



# Introduction to Environmental Health / Environmental Medicine

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# MDCH/ATSDR Services

- Health Education
- Human Health Risk Assessment
  - Document that describes possible risks.
  - Risk  $\neq$  Health Outcomes
  - Tool: evaluate severity of the exposure and determine public health actions
- Exposure Investigation
  - Study of the population engaging in behaviors that result in exposure
  - e.g. Blood or urine samples, monitoring devices
- Health Study
  - Assess health outcomes level relative to measured chemical exposures

# Overview

- Overview of Environmental Medicine within Environmental Health
- Case Studies
- Professional Human Resources
- Web Resources (CME )
- State and Local Examples of Environmental Exposures

# Environment – Key Elements

- The places a person inhabits
  - Non – occupational
    - Indoors and outdoors
      - Schools (children)
      - Home and back yard
      - Recreational areas
  - Occupational
    - OEM @ MSU: Ken Rosenman, MD (<http://oem.msu.edu//index.asp>)
    - Work environment
    - Overlaps with non-occupational
- Behaviors
  - Gardening, running, eating (fish, meat, etc.)

# [ EH Definitions (3 examples) ]

- Freedom from illness or injury related to **exposure to toxic agents** and other environmental conditions that are potentially detrimental to human health.
- Public health that protects against the effects of **environmental hazards** that can adversely affect health or the ecological balances essential to human health and environmental quality.
- Environmental health comprises of those aspects of human health, including quality of life, that are determined by **physical, chemical, biological, social, and psychosocial** factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.

# Environmental Medicine

- Work of clinicians
- Definition: Study of effects upon human beings of external **physical, chemical, and biological** factors in the general environment.
- Clinical EM: Evaluation, management, and study of **detectable** human disease or adverse health outcomes from exposure to external physical, chemical, and biologic factors in the general environment.

# [ Disciplines - EM ]

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- toxicology
- epidemiology
- public health and prevention
- industrial hygiene
- population medicine
- research methods

# [ Clinical Approach – EM ]

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- Characterizing Exposure
  - Chemical
  - Source
- Link exposure to disease

# [ Patients - EM ]

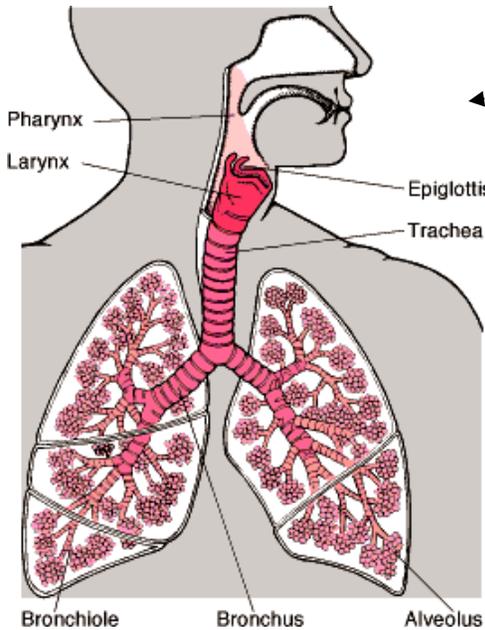
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- Concern about a chemical exposure; no symptoms but worried about future effects.
- Symptomatic – suspect environmental cause
- Symptomatic – known chemical exposure
- Symptomatic – no idea that something in their environment is the cause

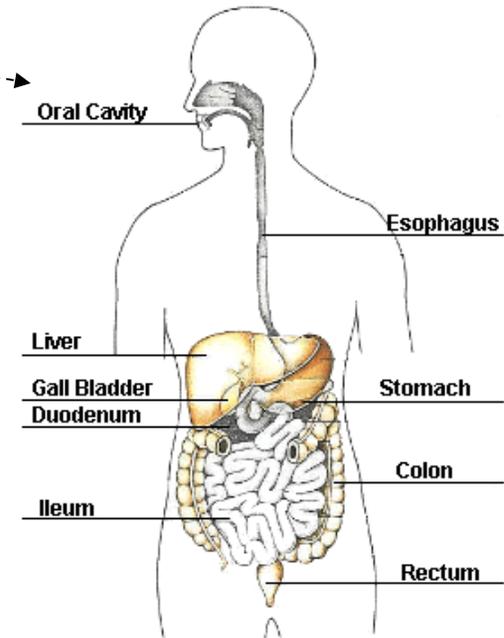
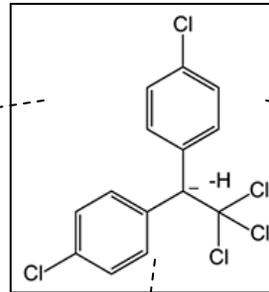
# Characterize Exposure - EM

- Confirm that exposure occurred
  - Medical History
  - Environmental Exposure History (I PREPARE)
  - Laboratory Testing
- Cardinal Exposure Information
  - Identify the hazardous substances
  - Dose received
    - Degree of contamination
    - Duration
    - Frequency
  - Pathway of Exposure

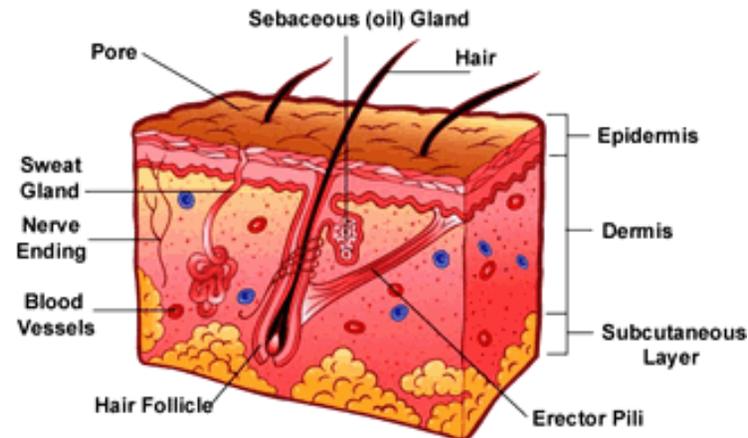
# Routes of Exposure



INHALATION



INGESTION

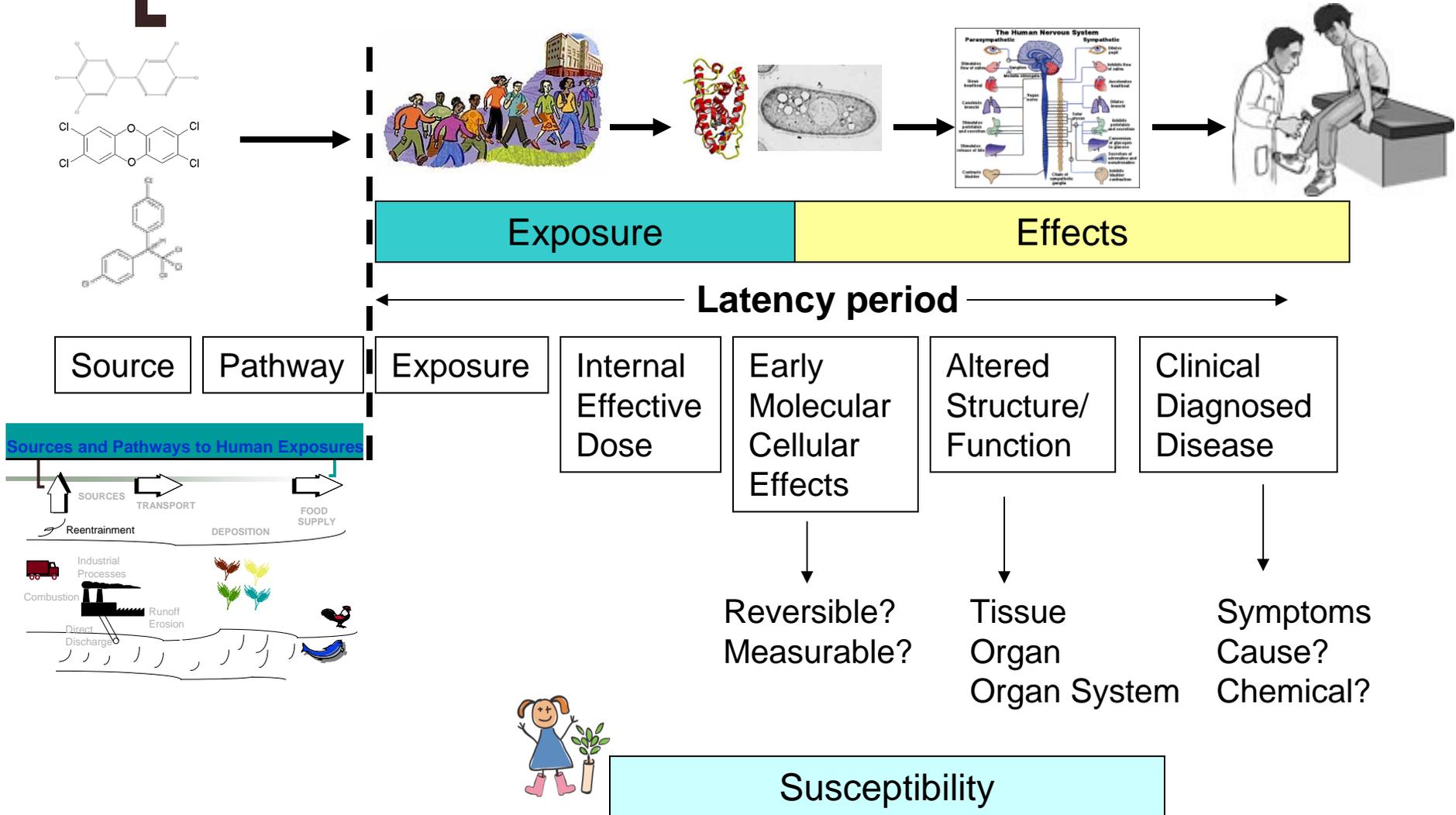


DERMAL CONTACT

# Environmental Media

- Soil - ingestion, dermal, inhalation
- Water - ingestion, dermal, inhalation
- Air - inhalation
- Sediment – ingestion, dermal
- Food (wild, local domestic, store purchased)

# Sequence of Exposure to Disease



# [ Link Exposure to Disease - EM ]

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- Complicating Factors
  - Latency period
  - Multiple chemical exposures
  - Pharmacokinetics
    - Long duration in the body
  - Lack of unique disease presentation
  - Lack of science (minimal toxicological or epidemiological published literature)

# Link Exposure to Disease - EM

- Good exposure information (chemical, dose, duration, frequency) exposure history
- Possible effects/outcome information
  - Epidemiology literature human health outcomes
  - Animal toxicology studies
    - Plausible effect
    - Histopathology or biochemical indicators
  - Clinical case report
    - Scientifically limited (lack controls, small sample, bias)
    - Clinically valuable information (tests and treatments)
  - Local Clinical Experience

# Link Exposure to Disease

- Evaluate medical history for alternative etiology and preexisting illness
- Evaluation of Chemical Test Results
  - What do the test results represent?
    - E.g. Time frame, tissue, relationship to exposure
  - Was quality assurance conducted?
  - What values would one use to interpret the chemical test results?
    - Is the comparison value appropriate for clinical use?
    - Human health based value?
    - How was the health based number calculated?
      - Calculation assumption
    - Is it in the same tissue as the test result?
- Timing and severity of health effects consistent with dose-response
- Removal from exposure ends clinical symptoms; re-exposure exacerbates symptoms

# [ Diagnostic Benefits ]

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- End ongoing or prevent future exposures.
- Assess future risk of disease from past exposures.
- Help patient identify or eliminate possible causes.
- MDCH/ATSDR – Can arrange a presentation by an OEM MD about making an Environmental Medicine Diagnosis.

# Case Study 1 – Event

Devine et al. 2002. *EHP*. V10 (10). P.1051-55 Grand Rounds Case Study

- November 1996, a gas leak and “high” CO levels detected by gas company, in a kitchen of a restaurant.
- 45 yr old white female, who worked at the restaurant for 2 years, went to hospital 6 hr after detection of CO.
- Faulty furnace caused of CO, likely been producing CO for an extended period of time.
- Patient had been experiencing range of symptoms for about 1 year leading up to this discovery

# Case Study 1 - Symptoms

- “flu-like”,
- balance problems unable to walk straight, bumping into things, several falls
- severe headaches that persisted 24 hr/day, exhaustion,
- ear problems (right ear),
- “cloudy” sensation,
- impaired reading, writing and speaking
- tingling or numbness in both thighs,
- difficulty hearing,
- irritability,
- brittle teeth,
- pain in face.

# Case Study 1:

## Medical History - Highlights

- College educated, full scholarship, best subject was in languages, IQ >130
- Patient denied birth trauma, hypertension, head injury, loss of consciousness, seizures, diabetes, thyroid, allergies, asthma, drug or alcohol use.
- Patient was on vacation 5 days prior to the gas leak and discovery of elevated CO levels.
- Peak symptoms were in Jan – April 1996.

# Case Study 1: Medical Evaluations

- First (May 1996)
  - Diagnosed with sinus infection – amoxicillin
  - Symptoms became more severe, could not finish amoxicillin
- Second - CO discovery (November 1996)
  - 6 hr after CO leak
  - Carboxyhemoglobin not elevated
  - No focal neurologic signs noted
- Third - (February 26, 1998)
  - Initial symptoms - 1 year prior to CO discovery
  - Symptoms ended with CO discovery, except reading, writing, and speaking difficulties
  - Neurologist – MRI, findings were “normal”

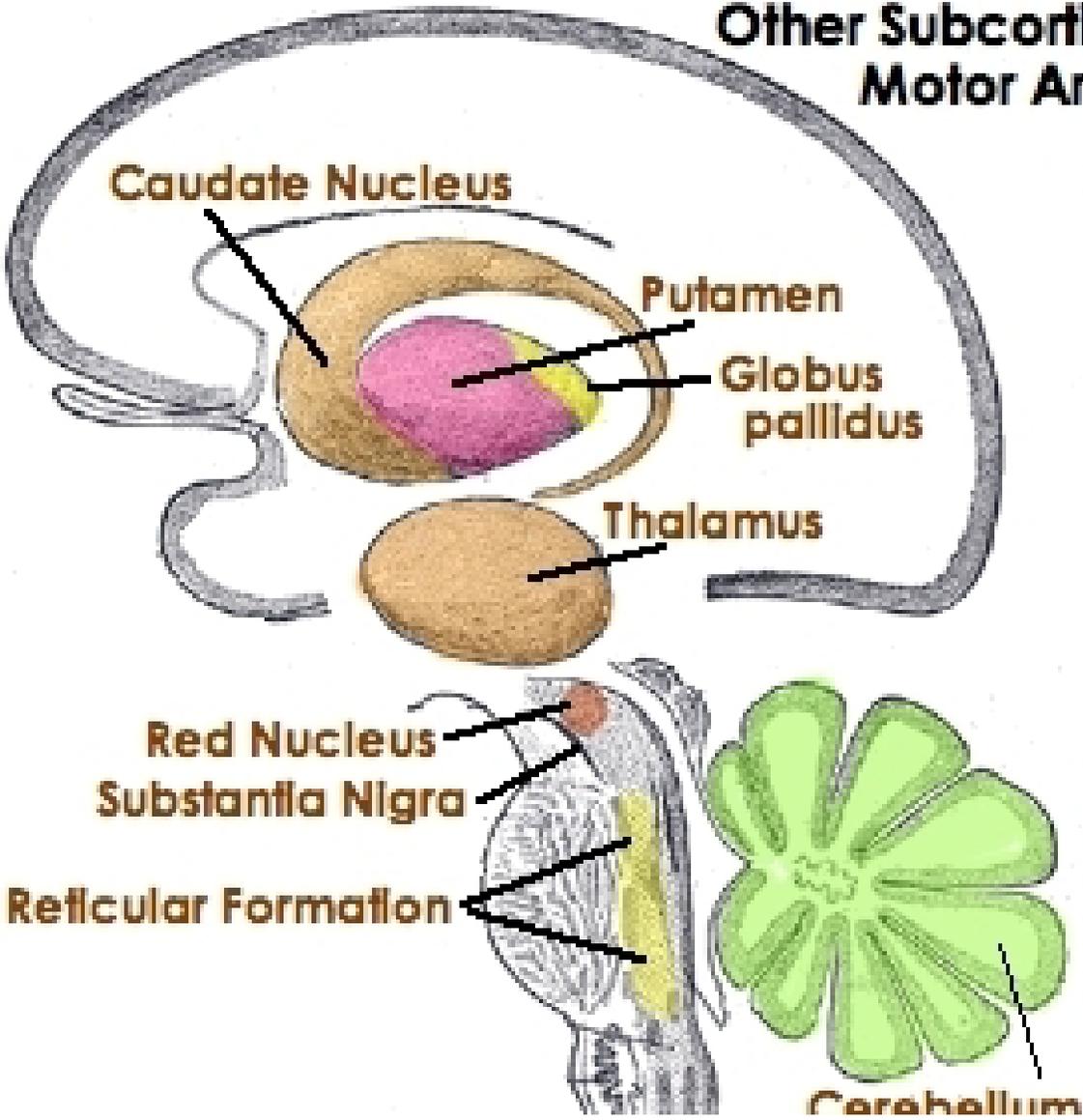
# Case Study 1: Medical Evaluations

- Fourth Medical Evaluation (April 15, 1998)
  - Neuropsychological testing
    - Below expectations
      - Demanding tasks (attention, learning, memory retrieval, mood)
      - Short-term memory
    - Sensitivity to interference when completing memory tasks
  - Results suggestive of subtle frontal/subcortical lobe dysfunction specifically in basal ganglia
  - Own clinical experience, typical of low level CO exposure without loss of consciousness.

# Case Study 1: Medical Evaluations

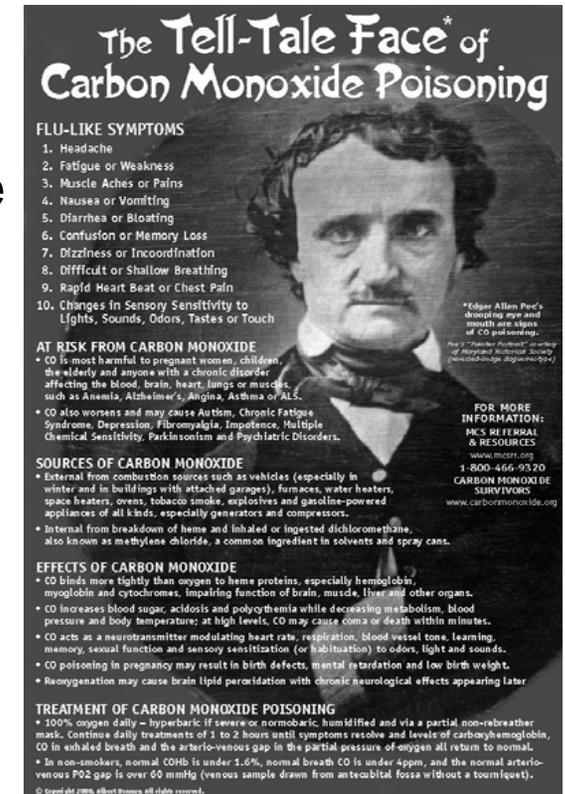
- Fifth Medical Evaluation (April 28, 1999)
  - Neuropsychological testing
    - Similar below expectation results
    - Executive system dysfunction
      - Perseveration, pull to stimulus, poor development of strategies
    - Significant decrease in psychomotor speed
  - Results suggestive of subtle frontal/subcortical lobe dysfunction specifically in basal ganglia
  - MRI Films
    - Conducted additional films with Fast Spin Echo MRI
    - 2 MRI experts (Neuroradiologist and Neuroscientist who does neuroimaging research from VA Boston Health Care systems)
    - Blind to the medical history
    - Multiple small lesions bilaterally in the basal ganglia
      - Most severe in globus pallidus, less in the putamen

**Basal Ganglia &  
Other Subcortical  
Motor Areas**



# Case Study 1: Literature

- CO can cause all symptoms of the patient and those symptoms are non-specific.
- Acute symptoms, recovery, days or weeks later have neurologic/psychiatric symptoms
  - Progressive demyelination of white matter
- Markers of Exposure
  - Carboxyhemoglobin (HbCO) in blood
    - Half-life 4-5 hr in ambient fresh air
    - 45-80 min. at rest with 100% oxygen
    - Reflect [blood], not other [tissue]
  - CO in breath
  - MRI
    - Lesions can be non-specific
  - Neurologic
  - Neuropsychological (lack distinctive pattern)



# Case Study 1: Basis of Diagnosis

- Environmental Exposure History
  - Known CO leak in her work environment that likely exist for an extend period of time
  - Denied history of prior similar health issues
  - High IQ and highly educated
- Symptoms
  - Headaches and “flu-like” symptoms
- Medical Examination
  - Lesions in the basal ganglia
  - Quantified memory difficulties
  - Executive system dysfunction
- Confirmed finding in scientific literature, case study literature, and local clinical experience

# Case Study 2: Case History

PCC-Detroit, Consult of the Week, V. 1, No. 7 1/14/05

- 2 year old boy taken to Primary Care Physician
- Diagnosed with viral upper respiratory infection and possible anemia (slightly pale)
- PCP ordered blood lead test and CBC
- Blood lead = 57 mcg/dl (CV: <10 mcg/dl)
- Hemoglobin = 9.6 g/dl (Normal: 11-13 g/dl)
- PCP called parents- child taken to emergency

## Case Study 2:

### ED Physical Exam, Labs, X-rays

- Physical exam: Normal except for paleness of the conjunctiva and delayed speech.
- Lab: Repeat Pb = 64 mcg/dl
- X-ray:
  - paint chips in large and small intestine
  - Abnormal bone remodeling and increased Ca deposits at several of the metaphyses.

# Case Study 2: Literature

- Symptoms are not unique
  - Abdominal Pain
  - Constipation/Diarrhea
  - Developmental Delays
  - Alterations in Mood
- Health Effects
  - Anemia
  - Damage hemoglobin formation
  - Kidney disease
  - Nerve damage
  - Developmental Delays

## Case Study 2: Child Reactions to Lead

<b>Blood Lead Level</b>	<b>Possible Health Effects</b>
10 $\mu\text{g}/\text{dL}$	←→ Slight loss in IQ; hearing and growth problems
20 $\mu\text{g}/\text{dL}$	←→ Moderate loss in IQ; hyperactivity; poor attention span; difficulty learning; language and speech problems; slower reflexes
40 $\mu\text{g}/\text{dL}$	←→ Poor bone and muscle development; clumsiness; lack of coordination; early anemia; decreased red blood cells; tiredness; drowsiness
50 $\mu\text{g}/\text{dL}$	←→ Stomach aches and cramps; anemia; destruction of red blood cells; brain damage
100 $\mu\text{g}/\text{dL}$ and over	←→ Swelling of brain; seizures; coma; death

## [ Case Study 2: Diagnosis ]

- Pica child who ingested lead based paint chips (x-ray of chips and elevated blood test)
- Abnormal bone growth was attributable to the Pb exposure
- Anemia was most likely due to low Fe levels (Pb usually needs to exceed 100 mcg/dl to cause anemia)
- Delayed speech was not address in the diagnosis

## Case Study 2: PCC treatment of lead poisoning of in asymptomatic children

[Pb] (mcg/dl)	Treatment
10 – 14	retest in 2-3 months, education
15 – 19	retest in 2 months, education, home inspection
20 – 39	retest lead level in 2 – 4 months, identify and abate source, education, nutrition counseling, medical evaluation by PCP
40 – 69	Admit for inpatient chelation with meso 2,3 dimercaptosuccinic acid (DMSA) (oral) and CaNaEDTA (intravenous infusion)
> 70	Admit for BAL (injections) and CaNaEDTA (intravenous infusion)

# [ Case Study 2. Treatment ]

- Clear intestine
  - glycol-electrolyte solutions (Golytely) via nasal gastric tube (NGT) with repeated abdominal films every 8 – 12 hours.
- Chelation
  - DMSA (oral)
  - CaNaEDTA (intravenous infusion)

## Case Study 2: Follow-up with Parents

- Does the child exhibit pica behavior?
- How old is the home the child lives in?
- Does the child go to other homes for care? How old?
- Do other young children come to you home? Might they be eating paint chips?
- Please describe your child's diet
  - Fatty foods cause paint chips to stay longer in the GI track
  - Diets low in Fe, Zn, Ca allows more Pb absorption.

# Groups of Chemicals

- Pesticides
  - home, farms, work, indoors and outdoors
- Heavy Metals / Elemental
- Volatile Organic Chemicals
  - Short-chain organics
  - Indoor Air Concerns (construction materials, glues, cleaning products)
- Semi-Volatile Organic Chemicals
  - Long-chain organics

# Regular Issues at MDCH – DEOE

- Arsenic
- Asbestos
- Asthma – Environmental Triggers
- Cancer Clusters
- Chemical Terrorism Preparedness
- Clandestine Lab
- Indoor Air
  - mold, sewer gases, CO, natural gas leaks
- Elemental mercury spills
- Lead
- Miscellaneous chemical exposure
- Persistent Chemicals (dioxins, PCBs, chlordane, PBB, DDT, methylmercury)
  - Fish Consumption Advisory
- Pesticides
- Site-specific hazardous waste sites

# Regional Exposure Pathways

- Frequent Fish Consumption local waters
  - Pine, Tittabawassee, Saginaw River and Bay – resident species and benthic dwellers
  - Inland lakes – top predator fish
- Wild Game Consumption from Tittabawassee R. flood plain (turkey meat and deer liver)
- Childhood lead exposure (homes older 1978)
- Carbon monoxide exposure
  - Gas generators, oil lamps, faulty furnaces
- Elemental mercury spills

# Regional ATSDR Site Work

- Tittabawasse River Contamination
- City of Midland Contamination
- Saginaw River Contamination
- Velsicol Chemical Plant Site (St. Louis, Mi)

# Overview of Velsicol Plant

- NIOSH documented exposures and effects 1977
- Source of state-wide PBB food contamination
- Chlorinated chemical production (e.g. DDT)
- Do not eat fish from Pine River between Alma and Midland
- Previously, wild game advisories along Pine River (end 1995)
- Recent discoveries of past plant-site clean-up (Late 1990s to present)
  - Leaking of DNAPL into Pine River (DDT)
  - Highly elevated shallow ground water contamination off-site (not used for drinking water)
  - p-CBSA in the drinking water wells of the City of St. Louis
  - Off-site soil contamination of multiple chemicals above background, some samples exceed residential protection criteria
  - Soil gas issues (VOCs)
- On-going investigations and clean-up both on and off the plant site
- Active locally-run Community Advisory Group and Technical Advisory Group that stay on top of the issues and conduct continuing education to the public.

# Human Resources

- Association of Occupational and Environmental Clinics (AOEC) ([www.aoec.org](http://www.aoec.org))
  - Lansing, East Lansing, Detroit, Royal Oak
- Pediatric Environmental Health Specialty Units (PEHSUs) ([www.aoec.org](http://www.aoec.org))
  - Chicago
- Poison Control Center ([www.mitoxic.org/pcc/](http://www.mitoxic.org/pcc/))
  - Health Care Professional Resources
- College of Medical Toxicologists
- Toxicology and Response Section of MDCH

# Web Resources

- Hazardous Substance Data Bank  
(<http://toxnet.nlm.nih.gov/cgi-bin/sis/search>)
- Environmental Health Perspectives (<http://www.ehponline.org/>)
- National Agricultural Pest Information System (NAPIS)  
(<http://ppis.ceris.purdue.edu/htbin/epachem.com>)
- ATSDR (<http://www.atsdr.cdc.gov/>)
  - Case Studies in Environmental Medicine
  - ToxFAQs
  - Toxicological Profiles
  - Medical Management Guidelines
  - ToxGuides
- MDCH-DEOE ([www.michigan.gov/mdch-toxic](http://www.michigan.gov/mdch-toxic))
  - MDCH Fact Sheet Matrix  
([www.michigan.gov/documents/fact\\_sheet\\_matrix\\_12-21-05\\_148400\\_7.xls](http://www.michigan.gov/documents/fact_sheet_matrix_12-21-05_148400_7.xls))

# Case Studies in Environmental Medicine

- Arsenic
- Asbestos
- Benzene
- Chromium
- Lead
- Nitrate/Nitrite
- Polychlorinated Biphenyls (PCBs)
- Environmental Triggers of Asthma
- Taking an Exposure History
- Radiation Exposure from Iodine 131
- Radon
- Stoddard Solvent
- Toluene
- Trichloroethylene
- Disease Clusters: An overview
- Pediatric Environmental Health

# Continuing Education Credits

## ***Continuing Medical Education (CME)***

The Centers for Disease Control and Prevention (CDC) is accredited by the [Accreditation Council for Continuing Medical Education](#) (ACCME) to provide continuing medical education for physicians. CDC designates this educational activity for a maximum of 2.0 hours in category 1 credit toward the [American Medical Association](#) (AMA) Physician's Recognition Award. Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

## ***Continuing Nursing Education (CNE)***

This activity for 2.3 contact hours is provided by CDC, which is accredited as a provider of continuing education in nursing by the [American Nurses Credentialing Center](#)'s Commission on Accreditation.

## ***Continuing Education Units (CEU)***

## ***Continuing Health Education Specialist (CHES)***



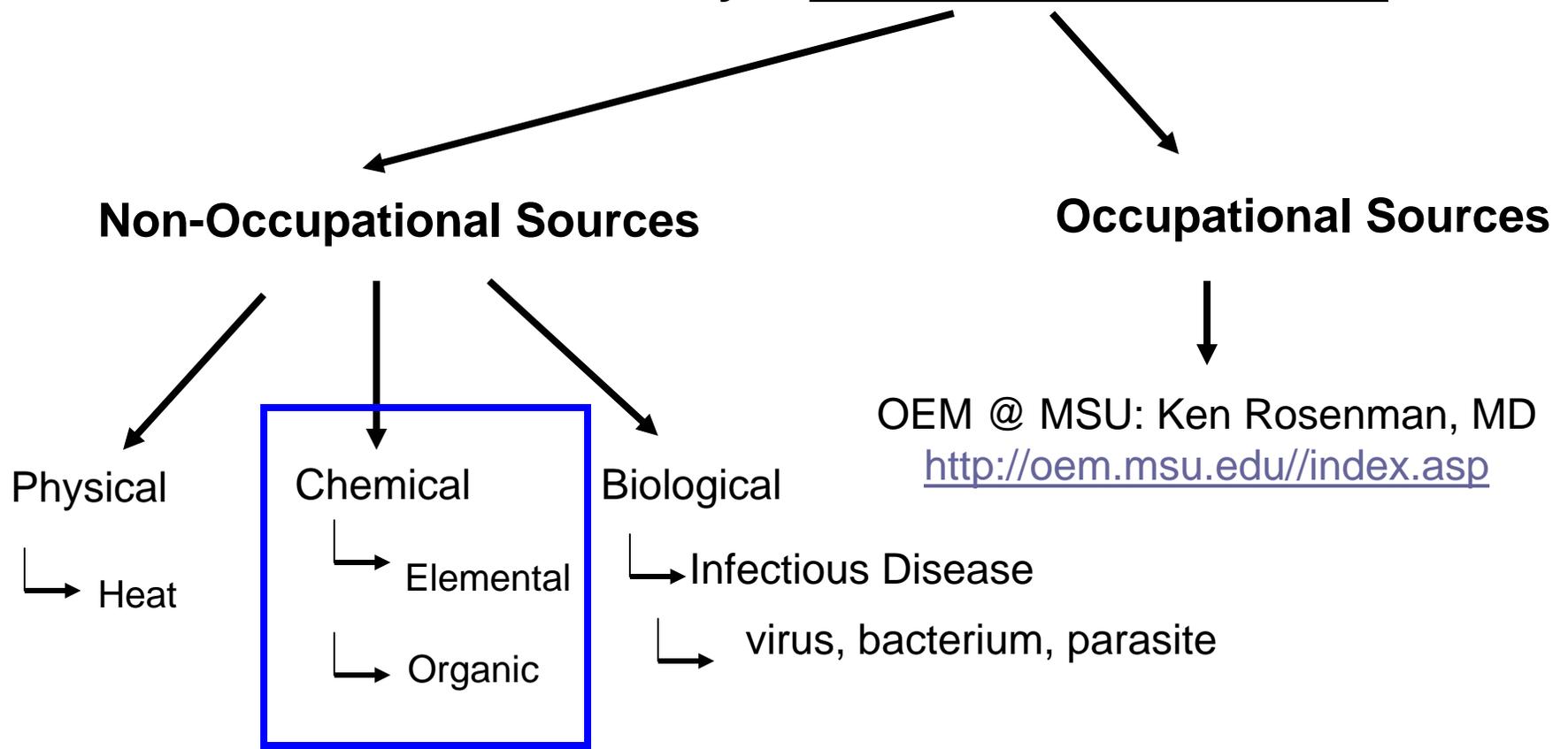
EXTRA SLIDES NOT USED

# Focal Neurological Signs

- Focal neurological signs help discriminate which part of the nervous system is affected by a lesion.
- Frontal lobe signs may include:
  - Mental disturbance, e.g. dementia, apathy, inappropriate emotion
  - Epilepsy
  - Grasp reflex, pout and snout reflexes
  - Unilateral anosmia (Loss of the sense of smell. Also called *olfactory anesthesia*.)
- Parietal lobe signs may include:
  - sensory disturbance, agraphia (A disorder marked by loss of the ability to write.), acalculia (A form of aphasia characterized by the inability to perform mathematical calculations.
- Temporal lobe signs may include:
  - loss of long and short term memory

# Factors that Result in Illness

Genetics, Current Health, Life Style, Environmental Exposures



Environmental Health / Medicine