PEHSU Pediatric Environmental Health Specialty Units

Fall 2011

Children's Environmental Health

NW PEHSU for WA-DOH School Environmental Health Workshops

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Overview

- Environmental health
- Children's environmental health
- Toxicology: Exposure, dose and toxicity
- Environmental health issues in schools
  - Lead, mercury, cleaning/disinfection
- PEHSU school cases
- PEHSU
- Resources

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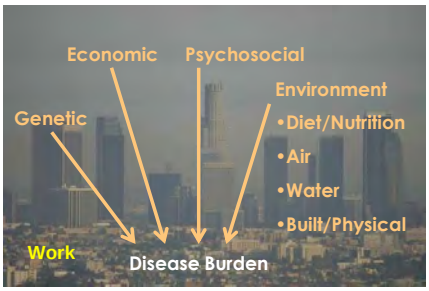
What is Environmental Health?



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What Is Children's Environmental Health?

- Recognition, treatment, and prevention of illness resulting from preconception, fetal, and pediatric exposures to environmental hazards and includes the creation of a healthy environment for children

adapted from Landrigan, 1998

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Key Exposures for US Children

- Environmental tobacco smoke
- Metal contaminants: lead, mercury, arsenic
- Outdoor air pollution: particulate matter, ozone, dust
- Indoor air pollution: mold, allergens, chemical irritants, carbon monoxide
- Pesticides on surfaces/soils, aerial drift, food residues
- Persistent organic pollutants (POPs) – PCBs, PBDEs
- Plasticizers – phthalates, bisphenol A

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Child Health Problems Linked to Environmental Contaminants

- Acute poisoning
- Asthma
- Neurodevelopmental disorders (ADHD, learning disabilities, autism)
- Obesity
- Endocrine disorders
- Cancer

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Unique considerations

Children are not small adults

Physical Differences

- Higher doses of env'l contaminants
  - Breathe more air per kg of body weight
  - Drink more fluids per kg of body weight
  - Eat more food per kg of body weight
  - Diet often differs from that of adults
  - Larger skin surface in proportion to body volume
- May respond to contaminants differently
  - Children are developing with dynamic organ systems

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Unique considerations, cont.

Behavioral differences that ↑ exposure

- Crawl on the floor
- Are closer to the ground
- Put things in their mouths
- Ingest inappropriate things such as dirt, paint chips, or magnets
- Spend more time outdoors and are outside at different times than adults

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Unique considerations, cont.

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Vulnerability: Dependency considerations

- They may ignore warning symptoms
- Limited to no hazard avoidance
  - Children rely on adults to provide safe environments

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Vulnerability: Latency considerations

- Some health conditions do not manifest for some time after the initiating event = "lag time"
- Children have more potential years of life to develop latent disease

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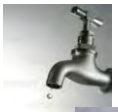
Toxicology: Exposure, Dose and Toxicity

- **Routes of Exposure**
  - Inhalation
  - Ingestion
  - Skin absorption
  - Bite or sting



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Toxicology: Exposure, Dose and Toxicity

- **Dose**
  - Contaminant concentration in a water, air, soil
  - How much of the contaminant enters the body?
    - Exposure duration: one time, multiple, continuous exposure?
    - Exposure frequency: minutes, hours, days, weeks, months, years?
    - Amount ingested

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Toxicology: Exposure, Dose and Toxicity

- **Contaminant inherent toxicity**
  - Target organ
  - Timing (windows of vulnerability)
  - Latency
    - Some health conditions do not manifest for some time after the initiating event = "lag time"
    - Children have more years of life to develop latent disease

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Environmental Health Histories

- Environmental health histories = key tool to help evaluate whether/how the environment may be affecting health
- Goals:
  - Identify current or past exposures (ex. school, work, home, community)
  - Reduce or eliminate current exposures
  - Reduce adverse health effects
- Example pneumonics:
  - IPREPARE (adults)
  - ACHOO (children)

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Environmental Health Histories

- ACHOO
  - A Activities
  - C Community
  - H Household & Hobbies
  - O Occupational
  - O Oral

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Environmental Health Histories

- IPREPARE
  - I Investigate potential exposures
  - P Present work activities
  - R Residence
  - E Environment
  - P Past work activities
  - A Activities (hobbies, etc.)
  - R Resources/referral
  - E Educate

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Workers' Compensation Attribution to Work

- Sudden injury or acute diseases generally straight forward
- Chronic or delayed effects of work causation determination more challenging

Legal Threshold

More probably than not, or >50% likelihood

(NOT beyond a reasonable doubt)

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Selected School Topics

- Lead
- Mercury
- Cleaning, Sanitizing, Disinfecting

Other exposures to consider:

- Indoor air quality, asbestos, PCBs, flame-retardants, BPA and plastics …

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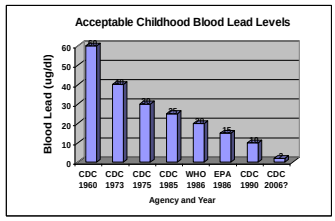
Lead

What is it?

- Blue-grey metal
- No safe blood lead levels (BLLs) for children



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Lead

Where is it (exposure sources)?

- BLLs ≥ 10 in U.S. Children
  - Lead paint and dust: 70%
  - Other: 30% +
- Numerous studies → multiple sources
- Important non-paint sources identified:
  - Ethnic remedies and goods
    - Azarcon, Greta, Paylooah, or Kohl
  - Consumer products
    - Toys, cosmetics, batteries, ammunition, metal products (solder and pipes)
  - Food-related items including ceramics
  - Drinking water from local plumbing (including schools)

Levin R et al. US Children's Lead Exposures, 2008: Implications for Prevention. EHP 2008; 116: 1265-98

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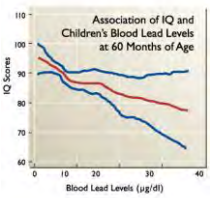
Lead

Health consequences

- Affects brain, nerves, kidneys, reproductive system
- Probably most important neurodevelopmental toxicant affecting kids in US, worldwide
- Most lead poisoning represents subclinical toxicity:
  - **Cognitive loss (lower IQ)**
  - **Behavioral effects**



Canfield R, et al. NEJM 2003;348:1517-1526

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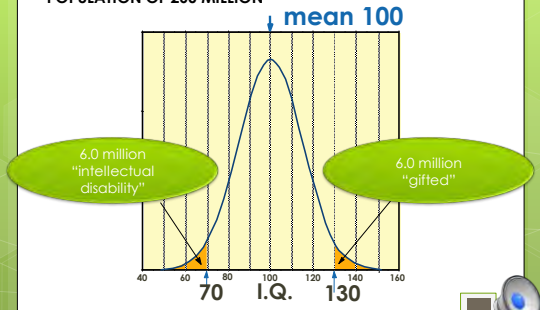
The Significance of Small Effects:

EFFECTS OF A SMALL SHIFT IN IQ DISTRIBUTION IN A POPULATION OF 260 MILLION



October 31, 2011

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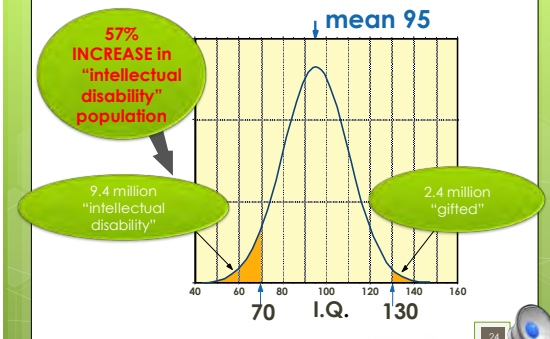
Then, a 5 Point Decrease in Mean IQ:



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Lead

Health consequences, cont.:
"Subclinical" lead toxicity:

Behavior
- Hyperactivity
- Impulsivity
- Distractibility
- Executive function
- Attention/vigilance
- Conduct problems
- Social skills

Learning
- Reading/math/spelling
- Pattern/word recognition

Other
- Pubertal onset
- Renal function
- Fine motor

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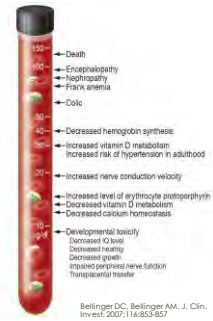
Lead

Health consequences, cont.:
- Requires index of suspicion & environmental history taking to identify
- With ongoing exposure, severity of symptoms will increase



Bellinger DC, Bellinger AM. J. Clin. Invest. 2007;116:853-857

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Lead Exposure Response

Exposure Prevention
- No lead paint, pipes, or solder
- Check consumer products for school use (art supplies)
- Check drinking water lead levels
  - Flush standing water from pipes
- EPA Renovate Right- applies to facilities w/ children ≤ 6
  - http://www.epa.gov/lead/pubs/renovation.htm

Exposure response
- State and Federal resources
  - Nancy Bernard or Margo Young (EPA region X)
    http://www.doh.wa.gov/ehp/Lead/

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Mercury: What & where is it?

- Metal
  - Elemental
    - Shiny silver-white liquid at room temp; colorless & odorless gas if heated
    - Dental amalgams, thermometers, batteries
  - Inorganic
    - Combined w/ other elements to create metal salts; powders/crystals
    - Air, soil, water, skin lightening creams, antiseptic creams and ointments
  - Organic
    - Combined w/ carbon; ex. methylmercury
    - Fish and shellfish

Form determines absorption and toxicity

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Mercury

Health consequences
- Affects brain, nerves, kidneys, developing fetus
- High exposures prenatally: severe mental retardation, cerebral palsy, blindness, deafness
- Lower exposures: language, attention, memory, IQ deficits
- Other impacts: irritability, tremors, changes in vision or hearing, memory loss, lung damage, nausea, etc.

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Mercury: What to do about it?

Prevention
- **Hg not allowed in WA schools except Hg barometers in science lab**
- **If you find it, eliminate it (Rehab the Lab Program)**
- Teach children not to play w/ shiny silver liquids
- Careful handling of thermometers and fluorescent fixtures
- Follow local fish advisories: http://www.doh.wa.gov/ehp/oehas/fish/fishadvisories.htm

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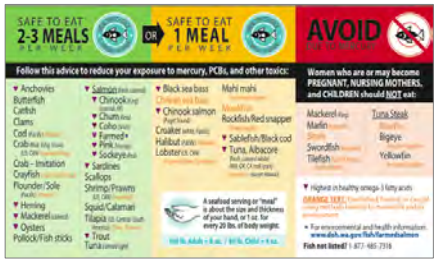
Mercury

Washington DOH "Healthy Fish Guide"



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Cleaning, Sanitizing, Disinfection Chemicals

- **Clean**
  - Physical removal of debris from surfaces by scrubbing and rinsing. Sanitizers, disinfectants require a cleaned surface
- **Sanitize**
  - Must kill **99.9%** of the germs on a surface. EPA registered. *Follow all directions.*
- **Disinfect**
  - Must kill ≥ **99.99%** of the germs (or inactivate them). EPA registered. *Follow all directions*

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Chlorine / Sodium Hypochlorite (Bleach)

- Very effective antimicrobial
- When properly diluted irritant properties low
- Does NOT cause allergic asthma
- May cause irritant-induced asthma if bleach conc is high such that exposure is IRRITATING
- Can trigger asthma attack in those with preexisting asthma as will other irritating exposures
- Corrosive to eyes and skin (concentrated bleach soln)
  - Requires eye wash
- REQUIRES STRICT ATTENDTION to proper dilution and use
- Mixing can create poisonous gas

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Disinfectants & Sanitizers

- Quaternary ammonium compounds
  - Asthmagen
  - Eye, skin and surface corrosivity
- Hydrogen Peroxide
  - Effective antimicrobial but may require long contact time. Long term stability concerns. Low toxicity, irritation.

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PEHSU School Case 1: VOCs

- Indoor air quality problem in a new school
- Following occupancy, slow ↑ complaints until spring 2010 ↑ ↑ ↑ ; odors and respiratory irritation
- Response ↑ outdoor air and IAQ investigation
  - Concrete improperly cured… alkaline component reacted w/ carpet & carpet pad and created typical and unusual volatile organic compounds (VOCs)
- School closed April 2011
  - PEHSU role
- School remediated and reopened fall 2011

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Case 1 Lessons Learned

- ↑ VOCs can cause short-term irritation, but long term health problems not expected
  - Odors interfere with work
- Take complaints seriously
- Hire trained experts to evaluate problem
- Facilitate effective and timely communication
  - Ensure parents, teachers unformed
- Contact Nancy Bernard to avoid pitfalls learned elsewhere
- PEHSU can aid with interpretation of likely health impacts with exposure information
  - Based on published medical evidence

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PEHSU School Case 2 Trichloroethylene (TCE)

- IAQ issue NYC school
- Env'l Site Assessment & Indoor Air Quality inspection conducted for school lease renewal
  - School site formerly was auto garage, lamp manufacturing facility
  - Testing revealed ↑TCE due to sub-slab soil gas
  - Information was NOT communicated from testing agency/DOE to parents, teachers in a timely manner
- PEHSU involved at end of process to try and re-establish trust
- Ultimately district did not renew lease
- School relocated

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Trichloroethylene (TCE)

TCE uses
- Industrial degreasing
- Common in consumer products: fabric cleaners, wood stains, paint removers, adhesives
- Can contaminate soil and seep out as a gas

TCE health effects
- Short-term exp: headaches; dizziness; ear, nose and throat irritation
  - Transient--go away quickly when away from exposure
- Long-term exp-negatively affect liver, heart, kidneys and nervous system. Animals exposed to levels much higher than found in the school developed some forms of cancer.

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TCE Case Lessons Learned

- Property survey prior to relocating a school to a former industrial site
  - New EPA School siting guidance
- Timeline (Communicate information as soon as possible: Sitting on information ↓↓ trust
- Role of PEHSU

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PEHSU

- NW Pediatric Environmental Health Specialty Unit (PEHSU)
- Provides evidence-based information and advice on environmental conditions that influence children's health
- Pediatricians, nurse, exposure science, other experts
- Sponsored by the US EPA and CDC- ATSDR

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PEHSU: Services

- Free telephone consultations on PEH
- Health care providers, public health professionals, school officials, community groups, parents/families, media
- Training for clinicians and public health professionals on PEH, others
- Student mentorship: undergrads, grad/med students
- Special projects
- PEH Fact sheets

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PEHSU: National Network

- Each PEHSU represents a region of the EPA (NW = region 10)
- Academic research institutions (NW = University of Washington)
- International PEHSUs

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PEHSU: Contact Us

- pehsu@uw.edu
- 1-877-KID-CHEM (1-877-543-2436)
- http://depts.washington.edu/pehsu/

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Resources

- WA DOH School page
- http://www.doh.wa.gov/ehp/ts/school/
- Northwest Pediatric Environmental Health Specialty Unit (PEHSU)
  - 1-877-KID CHEM, http://depts.washington.edu/pehsu/
- US EPA website (lead, mercury, pesticides, children's health, school siting guidelines)
- ATSDR Pediatric Environmental Health Tool
  - http://www.atsdr.cdc.gov/emes/health_professionals/pediatrics.html
- American Academy of Pediatrics. Handbook of Pediatric Environmental Health (most recent: 3rd edition, October 2011)

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Resources, cont.

- MSDS – strengths/limitations www.hazard.com/msds
- Association of Occupational and Environmental Health Clinics (AOEC) www.aoec.org
- Federal/state/local agencies
  - http://www.kingcounty.gov/healthservices/health.aspx
  - http://www.osha.gov/
  - http://www.cdc.gov/niosh/homepage.html

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Disclaimer

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Questions?