The omnipresence of PFAS—and what we can do about them

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Credit: Erik Mclean from Pexels

Per- and poly-fluoroalkyl substances (PFAS)—also known as "forever chemicals"—are everywhere. Created in the 1940s, these synthetic compounds are an unseen ingredient in many items that we use in our

daily lives, like cleaning products, food packaging, nonstick cookware, cosmetics, personal care items like dental floss, water-repellent clothing, as well as stain-resistant carpets and upholstery. Since the 1970s, they have also been used in firefighting foams and by the military.

"Food is another potential source," says Carsten Prasse, Ph.D., MSc, assistant professor in Environmental Health and Engineering. "Unfortunately, PFAS are also present in biosolids which are used as agricultural fertilizer," creating a pathway from contaminated soil to produce in the grocery store.

Because of their longevity and resistance to disintegration—a characteristic born of their carbon-fluorine chemical bonds—PFAS can last thousands of years. These "attributes also make them very resistant to degradation in our treatment systems," says Prasse.

The most common method of destroying PFAS is incineration, but some studies indicate that this fails to eliminate all the chemicals, and instead releases the remaining pollution into the air.

In water treatment systems, the main methods for destroying PFAS are reverse osmosis, activated carbon, and ion-exchange resins—but these technologies are costly. Other methods include supercritical water oxidation, plasma reactors, and most recently, sodium hydroxide (lye) and dimethyl sulfoxide, chemicals used in soap and as a medication for bladder pain syndrome, respectively.

But when items containing PFAS inevitably reach landfills, the compounds leach into the environment. And every day, people flush PFA-laden products—like shampoo, cleaning liquids, even some toilet papers—down the drain.

"If they're not removed in our wastewater treatment plants, [PFAS] get

into our rivers, streams, and groundwater, which are commonly used for drinking water production," Prasse says. "Around 50% of our rivers and streams contain measurable PFAS concentrations."

According to a 2020 study published in *Science* by the Environmental Working Group, an estimated 200 million Americans are served by water systems that contain PFAS. And it's not just public systems—a 2023 study by the U.S. Geological Survey found that approximately 20% of private wells are contaminated.

These compounds are now so ubiquitous, that an estimated 98% of the U.S. population has detectable concentrations in their blood. That's concerning, since studies have shown that exposure to some PFAS may be linked to harmful health effects, both in animals and humans.

"We know today that even very low concentrations can impact the reproductive system, [have] developmental effects, increase risk of certain cancers, reduce immune response, as well as increase cholesterol levels," Prasse says. The Environmental Protection Agency also links the compounds to thyroid disorders, obesity, and asthma.

Individuals who may have had high exposure to PFAS—in firefighting or chemical manufacturing industries, for example—should consider blood testing, Prasse says. "I think it is valuable … because it allows them at least to talk to medical professionals, to think about follow-up examinations, to really monitor potential health effects."

Prasse says we still know very little about the health impacts of PFAS, especially on a population level. While these compounds have been around for some time, there is insufficient research to answer many questions that have emerged over decades.

But some action is being taken. Last year, the EPA proposed the first

federal limits on forever chemicals in drinking water. And in February 2024, the agency proposed that nine PFAS be categorized as hazardous to human health—a designation only applied to substances that are toxic or cause cancer, genetic mutation, or embryo malformation.

"The main reason for the step that the EPA is taking is that there's increasing evidence that there are toxic effects on a variety of levels," Prasse says. "It will hopefully lead to more research to address the presence of these compounds in the environment, but also to more efforts to really elucidate the health impacts of these chemicals."

The proposal would classify the chemicals as "hazardous constituents" under the Resource Conservation and Recovery Act, making it easier for the agency to clean up contaminated sites—and to allocate funds to treat affected drinking water.

But these nine compounds are only the tip of the iceberg.

"We estimate there are more than 12,000 individual PFAS compounds, and unfortunately for most of them, we have basically no understanding about toxicity, and we don't really know a lot about their occurrence in the environment," Prasse says. "I think the step by the EPA is really urgently needed to protect our drinking water and ultimately our health."

A small study published in *Environment International* showed that cholestyramine—a cholesterol-lowering drug—could help scrub toxic forever chemicals from the blood of people who have been highly exposed. But the most efficient way to reduce contamination is preventatively, Prasse says, by regulating PFAS production and cleaning up the environment—especially waterways—and ensuring that our drinking water facilities are equipped to remove these compounds.

"The issue at this point is really that we don't know what levels are

concerning or lead to health effects, and which don't," Prasse adds. "That's something that only the future will tell."

Prasse and other experts recommend a variety of actions to minimize exposure to PFAS:

- Avoid using nonstick cookware.
- Limit use of food packaging, such as grease-resistant takeout containers.
- Filter your water at the tap, with pitchers that are certified for PFAS.
- Avoid wearing water-resistant textiles.
- Seek out PFAS-free retailers' products—including menstrual products and large items like carpets or furniture.

More information: Janne Julie Møller et al, Substantial decrease of PFAS with anion exchange resin treatment – A clinical cross-over trial, *Environment International* (2024). DOI: 10.1016/j.envint.2024.108497

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