

## RISK ASSESSMENT GUIDE

**3–8+ YEAR SERUM HALF-LIFE**  
PFOS: ~3.5–5 yrs | PFHxS: ~7–8 yrs

**4 ppt EPA MCL — PFOA & PFOS**  
Final rule 2024. Confirmed retained May 2025.

**45% U.S. TAP WATER CONTAMINATED**  
At least one PFAS type (USGS, 2023)

### OCCUPATIONAL EXPOSURE

Firefighters (Turnout gear & AFFF foam), Industrial manufacturing (Fluoropolymers), Aviation & Aerospace personnel.

### GEOGRAPHIC CORRELATION

Proximity to military installations (e.g., Willow Grove NAS), commercial airports, or land historically treated with biosolids (Lehigh Valley area).

### DIETARY & CONSUMER EXPOSURE

Non-stick cookware, stain-resistant textiles, microwave packaging, and food-contact materials. Contaminated well water is a primary direct exposure route.

### ABILITYFORGE MISSION:

Peer-reviewed resources to facilitate data-driven shared decision-making between patients and clinicians at the frontier of emerging evidence.

## REGULATORY & PUBLIC HEALTH

**Maternal Transfer:** PFAS readily crosses the placental barrier and accumulates in breast milk. Serum levels in gestating parents are predictive of neonatal chemical burden.

**EPA Standards (2024–2025):** Maximum Contaminant Levels for PFOA and PFOS set at **4.0 ppt**. These MCLs were reviewed and **confirmed retained in May 2025** — the most current regulatory anchor for clinical counseling on source reduction.

### DIAGNOSTIC AVAILABILITY:

Direct-to-consumer PFAS serum testing (Quest Diagnostics) allows patients to provide quantitative ng/mL data for clinical review using the NASEM 7-analyte summation panel.

**Veterans Note:** *The VA has recognized PFAS contamination at Willow Grove NAS and other military installations as a qualifying exposure basis for service-connected conditions including colorectal cancer — establishing legal precedent for causation.*

**Water Treatment Horizon:** NDSU/Iowa State (2026) confirmed ovalbumin binds PFOA and PFOS spontaneously at the atomic level via arginine/lysine docking sites — advancing bio-based remediation toward scalable clinical and municipal deployment. (*Cell Reports Physical Science*, 2026)



# PFAS EXPOSURE

## CLINICAL SUMMARY FOR PROVIDERS

MANAGING PER- AND POLYFLUOROALKYL SUBSTANCES  
IN HIGH-RISK PATIENT POPULATIONS

### NASEM ACTION TIERS (SUM OF 7 PFAS)

< 2 ng/mL — Standard of care

2–20 ng/mL — Enhanced screening

≥ 20 ng/mL — Expanded cancer surveillance

### THE BINDING CHAIN

Same hydrophobic protein-binding chemistry captures PFAS in water, in bile, and in blood. Remediation is possible at all three scales.

## CLINICAL PRESENTATION

PFAS mimics free fatty acids, binding to serum albumin with a half-life of 3–8+ years. This carrier-protein affinity is the basis of its persistence — and the key to its removal.

- **DYSLIPIDEMIA:** Treatment-resistant elevation of Total and LDL cholesterol.
- **HEPATIC STRAIN:** Elevated ALT; strong correlation with NAFLD/metabolic dysfunction.
- **ENDOCRINE:** Disruption of T4/TSH levels and impaired fertility markers.
- **ONCOLOGY:** Primary associations with renal and testicular carcinomas. Emerging peer-reviewed evidence for GI carcinogenesis and invasion — see Assessment panel.
- **INFLAMMATION:** Chronic prostatitis; elevated PSA (non-malignant origin); IBD-like intestinal injury in animal models.
- **OBSTETRIC:** Placental clots; preeclampsia; neonatal chemical burden via placental crossover and breast milk.
- **NEURO:** Chronic brain fog; impaired executive function; inflammation-linked fatigue.
- **DEVELOPMENTAL:** Milestone delays and regression in offspring. FDA-linked to parental serum burden.

## REMEDIATION: THE BINDING CHAIN

PFAS persistence is rooted in a single property: **affinity for protein hydrophobic binding sites** — particularly albumin's fatty acid domains. This same mechanism, exploited at three scales, is the basis of all viable PFAS remediation.

### THE THREE-SCALE CAPTURE MECHANISM

**WATER SOURCE** **Ovalbumin (egg white protein)** — arginine & lysine residues act as molecular binding hooks, wrapping around and trapping PFAS. Binds 7+ PFAS types including PFOA & PFOS with spontaneous, high affinity. Deployable as gels or sheets for municipal water treatment. More efficient than activated carbon. (Bezbaruah/Xia, NDSU/Iowa State, *Cell Reports Physical Science*, 2026)

**GUT LUMEN** **Bile Acid Sequestrants** (Cholestyramine) — anion exchange resin intercepts bile-bound PFAS in the intestinal lumen before portal reabsorption, interrupting the enterohepatic loop and accelerating elimination up to 5–10x. Indicated for symptomatic patients regardless of measured level vs. population averages.

**BLOOD SERUM** **Serum albumin** is the primary endogenous PFAS carrier — the same hydrophobic binding that creates persistence. Understanding this explains why the half-life is years, not days, and why sequestrant therapy must interrupt the recirculation loop before hepatic clearance is possible.

### ENTEROHEPATIC LOOP MECHANISM

PFAS excreted via bile into the small intestine is almost entirely reabsorbed into the portal vein — circumventing natural elimination. Cholestyramine breaks this cycle at the gut lumen level, the most accessible intervention point.

### CLINICAL TAKEAWAY

The same protein-binding chemistry operating at the water source, in the gut, and in the bloodstream means these are not three separate problems — they are one mechanism at three scales. Source reduction + sequestrant therapy represents the currently available two-point intervention strategy.

## PRACTITIONER ASSESSMENT

**1. Quantitative Panel:** NASEM 7-analyte serum panel (Quest Diagnostics): PFOA, PFOS, PFHxS, PFNA, PFDA, PFUnDA, MeFOSAA — reported as ng/mL sum.

**2. Baseline Labs:** CMP + Lipid Profile. Add TSH if  $\geq 20$  ng/mL. Urinalysis if  $\geq 20$  ng/mL and age  $> 45$ .

**3. Sequestrant Threshold:** Consider Cholestyramine when aggregate PFAS sum exceeds **7 ng/mL**, or when symptomatic burden aligns with known exposure history regardless of measured level.

### NASEM CLINICAL ACTION TIERS (2022)

<b>&lt; 2 ng/mL</b>	Standard of care. Adverse effects not expected.
<b>2–20 ng/mL</b>	Exposure reduction + lipid panel + BP monitoring in pregnancy + breast cancer screening per age/risk.
<b><math>\geq 20</math> ng/mL</b>	All above + TSH (age $> 18$ ) + urinalysis/renal cancer screen (age $> 45$ ) + testicular + ulcerative colitis (age $> 15$ ).

Sum: MeFOSAA, PFHxS, PFOA, PFDA, PFUnDA, PFOS, PFNA

### EVIDENCE FRONTIER — NOT YET IN EPA CLINICAL GUIDANCE

The following peer-reviewed findings are published but not yet reflected in current EPA/ATSDR clinical handouts. Clinicians are positioned ahead of the regulatory timeline.

#### TUMOR PROMOTION — PFOS

PFOS downregulates **HMGCS2** (ketogenic tumor suppressor) in intestinal tissue while upregulating  **$\beta$ -catenin**, **c-MYC**, **mTOR**, **FASN**, and cyclin D1. HMGCS2 loss correlates with lower 5-year CRC survival. (Tessmann et al., *Chemosphere*, 2024)

#### TUMOR INVASION — PFOA

PFOA activates **NF- $\kappa$ B** → **MMP-2/-9** upregulation in colorectal DLD-1 cells, dose-dependently enhancing invasiveness at non-cytotoxic concentrations  $\leq 1$   $\mu$ M. NF- $\kappa$ B inhibitor JSH-23 fully reverses the effect. (Miao et al., *Int J Clin Exp Pathol.*, 2015)

### EXPOSURE & COMORBIDITY NOTES

📍 Military/airport/biosolid proximity | 🏥 Renal, testicular, colorectal, thyroid Hx | 🤰 Preeclampsia, birth weight | 🧒 Pediatric milestone regression | 📄 PSA, ALT, lipid, TSH trajectories

### ⚠️ CURRENT LEVELS ARE LAGGING INDICATORS

A patient tested today reflects only the *residual* after years of slow elimination. Given 3–8+ year half-lives, peak burden may have been 4–10x higher. Back-calculate from exposure timeline. The damage precedes diagnosis.