Chemical Exposures Associated with Clandestine Methamphetamine Laboratories

National Jewish Medical and Research Center
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Multi-Agency Cooperation

• North Metro Drug Task Force
• National Institute for Occupational Safety and Health
• Tri-County Health Department
• High Intensity Drug Trafficking Area
• U.S. Drug Enforcement Agency
• National Jewish Medical and Research Center
Methamphetamine Myths

- The chemicals used are just household chemicals and will not hurt anyone.
- If it doesn’t hurt the cooks, it can’t hurt anyone else.
- As long as you don’t smell a chemical odor, everything will be OK.
- Exposures only last for a short time and therefore will not hurt anyone.
- Exposures are usually below current standards and do not present a hazard for anyone.

Meth Lab Responses: Inactive

- Responded to suspected clandestine laboratories
  - Hotel Rooms
  - Homes
  - Apartments
  - Vehicles
  - Mobile Homes
Definitions

- **Permissible Exposure Limit (PEL)**
  8 hour time-weighted average (TWA)
  Occupational exposures only

- **Ceiling Value**
  A concentration that should not be exceeded during any part of the working exposure

- **Short Term Exposure Limit (STEL)**
  Not to be exceeded for a 15 minute TWA

- **Immediately Dangerous to Life and Health (IDLH)**
  Irreversible health effects or death after 30 minutes of exposure

Other Definitions

- **PPM** – common measurement of airborne compounds
  1 minute in 2 years
  1 inch in 16 miles
  1 drop in 185 cans of beer

- **µg** – common measurement of mass
  1/1000th of a milligram
Phosphine

- Invisible with slight fish or garlic odor
- Symptoms
  - Severe pulmonary irritant
  - Nausea, vomiting, diarrhea, chest tightness, cough, headache, may be caused by exposures as low as 10 ppm
  - Pulmonary edema has caused death
  - Implicated in deaths at Meth Labs
- Current Exposure Standards
  - PEL = 0.3 ppm
  - STEL = 1 ppm
  - IDLH = 50 ppm

Phosphine Exposure Levels

- Red P and Hypophosphorous cooks:
  - ND to 3.5 ppm (10 x the PEL of 0.3 ppm)
  - In the area of the cook in a home it averaged 0.94 ppm
- The cook temperature and water content may have a significant effect on the amounts of phosphine generated
- Phosphine may be present in “death bag” at high concentrations
Iodine

- Sharp, metallic smell
- Iodine – Airborne
  - Irritant of the eyes, mucous membranes, and skin
  - May cause chest tightness and difficulty breathing
  - Levels of 1.63 ppm will cause eye irritation in all exposed within 5 minutes
  - Skin rash due to hypersensitivity can occur
- Current Exposure Standards
  - PEL = 0.1 ppm Ceiling
  - IDLH = 2 ppm

Iodine Exposure Levels

- Measured Exposure Range
  - 0.23 ppm – 3.7 ppm (almost 2x the IDLH)

- Levels measured in the house cook
  - Cook area = 0.16 ppm
  - Down the hall = 0.04 ppm

- Levels measured in the hotel cook
  - 0.001 ppm – 0.05 ppm
Anhydrous Ammonia

• Symptoms
  - Severe irritant of the eyes, respiratory tract, and skin
  - After 70 ppm, most individuals will report irritation
  - Levels over 2500 may cause corneal irritation, bronchospasm, chest pain, and pulmonary edema. Bronchitis and pneumonia may also occur
  - Tolerance may be acquired

• Current Exposure Standards
  PEL = 25 ppm
  STEL = 35 ppm
  IDLH = 300 ppm

Cook Results: Anhydrous

PEL = 25 ppm
IDLH = 300 ppm

Cook area: 190 ppm
Across room: <66 ppm
• Well Ventilated

Cook area: 410 ppm
Across room: 130 ppm
• Non-Vented

Real time instruments: Overloaded
Highest measurement: >3,000 ppm
Hydrochloric Acid

- Colorless gas with pungent odor
- Symptoms – Airborne
  - Upper respiratory tract irritation – cough, burning throat, choking, burning eyes, chest pain
  - Acute symptoms may occur as low as 5 ppm
  - Skin contact may cause burns and ulceration
- Current Exposure Levels
  - Ceiling = 2 ppm
  - IDLH = 50 ppm

Hydrogen Chloride Exposure Levels

- Average exposures during entire cook period:
  - 0.3 – 2.3 ppm (slightly above the 2 ppm Ceiling)
- Average exposure during salting out:
  - 3.8 – 7.2 ppm ( > 3 x the Ceiling)
- Peak concentrations during salting out:
  - 60 ppm – 155 ppm ( > 3 x the IDLH)
Methamphetamine

• Symptoms
  - Very little known regarding low level chronic exposures
  - Irritation of the skin, eyes, mucous membranes, and upper respiratory tract
  - High levels may cause dizziness, headache, metallic taste, insomnia, high or low blood pressure, etc.
  - Chronic exposures may cause irritability, personality changes, anxiety, hallucinations, psychotic behavior
  - Smaller infants, altered behavior patterns, lower IQ scores, teratogenic affects, cerebral hemorrhage

• Current Standards
  - Surface contamination: 0.1 – 0.5 µg/100 cm²
  - No Effect Level Unknown
  - Therapeutic dose = 5 mg (2 - 3 x per day)

Methamphetamine on Surfaces

• Ranged from non-detect to 16,000 µg/100 cm²
  - Average: 499 µg/100 cm²

• Levels inside microwaves were high

• Levels on air returns were elevated suggesting airborne quantities

• Levels on flat surfaces in the lab area were very high

• Levels exceeding the standard were found in every verified lab
Methamphetamine on Surfaces After One Cook

• Vertical Surfaces
  - 36 inches from Cook: 130 μg/100 cm²
  - 88 inches from Cook: 120 μg/100 cm²
  - 146 inches from Cook: 30 μg/100 cm²
  - 200 inches from Cook: 11.6 μg/100 cm²
  - Hallway 216 inches from Cook: μg/100 cm²

• Clothing Contamination
  - 1 μg/sample to 580 μg/sample
  - Highest during salting out
  - Higher in Red P Methodology

Airborne Methamphetamine Using Red P Method
Exposure Conclusions

- Exposures to iodine, phosphine, anhydrous ammonia, and hydrochloric acid may exceed occupational standards
- Hydrochloric acid, Iodine, and anhydrous ammonia may exceed IDLH Levels
- Significant amounts of airborne methamphetamine are released during the cook and deposited on both horizontal and vertical surfaces

Conclusions (cont)

- Entering the cook area will contaminate clothing with methamphetamine and other chemicals
- The entire area of the home is contaminated by the generated compounds
What About After the Cook?

- Meth in Carpet Dust
  59 µg/m² – 270 µg/m²
- Airborne Methamphetamine
  - During the Cook: 520 – 780 µg/m³
  - Walking Around: 70 – 117 µg/m³
  - Mild Activity: 106 – 170 µg/m³
  - Heavy Activity: 100 – 210 µg/m³
- Majority of airborne meth is less than 1 µm diameter
  - Easily inhaled
  - Travels to deepest part of lungs and directly into the blood

Exposures 24 Hours After Cook
Entry Only Contamination: 24 hours After Cook

- All individuals that entered the home came out with measurable contamination
  - Foot Contamination
    - 0.78 – 49 μg/wipe
  - Hand Contamination
    - 29 - 56 μg/wipe
  - Neck
    - All positive but most below 1.0 μg

Lab Bust Contamination

- Suspects
  - 0.9 μg/wipe to 17.4 μg/wipe
- Children
  - 0.2 μg/wipe to 1.18 μg/wipe
- Pets
  - 1.89 μg/wipe (fur)
- Law Enforcement Officers
  - 0.5 – 0.93 μg/wipe
Meth “Smoking” Experiment

- Detectable levels of meth are found when smoking as little as 0.1g
What Does This Mean?

• Anyone entering or taken from the lab area will be contaminated with low levels of methamphetamine

• In some cases, these levels may not be high

• The potential for high contamination levels does exist
  – Accidents, fires, entry during the cook, etc.

• Contamination may involve more than meth

• There is no adequate method for direct detection at this time

Symptoms Among Responders
At Risk Personnel

- Local, State and Federal Law Enforcement
  - Clan lab investigator
    - Narcotics agents
    - Chemists
    - Hazmat removal
- First Responder
  - Street Officers
  - Firefighters
  - Paramedics
- Social Services
- Waste Removal

Exposure to Chemicals

- >90% reported exposures:
  - Direct skin contact with chemicals
  - Inhaled fumes and gases
  - Smelled odors from the laboratory
  - Handled contaminated clothing or other items
- >90% reported requiring decontamination at the lab scene at some time
## Active Lab Investigations and Respirator Use

<table>
<thead>
<tr>
<th>Ever entered active lab (n=70)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean # active labs investigated per person (range)</td>
<td>55 (1-600)</td>
</tr>
<tr>
<td>Normally wear a respirator</td>
<td>80 %</td>
</tr>
<tr>
<td>Mean # active lab investigations w/ respirator (range)</td>
<td>111 (0-600)</td>
</tr>
<tr>
<td>Mean # active lab investigations w/o respirator (range)</td>
<td>57 (0-675)</td>
</tr>
</tbody>
</table>

## Health Effects

<table>
<thead>
<tr>
<th>Grouped health effect</th>
<th>Ever had effect (n=93)</th>
<th>Symptomatic &amp; sought medical treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>56 (60%)</td>
<td>5 (9%)</td>
</tr>
<tr>
<td>Sore throat</td>
<td>42 (45%)</td>
<td>4 (10%)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>41 (44%)</td>
<td>6 (15%)</td>
</tr>
<tr>
<td>Skin</td>
<td>38 (41%)</td>
<td>7 (18%)</td>
</tr>
<tr>
<td>CNS</td>
<td>29 (31%)</td>
<td>3 (10%)</td>
</tr>
<tr>
<td>Eyes</td>
<td>28 (30%)</td>
<td>3 (11%)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>14 (15%)</td>
<td>3 (21%)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>11 (12%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>
What About Children?

Methamphetamine Exposures (Hotel Cook)

Teddy Bear:
- Sweater:
  3,100 µg/100 cm²
- Layer under sweater:
  2,100 µg/100 cm²
- pH: <1
Dose Estimates vs. Exposure

<table>
<thead>
<tr>
<th>Basis for Dose</th>
<th>Calc. Dose (mg/ kg-day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RfD – Prenatal Development</td>
<td>0.005</td>
</tr>
<tr>
<td>RfD – Neurotoxicity Endpoints</td>
<td>0.007</td>
</tr>
<tr>
<td>5 mg oral dose to 70 kg Adult</td>
<td>0.07</td>
</tr>
<tr>
<td>Illicit usage - 150 mg for Adult</td>
<td>2.14</td>
</tr>
<tr>
<td>Infant exposed to 499 µg/100 cm²</td>
<td>0.41</td>
</tr>
<tr>
<td>Infant exposed to 0.1 µg/100 cm²</td>
<td>0.00008</td>
</tr>
</tbody>
</table>

How can I Protect Myself?

- Wear the appropriate personal protective equipment.
  - Initial entry – SCBA, Protective Clothing (fire and chemical), Gloves, Boots
  - After stabilization – Air Purifying Respirators may be OK
- Assume that everything in the building is contaminated
- Establish good decon procedures
Decontamination Questions

- **Who?**
  - Children, suspects, pets, responders, inadvertent exposures, evidence

- **Where?**
  - On scene, hospital, fire station, group home, etc.

- **How?**
  - Wet decon, dry decon, clothing removal and replacement, clothing cover and transport
  - How should contaminated clothing be handled

Decontamination

- **Thought out in advance**
  - Hospital decon should be planned.
  - What will happen to clothing?
  - What about evidence shipment?
  - Child friendly

- **Involve the least contact possible**
  - Hospital, ambulance, vehicles

- **Confine exposures to one area**

- **EMERGENCIES**
Decontamination:

Unanswered Questions

• Chronic health effects
  - Children
  - Law enforcement personnel

• Decontamination Methodologies
  - Effectiveness of decontamination
  - Law enforcement, child protective services, emergency services personnel
  - Children, adults, and items in the building.

• Education
  - Law enforcement
  - Medical Facilities
  - Child Protective Services