

Providing Scientific Support for the Pease Community



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Highly Fluorinated Compounds:
Social and Scientific Discovery
Boston, MA
June 15, 2017

Training & Experience



BA, Biological Sciences
(Rutgers University)



Associate Environmental Risk Assessor



PhD, Environmental Health (Boston University School of Public Health)



Postdoctoral Researcher, Pediatric Exposure Science (Dartmouth)



Postdoctoral Fellow, Environmental Reproductive Epidemiology (Harvard Chan)

Involvement at Pease

- Portsmouth resident
- Community Assistance Panel (ATSDR)
- Restoration Advisory Board (Air Force)

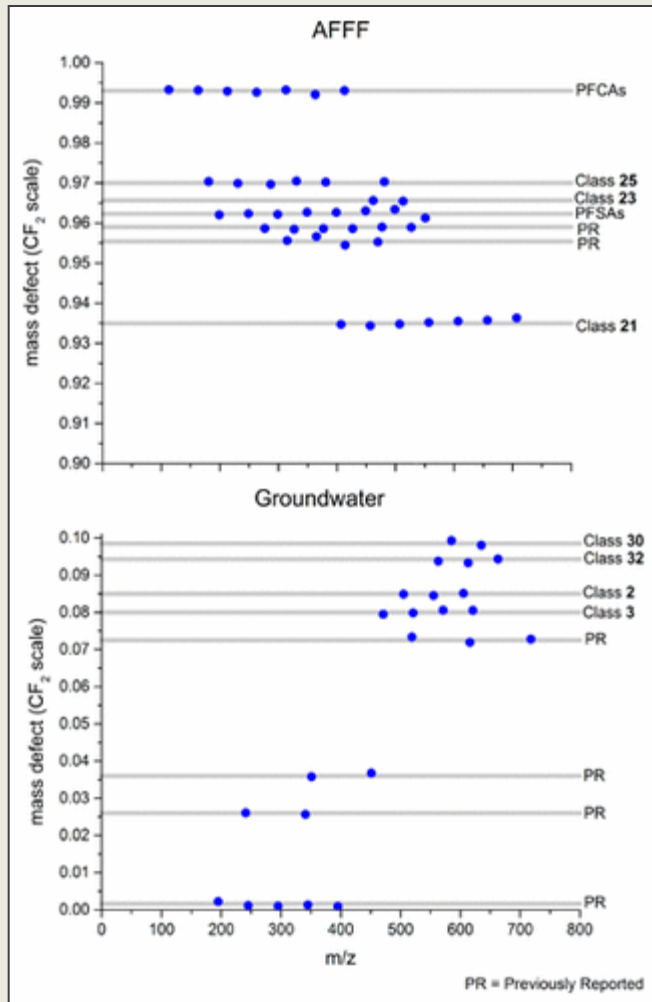
(See Andrea Amico's talk for more background about Pease)

Mixture of PFAS in AFFF

From Sweden, 2015

Namn	Kemisk formel	Old generation AFFF	New generation AFFF
6:2 FTS	$C_8F_{15}H_4SO_3^-$	X	X
PFOSA	$C_8F_{17}SO_3NH^-$	X	
PFBS	$C_4F_9SO_3^-$	X	
PFHxS	$C_6F_{13}H_4SO_3^-$	X	
PFHpS	$C_7F_{15}SO_3^-$	X	
PFOS	$C_8F_{17}SO_3^-$	X	
PFDCS	$C_{10}F_{21}SO_3^-$	X	
PFBA	$C_4F_9COO^-$	X	X
PFPeA	$C_5F_{11}COO^-$	X	X
PFHxA	$C_6F_{13}COO^-$	X	
PFHpA	$C_7F_{15}COO^-$	X	
PFOA	$C_8F_{17}COO^-$	X	X
PFNA	$C_9F_{19}COO^-$	X	
PFDA	$C_{10}F_{21}COO^-$	X	X
6:2 FTOH	$C_8F_{13}H_4O^-$		X
8:2 FTOH	$C_{10}F_{17}H_4O^-$		X
10:2 FTOH	$C_{10}F_{21}H_4O^-$		X

Discovery of 40 Classes of PFAS in AFFF and AFFF-impacted groundwater

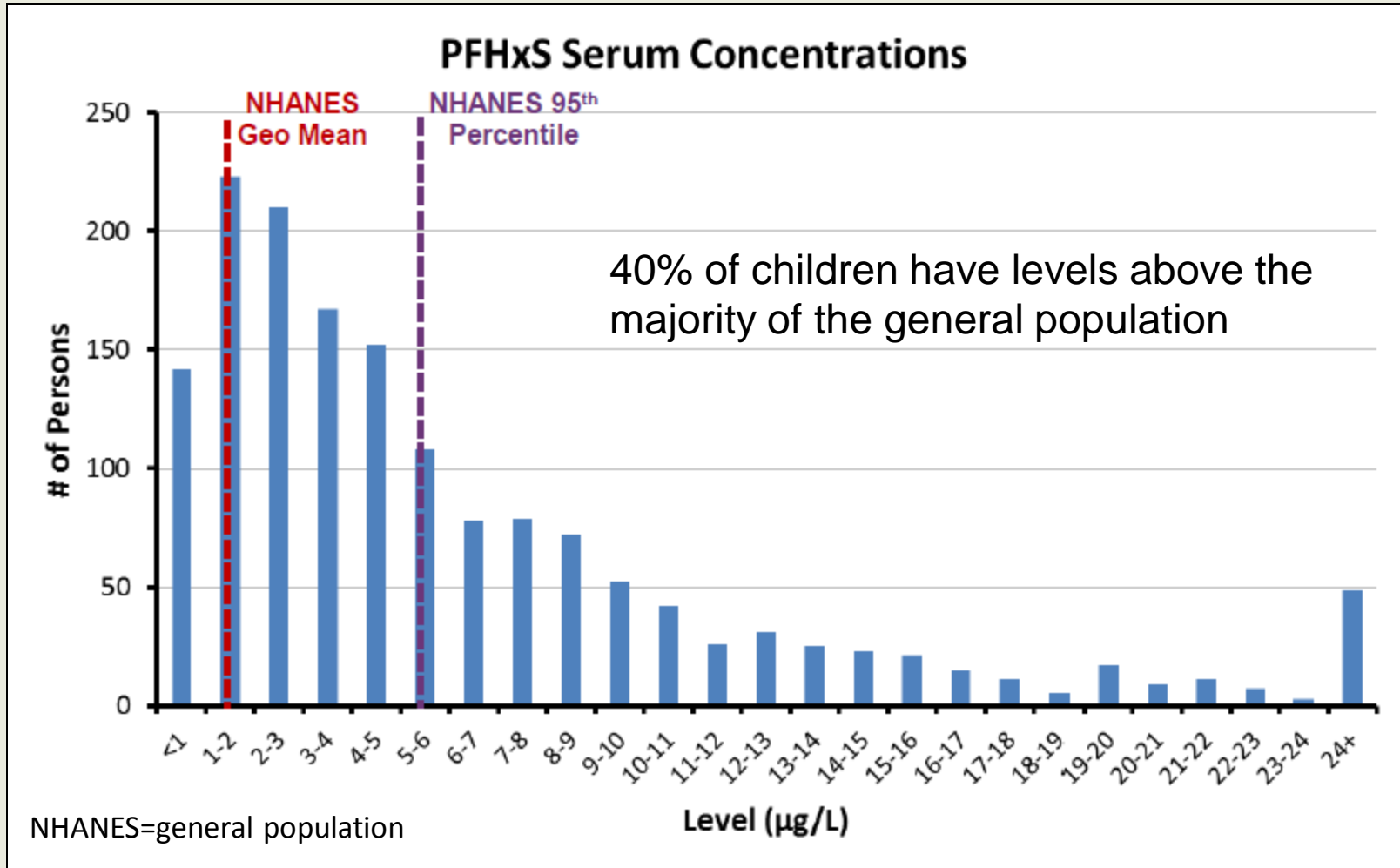


“Little is known about the newly discovered PFASs with regards to subsurface remediation strategies, transport, and toxicity. The (presumed) wide range of solubilities for the newly discovered PFASs may pose challenges for using ex situ remediation techniques, such as granulated active carbon, because shorter-chained compounds are likely to break through systems designed to capture PFOS and PFOA.”

New Info

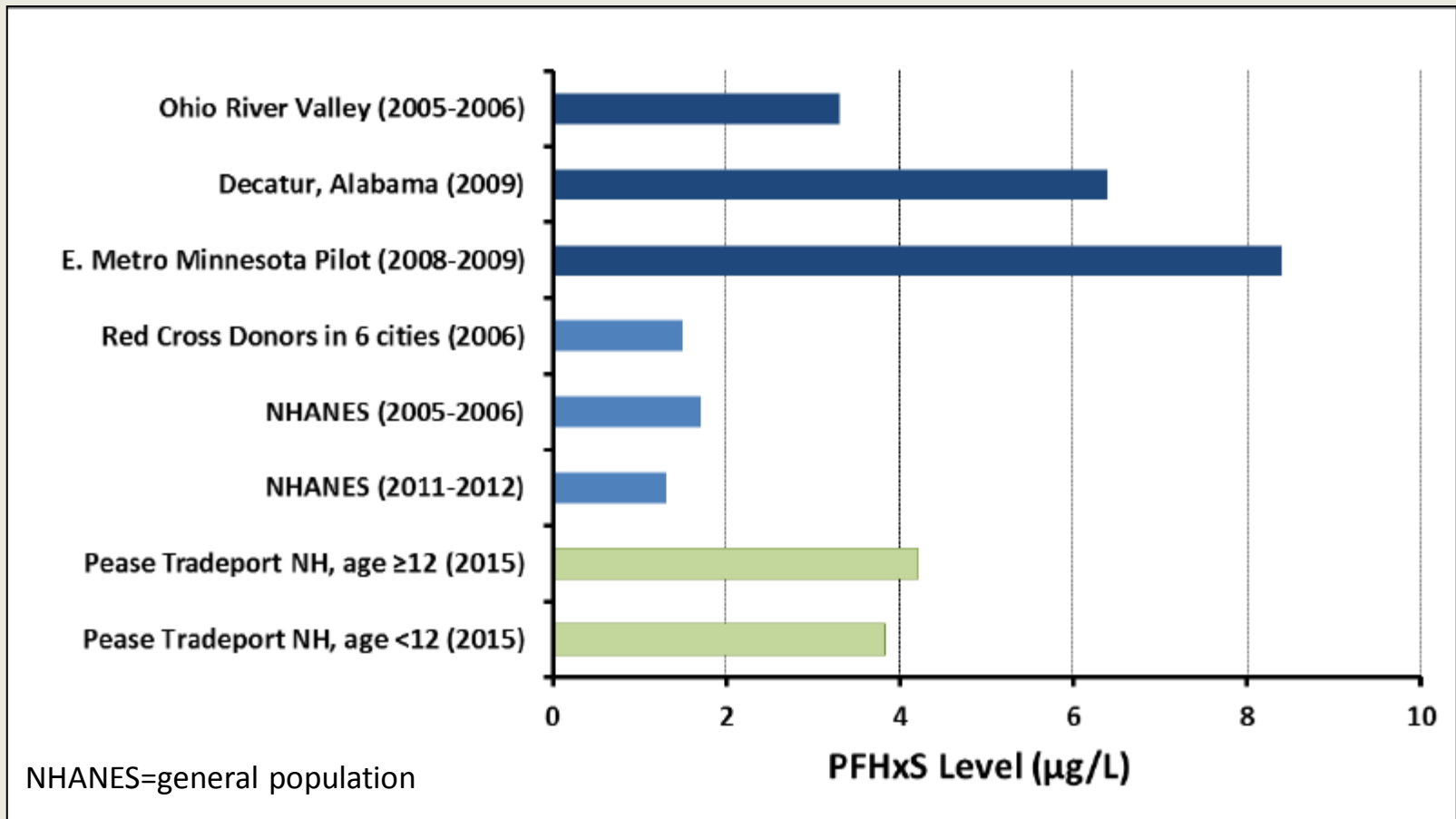
Elevated PFHxS among Pease Children

n=366 children <11

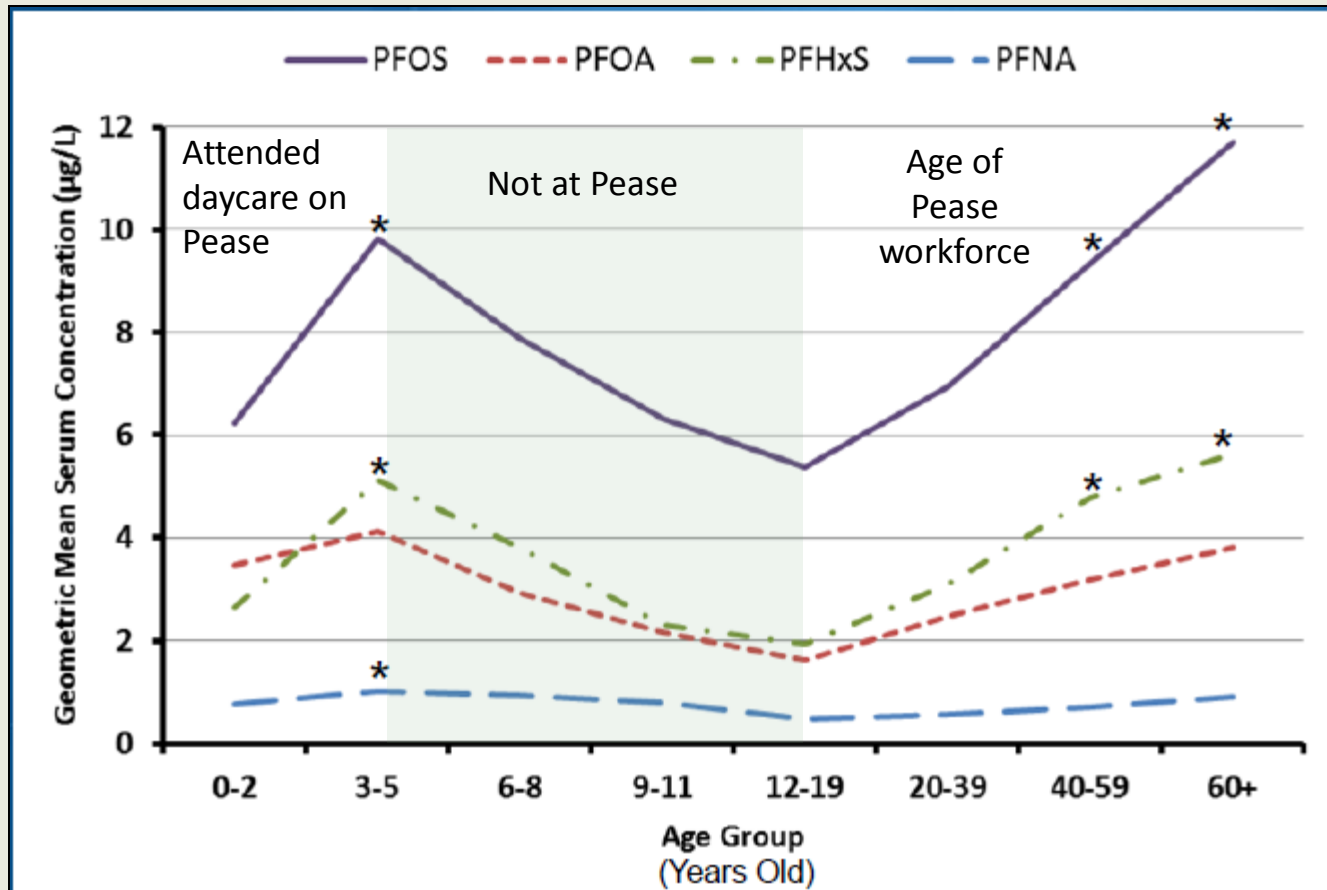


Elevated PFHxS among Pease Children and Adults

Comparison of central tendency values



Clear Drinking Water Influence



NH DHHS 2016

Thoughts on Stress

Learning about drinking water contamination is stressful



Can experience increased stress when it is perceived that information is withheld or risk is downplayed.

May counteract stress with support and information.

Share Health Monitoring Options for Discussion with Physician



- Cholesterol
- Thyroid
- Iodine sufficiency
- Vitamin D sufficiency
- Kidney function
- Reproductive cancers

ATSDR Physician Fact Sheet

Questions Patients May Ask	Key Patient Messages	Key Message Supporting Facts
		1-888-SAFEFOOD (1-888-723-3366).
<p>Could my health problems be caused by PFAS exposure?</p> <p>(Based on the health problems the patient has, there are two possible responses to this question.)</p> <p>(a) If the patient's health problem is in the list below, it may potentially be associated with PFAS exposure, based on limited evidence from human studies. The potential health effects include:</p> <ul style="list-style-type: none"> - Thyroid function (potential to affect T₄ and TSH levels) - High cholesterol - Ulcerative colitis - Testicular cancer - Kidney cancer - Pregnancy-induced hypertension - Elevated liver enzymes - High uric acid <p>(b) If the patient's health problem is not in the bulleted list above, then there is no current evidence that it is related to PFAS exposure. (However, research is ongoing and not all health outcomes have been adequately studied.)</p>	<p>(a) Although the evidence is not conclusive, your health problem could potentially be associated with exposure to PFAS. However, health effects can be caused by many different factors, and there is no way to know if PFAS exposure has caused your health problem or made it worse.</p> <p>(b) Based on what we know at this time, there is no reason to think your health problem is associated with exposure to PFAS.</p>	<p>For supporting facts on the listed health effects in this question (a), see "How can PFAS potentially affect human health." The information on potential illnesses and health effects will be briefly reviewed for each of these illnesses or health effects. This information can be found in this fact sheet on page 3 and 4.</p> <p>If your patient presents with health concerns that might be associated with PFAS exposure, it is appropriate to discuss the patient's concerns and perform a thorough health and exposure history and also a physical exam relative to any symptoms reported.</p>

https://www.atsdr.cdc.gov/pfc/docs/pfas_clinician_fact_sheet_508.pdf

C8 Health Study Medical Monitoring

You can see which screening protocols are recommended for you in the following table:

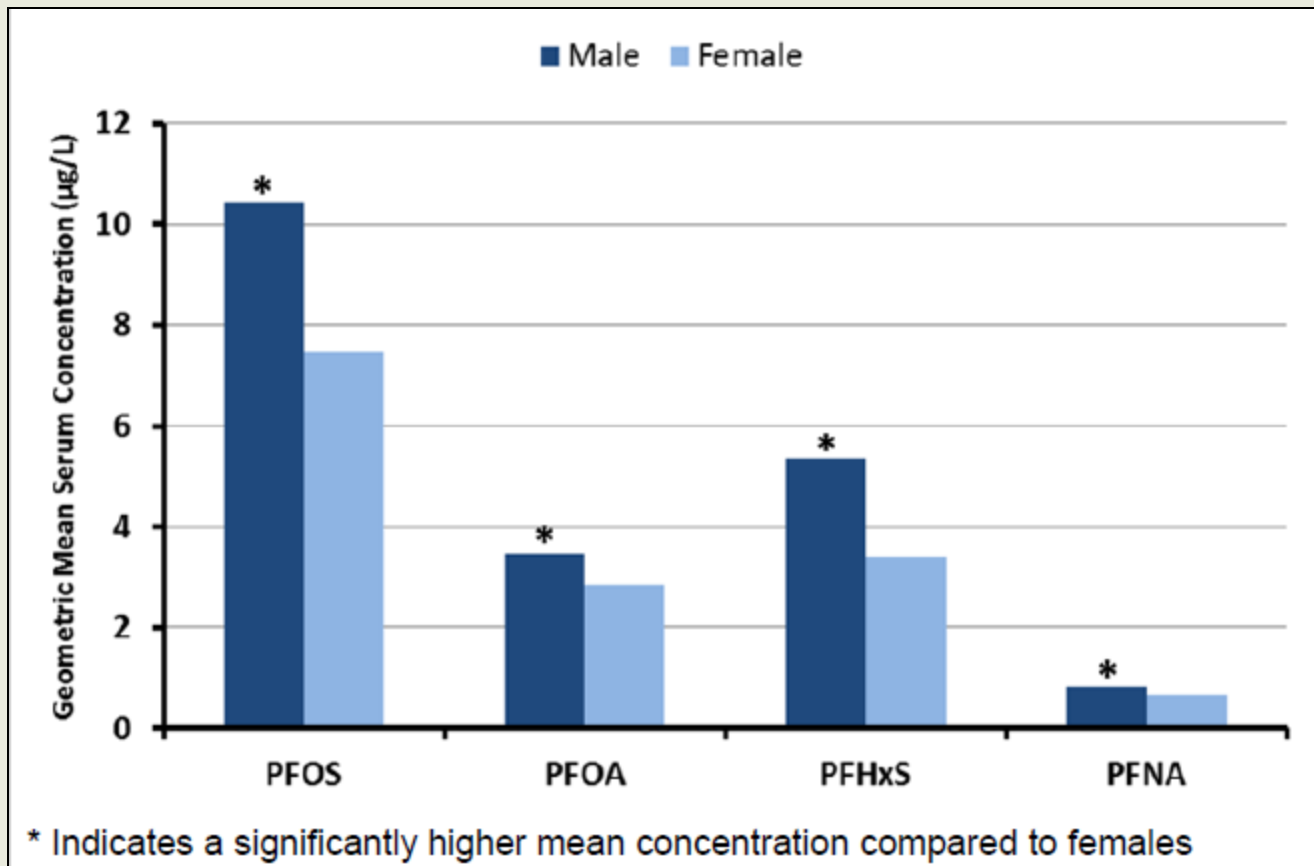
SCREENING BY AGE

< 15 years	<ul style="list-style-type: none">- High cholesterol- Thyroid disease (at parents' discretion)- Testicular cancer (exam not part of Program, but done as regular care)
15-18 years	<ul style="list-style-type: none">- High cholesterol- Thyroid disease (at parents' discretion)- Ulcerative colitis- Testicular cancer
18-19 years	<ul style="list-style-type: none">- High cholesterol- Thyroid disease- Ulcerative colitis- Testicular cancer
20 or older years	<ul style="list-style-type: none">- High cholesterol- Thyroid disease- Ulcerative colitis- Testicular cancer- Kidney cancer
Pregnant Females	<p>- Blood pressure & urine protein should be measured at each prenatal visit – these tests are part of standard prenatal care and may not be reimbursed by the Program. Pregnant women may receive blood pressure monitoring devices provided by the Program.</p>

http://www.c-8medicalmonitoringprogram.com/docs/med_panel_education_doc.pdf

Differential Excretion

Lower levels in women likely due to loss of blood from menstruation
Communities express strong interest in exposure reduction strategies



Unique AFFF Exposure

Standard PFC Serum Panel
PFOA
PFOS
PFHxS
PFUA
PFOSA
PFNA
PFDeA
Me-PFOSA-AcOH ₂
Et-PFOSA-AcOH

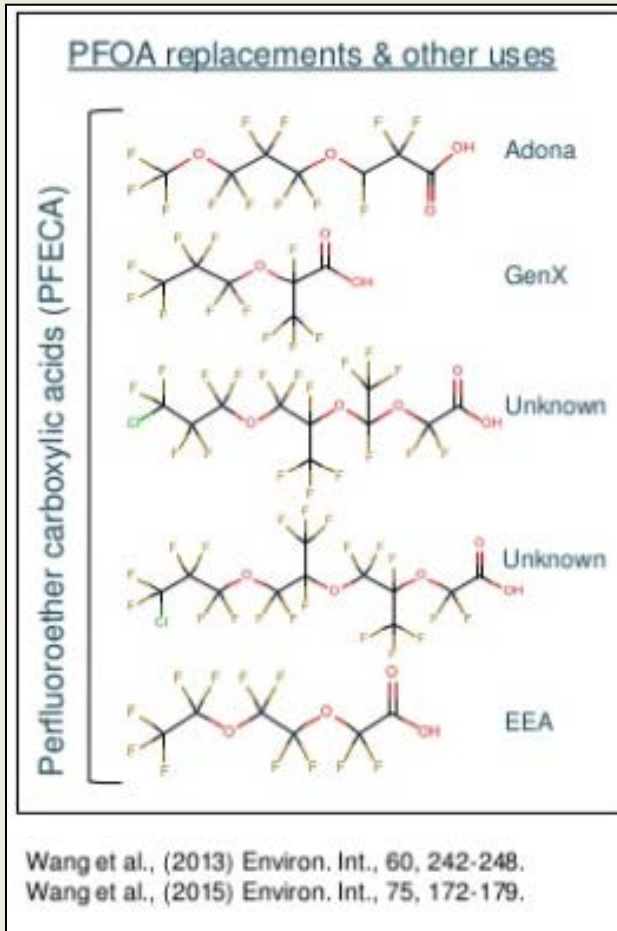
PFCs in AFFF

6:2 FTS	$C_8F_{15}H_4SO_3^-$
PFOSA	$C_8F_{17}SO_3NH^-$
PFBS	$C_4F_9SO_3^-$
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PFPeA	$C_5F_{11}COO^-$
PFHxA	$C_6F_{13}COO^-$
PFHpA	$C_7F_{15}COO^-$
PFOA	$C_8F_{17}COO^-$
PFNA	$C_9F_{19}COO^-$
PFDCA	$C_{10}F_{21}COO^-$

Are we monitoring all the relevant PFAS for AFFF-impacted communities?

New research from Higgins et al. (2017) found 40 classes of PFAS

New PFAS' and Mixtures



What about for manufacturing communities?

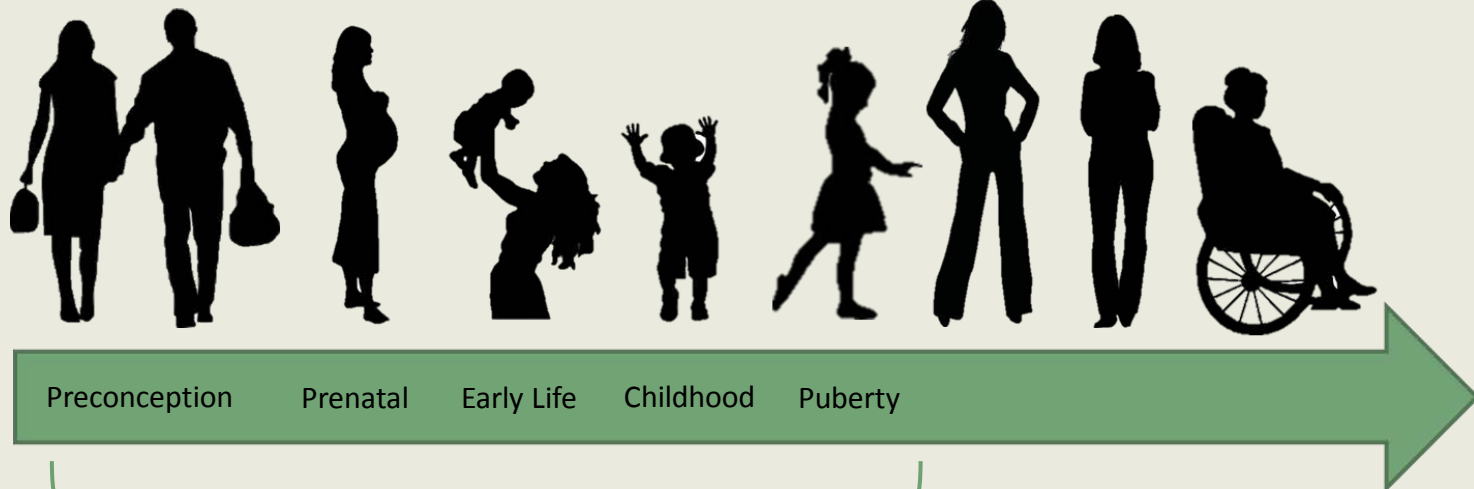
The C6 replacements being used in manufacturing of consumer products are not currently being monitored or regulated.

Health Study Considerations

- A coordinated health study of communities impacted by PFAS in AFFF-contaminated drinking water is needed that:
 - Determines/considers the relevant PFAS in AFFF and AFFF-impacted drinking water
 - Provides information that is useful to communities both in the short and long term
 - Includes sensitive developmental windows
 - Utilizes optimal study designs

Include Sensitive Developmental Windows

ATSDR's Draft
Feasibility Assessment,
Uses cross-sectional design*



Sensitive Developmental Window
Focus of many NIEHS funded grants

Complimentary Study Designs

- Cross-sectional design is useful for:
 - Characterizing exposure in a population
 - Medical monitoring
 - Baseline for surveillance
 - Studying certain health effects
- Case-control design is useful for studying cancer and other rare disease
- Longitudinal preconception and birth cohorts:
 - Studying health effects from exposure during sensitive developmental windows

Optimal Study Design

- Longitudinal preconception and/or birth cohort designs are ideal for studying health effects of PFAS and many other environmental chemicals
- Such studies could be nested within cross-sectional studies that monitor for clinical endpoints (cholesterol, immune function, ect)
- Case control studies using registry data are the optimal design for studying cancer and other rare disease

Tips for Conducting a Good Health Study

- Interact with community partners throughout
- Utilize technologies to be effective & efficient
- Be immediately useful (i.e., quick turnaround of estimated exposure and clinically relevant results)
- Measure exposure really well
- Tailor for key outcomes of interest
- Be flexible to unknown outcomes
- Involve the most qualified researchers

NIEHS and ATSDR

The National Institute of Environmental Health Sciences (NIEHS) is a branch of NIH with massive experience conducting longitudinal cohort studies with both intramural (within agency) and extramural (academic) scientists.

The Agency of Toxic Substances and Disease Registry (ATSDR) is a branch of CDC with experience producing impact assessments and have also conducted some cancer studies.

Agency of Toxic Substances and Disease Registry (ATSDR)



Has been meeting with the Community Assistance Panel at Pease for a year to develop a Feasibility Assessment

ATSDR's Draft Feasibility Assessment

Review of literature and outlines:

- Feasible to study at Pease alone
- May be possible to study at Pease alone
- Not feasible to study at Pease alone

Note: A multi-site study would make more endpoints feasible

Currently accepting comments on the draft

Proposed Child Enrollment

Ages 4 to 16

350 'exposed'

175 'unexposed'

Feasible to study in Pease children alone

- Lipids (cholesterol)
- Glomerular filtration rate (eGFR), a measure of kidney function
- Insulin-like Growth Factor -1, a measure of growth hormone deficiency
- Overweight/Obesity

May be possible to study in Pease children alone

- Uric acid
- Elevated total cholesterol (hypercholesterolemia)
- Elevated uric acid (hyperuricemia)
- IQ/neurobehavioral
- Thyroid function
- Sex hormones
- Asthma & atopic dermatitis (immune function)
- Rhinitis (stuffy, runny nose)
- Antibody response to rubella, mumps and diphtheria vaccines

Not feasible to study in Pease children alone

- ADHD
- Autism spectrum disorder
- Delayed puberty
- Thyroid disease
- Childhood cancers

Proposed Adult Enrollment

Ages 18+

1,500 'exposed'

1,500 'unexposed'

Feasible to study in Pease adults alone

- Lipids (cholesterol)
- Uric acid
- Elevated total cholesterol (hypercholesterolemia)
- Elevated uric acid (hyperuricemia)
- Thyroid disease (unconfirmed)
- Cardiovascular disease
- Hypertension
- Osteoarthritis and osteoporosis
- Serum immunoglobulin and C-reactive protein; increase in antinuclear antibodies; alterations in specific cytokines

May be possible to study in Pease adults alone

- Liver function
- Thyroid disease (confirmed)
- Thyroid function
- Endometriosis
- Pregnancy-induced hypertension

Not feasible to study in Pease adults alone

- Liver disease
- Kidney disease
- Ulcerative colitis
- Rheumatoid arthritis
- Lupus
- Multiple sclerosis
- Kidney cancer (and other adult cancers)

Former Military Service and Civilian Workers at the Pease Air Force Base

Concluded it is not feasible for Pease alone, would need to be a multi-site study.

“In addition to the military service and civilian workers who were stationed at the Pease Air Force Base, would require several thousands of exposed populations from military bases where PFAS-contaminated drinking water occurred, as well as several thousands of comparison populations from military bases that did not have drinking water contamination.”

Air Force Refused to Fund the Study

Update (6/29/17): NH Senator Jeanne Shaheen responded with an amendment in the Defense Authorization Act to create the first-ever national study on the health effects of people exposed to PFCs in their drinking water. Needs support to pass.

<http://www.seacoastonline.com/news/20170628/shaheen-amendment-calls-for-national-pfc-health-study>

Thank You

