

What are PFAS?

PFAS is an acronym for Per- and Polyfluoroalkyl Substances. PFAS are man-made chemicals that have been used in industry and commerce worldwide since the 1949, when Teflon[®] pans were introduced. PFAS are known for their stain-proof, grease-proof, heat-resistant and “slippery” properties. Currently, there are over 12,000 different PFAS chemicals. They all have one thing in common – at least one carbon-fluorine bond that is the strongest chemical bond known to man. They are called “forever chemicals” because the chemicals are not easily degraded and are long-lasting. PFAS also dissolve in water.

Why should I be concerned about PFAS?

The single greatest exposure for most people is through drinking water contaminated with PFAS. This can be from your well or from a public water system that contains PFAS.

What are PFAS used for?

PFAS are in almost everything that we use as a consumer. For example, in consumer products, PFAS make:

- carpets and clothing repel stains,
- food wrappers and pet food bags repel grease,
- pans non-stick,
- dental floss glide more easily,
- cosmetics and lotions flow easily,
- soaps remove and transport “dirt”,
- post-it notes stick better,
- raingear and boots become waterproof,
- ski wax help skis glide faster on snow,
- inks more permanent and flow better,
- paper coatings to assist in writing, and
- cosmetics be longer-lasting.

PFAS are used extensively in industry as well. For example, industry uses PFAS to:

- make firefighter suits heat- and chemical-resistant,
- increase flowability and smother petroleum fires with firefighting foam called AFFF,
- make mixtures stay suspended when used as a surfactant,
- make industrial containers that can impart PFAS to pesticides and herbicides,
- increase wetting properties in pesticides,
- increase flowability of liquids used in oil and gas fracking operations,
- enhance wetting properties in paints,
- increase performance in semi-conductor and communication cables,
- manufacture medical devices, and
- assist as a process aid in manufacturing in aerospace, cabling, metal finishing and many other industries.

Where are PFAS found in the environment?

PFAS are found all over the world in:

- wells,
- streams,
- rivers,
- oceans,
- rainwater,
- sediments,
- soil,
- biosolids,
- air, and
- household dust.

PFAS are found in the blood of mammals, fish and birds on all seven continents and in:

- snow cores in the Arctic and Antarctica,
- plants,
- vegetables,
- fruits,
- dolphins,
- pandas,
- bird eggs,
- cattle,
- cow milk,
- deer, and
- other plants and animals in the food chain.

How am I exposed to PFAS?

Risks from Drinking Contaminated Water. Scientists agree that for people who do not have industrial exposure, **the single greatest exposure is through drinking water contaminated with PFAS.** This can be from your well or from a public water system that contains PFAS.

Risks from Eating Contaminated Food. Other routes of exposure include eating fish caught from water contaminated by PFAS, inhaling and/or accidentally swallowing contaminated dust or soil, eating food grown or raised in areas of PFAS contamination (contaminated soil, watered with contaminated water, or rained on by contaminated rain), and eating food packaged in materials containing PFAS (especially microwave popcorn).

Risks from Working with PFAS Chemicals in the Workplace. Some of the most severe adverse health effects have been documented for workers in industrial settings where PFAS are manufactured or used. If you work in this setting, consult your physician.

Risks from Exposure to Some Stain-Repellent and Water-Repellent Clothing. Consumer products like stain-resistant carpets and upholstery degrade into dust that floats in houses and settles on floors that can be inhaled and ingested. Water repellent clothing also degrades and can cause similar exposure.

Risks from Exposure to Some Cosmetics and Personal Care Products. A recent study showed that 46 percent of cosmetics tested contained PFAS. Accidental ingestion of PFAS-containing lipstick or adsorption of PFAS-containing mascara into the eye are some exposure routes. Similarly, PFAS-containing lotions, shampoo or sunscreen can be inadvertently ingested by hand transfer.

Special Risks for Babies and Toddlers. Babies and toddlers can be exposed to PFAS during pregnancy through umbilical cord blood and through breast milk from mothers exposed to PFAS. They can also be exposed to PFAS by mixing formula with water that contains PFAS. Another source is from dust generated from furniture upholstery, carpets, rugs and clothes that have been treated with PFAS. Babies and young children that tend to crawl on the ground have a higher chance of inhaling the dust and also for hand-to-mouth transfer.

What are the Health Effects from PFAS Exposure?

Although many chemicals are included in PFAS, health effects are not known for the majority of PFAS chemicals and are still being studied. Health effects are derived from both human studies and extrapolated from animal studies. **Just because you are exposed to PFAS does not mean that you will have an adverse health effect.** Health effects depend on dose (how much you were exposed), duration (how long you were exposed) and frequency (how often you were exposed). There are other factors that may also be genetic that affect your tolerance to exposure.

PFOA and PFOS have been studied the most widely and were the first to be known to have the following associations in human studies:

- Increased risk of kidney cancer,
- Increased risk of testicular cancer,
- Thyroid disease,
- Ulcerative colitis,
- Increased risk of high blood pressure and preclampsia in pregnant women, and
- Increased cholesterol levels.

Additional PFAS health effects reported in the literature include:

- Lowered antibody response to vaccines,
- Lowering a woman's chance of getting pregnant, by lowering fertility,
- Lowering sperm counts, sperm quality, and sperm motility,
- Developmental effects in babies such as smaller head circumference, decreased birth weight, and shorter penises,
- Interfering with the body's natural hormones, including early menopause and delay in puberty of adolescent girls,

- Increased chance of obesity in girls at age 20 when exposed in utero,
- Effects on growth, learning, and behavior of infants and children,
- Changes in liver enzymes,
- Increased risk of liver cancer, and
- Increased risk of prostate cancer.

At this time, scientists are still learning about the health effects of exposures to mixtures of different PFAS.

Are there limits on PFAS in drinking water?

To date, the United States Environmental Protection Agency (USEPA) has not adopted enforceable limits on any PFAS in drinking water. However, USEPA has indicated that draft enforceable limits called maximum contaminant levels (MCLs) will be developed for PFOA and PFOS and proposed later in 2022 and adopted in 2023. In the interim, USEPA has developed health advisories for four PFAS - including PFOA, PFOS, GenX, and PFBS. According to the USEPA, these lifetime health advisories “*identify levels to protect all people, including sensitive populations and life stages, from adverse health effects resulting from exposure throughout their lives to these PFAS in drinking water*”. The health advisories provide for a margin of error and take into account other potential sources of PFAS such as food, air, consumer products, etc. in order to provide another layer of protection.

USEPA established two interim health advisories for PFOA and PFOS in June 2022. According to USEPA, these updated health advisories were based on human studies where associations were found between exposure and “*effects on the immune system, the cardiovascular system, human development (e.g., decreased birth weight) and cancer*”. **The interim health advisories are:**

PFOA = 0.004 parts per trillion (ppt)
PFOS = 0.02 parts per trillion (ppt)

USEPA also established two final health advisories for GenX and PFBS in June 2022. According to USEPA, the health advisory for GenX was based on animal studies that “*have been linked to health effects on the liver, kidney, the immune system, and developmental effects, as well as cancer*”. Similarly, the health advisory for PFBS was based on animal studies that linked PFBS “*to health effects on the thyroid, reproductive system, development, and kidney*”. **The final health advisories are:**

GenX = 10 parts per trillion (ppt)
PFBS = 2,000 parts per trillion (ppt)

The Ohio Environmental Protection Agency (OEPA) has also developed a PFAS Action Plan that includes health advisory levels for two additional PFAS – PFHxS and PFNA. Although not enforceable, these health advisory levels provide additional information for the consumer. **The additional OEPA health advisory levels are:**

PFHxS = >140 parts per trillion (ppt)

PFNA = >21 parts per trillion (ppt)

In the absence of federal regulations on PFAS in drinking water, other states have adopted maximum contaminant levels (MCLs) for some PFAS. MCLs are enforceable levels of a compound that cannot be exceeded in drinking water without some action to reduce the concentration below the MCL or to seek an alternate water source. Currently, there are eight states that have adopted MCLs that may also be referenced, although the numbers are frequently different due to different health risk assumptions.

Similarly, other states have also adopted health advisory levels, screening levels and other non-regulatory references for PFAS. These can also be referenced for additional information.

Do I have PFAS in my blood?

Because PFAS is everywhere, it is likely that PFAS is in your blood. The National Health and Nutrition Examination Survey (NHANES) has measured PFAS levels in blood in the U.S. population in two-year intervals since 1999-2000. The NHANES data shows that since reductions of PFOA and PFOS have been made in manufacturing and articles of commerce, the average concentration of PFAS in the general population has dropped. NHANES data shows that in 1999-2000, average PFOA concentrations in blood in the general population in the United States was 5,200 ppt, but by 2017-2018, average concentrations were reduced to 1,400 ppt. Similarly, average concentrations of PFOS in blood in 1999-2000 were 30,400 ppt and by 2017-2018 were 4,300 ppt. However, as new chemicals replace the old, there are indications that concentrations of newer chemicals are increasing.

How long does PFAS stay in my blood?

When exposure is reduced or eliminated, PFAS stay in blood for different lengths of time. In general, the more carbon-fluorine bonds in the PFAS, the longer that PFAS stays in the body. Here are some examples of how long it takes to remove half of the concentration in the blood (also called a half life):

PFOA half life = 3 years

PFOS half life = 2.9 years

PFHxS half life = 4.7 years

PFPeS half life = 1 year

PFHpS half life = 4.7 years

PFBA half life = 3 days

Can I have my blood tested for PFAS?

A blood test can tell you about the levels of PFAS in your blood. However, it cannot tell you if you will get sick or necessarily how you were exposed. If you want a traditional blood test, you should talk with your physician and obtain a prescription to do so. The Ohio EPA website states;

“The cost for PFAS blood testing is in the \$500-800 range, not including fees that a clinic might charge for drawing and shipping the blood”. The following laboratories are listed as providing analytical services:

- Vista Analytical Laboratory: (916)673-1520, vista-analytical.com
- Quest Diagnostics; 1-866-697-8378, www.questdiagnostics.com
- SGS AXYS; 1-888-373-0881, www.sgsaxys.com

In addition to the traditional blood-draw method, in 2022, a finger-stick kit for home use became available. For a cost of \$399, an individual can order the kit, follow the instructions, and send the kit to the laboratory. Secure online results will be available in four to five weeks for over 40 PFAS. This kit is available from:

- empowerDX; order online at <https://empowerdxlab.com/home>

Where can I get more information on PFAS?

The USEPA, Ohio EPA, and the Ohio Department of Health all have additional information on PFAS on their websites. The Interstate Regulatory Council (ITRC) has detailed technical information in fact sheets and chapters discussing different topics at <https://pfas-1.itrcweb.org/>. The Environmental Working Group (EWG) has an interactive map of the known locations of drinking water where PFAS has been detected in public water systems at https://www.ewg.org/interactive-maps/pfas_contamination/.

The science and regulatory arena for PFAS is changing rapidly. There is much information about the upcoming proposed regulatory changes in response to the PFAS Roadmap developed by USEPA. There is a flurry of activity at the federal level to try to restrict (and prevent restriction) of the use of PFAS in industry and commerce. Similarly, there are many technical studies on health effects that are being conducted, treatment technologies being developed, and laboratory methods being developed to test for PFAS in different media.

Recommended links to additional information on health effects are listed below:

- <https://www.atsdr.cdc.gov/pfas/index.html>
- <https://www.epa.gov/system/files/documents/2022-06/drinking-water-ha-pfas-factsheet-communities.pdf>
- <https://www.epa.gov/sdwa/drinking-water-health-advisories-pfoa-and-pfos>
- <https://odh.ohio.gov/know-our-programs/health-assessment-section/media/pfas-drinking-water-factsheet-201912>
- <https://epa.ohio.gov/monitor-pollution/pollution-issues/per-and-polyfluoroalkyl-substances-pfas>