METHAMPHETAMINE: Its Effects on You, the Environment, and Young Children

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A Monthly Timeline of DEA Case Initiations and Arrests, Local Clandestine Lab Seizures, and Political Mileposts

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Environmental Issues Associated with Methamphetamine Production and Use

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Contamination of our environment (including indoor air and structure contamination) may contribute to adverse health effects.

Children are particularly vulnerable to the chemicals used in production (or generated from production) of methamphetamine.

Gestational exposure is of concern with addicted mothers.
Children’s Vulnerability

- Levels of vapor high at floor level
- Spills/contamination at floor from hand to mouth
- Blood brain barrier not fully developed
- Respiration rate
- Nervous system still developing
Environmental Contamination

- The lay chemist, drug user and illicit drug producer is sloppy in how these dangerous chemicals are handled.
- Property such as yard, septic system may be contaminated by production waste.
- Wastes can contaminate watersheds.
Dangerous Chemicals

- Waste includes: corrosives, acid vapors, heavy metals, solvents

- Vapors from the Methamphetamine production permeate the structure

- Vapors highly volatile leading to explosions
Hazards

- Fire
- Explosions
- Intoxication by exposure to particulates, liquids, vapors and gases
- Environmental contamination
Potential Hazards – Inactive Meth Labs

- Chemical residues left behind
  - Methamphetamine
  - Iodine
  - Mercury/lead (a remote possibility)
  - High/low PH residues on surfaces

- Improper or dangerous disposal of hazardous waste products
  - To sewers?
  - To septic tanks?
  - Ditch, woods, trash cans
Chemical Exposures of Concern

- Methamphetamine
- Pseudoephedrine
- Acetone/ethyl alcohol/other solvents
- Freon
- Anhydrous ammonia
- Red phosphorus (phosphine gas)
- Lithium
- Iodine
- Mercury/lead
- Hydrochloric acid
- Sodium hydroxide (lye)
## Why Focus on Meth Events?

### Hazardous Substances Emergency Events Surveillance (HSEES) Events

1996-2001 ATSDR data from chemical releases

<table>
<thead>
<tr>
<th>Event Category</th>
<th>Meth events</th>
<th>Remaining chemical events</th>
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<tr>
<td></td>
<td>No.</td>
<td>%</td>
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<td>Events with actual releases</td>
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<td>Events with victims</td>
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<td>52.0</td>
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<td>Events with deaths</td>
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<td>Events with decontaminations</td>
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<td>Events with fires</td>
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<td>11.2</td>
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<tr>
<td>Events with explosions</td>
<td>44</td>
<td>8.5</td>
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</table>
Mobile Labs

• To avoid detection and prevent contamination of their home
• Frequently found in state parks, fishing areas and along roadsides
• State regulations limiting the sale of ephedrine has increased the number of abandoned box labs
• Preliminary Findings:
  - Some materials and chemical residues remaining from the production of methamphetamine pose novel environmental problems in locations where methamphetamine laboratories have been closed.
  - There has been little standardization of measures for determining when the site of a former methamphetamine laboratory has been successfully remediated.
Clean Up Issues

- Data on methamphetamine laboratory-related contaminants of concern are very limited, and uniform clean up standards do not currently exist. In addition, procedures for sampling and analysis of contaminants need to be researched and developed.
- Many states are struggling with establishing assessment and remediation guidelines and programs to address the rapidly expanding number of methamphetamine laboratories being closed each year.
QUESTIONS?
The Innocent Victims—Some Facts about Prenatal Meth Exposure

- Limited research exists on “ice babies”
  - Important area to investigate as these babies appear to be presenting differently than “crack babies”
  - Need to identify implications for development and learning
- IDEAL study is the first multi-site longitudinal study to examine prenatal meth exposure
- Women who use meth during pregnancy typically:
  - Abuse other substances
  - Were not planning their pregnancy
  - Receive less prenatal care
Case study: Methamphetamine and Its Effects on a Prenatally-Exposed Young Child

- **Purpose:** To identify early intervention needs for a young child who was exposed to methamphetamine prenatally.
- **Meet “Ann”** (a pseudonym)
  - Exposed to meth, marijuana, and tobacco prenatally
    - Stroke
    - Left-sided hemiparesis
    - Nystagmus
      - Slows significantly with neck flexion and rotation to the right
    - Seizures (starting around age 1)
    - Attention Deficit, Hyperactivity Disorder (ADHD)
    - Currently receives PT, OT, and SLP services
  - Father now has full custody; mother visits sporadically
Ann’s Story

Medical Findings
Physician Assistant Studies; Audiology
Physical Therapy; Physical Education
Dietetics; Nursing
Ann’s Story…

• Ann was a full-term vaginal delivery without complications and presents with a developmental history her parents considered ‘on track’ until age 1 when she had her first seizure. In addition to the nystagmus mentioned earlier, Dad reports he noted a difference in function between the left and right sides of her body at about 6-9 months of age (weaker on the left).

• Subsequent seizures have been non-febrile; an EEG in 09/04 was considered abnormal.
Ann came to us in October 2007 with her dad and paternal grandmother and a documented medical history of:

- Right congenital thalamic infarct;
- Epilepsy treated with Carbamazapan (Tegretal)
  - Initial seizure occurred with fever during an ear infection
- Ocular albinism with congenital nystagmus
- Behavior disorder with ADHD and features of oppositional defiant disorder
• She has a history of ear infections beginning in August 2003, summarized below:
  - 3 ear infections between 09/03 and 12/03;
  - 3 ear infections between 01/04 and 06/04;
  - 4 ear infections between 12/04 and 10/05;
  - 1 ear infection 10/06;
  - 1 ear infection 06/07.
• Father reports he thinks she just isn’t listening
• Paternal grandmother (PGM) thinks she doesn’t hear as well as she should
• There is no medical record documentation that addresses the status of her hearing
• Her history also includes three episodes of anemia documented 9/03, 02/05 & 01/07
• Neither dad or PGM know the cause of the anemia and cause was addressed in the medical record
• There is no history of bleeding or easy bruising
Ann’s Examination

- Skin clear without lesions; Hair sandy blonde - clean and well-groomed; Glasses worn without distress and nystagmus present; Nasal airway congested with swollen turbinates and inflamed mucosa; Teeth without caries; Pharynx without obstruction
- Neck soft and mobile without masses or swelling or tenderness
- Heart & lungs clear
Ann’s Examination… continued

- Ann was well-developed and appeared well-nourished. She was cooperative, delightful, inquisitive, and active. She was in no acute distress and explored the environment non-stop.

- Head, Eyes, Ears, Nose, Throat (HEENT):
  - EARS: Auricles intact and without deformity; External ear canals without obstruction;
  - **RIGHT TYMPANIC MEMBRANE RED, BULGING AND IMMOBILE WITH LOSS OF LANDMARKS.**
  - **LEFT TYMPANIC MEMBRANE DULL, INFLAMED AND SLUGGISH WITH MIDDLE EAR EFFUSION NOTED**
THE NORMAL EAR

Eardrum

External ear canal

MIDDLE EAR

Eustachian tube (connects ear to throat)
Normal Ear Drum

Acute Otitis Media
Summary of Hearing Status

• Otoscopic examination
  – **Right ear** congested with air bubble behind ear drum; **left ear** had retracted ear drum
• Hearing evaluation
  – Response to sounds presented via speakers was consistent with normal hearing
• Middle ear function test (Tympanometry)
  – **Right ear** had otitis media (middle ear fluid due to infection); **left ear** had eustachian tube dysfunction.
• Auditory Evoked Brainstem Response (ABR)
  – Tests the central auditory pathway at the brainstem level
  – Results suggested normal processing at the brainstem level
• **Overall findings and recommendation**
  – Ann can hear and process sound at brainstem level
  – Family still concerned with Ann’s ability to listen
  – Need to follow and treat apparent ear infection
Nutrition Findings: Diet Analysis

- Kcalorie, protein, calcium, and iron needs met by diet
- Inadequate fiber, excess sodium and fat
- Drinks about 10 ounces of juice per day
- Takes a daily children’s multivitamin
- Pica (eats ice)
Anthropometrics

- Height: 44 inches (84\textsuperscript{th} %ile)
- Weight 45.8 lb (91\textsuperscript{st} %ile)
- Weight for stature: 90-95\textsuperscript{th} %ile
- Body Mass Index: 17.7 (92\textsuperscript{nd} %ile)
Weight-for-stature percentiles: Girls

Published May 30, 2000 (modified 11/21/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
Interpretation

• At risk for overweight
  - Children with ADHD often exhibit impulsive behavior regarding food and are at increased risk for becoming overweight
• Red blood cell count, hemoglobin, hematocrit, mean corpuscular volume all low
• Red blood cells pale and small
• Findings consistent with iron deficiency anemia
• Pica also consistent with iron deficiency anemia
• Not from inadequate diet
  • ? Inadequate absorption or excessive losses
Recommendations

- Investigate origin of iron deficiency anemia
- Continue multivitamin supplement, additional iron if current labs indicate iron deficiency anemia
- Limit juice to 4-6 ounces per day, switch from whole to lower fat milk to reduce calories and prevent overweight
Sensory-Motor Findings

- Walks and runs independently but has difficulty slowing herself to a typical walking pace
- Muscle tone and range of motion (ROM) within normal limits on right
- Increased reflex activity (spasticity), decreased strength and ROM in left arm and leg (also in face but does not affect speech production)
  - Wears an ankle brace on left leg
- Limited core (trunk) strength and control
- Areas of strength:
  - Climbing stairs; jumping; lower body placement
- Areas of difficulty
  - Standing on one leg; walking on a line; walking backwards (motor planning; balance)
  - Tracking moving objects
  - Significant sensory seeking behaviors, esp. with vestibular and proprioceptive input,
    - Stuffing food in mouth; positive response to deep pressure stimulation
  - Decreased body awareness
Recommendations

• Develop goals and objectives for Physical Education to address areas of weakness
  ✷ Add goals and objectives to Individual Education Plan (IEP)
• Continue PT with focus on improving:
  ✷ Core strengthening of trunk
  ✷ Higher level balance and gait skills
  ✷ Range of motion
  ✷ Alignment of left ankle
  ✷ Body awareness and motor planning skills
Major Medical Findings for Continued Investigation

- Anemia of undetermined etiology
- Risk for becoming overweight
- Spasticity and weakness on left side
- Sensory integration issues
- Chronic otitis media with effusion associated with intermittent conductive hearing loss
- Activity and behavioral issues
Ann’s Story

Educational Findings

Speech-Language Pathology
Psychology
Social Work
Speech and Language

- **Speech**
  - Easily understood

- **Language**
  - Ability to understand: Moderately delayed
    - Difficulty following multiple directions
  - Ability to express self: Severely delayed
    - Speaks in sentences but with limited vocabulary

- **Social skills**
  - Inappropriate at times

- **Readiness for reading and writing (pre-literacy skills)**
  - Some areas emerging; findings consistent with language abilities
Recommendations

- Continuation of language services with specific goal suggestions
- Increased awareness of appropriate social behaviors
- Classroom modifications to optimize learning
- Increased facilitation of literacy skills
• **Visual scanning**
  - Children exposed to meth tend to have abnormal scanning patterns. This hinders visual learning.
  - Ann already has visual difficulties. She wears glasses and has a nystagmus. These difficulties prevented an accurate examination of her ability to scan visually at this time.
Scanning Patterns from High (IQ) Functioning Individuals Versus Low (IQ) Functioning Individuals
• **Abbreviated Stanford-Binet IQ test (72/100)**
  - **Vocabulary** – 86
    - Accurate picture identification but problems with word identification and meaning
  - **Pattern Analysis** – 62
    - Low score; very pleased with her successful puzzle completion; very sad and disappointed in her puzzle failure
  - **Quantitative Analysis** – 80
    - Low score may be affected by visual difficulties
  - **Bead Memory** – no derived score
    - Easily distracted; unable to follow detailed instructions
• **Beery-Buktenical Test of Visual-Motor Integration**

  (Assesses basic gross motor, fine motor, visual, and visual-fine motor development)

  - Immature grasp of pencil with right (dominant) hand
  - Some uncoordinated finger movements
  - Some perseveration on tasks
  - Apparent difficulty in following directions
  - Delayed functioning – about 1 year below chronological age level

**Conclusion:** At-risk for continued delayed development
Recommendations

• Continued evaluation over time
• Assist family with effective forms of reward and punishment to facilitate:
  ♦ Ann’s appropriate behavior, and
  ♦ Functional, rather than dysfunctional, parent-child relationships
Father and grandmother: most consistent, major adult attachment figures
- Some residual attachment issues
- Extended family history shows:
  - Mental illness
  - Chemical dependency
  - Tendency toward transitory relationships

**FAMILY STRENGTHS**
- Strong love and affectional bonds
- Strong wish to provide best possible environment and possibilities for Ann
- Stable employment/steady income
- Adequate housing
- Eagerness to complete evaluation and receive suggestions for helping Ann
- Consistency in school attendance

**FAMILY NEEDS**
- Consistent, effective parenting/discipline strategies
- Effective conflict resolution skills
- Increased level of separation-individuation for Ann’s father
- Further evaluation of several areas, including: Ann’s level of attachment to caregivers; father’s substance abuse; Ann’s mother’s ability to parent and potentially become more involved
Recommendations

- Family therapy to enhance
  - Family’s ability to cope with recurrence of paternal grandmother’s cancer
  - Discipline techniques and parenting skills
  - Father’s and grandmother’s abilities to resolve differences
  - Father’s ability to parent effectively
So...

Here is an almost 5-year-old child with nutritional, sensory-motor, language, cognitive, visual perception, learning, attentional and behavioral difficulties.

- These difficulties may be related to (we cannot say “caused by”) her exposure to meth.
  - Similar to results of study by Shah (2002).
- Anemia also can have adverse effects on thinking, memory, and behavior. It will be important to investigate the cause of Ann’s anemia and whether it is related to meth exposure.
Toxicity and Public Health Issues Associated with Methamphetamine Production and Use

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Eroding the Mind

Researchers have mapped brain decay caused by methamphetamine use. The damage affected memory, emotion and reward systems.

Average difference in brain tissue volume of methamphetamine users, as compared with non-users:

Source: Dr. Paul Thompson, U.C.L.A.
Methamphetamine Effects on Neurotransmitters

- Meth increases dopamine levels responsible for the euphoric effect
- High doses of Meth in both adults and fetuses/neonates may result in long-lasting depletion in Central Nervous System (CNS) dopamine neurons
- Alterations in mood, psychotic behavior, and aggressiveness may be due to CNS serotonin release
Meth Effects on the Brain and Behavior

• Meth is highly lipid soluble and redistributes to all organs
• Tolerance can lead to toxic levels in the blood
• The CNS is the target organ
• Mental powers deteriorate with high doses or chronic doses
• Agitation, suicidal idealism, hallucinations, delusions, confusion and despondent affect
Major Signs and Symptoms of Meth Exposure

- Cardiac
- Psychiatric
- Neurologic
- Respiratory
- Renal
- Weight loss/nausea/vomiting
- Dental
Unable at present to state that Meth specifically causes noted difficulties. This may be due to the confounding factors of:

- Environmental chemical exposures
- Nutritional status
- Health-promoting environments
- Access to health treatment
- Possible drug induced neglect
- Pre-existing medical conditions

A large comprehensive study is needed to establish an association between meth use and health and developmental deficits prenatally and postnatally.
Public Health Message and Recommendations

- Implement a multidisciplinary investigation, with federal and state funding and collaboration, for a regional or state study to review medical records of meth babies with continued follow-ups to research deficits in learning, medical conditions and mental status.
- Assign newly identified meth babies to case workers to coordinate developmental evaluations, follow-up, and provide counseling services until the children are well-adjusted with the school population. Make this part of the criteria for establishing an Individualized Family Service Plan (IFSP) and Individualized Education Plan (IEP).
- Continue research in environmental contamination of meth homes and what remediation is required to make them habitable again.
- Facilitate the ability of renters to research the history of the property they propose to rent.
  - DEA is proposing to make available (on-line) the addresses of meth busts.
- Develop an outreach program to deliver an anti-meth campaign targeting pre-teens and teens.
  - NIDR (July 2007) acknowledged gross under-estimation of meth use by teens.