Helping Communities Combat
Clandestine Methamphetamine Laboratories

Part B: A Guide for Clinicians and Health Care Professionals Responding to Methamphetamine Lab Exposures

Society for Public Health Education
In conjunction with

Agency for Toxic Substances and Disease Registry

The American College of Medical Toxicology

Acute Methamphetamine Laboratory Exposure: A Guide for Clinicians

The purpose of this guide is to give health care professionals guidance for responding to patients who have been exposed to methamphetamine laboratories.

I. Initial Decision Making

A. Assess the route(s) of exposure (can be several routes). Just walking in and out of a methamphetamine laboratory would be considered pulmonary exposure.

1. Pulmonary
2. Dermal
3. Ocular
4. Ingestion

B. Determine status of laboratory (listed in order of decreasing risk).

1. Active laboratory with a synthetic "cook" in process (most dangerous)
2. Methamphetamine laboratory fire
3. Inactive laboratory that is still set up
4. Laboratory is packed up in crates, boxes, cabinets, or trunks
5. Laboratory area after *nonprofessional* cleanup.
6. Laboratory area after *professional* cleanup (no risk).

C. If possible, determine the type of methamphetamine laboratory

1. Iodine/phosphorus
2. Liquid ammonia/alkali metal (Birch or "Nazi" method)
3. Thionyl chloride (rare, but similar to iodine/phosphorus)
4. P2P laboratory (rare, occasionally uses heavy metal salts)
5. Unknown or not a methamphetamine laboratory

II. Implicated Compounds (see table 1)

A. This table is not all-encompassing but includes common examples of the important groups of chemicals needed for the synthesis.

B. The **type/use** is what category the compound falls into. A brief overview of the hazards by each class follows:

1. **Solvents**: narcotizing symptoms, mild dermal injury, explosive vapors
2. **Reducing agent**: significant dermal injury, reactive
3. **pH modulators:** severe dermal and ocular injury
4. **Precursor:** Generally lesser toxicity except with ingestion

C. The **level of concern** is a *very rough* estimation of the health danger assuming these basic things: an individual experiences a short-term (10-minute maximum) exposure by the pulmonary route only to the compound at a "moderate" environmental level.

1. Low does not imply safe; many of these are caustic or flammable.
2. If the level is in red, the compound is flammable or explosive.

Table 1

Items Commonly Found in Methamphetamine Laboratories

Compound Name	Type/Use	Lab Type	Level of Concern
Acetone	Solvent	Any	Low
Carburetor cleaner	Solvent	Any	Low
Deicer (ethers)	Solvent	Any	Low
Gasoline, kerosene, coleman fuel	Solvent	Any	Low
Methylene chloride	Solvent	Any	Low
Methanol[a]	Solvent	Any	**Medium**[a]
Hypophosphorus acid	Reducing agent	Iodine/phosphorus	Low
Iodine[b]	Reducing agent	Iodine/phosphorus	Low[b]
Liquid ammonia[c]	Special	Birch/Nazi	**High**[c]
Lithium or sodium metal[d]	Reducing agent	Birch/Nazi	Low[d]
Red phosphorus, matches & road flares	Reducing agent	Iodine/phosphorus	Low
Phosphene[e]	Special	Iodine/Phosphorus	**High**[e]
Thionyl chloride	Reducing agent	Thionyl chloride	**High**
Hydrochloric acid, gas	pH modulators	Any	**High**[f]
Muriatic acid, liquid	pH modulators	Any	**Medium**
Hydroiodic acid, liquid	pH modulators	Iodine/phosphorus	**High**
Sulphuric acid, liquid	pH modulators	Any	**Medium**
Sodium hydroxide	pH modulators	Any	Low
Rock salt	Miscellaneous	Any	Low
Ephedrine tablets	Precursor	Birch/Nazi & iodine/phosphorus	Low
Methylamine/ N-methyl formamide	Precursor	P2P method	**Medium**
Phenyl-2-Propanone/ phenylacetic acid	Precursor	P2P method	Low
Lead & mercury salts[g]	Reducing agent	P2P method	Low[g]

Notes

[a]If significant dermal exposure or prolonged pulmonary exposure, serum methanol levels may be required for management.

[b]Iodine has minimal toxicity at airborne levels except immediately near a "cook" (Martyny, Arbuckle, McCammon, Esswein, & Erb, 2005).

[c]Liquid ammonia vapors cause significant pulmonary, dermal, and ocular injury.

[d]Dermal exposures are dangerous and should be physically decontaminated prior to irrigation with water. Burns or explodes when exposed to water.

[e]Phosphine is *only* present during active "cooking" or is potentially trapped in vapor traps or in enclosed areas such as coolers or closets.

[f](Martyny et al., 2005).

[g]Despite their use with the P2P method, one does not usually need to pursue testing for heavy metals. They are not volatile, and their use is rare.

III. Management

A. General laboratory cautions and safety

1. Entry into methamphetamine site (either active or inactive) that has not already been cleaned up is not recommended for anyone other than trained individuals wearing respiratory and dermal protective gear (Burgess, 2001).
2. Emergency responders should enter only long enough to perform their duties and remove any injured individuals (Burgess et al., 1996).
3. Without any contact with gross contamination or exposure to anhydrous ammonia, the short pulmonary only type of exposure presents minimal health risk.
4. No switches, knobs, or doors should be touched during entry unless absolutely necessary.
    i. Potential for explosion from vapors.
    ii. Potential for traps set by the criminals.
    iii. Potential to be exposed to vapor pockets (Burgess, 2001).
5. No smoking in or around a methamphetamine laboratory.
6. Most injuries occur in first responders and police officers (Centers for Disease Control and Prevention, 2005).

B. Although most individuals removed from a meth lab are unlikely to harbor enough residual chemicals to cause physiologic injury to others, there are good reasons to provide field decontamination with copious amounts of water after removal of their outer garments before bringing them to a health care facility (Horton et al., 2003).

1. The chemical odor may trigger a psychological illness in caregivers.

2. Small amounts of caustic elements or irritants on the skin may not be immediately recognizable but may result in a skin burn in the patient over time.

C. Pulmonary exposure: Most common route of exposure (Burgess, 2001; Burgess et al., 1996)

1. The pulmonary effects of exposure are highly dependent on the state of the methamphetamine laboratory when entered. An active laboratory can be generating phosphine, a significant pulmonary irritant (Willers, 1999).
   i. Active methamphetamine lab: Evaluate in a health care facility those with symptoms of cough, chest pain, dizziness, headache, difficulty breathing, or eye irritation.
   ii. Inactive methamphetamine lab: Pulmonary injury is much less likely to result from the methamphetamine laboratory when not employed in a "cook". Evaluate in a health care facility those with symptoms of cough, chest pain, dizziness, headache, difficulty breathing, or eye irritation.
2. In a health care facility
   i. Treat with 100% oxygen to keep $pO_2 \geq 95\%$.
   ii. Chest X-ray for cough or chest pain.
   iii. Bronchodilators for wheezing/bronchospasm.
   iv. Observe for 2–3 hours.
   v. If symptoms do not completely clear within 2–3 hours, admission for observation may be warranted to observe for pulmonary edema from phosphine or anhydrous ammonia.
   vi. Delayed pulmonary edema is a concern for phosphine exposure, although people are not usually completely asymptomatic initially.

D. Dermal exposure

1. For sodium/lithium metal dermal exposures (used in Birch/Nazi method), decontaminate by brushing off the metal prior to irrigation with water.

2. Exposure to anhydrous ammonia (vapor and liquid) causes significant dermal injury from its extremely cold temperature and its corrosive nature.
3. Determine the degree of chemical exposure
    i. Person exposed to areas of ammonia vapors, gross liquid contamination, or solid or liquid waste:
        a. Gently remove grossly contaminated clothing and place in plastic bag.
        b. Gently decontaminate with soap and water.
        c. Evaluate in a health care facility anyone with dermal burns from chemical exposure.
    ii. Persons without direct skin exposure to ammonia vapors, gross contamination, or solid or liquid waste:
        a. Launder clothing as normal.
        b. Bathe as normal.
        c. No potential for injury.
        d. No referral needed.
4. In the health care facility
    i. Decontaminate gently with soap and water.
    ii. Injured areas should be treated as any other chemical burn.
    iii. No laboratory testing is required.
    iv. Grossly contaminated clothing (and toys) should be handled with gloves, bagged, and discarded (after consultation with law enforcement).
    v. Clothing and toys without visible contamination should be laundered prior to reuse.

E. Ocular exposure

1. Immediate gentle decontamination with water.
2. Products of significant concern that **automatically** warrant health care facility evaluation:
    i. Eye splash exposures from pH modulators

ii. Anhydrous ammonia vapors causes significant injury secondary to its penetrating qualities because the vapors dissolve easily in water or moist areas such as the eyes.

3. For other eye splash exposures, if symptoms of pain or blurred vision persist after 10 minutes of gentle irrigation, refer to a health care facility
4. In a health care facility
   i. Perform a full ocular exam
   ii. Consult with ophthalmologist as warranted

F. Ingestion exposure

1. Patient ingested liquid laboratory waste or an item (e.g., food) with **gross contamination**.
   i. If no vomiting, administer small amount of water.
   ii. Refer to a health care facility anyone with symptoms of nausea, vomiting, diarrhea, abdominal pain, chest pain, difficulty swallowing, or change in voice.
2. Patient ingested potentially contaminated food or water near active methamphetamine laboratory (**no gross contamination**):
   i. Little to no potential for injury.
   ii. No automatic referral is needed.
   iii. Anyone with symptoms of nausea, vomiting, diarrhea, abdominal pain, chest pain, difficulty swallowing, or change in voice should be evaluated.
3. In a health care facility
   i. Severe gastrointestinal and pulmonary injuries have resulted from ingestion of methamphetamine laboratory chemicals.
   ii. The exact treatment required when methamphetamine chemicals are ingested is impossible to completely detail in this document.
   iii. Below is a partial list of compounds with some specific recommendations when ingestion occurs, but the caregiver should contact a poison center for assistance.
      a. Methanol: Acidosis, serum level required, treatment with fomepazole.

b. Iodine: Acidosis, treatment with oral starch solution.

c. pH modulators: Caustic ingestion, likely require endoscopy.

iv. Metal salts are occasionally used in meth labs, but there is almost no need for routine metal screening.

a. With *ingestion* the possibility of metal toxicity from mercury or lead salts does exist and should be pursued if relevant based on the laboratory type.

b. Children do not routinely require heavy metal screening.

G. Asymptomatic pediatric exposure for children younger than 6 years (Kolecki, 1998; Mecham and Melini, 2002)

1. Decontaminate skin with soap and water if not performed at scene.

   i. One does not need special gear; decontamination should be undertaken as rapidly as possible with minimal psychological trauma. A calm, simple shower or bath is sufficient.

   ii. No need for special hazmat setup for decontamination.

2. Provide a change of clothing.

3. *Grossly* contaminated toys and clothing need to be handled with gloves, bagged, and discarded (after consultation with law enforcement). **

4. Other toys and clothing may be returned after washing with soap and water.

   i. It is *totally unnecessary* to dispose of all toys.

   ii. Due to the risk of additional psychological injury, make every effort to return the toys or security (comfort) items to the child.

5. Screening physical exam by a doctor. If child is not visibly contaminated and is asymptomatic, this exam may be deferred to the child's pediatrician within a few days.

6. Routine laboratory testing for metals, solvents, or drugs of abuse is not required or recommended.

7. Neglect and abuse likely play a highly significant role in the adverse developmental effects on children from methamphetamine lab exposures.

8. Samples obtained for legal purposes should follow the chain of custody and should undergo proper analysis (not at the hospital lab). Obtaining these samples should not cause the child any discomfort.

H. Decontaminated methamphetamine laboratory site

1. If a certified hazmat group has already professionally cleaned the area, it poses no health threat.
2. If a *noncertified* hazmat group has cleaned the area, there is a small but real potential for toxicity:
   i. Contact landlord or homeowner.
   ii. Contact local law enforcement or fire department.
   iii. Contact certified hazmat disposal unit for complete cleanup (local law enforcement should have lists of companies in the area).

IV. Consider Poison Center for Professional Toxicological Involvement

A. For patients with significant pulmonary symptoms.

B. For patients with dermal contamination exceeding 15% of the body surface area.

C. For patients with deliberate ingestion of methamphetamine laboratory compounds, regardless of symptoms.

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Acute Methamphetamine Toxicity: A Guide for Emergency Care Providers

Introduction

Amphetamines have long been valued medicinally for their vasoconstrictive and central nervous system stimulation properties. Unfortunately these same properties make amphetamines a common drug of abuse in today's society. They are classified as schedule II drugs by the U.S. Controlled Substances Act (1970) and are therefore heavily regulated by the Drug Enforcement Administration (DEA) even in legal prescribing practices. Today, amphetamines are used clinically in the treatment of narcolepsy and attention deficit hyperactivity disorder.

In recent years, methamphetamine abuse and illegal manufacturing has skyrocketed and has become a major concern to emergency providers, public health officials, and law enforcement. Methamphetamine was first synthesized in 1887 by a Japanese pharmacologist in the attempt to make synthetic ephedrine for the treatment of asthma (Chang, 2006). Today the synthesis of methamphetamine can be accomplished with limited precursors by untrained chemists in relatively simple reaction sequences that are described on the Internet. In Georgia alone, 23% of all federal drug cases involved methamphetamine, and 12% of all drug treatment admissions reported secondary to methamphetamine abuse (DEA, 2006).

Street Knowledge

Methamphetamine has many street names including, "meth," "crystal meth," "crystal," "ice," "speed," "crank," "glass," and "chalk." It has a crystalline structure and may vary in color from completely clear to yellowish brown. Methamphetamine can be injected, smoked, or ingested orally or intranasally. Its effects are likened to

those of cocaine but with a longer "high." Intravenous use of the drug produces an intense rush for the user and, like other modes of abuse, it is associated with formication and skin picking, psychosis, agitation, and extreme suspiciousness. The intravenous use of methamphetamine carries the same risks as any intravenous drug use, including increased risk of HIV, Hepatitis B and C, endocarditis, and skin infections. Smokable methamphetamine is often referred to as "ice" and has the reputation of a rapid and intense onset of the high, which may last up to 15 hours. Smoking requires a larger dose than injecting, as the bioavailability is only about 50% when inhaled. Oral and intranasal abuse may be associated with increased tooth wear and sinus problems and may be the most common method of abuse worldwide (Lynton & Albertson, 2004).

Signs and Symptoms

Methamphetamine affects every organ system in the human body. However, there is particular damage to cardiovascular, pulmonary, and central nervous systems. The typical presentation is consistent with a sympathomimetic toxidrome with hypertension, tachycardia, mydriasis, hyperthermia, agitation, altered mental status, and diaphoresis. Patients may present with chest pain, palpitations, arrhythmias, myocardial infarction, vasculitis, severe hypertension, or aortic dissection or aneurysms. Hypotension and bradycardia have also been observed in the setting of severe overdose. Central nervous system signs and symptoms include agitation, paranoia, anxiety, florid psychosis or mania, compulsory movements, choroid athetosis, strokes, memory impairment, and decreased concentration. Tactile and audiovisual hallucinations and even coma are also common. For the respiratory system, patients may also present with pulmonary hypertension, pulmonary edema, barotrauma, and thermal injury. Patients also commonly present in rhabdomyolysis and frequently have signs or symptoms consistent with acute renal failure. Liver failure has been reported in association with methamphetamine toxicity, but it is uncommon. Methamphetamine abusers often have significant skin lesions and infections from formication and agitation. Bruxism, or teeth grinding, is often apparent. Pediatric patients have often presented with inconsolable irritability, agitation, vomiting, and abdominal pain after inadvertent exposure (Lynton & Albertson, 2004).

Mechanisms

The basic mechanism for most cardiovascular toxicity involves the release of catecholamines dopamine, norepinephrine (NE), and serotonin (5HT). There is some

evidence to suggest direct toxicity to myofibrils and inflammatory changes that contribute to vasculitis. Neurotoxic effects seem to be mediated by inhibition of reuptake of catechols, which directly affects neurotransmitter concentrations at the synapse leading to toxicity and cell death. Long-term abuse has been shown to decrease catecholamines dopamine stores in both the basal ganglia and substantia nigra and to decrease glucose utilization in the extrapyramidal system, dorsal raphe nucleus, and hippocampus. Decreased glucose utilization has been suggested as the mechanism of the development of psychosis and the reason for prolonged recovery in methamphetamine addicts even after cessation of abuse (Lynton & Albertson, 2004).

Evaluation

A patient's history is the best way to make a diagnosis, but emergency care providers should treat the symptoms even without diagnosis confirmation. All significantly symptomatic patients should have an accucheck (blood glucose check), EKG (electrocardiogram), blood chemistries, CPK (blood test to measure creatine phosphokinase), and urinalysis. Emergency care providers should monitor patients with abnormal vital signs. Careful assessment for hydration status is indicated, as many of the patients have poor oral intake while binging. If the patient has an altered mental status, providers should perform a head CAT scan to detect possible bleeding. Echocardiogram and cardiac catherization may be indicated for some patients with possible endocarditis or pulmonary hypertension (Albertson, 2007). Amphetamines and many related drugs appear in urine and gastric samples; however, it is not convenient to measure serum levels, which may not be correlated with toxicity. Methamphetamine metabolites may be present in urine for more than 48 hours; pH and hydration status affect the duration. There are many substances that yield false positive results on the common immunoassays, including trazodone, H_2-blockers, ritodrine, chlorpromazine, promethazine, segelineselegiline, doxepin, benzathine, and metabolites of labetalol. These results can usually be confirmed with GC/MS (gas chromatography/mass spectrometry) testing at qualified lab facilities (Lynton & Albertson, 2004).

Treatment

The basics of all emergency management apply to methamphetamine toxicity. Airway protection, supplemental oxygen, intravenous access, and rapid evaluation of severity of presentation are necessary. There is no antidote to methamphetamine

toxicity. The focus of treatment must be on controlling the stimulant effects of methamphetamine. Patients should receive supportive care for a life-threatening sign such as hyperthermia; cooling blankets, ice packs in axillae and groin, fans, pharmacologic control of muscle activity, and cold-water immersion are recommended. Dantrolene, though probably not harmful, is not indicated unless there is suspected neuroleptic malignant syndrome. Chemical rather than physical restraints are preferred for severe agitation as physical restraints may worsen muscle injury, worsen rhabdomyolysis, or result in further harm to a struggling patient (Lynton & Albertson, 2004). Benzodiazepines are often sufficient for treatment of agitation; however, haloperidol and droperidol have also been used with some success. Hypertension is generally best treated with sedation with the aforementioned agents. Nitroprusside or phentolamine may be used if sedation alone proves inadequate. Tachyarrhythmias can be controlled with esmolol or propanololpropranolol. Chest pain or arterial vasospasm may be treated with benzodiazepines or nitroglycerin (table 2). Activated charcoal should be considered in the patient presenting after an oral overdose. Gastric lavage is not indicated unless there is suggestion of ingestion of multiple pills or packets within one hour of presentation. Whole bowel irrigation with or without KUB (radiograph of the abdomen) should be considered for patients ingesting large amounts of pills or packets (table 3). Hemodialysis has limited efficacy because the drug is mostly eliminated in the liver (Albertson, 2007).

Table 2

Clinically Based Treatment Options in Acute Methamphetamine Intoxication

Signs and symptoms	Treatments
Hyperthermia	- Icepacks in axillae and groin - Cooling blankets - Cold-water immersion - Pharmacologic control of muscle activity: Benzodiazepines: Diazepam[a] 5–20 mg IV q 5–10 min
Hypertension	- Benzodiazepines: Diazepam[a] 5–20 mg IV q 5–10 min - Phentolamine - Nitroprusside
Tachyarrhythmias	- Benzodiazepines: Diazepam[a] 5–20 mg IV q 5–10 min - Esmolol[b] - Propanolol- Propranolol
Agitation	- Benzodiazepines: Diazepam[a] 5–20 mg IV q 5–10 min - Haloperidol[c] - Droperidol - Chemical restraints preferred over physical restraints
Chest pain	- Benzodiazepines - Nitroglycerine

Notes

[a]Diazepam preferred over lorazepam because maximum respiratory depression is observed at 5–10 min, whereas with lorazepam it will not be observed for 1 hour after administration.

[b]Esmolol is preferred for short duration of action and easy titration to effect.

[c]Antipsychotics are to be used with caution as they may increase anticholinergic symptoms, including hyperthermia secondary to decreased diaphoresis.

Table 3

Quick Reference for Decontamination Methods and Indications

Decontamination method	Indications in setting of methamphetamine use
Activated Charcoal (1g/kg or 10× the amount if ingested toxin)	- All ingestions when able to ensure adequate airway protection - Multi-dose may be appropriate for large packet ingestions, but no role in intravenous use
Whole bowel irrigation	- Large amount of ingestion or concretions on KUB; - Multiple packets ingested; or - Co-ingestion with other drugs
Gastric lavage	- Multiple pills or packets ingested ***within 1 hour*** of presentation[a]

[a]May have significant morbidity secondary to risk of esophageal perforation or aspiration and should be performed with extreme caution and only within 1 hour of ingestion.

After the Hospital

All patients presenting with methamphetamine-related complaints should be referred to treatment centers specializing in addiction either as inpatients or at discharge. Some studies recommend cognitive behavioral therapy as well to decrease addictive behaviors. Furthermore, patients who have been involved in the illegal manufacturing of methamphetamines may need additional care; consultation with a toxicologist or poison control center should be sought.

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Evaluation of Children Exposed to Methamphetamine Manufacture

I. Acute Exposure

Contact with a substance that occurs once or for only a short time (up to 14 days) (Agency for Toxic Substances and Disease Registry)

II. Emergency Department Evaluation of an Acutely Exposed Child

A. After decontamination and evacuation of the child from the clandestine lab site, a thorough and comprehensive health evaluation should be performed. This should involve local Child Protective Services (CPS) agencies.

B. Multiple local protocols have been developed to coordinate the removal, evaluation, and treatment of children found living at methamphetamine labs. Most incorporate a multidisciplinary approach involving law enforcement, social services, medical personnel, and mental health services.

C. In 2000, the National Alliance on Drug Endangered Children was established to provide a national protocol for the medical evaluation of children living in clandestine laboratory sites. This protocol defines specific roles for law enforcement, CPS, and medical personnel (National Alliance for Drug Endangered Children).

   i. The child should be transported to a safe environment with the assistance of law enforcement and local CPS when appropriate

   ii. If child appears ill (fast breathing, obvious burns, lethargy, or somnolence), or if there was an explosion or active chemicals at the scene, the child should be immediately transported to a hospital emergency department (ED) capable of providing medical evaluation of children

iii. A complete medical evaluation should be performed on all other children promptly, as called for in local guidelines

iv. Special emphasis should be place on the skin, pulmonary, and neurological exams, but a comprehensive exam is certainly indicated

v. Urine should be collected as soon as practical and within 12 hours for toxicological evaluation in accordance with the appropriate chain of evidence protocol of the local jurisdiction, when called for in local guidelines

vi. Children should be screened for acute injuries as well as for signs of abuse and neglect

vii. A CBC, Chem-7, and LFTs should be obtained if appropriate.

viii. After the complete medical examination, the child should undergo additional dental, developmental, and mental health examinations, which may be scheduled over the following days.

ix. Specific pediatric medical follow-up should be arranged for repeat examination after 30 days, 6 months, and 1 year.

III. Intermediate Duration and Chronic Exposure Issues

Intermediate duration exposure

"Contact with a substance that occurs for more than 14 days and less than a year" (Agency for Toxic Substances and Disease Registry).

Chronic exposure

"Contact with a substance that occurs over a long time" (more than 1 year) (Agency for Toxic Substances and Disease Registry).

A. Health

All long-term health effects associated with methamphetamine exposure in children have yet to be fully elucidated (The Initiative Foundation, 2004).

1. Neurological

a. "Enduring cognitive deficits" may occur in a neonate born to a mother who is a methamphetamine abuser (Anglin, Burke, Perrochet, Stamper, & Dawud-Noursi, 2000).

b. Developmental delay and severe delay with autistic feature are reported. Speech/language is the most common delay identified and the most common age is 4 to 6 years old (Grant, 2006b).

c. The chemicals (benzene, coleman fuel, ethanol, ephedrine, hexane, lead acetate, mercuric chloride, methyl alcohol, naphtha, nitroethane, pseudoephedrine, and pyridine), which are being used to manufacture methamphetamine, may also affect the central nervous system, especially in children. Refer to 4. **Toxicities from chemical used in or by-products from "cooking" methamphetamine**.

2. Ocular

a. Ocular exposure to acetic acid, acetic anhydride, ammonia, benzyl chloride, formic acid, hydrogen iodide, lithium aluminum hydride, mercuric chloride, methyl alcohol, methylamine, and naphtha may cause long-term injury such as permanent eye damage, corneal injury, or blindness. Refer to 4. **Toxicities from chemical used in or by-products from "cooking" methamphetamine**.

3. Respiratory

a. Inhalation or aspiration of acetic anhydride, acetone, ammonia, benzaldehyde, benzyl chloride, benzene, coleman fuel, ephedrine, formic acid, hydrochloric acid, hydrogen chloride, hydrogen iodide, iodine, lithium aluminum hydride, mercuric chloride, methyl alcohol, nitroethane, phosphine, phosphoric acid, and pseudoephedrine may affect the respiratory system. Refer to 4. **Toxicities from chemical used in or by-products from "cooking" methamphetamine**.

4. Toxicities from chemical used in or by-products from "cooking" methamphetamine (Burgess & Chandler, 2003)

i. Acetic Acid

a. Use: Synthesis of phenyl-2-proanone (P2P), which is used in the manufacture of methamphetamine

b. Health hazards: Irritant to eyes, nose, throat, and lungs. Sufficient exposure may also lead to dermal burns, pulmonary edema (swelling or fluid in the lungs), ocular ulcerations, and potentially permanent eye damage.

ii. Acetic anhydride

a. Use: Synthesis of P2P

b. Health hazards: Irritant to skin, eyes, and mucous membranes. It can also cause skin burns, blindness, bronchospasm, and nasal mucosa ulcerations, especially in high concentration.

iii. Acetone

a. Use: Methamphetamine production solvent

b. Health hazards: Airway, eyes, skin irritant. Flammable liquid at room temperature when mixed with air. Tremors, fatigue, blurred vision, bizarre behavior, coughing, coma, and death may occur if there is prolonged exposure.

iv. Ammonia

a. Use: Methamphetamine synthesis reagent

b. Health hazards: May cause burns to skin, eyes, nose, pharynx, and larynx. Ocular exposure can also cause temporary or permanent blindness. Bronchospasm, wheezing, laryngitis, tracheitis, chemical pneumonitis, and pulmonary edema may occur with respiratory exposure.

v. Benzaldehyde

a. Use: Synthesis of P2P or amphetamine precursor

b. Health hazards: Irritant to lungs, skin, and eyes. It may cause contact dermatitis.

vi. Benzyl chloride

a. Use: Production of methamphetamine

b. Health hazards: Irritant to eyes, skin, and mucous membranes. It may cause pulmonary edema with respiratory exposure, dermatitis with skin exposure, and corneal injury with eye exposure. Headache, weakness, and irritability may also occur at low concentrations.

vii. Benzene

a. Use: Methamphetamine production solvent

b. Health hazards: Flammable liquid. Irritant to eyes, nose, throat, and lungs. It may damage the central nervous system (headache, confusion, short-term memory loss, and dizziness). Kidney damage, anemia, and leukemia may be seen following chronic exposure, and

coma and death may occur following prolonged or sufficiently intense acute exposure.

viii. Coleman fuel

a. Use: D-methamphetamine extraction

b. Health hazards: Flammable liquid. Irritant to eyes and skin. It may cause delayed lung injury, depression of the nervous system, convulsions, and loss of consciousness.

ix. Ephedrine

a. Use: Precursor in methamphetamine production

b. Health hazards: Irritant to eyes, skin, and the respiratory system. Headache, hypertension, tachycardia, and stroke may occur with ingestion.

x. Ethanol

a. Use: Methamphetamine production

b. Health hazards: Flammable liquid. Nose and throat irritation, headache, confusion, nausea, vomiting and drowsiness may occur with inhalation. Burning sensation, seizures, dizziness, confusion, unconsciousness, and death may occur with ingestion. Pediatric ingestion of ethanol may result in clinically significant hypoglycemia. Damage to the nervous and gastrointestinal systems may occur with chronic exposure, especially with ingestion.

xi. Ethyl ether

a. Use: Amphetamine and methamphetamine production

b. Health hazards: Flammable liquid. It may cause headache, vomiting, and intoxication with ingestion or inhalation.

xii. Formic acid

a. Use: Manufacturing process

b. Health hazards: Irritating and corrosive to eyes, skin, lungs, and the gastrointestinal tract (resulting in bloody diarrhea). Pulmonary edema, shock, and death may occur with severe inhalation. Severe burns and pain may occur with ingestion.

xiii. Hexane

a. Use: Methamphetamine production

b. Health hazards: Flammable liquid. Permanent brain and nerve damage, bizarre behavior, coma, and death may occur with prolonged exposure.

xiv. Hydrochloric acid

a. Use: Methamphetamine manufacture

b. Health hazards: Very corrosive to skin, airways, throat, and lungs. Inhalation or vapor exposure to hydrochloric acid may cause permanent lung damage. Skin allergies and tooth decay may occur with prolonged exposure. Release of toxic and flammable gas may occur with heating of the chemical.

xv. Hydrogen chloride

a. Use: Methamphetamine manufacture

b. Health hazards: Irritation to nose and throat. It may cause pulmonary edema and burns.

xvi. Hydrogen iodide

a. Use: Methamphetamine manufacture

b. Health hazards: Corrosive and irritating to the throat, upper respiratory tract, and eyes. High concentrations may cause skin burns, bronchospasm, pneumonitis, chest pain, dyspnea, pulmonary edema, and laryngeal edema.

xvii. Hypophosphorus acid

a. Use: Methamphetamine manufacture

b. Health hazards: Corrosive. It causes burns to mucous membranes when inhaled and skin burns with contact.

xviii. Iodine

a. Use: Hydrogen iodide manufacture

b. Health hazards: Corrosive. Vomiting, headache, delirium, hypotension, and circulatory collapse may occur with ingestion. It may cause skin erythema and swelling with contact. High concentration may cause pulmonary edema.

xix. Lead acetate

a. Use: P2P synthesis

b. Health hazards: Abdominal cramps, nausea, vomiting, constipation, diarrhea, anorexia, and difficulty concentrating. Children are more susceptible having greater effects on the developing nervous system.

xx. Lithium aluminum hydride

a. Use: Hydrogenation in methamphetamine manufacture

b. Health hazards: Corrosive. Severe irritation to the skin, nose, eyes, mucous membranes, and lungs. May cause scarring and inflammation of the eyes.

xxi. Mercuric chloride

a. Use: Methamphetamine manufacture

b. Health hazards: Corrosive. Intense epigastric pain, abdominal pain, bloody emesis, and renal failure may occur with ingestion. Respiratory irritation, lungs and airways destruction, kidney failure, shock, and bizarre behavior may occur with inhalation. Corrosive injury may occur with eye exposure. Chronic exposure may lead to accumulation in the brain, liver, and kidneys.

xxii. Methyl alcohol

a. Use: Methamphetamine manufacture

b. Health hazards: Flammable liquid. Irritation to eyes, nose, throat, and lungs. Headache, nausea, abdominal pain, loss of consciousness, coma, blindness, and brain, pancreas, or kidney damage.

xxiii. Methylamine

a. Use: Methamphetamine manufacture precursor

b. Health hazards: Irritant to skin, eyes, and mucous membranes. Olfactory fatigue may occur. Conjunctival hemorrhage, edema, and superficial corneal opacities may occur with eye exposure.

xxiv. Naphtha

a. Use: Methamphetamine manufacture

b. Health hazards: Burns or irritation to skin and eyes. Headache, nausea, confusion, dizziness, unconsciousness, and central nervous system depression may occur with inhalation.

xxv. Nitroethane

a. Use: P2P synthesis precursor

b. Health hazards: Irritant to mucous membranes, respiratory tract, skin, and eyes. Depression of the central nervous system, renal and liver toxicity, weakness, ataxia, convulsions, nausea, vomiting, and diarrhea may occur.

xxvi. Phenylacetic acid

a. Use: P2P synthesis precursor

b. Health hazards: Tetratogen. Irritant to skin and eyes. Headache, dizziness, and nausea may occur.

xxvii. Phenyl-2-propanone (P2P)

a. Use: Precursor for methamphetamine production

b. Health hazards: Irritant to skin and eyes. Headache, nausea, and dizziness may occur with inhalation.

xxviii. Phosphine

a. Use: Product of methamphetamine production

b. Health hazards: Flammable gas. Dizziness, tremors, vomiting, shortness of breath, delayed lung damage, and convulsions may occur with inhalation.

xxix. Phosphoric acid

a. Use: Precursor in amphetamine and methamphetamine production

b. Health hazards: Irritant to eyes, skin, nose, and throat. Allergies and damage to lungs, liver, bloodstream, and bone marrow may occur with chronic exposure. Release of phosphine gas may occur when contact occurs with metal.

xxx. Pseudoephedrine

a. Use: Precursor in methamphetamine production

b. Health hazards: Irritant to eyes, skin, and the respiratory system. Headache, tachycardia, hypertension, and stroke may occur with ingestion.

xxxi. Pyridine

a. Use: P2P synthesis

b. Health hazards: Irritant and central nervous system depressant. Vapor exposure may cause headaches, vertigo, nausea, vomiting,

nervousness, sleeplessness. Repeated exposure may cause skin irritation. Lower back pain may also occur without evidence of a back injury.

B. Social

a. The social disease of illicit drug use and trafficking fractures the home environment of a child who lives in a methamphetamine lab

b. The binge-and-crash pattern of using the drug makes it difficult for parental abusers to meet the basic needs of their children (Mecham & Melini, 2002).

c. Children are frequently chronically malnourished and deprived of essential medical and dental care.

d. Children's hygiene and grooming are often neglected, and parents do not supervise children to safeguard them from the various environmental hazards present in the meth lab (Grant, 2006a).

e. In California, the Governor's Office of Criminal Justice Planning (n.d.) documented the living conditions of children rescued from two separate meth lab homes.

1. In the first, five children were found with needle marks on their hands, feet, arms, and legs from accidental contact with syringes. All five children were subsequently determined to be infected with hepatitis C.

2. In the second, a 2-year-old child was found with open sores around her eyes and on her forehead that resembled a severe burn. Later, the condition was diagnosed as chronic repeated cockroach bites that had been left untreated.

f. Children living in meth labs have a higher risk of physical and sexual abuse.

1. A constant parade of disinhibited strangers in the meth home may create an environment in which children are easy and convenient targets for physical and sexual abuse (Philpot, 2000).

2. Methamphetamine users are known to often experience states of hypersexuality.

3. Pornography and adult objects are often present and accessible to children in meth labs (Mecham & Melini, 2002).

g. Violence also commonly occurs in conjunction with illegal drug trafficking, and children can be witnesses or forced participants in these events.

h. Because meth users are often paranoid, there are often firearms and weapons present. Booby traps and explosives have also been reported in meth labs to combat police and rival drug traffickers (Swetlow, 2003).

i. Children may witness the arrest and forcible removal of parents or caregivers by police, leading to psychological trauma.

j. Chronic exposure to the combined chaos, neglect, abuse, and violence of the meth lab environment often leads to long-term sociologic sequelae.

   1. Children form their social mores from observing their parents' and caregivers' behavior.

   2. Children found in meth labs often develop low self-esteem, a sense of shame, an inability to trust others, and poor social skills.

   3. Latent consequences that manifest later in life include delinquency, school absenteeism, teen pregnancy, failure, isolation, and poor peer relations (Swetlow, 2003).

   4. Without effective intervention, many children imitate their parents and caregivers as adults and perpetuate the cycle of criminal behavior, violence, and substance abuse (Oishi, West, & Stuntz, 2000).

C. Psychological

   a. Living in the stressful and unstable environment of a meth lab home, children can develop behavioral, emotional, and cognitive problems that will plague them throughout their entire lives (Peed, 2004).

   b. Many children who live in meth homes develop an attachment disorder.

      1. This disorder occurs when parents or caretakers either fail to respond to an infant's basic needs or when they respond to the infant unpredictably.

      2. Infants with this disorder typically do not cry or show any emotion when separated from their parents.

3. Children who develop an attachment disorder are at greater risk of later engaging in criminal behavior and of abusing substances.
4. Early mental health intervention and the presence of stable, nurturing caregivers can help minimize long-term damage (Swetlow, 2003).

c. Repeated neglect and abuse undoubtedly cause lasting psychological and emotional trauma for children living in a meth lab household.

d. The effects are later manifested by developmental delays, behavioral problems, mental health disease, and antisocial behavior.

e. Children who are rescued from drug environments can suffer post-traumatic stress disorder for six months to a year after being removed from the environment (Peed, 2004).

f. To minimize long-term damage, a psychologist or other mental health professional should be made available to provide therapeutic services for all children rescued from meth labs.

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Environmental Considerations in Cleanup of a Clandestine Methamphetamine Lab

The following information is not a substitute for an evaluation by a trained medical toxicologist. This guide is intended to increase awareness and educate physicians, medical personnel, and the public about the potential dangers that clandestine methamphetamine labs present. If you feel that you may be exposed to methamphetamine or its by-products, see your doctor or a trained medical toxicologist.

Chronic environmental exposure to methamphetamine

The toxic effects of methamphetamine are commonly seen in chronic users. Like any toxic side effect, the severity is dependent on duration of exposure and dose. In other words, people who take in high doses of a substance tend to suffer more significant adverse effects than those who take in smaller amounts. People who are exposed to a substance for a longer period at the same dose tend to suffer more significant adverse effects than those who are exposed for only a short period. These principles form the basis for determining the potential for illness because of exposures from clandestine methamphetamine labs.

A chronic exposure occurs when someone encounters a substance more than once over an indeterminate period. Exposure could occur over days, weeks, months, or years.

Little objective data exist for chronic environmental exposure to methamphetamine. Most of the medical information comes from observations and studies in individual users who have abused methamphetamine. Obviously, these individuals tend to have much more severe and prolonged illnesses than someone who is

exposed to low levels of methamphetamine over the same period. However, these side effects are no less significant to the people who experience them.

Who is at risk of being exposed to methamphetamine or the chemicals used in the production of methamphetamine?

- People who live in or near a clandestine methamphetamine lab
- People who live in a former lab that was not appropriately cleaned and remediated
- People eating food grown in soil near a methamphetamine lab
- First responders (police, fire, hazmat, emergency medicine providers) who enter clandestine labs or who handle chemicals from methamphetamine labs

What are the routes of exposure?

- Inhalation
- Ingestion
- Dermal absorption

What are the possible medical issues that may be consistent with chronic exposure and toxicity from methamphetamine

- Insomnia
- Irritability
- Hyperactivity
- Personality changes
- Decreased appetite, weight loss
- Poor concentration
- Anxiety
- Compulsive behavior
- Dermatoses

Symptoms may be magnified in people who have conditions such as the following:

- Hypertension

- Hyperthyroidism
- Arteriosclerosis
- Glaucoma
- Psychiatric illness
- Pregnancy
- Animal studies have suggested that chronic exposure to methamphetamine may be associated with long-term neuropsychiatric changes (Smith, La-Gasse, Derauf, Grant, Shah, et al., 2006).

Some children may have neuropsychiatric, developmental, and behavioral problems if exposed to methamphetamine directly or while in utero. Fetal growth restriction may occur in some newborns with neonatal exposure to methamphetamine.

What should a primary care physician *consider* when faced with a patient that has had a potential environmental exposure to methamphetamine?

- Complete and detailed history and physical examination
- Blood pressure check
- Nutritional assessment
- Environmental exposure history
- Urine drug testing for methamphetamine
- Heavy metal screen
- Basic lab testing (complete blood count, blood chemistries)
- Consultation with a board-certified medical toxicologist
- Consultation with a psychiatrist for psychiatric disturbances
- Environmental testing (soil, septic tank, water, and surface sampling)

Clandestine methamphetamine labs come in many configurations. They are often located in remote areas and may be constructed in a wide variety of locales, including hotels, motels, trailers, trucks, automobiles, and houses. Clandestine methamphetamine labs can be erected for repeat "cooks" or can be intended for single use only in an effort to avoid law enforcement. In addition to the variety of locations these labs may be found in, methamphetamine production processes vary to some

degree. The synthesis pathway, reagents used, and by-products formed may vary by batch. The nature of the hazards involved range vastly; officials must carefully evaluate cleanup on a case-by-case basis.

The primary goals of cleaning up a clandestine methamphetamine lab include the following:

- Identify reagents, by-products, and other hazardous substances at the clandestine methamphetamine lab site.
- Remove or contain as much residual contamination as possible.
- Restore the structure to a suitable living condition.
- Dispose of hazardous waste in a safe manner (Centers for Disease Control and Prevention, 2000).

The potential hazards from a former clandestine methamphetamine lab may involve

- airborne contaminants,
- chemical spills,
- retained reagents,
- by-product waste, and
- contaminated surfaces and household items (Tennessee Department of Environment and Conservation).

These substances can be potentially harmful to cleanup workers and future occupants if not handled properly (Centers for Disease Control and Prevention, 2005).

Airborne contaminants include reaction by-products and volatilized reagents. Studies conducted in seized labs show that chemicals may disperse widely throughout structures and be deposited on household items in unpredictable patterns. Methamphetamine and other by-product contaminants may be found on carpets, furniture, walls, ceilings, insulation, clothes, toys, and any absorbent surface (Hammon & Griffin, 2007).

- A typical "cook" can release as much as 5,500 micrograms of methamphetamine per cubic meter into the air.
- The constant deposition of these aerosolized particles can accumulate up to16,000 micrograms per 100 square centimeters onto surfaces.

- If these highly concentrated residuals accumulate in ventilation ducts they may disperse contaminants throughout the facility.
- Cleanup crews should presume that all surfaces and structures may be contaminated and hazardous prior to remediation (Hammon & Griffin, 2007).

By-products such as phosphine gas may be given off during the cooking process. Other reagents can spontaneously volatilize. Liquid chemical spills of reagents such as ammonia, methanol, ether, and acetone can cause a slow release of volatilized reagents and pose an airborne threat until properly removed and disposed of.

Methamphetamine producers often discard hazardous waste indiscriminately in the most readily available way. Common places such waste may be found include

- household drains,
- bathtubs,
- large containers,
- backyard trenches, and
- soil.

These chemicals can contaminate groundwater and the environment. Residual contaminants left on surface soil or in drains may include various acids and bases that are corrosive and contain potentially hazardous components that need to be neutralized during cleanup.

When a clandestine methamphetamine lab is seized, bulk reagents, leftover chemicals, and methamphetamine are often found at the site. Because of concomitant drug use, needles, syringes and other drug paraphernalia often may be found and need disposal. These items often are helpful to law enforcement for prosecution.

The cleanup process of a seized clandestine methamphetamine lab should start with an assessment of the chemicals used at that site. Two common techniques used to produce methamphetamine are

- the anhydrous ammonia method (i.e. Birch method, "Nazi" method) and
- the red phosphorous method.

Each of these processes poses unique risks inherent to its ingredients, reaction intermediates, impurities, and by-products. A forensic chemist can assist in determining which method was used by sampling and identifying these substances in residual

contaminants (Barker, 2007). However, the possibility that more than one method has been used should not be overlooked during the cleanup.

The Birch method (also known as the "Nazi" method) is a reduction method that uses anhydrous ammonia and lithium or sodium metal to reduce ephedrine to methamphetamine. The reduction of the hydroxyl component of an ephedrine molecule creates methamphetamine. Solvents typically used in this reaction include diethyl ether, tetrahydrofuran, ethanol, and methanol (Burgess, 2003).

Ephedrine ⇨ Methamphetamine

The most popular method of reducing ephedrine or pseudoephedrine to methamphetamine is the so-called red phosphorous method. This method uses hydriodic acid and red phosphorous in a one-step process to synthesize methamphetamine. During the process, hydriodic acid vapors are aerosolized from the solution and can be very harmful. The hydriodic vapors can cause a chemical pneumonitis if proper personal protective equipment is not worn. When the red phosphorous is heated in the presence of hydriodic acid, phosphine gas is emitted. This is a potentially dangerous gas with a strong fishy odor.

Cleanup

- Clandestine methamphetamine labs should never be ignited (burned) or detonated. Burning may release potentially harmful substances into the air.
- Adequate ventilation is important when decontaminating a former clandestine methamphetamine lab. Adequately ventilating contaminated areas will help to safely decontaminate most solvent vapors that are dangerous to worker safety. Most solvents tend to evaporate easily and dissipate when ventilated.
- Spilled chemicals may cause a persistent release of volatile compound and should be removed and remediated as completely as possible.

- Some chemicals may be undetectable upon arrival to the scene, but disturbing the structure may re-aerosolize hazardous materials and pose a secondary risk. Also, some chemicals can volatize with a rise in humidity or temperature.
- Post-cleanup samples should be taken before humans reoccupy the structure.
- Surface samples for methamphetamine should be no greater than 0.5 microgram per 100 cm^2 (Minnesota Department of Health, 2007).
- Indoor ambient air samples for volatile organic compounds should be no greater than 1 part per million.

Worker Safety

- Police, firefighters, and medical responders should be aware of the potential dangers that clandestine methamphetamine labs hold
- Workers should take great caution because hazardous materials are often hidden or concealed in unassuming places.
- First responders and cleanup crews should wear appropriate personal protective equipment before entering clandestine methamphetamine labs. Chemical injuries and respiratory exposures are common in first responders entering clandestine methamphetamine labs without personal protective equipment (Centers for Disease Control and Prevention, 2005; Madden, Flynn, Zandonatti, May, Parsons, et al., 2005).

Disposal

- All demolition waste including carpet, furniture, and other items should be hauled to a class I landfill.
- Personal protective equipment, clothing, and remediation cleaning materials used at a site may be disposed of as municipal solid waste.
- Water used for cleaning purposes may generally be disposed to a municipal collection system or into a functional septic system as dilution will usually be adequate to render the harmful chemicals a low risk. However, consult local environmental authorities whenever possible.

- Check with local authorities for proper removal and disposal of materials containing asbestos, lead, and mercury because regulations vary from state to state.

Cleanup Scenarios

1. The "one-time cook" clandestine methamphetamine lab

A clandestine lab that produced only a small amount of methamphetamine. If reagents or products are found, only a small amount of reagents are present at the scene. These types of labs are typically found in trailers, motels, and homes. This is because the cook was mobile or transient and was not set up to make massive amounts of methamphetamine for a long period. A "cook" may have occurred over a weekend or for personal use only. This is the lowest level of risk because of the smaller amount of by-products and reagents involved.

- Ventilate the structure to remove remaining volatile chemicals.
- Screen air for volatile organic compounds.
- Remove any residual waste including cooking equipment or leftover reagents.
- Evacuate any containers found at the structure including buckets, tubing, and glassware.
- Discard all clothing and loose objects.
- Clean all surfaces.
- Commercially clean or replace carpets.
- After cleaning is complete, obtain samples to determine if the decontamination was sufficient (measure for volatile organic compounds, perform a methamphetamine swipe test, and take any other appropriate sample).

2. The "short-term cook" clandestine methamphetamine lab.

This is the same scenario as the "one-time cook" lab, but with more extensive contamination. This type of lab was used multiple times over a short period before the "cooks" moved on to another site. These labs are also found in trailers, motels, or homes. Leftover reagents, spills, waste, and paraphernalia are often found at these sites because the cookers are using the structure transiently. This is unlike a "one-

time cook," where the cooks live in the structure permanently. These cooks are usually nomadic and use the structures for a short period. They tend to be messy and careless, so spills and waste are common.

- The minimum cleanup should include the same requirements from "one-time cook" labs.
- Ventilate structure for a minimum of eight days with or without cyclic heating.
- Screen for volatile organic compounds prior to cleanup.
- Remove all residual waste products in containers.
- Dispose of all cooking equipment.
- Remove all absorbent surfaces such as carpets, drapes, clothes, mattresses, and drop ceilings.
- Remove surfaces that are stained or that are in close proximity to the site.
- Clean all surfaces including ventilation ducts. Replace air filter.
- Acquire confirmatory sample to ensure decontamination was adequate

3. The "recurrent cook" or "entrenched cook"

This type of clandestine methamphetamine lab is a property that was set up for cooking over an extended period. Its sole use may have been for producing methamphetamines, but people (the cook and associates or family members) may have also occupied the structure. These structures are usually located in rural or isolated areas. Trailers are common sites for reoccurring cooks. The nature of these sites make contamination much more serious. Methamphetamine and by-products may occur in high concentrations on the surfaces and materials of these structures. Large amounts of waste or reagents may also be found in storage within the structure. Officials often dispose entirely of trailers instead of decontaminating them for reuse. It is never acceptable to burn or detonate former clandestine methamphetamine labs.

- The minimum cleanup should include the. same requirements from "short-term cook" labs
- Ventilate the property for a minimum of two weeks.
- Screen for volatile organic compounds.

- Remove and dispose of any by-product or waste.
- Remove all contaminated surfaces or items that have been rendered unserviceable secondary to thorough contamination or inability to clean.
- Sample soil and septic tanks for a possible environmental decontamination.
- Close neighbors (within 200 yards) should not grow fruits and vegetables in the soil until samples confirm safety.

4. The "commercial cook"

This type of meth lab usually involves a mass production of methamphetamine in a larger structure such as a warehouse or commercial lab setting. These facilities have the potential to make massive amounts of methamphetamine and in turn generate substantial amounts of waste. Chemicals are often found in barrels or drums and stored or buried. These sites tend to be cleaner than smaller operations, but because of the massive amount of meth production, they are still highly contaminated.

- The minimum cleanup should include the same requirements from "recurrent cook" labs.
- Deconstruction of the equipment may be complicated and may cause more contamination of the site.
- Massive amounts of reagents and waste are found at these sites.

Testing prior to occupancy of a former clandestine methamphetamine lab

Structures have a wide range of contamination potential that depends on the type of lab that was seized. Investigate the property thoroughly for methamphetamine or by-product contamination before allowing anyone to move into a former clandestine methamphetamine lab.

- Surface samples for methamphetamine should be no greater than 0.5 microgram per 100 cm^2 (Minnesota Department of Health, 2007).
- Indoor ambient air samples for volatile organic compounds should be no greater than 1 part per million.
- Take soil samples to screen for potential dumping sites. There are maximum threshold limits available for substances found.

- Ensure ventilation systems are in operating condition and test them for potential recontamination at later point.
- Test well water and septic tanks if present
- Do not use commercial testing products available for purchase over the Internet because of potential unreliability and lack of scientific validation for many products.

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Tennessee Department of Environment and Conservation. Reasonable, appropriate, protective cleanup response and documentation guidance for properties quarantined because of clandestine methamphetamine laboratory activities.

Evaluation Form

The Society for Public Health Education and the American College of Medical Toxicology would like your feedback about the usefulness of this toolkit. Your response to the following questions is appreciated.

Considering your work responsibilities, how useful did you find each component of this toolkit?

	Not at all useful				Very useful	Did not use
The Primer	1	2	3	4	5	☐
Information Sheet for Property Owners, Landlords, and Real Estate Agents	1	2	3	4	5	☐
Information Sheet for Community Leaders	1	2	3	4	5	☐
Information Sheet for Law Enforcement	1	2	3	4	5	☐
Information Sheet for First Responders	1	2	3	4	5	☐
Information Sheet for Health Care Professionals and Child Welfare Officials	1	2	3	4	5	☐
Information Sheet for School Officials and Parents	1	2	3	4	5	☐
Information Sheet for Retailers and Other Community Members	1	2	3	4	5	☐
Community Action Information and Tools	1	2	3	4	5	☐
Resource Directory	1	2	3	4	5	☐
Acute Meth Toxicity: A Guide for Clinicians	1	2	3	4	5	☐
Acute Meth Toxicity: A Guide for Emergency Providers	1	2	3	4	5	☐
Evaluation of Children Exposed to Meth Manufacture	1	2	3	4	5	☐
Environmental Considerations in Cleanup of a Clandestine Meth Lab	1	2	3	4	5	☐

Comments:

Please indicate the extent to which the following occurred as a result of using this toolkit.

	Not at all				Quite a bit
Enhanced my own understanding of meth issues	1	2	3	4	5
Enhanced my presentations, etc., about meth to various audiences	1	2	3	4	5
Was easy to integrate into my presentations, etc.	1	2	3	4	5
Offered content that was at an appropriate level	1	2	3	4	5
Offered content that was too technical	1	2	3	4	5
Benefited some groups that I work with more than others. If so, who benefited most?_____ _____	1	2	3	4	5

Comments:

Since receiving and reviewing this toolkit, which of the following have you done?

a. Established contacts and relationships with other individuals or organizations that are conducting or have conducted educational or outreach activities for meth in my community.

☐ No ☐ Yes

If yes, please describe what types of events or activities.

b. Created or otherwise participated in an anti-meth coalition or task force.

☐ No ☐ Yes

If yes,

How often does or will this group meet?

How many meetings have you attended?

Do you intend to continue to participate in this group?

Comments:

What suggestions do you have for *additional materials* or *content* to add or change that may improve future versions of this toolkit or similar toolkits?

If you have not used or do not plan to use this toolkit, please indicate your primary reasons.

Additional comments:

In what setting(s) do you work? *(Check all that apply.)*

☐ Federal agency
☐ State health department
☐ County/city/local health department
☐ Hospital/other health care setting
☐ College/university
☐ School (K–12)
☐ Private business/industry
☐ Other (please specify): _____

☐ Community-based organization/voluntary agency/nongovernmental organization

Please indicate which of the following audiences you provide most of your services to. *(Check all that apply.)*

☐ Infants and children (birth–14 y)
☐ Youths/adolescents (15–24 y)
☐ Adults (25–64 y)
☐ Older adults (65+)
☐ Health professionals
☐ Special needs populations (please specify): _____
☐ Other (please specify): _____

In which state do you work? _____

Please describe your community: ☐ Urban ☐ Suburban ☐ Rural

Would you describe your work as public health education? ☐ No ☐ Yes

What is your job title? _____

Thank you for your time!

Please send your completed form to

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