Concerns on Benzene in Home

In January 2012, the Environmental Epidemiology Program (EEP), Utah Department of Health received a phone call from a concerned citizen in Cache County, UT regarding possible correlation of negative health effects experienced by her family members and exposure to an unknown vapor suspected to be pesticides stored on an adjacent property to the house. The home, constructed 2 years ago, experienced flooding during and after construction and a hole was made in the foundation to remove flood water. Shortly after the flooding the resident reported smelling a sweet odor–most prominently in the basement. The odor seemed strongest during warm weather and would disappear during windy or stormy weather. Additionally, the odor was noticed by neighbors and family members during various times outside the home and from across the street.

The person reported that approximately 11 months ago a family member, who spent most of their time in the basement, began experiencing frequent dizziness and fatigue. Blood test results indicated low blood cell counts. Upon consultation with several physicians the resident received conflicting diagnoses. In mid-November, the resident contracted ALS Labs to conduct an indoor air quality test. The test consisted of one Summa canister placed next to the covered hole in the foundation. Though no VOCs or other assayed contaminants exceeded ATSDR designated comparison values (CVs), benzene concentrations were detected at 2.6 ppb, only 0.4 ppb below the ATSDR CV for chronic benzene exposure (3.0 ppb).

On January 23, 2012, the EEP visited the home and inspected the main floor, basement, garage, and property. Photographs were taken, a home air assessment questionnaire was completed, and recommendations were discussed.

Due to the near significant level of benzene, the following addresses this chemical and references the Agency for Toxic Substances and Disease Registry ToxFAQs fact sheet (ATSDR, 2007): Benzene is a colorless liquid with a sweet odor that evaporates easily. It has an odor threshold of 4.68 ppm and a vapor density of 2.8 (air = 1) (ScienceLab, 2010). It is widely used in the production of plastics, resins, synthetic fibers, lubricants, dyes, and pesticides. Natural sources of benzene include volcano emissions and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

Common ways of being exposed to benzene are tobacco smoke, automobile service stations, motor vehicle exhaust, and industrial emissions. Air around gas stations and hazardous waste sites will contain higher levels of benzene. Products that contain benzene such as glues, paints, and detergents, can also be a source of exposure.

Benzene reacts with other chemicals in the air and breaks down within a few days. Additionally, benzene in the air can attach to rain or snow and be carried to the ground. Benzene breaks down more slowly in water and soil, and can pass through the soil into underground water.

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

Children can be affected by benzene exposure in the same ways as adults. It is not known if children are more susceptible to benzene poisoning than adults. Benzene can pass from the mother's blood to a fetus. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

Long-term exposure to high levels of benzene in the air can cause leukemia, particularly acute myelogenous leukemia, often referred to as AML. This is a cancer of the blood-forming organs. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. The International Agency for Research on Cancer (IARC) and the United States Environmental Protection Agency (EPA) have determined that benzene is carcinogenic to humans (ATSDR, 2007).

The EPA estimates that, if an individual were to continuously breathe air containing benzene at an average of 0.13 to 0.45 $\mu g/m^3$ over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of continuously breathing air containing this chemical. Similarly, EPA estimates that continuously breathing air containing 1.3 to 4.5 $\mu g/m^3$ would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and air containing 13 to 45 $\mu g/m^3$ would result in not greater than a one-in-ten thousand increased chance of developing cancer (EPA, 2002).

Several tests can show if you have been exposed to benzene. In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine to indicate exposure to benzene. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources. Other tests measure benzene in the breath but these must also be done shortly after exposure. Benzene can also be measured in the blood; however, since benzene disappears rapidly from the blood, this test is only useful for recent exposures.

After inspecting the home and researching the issue, it is the EEP's finding that three potential factors may be contributing to an adverse health condition for its occupants. The first factor is a potential source of benzene on the property. Connected to the house is a well-sealed, non-ventilated garage. The garage contains gas-powered vehicles and machines as well as gas containers. Upon investigation, a basement entry door from the garage was missing a lock assembly leaving a large hole in the door. Due to the nature of benzene being denser than air it is possible that fuel vapors could infiltrate the house through the door and settle in the basement. A second factor and potential source for airborne chemicals is the large amount of household cleaners stored in the home. The EEP found that at least 60 (sixty) bottles and containers of various cleaning products were being stored in the home. The third factor that may directly contribute to the potentially unhealthy environment of the home is its construction. The home is extremely well sealed from the outside environment. Research indicates that the construction of energy efficient dwellings may increase the accumulation of hazardous substances in the air and therefore increase exposure (ATSDR, 2010; Fleischer, Mogro-Campero, & Turner, 1983; Hileman, 1983). Taken together, the sources for air-borne chemicals coupled with the closed environment create a potentially harmful environment.

The EEP recommends that the homeowner collect air samples again. A minimum of three samples should be taken, one from the basement, the first floor, and the outside the home. Additionally the following is recommended prior to sampling: All petroleum operated machinery, fuel canisters, and cleaners should be removed from property 72 hours prior to sampling and the home be well ventilated with the outside air. HVAC should be running under

normal conditions prior to sampling. The home should be vacated and locked 24 hours prior to sampling. Should the testing show no elevated levels of airborne contaminants, then the source may be concluded as either the large amount of cleaning products or gasoline vapors originating from the garage. Should the air sampling still indicate high levels of contaminant, then alternative sources for the contamination should be investigated.

Furthermore, the EEP recommends the residents address their current health concerns by contacting an occupational health physician.

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