Summertime Toxicology

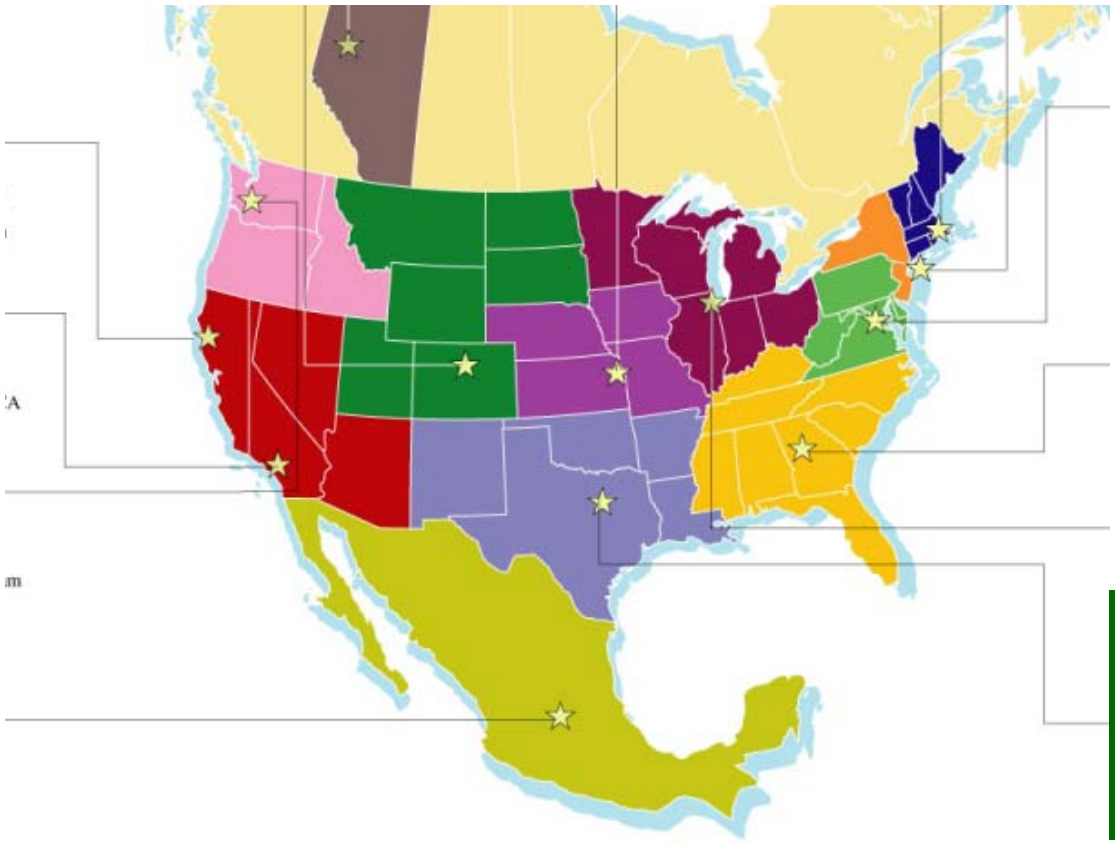
A Discussion of Environmental Concerns Related to Children's Summer Activities

Objective

- Introduction
- Case Scenarios
  - The Soccer Field
  - The Playground
  - The Lake
  - The River
  - The Air-Conditioned Room

Pediatric Environmental Health Specialty Units

- Tyler Unit: Established 9/00
- One of 13 Units
- Goals: Education, Consultation (hotline), Advocacy, Research, Networking



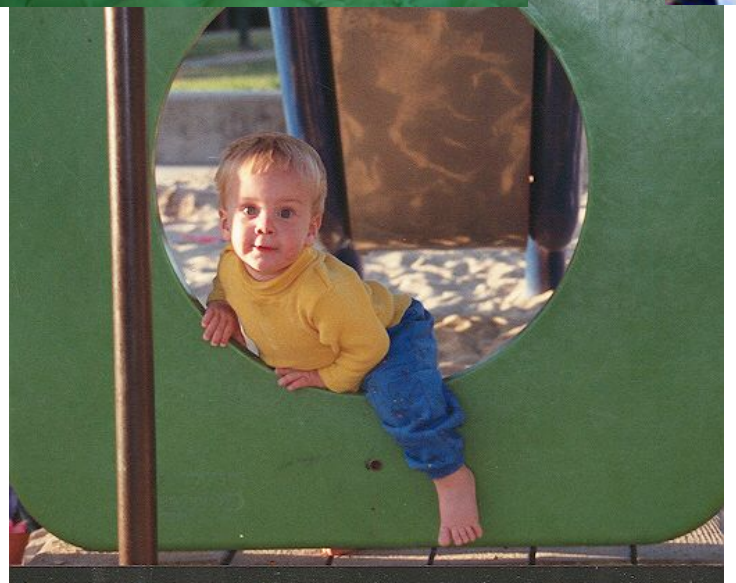
Region VI: SWCPEH, Tyler

Bridging the Gap

Occupational/
Environmental
Medicine

Pediatrics

Summer Activities



Scenario 1: The Soccer Field

- 12 year-old boy presents with asthma exacerbation during soccer practice on code red air quality, high ozone days
- Wheezing and shortness of breath persist until the next morning

Reference: Ozone and Your Patient's Health, U.S. EPA, http://www.epa.gov/air/oaqps/eog/ozonehealth/aqi.html#what, referenced 4/16/05

Houston, 2004: 5th Smoggiest City in U.S.

Smoggy Day

Clear Day

- In 1999, more days violated federal smog standards than Los Angeles
- Dense population, heavy auto traffic, and industry contribute to smog

- Images from the Batelle Institute (www.nasa.gov)

What is a Code Red Air Quality Day?

Converts the concentrations of fives specific pollutants (CO, ozone, NO_2, SO_2, and particulate matter) into one number, scaled from 0 – 500, but may specify the primary pollutant of concern.

0-50:	Good	Green
51-100:	Moderate	Yellow
101-150:	Unhealthy for Sensitive Groups	Orange
151-200:	Unhealthy	Red
201-300:	Very Unhealthy	Purple

Ozone: Good Up High, Bad Nearby

- Stratosphere: Absorbs UV Light
- Troposphere: Pollutant
  - VOCs (industry) + NOx (Autos) + Sunlight =

Does Ozone Trigger Asthma?

- It depends on…
  - Individual sensitivity to ozone
  - Baseline asthma status
  - Dose of ozone inhaled, where dose = outdoor ozone concentration x respiratory rate x duration of exposure

Should my child stay inside on red days? On orange days?

- It depends…
  - Can the asthma be better controlled with preventive medicines or reducing indoor triggers? (dust mites, cockroaches, animal danders, molds, environmental tobacco smoke)
  - How important is the outdoor activity? Can it be rescheduled?
  - How likely is the ozone to trigger a problem?

How can I reduce exposure to ozone?

- Stay indoors: Indoor ozone = 20% - 80% of outdoor ozone
- Exercise outdoors in the morning or evening, not in the afternoon
- Population based approaches:
  - Conservation (fewer cars, less electricity)
  - Support regulation of air pollutants, esp. ozone, NOx and VOCs

Despite Ozone ...

Jackie Joyner-Kersee: Olympic triple gold medalist with asthma

Indoor risks: Too sedentary, obese, isolated

Advice to Parent

- Can the team practice before 11:00 or after 6:00 on code red air quality days?
- Review medications and asthma triggers to improve baseline
- Try medication before symptoms occur
- As a last resort, stay inside between 11:00 and 6:00 on code red days

Scenario 2: The Playground

Elements in Playground Soil

- A nurse started her own business of helping people deal with toxics from the environment. She identified "high" levels of arsenic in soil from a public playground with a wooden structure. She presented the results to the city council, and now the city council is calling you for advice.

The Many Faces of Arsenic

Arsenic: A naturally occurring trace element and a metalloid

Uses: Pesticide, preservative, poison

Forms: Organic, inorganic, pentavalent, and trivalent forms

Exposure pathway: Mostly from food and water

Human carcinogen; increased lung cancer incidence observed in exposed smelting, chemical, and agricultural workers

Intentional poisoning: multi-system effects

Why Are My Children Playing in Arsenic?

- Chromated copper arsenate (CCA) has been widely used as a wood preservative since the 1930s

- Pesticides, including CCA, are regulated by EPA under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

- Playground equipment is regulated by the Consumer Product Safety Commission (CPSC) under the Federal Hazardous Substances Act

Did Someone Get Sick From Arsenic in Wood?

- Slight increase in cancer risk expected from playground exposure
- The Environmental Working Group (EWG) and the Healthy Building Network (HBN) petitioned CPSC to ban CCA treated wood from playground equipment in June ’01
- CCA manufacturers voluntarily agreed with EPA (FIFRA) to stop manufacturing CCA treated wood, so CPSC did not enact the ban
- The CCA wood was off the shelves by mid-2004

Uses of Pressure Treated Lumber

Advice to Caller

- Question the lab and sampling techniques
- Question the source
- Route of exposure: for most children, food and water are primary sources
- Refer to local health department for follow up
  - Hazardous waste site: call ATSDR

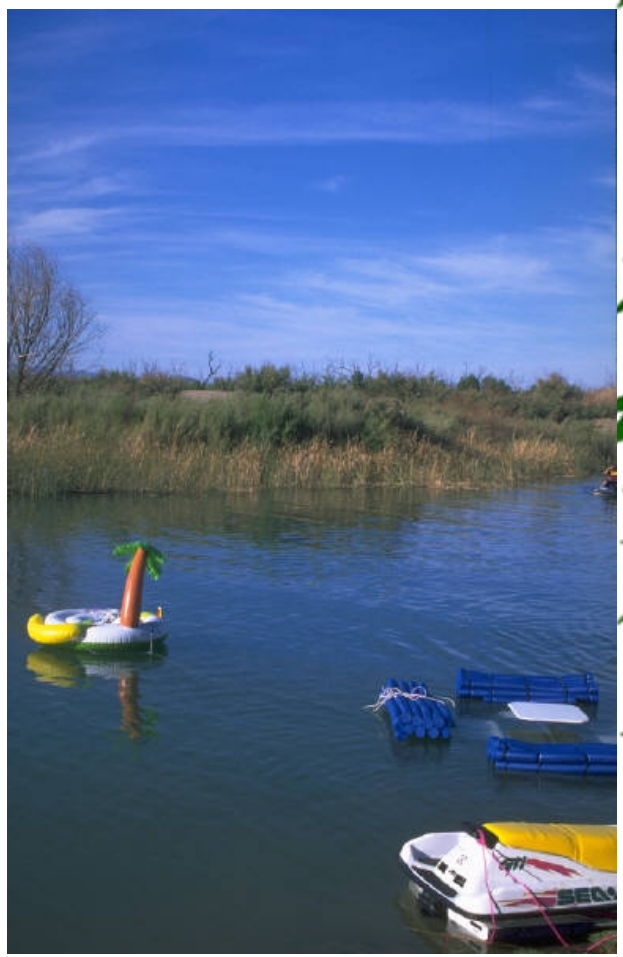
Other Options

- Ask the regional health department to repeat the test and find the source?
- Post a sign encouraging children to wash hands after playing and not to eat near the playground equipment?
- Tear down the equipment?

Scenario 3: The Lake

Swimming Sickness

- 8 year old boy presents to the ER after suddenly losing consciousness and falling in the water
- Retrieved immediately; had pulse but was not breathing; after a few rescue breaths, he regained consciousness and started breathing again



Presentation

- On arrival at ER, patient seemed drowsy, oriented only to person and place, and complained of a headache and nausea.
- VS: BP 120/80, Pulse 100, Resp 15 breaths/minutes, Rectal Temp 99 F
- Exam: Mid size reactive pupils; Supple neck; Lungs clear; Regular rhythm w mild tachycardia; Normal strength, sensation, and reflexes in limbs; refused to stand b/c of feeling weak and light-headed

What's Going On? Call 1-800-222-1222

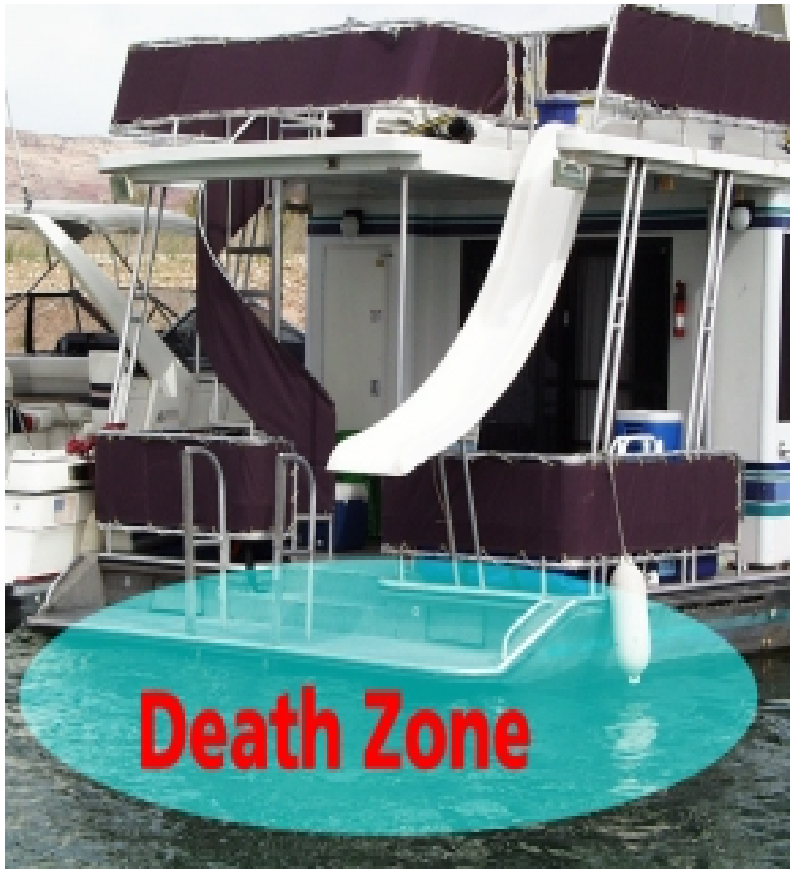
- History
  Previously healthy
- Lab Tests
- COHb: 14% (normal <5%), 3 hrs post exposure
- Supportive Measures
  - Oxygen by mask

Epidemiology of CO Poisoning

- Hundreds of deaths/year from unintentional poisoning (not fires), mostly from motor vehicle exhaust
- How many non-fatal poisonings?
- 46 children presenting to ER for flu-like symptoms
  - 23 had carboxyhemoglobin >2% (ref: 1-2 % in non smokers, up to 10% in smokers)
  - 6 had carboxyhemoglobin >10%

Source: Baker MD, J Pediatr, 1988; 113: 501-504

CO Below!!!



Clinical Effects and Diagnosis

- CO binds to hemoglobin but does not affect oxygen sat measured by pulse ox (machine misinterprets COHb as OHb), does not lower PaO2
- Symptoms are non-specific and not correlated well to COHb levels
- Long term cognitive and personality changes may occur following an acute exposure

Boats and CO

- Propulsion engines of recreational boats have no emissions-control devices
- CO may reach 27,000 ppm in stern of boat (WHO ceiling limit = 87 ppm for 15 min exposure)
- Consider immediate COHb level in any drowning near a boat or in boaters presenting with flu-like symptoms (HA, nausea, lethargy)

Source: MMWR, 51(37): 829 – 830, Sep 2002

Special Susceptibility of Children

- Infants and children: higher metabolic rates
- CO diffuses across the placenta, and fetal hemoglobin has higher affinity for CO and slower elimination
- Lethargy and syncope occur more frequently in children than in adults

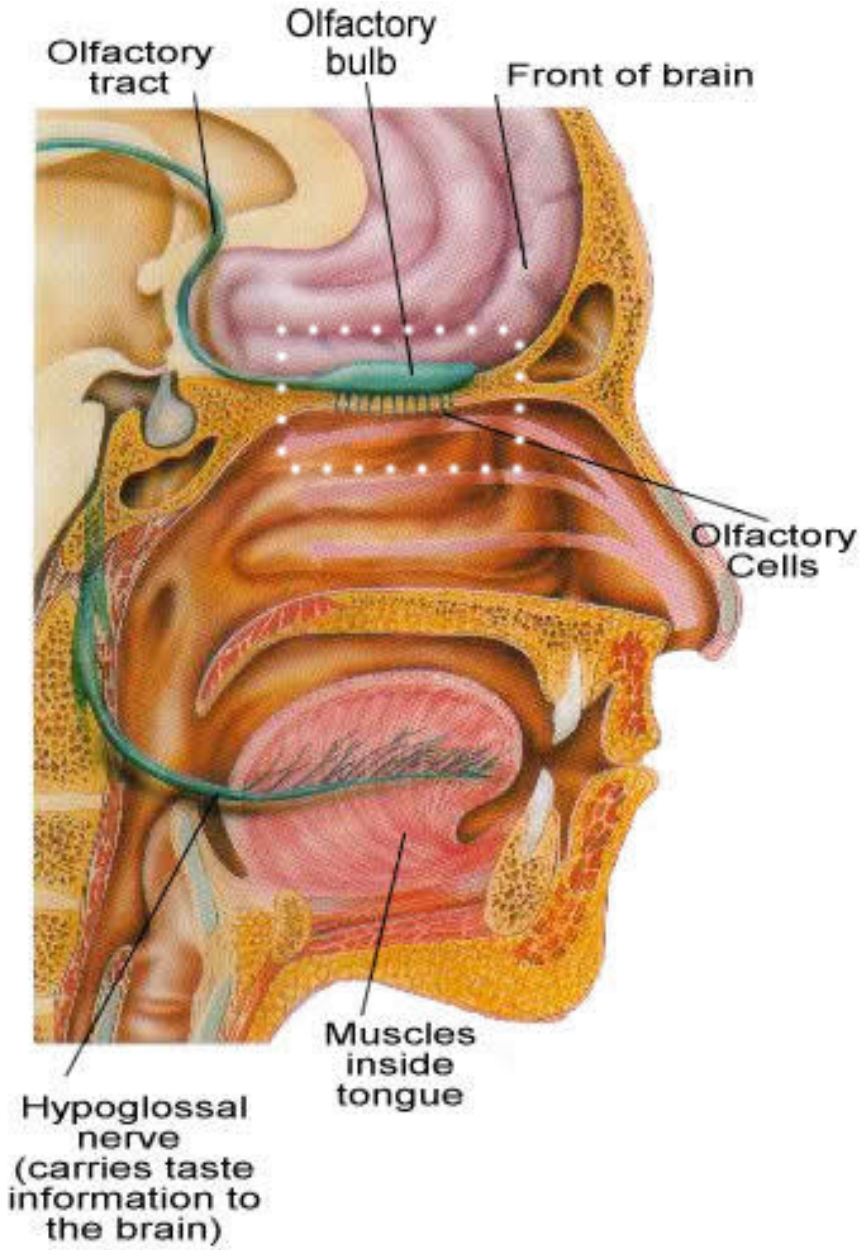
Why Not Row Your Boat, Gently Down the Stream?

Scenario 4: The River

- In 1995, a 13-year old Texas boy went swimming in the Rio Grande and in a holding tank containing water pumped from the river. Four days later, he developed headache, fever, nausea, vomiting and stiff neck; Day 5 – Seizures and coma; Day 6 - Death

Primary Amoebic Meningoencephalitis

- The Pathogen: *Naegleria fowleri*
- Occurs in active healthy children and young adults but only RARELY (24 cases/11 yrs).
- The amoeba enters through the nasal passages and invades the brain through the olfactory nerves.
- Proliferate in the subarachnoid space, and disseminates into the brain.


Olfactory tract
Olfactory bulb
Front of brain
Olfactory Cells
Muscles inside tongue
Hypoglossal nerve (carries taste information to the brain)

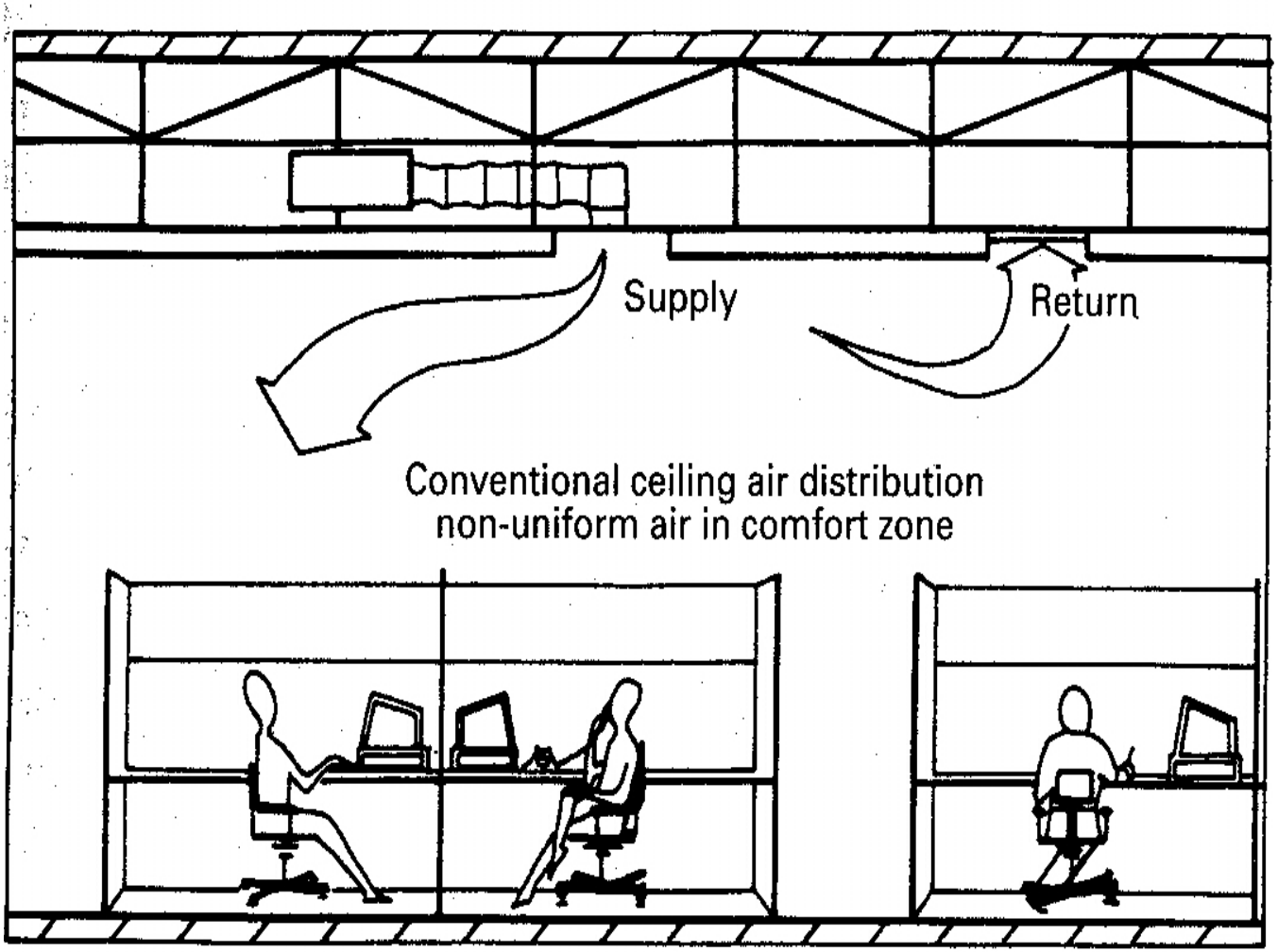
Outbreaks Associated with Recreational Water Use, 1971-2000

- 1. Cryptosporidium (15%)
- 2. Shigella (13%)
- 3. Naegleria (11%)
- 4. Giardia (6%)
- 5. Toxigenic E Coli (6%)

Risk Factors

- Warm, sluggish water
- Too many humans in the water
- Sewage discharge into surface water
- Swimming pool with inadequate filtration, disinfection
- Contamination from wild animals

Scenario 5: The Air-Conditioned Room



School Nurse Overwhelmed

- A private school had 610 students, pre-K through 8th grade, and 50 teachers. During the first 2 weeks of May, 45/610 (7%) students and 15/50 (30%) teachers visited the school nurse. Most complained of cough and eye irritation, which were worse at school and resolved immediately after leaving the school building.

School case, continued

- Investigation revealed that Aquachem, a chlorine product for pools, was placed in the drip pans of the school's air conditioner first of May, when complaints began. Maintenance had been running A/C to "get rid of fumes". The chemical was finally removed.

Drip or drain pan

Effects of chlorine

- Cl_2 reacts with H_2O to form HCl
- Moderate water solubility; upper airway irritation tends to be prominent
- Lower airway damage is possible where concentrations are high and victims are trapped
- Supportive tx : O_2, bronchodilators, steroids
- Chronic effects? Not usually, but…

What the school did

- Closed school for 3 days; called in environmental consulting firm; tested “all the levels”, which were “fine”
- Noted mold in some ducts
- Parents continued to have concerns over a period of months

Indoor air concerns

- In industrialized nations, people spend >90% of their time indoors
- Synthetic building materials, furnishings, and human occupants generate pollutants
- Since the 70's energy crisis, buildings are sealed more tightly with less ventilation
- IAQ complaints are increasing

Sick Building Syndrome

- Symptoms: More occupants than expected have headache, eye irritation, respiratory complaints, itchy/dry skin, fatigue
- Signs: rapid blinking, erythema

Building Related Poisoning

- CO: headache and nausea progressing to giddiness, malaise, weakness, and dyspnea + smell of combustion odors
- Lead, pesticides, solvents - less commonly

Building Related Infection

- Legionnaire's Disease: influenza-like illness or pneumonia; transmitted by inhalation of bacteria in droplets of water from aerosol-producing devices. Typically spread in air conditioning ducts from evaporative cooling towers.
- Possibly TB, common viruses, opportunistic fungi in immunocompromised hosts

Building Related Allergy

- Asthma exacerbation from molds, insects, or dust mites in sensitized individuals

Mass Psychogenic Illness

- Typically dramatic symptoms (fainting, choking, seizures);
- Odor may be a trigger;
- May spread from social leader of group to others working in close contact - line of sight transmission;
- NOT the same as SBS

Tools for Schools

- EPA has an indoor air kit just for schools
- Investigation protocol with worksheets for teachers, school nurses, principals, maintenance, etc; a video and an IAQ problem solving wheel
- Http://www.epa.gov.iaq/schools/

In Conclusion...

- Beware of ozone in the red zone
- Arsenic may be less toxic than television
- Row, row, row to avoid CO
- Chlorine: Needed for pools
- Chlorine: Not for A/Cs

The End

Enjoy your summer!

Disclaimer, acknowledgements & fine print

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