption, the effects of these regulations on production patterns seem more clear. Various efforts to regulate methamphetamine production through restrictions on precursors have had the unintended consequence of centralizing production and enriching powerful drug trafficking organizations. It seems likely that an increasingly centralized production and distribution system will also increasingly be associated with violence to protect the enormous profits involved. Regulations on precursors did not create the methamphetamine problem, nor did they create major trafficking organizations, but they did change the nature of the industry and the manner by which methamphetamine users had access to the drug.

HEALTH RISKS

Aside from the potential health risks from using methamphetamine are the potentially deadly consequences of manufacturing the drug. Legally manufactured drugs are created in highly controlled laboratory settings in which the process is overseen by skilled chemists. Neither situation necessarily exists in the illicit manufacture of methamphetamine. Methamphetamine labs, particularly small "mom and pop" labs, are often set up by individuals with no background in chemistry or in proper laboratory procedures. Combine this with the highly volatile chemicals used to manufacture methamphetamine, add a heat source and a sleep-deprived cook, and the potential for accidents or explosions is substantial. There are several respects in which cooking meth may damage health.

Methamphetamine can be made with everyday household items, such as lye and camping fuel. Some of those items are particularly harmful to the human body.

Some materials, such as sodium, magnesium and potassium can ignite or explode when exposed to air or water (Irvine and Chin 1991). Others, such as anhydrous ammonia, phosphorous, and lithium are not only harmful but are “everyday” only in the strictest sense of the word. Let us take just a few, beginning with anhydrous ammonia.

Anhydrous ammonia is a key ingredient in the Nazi or Birch method of methamphetamine production and is widely used in farming communities, where the chemical is a source of nitrogen fertilizer. Anhydrous ammonia is also used as an industrial refrigerant. It is one of the top 20 chemicals produced in the United States (Dakota Gassification Company n.d.). Anhydrous ammonia is not legally available to the public and can be legally purchased only by those with a special license. Thus, for most methamphetamine cooks it must be obtained through illegal channels.

In its natural state anhydrous ammonia is a gas. When used as a fertilizer it is stored under pressure, turning it into a liquid. Liquid anhydrous is injected into the ground where it expands into a gas, absorbs moisture from the surrounding ground, and remains in the ground as nitrogen. To keep it as a liquid for storage and transport it must be stored under considerable pressure, and the internal pressure of an anhydrous ammonia tank increases as the ambient temperature increases. For example, if the external temperature is 60° F, the internal pressure is 93 psi (pounds per square inch). However, if the external temperature is 100° F, the pressure inside the tank may reach 200 psi. If thieves who steal anhydrous ammonia transport it in a container that cannot withstand the pressure, the container will burst or even explode. Further, the material of which the carrier is made makes a difference. For example, anhydrous ammonia is corrosive to copper, brass, bronze and zinc, and consequently will eat away at the metal in the valves of propane tanks (as used in outdoor barbeques) causing them to eventually fail and release the chemical. As these tanks are often used by anhydrous thieves, a risk is posed to both the thief and to others who might later use the tanks for legitimate purposes.

The word anhydrous means “without water.” The chemical is considered hydroscopic, meaning that it seeks water from the nearest source. In humans, the skin, eyes, nose, throat and lungs are loaded with moisture, and if they come into contact with anhydrous the water they contain is instantly removed, leading to serious burns. “When large amounts are inhaled, the throat swells and victims suffocate. Exposure to vapors or liquid can also cause blindness. . . . The chemical

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freezes on contact at room temperature. It will cause burns similar to, but more severe than, those caused by dry ice (Schwab, Hanna, and Miller 2002).” The chemical will burn its way into the body killing cells with which it has contact unless diluted with water, which is why some states require those who legally handle anhydrous to keep water nearby. “When anhydrous ammonia is released from compression in a storage tank (200 psi) to the atmosphere (0 psi), the temperature drops from 100 degrees F to minus 28 degrees F. At this temperature, ammonia will freeze-burn the skin on contact. Clothing is actually frozen to the skin. Another risk is that ammonia when released will quickly expand from the point of release. A sudden rupture can shoot ammonia 10 to 20 feet from the point of release (Maher 1998).”

If anhydrous ammonia is so easily released into the air, what are the implications for the environment in which the meth cook operates? In an outdoor cook, one conducted in a car’s trunk or in a national forest, the wind can carry away and dissipate the ammonia. In an enclosed house or apartment, however, the situation may be very different. Martyny et al. (2004a, 2004b, 2004c) undertook studies to simulate real-world conditions under which methamphetamine is produced. Three abandoned houses were outfitted with environmental monitors and methamphetamine was then manufactured using the Nazi method. Anhydrous ammonia was detected in the air within five minutes after the cooking began, and within 16 minutes all of the monitors were overloaded. The levels were not necessarily fatal, but they were sufficient to cause respiratory problems. The risk of harm can be dramatically reduced if the anhydrous is handled in a well-ventilated area, but to avoid detection of the noxious odors generated by a meth lab, meth cooks often attempt to seal the rooms in which they manufacture the drug.

Another health hazard from cooking methamphetamine comes from using flammable solvents, such as camping fuel or acetone (as found in nail polish remover). By themselves these products are not particularly dangerous, but can become so when meth cooks heat their mixtures with open flames. When this happens, the risk of fire or explosions is substantial. Besides burns from the resulting fire, laboratory explosions may spray shards of glass and caustic chemicals through the air, including sulfuric acid, anhydrous ammonia, and hydrochloric acid (Centers for Disease Control 2000; Charukamnoetkanok 2004). Thus, besides burns from the fire itself, the patients must be decontaminated and treated for chemical burns (Mitka 2005).

One study carefully matched burn patients from meth lab explosions with other patients suffering similar total body surface area (BSA) burns. Methamphetamine-related burn patients were far more likely to die, either directly from their burns or from exposure to chemicals present at the explosion (Warner et al. 2003). Others have found that compared with other burn patients, methamphetamine-related burn patients were three times more likely to sustain inhalation injuries, had longer hospital stays, higher death rates, had more days on a ventilator, more graft loss, and had triple the level of hospital charges. One burn center reported having to chisel melted plastic from the face of a patient who had lined the walls of her lab with it (Campo-Flores 2005). Few of those treated for methamphetamine-related burns have private insurance, and many have no government assistance to cover the costs of medical treatment, putting a financial strain on hospitals (Danks et al. 2004).

To complicate matters, methamphetamine-related burn patients are often substantially more agitated, making it difficult to immobilize them and increasing the failure rate of grafts. Under ordinary circumstances skin grafts fail about 33 percent of the time, but for meth patients the failure rate is 50 percent, due mainly to their agitated state (Santos et al. 2005). Others report that nearly half methamphetamine-related burn patients need to be sedated to control their agitation (Danks et al. 2004). Methamphetamine-related burn patients were also relatively uncooperative in follow-up medical treatment (Santos et al. 2005:232):

On the basis of our experience, there is a poor follow-up in this group of patients and when our coordinator tried to contact each patient for their clinic visit; either they had given false information, transferred residence, or ceased contact with the hospital. One possible explanation for the poor follow-up is fear of prosecution.

Not surprisingly, those suffering from methamphetamine-related injuries who admit themselves to the emergency room are often reluctant to reveal the source of the burn, instead attributing it to other kinds of accidents.

Phosphine gas is an odorless and colorless gas produced when methamphetamine is manufactured using the red phosphorous (Red-P) method. In its pure form it is odorless, but when discovered at methamphetamine lab sites it may have an odor reflecting the presence of contaminants. Phosphine gas is created when iodine is combined with red phosphorous under conditions that a trained

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chemist should know to avoid. In particular, phosphine gas may be created when red phosphorous is heated in the presence of acids (Burgess 2001). Phosphine gas is highly toxic and is used in agriculture as a grain fumigant to protect grains in storage or in shipment from insects and rodents. Low-level exposure can result in “headache, fatigue or weakness, thirst, pain or pressure in the diaphragm or chest, dyspnea or shortness of breath, nausea, vomiting, convulsions and coma. Some references also report vertigo, irritation of the lungs, coughing and a feeling of coldness (Willers-Russo 1999:647).” The toxins often collect in areas of the body that demand oxygen, including the brain, lungs, kidney, heart, and liver. Higher doses can cause death, a fate that has befallen some methamphetamine cooks (Willers-Russo 1999). The presence of the gas may also pose a hazard to law enforcement and emergency response personnel who enter an active lab site.

Lead poisoning is another health risk generated by the untrained meth cook. Here the risk comes not from the cooking process itself, but from a final product contaminated with lead. Cut off from legitimate supplies of P2P, some meth cooks have resorted to synthesizing their own supplies of P2P. One recipe for doing this involves combining lead acetate with other chemicals to produce P2P. The careless or ill-informed cook can easily produce methamphetamine that contains a considerable amount of residual lead. In one case the cook created a product that was 60% lead (Norton et al. 1989). The extent to which lead poisoning is an issue in methamphetamine production is unknown. Methamphetamine cooks entering the emergency department or visiting a doctor are not likely to volunteer information about their illegal activity. And, because the symptoms of lead poisoning mimic a variety of other problems, physicians may not immediately think of a lead poisoning diagnosis. To complicate matters further, the symptoms of lead poisoning are variable and nonspecific, depending on the exposure and the individual, and may include any or all of the following: weakness, headaches, abdominal pain, chills, sweats, nausea, weight loss, lower back and leg pains, diarrhea, constipation, seizures and even coma. Acute lead poisoning has been linked to methamphetamine production (Allcott, Barnhart, and Mooney 1987; Centers for Disease Control 1989).

Finally, iodine is released during the manufacture of methamphetamine when the red phosphorous method of production is used. Sometimes iodine has stained the walls of the room in which methamphetamine was prepared. Iodine is a naturally occurring element that the body requires for good health. A level of iodine is required for the proper functioning of the thyroid gland. Every cell in the body

depends on the hormones produced by the thyroid gland and only the thyroid gland can absorb iodine, which is then converted into the hormones that regulate the body's metabolism (EndocrineWeb.com 2005). For most people the concern is whether they are taking in too little iodine and consequently will have too few of the hormones to regulate their body's physical functions properly. Taking in too much iodine is possible, however. Ironically, too much iodine can affect the thyroid gland much like too little iodine. When presented with too much iodine the thyroid gland will experience a decrease in blood flow and growth of the thyroid gland and will subsequently produce too few hormones (Mathur 2006).

When most people think of iodine, they think of nutrition, as in the consumption of iodized salt. Like anhydrous ammonia, iodine also has agricultural applications. It is used as a disinfectant for farm animals, including sanitizing the teats of milk cows. As with anhydrous ammonia, the agricultural applications of iodine facilitate rural methamphetamine production and diversion of iodine from agricultural supplies is a concern.

Methamphetamine cooks generally prefer iodine in a crystal form, which is highly potent. The U.S. Department of Justice warns that in this form it can be dangerous:

If iodine comes in contact with the skin it can result in painful irritation and chemical burns. Contact with the eyes can cause redness, burns, and permanent damage. Inhalation of iodine gas can lead to respiratory problems or even death. Iodine has sufficient vapor pressure to allow toxic levels of iodine gas to build up in a closed container. . . . Although iodine alone is not flammable, it is a strong oxidizer that can ignite or cause explosions when mixed with other combustibles or reducing agents such as alkali metals, ammonia, and phosphorous (U.S. Department of Justice 2002:1).

Whether the practicing methamphetamine cook is exposed to sufficient levels of iodine and over a sufficient period to seriously damage their health remains an open question. It appears that when handled properly, levels of iodine released during the process of manufacturing methamphetamine are measurable but not toxic (Martyny 2004b). Direct exposure to the crystals, or the improper handling of them is quite another matter. It is for this reason that some states have added iodine to the list of regulated precursor chemicals.

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CONTAMINATED LABORATORY SITES

Given the chemicals involved in cooking methamphetamine, concerns have been raised about the chemical contamination of methamphetamine laboratory sites. Besides the meth cooks themselves, concerns have been raised about the health and safety of emergency responders. When methamphetamine is prepared in a hotel room the health and safety of hotel staff and subsequent occupants are a concern. It is not unusual for children to be present when methamphetamine is prepared in a home, and later occupants may have reason to be concerned about chemical contamination of the carpet and walls. Police have reported respiratory and eye irritation, sore throat, cough, and headaches after entering meth lab sites. There have even been reports of symptoms from simply transporting arrested meth cooks from the cook site. Fires or explosions account for as many as 10% of cases where there are reported adverse health consequences from methamphetamine laboratory chemicals (Centers for Disease Control 2005) and some have reported that 20-30% of methamphetamine labs are discovered because of fires or explosions (Skeers 1992). When fires or explosions occur during a methamphetamine cook, firefighters may be exposed to both the chemicals used in manufacturing and to toxic fumes generated by the fires. And, in moving through smoke-filled buildings, they may also be exposed to contaminated needles left behind by those who inject the drug. Others have found that methamphetamine laboratory investigators experience a reduction in their lung capacity comparable to that of continuing smokers, although most do not smoke (Burgess et al. 2002).

While it has been known for decades that chemicals are released in the cooking process, the nature and extent of contamination was highly speculative until a series of studies was conducted by the National Jewish Medical and Research Center in the early and mid-2000s (Martyny et al. 2004a, 2004b, 2004c, 2005). These studies are remarkable in their attention to detail and in their consideration of multiple cooking techniques and a range of settings in which cooking occurs. The studies test for both airborne and surface chemical residue from the three most popular methods for cooking methamphetamine: P2P, Red-P, and Nazi. Chemical residue was tested for during, immediately after, and for many hours after cooking in settings that included a police laboratory, abandoned houses, abandoned hotels, mobile homes, and apartments. The findings of these chemical analyses were supplemented by a survey of police officers who had investigated meth labs, inquiring about perceived health effects of their work. Some of the highest levels of chemical release were associated with the red phosphorous (Red-P) method of

cooking. This method caused the release of phosphine, hydrogen chloride and iodine, often at high levels. Cooking based on anhydrous ammonia (the Nazi method) released high levels of both anhydrous ammonia and hydrochloric acid. Finally, the P2P method released phosphorous, iodine and hydrogen chloride, but at relatively low levels – levels considered acceptable by standards of occupational safety. For all methods of cooking concentrations were highest during the various stages of cooking, with some chemicals reaching dangerous levels. Airborne chemicals dissipated quickly with ventilation, but iodine remained on surface areas near the cook site for months. The level of chemical release varied from one cooking trial to the next, suggesting that the manner in which the chemicals are handled and mixed influence the level of chemical release into the environment.

Another finding that characterized every method of manufacturing the drug was that methamphetamine was found in the air and on surface areas (e.g., carpets, walls, ceiling fans, table tops) throughout the building in which the methamphetamine was cooked. When methamphetamine is manufactured in a home laboratory, part of it is released as an aerosol. Also surprising was the ease with which the methamphetamine “dust” was spread. Shoes, for example, tracked meth from the apartment in which it was made into the hallway, and “police officers handling suspects or children at the scene, for very short periods of time, can become contaminated with methamphetamine. It is possible, therefore, for these individuals to carry this material away from the scene and to their own families (Martyny et al. 2004a:24).” The Centers for Disease Control has identified cases in which methamphetamine-related injuries were reported by police officers, EMTs, firefighters, and hospital employees (Centers for Disease Control 2000).

Taken together this series of studies by the National Jewish Medical and Research Center make a compelling case for short- and long-term contamination of methamphetamine lab sites. What these studies were not designed to do, and what they could not do, was determine the long-term health effects of exposure to these chemicals at the levels and duration of exposure typically observed while making methamphetamine. The percentage of methamphetamine laboratory officers with injuries from chemical contamination may be as low as 3.4%, and these are often minor injuries. However, such findings are based self-reports and not on systematic medical examinations, and are therefore of questionable accuracy (Burgess, Barnhart, and Checkoway 1996). While there have been reports of minor health symptoms experienced by first responders, perhaps the best way to determine the long-term health effects of manufacturing methamphetamine would

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be to monitor the health of former methamphetamine cooks. These are the individuals who are most exposed to the chemicals in question and an understanding of the long-term impact of cooking on their health would provide a “worst case scenario” of exposure to airborne and surface chemicals released while making methamphetamine. While studies of the long-term health effects on methamphetamine cooks would be of obvious value, such studies have not been done.

The chemical found in the air and on surface areas at all methamphetamine cook sites is methamphetamine itself, but the doses received from crawling on the carpet or running one’s hands across a contaminated table top are likely to be very small compared with the typical dose taken for recreational purposes. As we have noted elsewhere, in small doses methamphetamine is probably not harmful – after all it is given in pure form (under monitored conditions) to some children with attention deficit hyperactivity disorder and to some adults suffering from narcolepsy or who are morbidly obese. Other chemicals that remain at the site are likely to do considerably more long-term damage.

Decontaminating a methamphetamine lab site can be expensive given that methamphetamine and other chemicals may permeate carpet, drapes, furniture, bedding and other porous materials, and may be deposited on both vertical and horizontal smooth surfaces. Besides the chemicals used in methamphetamine production, the poor ventilation that characterizes many production sites often leads to high levels of mold and mildew, which are expensive to remove (Holton 2001).

Decontamination may involve removing porous materials, neutralizing corrosives, industrial steam cleaning and pressure washers, detergent washes and the use of chemical neutralizers and cover-ups to hide odors that remain (Irvine and Chin 1991). In many states decontamination is the responsibility of the property owner, even if that owner unknowingly purchases previously contaminated property. The state of Washington, for example, was one of the first states to legislate on this issue. Under Washington law, the property owner is responsible for cleanup costs despite the owner’s innocence, and cleanup must be done by a contractor certified by the state specifically to decontaminate methamphetamine labs (Krause 2006). Often insurance will not cover the cost of decontamination. Homeowners who are unable to pay the cost of decontamination sometimes decide that abandoning the building is easier (Holton 2001). After a site has been thoroughly decontaminated there is no evidence that the site presents future health

risks (Irvine and Chin 1997). Despite this, some states require that future owners be notified that the site was once contaminated (Krause 2006).

Even if properly decontaminated methamphetamine laboratory sites are safe, the public is likely to be wary of such locations. The DEA has created the “National Clandestine Laboratory Register” to inform the public about the location of known methamphetamine laboratories, similar to the sex offender registries posted by many states (DEA n.d.b). A map of the U.S. at this site allows visitors to click on any state to see a listing of meth lab sites identified since 2004. The site provides the name of the county, city, street address and date on which the lab was seized. The implicit message behind the web site is that the property is dangerous. Only time will tell whether this site protects the public or merely makes the property impossible to sell while driving down the value of surrounding property.

METH TRASH

Methamphetamine laboratories also have the potential to exact substantial environmental damage after the cooking itself has been completed. It is claimed that each pound of methamphetamine produced yields 5-6 pounds of toxic waste (Hargreaves 2000; Holton 2001). That waste must go somewhere, and meth cooks have no incentive to dispose of those materials in an environmentally safe way. Often it is unlikely they know of the hazards, or care. It is not simply the effect of the chemicals in isolation, but the possibility of continuing chemical reactions if mixed chemicals are disturbed. Picking up a discarded container in which chemicals had been mixed may reactivate a chemical reaction and release noxious or even toxic fumes—a hazard for citizens engaged in highway cleanup or for highway and utility crews. Children playing in their lawn have been contaminated by chemicals discarded by their parents (Manning 1999).

Liquid wastes may be thrown out the window, poured down the toilet or sink drain, buried or burned. In rural areas, contamination to soil and groundwater can threaten private drinking water wells and septic tank systems (Hannan 2005:28).

Though they are probably unaware of it, arrested methamphetamine cooks not only face criminal charges for manufacturing methamphetamine, but their criminal penalties may be enhanced for violating environmental laws regulating the storage, handling and disposal of hazardous waste (Gates 2005).

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METH LABS AND CHILDREN

Children have been exposed to illegal drugs through their parents, other adults, siblings, or peers for as long as there have been illegal drugs. Methamphetamine is different, however, because in addition to all of the things that go along with the presence of drugs in the home, children are exposed to the chemicals and dangers associated with producing the drug. Infants crawl on contaminated carpets and then put their fingers in their mouths, thus being exposed both through the skin and through the mouth. Others have been admitted to the emergency room after ingesting lye carelessly left in their reach by drug addled parents (Farst et al. 2007). Others have been admitted to the emergency room with burns on their arms after falling from their bicycles onto dirt in the yard—dirt upon which their parents had dumped meth chemicals. Still others have been injured or died in methamphetamine-related fires and explosions (Manning 1999). Children taken from homes where methamphetamine was made often test positive for methamphetamine on their skin, clothing, toys and even in their urine.

States have responded to the problem of meth labs and children in two ways. First, in many states there are now enhanced penalties for anyone who manufactures methamphetamine in the presence of children. Second, protocols have been developed to facilitate a coordinated response by police and social service workers.

Some states have enacted laws with penalties specifically targeting adults who manufacture methamphetamine in the presence of children. In Illinois, for example, manufacturing less than 15 grams of methamphetamine is a Class 1 felony, for which the punishment is imprisonment for 4-15 years. Manufacturing methamphetamine in the presence of children (or other protected groups) means the individual may also be charged with “aggravated participation in the manufacture of methamphetamine” if that manufacturing takes place in:

“ . . . a structure or vehicle where a child under the age of 18, a person with a disability, or a person 60 years of age or older who is incapable of adequately providing for his or her own health and personal care resides, is present, or is endangered by the manufacture of methamphetamine (Illinois Public Act 094-0556).”

That crime is considered a Class X felony for which the penalty is 6-30 years and a fine of up to \$100,000.

Other states have modified their laws to define manufacturing of methamphetamine in the presence of children as a form of child abuse. Michigan, for example, includes methamphetamine as child neglect and Iowa law defines methamphetamine production in the presence of minors as child endangerment (O'Connor, Chriqui, and McBride 2006). In Arizona and New Mexico child abuse has been legally defined to include allowing a child to be present where chemicals or equipment for methamphetamine production are stored, and Oregon includes exposing children to drug paraphernalia (Hopper 2006).

Another trend has been the development of protocols for responding to drug endangered children. Police responding to methamphetamine laboratory incidents are often ill prepared to deal with children at the scene. Police are trained to find and arrest offenders, not to change diapers or determine the immediate medical needs of children found at meth labs. Drug endangered children protocols emerged in response to various needs of these children. These protocols outline the roles to be played by various agencies when children are discovered at a methamphetamine laboratory site. The specific agencies involved will vary from one jurisdiction to another, as does the geographic reach of these protocols. In some states these protocols are statewide while in others they apply to a county.

The first drug endangered children protocol was developed in the spring of 1997 in Butte County, California. During the Christmas holiday of 1996 three children died in a fire caused by an exploding methamphetamine laboratory. In response, a local Narcotics Task Force Officer named Sue Webber Brown initiated the establishment of a protocol that would identify the duties of various agencies when children were discovered at the scene of a methamphetamine laboratory (Altshuler 2005; Hopper 2006).

Since that first drug endangered children protocol in 1997 the concept has spread across the country and there is now a national organization to facilitate information sharing and training, the National Alliance for Drug Endangered Children (2007). Usually, participating agencies include police, child protective services, public health, emergency medical technicians, local hospitals, and in some jurisdictions the local school system. Before the era of home-cooked methamphetamine, children found in drug houses were often incidental to the criminal case against adults. Under many drug endangered protocols there is a simultaneous effort to protect the child and build a stronger legal case against the adults. Thus, forensic interviews with the children will be conducted at the scene and again several days later. At these interviews questions focus on the health and

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well being of the child as well as any criminal behavior by adults. Commonly there will also be medical protocols developed specifically for children found near methamphetamine production. Medical protocols provide a detailed list of the various medical tests and assessments that are to be performed by medical staff on children exposed to methamphetamine labs. Thus, state and local governments have taken aggressive action to protect children exposed to the chemicals and byproducts of methamphetamine production.

DISCUSSION

Rural American has long been involved in drug production, first with alcohol and then with marijuana. More recently methamphetamine production has become an issue for rural Americans. The country has also seen a series of drug panics as “new” drugs gain popularity. Until the recent rise of methamphetamine these panics have generally focused on what the drug did to the user and how the user’s lifestyle affected family, friends and the community. Claims that “this drug is different and presents a new danger” are usually overblown. Methamphetamine, however, can legitimately claim to be different and to pose a new danger, at least in the sense that it presents the added risk of harm from the manufacturing process itself.

Is methamphetamine safe to cook? Yes – if done by a trained chemist, with the proper equipment, with raw materials of known purity, in a laboratory designed to capture toxic fumes, and where waste materials are disposed of safely. Unfortunately, almost none of these conditions exist in the real world of illicit methamphetamine manufacturing.

There is widespread concern, even panic, over the toxic effects of methamphetamine labs on emergency responders, children near a lab, and the environment. Lacking solid evidence regarding the long-term health effects of methamphetamine labs serious precautions are justified, but there is a dearth of hard evidence. More research is needed, perhaps with former methamphetamine cooks themselves as the most obvious subjects for research. The creation of a national registry of locations where methamphetamine labs have been discovered sends a message that such locations are permanently hazardous. This seems unlikely, but also merits further research.

Perhaps the most significant consequence of the proliferation of methamphetamine labs in America is that it undercuts the notion that our drug problem can be laid in the lap of foreign drug producers. Ultimately it is a reminder

that drug abuse of all varieties is our problem, that it ultimately must be tackled here at home, and that drug problems are not restricted to large urban centers.

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