Objectives
After this presentation, the participant should be able to discuss:
1) taking an exposure history
2) human health effects related to trichloroethylene (TCE) and tetrachloroethylene (PCE) exposure
3) the evaluation of patients with possible exposure to TCE and PCE.

Exposure pathway: Air, soil, water
Routes of Exposure: Inhalation, ingestion, dermal contact
Time Frame: past, present, future

Vapor Intrusion
Migration of volatile compounds from contaminated groundwater through the soil into buildings
Health implications: Acute and chronic health effects, cancer risk, fire and explosion hazards

Association of Chemical Exposure with Health Impacts
Health effect has biologically plausible association with known toxicity of chemical
Level of exposure is consistent with dose known to cause health effects
  o Complete exposure pathway
  o Frequency and duration of exposure
  o Concentration

Medical Exam: Exposure History
1. Do you live next to or near an industrial plant, commercial business, dump site, or nonresidential property?
2. Which of the following do you have in your home? Please circle those that apply.
   Air conditioner  Air purifier  Central heating  Gas stove
   Electric stove  Fireplace  Wood  Humidifier
   (gas or oil?)
3. Have you recently acquired new furniture or carpet, refinished furniture, or remodeled your home?
4. Have you weatherized your home recently?
5. Are pesticides or herbicides (bug or weed killers; flea and tick sprays, collars, powders, or shampoos) used in your home or garden, or on pets?
6. Do you (or any household member) have a hobby or craft?
7. Do you work on your car?
8. Have you ever changed your residence because of a health problem?
9. Does your drinking water come from a private well, city water supply, or grocery store?
10. Approximately what year was your home built?_________________

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1. Are you currently exposed to any of the following?
   - metals
   - dust or fibers
   - chemicals
   - fumes
   - radiation
   - loud noise, vibration, extreme heat or cold
   - biologic agents

2. Have you been exposed to any of the above in the past?

3. Do any household members have contact with metals, dust, fibers, chemicals, fumes, radiation, or biologic agents?

4. Do you know the names of the metals, dusts, fibers, chemicals, fumes, or radiation that you are/were exposed to? [If yes, list them below.]

5. Do you get the material on your skin or clothing?

6. Are your work clothes laundered at home?

7. Do you shower at work?

8. Can you smell the chemical or material you are working with?

9. Do you use protective equipment such as gloves, masks, respirator, hearing protectors? [If yes, list the protective equipment used.]

10. Have you been advised to use protective equipment?

11. Have you been instructed in the use of protective equipment?

12. Do you wash your hands with solvents?

13. Do you smoke at the workplace?
   - at home?

14. Are you exposed to secondhand tobacco smoke at the workplace?
   - at home?

15. Do you eat at the workplace?

16. Do you know of any coworkers experiencing similar or unusual symptoms?

17. Are family members experiencing similar or unusual symptoms?

18. Has there been a change in the health or behavior of family pets?

19. Do your symptoms seem to be aggravated by a specific activity?

20. Do your symptoms get either worse or better at work?
   - at home?
   - on weekends?
   - on vacation?

21. Has anything about your job changed in recent months (such as duties, procedures, overtime)?

22. Do you use any traditional or alternative medicines?

23. Have you or your child ever eaten on-food items, such as paint, plaster, dirt, clay?

(From: ATSDR’s Case Studies in Environmental Medicine: Taking an Exposure History; http://www.atsdr.cdc.gov/csem/csem.html )
Trichloroethylene (TCE)

Volatile chlorinated hydrocarbon
Industrial degreaser/solvent
Consumer products: adhesives, spot removers, cleaning fluids for rugs, paint removers/strippers, typewriter correction fluids
Historical uses: extractant, medical

Pharmacokinetics
Absorption—readily absorbed across membranes
   Ingestion: 90-95%
   Inhalation: ≈ 75%
   Skin absorption: negligible from vapors; high from liquids
Distribution—lipophilic
   Richly perfused organs (liver, kidneys, lung)
   Adipose tissue (1/2 life 3.5-5 hours), brain
Metabolism—rapid
   Oxidation by Cytochrome P450 – major pathway, primarily liver
   Conjugation with GSH
Elimination: Urine and Exhaled breath

Acute human health effects (inhalation)
Neurologic
   81-110 ppm threshold for mild CNS depression
   >500 ppm: excitation, light-headedness, headache, nausea, incoordination, impaired ability to concentrate
   >2000 ppm: anesthesia
Cardiovascular: High concentrations: cardiac arrhythmia
Hepatic
   Liver toxicity at high concentrations; Increased ALT, AST
   Alcohol consumption increases risk

Chronic human health effects (inhalation)
Neurologic
   Damage to cranial nerves
   Impaired trigeminal nerve function (blink and masseter reflexes)
   Memory loss, impaired cognitive function
Renal: High repetitive exposures—renal proximal tubule damage
Reproductive and developmental
   Crosses the placenta
   Congenital cardiac anomalies (ingestion exposure)
Respiratory: Minimal irritant; RADS or irritant induced asthma at very high concentrations
Dermal
   Contact dermatitis, rashes, burns
   Degreaser’s flush (alcohol plus inhaled TCE)
Immunological
   Exacerbate underlying autoimmune disease or trigger the onset of a syndrome
   Genetic susceptibility: TCE metabolism
   Association with systemic scleroderma

Cancer
International Agency for Research on Cancer – Group 2A (probably carcinogenic to humans)
   Kidney: RR = 1.7 (1.1-2.7), Liver: RR = 1.9 (1.0-3.4)
      Non-Hodgkin’s lymphoma: RR = 1.5 (0.9-2.3)
      Hodgkin’s lymphoma, Cervical cancer
   Confounded by exposure to other solvents, quantifying exposures, risk factors

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Tetrachloroethylene (PCE)

Volatile chlorinated hydrocarbon
Industrial degreaser/solvent; chemical intermediate, dry cleaners
Consumer products: spot removers, fabric water repellants, paint removers/strippers, typewriter correction fluids

Pharmacokinetics
Absorption—readily absorbed across membranes
  Highly lipophilic
  Readily absorbed by inhalation
  Proportional to ventilation rate
Distribution—lipophilic
  Richly perfused (12-16 hrs)
  Poorly perfused (30-40 hrs)
  Adipose (55 hours)
  Crosses the placenta
Metabolism—rapid, primarily in the liver
  Oxidation by Cytochrome P450 – major pathway; Conjugation with GSH
Elimination: Urine (1-3%) and Exhaled breath (97-99%)

Human health effects (inhalation)
No clinical effects at exposures below 50,000 ppb
Major Target Organs: brain, liver, kidney
International Agency for Research on Cancer – Group 2A (probably carcinogenic to humans)
Liver and kidney tumors in animals

<table>
<thead>
<tr>
<th>TCE and PCE: Medical Testing</th>
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<tr>
<td>Occupational settings:</td>
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<tr>
<td>TCE and PCE: Medical Management</td>
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<tr>
<td>(Inhalational vapor intrusion exposure)</td>
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<table>
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<tr>
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<th>PCE</th>
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<tbody>
<tr>
<td>Blood</td>
<td>trichloroethylene, free trichloroethanol</td>
</tr>
<tr>
<td>Urine</td>
<td>trichloroacetic acid, trichloroethanol</td>
</tr>
<tr>
<td>End-exhaled air</td>
<td>trichloroethylene</td>
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</tbody>
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For More Information:
ATSDR (www.atsdr.cdc.gov)
- Case Studies in Environmental Medicine
  - Taking an Exposure History, Pediatric Environmental Health, Trichloroethylene, Tetrachloroethylene
  - Toxicological Profiles
  - Medical Management Guidelines

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