Trichloroethylene (TCE) Exposures in Pregnant Women and Children

Guidance for the General Public

What is TCE and Where is it found?

Trichloroethylene (TCE) is a man-made, colorless liquid used in industry to clean grease off metal. It is also called "trichloroethene" or "trilene." TCE has a sweet odor and burning taste. At room temperature, some of the liquid TCE turn into vapor and mixes with the air. TCE can contaminate water supplies when it is released during manufacturing and disposal.

TCE can also be found in products at home and at work, including

- Paint removers, paint strippers
- Glues, adhesives
- Varnishes, car cleaning products
- Spot removers
- Rug cleaning fluids
- Metal cleaners

How can we be exposed to TCE?

- **Drinking water:** The most common home exposure for children is from contaminated drinking water. Groundwater or surface water can be polluted when industries release TCE, so contamination is more common near industrial areas. If you drink water contaminated with TCE, most of the TCE will be absorbed into your body.
- **Air:** TCE can enter the outdoor and indoor air through evaporation from contaminated soil. TCE vapors from soil and groundwater can travel through cracks or pipes entering the building foundation and then into the indoor air. TCE can also evaporate from polluted tap water and you can breathe it in (inhale it) during such activities as showering or bathing, washing dishes, and doing laundry. If you breathe in TCE, about half of it gets into your blood and you breathe out (exhale) the rest.
- **Contact with skin**: TCE can also get inside your body through your skin. The amount of TCE that gets inside your body through your skin is less than the amount that gets inside your body when you breathe or swallow it. Children playing in areas with contaminated soil may be exposed to TCE both through skin contact and breathing in vapors if playing close to the ground.
- **Commercial or industrial settings:** Adults working in places that use TCE may be exposed by breathing in vapors or through skin contact. There are additional concerns about pregnant women with TCE exposure since TCE can cross the placenta and has the potential to then affect the developing fetus.

What happens after TCE enters our bodies?

- Once TCE gets into your body, some of it goes to the liver. The liver changes most of the TCE into other chemicals, which then leave the body in the urine within one day.
- A small amount of the TCE, or the chemicals created by its breakdown, may be stored in fat or in the liver for several weeks after an exposure.
- Some of the TCE is exhaled directly and leaves the body without getting processed in the liver.

How can TCE affect our health?

In general, the effects of exposure to chemicals, including TCE, depend on the amount of chemical you are exposed to, how often you are exposed, and how long you are exposed. Health effects may also be influenced by some personal factors, like gender, age, body size, genetics, and current health issues.

Health effects from TCE exposure

The amount of exposure (also called dose) can be described as parts per million (ppm) or parts per billion (ppb) or in other units (see below). Symptoms and health effects may be different at different levels (or amounts) of exposure, as described below

- **High exposures-for a short period of time (hours or days)**: An acute exposure, as in the workplace, to TCE at levels between 81-110 ppm [ATSDR, 2010] has been associated with fatigue, drowsiness, slower reaction time and headache. If the exposure is short, and then stops and does not recur, these symptoms tend to disappear. At much higher levels, a person might pass out and lose consciousness. Such high exposures and acute effects occur more often in the workplace and would be very unusual in the home environment.
- **High exposure-for long period of time (weeks, months, years):** Chronic exposures in a work place setting have been associated with more persistent complaints of headache, memory problems, balance problems, and kidney effects. In general, chronic exposure to TCE (indoors or outside) is associated with an increased risk for certain cancers (such as kidney cancer). Some studies have shown that chronic exposure can also lead to an increased risk for developing some autoimmune conditions in which the immune system reacts against the body.
- **Potential effects on the developing fetus**: Pregnant women working with TCE could be exposed through drinking contaminated water, skin contact or inhalation. TCE crosses the placenta and can affect the developing fetus; Some studies have shown fetal exposure during the early part of the first trimester has been associated with an increased risk for certain types of heart defects. A small amount of TCE may also get into breast milk and create a possible risk for nursing infants. In general, however, the positive health effects of breastfeeding tend to outweigh these possible risks.

How can we detect TCE in our home?

- ***Air*:** You cannot smell TCE at the low levels generally found in your home. Therefore, you cannot rely on your sense of smell to detect TCE in your house. If you live in an area with TCE in the groundwater or soil, the best way to detect it in your home is to have licensed experts test the indoor air.
- ***Water:*** Municipal water sources or water wells serving 25 or more people are regularly tested by the US Environmental Protection Agency (EPA); private wells are not. If you have a private well, you should consider having it tested for TCE. Testing your well water is even more important if your home is near a hazardous waste site, such as a Superfund site. A list of U.S. EPA designated Superfund sites by state is available online at: http://www.epa.gov/superfund/sites/

Medical tests that measure your exposure to TCE:
TCE is difficult to measure in your body since it is so quickly eliminated. There is a urine test for TCE and its breakdown chemicals which can measure exposure that happened in the last 24 hours. If you had a high level of exposure, TCE can be found in blood for a couple of days.

Right after an exposure, TCE can be measured in exhaled breath. This test can tell you if the exposure levels were high or low. The blood, urine, and exhaled breath tests are not usually available from most doctors and can be expensive.

Guidelines for limits of TCE in air or water in the United States:
Federal and state agencies set TCE guidelines at levels lower than levels that can cause health effects in humans. EPA and ATSDR guidance is meant to protect the general public, especially children, including the developing fetus. If you should get a report of air or water testing in your home or neighborhood, results may be compared to these recommended levels. Below is an explanation that might help you to understand any reports that you receive with test results and what the levels mean.

- This guideline assumes that people are exposed to TCE all day, every day, for as long as a lifetime. This is rarely the case.
- Guidance for workers refers to adults working 8 hours per day, for a 40-hour work week for a working lifetime (generally 40 years). For that reason, the acceptable levels for workers are higher than levels for the general population.
- TCE in air is measured as milligrams per meter cubed (mg/m^3).

WATER:

EPA maximum contaminant level (MCL)[1]	0.005 mg/L	0.005 ppm 5 ppb
EPA's Integrated Risk Information System (IRIS) oral reference dose[2]	0.0005 mg/kg/day	
Agency for Toxic Substances and Disease Registry minimal risk level (MRL)[3] for TCE in drinking water (chronic exposure of more than one year)	0.0005 mg/kg/day	

AIR: (1 ppm= 5.37 mg TCE/m^3)

ATSDR's minimal risk level (MRL) for TCE in indoor air	0.0004ppm	0.002mg/m^3 2$\mu g/m^3$
ACGIH[4]: Threshold Limit Value (TLV)[5], 8 hr time weighted average (TWA): air at the	10 ppm	50 mg/m^3

[1] **Maximum Containment Level (MCL)** is the maximum concentration of a chemical that is allowed in public drinking water systems, and is established by EPA.

[2] **oral reference dose** (IRIS) : an estimate (with an uncertainty or protection factor) of a daily oral exposure to a human population (including sensitive subgroups, like children) that is likely to be without an appreciable risk of harmful effects over a life time

[3] **Minimal Risk Level (MRL):** An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects.

workplace Short Term Exposure Limit (STEL)- 15 minutes	25 ppm	134 mg/m^3
NIOSH[6]: recommended exposure limit (REL) Air at the *workplace*; 10 hr TLV	25 ppm	134 mg/m^3
OSHA: Permissible Exposure Limit (PEL)[7]	100 ppm	500 mg/m^3

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[4] The American Conference of Governmental Industrial Hygienists (**ACGIH**) is a private, not-for-profit, nongovernmental corporation whose members are occupational health and safety professionals who regularly publish (and update) guidelines to promote health and safety at the workplace. These are not regulations, but just guidelines. They are sometimes updated more frequently than government agencies.

[5] **Threshold Limit Value (TLV)** refers to air concentrations of chemicals under which it is believed that nearly all workers may be repeatedly exposed over a working lifetime without adverse effects

[6] National Institute of Occupational Safety and Health (**NIOSH**) advises OSHA concerning what should be recommended exposure limits. For carcinogens it is as low as possible or feasible.

[7] Occupational Safety Health Administration, PEL is a TWA for TCE –is based on a 1970's PEL, and not updated in 1993.

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