

# Knowns and Unknowns on Health and Environmental Justice for PFAS

MWRA Water Supply Citizens Advisory Committee and Wastewater Advisory Committee

**Phil Brown Ph.D.**

University Distinguished Professor of Sociology and Health Sciences

**PFAS Project Lab**

Social Science Environmental Health Research Institute, Northeastern University  
Whitman College



**Northeastern University**  
*Social Science Environmental Health  
Research Institute*

**PFAS PROJECT LAB**  
SOCIAL SCIENCE ENVIRONMENTAL HEALTH  
RESEARCH INSTITUTE  
Northeastern University



**WHITMAN COLLEGE**

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Co-Directors

- Phil Brown –Northeastern University
- Alissa Cordner – Whitman College

Collaborating Faculty and Scientists

- Rosie Mueller – Whitman College
- Jennifer Ohayon – Silent Spring Institute
- Lauren Richter – Rhode Island School of Design
- Loretta Fernandez – Northeastern University
- Laurel Schaidler – Silent Spring Institute
- Ruthann Rudel – Silent Spring Institute
- Julie Brody -- Silent Spring Institute
- Vincent Bessonneau – Silent Spring Institute
- Maia Fitzstevens – Silent Spring Institute
- Otak Conroy-Ben – Arizona State University
- Martha Powers– Environmental Protection Agency

Current Graduate Students

- Grace Poudrier – Northeastern
- Marina Atlas – Northeastern
- Miranda Dotson – Northeastern

Current Undergraduates

- Berty Lakjohn – Whitman College
- Ricky Salvatore – Northeastern
- Kira Mok – Northeastern
- Anna Allgeyer – Northeastern
- Lilyana Ibañez – Northeastern

Community and Organizational Collaborators

- Testing for Pease
- Massachusetts Breast Cancer Coalition
- Community Action Works
- Environmental Working Group
- Green Science Policy Institute
- Four collaborating tribes

## **OUTLINE OF THIS PRESENTATION**

- 1) Significant gaps in our knowledge of, and awareness efforts on, PFAS and its health effects**
- 2) The inequitable community impacts of PFAS along race and class lines**
- 3) Medical guidance documents and related research**
- 4) Ideas and recommendations for dealing with the problem**

# Funded since 2015 by the National Science Foundation and National Institute of Environmental Health Sciences

- Document social and scientific discovery of PFAS
- Website now a valuable resource with thousands of visitors
- Includes almost daily news updates
- [www.pfasproject.com](http://www.pfasproject.com)

**SSEHRI** Northeastern University  
Social Science Environmental Health Research Institute

**THE PFAS PROJECT LAB**  
Studying Social, Scientific, and Political Factors of Per- and Polyfluoroalkyl Substances

HOME ABOUT US PUBLICATIONS & PRESENTATIONS TIMELINES CONTAMINATION SITE TRA

  
**NEWS**  
Newsom Signs Laws Banning 'Forever Chemicals' In Children's Products, Food Packaging  
October 6, 2021 – 0 Comments

  
**NEWS**  
FAA Must End The Use of Polluting PFAS Firefighting Foam  
October 6, 2021 – 0 Comments

Bamboo or palm leaf	
Biowax-coated paper	
Polyactic acid-coated paper	
Paper coated with unknown alternatives	

  
**NEWS**  
PFAS Contamination: Of 21 Barnstable Ponds Tested, 21 Had Contaminants, Town Report Finds  
October 5, 2021 – 0 Comments

  
**NEWS**  
Gore-Tex Manufacturer Announces Availability of New PFAS-Free Membrane, But Still Uses 'Forever Chemicals' in Other Products  
October 5, 2021 – 0 Comments

**Northeastern Uni**  
Social Science Environmental Health Research Institute

**JOB OPPORTUNITY, SSEHRI**  
Northeastern University: Student Opportunity in Environmental Health  
October 4, 2021 – 0 Comments

We're fortunate to have a state government that has taken many environmental health issues so seriously, including DEP issuing some of the strongest Maximum Contaminant Levels (MCLs) for PFAS in the US, and also Interagency Task Force



## Massachusetts Drinking Water Standard and Health Information

### PFAS Standard for Public Drinking Water Supplies

On October 2, 2020, MassDEP published its PFAS public drinking water standard, called a Massachusetts Maximum Contamination Level (MMCL), of 20 nanograms per liter (ng/L) (or per trillion (ppt)) – individually or for the sum of the concentrations of six specific PFAS. These PFAS are perfluorooctane sulfonic acid (PFOS); perfluorooctanoic acid (PFOA); perfluorohexane sulfonic acid (PFHxS); perfluorononanoic acid (PFNA); perfluoroheptanoic acid (PFHpA); and perfluorodecanoic acid (PFDA). MassDEP abbreviates this set of six PFAS as “PFAS6.” This drinking water standard is set to be protective against adverse health effects for all people consuming the water.

## **But it's not only regulatory agencies that take on the issue...**

- Water suppliers have been central ever since the original DuPont case in Parkersburg, WV
- Municipal governments here in MA has been early leaders in tackling the problem: Hyannis, Ayer, Easton (you can hear their testimony from MA Task Force)

**So, YOU have a role to play**



# 1. Gaps in knowledge and action

# Decades of Industry Research and Secrecy

- 1961 – DuPont finds evidence of liver toxicity in animals
- 1962 – DuPont finds evidence of toxicity in humans
- 1976 – 3M finds PFOA in workers' blood
- 1981 – 3M finds PFOA causes rare birth defects in rats
- 1981 – DuPont workers give birth to infants with similar rare birth defects; DuPont removes all women workers from Teflon unit but doesn't say why and doesn't share this data with EPA
- 1984 – DuPont finds PFOA in community drinking water, doesn't disclose results
- 1987 – 3M looks for uncontaminated blood samples to compare to their workers and finds widespread global contamination

For more details: DuPont and 3M documents in EWG's Chemical Industry Archives; Toxic Docs (Columbia SPH); Callie Lyons *Stain Resistant, Non-stick, Waterproof and Lethal: The Hidden Dangers of C8* (2007)

# Barriers to information

- Confidential business information
- Quick turnaround at EPA of new-use applications
- Reporting under TRI only just started and only 38 facilities reported to date
- Many small facilities are exempt from TRI
- Industry denial and falsehoods, e.g. American Chemistry Council
- Industry suing states over regulations (e.g. 3M in New Hampshire)
- We don't know all the sources

# PFAS sources in the environment: Continued expansion

## ***Traditional sources***

- Production facilities
- Other industries that incorporate PFAS
- *Later on:* AFFF firefighting foams for fuel fires

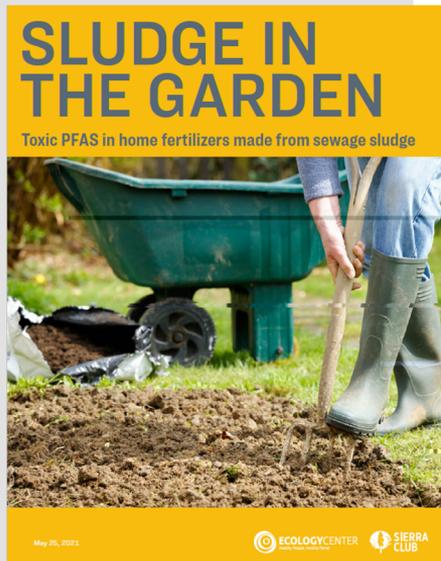
## ***More recent sources***

- Landfills
- Wastewater treatment plants and sludge
- Food grown with sludge
- Food packaging
- Septic systems



# Expansion of likely sources

- Chrome-plating and other metal-plating shops
- Refineries
- Oil rigs
- Bulk fuel storage
- Munitions facilities
- Artificial turf
- Pesticides
- Plastics
- Dry cleaners



## Initial test results reveal 'forever chemicals' showing up in sludge

[pressherald.com/2019/05/22/initial-test-results-show-forever-chemicals-showing-up-in-sludge/](https://pressherald.com/2019/05/22/initial-test-results-show-forever-chemicals-showing-up-in-sludge/)

By Kevin Miller Staff  
Writer

May 23,  
2019



### SCIENTIFIC OPINION



ADOPTED: 22 March 2018

doi: 10.2903/j.efsa.2018.5194

### Risk to human health related to the presence of perfluorooctane sulfonic acid and perfluorooctanoic acid in food

EFSA Panel on Contaminants in the Food Chain (CONTAM).  
Helle Katrine Knutsen, Jan Alexander, Lars Barregård, Margherita Bignami, Beat Bruschweiler, Sandra Ceccatelli, Bruce Cottrill, Michael Dinovi, Lutz Edler, Bettina Grasl-Kraupp, Christer Hogstrand, Laurentius (Ron) Hoogenboom, Carlo Stefano Nebbia, Isabelle P Oswald, Annette Petersen, Martin Rose, Alain-Claude Roudot, Christiane Vleminckx, Günter Vollmer, Heather Wallace, Laurent Bodin, Jean-Pierre Cravedi, Thorhallur Ingi Halldorsson, Line Småstuen Haug, Niklas Johansson, Henk van Loveren, Petra Gergelova, Karen Mackay, Sara Levorato, Mathijs van Manen and Tanja Schwerdtle

#### Abstract

The European Commission asked EFSA for a scientific evaluation on the risks to human health related to the presence of perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) in food. Regarding PFOS and PFOA occurrence, the final data set available for dietary exposure assessment contained a total of 20,019 analytical results (PFOS  $n = 10,191$  and PFOA  $n = 9,828$ ). There were large differences between upper and lower bound exposure due to analytical methods with insufficient sensitivity. The CONTAM Panel considered the lower bound estimates to be closer to true exposure levels. Important contributors to the lower bound mean chronic exposure were 'Fish and other seafood', 'Meat and meat products' and 'Eggs and egg products', for PFOS, and 'Milk and dairy products', 'Drinking water' and 'Fish and other seafood' for PFOA. PFOS and PFOA are readily absorbed in the gastrointestinal tract, excreted in urine and faeces, and do not undergo metabolism. Estimated human half-lives for PFOS and PFOA are about 5 years and 2-4 years, respectively. The derivation of a health-based guidance value was based on human epidemiological studies. For PFOS, the increase in serum total cholesterol in adults, and the decrease in antibody response at vaccination in children were identified as the critical effects. For PFOA, the increase in serum total cholesterol was the critical effect. Also reduced birth weight (for both compounds) and increased prevalence of high serum levels of the liver enzyme alanine aminotransferase (ALT) (for PFOA) were considered. After benchmark modelling of serum levels of PFOS and PFOA, and estimating the corresponding daily intakes, the CONTAM Panel established a tolerable weekly intake (TWI) of 13 ng/kg body weight (bw) per week for PFOS and 6 ng/kg bw per week for PFOA. For both compounds, exposure of a considerable proportion

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# Documented Health Effects: C8 Health Panel 2005-2013

- Thyroid disease
- Kidney cancer
- High cholesterol
- Ulcerative colitis
- Pregnancy-induced hypertension
- Testicular cancer

# Documented Health Effects: Other Studies

## —International Agency for Research on Cancer (IARC)

—PFOA possibly carcinogenic in humans

## —Other research

—Hormonal changes

—Liver malfunction

—Obesity

—Immunotoxicity, incl. interference with child vaccine response

—Lower birth weight and size

—Delayed puberty, decreased fertility, early menopause

—Reduced testosterone

—Prostate cancer

—Ovarian cancer



# A class-based approach to PFAS is needed

When looking at long-chain compared to alternatives/next generation, replacement is not the answer

- Concerns about toxicity, bioaccumulation, and persistence led industry to phase-out production of long-chain PFAS by 2015 (EPA PFOA Stewardship Program)
- Replacement compounds: Short-chain PFASs
  - PFHxA, PFBS, NextGen, short-chain fluorotelomer, 6:2 FTOH, etc.
  - Likely less bioaccumulative...
  - ... But significant exposure and toxicity concerns, mobility in environment, persistence, and significant data gaps



pubs.acs.org/journal/estlcu

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Global Perspective

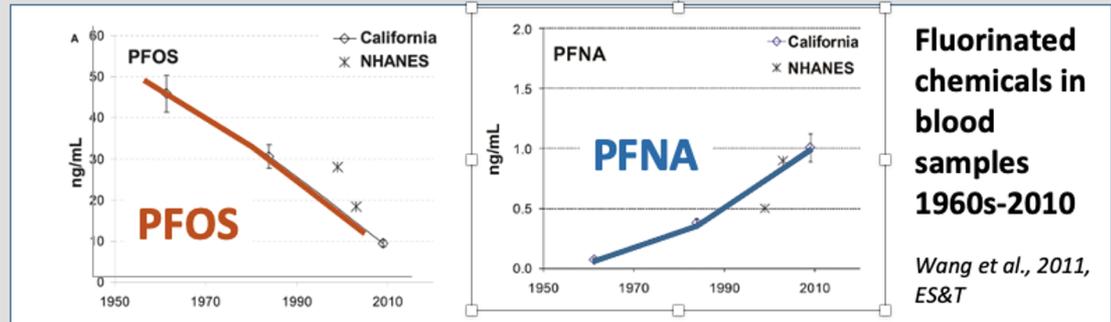
## Scientific Basis for Managing PFAS as a Chemical Class

Carol F. Kwiatkowski,\* David Q. Andrews, Linda S. Birnbaum, Thomas A. Bruton, Jamie C. DeWitt, Detlef R. U. Knappe, Maricel V. Maffini, Mark F. Miller, Katherine E. Pelch, Anna Reade, Anna Soehl, Xenia Trier, Marta Venier, Charlotte C. Wagner, Zhanyun Wang, and Arlene Blum

# ...because whack-a-mole approach to chemical policy doesn't work



## Regrettable Substitution



Gen-X crisis in North Carolina is a clear example

## 2. Inequitable impacts

# What is environmental justice?

**Environmental justice:** “the right of all people to share equally in the benefits bestowed by a healthy environment”

The **environment:** “the places in which we live, work, play, and worship”

(Adams, Evans, and Stein 2002)

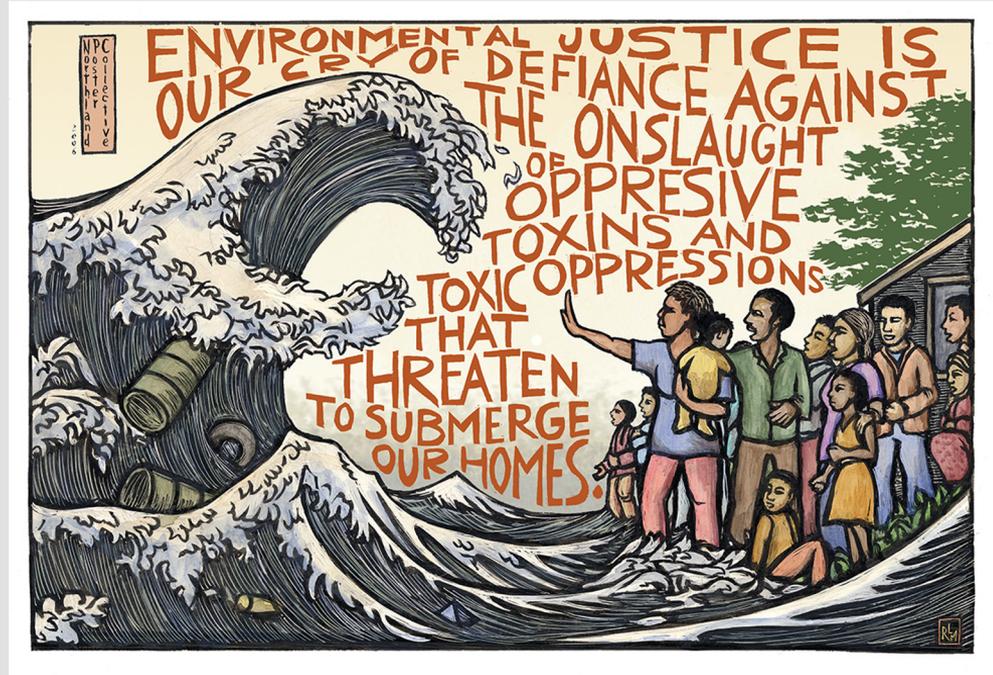


Image: Ricardo Lemins Morales, 2006

# Toxic chemicals and unequal exposure

**Decades of research documents uneven distribution of environmental hazards for Black, Indigenous, and People of Color and low-income communities**

- More likely to live near hazardous and industrial facilities
- Higher levels of exposure to air and water pollutants
- Higher rates of illnesses associated with environmental pollution
- Higher levels of toxic chemicals from some consumer and household products
- Slower clean-up and less protective clean-up standards
- Less meaningful participation in environmental decision-making

**EJ attention to *cumulative* exposure, including chemical and non-chemical stressors**

# PFAS exposure and Inequality?

## *Potentially few inequities?*

- PFAS exposure is ubiquitous
- Many exposure pathways, not just from industry
- For some other chemicals, body burden is higher in high-SES populations

## *Potentially significant inequities?*

- PFAS contamination at military bases (more BIPOC and low-income)
- Industrial sources of exposure sources, including newly identified ones (linked to residential discrimination)
- Low-income and BIPOC communities more likely to receive drinking water in violation of federal standards

# Existing research on PFAS and exposure distribution

- African American women had lower levels of two PFAS in blood compared to non-Hispanic White women
- Positive associations between income and education levels with PFAS
- Non-Hispanic Black Americans and Asian Americans have highest exposure to certain PFAS

Journal of Exposure Science & Environmental Epidemiology (2019) 29:206–217  
<https://doi.org/10.1038/s41370-018-0109-y>

ARTICLE

Check for updates

**Serum concentrations of PFASs and exposure-related behaviors in African American and non-Hispanic white women**

Katherine E. Boronow<sup>1</sup> · Julia Green Brody<sup>1</sup> · Laurel A. Schaidler<sup>1</sup> · Graham F. Peaslee<sup>2</sup> · Laurie Havas<sup>3</sup> · Barbara A. Cohn<sup>4</sup>

International Journal of  
*Environmental Research  
and Public Health*

MDPI

Article

**Socio-Economic Status and Health: Evaluation of Human Biomonitoring Chemical Exposure to Per- and Polyfluorinated Substances across Status**

Jurgen Buekers<sup>1,\*</sup>, Ann Colles<sup>1</sup>, Christa Cornelis<sup>1</sup>, Bert Morrens<sup>2</sup>, Eva Govarts<sup>1</sup> and Greet Schoeters<sup>1</sup>

CDC Centers for Disease Control and Prevention  
CDC 24/7: Saving Lives. Protecting People™

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Early Release: Per- and Polyfluorinated Substances (PFAS) Tables, NHANES 2011–2018



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# Dirty Water: Toxic “Forever” PFAS Chemicals Are Prevalent in the Drinking Water of Environmental Justice Communities

Map

by Avinash Kar & Anna Reade & Susan Lee

August 18, 2021

# This week's news:

Newsom Signs Laws Banning 'Forever Chemicals' In Children's Products, Food Packaging



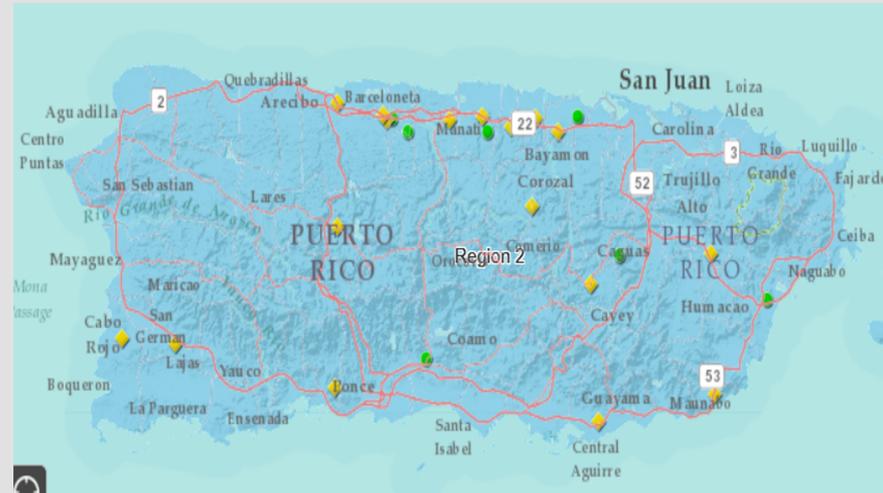
After John Oliver episode, 1,252 visits to our website the next day

# Ongoing work in our lab...

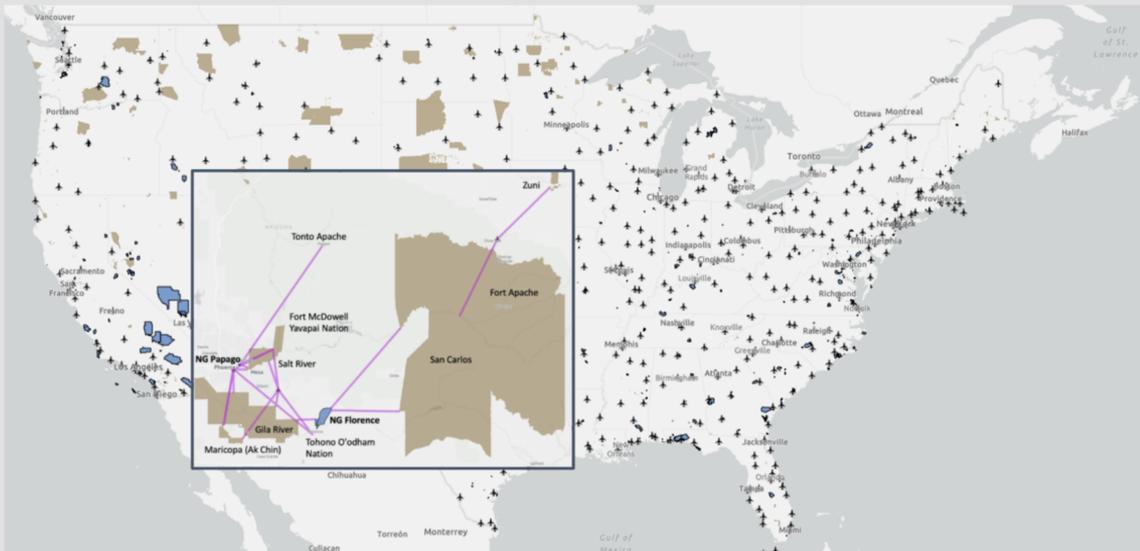
- Community activism (dozens of groups around the US)
- Governance (local, state, and federal gov.; non-regulatory groups; business)
- Environmental justice and PFAS contamination
- PFAS risk communication by state governments
- Economic costs of PFAS (with collaborators at EPA, NIEHS, NYU, and Commonwealth)
- PFAS contamination on indigenous lands (with four collaborating tribes)
- PFAS and medical monitoring

# Also planned: Testing for PFAS in groundwater in Puerto Rico as part of Northeastern's Superfund Research Program

- Puerto Rico is very under-studied in terms of environmental health, and is totally an environmental justice island
- Funding received last week

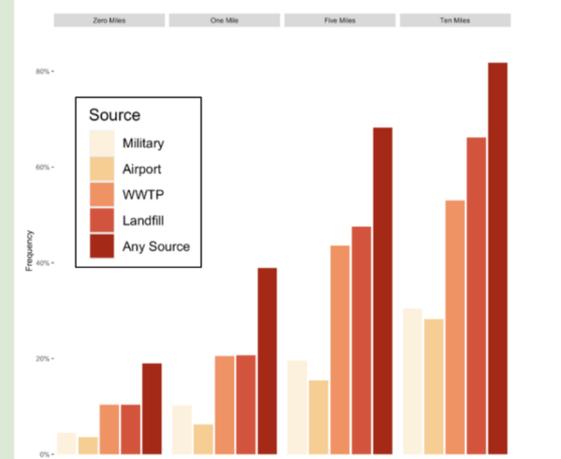


# PFAS in American Indian and Alaska Native Communities



- 19% of Tribes border or contain within their boundary at least one PFAS source
  - 10% of all Tribes are adjacent to 2+ sources
- 80% of all Tribes are within 10 miles of at least one source
  - 70% of all Tribes are within miles of 2+ sources

Figure 1. Percentage of tribes (n= 532) and distance to known PFAS contamination source



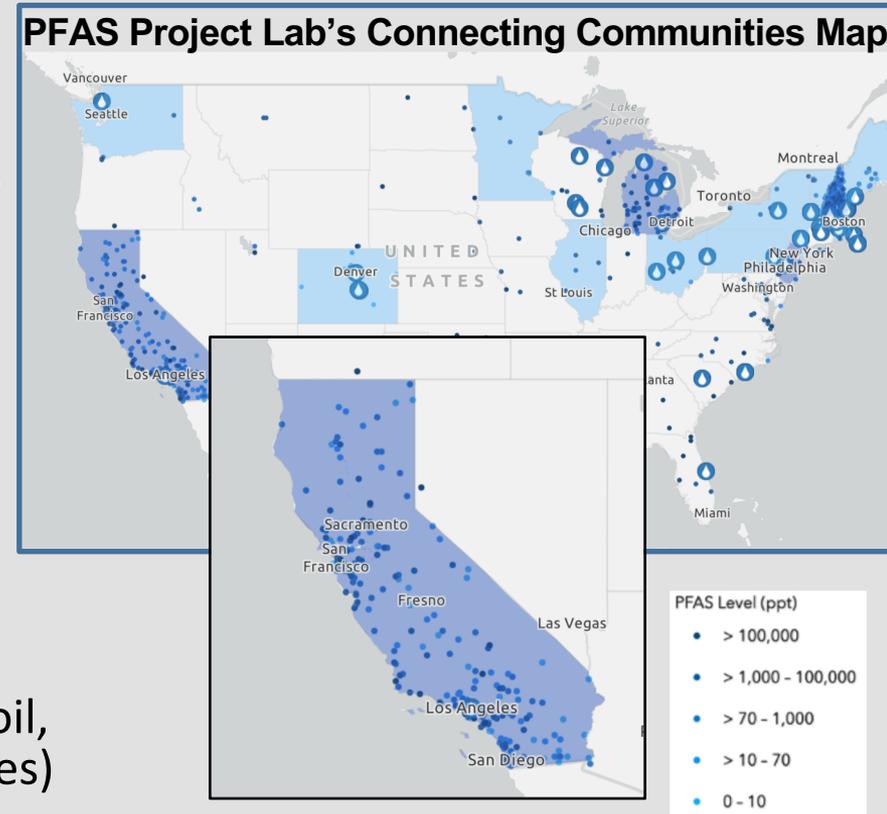
# Existing knowledge about PFAS might underestimate inequalities

## Uneven testing may reflect:

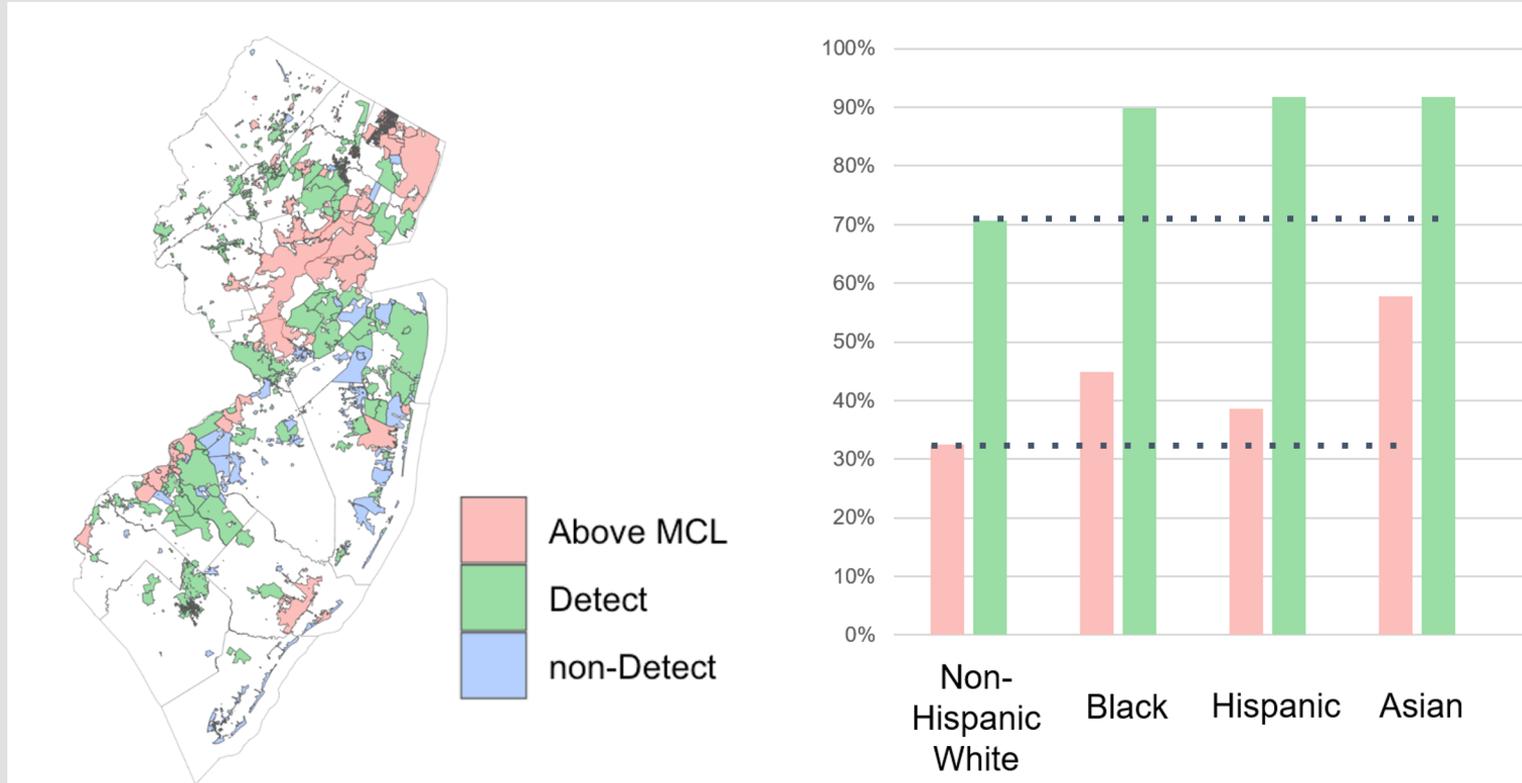
- Communities with more social capital
- States with more resources and technical capacity
- Large water systems (federal UCMR testing)
- Prior testing locations

## Testing has largely overlooked:

- Small water systems
- Private wells
- Non-drinking water contamination (soil, wastewater, landfills, industrial sources)



# Our research: NJ public drinking water systems and community demographics



### **3) Medical guidance documents and related research**

# PFAS Medical Monitoring: Our goal and process

- One year in the making
- Goal: provide community members and clinicians information about the types of tests that would be appropriate to consider for people who've had high PFAS exposures, not necessarily to say that everyone who thinks they've been exposed to PFAS should get all of these tests
- Guidance was inspired by the C8 Medical Monitoring Program and relied heavily on comprehensive documents from federal and international agencies as well as individual peer-reviewed studies
- Input from community partners in PFAS-REACH
- Learning from affected communities around the US and abroad
- Discussions with physicians and scientists on our Science Advisory Board
- Analysis of weaknesses in existing ATSDR medical guidance
- Iterative feedback
- Input from health communication professionals
- Posted to website on July 21, 2021
- Blood testing document in progress - we're working with National PFAS Contamination Coalition members for feedback and their knowledge on the issue

Guidance Documents available at <https://pfas-exchange.org/>

# Medical Guidance Documents – Our Team

- Andrea Amico – Testing for Pease
- Phil Brown – Northeastern Univ.
- Alissa Cordner – Whitman College
- Courtney Carignan – Michigan State Univ.
- Jamie DeWitt – East Carolina University
- Alan Ducatman – West Virginia University (retired)
- Edward Emmett – University of Pennsylvania
- Maia Fitzstevens – Silent Spring Institute
- Tony Fletcher – London School of Hygiene & Tropical Medicine
- Elizabeth Friedman – Children’s Mercy Hospital, Kansas City
- Alex Goho– Silent Spring Institute
- Philipp Grandjean- Harvard University
- Shaina Kasper – Community Action Works
- Cheryl Osimo – Massachusetts Breast Cancer Coalition
- Martha Powers – EPA
- Laurel Schaider– Silent Spring Institute

### Purpose

This guidance document is intended for people living in communities with contaminated water or who have had some other source of substantial exposure to PFAS. This guidance document is not targeted to those at average risk from PFAS.

### What is medical screening?

Medical screening is the testing for early signs of disease. Screening for certain conditions or subclinical changes may be advised for those who have or have had known elevated exposure to PFAS. Medical screening may identify early indicators of disease and allow you to work with your clinician to determine next steps.

### What are PFAS?

Per- and polyfluoroalkyl substances (PFAS) are a large group of over 9,000 human-made chemicals, exposure to which has been associated with several serious health effects. They are extremely resistant to breakdown, highly mobile in the environment, and have contaminated hundreds of drinking water supplies. PFAS have been found in the blood of over 99% of Americans and some PFAS can remain in the body for years.

### How can I be exposed to PFAS?

#### At home

- ✓ Drinking contaminated water
- ✓ Eating food contaminated from environmental sources or from processing and packaging
- ✓ Using stain- and water-resistant products, grease-proof food packaging, nonstick cookware, and many other consumer products

#### At work

Some people, such as firefighters and those in chemical production and application industries, may be exposed to products containing PFAS at work.

#### Early in life

PFAS can cross the placenta and accumulate in breast milk, so children can be exposed in the womb and during early life through breastfeeding.



### How are PFAS regulated in drinking water?

- ✓ PFAS are not regulated under the U.S. Environmental Protection Agency's Safe Drinking Water Act. This means there are no federally enforceable standards and public water suppliers are not required to routinely test or treat for PFAS under federal law.
- ✓ In 2016, the U.S. Environmental Protection Agency established a non-enforceable Lifetime Health Advisory of 70 parts per trillion (ppt) for PFOA and PFOS (two of the most common PFAS chemicals) individually or combined, for municipal drinking water. Some scientists and regulators think this advisory is not sufficiently protective of human health.
- ✓ As of April 2021, 12 states have adopted more stringent, and in some cases enforceable, drinking water guidelines. The [PFAS Exchange](#) provides more information about national and state drinking water guidelines. Some states have established guidelines for additional PFAS chemicals, down to 10-20 ppt.
- ✓ The Northeastern University [Contamination Site Tracker](#) has documented hundreds of contaminated sites in the U.S., with more sites being added as testing continues.

### What are the health effects of PFAS?

Many studies have evaluated harmful health effects of PFOA, PFOS, and a handful of other PFAS chemicals. Several national and international health agencies have reviewed the results of peer-reviewed epidemiological (human populations) and toxicological (laboratory animals) research and written scientific assessments based on these studies, including:

- Agency for Toxic Substances and Disease Registry (2021)
- Centers for Disease Control and Prevention (2019)
- CB Science and Medical Panels (2005-2013)
- European Environment Agency (2019)
- International Agency for Research on Cancer (2017)
- National Toxicology Program (2016)

#### A note about these studies

Current strength of evidence ranges from very strong and near certain for lipid, liver, and immune outcomes, to "more likely than not" for others.

At least one of these assessments concluded that PFAS exposure is associated with:

- Increase in total cholesterol and LDL cholesterol
- Decreased antibody response to vaccines
- Longer time to pregnancy
- Kidney and testicular cancer
- Thyroid disease
- Liver damage
- Increased risk of pregnancy-induced hypertension and/or pre-eclampsia
- Chronic kidney disease, elevated uric acid, hyperuricemia, and gout
- Immune system disruption
- Inverse developmental outcomes, including small decrease in adult birth weight and altered mammary gland development

#### What about COVID-19?

It is currently unknown whether PFAS has any effect on the COVID-19 vaccination. There is no evidence that anyone should not be vaccinated against COVID-19 on the basis of prior PFAS exposure. All groups are strongly advised to follow updated advice from the Centers for Disease Control and Prevention on the COVID-19 vaccination, which is based on the latest research findings.

As the scientific community continues to study the health impacts of PFAS, preliminary and/or suggestive epidemiologic and animal evidence is regularly emerging. Some studies have found associations with:

- Non-alcoholic fatty liver disease
- Autoimmune disease, such as ulcerative colitis and Type 1 diabetes
- Shortened duration of lactation in mothers
- Decreased male fertility

### How can I reduce the amount of PFAS in my body?

For people with known elevated PFAS levels in their body, the most important way to reduce the amount of PFAS in the body is to avoid new exposures. Some PFAS chemicals, like PFOS and PFOA, can remain in the body for years. Currently, there are **no medically approved treatments** to speed up removal of PFAS from the body.

- ✗ Agents or processes known to remove PFAS from the body, such as cholestyramine, phlebotomy, hemodialysis, or apheresis, are not medically approved treatments for PFAS specifically.
- ✗ Chelation and "alternative" medicine programs, such as detoxes and cleanses, are not known to remove PFAS from the body. Many of these can also pose their own health risks.

### How can I avoid PFAS exposure?

PFAS exposures are widespread, so it is difficult to avoid PFAS entirely. However, you can take steps to reduce your personal exposure going forward:

- If you know or suspect PFAS to be in your drinking water, you can use a filter to lower the levels. Visit the PFAS Exchange's [drinking water fact sheet](#) to learn more about where to find a lab to test your water for PFAS, and resources to find filters for removing PFOA and PFOS in your drinking water.
- Avoid stain-resistant carpets, treatments, and waterproofing sprays. Green Science Policy Institute's [PFAS Central](#) maintains a current list of PFAS-free products.
- Avoid take-out containers and other food packaging that may contain PFAS by eating more fresh foods and home-cooked meals.

### About this guidance document

The guidance summarized here is to help inform discussion and decision making for physicians and their patients. Many of the tests and screenings noted are part of basic primary care annual appointments. In 2019, the American Medical Association (AMA) resolved to support research and policy to address the effects of PFAS exposure.

We based the following suggestions for medical screening tests on those previously developed and implemented for a PFAS-impacted community as well as peer-reviewed research and scientific assessments using weight of evidence approaches from:

- ✓ Agency for Toxic Substances and Disease Registry (2021)
- ✓ Centers for Disease Control and Prevention (2019)
- ✓ CB Science and Medical Panels (2005-2013)
- ✓ European Environment Agency (2019)
- ✓ International Agency for Research on Cancer (2017)
- ✓ National Toxicology Program (2016)

These recommendations are for those living in communities with contaminated water or who are exposed to other sources of PFAS that substantially increases their internal burden of PFAS. These recommendations are not targeted to those with average levels of PFAS exposure.

### Guidance for adult patients

#### Laboratory tests

- ✓ **Lipid panel (cholesterol, LDL, HDL, triglycerides)**, PFAS exposure has been associated with higher total and LDL cholesterol and fatty liver.
- ✓ **Liver function tests**, such as ALT, AST, and GGT. PFAS exposure has been associated with higher-than-normal liver function tests, as well as hepatotoxicity, including hepatocyte and liver architecture damage.
- ✓ **Serum creatinine and urine protein and urine albumin**, PFAS exposure is associated with chronic kidney disease and kidney cancer. An important note for researchers is that there is enhanced excretion of PFAS in moderate-to-severe kidney disease, especially if there is albuminuria. Reduced serum PFAS concentrations for those individuals introduces a bias towards the null if not controlled for in epidemiologic studies.
- ✓ **Thyroid tests**, such as TSH with or without FT4. PFAS exposure has been associated with thyroid disease.

#### Clinical examinations

- ✓ **Regular testicular examinations** Exposure to high levels of PFAS has been associated with increased risk of testicular cancer.

#### Counseling topics

- ✓ **Vaccine response**, PFAS exposure has been associated with decreased antibody response to vaccines. There is currently no consensus on re-vaccinating patients with low vaccine titer when tested a month following vaccination (i.e., Tdap, MMR); more research is needed.
- ✓ **Home blood pressure monitoring during pregnancy**, PFAS are associated with elevated blood pressure during pregnancy and with preeclampsia.
- ✓ **Breastfeeding**, Babies can be exposed to PFAS during pregnancy since PFAS can cross the placenta. PFAS chemicals also accumulate in breast milk. However, the benefits of breastfeeding are dear, and include benefits to maternal as well as child health. There is insufficient evidence to recommend against breastfeeding based on maternal PFAS exposure.

### Guidance for pediatric patients

#### Laboratory tests

- ✓ **Lipid panel (cholesterol, LDL, HDL, triglycerides)**, PFAS exposure has been associated with higher total and LDL cholesterol and fatty liver.
- ✓ **Liver function tests**, such as ALT, AST, and GGT. PFAS exposure has been associated with higher-than-normal liver function tests, as well as other evidence of hepatotoxicity, including hepatocyte and liver architecture damage.
- ✓ **Thyroid test**, such as TSH with or without FT4. PFAS exposure has been associated with thyroid disease.

#### Clinical examinations

- ✓ **Regular testicular examinations** Children have a longer duration of exposure and therefore may have greater risk for the presumed long-term effects of PFAS exposure, such as testicular cancer.

#### Counseling topics

- ✓ **Vaccine response**, PFAS exposure has been associated with decreased antibody response to vaccines. There is currently no consensus on re-vaccinating pediatric patients with low vaccine titer when tested a month following vaccination (i.e., DTaP, MMR); more research is needed.
- ✓ **Endocrine disruption**, PFAS have been associated with lower levels of sex hormones in young children.

### References

**Agency for Toxic Substances and Disease Registry (ATSDR)**. Toxicological Profile for Perfluoroalkyls. U.S. Department of Health and Human Services. 2021. <https://www.atsdr.cdc.gov/ToxProfiles/tp200.pdf>.

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**CB Medical Panel**. Information on the C-8 (PFOA) Medical Monitoring Program Screening Tests Prepared by the Medical Panel for the C-8 Class Members. 2013. [http://www.c-8medicalmonitoringprogram.com/docs/med\\_panel\\_education\\_doc.pdf](http://www.c-8medicalmonitoringprogram.com/docs/med_panel_education_doc.pdf).

**Centers for Disease Control and Prevention (CDC)**. CDC Public Health Grand Rounds PFAS and Protecting Your Health. 2019. <https://www.cdc.gov/grand-rounds/pp/2019/20191119-pfas-health.html>.

**European Environment Agency**. Emerging chemical risks in Europe – PFAS’. 2019. <http://dx.doi.org/10.2809/486213>.

**International Agency for Research on Cancer (IARC)**. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Some Chemicals Used as Solvents and in Polymer Manufacture. Lyon (FR): International Agency for Research on Cancer; 2017. PMID: [31829531](https://pubmed.ncbi.nlm.nih.gov/31829531/).

**National Toxicology Program (NTP)**. 2016. Systematic Review of Immunotoxicity Associated with Exposure to Perfluoroacetic Acid (PFOA) or Perfluorooctane sulfonate (PFOS). Office of Health Assessment and Translation, Division of the National Toxicology Program, National Institute of Environmental Health Sciences Research Triangle Park, NC. [https://ntp.niehs.nih.gov/rtp/ohat/prog/pfas/pfas\\_toxicomograph\\_508.pdf](https://ntp.niehs.nih.gov/rtp/ohat/prog/pfas/pfas_toxicomograph_508.pdf).

### Acknowledging stress & addressing uncertainty

Uncertainty about long-term health effects can cause stress among patients who have been exposed to PFAS contamination.

Previous studies have shown that providing results of chemical exposure tests, along with contextual information and steps for action, can make people feel empowered.<sup>1</sup>

ATSDR has developed resources for medical professionals to address concerns of residents in communities impacted by contamination: [www.atsdr.cdc.gov/stress/resources/clinicians-tip-sheet.html](https://www.atsdr.cdc.gov/stress/resources/clinicians-tip-sheet.html)

<sup>1</sup>JG Brody et al. (2006). <https://doi.org/10.2105/AJPH.2006.094813>

### Contributors

#### PFAS-REACH partners



#### Medical partner organization



Thank you to the researchers, medical professionals, and community members who reviewed this document.

# *In progress:* PFAS Blood Testing

## **Purpose of this document**

If an individual has learned that they have been exposed to high levels of PFAS, they often seek out a PFAS blood test to learn more about their own exposures. This document is intended to provide information about what PFAS blood testing can and can't provide.

## **What can I learn from a PFAS blood test?**

A blood test measures how much of certain PFAS are in a person's blood at the time of the test. This can provide an indication of how much PFAS has entered their body over time (years) and allow comparisons to determine whether levels are elevated. Personal blood test results can also help an individual make more informed decisions with their doctor about reducing their exposures and monitoring their health [Learn more from our resource [PFAS Exposure: Information for patients and guidance for clinicians to inform patient and clinician decision making](#)].

Residents of communities with known PFAS-contaminated drinking water and/or those with occupational exposures may seek PFAS blood testing; with this information they can document a baseline of exposure, feel empowered to reduce exposure, and compel local and/or state and/or federal action.

# PFAS Blood Testing

- What won't a PFAS blood test tell me?
  - Test results cannot provide definitive information about specific health problems that might be related to PFAS exposure.
- How to interpret your PFAS blood test
  - Our tool, *What's My Exposure*, can help you interpret your test results: <https://www-pfas.pfas-exchange.org/report/graphtool/>
- How do I get a PFAS blood test?
- Limitations

## List of North American labs that offer PFAS blood testing

## Common PFAS Blood Testing Questions

*In progress:*

## **Vaccine Response and PFAS Exposure in Children**

- How do I know if my child's vaccinations are still effective given their exposure to PFAS?
- Where do I get an antibody titer test for my child?
- Are antibody titer tests covered by health insurance?

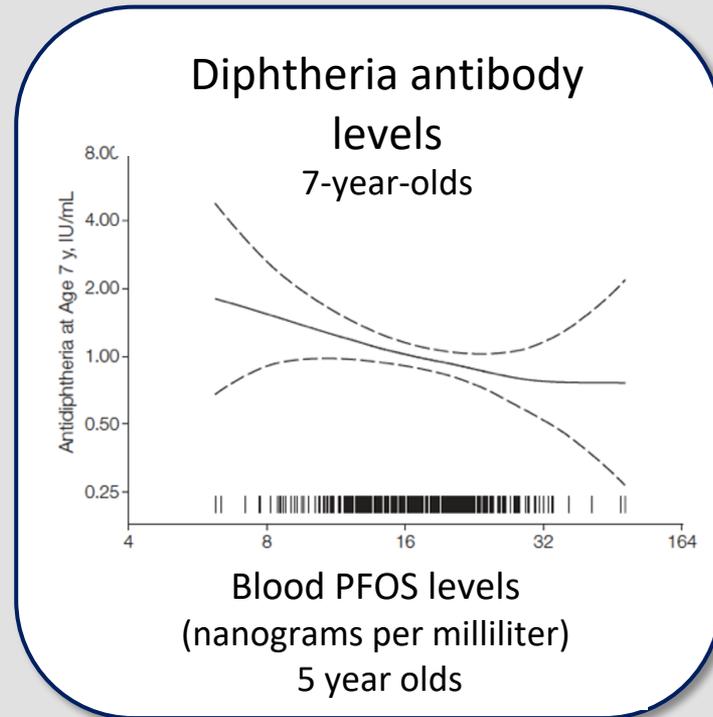
### ***Will the results tell me if my child should be revaccinated?***

Revaccination is a personal discussion you can have with your child's clinician. It's not clear that low levels of antibodies would mean that your child is likely to get sick and it's not clear whether a second vaccination would raise antibody levels. The current standard of care does not call for revaccination based on low titer results.

In addition to monitoring antibody levels, you can talk to your doctor about other medical monitoring options to check for other early markers of disease that could be linked to PFAS exposure

# Immune system toxicity

- Decreased vaccine responses in children with higher PFAS levels in Faroe Islands studies
- National Toxicology Program: PFOS and PFOA are “presumed to be an immune hazard to humans” (2016)

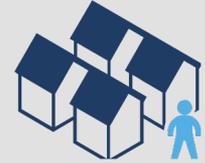


Grandjean *et al.* 2012.

1/11/14

# PFAS-REACH

## PFAS-Research, Education, and Action for Community Health



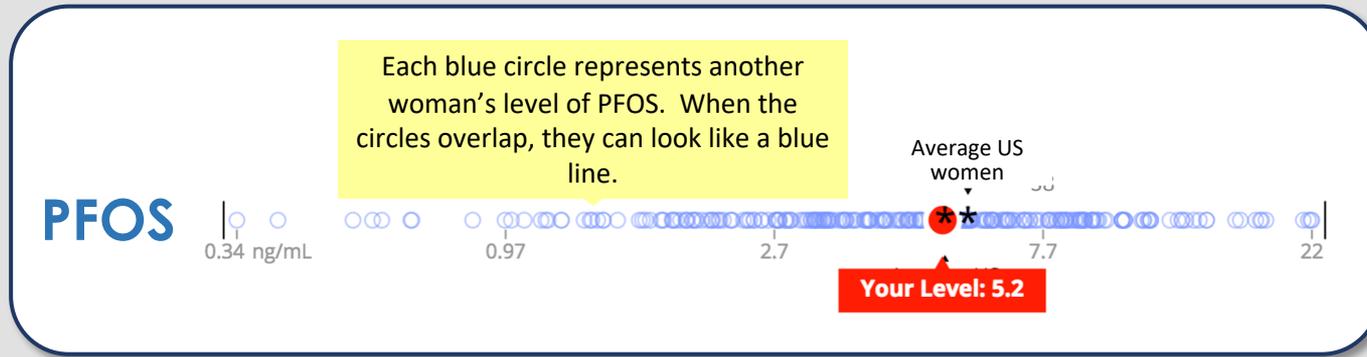
- Aim 1. Quantify associations of child serum PFOA, PFOS, PFHxS, and total PFASs with a) serum antibody levels following diphtheria and tetanus (DTaP) vaccinations and b) metabolomic markers of inflammation

now recruiting in Hyannis and Pease Tradeport, NH

- Aim 2. Develop an innovative online resource center, the PFAS Exchange, with data interpretation tools, tap water testing, and educational materials for affected communities<sup>37</sup> and other stakeholders.
- Aim 3. Assess individual, family, and community-level experiences of residents in areas impacted by PFAS-contaminated drinking water.

# Report-back

- Individualized reports generated with Silent Spring's DERBI report-back tool
- Information about health effects and exposure reduction



*Example report-back graph from  
Child Health and Development Study*

# PFAS Exchange

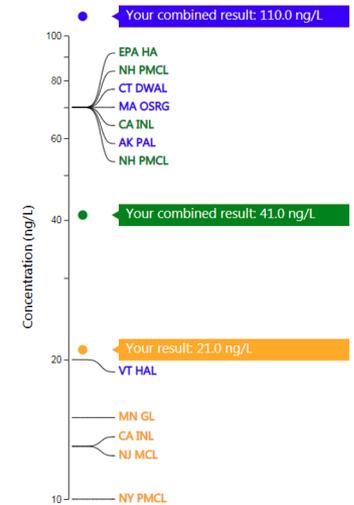


- Web platform for residents, water and health officials, medical professionals, firefighters
- Data interpretation for blood and water test results
- Water testing
- Supporting connections and knowledge sharing among communities

## ▶ PFOS (in water) -- Perfluorooctane sulfonic acid

Your result: 21.0 ng/L

- ✔ Your result (21.0) was **below** the New Hampshire Proposed Maximum Contaminant Level and Ambient Groundwater Quality Standards of 70.0 ng/L
- ✔ Your result (41.0) **PFOA+PFOS (in water)** was **below** the US EPA Health Advisory Level of 70.0 ng/L
- ⚠ Your result (110.0) **PFOA+PFOS+PFNA+PFHxS+PFHpA (in water)** was **above** the Alaska proposed PFAS Action Level of 70.0 ng/L
- ✔ Your result (41.0) **PFOA+PFOS (in water)** was **below** the New Hampshire Proposed Maximum Contaminant Level and Ambient Groundwater Quality Standards of 70.0 ng/L
- ✔ Your result (41.0) **PFOA+PFOS (in water)** was **below** the California Interim Notification Level of 70.0 ng/L
- ⚠ Your result (110.0) **PFOA+PFOS+PFNA+PFHxS+PFHpA (in water)** was **above** the Connecticut Drinking Water Action Level of 70.0 ng/L
- ⚠ Your result (110.0) **PFOA+PFOS+PFNA+PFHxS+PFHpA (in water)** was **above** the Massachusetts DEP Office of Research and Standards Guideline of 70.0 ng/L
- ⚠ Your result (110.0) **PFOA+PFOS+PFNA+PFHxS+PFHpA (in water)** was **above** the Vermont Health Advisory Level of 20.0 ng/L
- ⚠ Your result (21.0) was **above** the Minnesota DOH health-based guidance level of 15.0 ng/L
- ⚠ Your result (21.0) was **above** the New Jersey DEP Maximum contaminant level of 13.0 ng/L
- ⚠ Your result (21.0) was **above** the California Interim Notification Level of 13.0 ng/L
- ⚠ Your result (21.0) was **above** the New York Proposed Maximum Contaminant Level of 10.0 ng/L



# PFAS and COVID

- Community groups posed this question
- Research under way by others
- REACH requesting supplement

## **Severity of COVID-19 at elevated exposure to perfluorinated alkylates**

 Philippe Grandjean, Clara Amalie Gade Timmermann, Marie Kruse, Flemming Nielsen, Pernille Just Vinholt, Lasse Boding, Carsten Heilmann, Kaare Molbak

**doi:** <https://doi.org/10.1101/2020.10.22.20217562>

# Disseminating the Documents

- Pediatric Environmental Health Specialty Units (PEHSUs) – supported by ATSDR
- Activist groups
- Health professional organizations
- PFAS research centers
- State and federal agencies
- National organizations such as AAAS EPI-Center, ECOS, ASTHO, National Governors Association, ITRC
- Presentation at International Society for Exposure Science: "Translating Research to Action with Improved Medical Screening Guidance for PFAS" (August 2021)
- Article in Environmental Health News (next slide)
  
- *And doing lots of educational work with health professionals*



Jun 29, 2021

## Improved medical screening in PFAS-impacted communities to identify early disease

People highly exposed to PFAS often face significant hurdles in getting screened for potential health effects from the exposure. That needs to change.

[Isabella Raponi](#) , [Phil Brown](#) and [Alissa Corder](#)

# How are our guidance documents being used?



Ayesha Khan and Jaime Honkawa from Nantucket PFAS Action Group set up a presentation to Nantucket Health Dept. and Nantucket Cottage Hospital that will be used nationally



# Community Engagement and Policy

Significant attention by EPA, ATSDR (part of CDC), and DOD

Registration Open for Environmental Justice Academy in Dayton

Release Date: 06/07/2021

EPA Commits to Helping Sacramento Food Hubs

Release Date: 06/03/2021

Biden Administration Pledges to Assist City of Norfolk in Tackling Food Insecurity

Release Date: 06/03/2021

EPA Commits to Local Food Systems

Release Date: 06/02/2021

EPA Uses Emergency Bay Refinery to

Release Date: 05/14/2021

EPA awards \$615

communities

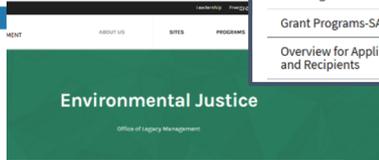


The screenshot shows the EPA Grants page with the following content:

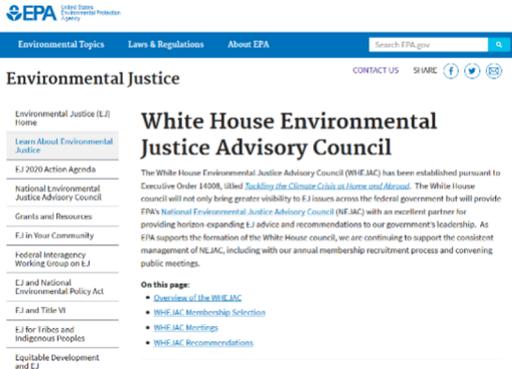
- Navigation: Environmental Topics, Laws & Regulations, About EPA, Search EPA.gov
- Section: EPA Grants
- Sub-sections: EPA Grants Home, Open Opportunities - Grants.gov, Grant Programs-SAM.gov, Overview for Applicants and Recipients
- Feature: Multipurpose Grants to States and Tribes
- Listed items:
  - Grant Guidance for Multipurpose Grants to States
  - Grant Guidance for Multipurpose Grants to Tribes



The screenshot shows the website for the U.S. Department of the Interior, Office of Environmental Policy & Compliance. It includes a search bar and navigation links for 'Who We Are', 'What We Do', and 'Library'.



The screenshot shows the Environmental Justice Office of Legacy Management website. It features a video player with the title 'A Review of Executive Order 12898' and a 'Watch on YouTube' button.



The screenshot shows the EPA Environmental Justice page with the following content:

- Navigation: Environmental Topics, Laws & Regulations, About EPA, Search EPA.gov
- Section: Environmental Justice
- Sub-sections: Environmental Justice (EJ) Home, Learn About Environmental Justice, EJ 2020 Action Agenda, National Environmental Justice Advisory Council, Grants and Resources, EJ in Your Community, Federal Interagency Working Group on EJ, EJ and National Environmental Policy Act, EJ and Title VI, EJ for Tribes and Indigenous Peoples, Equitable Development and EJ
- Feature: White House Environmental Justice Advisory Council
- Text: The White House Environmental Justice Advisory Council (WHEJAC) has been established pursuant to Executive Order 14008, titled *Tackling the Climate Crisis at Home and Abroad*. The White House council will not only bring greater visibility to EJ issues across the federal government but will provide EPA's National Environmental Justice Advisory Council (NEJAC) with an excellent partner for providing horizon expanding EJ advice and recommendations to our government's leadership. As EPA supports the formation of the White House council, we are continuing to support the consistent management of NEJAC, including with our annual membership recruitment process and convening staff meetings.
- On this page:
  - Overview of the WHEJAC
  - WHEJAC Membership Selection
  - WHEJAC Meetings
  - WHEJAC Recommendations



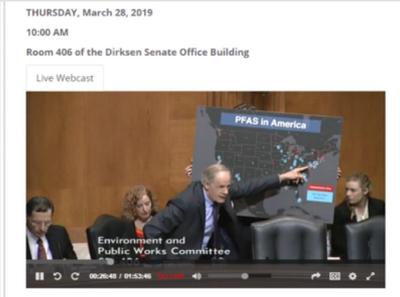
The screenshot shows the Environmental Justice Office of Legacy Management page. It features a large image of a landscape with a road and mountains. Below the image is a video player with a red play button and the title 'A Review of Executive Order 12898'.

The Office of the Secretary's Office of Environmental Policy and Compliance (OEPC) is the coordination and development of environmental policy and program evaluation. Its approach and response to environmental issues that affect multiple bureaus in our entity with respect to those issues. It provides guidance for the Department's compliance with environmental statutes, executive orders, regulations and other requirements.

## 4. We made these recommendations for the MA Interagency Task Force this past summer (some specifically relevant to you at MWRA)

What should legislatures and health and environmental agencies do?

- **Test water in locations with likely contamination**
- **Offer blood testing** to people in exposed areas
- **Proactively target testing** in low-income and BIPOC communities
- **Prioritize EJ communities** for remediation
- **Provide financial support to towns and cities** - remediation is expensive and while some towns and cities have taken early action, many are unaware of the problem or lack financial resources and technical capacity
- **Provide funds** for statewide research, education, testing and surveillance, and remediation
  - Yes, MA has started but we need more
- **Turn off the tap** - stop new uses and emissions of PFAS for all non-essential uses
- **Pass legislation** to restrict many uses of PFAS, including AFFF foam, food packaging (hearing yesterday), textiles, and carpets, require health insurers to cover blood testing
- **Issue investigative orders** for likely sources (e.g. CA State Water Resources Control Board)
- **Provide education to health providers** so they can properly inform patients



Sen. Carper (D-DE)  
pointing to our map



Our  
conferences

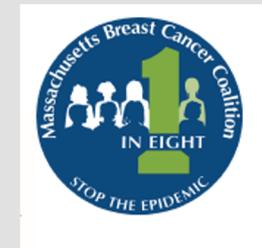


## Recommendations (continued)

- **Learn from the experts:** Our international conferences (past presentations on our website [pfasproject.com](http://pfasproject.com)), PFAS-Exchange ([pfas-exchange.org](http://pfas-exchange.org)), Interstate Technology and Regulatory Council ([itrcweb.org](http://itrcweb.org)), National Academy of Science, Green Science Policy Institute ([greensciencepolicy.org](http://greensciencepolicy.org)), Safer States ([saferstates.com](http://saferstates.com)), Environmental Working Group ([ewg.org](http://ewg.org))
- **Work with the EPA** for national action, including MCLs, Superfund (CERCLA) listing, abolish corporate withholding of data and Confidential Business Information claims
- **Work with academics** in life sciences, natural sciences, and social sciences
- **Work with our Congressional delegation** – Representatives and Senators are playing important roles
- **Use a class-based approach** and don't be fooled into thinking that one or two chemicals at a time is OK
- **Work with community groups** who have always been at the forefront

# Research and Community Partners

- Core research team:
  - Laurel Schaidler, PI, Silent Spring Institute
  - Phil Brown, PI, Northeastern University
  - Courtney Carignan, co-I, Michigan State University
- Core community partners
  - Testing for Pease
  - Community Action Works
  - Massachusetts Breast Cancer Coalition
- Other affiliated researchers:
  - Farzad Noubary, Northeastern University
  - Vincent Bessonneau, Ruthann Rudel, Julia Brody, Silent Spring



## PUBLICATIONS

### Published

Matthew Judge, Phil Brown, Julia Brody, Ruthann Rudel, and Serena Ryan, “The Exposure Experience: Participant Responses to a Biomonitoring Study of Perfluorooctanoic Acid (PFOA).” *Journal of Health and Social Behavior*. 2016 57: 333-350,

Lauren Richter, Alissa Cordner, and Phil Brown, “Non-Stick Science: Sixty Years of Research and (In)Action on Fluorinated Compounds” *Social Studies of Science* 2018 45(5):691-714

Alissa Cordner, Vanessa Y. De La Rosa, Laurel A. Schaidler, Ruthann A. Rudel, Lauren Richter, and Phil Brown “PFAS Drinking Water Guideline Levels: The Role of Scientific Uncertainty, Risk Assessment Decisions, and Social Factors” *Journal Of Exposure Science And Environmental Epidemiology* 2019. 29: 157–171 (*winner of Best Paper of the Year Award*)

Alissa Cordner, Lauren Richter, and Phil Brown, “Can chemical-class based approaches replace chemical-by-chemical strategies?: Lessons from recent FDA regulatory action on perfluorinated compounds.” *Environmental Science & Technology* 2016 50 (23), pp 12584–12591.

Clare Malone, Gülnaz Çiğ, Phil Brown, and Alan Ducatman “Participant Satisfaction in the C8 Study of PFOA” *New Solutions* 2019 29(2): 186–204.

Alissa Cordner, Phil Brown, and Lauren Richter “Environmental Chemicals and Public Sociology: Engaged Scholarship on Highly Fluorinated Compounds” *Environmental Sociology* Online June 24, 2019

Elicia Cousins, Lauren Richter, Alissa Cordner, Phil Brown, and Sokona Diallo. “Risky Business? Manufacturer and Retailer Action to Remove Per- and Polyfluorinated Chemicals from Consumer Products” *New Solutions* 2019 29(2): 242-265.

Lauren Richter, Alissa Cordner, and Phil Brown “Producing Environmental Ignorance Under the Toxic Substances Control Act: The Case of Per- and Polyfluoroalkyl Substances (PFAS)” *Sociological Perspectives* 2020

Alissa Cordner, Gretta Goldenman, Linda Birnbaum, Phil Brown, Mark F. Miller, Rosie Mueller, Sharyle Patton, Derrick Salvatore, and Leonardo Trasande “The True Costs of PFAS and the Benefits of Acting Now” *Environmental Science & Technology* online June 18, 2021

Martha Powers, Phil Brown, Grace Poudrier, Jennifer Ohayon, Alissa Cordner, Cole Alder, and Marina Atlas “COVID-19 as Eco-Pandemic Injustice: Exploitation of a Crisis and Opportunities for Collective and Anti-racist Approaches to Environmental Health” *Journal of Health and Social Behavior* 2021 62(2):222-229

## PUBLICATIONS

**Helena Zindel, Martha Powers, Alissa Cordner, and Phil Brown, “State Messaging on Toxic Chemical Exposure: Per- and Polyfluoroalkyl Substances and the Individualization of Risk on State Websites in the US” *Environmental Communication*. In press**

### Under Review

**Jennifer Ohayon, Alissa Cordner, Andrea Amico, Phil Brown, and Lauren Richter, “Persistent Chemicals, Persistent Activism: Scientific Opportunity Structures and Social Movement Organizing on Contamination by Per-and Polyfluoroalkyl Substances”**

**Rosie Mueller, Alissa Cordner, Derrick Salvatore, and Phil Brown “Disparities in exposure to per- and polyfluoroalkyl substances (PFAS) in drinking water: Evidence from New Jersey”**

# Visit our website: [pfasproject.com](https://pfasproject.com)

The screenshot shows the homepage of the PFAS Project Lab website. At the top left is the SSEHRI logo and the Northeastern University Social Science Environmental Health Research Institute name. Below this is the title 'THE PFAS PROJECT LAB' and the subtitle 'Studying Social, Scientific, and Political Factors of Per- and Polyfluoroalkyl Substances'. A green navigation bar contains links for HOME, ABOUT US, PUBLICATIONS & PRESENTATIONS, TIMELINES, CONTAMINATION SITE TRACKER, and ADDITIONAL RESOURCES. The main content area features four news items, each with a thumbnail image and a title. On the right side, there is a search bar, a 'PFAS NEWSLETTER' sign-up section, and a 'JOB POSTINGS' section listing several opportunities.

**SSEHRI**  
Northeastern University  
Social Science Environmental Health  
Research Institute

## THE PFAS PROJECT LAB

*Studying Social, Scientific, and Political Factors of Per- and Polyfluoroalkyl Substances*

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**'Something Has To Be Done': Living Along Madison's Starkweather Creek, One Of Wisconsin's Most Polluted Waterways**  
October 7, 2021 – 0 Comments

**NEWS**  
**Fertilizer Used in DC School Gardens Highest Nationwide For Potentially Toxic Chemical**  
October 7, 2021 – 0 Comments

**NEWS**  
**Newsom Signs Laws Banning 'Forever'**

**NEWS**  
**FAA Must End The Use of Polluting**

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Maine Department of Environmental Protection Job Postings  
Postdoctoral Position in PFAS Research and Data Science  
Postdoctoral Position- Social Scientist for Transdisciplinary Environmental Health-Social Science Team

Contact me: [p.brown@northeastern.edu](mailto:p.brown@northeastern.edu)