PFAS (Forever Chemicals) 9 Panel

Test code: 13761

Specimen requirements: **Preferred:** 2 mL room-temperature serum in a red-top tube with no additives (1 mL minimum)

Note: Specimen collection devices coated with PTFE/Teflon® and PVDF should be avoided because of potential contamination.

CLINICAL USE

- Evaluate exposure to per- and polyfluorinated alkyl substances (PFAS)

CLINICAL BACKGROUND

PFAS are a group of manufactured chemicals widely used in industry and consumer products since the 1940s. Their water-, oil-, friction-, and temperature-resistant properties have found application in cookware, textiles, cosmetics, protective equipment, and fire-fighting foams. However, their common chemical characteristic of carbon-fluorine bonds that do not naturally break down has led them to be called "forever chemicals."[1]

The accumulation and persistence of PFAS in the environment, animals, and humans has created human health concerns. The National Academies of Sciences, Engineering, and Medicine (NASEM) has found sufficient evidence to suggest that PFAS exposure is associated with decreased antibody response (adults), impaired growth (fetal and infant), increased total cholesterol levels (adults and children), and risk of kidney cancer (adults).[1] NASEM found limited evidence to suggest that PFAS exposure is associated with increased risk of breast and testicular cancers, ulcerative colitis, gestational hypertension, preeclampsia, thyroid dysfunction and disease (all in adults), and liver enzyme alterations (children and adults).[1] NASEM defines evidence of an association between a health outcome and PFAS as "sufficient" (chance or bias unlikely to explain the association) if confidence is strong and "limited" (chance or bias could possibly explain the association) if confidence is moderate.

In 2022, NASEM provided guidance on PFAS exposure, testing, and clinical follow-up.[1] PFAS exposure assessment should involve conversations about occupational exposures (eg, working in the fluorochemical industry; firefighting; serving in the military) or known environmental exposures (eg, living near fluorochemical industries; exposure to PFAS-contaminated drinking water, fish, meat, or dairy products).[1] PFAS testing may be offered to people likely to have a history of exposure such as those working in relevant industries or those who have lived or are living in areas with PFAS contamination[1] (eg, documented by the Agency for Toxic Substances and Disease Registry[2]). Populations particularly sensitive to the effects of PFAS include children and pregnant individuals.[1]

According to NASEM, clinical follow-up for PFAS-affected individuals should involve exposure reduction (eg, replace or filter drinking water, if water is the identified source of PFAS) as well as screening and assessment for other health conditions.[1] Recommendations depend on PFAS levels and age (**Table 1**).[1]

Quest Diagnostics offers the PFAS (Forever Chemicals) 9 Panel (test code 13761) to evaluate exposure by detecting PFAS in blood circulation. Following the recommendations of NASEM, the panel includes the individual and combined levels of 9 PFAS in patient serum (**Table 2**). Panel components cannot be ordered separately.

For individuals with elevated PFAS (**Table 1**), Quest offers the following tests: Lipid Panel, Standard (test code 7600) to assess dyslipidemia; TSH (test code 899) to assess thyroid function; and Urinalysis, Macroscopic (test code 6448) to assess kidney disease.

INDIVIDUALS SUITABLE FOR TESTING

- Individuals with a history of exposure to PFAS through their environment or occupation

METHOD

- Liquid chromatography-tandem mass spectrometry
- Clinical reportable range: 0.10-25.00 ng/mL for all PFAS compounds
- NASEM-recommended summation[1]: 9 PFAS analytes are summed and a 0.07 ng/mL value is assigned and added for any analyte not detected at cutoff (0.10 ng/mL)

Table 1. NASEM Recommendations for Follow-Up for PFAS-Related Health Effects

Recommendations[1]	Summed PFAS serum levels, ng/mL[a]		
	<2	2 to <20	≥20
Usual standard of care appropriate for age	●	●	●
Exposure reduction		●	●
Screen for dyslipidemia (lipid panel: once between 9-11 years of age, then every 4-6 years when >20 years of age)[b]		●	
Screen for dyslipidemia (lipid panel: patients >2 years of age)[c]			●
Screen for hypertensive disorders of pregnancy[b]		●	●
Screen for breast cancer[b]		●	●
Thyroid function (TSH) testing (>18 years of age)[d]			●
Kidney cancer assessment (including urinalysis, >45 years of age)[d]			●
Testicular and ulcerative colitis assessment (>15 years of age)[d]			●

●, recommendation is indicated; NASEM, National Academies of Sciences, Engineering, and Medicine; PFAS, per- and polyfluorinated alkyl substances; TSH, thyroid-stimulating hormone.
[a] NASEM-recommended summation (see Methods) for PFAS (Forever Chemicals) 9 Panel (test code 13761) components.
[b] Prioritize within usual standard-of-care guidance provided by relevant medical societies cited in reference 1.
[c] Following guidance for high-risk children and adults.
[d] At all wellness visits.

- No known interferences from common illicit and licit drugs of abuse as well as related PFAS compounds
  - Some structurally similar branched PFOS isomers may result in the standard interference message reporting for branched PFOS (Sb-PFOS) in the panel.

REFERENCE RANGES

- None provided (NASEM indicates an ideal summation is <2 ng/mL)
- **Table 2** provided in patient report to understand current population PFAS median concentrations

INTERPRETIVE INFORMATION

NASEM has advised that if the NASEM-recommended summation of PFAS in serum is

- <2.00 ng/mL, then adverse health effects related to PFAS are not expected
- 2.00-20.00 ng/mL, then there is potential risk of PFAS-related adverse health effects, especially in sensitive populations (eg, children and pregnant individuals), but generally the recommendation for results within this range is to follow normal standard of care, ensuring the patient remains current on annual health screenings appropriate for their age
- >20.00 ng/mL, then there is increased risk of PFAS-related adverse health effects

Table 2. CDC-NHANES US Population PFAS Median Serum Concentrations (2017-2018, n=1,929)

PFAS	Median concentration, ng/mL[3]
MeFOSAA	0.10
PFHxS	1.10
Linear PFOA (n-PFOA)	1.30
Branched PFOA (Sb-PFOA)	0.07
PFDA	0.20
PFUnDA	0.10
Linear PFOS (n-PFOS)	3.00
Branched PFOS (Sm-PFOS)	1.20
PFNA	0.40
NASEM recommended summation	7.47

CDC, Centers for Disease Control and Prevention; MeFOSAA, N-methylperfluorooctane sulfonamidoacetic acid; NASEM, National Academies of Sciences, Engineering, and Medicine; NHANES, National Health and Nutrition Examination Survey; PFDA, perfluorodecanoic acid; PFHxS, perfluorooctane sulfonic acid; PFNA, perfluorononanoic acid; n-PFOA, perfluorooctanoic acid, linear; Sb-PFOA, branched-chain PFOA isomers; n-PFOS, perfluorooctane sulfonic acid, linear; Sm-PFOS, branched chain PFOS isomers; PFUnA, perfluoroundecanoic acid.

NASEM notes that "exposure biomonitoring results do not predict future health conditions and can only indicate the potential for increased risk for certain conditions associated with exposure."[1]

See **Table 1** for NASEM recommendations, which are not a substitute for medical judgment. Recommendations were based on data from the Agency for Toxic Substances and Disease Registry (ATSDR) and epidemiological studies that reported associations between PFAS and health conditions. The NASEM committee considered the strength of evidence for association vs causation but could not definitively conclude any of these health conditions were caused by PFAS alone. For the full analysis, see https://public.tableau.com/app/profile/nationalacademies/viz/NASEMPFASEvidenceMaps/PFASEvidenceMap

These statements have not been evaluated by the Food and Drug Administration. This diagnostic service is not intended to diagnose, treat, cure, or prevent any disease.

This testing is for medical treatment only. Analysis was performed as non-forensic testing, and these results should be used only by healthcare providers to render diagnosis or treatment or to monitor progress of medical conditions.

For healthcare providers who need interpretation assistance, please contact Quest at 1.877.40.RXTOX (1.877.407.9869) Monday through Friday, between 8 AM and 10 PM Eastern time.

References

1. National Academies of Sciences, Engineering, and Medicine. *Guidance on PFAS Exposure, Testing, and Clinical Follow-Up.* The National Academies Press; 2022. doi:10.17226/26156
2. Per- and polyfluoroalkyl substances (PFAS) and your health. What is ATSDR doing? Agency for Toxic Substances and Disease Registry. Updated November 1, 2022. Accessed October 10, 2023. https://www.atsdr.cdc.gov/pfas/activities/index.html
3. 2017-2018 Laboratory data - continuous NHANES. Centers for Disease Control and Prevention. Accessed October 11, 2023. https://wwwn.cdc.gov/nchs/nhanes/search/datapage.aspx?Component=Laboratory&CycleBeginYear=2017