Evaluation of Exposure to Perfluorinated Chemicals (PFCs) due to Contamination of Drinking Water in Gloucester County, New Jersey

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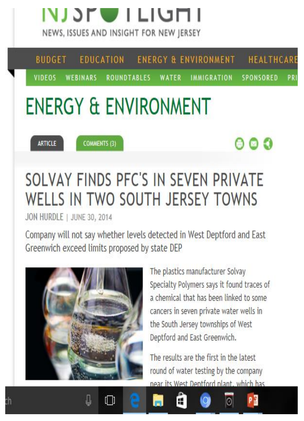
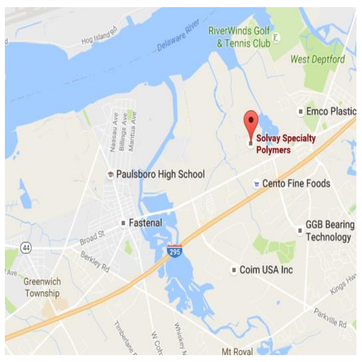
The Issue

- PFAs (also called PFCs) have been released into the environment contaminating water supplies across US
- PFAs degrade slowly so contamination lasts for years
- PFAs have long biological half-lives, so remain in the body for years
- Drinking water in Gloucester County, NJ, was contaminated with perfluoro-n-nonanoic acid (PFNA) (>100ng/L) and perfluorooctanoic acid (PFOA) (>25ng/L)
- Residential water is now filtered through activated charcoal





Methodology

- A convenience sample of 120 adult (20-74years) residents in the area have been recruited
- A questionnaire administered asking about previous and current water use, demographics, sources of food, and occupation
- Serum, household tap water, and household dust were collected, serum samples will be collected twice more
- Twelve PFAs were measured using LC/MS using an optimized CDC methodology (Yu et al J Chromatogr A 2017, 1480: 1-10)
- Detection Limits between 0.02 and 0.9 ng/mL (serum), 5ng/L (water), and 10 ng/g (dust)
- Reports were provided to participant comparing the levels in their serum with nationwide levels reported within CDC NHANES

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Sample Report Provided to Participants

Table 1: PFAS Concentration (ng/ml) in serum (blood). – Using Mean Concentrations

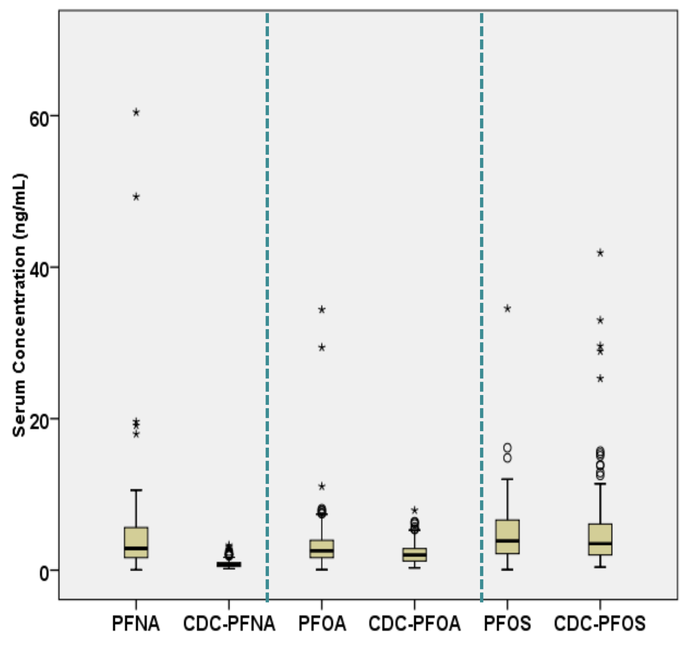
Analyte Name	Your Results (NJDOH) (ng/mL)	On the bottom is the percent of the US population with that level (for the 50th, 75th, 90th and 95th% - 50th% is the median or middle level of the US population) Triangle is your value. If it is at the 50th% your levels are similar to most people in the US.
Perfluorononanoic acid (PFNA)	4.7	0.7 1.0 1.6 2.0 — 50% 75% 90% 95%
2-(N-ethyl-Perfluorooctanesulfon amidoacetic acid (Et-PFOSA-AcOH)	Below our ability to measure	<0.1 0.11 — 50% 75% 90% 95%
2-(N-methyl-Perfluorooctanesulfon amidoacetic acid (Me-PFOSA-AcOH)	0.19	<0.1 0.2 0.4 0.6 — 50% 75% 90% 95%
Perfluorobutanesulfonic acid (PFBuS)	Below our ability to measure	<0.1 — 50% 75% 90% 95%
Perfluorodecanoic acid (PFDeA)	0.40	0.2 0.3 0.5 0.8 — 50% 75% 90% 95%
Perfluorododecanoic acid (PFDoA)	0.15	<0.1 0.2 — 50% 75% 90% 95%
Perfluoroheptanoic acid (PFHpA)	0.06	<0.1 0.1 0.2 — 50% 75% 90% 95%
Perfluorohexanesulfonic acid (PFHxS)	1.7	1. 2. 4. 5. — 50% 75% 90% 95%
Perfluorooctanoic acid (PFOA)	3.5	2. 3. 4. 5. — 50% 75% 90% 95%
Perfluorooctanesulfonic acid (PFOS)	4.8	5. 9. 15. 20 — 50% 75% 90% 95%
Perfluorooctanesulfonamide (PFOSA)	Below our ability to measure	<0.1 — 50% 75% 90% 95%
Perfluoroundecanoic acid (PFUA)	0.38	<0.1 0.2 0.3 0.5 — 50% 75% 90% 95%

Note: we can measure as low as 0.1 ng/mL, which is similar to the detection level reported by the Center for Disease Control for the NHANES Study.

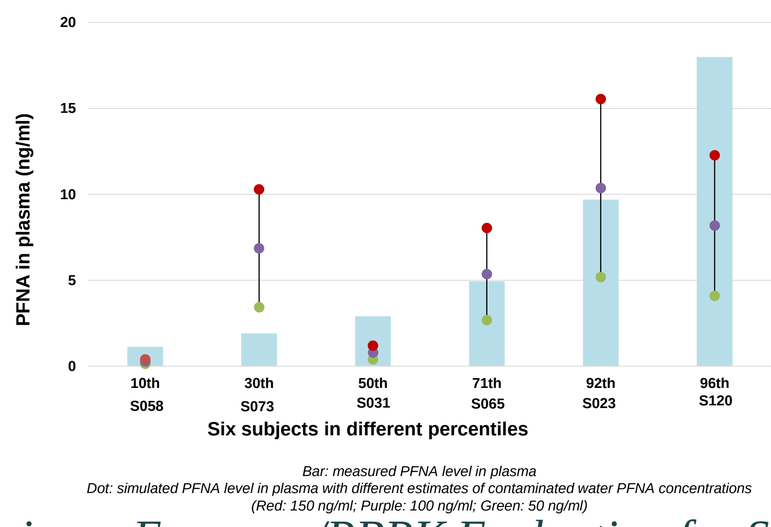
- A customized report is provided to each participant indicating the levels measured in serum, tap water and household dust along with an explanation of how their serum levels compared to the US population as reported in NHANES for the same age range
- The water levels were compared to NJ recommended guidelines
- Potential sources of PFAs, simple steps to reduce exposure and websites with additional information are also provided

Results – Comparison of PFNA, PFOA and PFOS to NHANES Levels Initial Exposure Characterization with PFPK Model of Serum Levels

	Me-PFOSA-AcOH	PFDeA	PFDoA	PFHpA	PFHxS	PFNA	PFOA	PFOS	PFUnA
Serum ng/ml									
Mean	**0.03**	**0.16**	**0.14**	**0.05**	**1.6**	**4.6**	**3.3**	**4.5**	**0.36**
Std Dev	**0.07**	**0.38**	**0.13**	**0.06**	**1.2**	**7.3**	**4.2**	**4.1**	**0.59**
# > DL n=120	**7**	**79**	**102**	**35**	**116**	**120**	**120**	**120**	**118**
Water ng/L									
Mean	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**4.0**	**2.3**	**2.1**	**2.1**
Std Dev	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**3.3**	**1.3**	**0.9**	**0.9**
# > DL n=105	**0**	**0**	**0**	**0**	**0**	**40**	**10**	**0**	**0**
Dust ng/g									
Mean	**14**	**10**	**4**	**14**	**58**	**11**	**42**	**68**	**7**
Std Dev	**37**	**44**	**7**	**38**	**381**	**31**	**130**	**267**	**16**
# > DL n=105	**32**	**11**	**5**	**37**	**19**	**34**	**80**	**53**	**19**



Serum PFNA, PFOA & PFOS Levels in NJ Samples vs. US Population



Bar: measured PFNA level in plasma
Dot: simulated PFNA level in plasma with different estimates of contaminated water PFNA concentrations
(Red: 150 ng/ml; Purple: 100 ng/ml; Green: 50 ng/ml)

Preliminary Exposure/PBPK Evaluation for Six Subjects Across a Range of Water Concentrations

Initial Findings

- **Three years after the intervention mean serum levels of PFNA in the community exceeded the 95th percentile of those reported in NHANES**
- **Cohort will be followed to assess the effectiveness of the water intervention to reduce community blood levels**
- **A preliminary exposure/PBPK model evaluation shows reasonable agreement suggesting it can be used to assess the variability across the population and support interpretation of measurements**