The Decontamination of Methamphetamine Labs - A Search for Best Practices

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The Decontamination of Methamphetamine Labs -
A Search for Best Practices

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Wright State University
June 30, 2010
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Abstract

The use of methamphetamine as a drug of abuse in the United States has skyrocketed in recent years, with much of the drug being manufactured in primitive makeshift laboratories clandestinely located in residential dwellings. The contamination of these environments with methamphetamine, its precursors, and its by-products can be severe. Often, after being contaminated, these dwellings are re-occupied by people unaware of the former use as a methamphetamine production site, and unaware of the contaminant load they now find themselves living in. This paper discusses the extent of contamination of the lab area and how this contaminant loading may affect the health and wellbeing of those living in these environments. An attempt to correlate varying contaminant loading levels to health risks posed to the occupants is made. Mitigating the health risks to these inhabitants is a major thrust of this paper. While most states do not have regulations specifically addressing the issue, some have made varying attempts to protect their citizens with codified cleanup methodologies and standards. A comparison of a representative sample of state efforts is presented, and from these comparisons it is hoped that the reader can glean best practices that may apply to their situation. There also have been several federal efforts developed to combat the problem as well, which are discussed. Finally, a discussion of the challenges to developing an absolute cleanup standard is presented, shedding light on additional research that could be done to fill in knowledge gaps on the subject.

Keywords: drug abuse, contamination, health risk, residential
The Decontamination of Methamphetamine Labs - A Search for Best Practices

Methamphetamine (meth) is a synthetic chemical with a Chemical Abstract Registration Number of 537-46-2, and the following chemical structure:

\[
\begin{array}{c}
\text{\textbf{Methamphetamine}}
\end{array}
\]

(US DHHS, 2008)

The use of methamphetamine as a drug of abuse in the United States has skyrocketed in recent years, and the domestic manufacturing of this product has grown to keep pace with the demand for this highly addictive drug.

The acute health effects that meth use has on users themselves are dramatic and well documented. But also exposed to residual contaminants that may be acutely and chronically hazardous are non-users that may be present during production, as well as individuals occupying the building after production has ceased. These labs often occur in homes that are repopulated by people unaware of the former history of the dwelling they now occupy.

For every pound of meth produced, five pounds of toxic by-products are generated (Guevara, 2003). Much of this is poured down plumbing fixtures within the home, or dumped on the ground outside. At the meth field site, the most contaminated area is the cooking location itself, and the contamination tends to plume from that area. The fumes permeate any porous surface with which they come in contact, and the meth powder often becomes airborne during the drying process, covering every surface in the cooking area (Harmon, 2006). These contaminants are often present throughout the structure, in many cases having permeated drywall, carpeting, furnishings & fixtures, and deposited in plumbing, septic, and heating/ventilation/air conditioning systems.
The presence of varying levels of residual contamination poses questions about the level of hazard a dwelling poses to occupants after the meth lab is dismantled. Local public health agencies are often called upon to establish if former meth labs are safe to reoccupy. The federal government has made an unsuccessful attempt to pass federal legislation addressing the issue. A small number of local and state public health jurisdictions have attempted to address this issue out of concern and a desire to act in a precautionary manner - often fueled by political pressure and public outcry for local health jurisdictions to do something to address the problem. But is there a problem?

**Purpose**

It is known that contaminants remain after meth production has ceased, and that the levels are measurable, but are the contaminants toxic to people, and if so at what levels? It is also known that there are both public and political pressures pushing for a public health response, and with potential risks posed to occupants of former meth labs the issue merits exploration, as does some level of precautionary, mitigating response. But how do policy makers set a precautionary response policy on an issue with unknown levels of risk? The research questions for this project are as follows:

1. Are the contaminants found at former meth lab sites toxic to people?
2. If so, at what levels are the contaminants toxic?
3. What best practices have been established to mitigate risks to future inhabitants of former meth lab sites?

**Literature Review**

Methamphetamine (meth) is an extremely addictive stimulant drug that primarily affects the central nervous and cardiovascular systems, and can produce psychological symptoms
(NIDA, 2002). It can be smoked, snorted, injected, or taken orally. Meth is one of the most addictive of all drugs, with one of the lowest recovery rates, at around 5%. “In 2005, researchers have estimated that 1.3 million Americans were addicted to methamphetamine” (Harmon, 2006).

The Effects of Methamphetamine on the User

The use of methamphetamine causes large amounts of the neurotransmitters serotonin, dopamine, and norepinephrine to be released from the brain, dramatically impacting the mood of the user. Users describe intense euphoria, loss of appetite, increased energy, improved mood, and enhanced sex drive while under the influence of the drug. It makes them feel more alert, talkative, and confident, and provides an extended high that can last up to twelve hours (Harmon, 2006).

Physiologically, meth takes a large toll on the user. The primary effect meth has on a user is as a stimulant to the central nervous system. Additional effects on the central nervous system include involuntary writhing, jerking, and/or flailing body movements. Irritability, insomnia, mental confusion, tremors, anxiety, aggression, hyperthermia, and convulsions may also occur. Death can occur from hyperthermia and convulsions (NIDA, 2002).

Cardiovascular effects can also occur from acute use of meth, including: increases in heart rate, blood pressure, and chance of stroke; chest pain; hypertension; as well as cardiovascular collapse and death. Irreversible damage to blood vessels in the brain can also occur (NIDA, 2002).

Acute meth exposure can also result in psychological symptoms similar to schizophrenia, characterized by paranoia, hallucinations, patterns of repetitive behavior, and delusions of insects or parasites under the surface of the skin. Abusers often exhibit aggression and violent tendencies, and can experience homicidal or suicidal thoughts (NIDA, 2002).
Users have an increased risk for complications such as cardiac valve sclerosis, pulmonary hypertension, and anorexia. Long term use can lead to brain damage, liver damage, strokes, coma, and death (Harmon, 2006).

**The Growing Prevalence of Use**

The use of methamphetamine appears to be on the increase. In 1993, the U.S. Drug Enforcement Agency (DEA) seized 218 meth labs. By 2004, there were nearly 16,000 labs in 49 states (Harmon, 2006). The Chief of Operations for the U.S. DEA reports, in testimony provided to the U.S. House of Representative’s Committee on Government Reform, that 4.3% of the U.S. population reported having tried methamphetamine at least once. The Chief went on to testify that although clandestine labs can synthesize other drugs such as PCP, MDMA, and LSD, meth has always been the major drug manufactured in the vast majority of the labs seized throughout the nation. He further reported that since 1997 (through July, 2003), 97% or more of the clandestine lab seizures reported to the DEA were either methamphetamine or amphetamine labs (Guevara, 2003).

Government statistics show the number of newly discovered clandestine methamphetamine labs rose nationwide by 14% in 2008 to 6,783. Furthermore, federal data on these seizures suggest that there are tens of thousands of contaminated residences in the United States (Dewan, & Brown, 2009).

**Methamphetamine Manufacture**

Meth is easy to manufacture using readily available recipes, equipment, and ingredients. There are approximately 150 different methods of manufacturing meth, and around 32 different chemicals can be used to make it. It is the most commonly synthesized controlled substance, and the drug most commonly manufactured in clandestine labs (Harmon, 2006).
While there are about 150 different recipes for producing meth, they all typically use the active ingredients in cold medications: ephedrine hydrochloride and/or pseudoephedrine hydrochloride. The most common methods of manufacture are the red phosphorus (aka Red P) method, the hypophosphorus method, and the ammonia (aka Birch Reduction) method. The Red P method involves the reduction of the ephedrine and pseudoephedrine with hydriodic acid and red phosphorus (obtained by scraping the phosphorus off of road flares or match tips). The ammonia method uses lithium metal and anhydrous ammonia (a common chemical used in agriculture as a fertilizer) to reduce the ephedrine and pseudoephedrine. With either method, the resulting mixtures are combined with solvents, strong caustics, and reactive metals to strip a hydroxyl group from the ephedrine/pseudoephedrine. Next, the meth itself is extracted by bubbling an acid gas through the solution (typically muriatic acid [HCl] is used). The meth precipitates out to the bottom of the vessel, and is then filtered and dried (the “salting-out” step) (Harmon, 2006).

A “cook” is the term used in reference to the process of setting up a manufacturing lab and producing the methamphetamine, and involves the cooking phase, filtering phase, and the salting-out phase. It is during the salting out phase that the most meth becomes airborne and deposits on environmental surfaces throughout the lab area. (Martyny, Arbuckle, McCammon, Esswein, & Erb, 2003).

**Contamination of Lab Area**

For the purposes of this project, methamphetamine is being considered as the primary contaminant of concern creating problems in meth lab environments. According to Martyny, Arbuckle, McCammon, Esswein, and Erb (2003), “The most likely compound of concern is the methamphetamine, but iodine and other chemicals may also be transferred”. So while meth is
typically the metric with which both the level of contamination and the effectiveness of cleanup are determined, it is important to remember that there are other chemicals found in the meth lab environment, either as precursor ingredients or as byproducts of the production that may pose an acute and/or chronic hazard. Fortunately, from a decontamination perspective, “it is assumed that the cleanup processes necessary to reduce the levels of methamphetamine to 0.1μg/100 cm² should be sufficient to reduce the concentrations of other methamphetamine manufacturing precursors to acceptable levels” (CDPHE, 2005, Section 3.0, p. 5).

The amount of meth released during a cook appears to depend on the method used. According to studies conducted by Martyny and colleagues (2003), the hypophosphorus method yields little volatile meth, while both the red phosphorus and the ammonia methods yield significant amounts. In one of their studies, chemists from the United States DEA conducted cooks in three structures, two houses and one abandoned hotel, with the hypophosphorus method used in one house and red phosphorus method used in another house and in the hotel. Due to the controlled cook by chemists well versed in the manufacture of methamphetamine, it is expected that aerosolization and subsequent deposition on environmental surfaces in the lab area would be minimized. Despite this, the results were quite dramatic, and are discussed with other study results below.

Depending on the process employed to manufacture the meth, products such as phosphine, iodine, hydrogen chloride, and various solvents are also released. During the cook, especially during the “salting out” phase, the exposure levels for all of these may meet or exceed occupational exposure guidelines established by the U.S. Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists. Hydrogen chloride levels often approach OSHA’s “Immediately Dangerous to Life and Health”
(IDLH) levels (Martyny et al., 2003). Fortunately, many of the solvents used to cook meth, and gases such as phosphine produced during the cook, are volatile compounds and dissipate rapidly with ventilation. In fact, the State of South Dakota requires a structure to be ventilated for a full day before persons can enter a building to perform evaluation activities (SDGRSMTF, 2004).

These solvents and gases do, however, present an acute exposure risk of contamination in the lab environment, both from chemical exposures and from the fire and explosion hazard they create. The Agency for Toxic Substances and Disease Registry (ATSDR), a branch of the U.S. Department of Health and Human Services’ Centers for Disease Control and Prevention, maintains a surveillance and reporting system that encompasses sixteen states. Researchers from ATSDR analyzed data from the Hazardous Substances Emergency Events Surveillance System for the 54 month period January, 2000 through June, 2004. They found that, in the sixteen states reporting, there were 40,349 events reported to the system, with 1,791 associated with illicit methamphetamine production. Events involving meth had a higher percentage of persons with injuries than did non-meth events. Of these 1,791 meth events, 186 (10%) involved fire or explosion. These 1,791 events resulted in a total of 947 injured persons, usually law enforcement officers. Nine of these injured persons died as a result of their injuries (Morbidity & Mortality Weekly Report [MMWR], 2005).

Iodine deposited in the lab environment during a cook may persist for some time in the walls, carpeting, draperies, furniture, and other belongings in many of these clandestine laboratories. “The fact that the iodine is persistent in the environment of the cook is very important to the children that are present in the clandestine laboratories as well as children who inadvertently become residents in a building previously used as a methamphetamine laboratory.
Children crawling on contaminated carpeting may pick up high levels of iodine” (Martyny et al., 2003).

Studies conducted by the National Jewish Medical & Research Center show meth to be a major contaminant in the meth lab area. The meth aerosolizes during the cook and can contaminate areas well removed from the process itself. These studies have shown a single cook, using the red phosphorus method of production, can produce residual surface contamination ranging from 1.5 ug/100 cm² to 860 ug/100 cm². A single cook using the ammonia method of manufacture can produce residual surface contamination ranging from 0.1 ug/100 cm² to 160 ug/100 cm². Airborne levels of methamphetamine may range from less than 2.0 ug/M³ to as high as 5000 ug/M³ (Martyny, Arbuckle, McCammon, & Erb, 2004).

Carpet samples taken from simulated cooks and analyzed for methamphetamine, with respect to distance from the cooking area, demonstrate that even twenty feet from the cook area levels of meth can be 6.02 ug/100cm². These results indicate the contamination can also be dispersed from the cook area by foot travel and other mechanisms of physical cross-contamination (Martyny et al., 2003).

During one study, a total of 97 wipe samples of various household items (microwave oven, furnace return grill, bedroom blinds, etc.) were taken from throughout the premises at 14 different, actual meth labs. For comparison purposes an attempt was made to take all wipe samples in 100cm² areas, but that was not possible in all cases. For this reason, results are reported in ug/sample. Six of the samples were blanks (one of which was positive, at 5.7 ug/wipe), and of the remaining 91 samples, 83 were positive. These positive samples ranged from 0.4 ug/sample to 16,000ug/sample. The mean of the samples was 499 ug/sample, and the
median was 25 ug/sample. In general, all of the meth labs sampled had widespread, high levels of meth in many areas of the structure (Martyny et al., 2003).

To put the above numbers in perspective, those states that have cleanup standards set limits ranging from 0.05 to 0.5 ug/100cm². These studies show that, without proper decontamination, these properties can be left heavily contaminated, leaving any future occupants exposed to any dangers resulting from these exposures.

In addition to the methamphetamine that escapes capture in the crude lab environments that are typical and becomes aerosolized, along with several airborne byproducts (phosphine, iodine, hydrogen chloride, and various solvents) that result from the cook, the production of each pound of meth also produces five pounds of solid and liquid toxic waste products such as lye, red phosphorus, hydriodic acid, spent solvents, iodine, etc. (Guevara, 2003). These products generally end up being disposed of in a variety of ways – poured into the dwelling’s public or private sewage system, dumped on the ground on-premises, or often, in an attempt to prevent detection, products are dumped off-premise along nearby roads, agricultural fields, or other convenient secluded spots.

**Chronic Health issues Associated with Methamphetamine Use**

Though the acute health effects of methamphetamine use itself are well documented, considerably less is known of the chronic health effects of exposure to residual contamination from the chemical precursors used in meth production, from the meth residue itself that contaminates environmental surfaces within the former lab, as well as from the by-products resulting from the production of meth.

The low level, second hand, chronic exposures to methamphetamine simply have not been well studied. As a result of this, states that do have cleanup standards for former meth labs
have technology-based standards, established on the ability to detect a certain level of meth, its precursors, and/or the byproducts of production. There are simply not enough health data available on long term, low level exposures to establish a truly health-based standard for cleanup and decontamination.

There is, however, a growing quantity of anecdotal evidence from subsequent occupants of former clandestine meth labs to indicate there may be a problem. A typical story goes like this, excerpted from Dewan & Brown (2009):

Winchester, Tennessee – The spacious home where the newly wed Rhonda and Jason Holt began their family in 2005 was plagued by mysterious illnesses. The Holts’ three babies were ghostlike and listless, with breathing problems that called for respirators, repeated trips to the emergency room and, for the middle child, Anna, the heaviest dose of steroids a toddler can take.

Ms. Holt, a nurse, developed migraines. She and her husband, a factory worker, had kidney ailments. It was not until February, more than five years after they moved in, that the couple discovered the root of their troubles: their house...was contaminated with high levels of methamphetamine left by the previous occupant....

When the family left the house, moving in with Mr. Holt’s parents, their health problems largely subsided. The children no longer needed medication to breathe. The migraines and the kidney ailments vanished, though Anna, 2, had a relapse and had to return briefly to the hospital.

We don’t know what it’s going to be in the future”, Ms. Holt said. “This meth contamination is all their immune systems have ever known”. (p. A1)
Methods

The research for this project was performed using qualitative research methods consisting of reviewing and analyzing various subject relevant literature. The researcher used a knowledge support approach while reviewing various pieces of literature from which evidence was gathered, generalized, and used to help develop policy regarding the decontamination of meth labs (Mays, Pope, & Popay, 2005). An attempt was made to determine if there are known chronic health risks for people exposed to the meth lab after production has ceased. This researcher also gathered information about the impact that various cleanup methods have on residual contaminant levels, as well as reviewing federal and state regulations adopted to address the issue. From this information, it was anticipated that a set of best practices can be developed that takes a reasonable level of precautionary and mitigating response to ensure contaminants are removed from or sequestered in the home environment.

Out of a total of eight or nine states considered, the five states whose methamphetamine cleanup regulations were chosen for analysis (Colorado, Kentucky, North Carolina, Oregon, and Washington) were chosen for various reasons. Washington was one of the first states to codify standards, and the search began there. In talking to Sid Forman, R.S. of Public Health–Seattle & King County’s Illegal Drug Labs & Local Source Control Programs, he mentioned Oregon’s regulations and the search went there. I chose North Carolina’s because they tend to have a progressive public health track record, and the regulations were unique in having no codified limits for chemical contaminants, instead requiring a step by step process that must be carried out to clean the site. Kentucky’s regulations were chosen because it was the closest state to the author’s home state of Ohio that had such regulations. Colorado was chosen because their
regulations appeared to be quite strict, and the contrast with some of the others that already chosen merited further exploration.

**Results and Discussion**

Substantial success was achieved at answering the question “Are the contaminants found at former methamphetamine (meth) labs toxic to people, and if so at what levels?” One knowledge gap that remains is the question of toxic levels of residual methamphetamine itself. While an absolute answer for the level of meth toxicity was not found, some good information does exist than enables one to make some sound judgments and conclusions regarding cleanup of this compound.

Most states do not have regulations requiring the decontamination of former clandestine methamphetamine laboratories. Of the five state regulations studied for the purposes of this paper, one of them (North Carolina) had no specific decontamination standards for any of several contaminants that are typically found in these environments. Of the other four states studied that have clean-up standards: one has standards for meth, lead (Pb), mercury (Hg), and volatile organic compounds (VOCs); one has standards for meth, Pb, Hg, and Iodine (I); and the other two states have a standard for meth alone.

The two states with a Pb cleanup (clearance) standard established the levels at 20 ug/ft² and 40 ug/ft². The health protective standard set by the US Occupational Safety and Health Administration (OSHA) is a permissible exposure limit (ceiling value) airborne standard set at 50 ug/M³ (NIOSH, 1981).

The two states with an Hg standard established them at 50 nanograms/M³ and 1 ug/M³. The health protective standard set by the National Institutes for Occupational Safety and Health
(NIOSH) is 10 ug/M³ (8 hr. average), with a permissible exposure limit (ceiling) of 40 ug/M³ (NIOSH, 1981).

The state with the standard for volatile organic compounds (VOCs) established it at 1 part per million in air. Health protective standards for VOCs set by NIOSH vary with the specific compound. A level for general VOCs in air was not in the literature.

The state with the standard for iodine has the standard at 22 ug/100 cm². The health protective standard set by NIOSH is a permissible exposure limit (ceiling value) airborne standard and is set at 1 mg/M³ (NIOSH, 1981).

The standards set by the NIOSH for lead and iodine are Inhalation Reference Concentrations (RfC) and are analogous to the Oral Reference Dose (RfD). The ventilation of the structure during initial cleanup serves to reduce the airborne contaminants present in the structure at the time of ventilation to safe levels. The presumption is that cleaning environmental surfaces such as floors, walls, ceilings, counters, etc., will remove the reservoirs of deposited chemicals that can subsequently be disturbed and again become airborne, creating respiratory exposure risk to occupants of the structure. Similar elimination of exposure risk may be achieved through encapsulation of contaminants on-site. Additionally, removing the contaminants from the structure by cleaning and/or encapsulation further serves to reduce risk from all exposure routes.

The listed regulated compounds (Hg, I, Pb, and VOCs) have been around for a long time, their chemistry and their health effects have been thoroughly studied, and the toxicology database is sufficient to conclude the levels of exposure where health effects occur.

The same appears to not be true for methamphetamine itself, as the author was unable to locate data concluding the exposure level at which health effects initiate. Despite the database
being insufficient to establish health based cleanup standards for methamphetamine, of the five states considered for the purpose of this paper, four of them have a standard for meth, with this standard being the only cleanup standard established in two of the states studied. But this standard, ranging from 0.05 ug/100 cm² to 0.5 ug/100 cm² in the states studied, is a technology based standard, based on science’s ability to detect the meth at those levels, and on a contractor’s ability to achieve those levels during cleanup and decontamination. But because not enough is known about the meth concentrations at which various health effects initiate, the standards in use in the various states do not necessarily have any correlation to any concentrations that may cause health effects.

So while sufficient data is lacking to conclude the absolute methamphetamine exposure levels at which health effects occur, some good work has been done to validate that the standards for meth cleanup that are found in the various state meth lab regulations (0.05 to 0.5 ug/100cm²) are indeed protective of the health of the occupants of former meth labs. The Colorado Department of Public Health and Environment (CDPHE), in particular, has attempted to reconcile the known health effects of meth with the various decontamination levels currently codified in state standards. Their work started with an effort to quantify the exposures an individual would encounter by spending a day in a meth contaminated environment, both in terms of the numbers of different types of exposures and the imparted dose per each type of exposure. Use of data from high-dose animal studies and clinical case reports also allowed a better understanding of the mechanisms by which meth exerts toxicity. Knowing these mechanisms, then the intent of the exposure calculations and the dose calculations is to estimate an upper bound (reasonable maximum) exposure to the individuals of concern (CDPHE, 2005).
The CDPHE calculated these exposure and dose estimates for methamphetamine for three categories of individuals: infants (1 year old); child (6 years); and adult female (childbearing age). Infants were selected to study because of their unique exposure patterns, which may result in them receiving the highest exposure levels to meth in a household. Their tendencies to crawl, roll, or scoot across floor surfaces; their propensity to place fingers and all manner of objects in their mouths; and the fact they are more likely to wear less clothing than adults tend to increase the likelihood and hence number of exposures. The relatively high surface area per unit volume of an infant body means a given dose results in greater concentration per unit mass than in a larger body, such as an adult’s. Perhaps most importantly, the fact that an infant’s body is still rapidly developing makes them worthy of evaluation (CDPHE, 2005).

Children age six were chosen to study due to the therapeutic use of meth to treat attention deficit disorder that is indicated beginning at age six. This makes it possible to compare the estimated exposure to a child living in a former meth lab to the exposure imparted via therapeutic use by a same-aged child (CDPHE, 2005).

The numbers of exposures and their doses for women of reproductive age were studied due to the exposure to meth being correlated to adverse reproductive outcomes. These predicted exposures can be compared to the doses associated with adverse outcomes to assess the likelihood of the fetus being impacted (CDPHE, 2005).

The states that currently have codified numerical meth cleanup standards use one of the following three levels as the maximum permitted concentration to remain after cleanup:

- 0.5 ug/100cm²,
- 0.1 ug/100cm², or
- 0.05 ug/100cm²
Assuming exposure to residual meth at these 3 technology-based cleanup standards, numerous exposure parameters were calculated and used by the CDPHE in estimating the reasonable maximums for each of the three population categories of the study (infants, child, & adult female). These exposure parameters included: the concentration of meth on a surface, based on current state cleanup standards; average body weight; the average body surface area; exposed hand surface area; contact frequency of hand to surface; fraction transferred from surface to hands; fraction transferred from hands to mouth; oral absorption fraction; exposed skin surface area, contact frequency of skin to surface, fraction transferred from surface to skin; and dermal absorption fraction. From these equations and input parameters, an estimated daily dose of methamphetamine was calculated for each of the three population categories at each of the three cleanup standards currently in use. These values are found in Table 1 (CDPHE, 2005).

Table 1. Estimated Daily Dose Based on 3 State Cleanup Standards

<table>
<thead>
<tr>
<th>Methamphetamine Cleanup Standard</th>
<th>Target Population</th>
<th>Oral Dose (Do) mg/kg-day</th>
<th>Dermal Dose (Dd) mg/kg-day</th>
<th>Total Dose mg/kg-day</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5ug/100 cm$^2$</td>
<td>Infant</td>
<td>2.23E-04</td>
<td>1.92E-04</td>
<td>4.15E-04</td>
</tr>
<tr>
<td></td>
<td>Child</td>
<td>1.15E-04</td>
<td>6.45E-05</td>
<td>1.80E-04</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>5.13E-05</td>
<td>4.07E-05</td>
<td>9.20E-05</td>
</tr>
<tr>
<td>0.1ug/100 cm$^2$</td>
<td>Infant</td>
<td>4.46E-05</td>
<td>3.83E-05</td>
<td>8.29E-05</td>
</tr>
<tr>
<td></td>
<td>Child</td>
<td>2.31E-05</td>
<td>1.29E-05</td>
<td>3.60E-05</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>1.03E-05</td>
<td>8.14E-06</td>
<td>1.84E-05</td>
</tr>
<tr>
<td>0.05 ug/100 cm$^2$ (0.5ug/ft$^2$)</td>
<td>Infant</td>
<td>2.23E-05</td>
<td>1.92E-05</td>
<td>4.15E-05</td>
</tr>
<tr>
<td></td>
<td>Child</td>
<td>1.15E-05</td>
<td>6.45E-06</td>
<td>1.80E-05</td>
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<td></td>
<td>Adult</td>
<td>5.13E-06</td>
<td>4.07E-06</td>
<td>9.20E-06</td>
</tr>
</tbody>
</table>

Next, these total estimated doses for each of the three categories were correlated to known methamphetamine health effect ranges for neurotoxicity, developmental toxicity, and reproductive toxicity. From this data, reference doses were calculated. A reference dose (RfD) is an estimate of a daily exposure that is likely to be without an appreciable risk of harmful effects during a lifetime. The RfD’s calculated by the CDPHE were as follows:

- Neurotoxicity 0.007mg/Kg/day
- Developmental Toxicity 0.005 mg/Kg/day (prenatal)
  0.01mg/Kg/day (postnatal)
- Reproductive Toxicity 0.004mg/Kg/day

So, while these RfD values provide a scientifically grounded approach to what toxic levels are of concern to the three populations considered, as the authors of the CDPHE study point out, “The RfD values that have been derived above…were not intended to establish a state approved toxicity standard, but to provide a credible basis for evaluating the health protectiveness of the proposed technology cleanup standards” (CDPHE, 2005, pp. 24-25).

Based on the RfD values thus derived by Colorado, it can be concluded that all three of the cleanup standards currently in use (0.05 ug/100 cm², 0.1 ug/100 cm², and 0.5 ug/100 cm²) would be protective of the three populations studied.

It is well known that, without remediation, meth is present long after production has ended. Research by John Martyny found concentrations of methamphetamine at former clandestine drug labs to be as high as 16,000 ug/sample. The average concentration of meth found at these labs, based on a sample size of 97 samples, was found to be 499 ug/sample. Entering these figures into their exposure model (499 ug/100cm² for average exposures and 16,000 ug/cm² for a maximum exposure), the CDPHE determined the resulting dose to an infant
at 0.41 and 13.3 mg/Kg/day, respectively. These doses are clearly within a range where health effects would be expected (CDPHE, 2005, pp. 24-25).

**Mitigating Risks to Future Inhabitants of Former Meth Lab Sites**

Thus, based on the information above, it is important to clean up former meth labs before they are reoccupied in order that to protect the health of future inhabitants. This brings us to the next question the research has attempted to answer: “What best practices have been established to mitigate risks to future inhabitants of former meth lab sites?

There have been substantial efforts made in recent years to address the problem of meth contaminated indoor environments. There are now various ongoing federal and state efforts underway to both prevent the illegal manufacture of the drug and the resultant contamination of the lab environment, as well as various practices established to effectively clean up the lab environment once contamination has occurred. As is the tendency of governments, a reaction to a problem is made only after it has become a well-established problem.

**Federal Efforts to Combat Growing Problem**

The radical increase in the production and use of methamphetamine caught the federal government and many states completely off guard. “The rapid spread of this epidemic has outpaced the ability of state legislatures and federal agencies to respond. As a result, state reactions to the multiple problems posed by methamphetamine (production, sale, use, site cleanup) have been erratic and disjointed” (Harmon, 2006).

The U.S. Drug Enforcement Agency (DEA) has made an effort to react to the rapid increase in clandestine drug labs. However, like any large bureaucracy dealing with any large problem, it is reactive by nature, and hence the problem exists for a period of time before the response initiates. The agency further confronts a cumbersome and lengthy process to pass
federal legislation aimed at the problem and it takes time to develop programs based on scant and evolving information, to hire or reassign staff and, importantly, to locate and commit funding. As a result, on the federal level, it seems difficult to mobilize resources toward an effort quickly. Furthermore, the DEA is a federal agency, and has limited jurisdiction and authorities to deal directly with individual labs located within the jurisdiction of local law enforcement agencies (LEAs). Despite these limitations, there is a federal response to the issue.

The DEA provides support for local efforts by providing some coordination between different jurisdictions both horizontally between fellow neighboring LEAs and vertically with relevant state and federal agencies. They are also able to provide some intelligence and provide useful, “big picture” statistics they gather from LEAs nationwide and compile, report on, and disseminate the information to state and local law enforcement.

The DEA provides basic and advanced level clandestine lab safety training for local, state, and federal LEA officers at their Clandestine Laboratory Training Facility in Quantico, Virginia. Among the trainings offered are Basic Clandestine Laboratory Certification School, Advanced Site Safety School, and Clandestine Laboratory Tactical School. Each course exceeds the U.S. Occupational Safety & Health Administration’s required minimum safety requirements, lasts about one week each, and is provided all expenses paid to qualified law enforcement officers. Upon graduation from the Basic Clandestine Laboratory Certification School, the officers are issued over $2,500 in specialized clandestine lab safety equipment. Between 1997 and mid-2003, the participants included 9,300 U.S. Special Agents and state and local law enforcement officers who graduated from the basic certification training (Guevara, 2003).

There was also a piece of federal legislation aimed at addressing the problem. House Resolution 798 was introduced into the 109th Congress via the House of Representatives on
February 15, 2005. It passed the House on December 13, 2005, the Senate on December 9, 2006, and then died for lack of resolution between the House and Senate versions when the 109th Congress adjourned for the year. It was not reintroduced. If passed, it would have directed the U.S. Environmental Protection Agency (EPA) to develop voluntary cleanup standards for the states to adopt as they choose. It would have developed a research program aimed at the chemicals of concern and the types and levels of exposures to those chemicals. The EPA would have also conducted a research gap analysis, evaluated remediation techniques, conducted a residual effects study, supported research to develop new meth detection technologies, and established a triennial technology transfer conference to share the outcomes of the research. It also would have appropriated $1,750,000 for each of the years 2007 and 2008 to initiate the effort (U.S. House of Representatives, 109th Congress, 2006).

One issue that remains at all levels of law enforcement is that once meth labs are seized, federal law makes the LEA the “generator” of the hazardous wastes, and as such responsible for cleanup and ensuring that all wastes are managed to the grave, in compliance with all applicable health, safety, transportation, and environmental regulations (Guevara, 2003). This substantially increases the costs of a seizure, not just in terms of chemical disposal, but in simply managing the whole affair with cleanup contractors, property owners, etc. This is not typically a role of law enforcement, who are used to moving into a scene, arresting the suspects, and leaving with the evidence – a clean break, so to speak.

This raises an interesting question about ultimate liability when it comes to the re-occupancy of meth labs, many of which are in rental properties and private houses. Who is responsible if, after a lab is seized, after the bad guys have been arrested, after the bulk precursors, meth, and by-products have been packed up and safely removed, and after some level
of cleanup is conducted, the subsequent occupants move in and begin to suffer health consequences from symptoms that have been widely reported after meth lab exposures?

The short answer is nobody knows. Ultimately, liability is assigned by a court of law, and there does not seem to be a lot of legal precedence regarding the matter. While most government agencies and their employees acting on behalf of those agencies enjoy a good degree of immunity from liability, this generally applies only in the absence of nonfeasance, misfeasance, or malfeasance. But if the science begins to show that levels of meth remaining in the home environment after inadequate cleanup have health consequences to the occupants, who is responsible for damages resulting from those health consequences? The issue begs a cleanup standard.

**State Efforts to Combat Growing Problem**

Some individual states have responded, in varying degrees, to the issue of clandestine methamphetamine labs. To partially deflect the ultimate liability issue, some states have enacted real estate disclosure requirements wherein it must be disclosed in a purchase contract between buyer and seller if the property was known to have been used as a clandestine meth lab.

Many states have enacted “Precursor Limitation Legislation”, with which some of the key ingredients needed to manufacture household produced meth have been relegated, in a sense, to controlled substance status. In a 2006 survey of 500 county law enforcement agencies in 44 states, commissioned by the National Association of Counties, 90% of respondents indicated that precursor legislation was in effect in their jurisdiction. The survey went on to state that 46% of the sheriffs indicated that they had seen a decrease in meth lab seizures during the last year, while 41% said they stayed the same, and 12% reported an increase in lab seizures (National Association of Counties, 2006).
A typical strategy with the precursor legislation, including Ohio’s, is to limit the number of units of cold medications containing pseudoephedrine that a person is allowed to buy at one time and require anyone attempting to purchase the product to show photo identification and sign a roster. While annoying to the average law abiding citizen, these laws have been somewhat effective in slowing individuals from quickly amassing the quantities of precursors necessary to produce large amounts of the drug. Interestingly, according to Rick Combs, Chief Deputy of the Clermont County, Ohio Sheriffs Office (personal conversation, July, 2008), when their Drug Task Force members review the rosters from the various retail establishments selling the cold medications, they see the same names buying the maximum amount of product allowed by law at each store, and they see those names on a routine basis. Two additional points made during that discussion was that while the precursor law slows down the cookers, it does not stop them, because the law is not broken until they use the ingredients to manufacture methamphetamine.

Dewan and Brown (2009) reported that approximately twenty states, including Oregon, North Carolina, Washington, Colorado, and Kentucky have adopted regulations requiring the cleanup and decontamination of former methamphetamine labs. These states have also established a variety of cleanup standards by which to determine the effectiveness of that cleanup, most involving a numerical standard that ranges from 0.05 to 0.5 ug/100cm².

North Carolina has taken a novel approach in their rules development after the state legislature mandated that the State Commission of Public Health “shall adopt rules establishing decontamination standards to ensure that certain property is reasonably safe for habitation” (North Carolina General Statutes, 2009, p. 1). The rules were written without establishing any numerical (sample based) cleanup standards. However, the authors developed standards
nonetheless by defining a remediation process that includes precise instructions for the following:

- what can be cleaned and how to clean it;
- what must be disposed of and how to dispose of it;
- what materials are amenable to encapsulation to prevent exposure and how to encapsulate them; and
- when and how to ventilate and for how long; (N. C. Administrative Code [NCAC], Subchapter 41D, 2009).

Other states, including Oklahoma, Missouri, Illinois, and Minnesota, have adopted cleanup guidelines, but as guidelines they lack the backing of statute and hence have no requirement for the responsible party to carry out cleanup and decontamination of the structure. Most states, including Ohio, have done nothing to address the issue of meth lab decontamination.

For the purposes of this paper, the regulations for five states that have adopted legislation and codified cleanup standards in law were studied – Washington, Colorado, Oregon, North Carolina, and Kentucky. All five of the states require a pre-cleanup assessment, either by the local health department (LHD) (n=1), a certified consultant/contractor (n=3), or the homeowner using a standard template (n=1). Three of the five states, Washington, Colorado, and Oregon, required environmental sampling as part of their pre-cleanup assessment (NCAC, 2009; Oregon Administrative Rules [OAR], 2009; Washington Administrative Code [WAC], 2006; Colorado Code of Regulations [CCR], 2005; & Kentucky Revised Statute [KRS], 2009).

Of the five states, only Oregon and Kentucky allowed a contaminated property to be sold prior to decontamination (Oregon Revised Statute, 2009; KRS, 2009). While prohibiting the sale of a contaminated property may seem like a good control measure, like many solutions it may
solve one problem, while creating another. For example, there may be property owners with rental properties that became meth labs without their knowledge, until informed by the authorities. Then, for whatever reasons they don’t want to be saddled with cleaning up and decontaminating the property, they may instead prefer to sell and dispense with the property and its problem, even at a financial loss. This activity, and the niche business opportunities it creates, is prohibited in three states as a result of this restriction.

Not all states that have methamphetamine lab cleanup regulations use a numerical standard or maximum contaminant level by which to determine the success of cleanup efforts. As briefly mentioned previously, North Carolina does not have a numerical standard, instead relying on a prescribed set of steps that include the following:

- pre-cleanup ventilation; triple washing/rinsing of non-porous surfaces;
- double machine washing/rinsing of porous surfaces;
- disposal of certain items that cannot be effectively cleaned, such as carpeting and upholstered furniture; and
- encapsulation.

North Carolina further describes how to clean the HVAC system and the plumbing system, as well as how to inspect the on-site sewage system for contamination. Finally, they describe how to dispose of or decontaminate personal property and then require a final period of ventilation of the structure. Health officials then review the cleanup documentation provided by the person conducting the cleanup, and decide whether it is adequate or not. No clearance sampling is required (NCAC, 2009).

The other four states established one or more numerical standard limits for determination of adequate decontamination. All four have a meth standard. Both Kentucky and Washington
have set their meth standard at 0.1 ug/100 cm², while the Colorado standard is 0.5 ug/100 cm² (KRS, 2009; WAC, 2006; CCR, 2005). Oregon’s regulation requires initial assessment sampling that states simply, “If contamination is found, the contractor shall proceed as follows to decontaminate…” (OAR, 2009). This is, by default, setting the standard limit at the level of detection. One issue with such a standard is that Oregon has codified a moving target. As technology enables detection at lower and lower concentrations, such a standard becomes increasingly difficult to achieve, and its relevance to any health-based risk more difficult to defend.

In addition to a methamphetamine standard, Washington and Colorado set other final cleanup standards to determine the effectiveness of decontamination. Washington has standards for lead (Pb) at 20 ug/ft², airborne mercury (Hg) at 50 nanograms/M³, and volatile organic compounds (VOCs) at 1 part per million total hydrocarbons and VOCs in air (WAC, 2006). Colorado also has standards for Pb at 40 ug/ft² and airborne Hg at 1 ug/M³, but instead of VOCs they have a standard for iodine at 22 ug/100 cm² (CCR, 2005).

Of the four states with a numerical standard, only Washington and Colorado required submission of the laboratory results from prescribed sampling for verification of decontamination to their standards (WAC, 2006; CCR, 2005). Oregon, which uses the detectable level as the meth standard, reserves the right to conduct its own sampling as a quality control measure of the cleanup contractor, but does not require submission of lab results (OAR, 2009). Kentucky, the other state with a standard (meth at 0.1 ug/100 cm²), simply requires the owner of the property to submit a final report certifying the standard was met before the local health jurisdiction will release the property for re-occupancy. While it would be in the best interest of the contractor to sample in order to certify that the standard is met, the Kentucky regulation does
not explicitly require it, the homeowner report has no prescribed content such as sampling results, there appears to be no quality control/assurance step on the part of the local health jurisdiction, and submission of laboratory results are not required (KRS, 2009).

Two of the states, Colorado and North Carolina, prescribe the cleanup process to follow step by step. This would seem reasonable for North Carolina, where there are no certification or training requirements for individuals conducting the cleanup, where no environmental sampling is part of the initial site assessment, and no post-cleanup sampling is required. This level of prescribed detail seems less reasonable for Colorado, where the consultant conducting the initial site assessment is required to be a registered industrial hygienist, and where sampling is done both pre-cleanup to provide the basis for the cleanup plan and also post-cleanup for clearance sampling (CCR, 2005). Washington, Oregon, and Kentucky require that cleanup work be performed by a contractor trained and certified by the state to do such work, but do not prescribe precisely how to conduct each individual cleanup (WAC, 2006; OAR, 2009; KRS, 2009).

Kentucky takes a unique approach by developing a tiered system, wherein there are four levels of cleanup response depending on the severity of contamination. Regardless of the tier (1–4) any individual lab site is assigned in Kentucky, the site must still meet the 0.1 ug/100 cm² meth standard (KRS, 2009).

It is interesting to note that Colorado may appear to have the strictest requirements for cleanup of those studied, with a 26 point cleanup process precisely described, where a certified industrial hygienist develops a cleanup plan and certifies that cleanup was done in accordance with the plan, and where the submission of lab results from post-cleanup environmental sampling is required. They were also the only state where the property owner is awarded immunity from
health based civil actions regarding that property, provided the property was decontaminated in compliance with the established standards (Colorado Revised Statute, 2005).

The credentialing of workers performing the decontamination tasks in clandestine drug labs vary from Washington and Oregon, where there is involved credentialing, to North Carolina, where there is none.

Washington and Oregon’s requirements for employees conducting decontamination are basically the same. There are three levels of worker certification, one each for contractors, supervisors, and workers. There are separate, standardized training courses for each of the three credentials, with the administration and passing of an exam needed for each along with biannual recertification. The contractor is required to follow a work plan based on an initial site assessment that includes environmental sampling. Only certified workers are allowed to perform any functions on-site and there must be a certified supervisor on site any time a worker is present. There can be multiple credentialing, for example a contractor can also be certified as a supervisor or a worker, and perform the functions of all three. The contractor is ultimately responsible for all work conducted on-site and for the compliance of all supervisors and workers employed at the site. The contractor’s certification can be suspended or revoked for failure to comply with the code and civil penalties can apply. There is a provision in the regulations of both Washington and Oregon that allow the local health jurisdiction (LHD) the authority to allow the property owner to conduct the cleanup themselves, without certified personnel, placing the responsibility on the LHD to ensure the decontamination is accomplished to the level of the standards (WAC, 2006; OAR, 2009).

In Colorado, as mentioned earlier, a registered industrial hygienist consultant is required to perform the preliminary site assessment, including sampling. The consultant then oversees a
contractor (no certification required for contractor) that performs the cleanup, after which the consultant submits a detailed final report, including clearance sampling results for meth, lead, mercury, and volatile organic compounds. Unlike Washington, in Colorado the consultant and the contractor can have no common business ties (CCR, 2005).

In Kentucky, the decontamination contractor is required to be certified as well as being registered, bonded, and insured. The rules include provisions for the certification to be revoked for cause, and the bond forfeited to fund the cleanup if the contractor fails in his or her duties. The contractor certification regulations are currently being refined by the Kentucky Cabinet of Health and Human Services (KRS, 2009).

While four of the states had a large degree of similarity, again North Carolina stood out among the five as unique, this time in terms of credentialing the individuals conducting the cleanup. In North Carolina there are no certification or training requirements for individuals conducting the cleanup. An owner or other individual proposing to perform a cleanup uses a template developed by the North Carolina Division of Public Health to conduct an initial site assessment and develop a work plan, which is submitted to the local health jurisdiction (LHD) for review and approval before work commences. A similar template to document decontamination activities performed is used after cleanup and likewise submitted to the LHD for review and approval before the property can be released for reoccupancy (NCAC, 2009).

During the research, it was discovered by the author that there are some progressive local health jurisdictions that have established guidelines for cleanup - Stark County in Ohio is an example. Again, like the state guidelines, there is no statutory requirement to do anything and no follow up by a certifying entity (regulator, independent sampling lab, etc) to attest that anything was done.
Summary of States’ Efforts to Combat Problem

A number of measures have been taken on the state level to combat the methamphetamine problem. Some have a real estate disclosure regulation requiring the seller of a property to disclose to the buyer if the property has former history as a meth lab. Many states have passed legislation limiting the amount of pseudoephedrine-containing cold medication an individual can purchase at one time, and require identification and a signature to purchase it. Some states have opted to develop guidelines to help people who wish to conduct a cleanup, but these guidelines lack any regulation requiring that cleanup be done. Most states have done nothing to address the issue.

Approximately twenty states have adopted regulations requiring cleanup and decontamination of former meth labs (Dewan, & Brown, 2009). For the purpose of this paper, five states that have adopted such legislation were selected to study – Colorado, Kentucky, North Carolina, Oregon, and Washington. Most of the twenty states with meth lab cleanup regulations have adopted a numerical cleanup standard for methamphetamine ranging from 0.05 to 0.5 ug/100cm² while at least one, North Carolina, have instead opted to dictate a precise cleanup protocol in place of any numerical standards. The other four states studied that have a standard for meth have other numerical standards as well. Depending on the state, there are standards for VOCs, Hg, Pb, and I.

All five states require a pre-cleanup assessment, with three of the five requiring environmental sampling as part of that assessment. Only two of the five states require post-cleanup laboratory results be submitted to verify that cleanup standards were met (WA & CO). Four of the states require the individuals conducting the cleanup to be certified to do the work,
while North Carolina does not, instead relying on the precise cleanup protocol to guide the person conducting cleanup.

Colorado has the strictest cleanup requirements with environmental sampling required as part of the pre-cleanup assessment, where a 26 point cleanup process is precisely prescribed, where a certified industrial hygienist is required to develop and follow a cleanup plan, and where post-cleanup environmental sampling is required. It is also the only state where the property owner is awarded immunity from health-based civil actions regarding the property.

In contrast, North Carolina has the most lenient cleanup requirements. There are no credentials required of the person conducting the cleanup. There are no codified standards to meet. No pre- or post-cleanup environmental sampling is required. The state instead relies on a standard template to conduct an initial site assessment and develop a work plan that must be approved by the LHD, and a similar template to document cleanup activities that is likewise submitted to and approved by the LHD. (See Appendix 1)

**A Summary of Best Practices for a Model Program**

In the absence of a known level at which residual methamphetamine initiates a health risk, the author suggests no mandated cleanup. However, with sufficient anecdotal evidence to suggest there can be health effects associated with occupying a former meth lab, a cleanup program and guideline should be established with a level of methamphetamine of 0.5 ug/100 cm² to give a reasonable cleanup target. As this paper demonstrates, a 0.5 ug/100 cm² level is protective of health, it is an achievable standard, and can give a level of assurance to property owners and occupants that a structure was cleaned to a safe standard. The property owner should have the choice of not cleaning the property up, of cleaning up the property on their own using a standardized template and guidance document, or hiring the task out to private entities to do the
work. A public environmental or public health agency such as a local health district should be tasked with overseeing the program. Their main role would be to intake, review, advise, and ultimately approve cleanup work plans, as well as maintaining the guidance document and standardized template. This agency would function as a certifying entity to intake and review final assessment reports, to include third-party standardized sampling and lab results and, after everything is in order, to certify a structure “clear”. Real estate point-of-sale disclosure or a rental agreement disclosure should be required of any structure changing occupants, so all parties are making an informed choice concerning whether a structure has an “all-clear” status before they make a choice to occupy it.

Challenges Encountered in Researching Topic

The most challenging aspect of researching the topic was a lack of information on the chronic health effects of methamphetamine. While the acute health effects of meth are well documented and understood, there is a dearth of information on chronic exposures at any concentration, high or low.

Another challenge was attempting to correlate the NIOSH, OSHA, ATSDR, and USEPA standards, measured in parts per million volumetric (airborne) standards to the state standards, established and sampled in mass per surface area (ug/100 cm² or similar) for both Pb and I.

Next Steps for Future Research

In the opinion of the author, the most pressing piece of research needed to address the issue centers on the chronic health effects of methamphetamine itself. While there is sufficient anecdotal information to suggest there are health effects resulting from chronic exposure to meth, what exactly are those health effects, and at what concentrations do those effects initiate?
Correlating contaminant loading to the health risks posed to those exposed to the contaminants would be invaluable to establish a health-based standard for cleanup and decontamination.

Research and development of instrumentation that can accurately detect and quantify meth in the field would facilitate not only the academic research of these environments, but would aid law enforcement agencies, the individuals conducting cleanup, as well as the agencies responsible for overseeing the cleanup. Currently, swab or materials samples must be sent to a lab for detection and quantification.
References


Methamphetamine.


http://www.drugabuse.gov/ResearchReports/methamph/methamp.html


Decontamination Standards for Methamphetamine Sites. Section 130A-284.

(Division 40). State of Oregon, Department of Human Services, Public Health Division.


South Dakota Governor Rounds’ Statewide Methamphetamine Task Force (SDGRSMTF)
http://denr.sd.gov/des/wm/hw/MethLabCleanup.pdf


Services, Centers for Disease Control and Prevention, Morbidity & Mortality Weekly Report.


### Appendix I – Five State Regulations

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Washington</th>
</tr>
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<tbody>
<tr>
<td><strong>Initial Site Assessment Required</strong></td>
<td>Lhd to post property warning of potential contamination, inspect property, make a determination of necessary sampling, and review contractors’ work plans for approval.</td>
</tr>
<tr>
<td><strong>Initial Assessment Sampling</strong></td>
<td>Sampling to be done by qualified personnel using standard methods &amp; proper chain-of-custody.</td>
</tr>
<tr>
<td><strong>Prohibition of Use of Property Pending Decontamination</strong></td>
<td>If found to be contaminated, health official to prohibit use of property until proper cleanup &amp; release, post property as such, &amp; report such property contamination to State HD.</td>
</tr>
<tr>
<td><strong>Decontamination Standards</strong></td>
<td>Decontamination standards exist for methamphetamine, lead, mercury, &amp; volatile organic compounds.</td>
</tr>
<tr>
<td><strong>Verification of Decontamination</strong></td>
<td>Certified contractor to submit clean-up records for review by LHD. Work to have been in accordance with approved work plan. Submission of laboratory results documenting that decontamination standards were met.</td>
</tr>
<tr>
<td><strong>Decontamination Procedures</strong> Prescribed</td>
<td>Not prescribed in code, but work must be performed by certified contractor working under approved work plan.</td>
</tr>
<tr>
<td><strong>Property Owner Immunity</strong></td>
<td>Nothing codified on topic.</td>
</tr>
<tr>
<td><strong>Contractor Certification</strong></td>
<td>Certification required to perform decontamination, demolition, or disposal work at drug lab site. Involves standardized training course and administration/passage of exam. Recertification required every 2 years.</td>
</tr>
<tr>
<td><strong>Contractor Performance Standards</strong></td>
<td>All contractors, workers, &amp; supervisors must: be certified; file a work plan &amp; obtain approval from LHD; perform work in accordance with approved work plan; certified supervisor to be on-site overseeing work at all times; comply with applicable requirements; receive LHD approval after completion of project.</td>
</tr>
<tr>
<td><strong>Contractor Oversight</strong></td>
<td>Certification can be denied, suspended, or revoked for failure to comply with code requirements. Civil penalties can apply.</td>
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Appendix I – Five State Regulations

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<tr>
<th><strong>Initial Site Assessment Required</strong></th>
<th><strong>Colorado</strong></th>
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<tbody>
<tr>
<td>Consultant to make preliminary assessment of property, to include sampling. Information gained to be the basis for decontamination and clearance sampling.</td>
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</tbody>
</table>

| **Initial Assessment Sampling** | |
| Sampling to be done by qualified personnel using standard methods & proper chain-of-custody. |

| **Prohibition of Use of Property Pending Decontamination** | |
| Consultant to prohibit use of property until proper cleanup & release. |

| **Decontamination Standards** | |
| Decontamination standards exist for methamphetamine, lead, mercury, & iodine. |

| **Verification of Decontamination** | |
| Consultant to submit final report certifying 26 details of work completed, & submission of laboratory results documenting decontamination standards were met. |

| **Decontamination Procedures Prescribed** | |
| Procedures to be used, as applicable: 1) HEPA vacuumed; 2) Detergent wash of non-porous surfaces; 3) Remove materials contaminated but not to be reclaimed; 4) Encapsulation after clean-up; 5) Decon HVAC; 6) Flush Plumbing; 7) Inspect on-site sewage treatment system; 8) Personal property - dispose or decon & sample. |

| **Property Owner Immunity** | |
| Immunity from health-based civil actions provided if clean-up in compliance with established standards. |

| **Contractor Certification** | |
| Consultant req'd to be registered industrial hygienist. Contractor bound to compliance with clean-up regs. Consultant & contractor shall have no common business ties. |

| **Contractor Performance Standards** | |
| Consultant must submit detailed final report. |

| **Contractor Oversight** | |
| Consultant's licensure as industrial hygienist. No contractor (consultant) oversight codified. |
**Appendix I – Five State Regulations**

| **Oregon**                                | **Initial Site Assessment Required** | Consultant to make preliminary assessment of property, to include sampling. Information gained to be the basis for decontamination and clearance sampling. |
| **Initial Assessment Sampling**           |                                           | Sampling to be done by qualified personnel using standard methods & proper chain-of-custody. |
| **Prohibition of Use of Property Pending Decontamination** |                                           | If found to be contaminated, LHD to post property as such. Property owner to prohibit use of property until proper cleanup & release, except that owner may sell property with full disclosure. Owner to report such property contamination to state health department. |
| **Decontamination Standards**             |                                           | The detection of meth is the codified standard. |
| **Verification of Decontamination**       |                                           | Not required, but rights to do so reserved. |
| **Decontamination Procedures Prescribed** |                                           | Not prescribed in code, but work must be performed by certified contractor working under approved work plan. |
| **Property Owner Immunity**               |                                           | Transfer of property prohibited unless decontaminated or full disclosure provided to buyer. |
| **Contractor Certification**              |                                           | Decontamination contractor license required, in addition to being registered, bonded, and insured. |
| **Contractor Performance Standards**      |                                           | Contractors to be licensed to oversee work. Workers & supervisors must be trained & certified. Work plan must be submitted & approved. Work must be performed in accordance w/ approved work plan. Certified supervisor to be on-site overseeing work at all times. Contractor must comply with applicable requirements, and receive LHD approval after completion of project. |
| **Contractor Oversight**                  |                                           | Certification can be denied, suspended, or revoked for failure to comply with code requirements. Civil penalties can apply. |
**Appendix I – Five State Regulations**

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<thead>
<tr>
<th><strong>Initial Site Assessment Required</strong></th>
<th><strong>North Carolina</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Person in control required to conduct assessment and develop work plan using standard template provided by the N.C. Division of Public Health.</td>
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<tr>
<th><strong>Initial Assessment Sampling</strong></th>
<th><strong>No initial sampling requirements codified.</strong></th>
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<tr>
<th><strong>Prohibition of Use of Property Pending Decontamination</strong></th>
<th><strong>If found to be contaminated, law enforcement to post property as such &amp; report contamination to local health jurisdiction. Property owner to prohibit use of property until proper cleanup and release.</strong></th>
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<tr>
<th><strong>Decontamination Standards</strong></th>
<th><strong>No codified standards.</strong></th>
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<tr>
<th><strong>Verification of Decontamination</strong></th>
<th><strong>LHD to review decon documentation provided by individual performing work. No inspection/sampling required, but rights to do so reserved.</strong></th>
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<tr>
<th><strong>Decontamination Procedures Prescribed</strong></th>
<th><strong>Procedures to be used, as applicable: 1) Site ventilation; 2) Chemical spills remediated 3) Triple wash/rinse of non-porous surfaces; 4) Double machine wash of porous materials; 5) Disposal of carpeting, upholstered items; 6) Encapsulation after clean-up; 5) Decon HVAC; 6) Replace or flush plumbing; 7) Inspect on-site sewage system; 8) Personal property - dispose or decon; 9) Final ventilation of structure.</strong></th>
</tr>
</thead>
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<tr>
<th><strong>Property Owner Immunity</strong></th>
<th><strong>Nothing codified on topic.</strong></th>
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<tr>
<th><strong>Contractor Certification</strong></th>
<th><strong>No certification or training requirements for individuals conducting decontamination work.</strong></th>
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<tr>
<th><strong>Contractor Performance Standards</strong></th>
<th><strong>Individual conducting decon work to provide decon activity documentation to local health jurisdiction for review.</strong></th>
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<tr>
<th><strong>Contractor Oversight</strong></th>
<th><strong>LHD reserves right to inspect property before, during, or after decon.</strong></th>
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<tbody>
<tr>
<td>Appendix I – Five State Regulations</td>
<td></td>
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<td>-------------------------------------</td>
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<tr>
<td><strong>Kentucky</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Initial Site Assessment Required</strong></td>
<td>Consultant to make preliminary assessment of property. Information gained to be the basis for decontamination &amp; post-decon clearance sampling.</td>
</tr>
<tr>
<td><strong>Initial Assessment Sampling</strong></td>
<td>No initial sampling requirements codified at this time (relevant rules still under development at this writing [December 2009]).</td>
</tr>
<tr>
<td><strong>Prohibition of Use of Property Pending Decontamination</strong></td>
<td>Owner may sell, rent, or lease contaminated property with disclose in writing that property is contaminated &amp; has not been decontaminated.</td>
</tr>
<tr>
<td><strong>Decontamination Standards</strong></td>
<td>Decontamination standard exist for methamphetamine (0.1 ug/100 cm²).</td>
</tr>
<tr>
<td><strong>Verification of Decontamination</strong></td>
<td>Owner of property to submit final report certifying that decontamination standard was met.</td>
</tr>
<tr>
<td><strong>Decontamination Procedures Prescribed</strong></td>
<td>Severity of contamination assessed and a tiered system (1 - 4) applied to each property depending on that level of contamination. The tier assignment dictates which set of decontamination procedures to follow (relevant rules still under development at this writing [December 2009]).</td>
</tr>
<tr>
<td><strong>Property Owner Immunity</strong></td>
<td>Before selling, renting, or leasing contaminated property, owner to disclose in writing that property is contaminated &amp; has not been decontaminated.</td>
</tr>
<tr>
<td><strong>Contractor Certification</strong></td>
<td>Decontamination contractor certification required, in addition to being registered, bonded, and insured.</td>
</tr>
<tr>
<td><strong>Contractor Performance Standards</strong></td>
<td>The Kentucky Cabinet of Health &amp; Human Services is currently promulgating regulations to establish standards &amp; procedures for contractor certification and oversight.</td>
</tr>
<tr>
<td><strong>Contractor Oversight</strong></td>
<td>Certification can be revoked for cause, &amp; financial assurance (bond) forfeited if contractor found in violation of rules. The forfeited bond may be used by the Kentucky Cabinet of Health &amp; Human Services to decontaminate the property.</td>
</tr>
</tbody>
</table>
Appendix II: Public Health Competencies Achieved

The following public health competencies were achieved, developed, and/or refined throughout the completion of this project:

**Domain 1 - Analytic Assessment Skills:**

- Defines a problem
- Identifies relevant and appropriate data and information sources
- Recognizes how the data illuminates ethical, political, scientific, economic, and overall public health issues
- Identifies relevant and appropriate data and information sources
- Makes relevant inferences from quantitative and qualitative data

**Domain 2 – Policy Development/Program Planning Skills:**

- Collects, summarizes, and interprets information relevant to an issue
- Identifies, interprets, and implements public health laws, regulations, and policies related to specific programs

**Domain 3 - Communication Skills:**

- Communicates effectively both in writing and orally, or in other ways
- Effectively presents accurate demographic, statistical, programmatic, and scientific information for professional and lay audiences

**Domain 5 – Community Dimensions of Practice Skills:**

- Identifies how public and private organizations operate within a community
- Describes the role of government in the delivery of community health services
Domain 6 – Basic Public Health Sciences Skills:

Applies the basic public health sciences including behavioral and social sciences, biostatistics, epidemiology, environmental public health, and prevention of chronic and infectious diseases and injuries

Identifies and retrieves current relevant scientific evidence

Develops a lifelong commitment to rigorous critical thinking

Identifies the limitations of research and the importance of observations and interrelationships

Domain 8 – Leadership and System Thinking Skills:

Identifies internal and external issues that may impact delivery of essential public health services (i.e. strategic planning)