

PHIP No. 001-1023

## An Overview of the Science for Per-and Polyfluoroalkyl Substances (PFAS) for Clinicians

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### EXECUTIVE OVERVIEW

#### Patient Care for PFAS Exposed Individuals

Epidemiological and toxicological research on PFAS as a risk factor to human health is ongoing. The body of evidence showing exposure to PFAS as a risk to human health is increasing. The evidence to date has not established a causal relationship between PFAS exposure and actual disease. Care of a patient exposed to PFAS may be considered based on the patient's overall risk factors, magnitude of exposure, family history, patient signs and symptoms of illness, and physical examination. Standard medical care for the given condition should be applied based on what is found on your medical examination and pertinent laboratory results. For asymptomatic individuals exposed to PFAS, insufficient evidence currently exists to support deviations from established standards of medical care. Clinicians should approach additional screening or testing with caution particularly if there is a potential to cause harm. The clinician should use their clinical judgement to care for individual patients. For patients with signs or symptoms of disease, clinicians can treat these patients using the same established standards of care they would use for a patient who did not have PFAS exposure.

#### PFAS Blood Testing

Most people in the United States have measurable amounts of PFAS in their blood. There is no established PFAS blood level at which a health risk is expected or that predicts health problems. There is no established PFAS blood level at which adverse health effects are expected, nor is there a level that predicts organ injury and disease. Most people in the United States will have measurable amounts of PFAS in their blood because of wide-spread use of consumer products and food and water containing PFAS.

#### What are the Exposure Limits for PFAS in Drinking Water?

The U.S. Environmental Protection Agency (EPA) established a non-regulatory Health Advisory level for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) in drinking water presently at 70 parts per trillion (ppt) (0.07 micrograms per liter), individually or combined. Some states have established their own PFAS drinking water guidelines. In California, these guidelines are 20 ppt, lower than the EPA Health Advisory.

On 14 March 2023, the EPA announced a proposed National Primary Drinking Water Regulation (NPDWR) which, if implemented, would result in enforceable standards for six PFAS including PFOA, PFOS, perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA, commonly known as GenX Chemicals), perfluorohexane sulfonic acid (PFHxS) and

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perfluorobutane sulfonic acid (PFBS). The proposal so far calls for the following standards:

- PFOA at 4.0 ppt,
- PFOS at 4.0 ppt,
- PFNA at 10 ppt,
- HFPO-DA 10 ppt,
- PFHxS at 9.0 ppt, and
- PFBS at 2,000 ppt.

These proposed PFAS NPDWR do not require any actions until it is finalized which is expected by end of 2023.

### **How can PFAS Potentially Affect Human Health?**

PFAS exposure is associated with some adverse effects to human health, including increased cholesterol and liver enzymes levels, increased risk for liver cancer, decreased immune response to vaccines in children, increased risk for high blood pressure and preeclampsia, and decreased infant birth weight.

### **INTRODUCTION**

This document provides an overview of what is known about PFAS and identifies health effects associated with PFAS exposure. The following information will help clinicians respond to patient concerns about PFAS exposure includes:

- PFAS basics,
- PFAS health studies,
- Questions patients may ask clinicians about PFAS, and
- Where to find additional PFAS resources and references.

The Department of Defense (DoD) has been involved in the investigation and remediation of PFAS in drinking water since 2016. We work closely with The Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) who are leading PFAS health studies and make public recommendations for physicians regarding the care of people exposed to PFAS.

### **PFAS BASICS**

The name PFAS stands for per- and polyfluoroalkyl substances. PFAS are a large group of synthetic complex chemicals that contain a chain of carbon atoms bonded to fluorine atoms. PFAS is not a single chemical but is rather a class of chemicals, comprised of thousands of substances with related molecular structures. They have been used in a multitude of items as they resist heat, water, oil, and stains, and are non-stick and have low friction properties. PFAS is widely used with common examples including non-stick cookware, carpets, clothing, upholstery, paper food packaging, and aqueous film-forming firefighting foam (AFFF) used at

many military bases and airfields and commercial fire departments. Their use in legacy firefighting foam (AFFF) was to effectively fight liquid fuel fires, saving lives and property (Fluorine-free firefighting foams are being evaluated now to replace legacy AFFF). The most consistent feature within the class of PFAS is that they do not break down or do so very slowly under natural conditions. This is why PFAS are often called “forever chemicals.” These chemicals can persist in humans, animals, and the environment. They may accumulate or concentrate in all aspects of the environment, including in water, sediment, soil, and plants. They may have migrated into drinking water in your community.

## PFAS HEALTH STUDIES

The recommended primary reference documents for clinicians are the following:

- **An Overview of the Science and Guidance for Clinicians on PFAS**: This document will provide you an overview of what is known about PFAS and identifies health effects associated with high levels of PFAS exposure. It also provides a list of questions patients may have. In addition to these questions, each one has supporting information for answers to these questions. It is recommended that you review this document to better understand PFAS, ways patients may prevent further PFAS exposure, and recommendations on how to undertake a PFAS-related patient visit.  
[ATSDR PFAS Clinical Guidance \(cdc.gov\)](#)
- **Talking to Your Doctor about Exposure to PFAS**: This document is supplemental to the ATSDR Clinician Guidance and focuses on the patient. It provides answers to questions that patients may have during their clinical visit and can be sent home with them.  
[Talking to Your Doctor about Exposure to PFAS \(cdc.gov\)](#)
- **PFAS and Breastfeeding**: This document is also supplemental to ATSDR Clinician Guidance and answers the question regarding PFAS exposure for expectant and breastfeeding mothers.  
[PFAS and Breastfeeding Fact Sheet \(cdc.gov\)](#)
- **PFAS and Pediatrics**: This document is produced by the American Academy of Pediatrics and provides clinical guidance for the pediatric population exposed to PFAS.  
[HealthyEnv PFAS.pdf \(aap.org\)](#)
- **Per- and Polyfluorinated Substances (PFAS) Factsheet (CDC)**: The CDC has compiled a printable list of basic facts for PFAS.  
[https://www.cdc.gov/biomonitoring/PFAS\\_FactSheet.html](https://www.cdc.gov/biomonitoring/PFAS_FactSheet.html)
- **Guidance on PFAS Exposure, Testing, and Clinical Follow-Up (2022)**: This report produced by the National Academies of Science, Engineering, and Medicine provides clinical guidance to clinicians for patients exceeding the recommendations of CDC and ATSDR. <https://nap.nationalacademies.org/catalog/26156/guidance-on-pfas-exposure-testing-and-clinical-follow-up>

## QUESTIONS PATIENTS MAY ASK CLINICIANS ABOUT PFAS

When patient raises their concerns about PFAS, provide an empathic ear. Empathy should be at the foundation of a discussion regarding potential health effects. Key messages to share are:

- Most people in the United States have some PFAS in their body. (The National Health and Nutrition Examination Survey [NHANES] found PFAS in 97% of Americans).  
<https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html>
- Reducing further exposure to PFAS is the most important step for families with concerns.
- When a patient presents with health concerns that may be associated with PFAS exposure, it is appropriate to discuss these concerns and perform a thorough exposure history and physical exam relative to any symptoms reported.
- Blood/urine lab testing is not routinely recommended. The blood test will not provide information to predict a health problem, nor will it provide information for treatment. Test results will only tell you the levels of PFAS in your blood and is not predictive towards future health consequences. There is no intervention or treatment associated with the PFAS test results and no means to remove PFAS from the body.
- The 2020 National Defense Authorization Act mandates that DoD Firefighters are offered blood testing for PFAS at the time of their annual occupational medical examinations. This testing is not part of the medical qualification or medical surveillance program, rather, it is a Congressionally mandated annual exposure assessment to document occupational exposures.

## ADDITIONAL PFAS RESOURCES AND REFERENCES

Clinician Fact Sheet

[PFAS Clinician Fact Sheet | ATSDR \(cdc.gov\)](#)

Information for Clinicians and Environmental Health Professionals

[PFAS Information for Clinicians and Environmental Health Professionals \(cdc.gov\)](#)

Toxic Substances Portal: Toxicological Profile for Perfluoroalkyls

[Perfluoroalkyls | Toxicological Profile | ATSDR \(cdc.gov\)](#)

Toxic Substances Portal: ToxFAQs™ for Perfluoroalkyls

[Perfluoroalkyls | ToxFAQs™ | ATSDR \(cdc.gov\)](#)

ATSDR Per- and Polyfluoroalkyl Substances (PFAS) and Your Health

[Learn about PFAS | ATSDR \(cdc.gov\)](#)

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Estimating Levels of PFAS in Your Blood

[Estimating Levels of PFAS in Your Blood | Per- and Polyfluoroalkyl Substances \(PFAS\) and Your Health | ATSDR \(cdc.gov\)](#)

PFAS Exposure Assessment Technical Tools (PEATT)

[PFAS Exposure Assessment Technical Tools | ATSDR \(cdc.gov\)](#)

PFAS FAQs

[Frequently Asked Questions about PFAS Chemicals | ATSDR \(cdc.gov\)](#)

ATSDR's Minimal Risk Levels (MRLs) and Environmental Media Evaluation Guides (EMEGs) for PFAS

[PFAS Minimal Risk Levels and Environmental Media Evaluation Guides \(cdc.gov\)](#)

What are the health effects of PFAS?

[Potential health effects of PFAS chemicals | ATSDR \(cdc.gov\)](#)

**STATEMENT ON POTENTIAL INTERSECTION BETWEEN PFAS EXPOSURE AND COVID-19**

The CDC/ATSDR understands that many of the communities we are engaged with are concerned about how PFAS exposure may affect their risk of COVID-19 infection. We agree this is an important question.

The CDC/ATSDR recognizes that exposure to high levels of PFAS may impact the immune system. A National Toxicology Program review found that exposure to PFOA and PFOS is an immune hazard to humans based on a high level of evidence that PFOA and PFOS suppressed the antibody response from animals and a moderate level of evidence from studies in humans (National Toxicology Program (NTP) 2016). More research is needed to understand how PFAS exposure may affect illness from COVID-19.

**REFERENCES**

NTP. 2016. *NTP Monograph on Immunotoxicity Associated with Exposure to Perfluorooctanoic acid (PFOA and Perfluorooctane Sulfonate (PFOS))*. [Monograph: Perfluorooctanoic Acid or Perfluorooctane Sulfonate; Sept. 2016 \(nih.gov\)](#)

What are PFAS?

[PFAS chemicals overview | ATSDR \(cdc.gov\)](#)

PFAS in the U.S. Population

[PFAS in the U.S. Population \(cdc.gov\)](#)

PFAS Exposure Assessments

[PFAS Exposure Assessment | ATSDR \(cdc.gov\)](#)

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PFAS Environmental Sampling

[PFAS Environmental Sampling | Per- and Polyfluoroalkyl Substances \(PFAS\) and Your Health | ATSDR \(cdc.gov\)](#)

Map of ATSDR PFAS Sites

[Investigating PFAS in the Environment | ATSDR \(cdc.gov\)](#)

Health Studies

[PEATT | PFAS Exposure Assessment Technical Tools | ATSDR \(cdc.gov\)](#)

PFAS Multi-site Study (MSS)

[PFAS Multi-site Study \(MSS\) | Per- and Polyfluoroalkyl Substances \(PFAS\) and Your Health | ATSDR \(cdc.gov\)](#)

Pease Study

[PFAS Pease Study | ATSDR \(cdc.gov\)](#)

Other PFAS Sites by Region

[Other PFAS Sites by Region | ATSDR \(cdc.gov\)](#)

National Report on Human Exposure to Environmental Chemicals

[Biomonitoring Data Tables for Environmental Chemicals | CDC](#) and <https://www.aap.org/en/patient-care/environmental-health/promoting-healthy-environments-for-children/perfluoroalkyl-and-polyfluoroalkyl-substances/>

National Academies of Science, Engineering, and Medicine (NASEM)

Updates to the Overview of the Science and Guidance for Clinicians on PFAS. NASEM was contracted by CDC, ATSDR, and the National Institute of Environmental Health Sciences (NIEHS) to produce a report that includes suggestions for updating ATSDR's *Overview of the Science and Guidance for Clinicians on PFAS*. ATSDR is currently reviewing the report's public health recommendations.

National Academies of Science, Engineering, Medicine. 2022. *Guidance on PFAS Exposure, Testing, and Clinical Follow-Up*. <https://nap.nationalacademies.org/catalog/26156/guidance-on-pfas-exposure-testing-and-clinical-follow-up>

Stephenson, J. 2022. "National Academies Report Calls for Testing People with High Exposure to 'Forever Chemicals'." *JAMA Health Forum* 3(8):e223313. doi:10.1001/jamahealthforum.2022.3313

Kwiatkowski, CF, Andrews DQ, Birnbaum LS, Bruton TA, DeWitt JC, Knappe DRU, et al. 2020. "Scientific Basis for Managing PFAS as a Chemical Class." *Environmental Science & Technology Letters* 7(8):532-543. DOI: 10.1021/acs.estlett.0c00255