Per- and Polyfluoroalkyl Substances (PFAS) Guidance for Clinicians

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Alliance of Nurses for Healthy Environments

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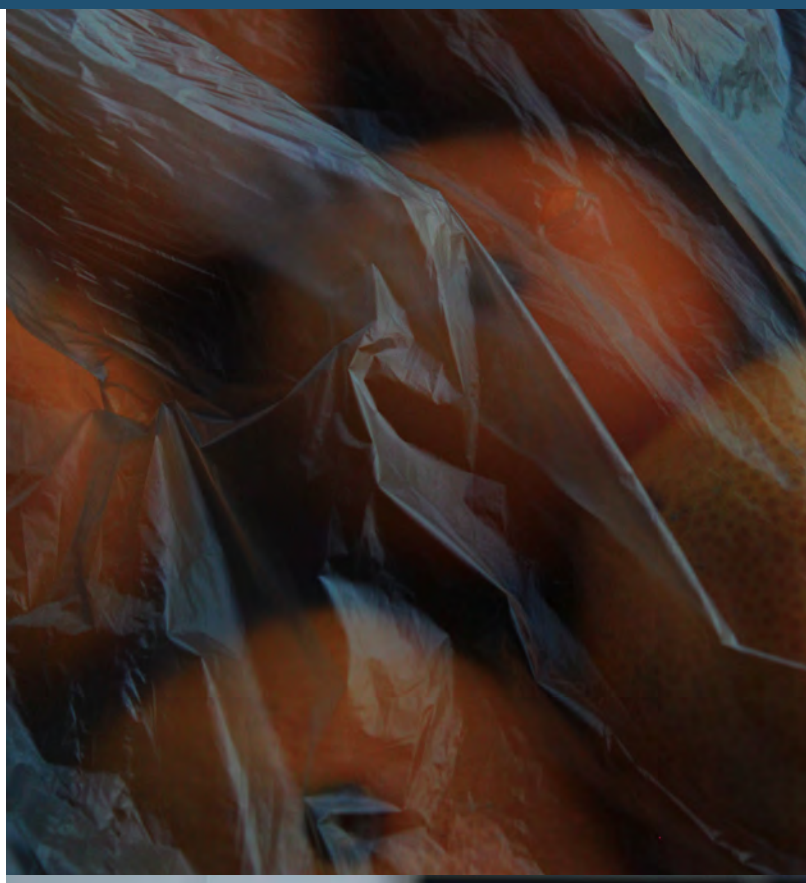
Introduction

Nurses and other healthcare providers are likely familiar with hearing the term "PFAS" or "forever chemicals" and that these chemicals can impact human health. There are thousands of PFAS (short for per- and polyfluoroalkyl substances) chemicals which can be found in a variety of products most people use on a daily basis. However, most healthcare providers do not know where to find information critical to providing evidence-based care when a patient comes in with questions nor how to manage care if an exposure is identified.

The purpose of this toolkit is to provide useful information to guide clinical practice and decision making. Patients, community members or colleagues may present with questions around PFAS exposures, PFAS testing and/or results, health implications, and what actions they can take to reduce exposures. We hope this toolkit will be a valuable resource for providing guidance around these questions.

As PFAS research continues, we anticipate knowledge around PFAS' health impacts to expand. The information provided in this toolkit is pulled together with the most recent information available as of July 2023. Please visit the resources listed in this guide to stay up-to-date on current best practices.

Overview



What are per-and poly-fluoroalkyl substances (PFAS)?

PFAS are per-and polyfluoroalkyl substances that make up a group of over 12,000 chemicals and are used to make fluoropolymer coatings and products. PFAS chemicals are used in a variety of products due to their ability to resist heat, oil, stains, grease, and water. There are more than 600 PFAS chemicals currently being used in commercial products in the United States. PFAS are stable substances due to Carbon-Fluorine (C–F) bonds, which are some of the strongest single bonds in chemistry. These C–F bonds make them extremely difficult to break down and are very persistent in the environment, leading to them being called “forever chemicals.”

Where are PFAS chemicals found?

Fluoropolymer coatings are used in many different products, such as heat-resistant non-stick cooking surfaces, waterproof and stainproof clothing, food packaging, adhesives, furniture, paint, personal care products, and cleaning products.

Many food consumer products contain PFAS chemicals, such as fast-food containers and wrappers, microwave popcorn bags, pizza boxes, and candy wrappers. Personal care products like shampoo, dental floss, nail polish, and eye makeup may have PFAS as an ingredient.

Figure 1. Common Uses of PFAS[1]

Consumer Products


Cookware (Teflon, Nonstick)


Fast Food Containers


Candy Wrappers

Microwave Popcorn Bags


Personal Care Products (Shampoo, Dental Floss)


Cosmetics (Nail Polish, Eye Makeup)


Paints and Varnishes


Stain Resistant Carpet


Stain Resistant Chemicals (Scotchguard)


Water Resistant Apparel (Gore-Tex)


Cleaning Products


Electronics

Industrial Uses


Photo-imaging


Metal Plating


Semi-conductor Coatings


Aviation Hydraulic Fluids


Medical Devices


Fire-Fighting Foam


Insect Baits


Printer and Copy Machine Parts


Oil and Gas Production (Fracking)


Textiles, Upholstery, Apparel and Carpets


Paper and Packaging


Rubber and Plastics

How are humans exposed to PFAS?

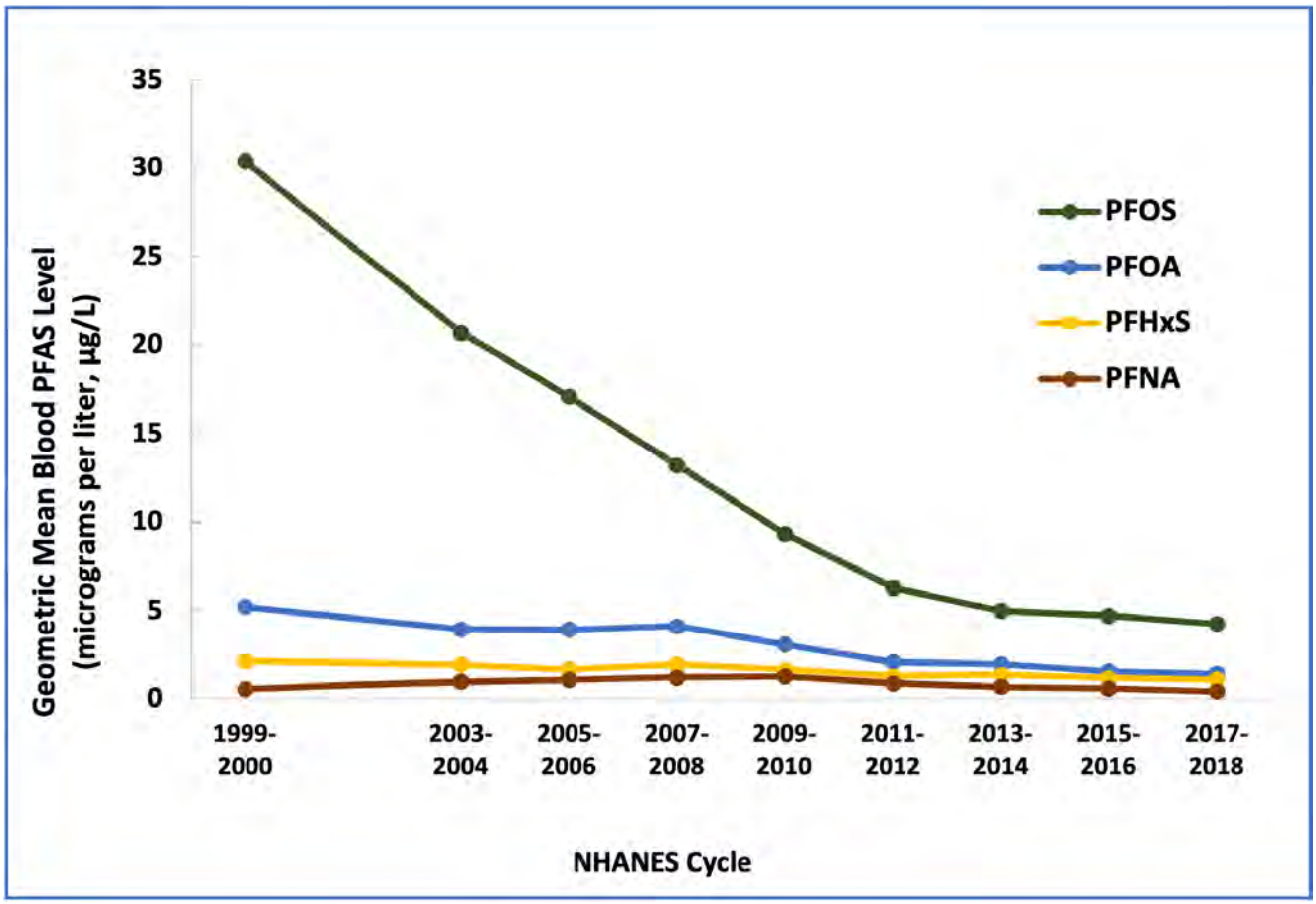


Figure 2. Blood Levels of the Most Common PFAS in People in the United States Over Time[3]

Most people in the United States have measurable amounts of PFAS in their blood. However, as the production and use of PFOS and PFOA, two of the most common types of PFAS, in the United States has declined, some blood PFAS levels have decreased as well.

- From 1999-2000 to 2017-2018, blood PFOS levels declined by more than 85%
- From 1999-2000 to 2017-2018, blood PFOA levels declined by more than 70%[2]

Humans are primarily exposed to PFAS through ingestion. Ingestion sources include through food, specifically fish or shellfish grown or raised

While PFOS and PFOA are being phased out and replaced, there is concern of exposure to other PFAS that are taking their place in consumer products and industrial uses.

in contaminated water or soil or through food packaged in materials containing PFAS. PFAS chemicals can be found in soil and private water wells and public drinking water systems due to contamination from manufacturing, firefighting foam used at airports and military sites, and leaching from landfills. For infants and toddlers, additional exposure sources to consider include through formula mixed with contaminated water, breast milk from persons who have current or past exposures to PFAS, and through hand-to-mouth behaviors and interaction with contaminated surfaces (surfaces treated with PFAS-containing products).[4] Other sources of exposure include breathing in contaminated dust in the air from PFAS treated products and transplacental exposure, with some PFAS shown to cross the placenta and enter umbilical cord blood.[5]

The EPA has established a Health Advisory level for PFOA and PFOS in drinking water at 4 parts per trillion (ppt). These levels are recommended based on the best available science and are noted by EPA as the lowest level that can be reliably measured. This Health Advisory, which is unenforceable and non-regulatory, was released in advance of the National Primary Drinking Water Regulation which will be enforceable. Additionally, some states have established their own PFAS drinking water guidelines.[6]

In March 2023, the EPA issued a proposed rule under the National Primary Drinking Water Regulation that will regulate 6 PFAS chemicals and require municipal water supplies to take action if levels are found above the maximum contaminant level (MCL). For PFOA and PFAS the MCL is 4 ppt.[7] The Environmental Working Group has developed an interactive map documenting PFAS pollution in public and private water systems.

The EPA has identified 180 Superfund sites that have PFAS contamination.[8] Airports and military bases are shown to have higher levels of contamination due to use of firefighting foam. The Department of Defense[9] is investigating over 700 active and formerly used sites for PFAS use or potential release.

There are 2,858 locations in 50 states and two territories confirmed to be contaminated with PFAS.[10]

Why are PFAS chemicals harmful?

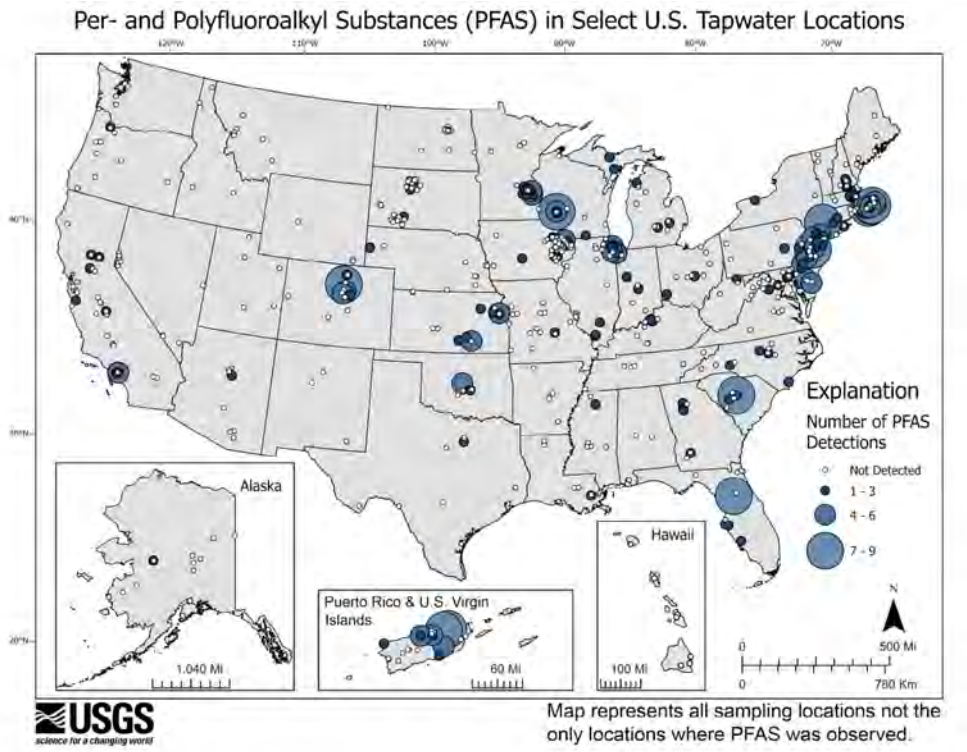


Figure 3. Per-and Polyfluoroalkyl Substances (PFAS) in Select U.S. Tapwater Locations[11]

PFAS chemicals are harmful because they do not break down in the environment, some can accumulate in the body over time, and are linked to adverse human health effects by targeting multiple organs and the immune system. When PFAS chemicals are introduced into the environment, drinking water can be contaminated, they bioaccumulate (build up) in fish and wildlife, and can be retained in soil.

There are many harmful health effects of being exposed to PFAS chemicals. While not all effects are known yet, current research shows being exposed can increase cholesterol levels, increase the chance of kidney and testicular cancer, decrease vaccine response in children, and change a person's liver enzymes. PFAS chemicals are detected in animals and humans through blood testing. PFAS-exposed breastfeeding persons can pass the chemicals on to their children through breastmilk.[13]

At least 45% of the nation's tap water is estimated to have one or more types of the chemicals known as per- and polyfluorinated alkyl substances, or PFAS, according to a study by the U.S. Geological Survey.[12]

Figure 4: Evidence determination for health effects from PFAS exposure[14]

Clinical Guidance

The science around the health impacts of PFAS is still emerging, creating uncertainty. Having conversations with people surrounding exposure can be difficult. What we do know is that when exposure is reduced, risk is decreased.

These are ways you can talk to patients and communities about what we know and don't know. These include:

- Review potential exposure and possible resulting health impacts
- Discuss the emerging science and the current lack of standardized methods for PFAS exposure biomonitoring
- Acknowledge that there are a number of unknowns about PFAS exposure and health effects.
- Discuss patient concerns by referring to Agency for Toxic Substances Disease Registry (ATSDR) handout "Coping with the stress that environmental contamination can cause"
- Encourage patients to verbalize concerns about exposure, testing and follow-up. Ensure appropriate follow up referrals.

Patients may have questions about future health problems, pregnancy, fertility, breastfeeding, immunity for themselves and their families and overall uncertainty. Listening empathetically, acknowledging and exploring patient concerns, and ongoing check ups are critical. Refer to ATSDR's PFAS: An Overview of the Science and Guidance for Clinicians on PFAS on Per- and Polyfluoroalkyl Substances (PFAS) for suggested messaging regarding patient concerns.

For patients/communities with known or suspected exposure to PFAS the following information is intended to serve as a guidance for clinical management by healthcare providers.

Clinical Testing

Currently, there are no standard methods for PFAS exposure biomonitoring. Further, there are certain limitations with PFAS blood testing, which include:

1) PFAS blood testing does not identify the sources of exposure or predict future health outcomes; it only assesses body burden at the time of sample collection

2) Labs can only test for a small number of PFAS chemicals in blood, and

3) Blood testing for PFAS is not a routine test offered by most providers or health departments.

Clinicians should offer PFAS testing to patients likely to have a history of elevated exposure. To determine exposure risk, patients who are likely to have a history of elevated exposure to PFAS include those who:

- had occupational exposure to PFAS (such as those who have worked with fluorochemicals or served as a firefighter);
- lived in communities where environmental and public health authorities (Centers for Disease Control and Prevention [CDC], Agency for Toxic Substances and Disease Registry [ATSDR], U.S. Environmental Protection Agency [EPA], state and local environmental or health authorities), or academic researchers have documented PFAS contamination;
- regularly consume fish from bodies of water with known PFAS contamination; or
- lived in areas where PFAS contamination may have occurred, such as near facilities that use or have used fluorochemicals, commercial airports, military bases, wastewater treatment plants, farms where sewage sludge may have been used, landfills or incinerators that have received PFAS-containing waste[15], or oil and gas drilling and fracking sites.[16]

The PFAS Exposure Assessment Questionnaire at the end of the report (Page 24) can be utilized to assess risk and exposure.

Laboratories

Laboratories that offer PFAS testing are not subject to measurement standardization, nor do they need to comply with clinical certification for reporting of results to patients. Therefore, PFAS testing should be conducted in laboratories that meet the following criteria[17]:

- have an extensive quality assurance/ quality control (QA/QC) program[18];
- report National Institute of Standards and Technology Standard Reference Material (NISTSRM)–traceable data[19]; and
- employ laboratory methods with relative standard deviations of less than 15 percent and with limits of detection (LODs) in the picogram/mL region, consistent with the LODs of the CDC and academic laboratories.[20, 21]

Providers can use any lab as long as they test for PFAS and use the EPA method 537.1. Laboratories capable of processing an individual clinical serum sample collected by healthcare providers are (Note: billing code for blood draw is 83921; CPT code 82542):

- Eurofins
- AXYS Analytical
- Quest Diagnostics
- Enthalpy Analytical
- NMS
- The PFAS-REACH Exchange provides further resources for obtaining PFAS blood tests

Laboratory Results Interpretation

Health risk from PFAS exposure is estimated to increase with increased exposure (for example, it is expected that those with levels greater than 20 ng/mL likely have a higher risk of health outcomes than those at lower levels).

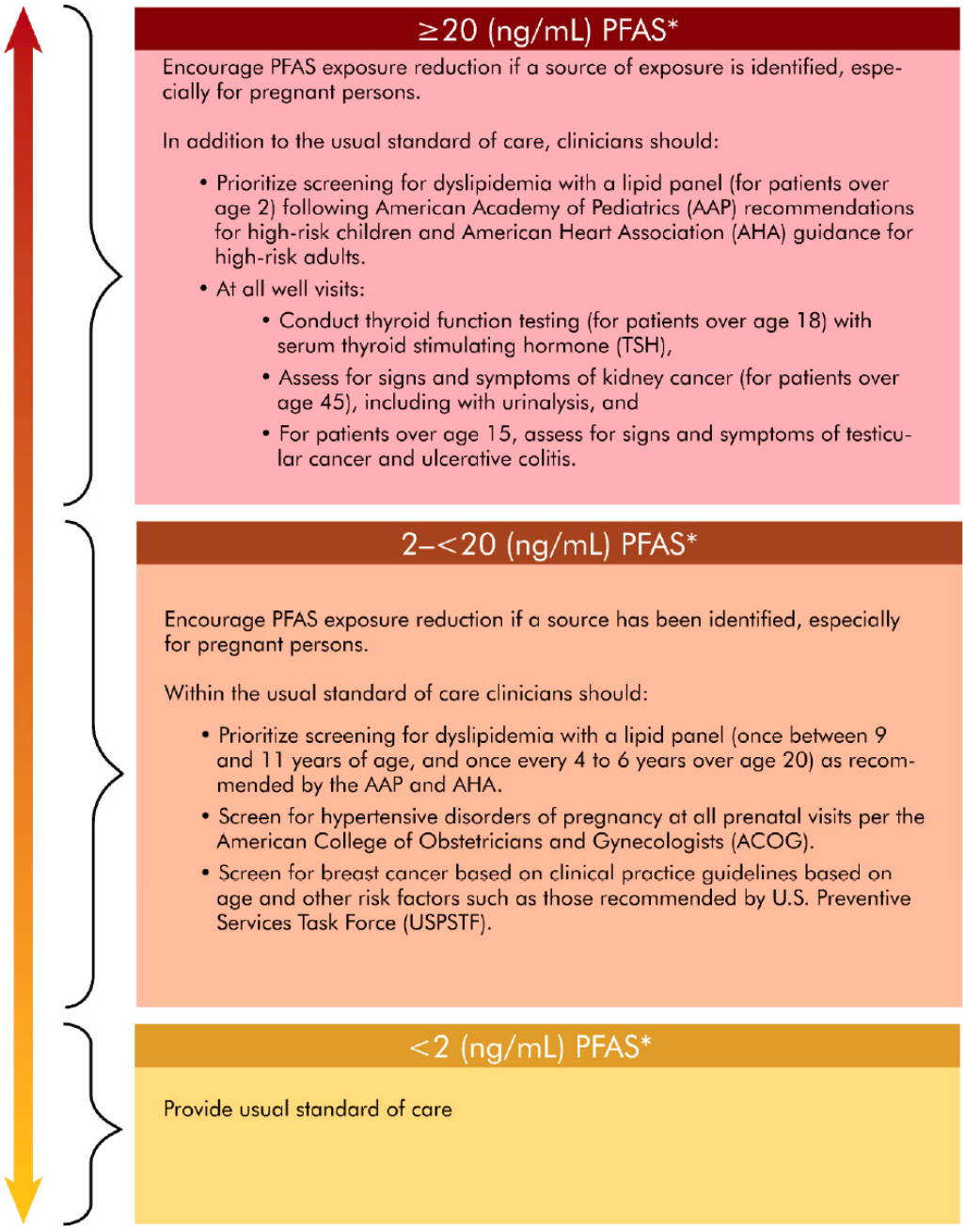
Those with low blood levels at the time of testing may have had higher levels in the past, as PFAS blood testing is only a measure of body burden at the time of collection. The following figure (Figure 5, Page 11) is to assist clinicians in identifying follow-up care based on testing results.

Follow-up testing for PFAS should be determined based on patients' exposure history and risk, and determined in conjunction with the patient and provider. Considerations for frequency of PFAS testing include:

- Confirmatory retesting when the result is much higher or lower than anticipated given exposure history.
- Retesting if exposure changes because – public health actions (such as drinking water treatment programs or site cleanup are taken to reduce exposure); the patient takes action(s) to reduce exposure (such as installing water filters, moving from a community with known high levels of PFAS in drinking water, or modifying occupational exposures); or – the patient moves into a community with known high levels of PFAS or otherwise has a suspected increase in exposure risk.

For follow-up testing of PFAS with a long half-life, allow at least a year before retesting. Retesting is of no or limited value if initial serum levels are low, and exposure does not change.

Clinical Guidance for Follow-Up After PFAS Testing[22]



* Simple additive sum of MeFOSAA, PFHxS, PFOA (linear and branched isomers), PFDA, PFUnDA, PFOS (linear and branched isomers), and PFNA in serum or plasma

Figure 5

Clinical Management

For those with elevated levels of PFAS identified through testing, additional testing and follow-up considerations include:

- **Regular examinations for testicular cancer:** exposure to high levels of PFAS has been associated with increased risk of testicular cancer. For pediatric exposure, screening should be considered starting around onset of adolescence.
- **Screening for breast cancer (consistent with usual standard of care based on age and other risk factors):** there is some evidence that exposure to PFAS can lead to increased risk of breast cancer.
- **Screening for ulcerative colitis:** exposure to high levels of PFAS has been associated with increased risk of ulcerative colitis.
- **Blood pressure monitoring during pregnancy:** PFAS are associated with elevated blood pressure during pregnancy and preeclampsia. Encourage home blood pressure monitoring during pregnancy for highly exposed people.
- **Depending on clinical background, the following laboratory tests may be appropriate for follow-up care[23]:**
  - **Lipid panel (cholesterol, LDL, HDL, triglycerides).** PFAS exposure has been associated with higher total and LDL cholesterol and fatty liver. Consider testing for pediatric exposure.
  - **Liver function tests (ALT, AST, GGT).** PFAS exposure has been associated with higher-than-normal liver function tests, as well as hepatotoxicity, including hepatocyte and liver architecture damage. Consider testing for pediatric exposure.
  - **Serum creatinine and urinalysis (including protein, albumin, and cell counts).** PFAS exposure has been associated with chronic kidney disease and kidney cancer. Note that there is enhanced excretion of PFAS in moderate to severe kidney disease, leading to misleadingly lower levels of PFAS in blood serum, especially if there is albuminuria.
  - **Thyroid tests (TSH with or without FT4).** PFAS exposure has been associated with thyroid disease. Consider testing for pediatric exposure.
  - For pediatric exposure, PFAS have been associated with lower levels of sex hormones in young children.
  - PFAS exposure has been associated with decreased antibody response to vaccines. However, there is currently no consensus on whether to measure antibody titers or to revaccinate patients with low vaccine titers. (See the PFAS-REACH fact sheet on PFAS and vaccines.)

Clinical Follow-up

The following information can be included in patient education and follow-up as appropriate:

- **Breastfeeding:** PFAS can cross the placenta and pass from parent to child during pregnancy. PFAS also accumulates in breast milk, so infants can be exposed through breastfeeding. However, breastfeeding provides clear benefits to both parental and child health. There is insufficient evidence to broadly weigh the risks and benefits of breastfeeding in highly exposed persons.
- **Water testing**: Those who would like to test their drinking water for PFAS should use a certified laboratory. The U.S. Environmental Protection Agency (EPA), the U.S. Department of Defense (DOD), and the National Environmental Laboratory Accreditation Conference (NELAC) all certify laboratories for testing PFAS.

The EPA's Office of Water requires that Method 537 be used to analyze samples, as it was shown to be a reliable method for testing PFAS in drinking water.

- Full list of list of EPA Approved Laboratories - Labs highlighted in yellow offer EPA Method 537 analysis for PFAS
- List of NELAC accredited laboratories - Select "EPA 537" from the Method dropdown list and search
- List of DOD accredited laboratories - Select "EPA 537" from the Method dropdown list and search
- For those with well water, the State of Michigan has created a water sampling guidance which can be found here.

Prevention

Preventing exposure to PFAS is critical. When possible, the patient should be provided with ways to reduce exposure to PFAS, which include:

- If patients may be exposed occupationally, such as by working with fluorochemicals or as a firefighter, clinicians should consult with occupational health and safety professionals knowledgeable about the workplace practices to determine the most feasible ways to reduce that exposure.[24]
- Clinicians should advise patients with elevated PFAS in their drinking water that they can filter their water to reduce their exposure. Drinking water filters are rated by NSF International, an independent organization that develops public health standards for products. The NSF database can be searched online for PFOA to find filters that reduce the PFAS in drinking water. Individuals who cannot filter their water can use another source of water for drinking.[25] For home water filtration, a water filter must be able to reduce these chemicals to below the EPA health advisory limit of 4 parts per trillion. Certified products must be retested periodically, and manufacturing facilities must be inspected every year, which ensures products continue to meet all requirements.
- In areas with known PFAS contamination, clinicians should advise patients that PFAS can be present in fish, wildlife, meat, and dairy products and direct them to any local consumption advisories.[26]
- Reduce use of products that contain PFAS:
  - Check product labels for ingredients that include the words "fluoro" or "perfluoro."
  - Avoid foods whose packaging contains grease-repellent coatings. Examples include microwave popcorn bags and fast-food wrappers and boxes.
  - Avoid stain-resistance treatments. Choose furniture and carpets that aren't marketed as "stain-resistant," and don't apply finishing treatments to these or other items.
  - Avoid clothing, luggage, camping, and sport equipment that were treated for water or stain resistance.
  - Avoid or reduce use of non-stick cookware. Stop using products if non-stick coatings show signs of wear. Use cast iron pans instead.

Advocacy Opportunities for the Clinician

Because PFAS regulation and research is ongoing and relatively new, there are a number of barriers both clinicians and patients may face. These include but are not limited to:

- Difficulties with PFAS testing
- Lack of data standardization
- Poor coordination among experts from different disciplines
- Lack of funding for and availability of education in environmental and occupational medicine and environmental health literacy activities
- Lack of funding for public health systems
- Few labs able to test for PFAS
- Testing methodology is complex; not all PFAS can be detected.[27]

While a number of these barriers are not directly under the clinician's control, we encourage you to advocate for the following highlighted needs to improve patient care and improve public health resources and access in your community.

Photo credit: Zero Waste Ithaca

Photo credit: Zero Waste Ithaca

Current Federal Action

In March 2023, EPA proposed regulations regarding National Drinking Water Standards for PFAS. Once finalized, these rules are scheduled to be fully implemented in 3 years. The proposal includes a "national benefits" estimate which includes quantifiable adverse health effects and benefits from reducing PFAS.

The proposal contains health-based Maximum Contaminant Level Goals (MCLG) for the following four PFAS and mixtures of PFOA and PFOS:

- perfluorohexane sulfonic acid (PFHxS)
- hexafluoropropylene oxide dimer acid (HFPO-DA) and its ammonium salt (also known as a GenX chemicals)
- perfluorononanoic acid (PFNA)
- perfluorobutane sulfonic acid (PFBS)
- mixtures of these PFAS as contaminants under the Safe Drinking Water Act
    - PFOA*
    - PFOS*

*EPA is proposing a health-based value (MCLG) for PFOA and PFOS at zero

This is the first federal proposed drinking water limits for PFAS, however, 10 states, including Maine, Massachusetts, Michigan, New Jersey and New York, already have final or interim enforceable drinking water limits for PFAS.

In April 2023, EPA released an Advanced Notice of Proposed RuleMaking (ANPRM) regarding the consideration of potential development of future EPA regulations pertaining to certain PFAS under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Superfund laws.

Potential future hazardous substance designation under CERCLA and designation of PFAS (or PFAS' salts and structural isomers or precursors to certain PFAS) as "hazardous substances" would help hold polluters accountable for PFAS clean up and allow laws such as CERCLA/Superfund to be used in order to lower exposures from contaminated sites and give EPA more authority to investigate and remediate waste sites.

Recommendations for Federal Action

Expand national biomonitoring and surveillance: While CDC and ATSDR are doing biomonitoring and NHANES (National Health and Nutrition Examination Survey) is doing surveillance, they are not comprehensive nor national.[28] We are unable to target communities at greatest risk. Expanded national biomonitoring and surveillance is needed.

Develop a more collaborative, standardized approach to data collection, reporting, and analysis: Conduction of PFAS testing should include reporting results to state public health authorities and having results linked to an expanded Environmental Public Health Tracking Network with the CDC to help build increased capacity in a state-based national biomonitoring network resulting in Better Information for Better Health. Increase national tracking of elevated PFAS areas especially in "vulnerability zones" and in locations of known and suspected PFAS contamination.

Address research gaps that have been identified in developmental outcomes in children and associations with health outcomes and breastfeeding.[30] Promote continued funding and support for research of PFAS health effects particularly for groups more vulnerable to health impacts such as pregnant persons, breastfeeding persons and infants, and children 12 and under in order to assess developmental outcomes and generate reference populations for these groups.

Additional regulatory actions are needed to protect people from exposure to PFAS. Nurses can advocate for the following:

- FDA (Food and Drug Administration) to limit PFAS in bottled water
- OSHA (Occupational Safety and Health Administration) to set PFAS limits; currently there are no set occupational limits
- Updated ATSDR PFAS clinical guidance for clinicians with health effects updated every 2 years and clinical guidance updated at least every 5 years[29]
- Individual health insurance policies to facilitate reimbursement for PFAS testing
- Equal testing of PFAS exposure through a funded PFAS testing program with a national scope
- Accessible and affordable laboratory testing for PFAS and standardized testing methods
- Restricting PFAS discharges to our waterways by strengthening Clean Water Act standards
- Finalizing chemical data and safety rules that will increase our knowledge about PFAS, allowing us to act faster and more strategically, and restrict legacy PFAS from reentering production.
- Ongoing strengthening of health protections under the Toxic Substance Control Act (TSCA) as new science around PFAS emerges. Visit EPA's Overview of PFAS Actions under TSCA.
- Push for research into safer substitutes for PFAS, especially for essential applications such as medical devices.

Recommendations for State/Local Advocacy and Action

1. Consider local action and advocacy around use of Bipartisan Infrastructure Law funding for PFAS (states and communities can also leverage funds)

2. Stay informed of the monitoring of thousands of drinking water systems across the country for dozens of PFAS, beginning 2023; EPA expects (at least 66,000 water systems to fall under proposed regulations with 3400-6300 systems anticipated to exceed 1 or more MCL (Maximum Contaminant Level)

3. Promote importance of clear communication and notification of elevated PFAS levels

4. Promote communication between local health departments and communities

5. Promote public access to health resources and drinking water information in multiple languages, in easy to understand written and audio formats, on a variety of platforms:

- Identify enforcement mechanisms for PFAS findings in water supply
- Educate around PFAS reduction strategies once drinking water standards are exceeded
- Promote detection of treatment of PFAS related health risks and conditions, particularly for areas identified as high risk exposure areas
- Plan for necessary interdisciplinary and collaborative education and continuing education of healthcare providers around appropriate medical and nursing follow up care for those with exposure or concerns of exposure

6. Develop and add to resources with Regional PEHSUs on environmental assessment education, referrals for NSF certified filters (see "clinical follow up - water testing") and potential funding around accessibility and affordability of filters; local consumption advisories for fish, wildlife, meat and dairy, develop resources for pregnant persons or those breastfeeding infants

7. Develop occupational contacts that will be able to assist with workplace PFAS exposures

8. Recognize and educate around the many ways that people are exposed to PFAS and provide anticipatory guidance on exposure reduction

"We must come together to demand change and hold those responsible accountable for their actions. I urge all of you to take a stand against these toxic chemicals and demand change. Together we can make a difference and protect ourselves and future generations from the devastating effects of PFAS." - in memory of Amara Strande (2002 - 2023) photo via Clean Water Action

Resources

Agency for Toxic Substances and Disease Registry (ATSDR) has a 2019 PFAS Overview of the Science and Guidance for Clinicians on PFAS on Per- and Polyfluoroalkyl substances (PFAS). This is ATSDR's most up-to-date guidance. Additional resources from ATSDR include facts sheets, FAQs and resources on Per- and Polyfluoroalkyl Substances. Clinicians can sign up for the PFAS Progress Newsletter to stay up to date on the latest community health activities related to PFAS. View the toxicological profile for perfluoroalkyls from the U.S. Department of Health and Human Services (2021) and the ATSDR Perfluoroalkyls - ToxFAQs™ from March 2020.

Centers for Disease Control and Prevention (CDC) resources include the PFAS Blood Level Estimation Tool which was created to help individuals who have consumed PFAS-contaminated drinking water and who have information about the levels of PFAS in their water estimate their PFAS blood levels.

C-8 Science Panel and the C-8 Medical Panel: As a result of a class action lawsuit settlement near Parkersburg, West Virginia, the formation of a scientific and a medical panel were required. The C-8 medical panel's recommendations included screenings for high cholesterol, thyroid disease, ulcerative colitis, testicular cancer, kidney cancer, pregnancy-induced hypertension, and blood testing for PFOA.

Environmental Protection Agency: Environmental Protection Agency's Per-and Polyfluoroalkyl Substances site provides the most up-to-date information on what EPA is doing to address PFAS. To review EPA's strategy to address PFAS see PFAS Strategic Roadmap: EPA's Commitments to Action 2021–2024.

Environmental Working Group (EWG)'s interactive map (updated as of March 2023), EWG documents PFAS pollution in public and private water systems. New data show 2,858 sites in 50 states and two territories. Information about sites newly added to the map comes from various PFAS detections reported to government agencies in Colorado, New Hampshire, North Carolina, Ohio and other states, as well as updated records from the Department of Defense. EWG additionally has a guide to remove PFAS with water filters (July 11, 2023) - this is based on their experience with several brands. EWG staff bought and used 10 different types of water filters, testing them in real homes using their water.

National Academies of Sciences, Engineering, and Medicine (NASEM) are private, nonprofit institutions that provide independent, objective analysis and advice to the nation to solve complex problems and inform public policy decisions related to science, technology, and medicine. NASEM's 2022 report expanded PFAS testing for people with a history of elevated exposure and offers guidance for clinical treatment.

Pediatric Environmental Health Specialty Units (PEHSUs) are a national network of experts in the prevention, diagnosis, management, and treatment of health issues that arise from environmental exposures from preconception through adolescence. The PEHSU network has experts in pediatrics, allergy/immunology, neurodevelopment, toxicology, occupational and environmental medicine, nursing, reproductive health, and other specialized areas. You can contact your regional PEHSU to talk to an expert free of charge. PEHSU has specific resources for PFAS.

PFAS Central provides current and curated information about PFAS, including press, peer-reviewed scientific articles, meetings, job listings, and consumer information. Content is provided by a partnership between the Green Science Policy Institute and the Social Science Environmental Health Research Institute at Northeastern University. A listing of PFAS free products is available at the PFAS Central PFAS Free Product List.

PFAS-Exchange is part of a multi-year project called PFAS-REACH (Research, Education, and Action for Community Health) funded by the National Institute of Environmental Health Sciences. It includes online tools to create a personalized report that shows how PFAS levels from blood tests or water results compare with state and federal health guidelines, provides information on health effects, and shares tips for reducing exposures.

PFAS Project Lab at Northeastern University studies social, scientific, and political factors related to Per- and Polyfluoroalkyl substances (PFAS). They produce rigorous, accessible research about the PFAS contamination crisis through collaborations with impacted communities, leading interdisciplinary researchers, and nonprofits and share this PFAS research with impacted communities and a broad range of other stakeholders. PFAS Project Lab also features an interactive map from December 2021 of PFAS sites.

Water Filtration Resources: Water contaminated with PFAS can be treated with carbon filters and reverse osmosis. **American National Standards Institute (ANSI)** publishes standards (NSF/ANSI 53 and 58) related to the removal of PFAS through these systems. The **National Sanitation Foundation** lists products it has certified to reduce PFOA/PFOS in drinking water. To comply with NSF certification standards, a water filter must be able to reduce these chemicals to below the former EPA healthy advisory limit of 70 parts per trillion. Certified products must be retested periodically and manufacturing facilities must be inspected every year, which ensures products continue to meet all requirements. To find products that are certified by NSF to reduce PFOA/PFOS in drinking water, see NSF's certification listings. The NSF Standards were updated in 2023 with the PFOA/PFOS limits updated from 70 ppt to 20 ppt, however, most products are currently Certified to the previous version of the Standard (70 ppt). Products are listed with a note to indicate if they are approved for the 2021 version of the Standard (70 ppt) or the 2022 version (20 ppt). NSF expects once EPA limit becomes final, that the Joint Committee will update the Standards to meet the EPA's limit of 4 ppt.[31]

Endnotes

[1] Agency for Toxic Substances and Disease Registry (ATSDR). Exposure assessment protocol: Biological and environmental sampling of per- and polyfluoroalkyl substances (PFAS), p 91. https://www.atsdr.cdc.gov/pfas/docs/pfas-exposure-assessment-protocol-508.pdf

[2] Agency for Toxic Substance and Disease Registry (ATSDR). (Last reviewed June 29, 2023). Per- and Polyfluoroalkyl Substances (PFAS) and your health: PFAS in the U.S. population. https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html

[3] Centers for Disease Control and Prevention (CDC). (January 2017). Fourth report on human exposure to environmental chemicals, updated tables. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention as cited in Agency for Toxic Substance and Disease Registry (ATSDR). (August 21, 2017.) PFAS in the U.S. population. https://www.atsdr.cdc.gov/pfas/docs/PFAS_in_People.pdf

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Exposure Assessment Questionnaire

Adapted from CDC PFAS Exposure Assessment Technical Tools

Healthcare providers should be aware of local water contamination, soil contamination, and fish advisories in order to assess for PFAS exposure risk.

1. What is your current main source of drinking water in your home?	(Select one) ☐ Public water system (City or County) Provide name: _____ ☐ Private Well (If selected, include Questions 4 and 5 below) ☐ Community well ☐ Bottled Water ☐ Don't Know ☐ Refused to answer
2. If you have a private well, has it been tested for PFAS?	☐ Yes, results: _____ ☐ No ☐ Don't know ☐ Refused to answer ☐ Not Applicable
3. Do you live near a military, airport, or industrial site that produces PFAS?	☐ Yes, site: _____ ☐ No ☐ Don't know ☐ Refused to answer ☐ Not Applicable

If area soil may be contaminated from past air contamination deposition from a nearby manufacturer, or by watering lawns, gardens, crops with contaminated water consider these potential exposure sources (Questions 4 and 5).

4. How frequently do you work or play in the soil (e.g. gardening, digging, farming, building, repairing, etc.) in {insert affected area/sampling frame/locations}?	(Select one) ☐ Once per month ☐ A few times per year ☐ Once per year ☐ Rarely ☐ Never ☐ Don't know ☐ Refused to answer
5. How often do you eat "homegrown" or locally grown vegetables from {insert affected area/sampling frame/locations}?	(Select one) ☐ Several times per month ☐ Few times per month ☐ Once per month ☐ A few times per year ☐ Once per year ☐ Rarely ☐ Never ☐ Don't know ☐ Refused to answer
6. How often do you eat food that is wrapped in packaging - take out, fast food, processed foods (such as frozen pizzas).	☐ Several times per month ☐ Few times per month ☐ Once per month ☐ A few times per year ☐ Once per year ☐ Rarely ☐ Never ☐ Don't know ☐ Refused to answer

7. Do you use non-stick cookware for cooking (such as Teflon coated)?

- ☐ Yes, results: _____
- ☐ No
- ☐ Don't know
- ☐ Refused to answer
- ☐ Not Applicable

8. Do you use treated fabrics in your home or clothes (these include fabrics treated for stain resistance and waterproofing such as Scotchgard® and GORE-TEX®).

- ☐ Yes, results: _____
- ☐ No
- ☐ Don't know
- ☐ Refused to answer

If area surface water bodies are contaminated and local fishing is possible:

9. How often do you eat fish locally caught from ponds, lakes, or rivers in {insert affected area/sampling frame/locations}?

(Select one)
- ☐ Several times per month
- ☐ Few times per month
- ☐ Once per month
- ☐ A few times per year
- ☐ Once per year
- ☐ Rarely
- ☐ Never
- ☐ Don't know
- ☐ Refused to answer

If livestock are raised in areas with soil contamination or if their drinking water source was contaminated:

10. How often do you consume milk from animals raised on farms within {insert sampling/affected area/location or list of affected farms}?

- ☐ Several times per month
- ☐ Few times per month
- ☐ Once per month
- ☐ A few times per year
- ☐ Once per year
- ☐ Rarely
- ☐ Never
- ☐ Don't know
- ☐ Refused to answer

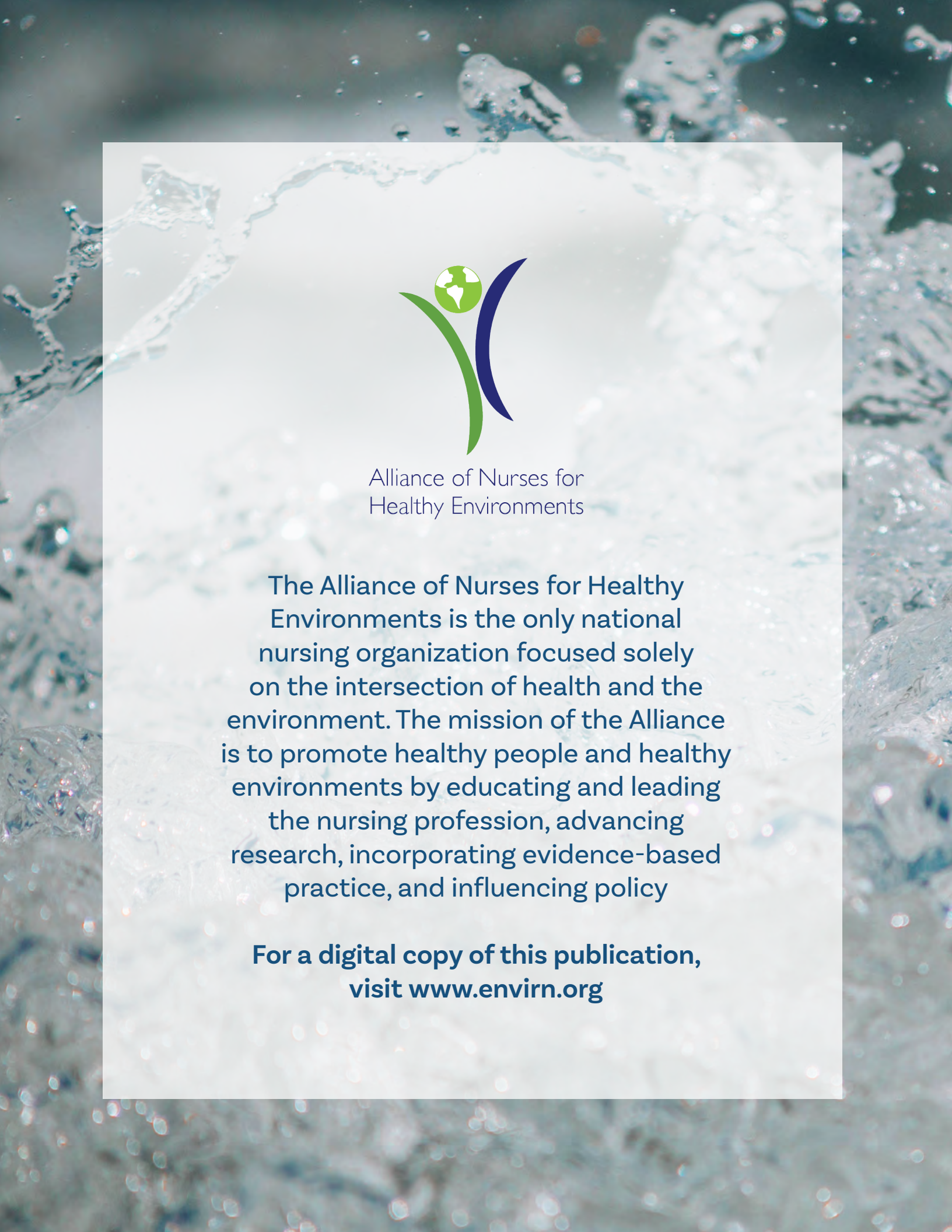
Occupational Exposures

11. Did you in the last {add duration based on exposure e.g., 1 yr or 5 yr} work at any of the following industries?

- ☐ Manufacturing of nonstick cookware such as Teflon® coated pots/pans
- ☐ Manufacturing of stain resistant coatings (e.g. Scotchgard®) used on carpets, upholstery, and other fabrics or carpet installation and treatment with stain resistant coatings
- ☐ Manufacturing of water resistant clothing (e.g. GORE-TEX®)
- ☐ Working with ski wax
- ☐ Handling of PFAS containing food packaging, such as a food worker or packager
- ☐ Never worked in the industries listed above

12. Were/Are you a firefighter {add duration based on exposure e.g., 1 yr or 5 yr etc.}?

- ☐ Yes
- ☐ No
- ☐ Refused to answer



Alliance of Nurses for
Healthy Environments

The Alliance of Nurses for Healthy Environments is the only national nursing organization focused solely on the intersection of health and the environment. The mission of the Alliance is to promote healthy people and healthy environments by educating and leading the nursing profession, advancing research, incorporating evidence-based practice, and influencing policy

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