



NC DEPARTMENT OF
**HEALTH AND
HUMAN SERVICES**

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TO: North Carolina Clinicians

FROM: Zack Moore, MD, MPH, State Epidemiologist

SUBJECT: Updated Guidance for Clinicians with Patients Concerned about Exposures to Per- and Polyfluoroalkyl Substances (PFAS)

Since 2017, the NC Department of Health and Human Services (NCDHHS) has been responding to public health concerns about chemicals known as per- and polyfluoroalkyl substances (PFAS), which includes GenX. The NCDHHS Occupational and Environmental Epidemiology Branch developed this memo to provide PFAS information and educational materials to clinicians in affected communities to help them address patient concerns, including:

- What are PFAS?
- How can I be exposed?
- What are the health effects?
- How can I measure PFAS in my blood, and what does that mean?

PFAS Basics

PFAS are a large group of human-made chemicals that have been used in industry and consumer products worldwide since the 1940s. These chemicals are used to make products that resist stains, water, and grease and have been used in furniture, cookware, fast food packaging and fire-fighting foam. PFAS are found in water, people, and wildlife all over the world. Most PFAS do not break down easily in the environment and can stay in people's bodies a long time.⁽¹⁾

There are several ways patients can be exposed to PFAS. Exposure routes include drinking contaminated water, eating contaminated food, inhaling contaminated air, and working in occupations that utilize PFAS (e.g., textiles, chemical manufacturing, and firefighting). Babies born to mothers who were exposed to PFAS can also be exposed before they are born, while breastfeeding, or by drinking formula mixed with PFAS-contaminated water.⁽¹⁾ There are several communities with known contamination in North Carolina, including the area around the [Chemours Fayetteville Works Facility and the lower Cape Fear River basin](#) and areas around certain [fire stations](#) and [landfills](#).

Health Concerns Related to PFAS

Research is still being conducted to better understand the health impacts of PFAS exposure. Studies to date have identified a growing list of associated health effects, including:

- Increased cholesterol levels in adults and children;
- Liver enzyme changes in adults and children;
- Increased risk of high blood pressure for pregnant people;
- Negative impacts on growth for fetus and infants;
- Increased risk of thyroid disease in adults;

- Reduced immune system function, such as reduced antibody response to vaccines in adults and children;
- Increased risk of ulcerative colitis in adults, and
- Increased risk of certain types of cancer, including breast, kidney and testicular^(1,2,3)

Measuring PFAS Exposure in Serum

Although PFAS are not naturally occurring, exposures are so widespread that most people have some detectable PFAS in their blood. Some patients may want to have their blood tested for PFAS to gain information about their exposures, which can be compared with national surveillance like the CDC's National Health and Nutrition Examination Survey ([NHANES](#)) or results from research studies like the [GenX Exposure Study](#), which represents a more highly exposed population. Higher levels may suggest increased risk for certain adverse health conditions, although it is not generally possible to directly link individual serum levels with specific health outcomes.

Benefits and Limitations of Serum Testing

Testing for PFAS in the blood has several potential benefits and limitations that a clinician may want to discuss with their patients.^(4,5,6)

Benefits

- Results indicate PFAS levels in the blood when tested, which provides information about PFAS exposure levels and increases awareness of PFAS exposure
- Additional medical screenings can be offered for those with elevated levels
- Results could inform the need to reduce PFAS exposures
- Patients may find psychological relief from knowing their PFAS blood level

Limitations

- Results cannot indicate when exposure occurred or from what source
- Results cannot link specific illnesses to PFAS exposures or predict future health problems
- There is a potential for false positives from medical screenings performed in response to detection of PFAS in serum or complications from subsequent testing and treatment

Importantly, conducting serum testing for PFAS can provide information on exposure levels, but there are currently no approved medical treatments available to remove PFAS from the body.

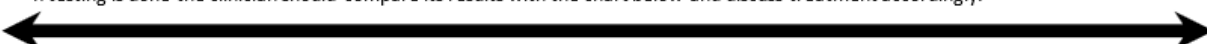
How to Order Serum Testing

Clinicians can order serum testing for PFAS through Clinical Laboratory Improvement Amendments (CLIA)-certified commercial clinical laboratories using the ICD-10 diagnosis code Z13.88, Test Code 39307 and CPT code 82542.^(4,7,8) The [PFAS Exchange](#) recommends using the ICD-10 diagnosis code Z13.88, and if ordering a test through Quest, using Test Code 39307 and CPT code 82542. Patients can also contact a lab directly to request the test. It is important to note that health insurance may not cover costs of testing. PFAS-REACH, the research and community initiative that created The PFAS Exchange, developed a [PFAS Blood Testing Fact Sheet](#) for more information on lab specifics.

Interpretation of Serum Testing Results

Interpreting individual serum PFAS levels can be challenging. However, clinicians can compare these results with national biomonitoring data, such as NHANES, to see whether a patient's exposure is typical or elevated compared to available population-level data. While this comparison does not indicate specific risk or diagnose disease, it helps place results in context, inform screening practices, and guide discussions about possible exposure sources.^(1,5,7)

The National Academies of Science, Engineering and Medicine (NASEM) have provided the following guidance to help guide clinical follow up based on PFAS levels in serum.⁽⁷⁾

PFAS Exposure: Clinical Follow-Up		
- Clinicians should offer PFAS testing to patients who are likely to have a history of elevated exposure. In all discussions of PFAS testing, clinicians should describe the potential benefits and harms of PFAS testing and the potential clinical consequences (such as additional follow-up), related social implications, and limitations of the testing so patient and clinician can make a shared, informed decision. - If testing is done the clinician should compare its results with the chart below and discuss treatment accordingly.		
		
<2 (ng/mL) PFAS* 2–<20 (ng/mL) PFAS* ≥20 (ng/mL) PFAS*		
Provide usual standard of care.	Encourage PFAS exposure reduction if a source has been identified, especially for pregnant persons. Within the usual standard of care clinicians should: - Prioritize screening for dyslipidemia with a lipid panel (once between 9 and 11 years of age, and once every 4 to 6 years over age 20) as recommended by the American Academy of Pediatrics (AAP) and American Heart Association (AHA). - Screen for hypertensive disorders of pregnancy at all prenatal visits per the American College of Obstetricians and Gynecologists (ACOG). - Screen for breast cancer based on clinical practice guidelines based on age and other risk factors such as those recommended by US Preventive Services Task Force (USPSTF).	Encourage PFAS exposure reduction if a source of exposure is identified, especially for pregnant persons. In addition to the usual standard of care, clinicians should: - Prioritize screening for dyslipidemia with a lipid panel (for patients over age 2) following AAP recommendations for high-risk children and AHA guidance for high-risk adults. - At all well visits: - Conduct thyroid function testing (for patients over age 18) with serum thyroid stimulating hormone (TSH), - Assess for signs and symptoms of kidney cancer (for patients over age 45), including with urinalysis, and - For patients over age 15, assess for signs and symptoms of testicular cancer and ulcerative colitis.
* Simple additive sum of MeFOSAA, PFHxS, PFOA (linear and branched isomers), PFDA, PFUnDA, PFOS (linear and branched isomers), and PFNA in serum or plasma		

Additional Considerations for Patients in North Carolina

There are some PFAS found in North Carolina that were not part of the NASEM guidance but have been measured in residents of North Carolina, including GenX, Nafion byproduct 2, PFO4DA, PFO5DoA, Hydro-Eve and PFMOAA.⁽²⁾ Toxicology and epidemiology studies have documented potential health impacts associated with these compounds, as summarized below.

GenX – Used in the manufacture of nonstick coatings and produced as a byproduct of certain industrial processes, GenX is difficult to measure in serum even among patients with known exposures, likely due to its short half-life.^(2,3,9) Exposure to GenX has been linked to health effects in animals on the liver, the kidney, the immune system, and developmental effects, as well as cancer.⁽¹⁰⁾

PFMOAA – Identified by the U.S. Environmental Protection Agency (EPA) to be the highest concentration PFAS in eastern NC drinking water samples, PFMOAA has been linked to maternal, neonatal and developmental effects in animals, including lower birthweights, blood sugar abnormalities, and changes in liver and thyroid function.⁽¹⁰⁾

Nafion byproduct 2 – One of five byproducts created when GenX was used to produce Nafion, it was recently detected in the serum of 99% of a study population in eastern NC and is associated with liver toxicity and cardiac effects in animals.⁽⁶⁾

PFO4DA – Recently detected in the serum of 99% of a study population in eastern NC, this compound is associated with fetal metabolic/thyroid disruption and liver gene expression changes in animals.⁽¹²⁾

PFO5DoA – More potent than PFO4DA, this compound was recently detected in the serum of 88% of a study population in eastern NC and is associated with fetal/neonatal toxicity in animals.⁽¹²⁾

Hydro-EVE – Detected in serum samples of a study population in eastern NC, Hydro-EVE was found to accumulate in the liver of animals in an EPA screening study. There are no published studies on specific health effects to date.⁽¹³⁾

Reducing PFAS Exposure

It is difficult to fully prevent PFAS exposure because PFAS are present at low levels in a variety of foods and in the environment.⁽¹⁾ However, patients can be counseled regarding possible steps to reduce PFAS exposure.

- **Test and treat drinking water.** If living near known sources of PFAS contamination or if PFAS is found in drinking water, consider using a different water source or filtering water before drinking, cooking, and preparing infant formula. Please see the NCDHHS factsheet on [water testing and treatment](#) for more information.
- **Eat a variety of fresh foods.** Eat more fresh foods to avoid take-out containers and other packaging and consume a wide variety of foods. Limit or avoid fish, meat, eggs or dairy known to be contaminated with PFAS.⁽⁵⁾ In 2023, NCDHHS issued PFAS fish consumption advisories for the Middle and Lower Cape Fear River. NCDHHS also developed [gardening guidance](#) for homeowners in areas with known PFAS contamination.
- **Select PFAS-free consumer products.** Whenever possible, choose consumer products that don't contain PFAS. Avoiding stain and water-resistant carpets, upholstery, and clothing as well as stain-proofing and waterproofing sprays. Choose cookware made of cast iron, stainless steel, glass, or enamel rather than with nonstick coatings. Look for nylon or silk dental floss that is uncoated or coated in natural wax.⁽¹⁴⁾ More information about consumer products which have been identified as PFAS-free can be found in at [PFAS Central](#) or [Environmental Working Group](#).
- **Boiling water will NOT remove PFAS.**

Additional PFAS Resources

For more information about PFAS-related health concerns, or to discuss serum testing, interpretation of results, recommended screening based on PFAS levels, and other clinical considerations, clinicians may contact the NCDHHS Occupational and Environmental Epidemiology Branch (OEEB) Medical Consultant at (919) 707-5900 or OEEB@dhhs.nc.gov.

NCDHHS

[PFAS Main Page](#)



[PFAS Factsheet](#)



[PFAS Testing and Treatment for Drinking Water Factsheet](#)



[Gardening Factsheet](#)



[Fish Consumption Advisories](#)



CDC/ASTDR

- [For Clinicians: Frequently Asked Questions about PFAS](#)
- [PFAS Blood Level Estimation Tool](#)

EPA

- [PFAS National Primary Drinking Water Regulation](#)
- [Understanding the PFAS National Primary Drinking Water Proposal Hazard Index](#)

PFAS-REACH

- [PFAS Blood Testing: What You Need to Know](#)
- [Information about PFAS blood testing laboratories for individuals](#)

CME Credit - AMA PRA Category 1 Credits™ (1.00 hours)

- [Nonstick Nuisance: Medical Monitoring for PFAS](#) (expires August 1, 2027)

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