Mount Sinai Pediatric Environmental Health Specialty Unit
WTC Volatile Organic Compounds Fact Sheet

This fact sheet answers frequently asked health questions (FAQs) about volatile organic compounds (VOCs). It is part of a series of fact sheets describing potential health risks to children from exposures related to the World Trade Center.

What are volatile organic compounds?

Volatile organic compounds are carbon-based chemicals that easily evaporate into gaseous forms at room temperature. VOCs are commonly referred to as solvents. They are found in everyday household items such as paints, paint strippers, varnishes, lacquers, wood preservatives, craft kits, glues, fuels, aerosols, cleaners, pesticides, cigarette smoke and dry-cleaned clothes. They act as carriers and can dissolve grease. Formaldehyde, benzene, toluene and acetone are all considered volatile organic compounds.

How are children exposed to volatile organic compounds?

VOCs are released into the environment in a number of ways. Paint, furnishings, gasoline, smoke from fires and even stored products such as closed paint canisters may release large amounts of VOCs into the air. Renovation of homes and buildings leads to an accumulation of VOCs within enclosed spaces, thus accounting for higher levels of VOCs indoors compared to outdoors. Once VOCs are released into the environment in the form of gases, they can react with sunlight to form ozone or smog.

The primary route of exposure to VOCs is by breathing in these gases. Less commonly, children may be exposed through direct contact with skin. Inhaling the fumes from toluene, better known as glue-sniffing, is another source for exposure among teenagers.

Were volatile organic compounds released into the environment after the collapse of the World Trade Center?

VOCs were released into the air from the fires at the World Trade Center due to the evaporation of fumes from burning paint, plastics, furniture, papers, carpeting and jet fuel.

Levels of VOCs were elevated while the fires were still burning at the World Trade Center site, in the period from September 11th through the end of December 2001. The EPA measured "spot samples" of VOCs by collecting air samples over minutes, sometimes obtaining samples directly from smoke plumes at the World Trade Center site. The purpose in obtaining spot samples was to assess potential risks for workers at Ground Zero. These levels were found to be significantly higher than the average concentration of VOCs for a 24-hour period, indicating that VOC levels fluctuated greatly and were highest in the smoke plumes at the work site.

In contrast, the average concentrations of VOCs in full day air samples were well below the level at which any known health effects are seen, known as a screening level. The concentration of VOCs just outside the World Trade Center site and as close as one block away rapidly decreased to below screening level, reflecting the fact that the levels of volatile organic compounds diminish rapidly in the outdoors.

In their measurements, the EPA was able to detect a total of 51 VOCs, primarily within the World Trade Center clean-up site. Benzene, a chemical widely used in the United States, was one volatile organic compound monitored by the EPA. It is used to make plastics, nylon, synthetic fibers, rubber products, dyes, detergents, and pesticides. The screening level for benzene is 20 ppb. This means if you are exposed to an average concentration of 20 ppb of PCB continuously over a year, you would then have a 1 in

10,000 increased risk of cancer. Background air levels of benzene of 0.51 ppb represent the annual average of air PCB levels in Brooklyn for the period from 1994-1998, though background levels in New York City pre 9-11 have been reported as high as 4 ppb. These background levels are affected by factors common to the urban setting such as city traffic, tobacco smoke, and gasoline fumes from service stations. Efforts are underway to reduce overall benzene emissions.

To illustrate the varying levels of VOCs at the work site versus those just outside the work site, we can look at full-day air monitoring for benzene conducted by the EPA. Some levels of benzene detected at the work site were found to be above the screening level (>20 ppb) primarily during the fires. These levels decreased to below detection limits by mid-October at Austin Plaza, by late December at the South Tower and by mid-January at the North Tower. While "spot sample" levels at the World Trade Center site were elevated, 24-hour monitoring levels just outside the site were found to be much lower. Full-day air monitoring for benzene conducted by the EPA from September 11, 2001 through December 17, 2002 at sites in and around the World Trade Center area indicated an average air benzene concentration of 1.45 ppb, well below the EPA screening level, and significantly below the grab sample levels obtained directly at the work site.

How do volatile organic compounds affect the health of children?

Health effects from VOCs are usually temporary and improve once the source of the exposure is identified and removed. These health effects can include irritation of the eyes, nose, throat and skin. Headache, nausea and dizziness may occur, as well as fatigue and shortness of breath. Health effects vary depending on the chemicals involved and the duration of the exposure. Formaldehyde and pesticides are considered probable carcinogens.

Exposure to benzene can result in headache, dizziness, a fast heart rate, tremors, drowsiness and confusion. Benzene can affect the bone marrow by decreasing red blood cells (anemia) or by decreasing platelets, which causes excessive bleeding. High-level exposure to benzene of a long duration is known to cause leukemia and other cancers of the blood forming organs in humans.

The effects of benzene exposure during pregnancy are not known. Research institutions are currently conducting studies to determine health effects related to prenatal exposures to VOCs.

Is my child at risk of exposure to volatile organic compounds related to the World Trade Center?

While VOC levels such as benzene obtained directly from the World Trade Center site were found to be elevated, levels as close as one block away from Ground Zero were significantly lower and did not exceed the EPA's screening level of 20 ppb. The screening level is set below the level at which any health effects are seen. **Accordingly, we feel that the risk of health effects in children caused by volatile organic compounds exposure from the World Trade Center is probably small.** Research on the health impacts of volatile organics in children and developing babies is lacking. Subsequently, we do not know if brief, high exposures to VOCs lead to health effects in children. However, there is no evidence of high levels of VOCs outside of the World Trade Center site.

How do we test for exposure to volatile organic compounds?

We do not recommend routine biological testing to check for the presence of VOCs in your child. Your child's Pediatrician can assess if risk factors are present for VOC exposure by taking an environmental history and performing a complete physical.

How do we treat volatile organic compound toxicity?

The mainstay of treatment is to remove the source of the exposure. You can increase your home's ventilation by opening windows and doors and using fans to increase air circulation. Fumes may remain for longer periods of time if the room is very humid. Keeping the humidity in your home between 30-50% will help improve the indoor air quality of your home.

Once removed, symptoms will improve with time. If your child exhibits signs of wheezing or shortness of breath, he/she should be seen by a physician to determine if allergy or asthma medications are needed.

How do we prevent further exposure?

The following may help you reduce your child's exposure to VOCs:

- Increase ventilation by opening doors and windows in your home when using products that may release VOCs such as paints and glues.
- Try not to store canisters of paint or similar products in your home that may release VOCs. Even closed containers can release gases into your home.
- Follow directions when using any consumer products. They will advise you about the working conditions needed to reduce exposure to VOCs.
- Keep products containing VOCs out of reach of children.
- Ask your retailer about paints, furniture, and carpets that are considered "low VOC." Products are now available that have low amounts of VOCs.

- If furniture varnishes or lacquers are causing irritation, consider coating the furniture with a non-toxic sealant like polyurethane. This will help decrease the amount of gases released from the furniture.

Where can I get more information?

For more information, contact the Mount Sinai Pediatric Environmental Health Specialty Unit, Mount Sinai Medical Center, 1 Gustave L. Levy Place, Box 1512, New York, NY 10029. Phone:1-866-265-6201 or 212-241-0938. Fax:212-241-4309. Visit us online at http://www.mssm.edu/cpm/peds_environ.shtml.

You may also contact your local health or environmental department or regional EPA office. Or, visit the U.S. Department of Health and Human Service's Agency for Toxic Substances and Disease Registry (ATSDR) ToxFAQs for volatile organic compounds.