

PFAS Health Effects and Risk Communication

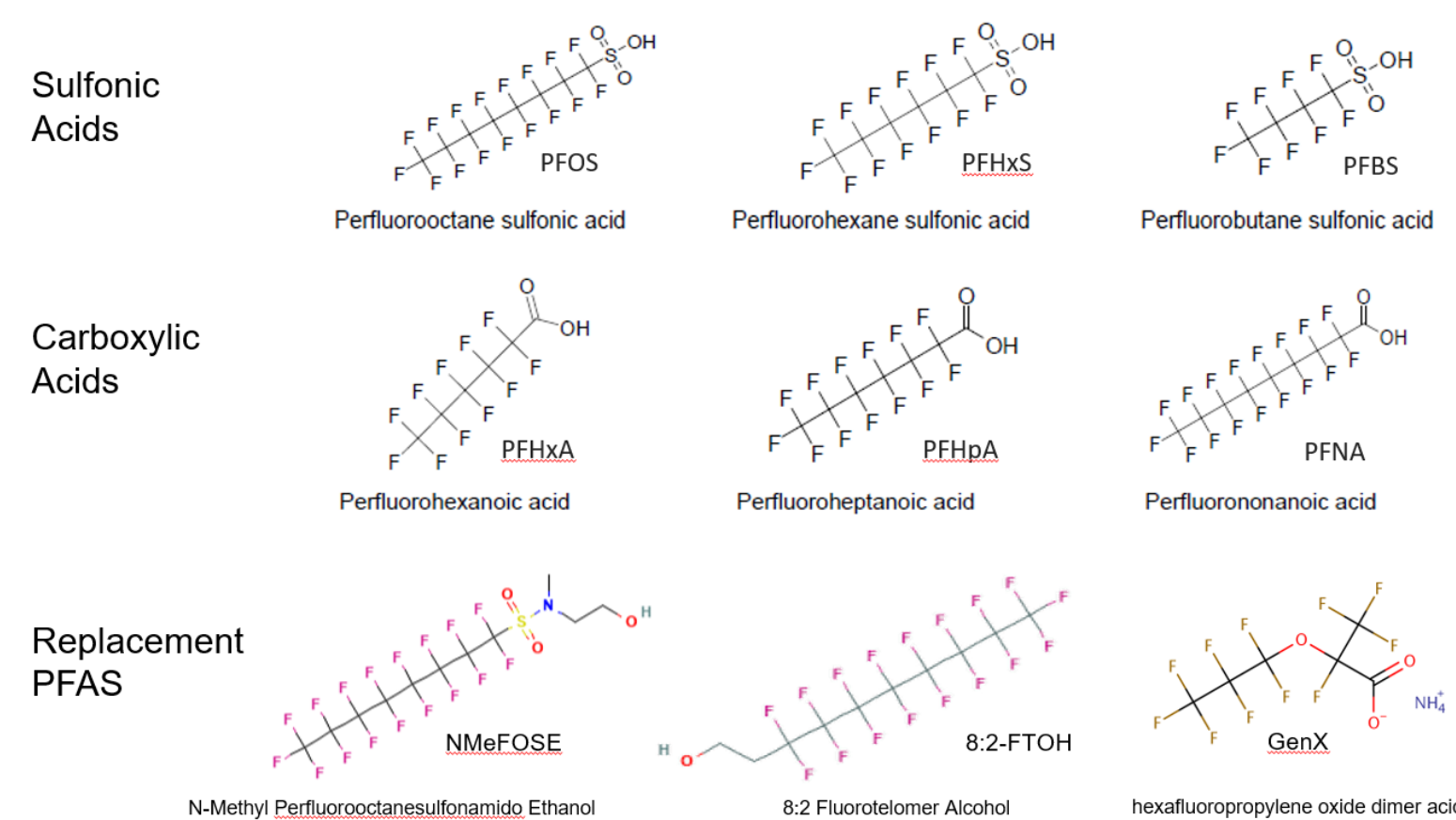
Stephen Zemba, PhD, and Sarah Pope, EIT, Sanborn, Head & Associates



Background

PFAS (per- and polyfluoroalkyl substances) are a group of thousands of chemicals. PFAS have been used in commerce for more than 60 years because of their unusual ability to repel both water and fats. Concerns over health effects have evolved over the past ~25 years. Information on PFAS toxicity continues to evolve as states and the U.S. EPA embark on establishing drinking water guidelines and standards at low and sub part-per-trillion levels.

Examples of Some PFAS



Lifetime Health Advisories (LHAs) and Maximum Contaminant Levels (MCLs)

PFAS	EPA LHAs			PA MCLs	EPA MCLs
	2009	2016	2022	2023	2023 (proposed)
PFOA	400	70	0.004	14	4
PFOS	200	70	0.02	18	4
GenX	-	-	10		10 *
PFBS	-	-	2000		2000 *
PFNA	-	-	-		10 *
PFHxS	-	-	-		9 *

Units: ppt = ng/L

♦ppt = parts per trillion
♦ng/L = nanograms per liter

* Health-Based Concentrations from Hazard Index formula

U.S. EPA's Proposed Hazard Index (HI) MCL

$$HI = \frac{GenX}{10 \text{ ppt}} + \frac{PFBS}{2000 \text{ ppt}} + \frac{PFNA}{10 \text{ ppt}} + \frac{PFHxS}{9 \text{ ppt}}$$

HI > 1 indicates potential concerns

U.S. EPA: What We Know About Health Effects

Current peer-reviewed scientific studies have shown that exposure to certain levels of PFAS may lead to:

- ♦ Reproductive effects such as decreased fertility or increased high blood pressure in pregnant women.
- ♦ Developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes.
- ♦ Increased risk of some cancers, including prostate, kidney, and testicular cancers.
- ♦ Reduced ability of the body's immune system to fight infections, including reduced vaccine response.
- ♦ Interference with the body's natural hormones.

PFAS Risk Communication

U.S. EPA's health effects summary fails to provide meaningful information on supporting evidence to help answer questions such as:

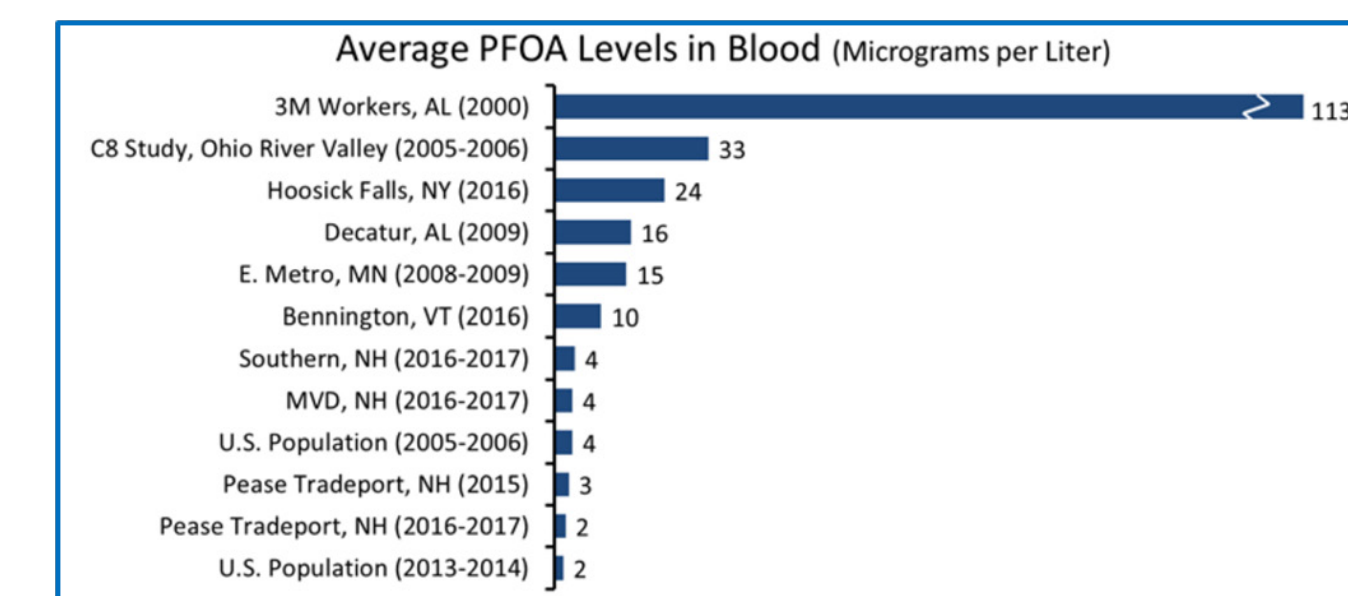
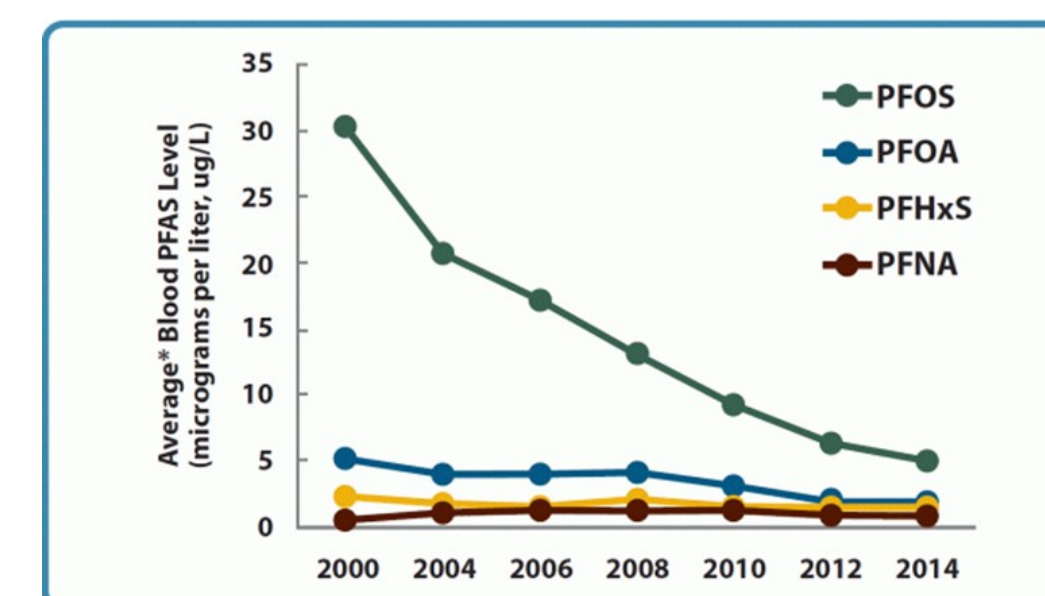
- ♦ Which PFAS have been studied, and which health effects have been observed, and at what levels of exposure?
- ♦ Have the effects been seen in animal laboratory studies or human epidemiologic studies?
- ♦ How many studies are available, and have multiple studies shown similar effects?
- ♦ How do PFAS behave in animals vs. people?

Reference (Safe) Doses (RfDs)

Animal studies have been used to estimate safe levels of exposure to PFAS. RfDs are expressed on an exposure per body weight basis and consider non-cancer effects. The RfD basis of the U.S. EPA's 70 ppt LHA comes from a study in which the pups of mice exposed to 1,000,000 ng/kg-d showed slower development of toes and hastened puberty (in males). A factor of 200 to account for interspecies differences in metabolism and a protective safety factor of 300 resulted in an RfD (safe dose) of 20 ng/kg-d. PA's MCLs are also based on RfDs from animal studies using different assumptions.

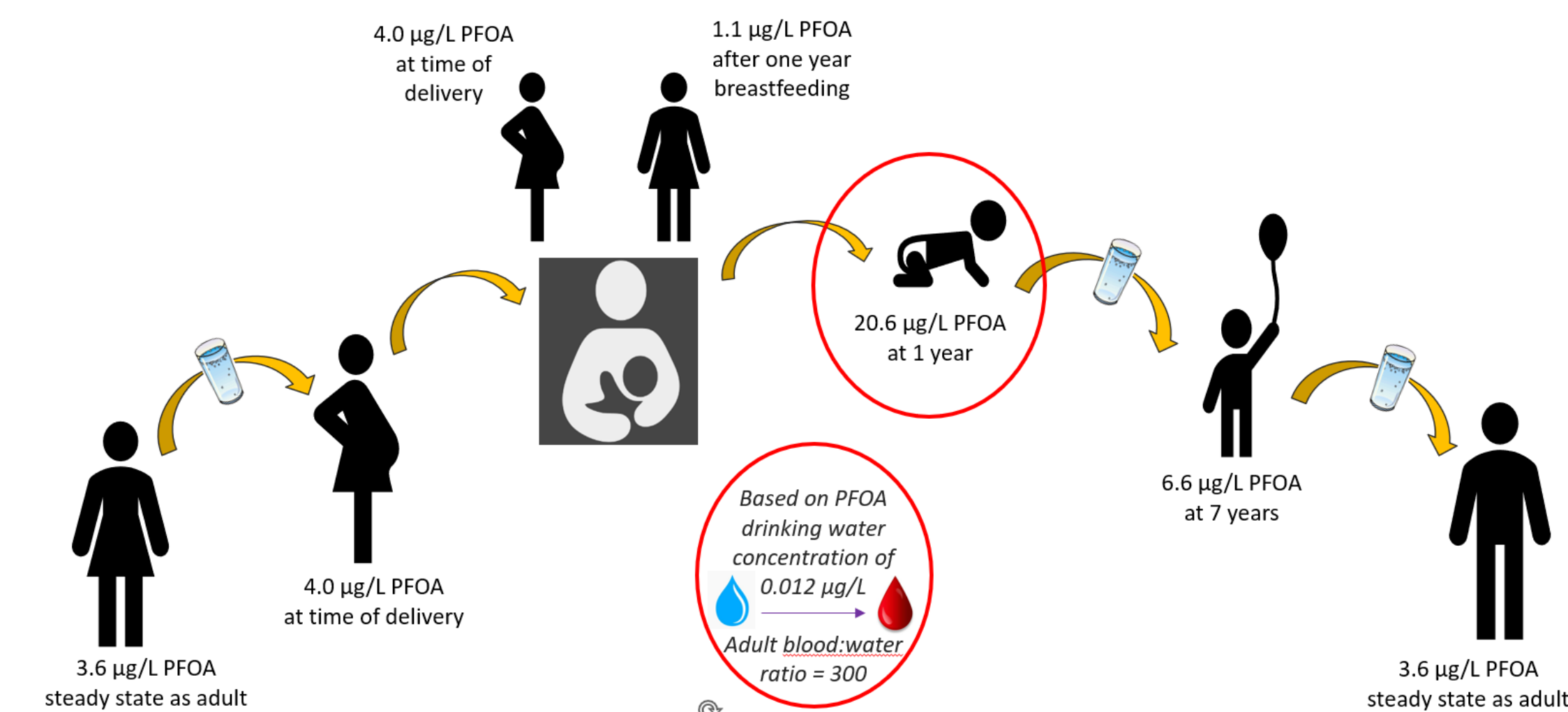
Human Exposure to PFAS

Some PFAS bioconcentrate in human blood. Levels of PFOA and PFOS in blood have decreased substantially from the 1990s. However, PFAS levels in blood are higher in areas where PFAS levels are elevated in drinking water.



Recent concerns on PFAS health effects have focused on potential impairment of the immune system. New Hampshire's development of drinking water standards serves as an example of limiting a mother's exposure to PFAS so that the level of PFAS in her child's blood remains below a target level.

NH Application of Multigenerational Model for PFOA



Immunotoxicity Basis of the U.S. EPA's Recent LHAs

The U.S. EPA's 2022 part-per-quadrillion LHAs for PFOA and PFOS are based on concerns over immune system impairment, specifically decreased antibody response to tetanus and diphtheria from an epidemiological study in humans. However, compared with NH's goal of limiting a child's blood concentration to ~20 µg/L (ppb, or parts per billion), U.S. EPA analysis finds the PFAS safe level in blood is ~0.2 ppb — a level that is likely below current levels in children's blood.

References (Scan or See Reverse)

Scan the code at the right for a reference list and obtain a copy of this poster. The authors can also be contacted at szemba@sanbornhead.com and spope@sanbornhead.com

