



Fall 2011

Children's Environmental Health

NW PEHSU for WA-DOH School
Environmental Health Workshops

Ada Otter
DNP, ARNP

Nancy Beaudet
MS, CIH



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



What is Environmental Health?



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



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



Child Health Problems Linked to Environmental Contaminants

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



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



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



Unique considerations, cont.



Vulnerability: Dependency considerations

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



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



Toxicology: Exposure, Dose and Toxicity

○ Routes of Exposure

- Inhalation
- Ingestion
- Skin absorption
- Bite or sting



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



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



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)



Environmental Health Histories

- ACHOO

- A Activities

- C Community

- H Household & Hobbies

- O Occupational

- O Oral



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



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)



Selected School Topics

- Lead
- Mercury
- Cleaning, Sanitizing, Disinfecting

Other exposures to consider:

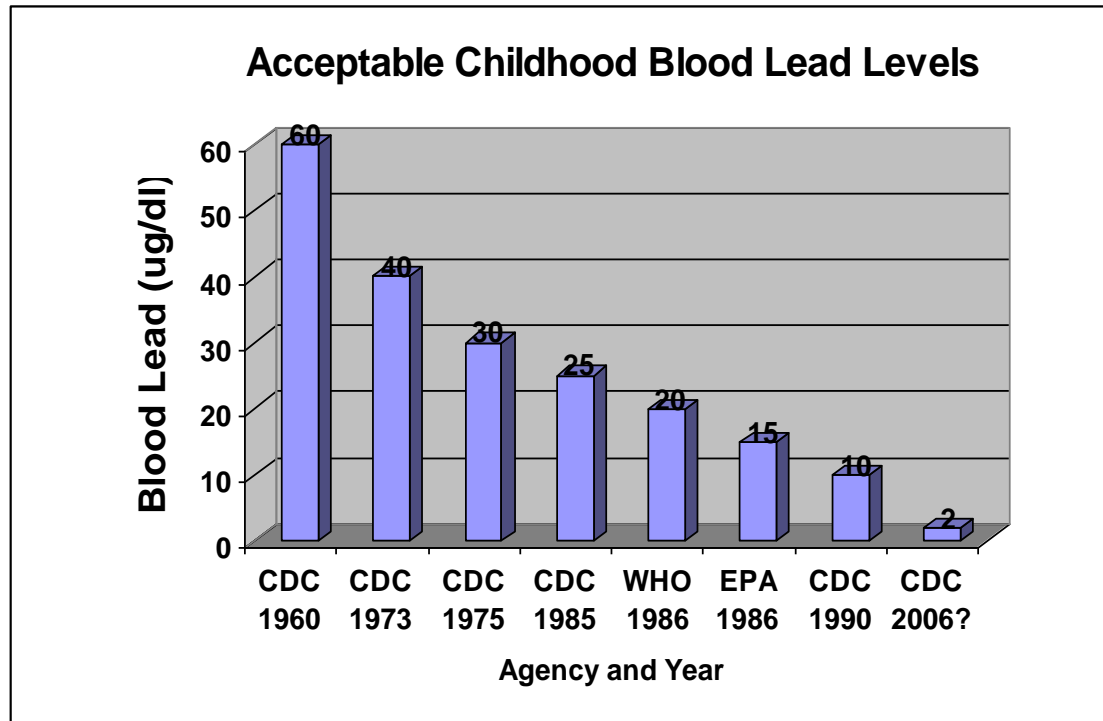
- Indoor air quality, asbestos, PCBs, flame-retardants, BPA and plastics ...



Lead

What is it?

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



Lead

Where is it (exposure sources)?

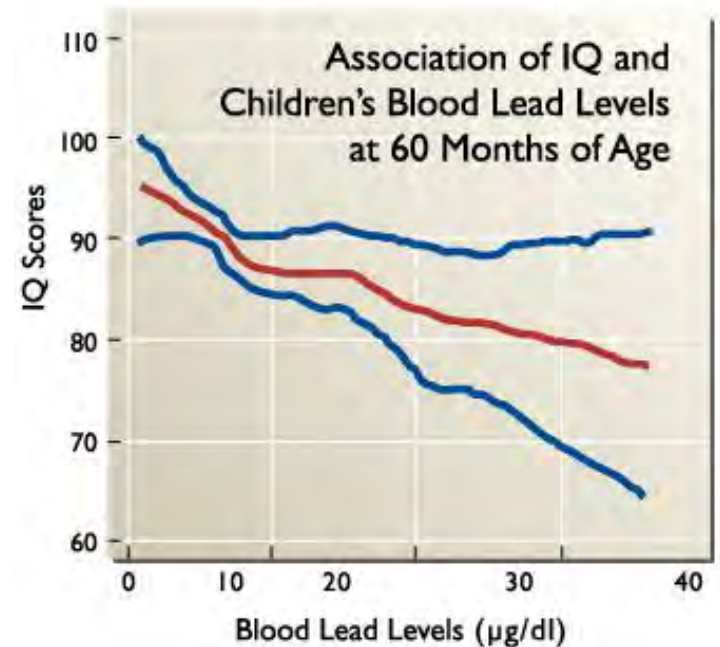
- BLLs \geq 10 in U.S. Children
 - Lead paint and dust: 70%
 - Other: 30% +
- Numerous studies \rightarrow multiple sources
- Important non-paint sources identified:
 - Ethnic remedies and goods
 - Azarcon, Greta, Paylooh, or Kohl
 - Consumer products
 - Toys, cosmetics, batteries, ammunition, metal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



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**

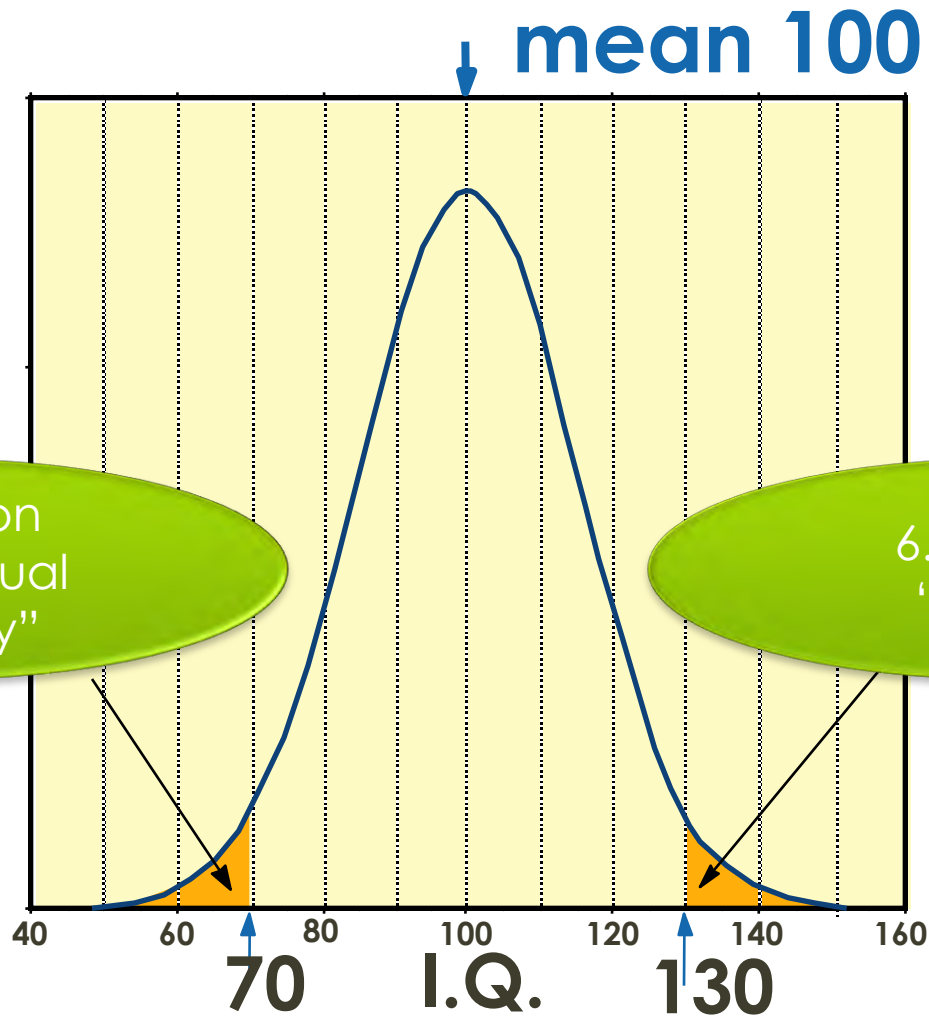


Canfield R, et al. NEJM 2003;348:1517-1526



The Significance of Small Effects:

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

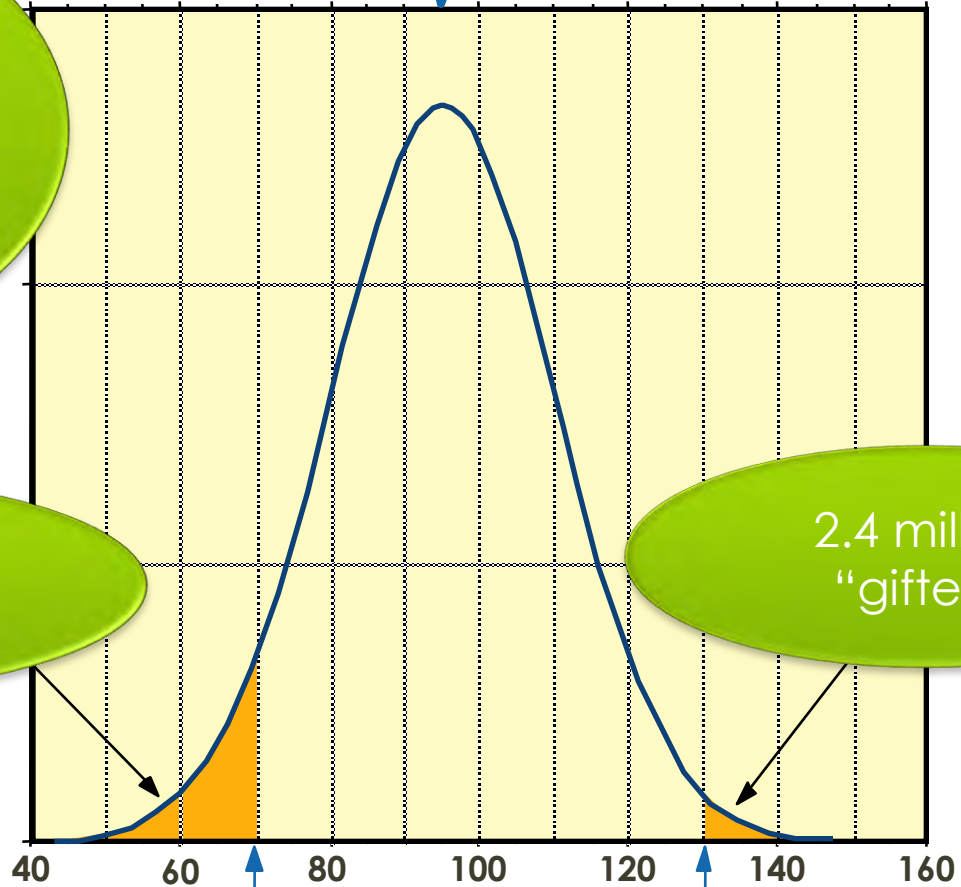


Then, a 5 Point Decrease in Mean IQ:

↓ mean 95

**57%
INCREASE in
“low IQ”
population**

9.4 million
“intellectual
disability”



2.4 million
“gifted”



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

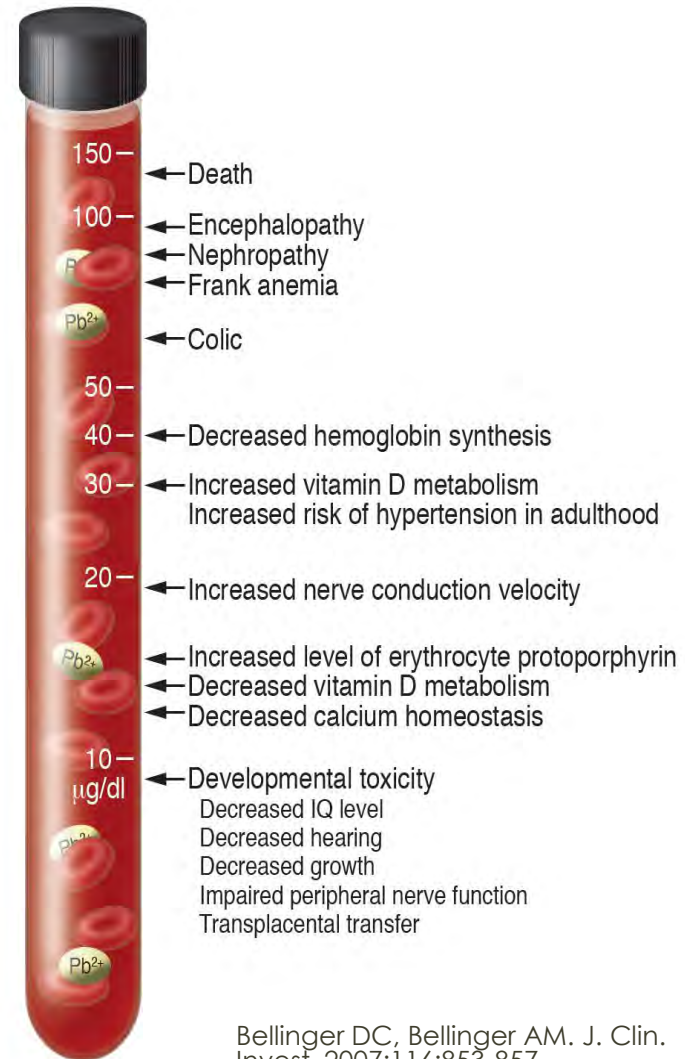
- Pubertal onset
- Renal function
- Fine motor



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



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/>



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



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.



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>



Mercury

Washington DOH "Healthy Fish Guide"

| SAFE TO EAT 2-3 MEALS PER WEEK | | OR | SAFE TO EAT 1 MEAL PER WEEK | | AVOID DUE TO MERCURY |
|---|--|---|--|--|---|
| <p>Follow this advice to reduce your exposure to mercury, PCBs, and other toxics:</p> | | | | | |
| <ul style="list-style-type: none"> ♥ Anchovies Butterfish Catfish Clams Cod (Pacific) (USA/UK) Crab (Blue King, Snow) (US, CAN) (except King) Crab - Imitation Crayfish (USA/UK/Canada) Flounder/Sole (Pacific) (USA/UK) ♥ Herring ♥ Mackerel (canned) ♥ Oysters Pollock/Fish sticks | <ul style="list-style-type: none"> ♥ Salmon (fresh, canned) ♥ Chinook (King) (coastal AK) ♥ Chum (Keta) ♥ Coho (Silver) ♥ Farmed* (USA/UK) ♥ Pink (Humpy) ♥ Sockeye (fresh) ♥ Sardines Scallops Shrimp/Prawns (US, CAN) (except King) Squid/Calamari Tilapia (US, Central/South America) (China, Thailand) ♥ Trout Tuna (canned light) | <ul style="list-style-type: none"> ♥ Black sea bass Chilean sea bass ♥ Chinook salmon (Puget Sound) Croaker (white, Pacific) Halibut (Pacific) (USA/UK) Lobster (US, CAN) (except Spiny King Lobster) | <ul style="list-style-type: none"> Mahi mahi (spoonfish/nycteryx) Monkfish (USA/UK/Canada) ♥ Sablefish/Black cod (fresh, canned white) (WA, OR, CA) (pink/pale) (Japan - except Hovaco) | <p>Women who are or may become PREGNANT, NURSING MOTHERS, and CHILDREN should NOT eat:</p> <ul style="list-style-type: none"> Mackerel (King) Marlin (fresh) Shark Swordfish (fresh) Tilefish (Lake of Mexico) (South Atlantic) <u>Tuna Steak</u> Bluefin Bigeye (fresh) (Japan) Yellowfin (fresh) (Japan) | |
| <p>♥ Highest in healthy omega-3 fatty acids</p> <p>ORANGE TEXT: Overfished, farmed, or caught using methods harmful to marine life and/or environment</p> <p>★ For environmental and health information: www.doh.wa.gov/fish/farmedsalmon</p> <p>Fish not listed? 1-877-485-7316</p> | | | | |  |
| <p>A seafood serving or "meal" is about the size and thickness of your hand, or 1 oz. for every 20 lbs. of body weight.</p> <p>160 lb. Adult = 8 oz. / 80 lb. Child = 4 oz.</p> | | | | | |



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 \geq **99.99%** of the germs (or inactivate them). EPA registered. *Follow all directions*



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 ATTENTION** to proper dilution and use
- Mixing can create poisonous gas



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.



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



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



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



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.



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



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



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



PEHSU: National Network



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



PEHSU: Contact Us

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



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)



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>



Disclaimer

This presentation was prepared by the Association of Occupational and Environmental Clinics (AOEC) and funded (in part) by the cooperative agreement award number 1U61TS000118-02 from the Agency for Toxic Substances and Disease Registry (ATSDR).

Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing funds to ATSDR under Inter-Agency Agreement number DW-75-92301301-0. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications.



Questions?

