Preliminary Results for PFAS-AWARE: Health Effects Study on Poly- and Perfluoroalkyl Substances

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www.PFAS-AWARE.org

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Objectives:

1. Understand the relationship between exposure to PFASs in drinking water and how quickly the body accumulates and/or eliminates various PFASs

2. Evaluate how exposure to PFASs affects health
Talk Roadmap

• PFAS-AWARE Study
  – Background on PFASs
  – Timeline & Study Progress
• Water Results
• Blood Results
• Future Directions
• Questions
PFAS Exposure

- Poly- and Perfluoroalkyl substances (PFASs)
  - Large number of compounds: it’s a mixture
  - Two most common are PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoate)
    - 99% of the US population has measurable levels of these compounds
    - Most health studies in humans look at these two compounds
  - These compounds are found in many household products, not just contaminated water. Examples include:

  ![Non-stick cookware](image1)
  ![Grease-repellent food wrappers](image2)
  ![Water- and stain-resistant fabrics](image3)
PFAS Exposure in Fountain, Security and Widefield Wells

- **AFFF (Aqueous Film Forming Foam)** was used at airports, military installations, fire-fighting training sites, manufacturing sites, and other places.
  - PFASs from **AFFF** are a different mixture from the one in consumer products. This includes **PFHxS** (perfluorohexane sulfonate) and related substances
  - Less is known about exposure and health effects of **PFHxS** than **PFOA/PFOS**

- **If you are on one of the public water systems (Fountain, Security, and Widefield)** your exposure ended around August 2015 because of changes in water sources or addition of treatment systems
PFAS-AWARE Study Timeline

**January 2018**
- IRB Approval and develop protocol

**February 2018**
- Recruit 200 participants beginning mid-April

**March 2018**
- Blood sampling/questionnaires/water Sampling in F-S-W

**April 2018**
- Blood sample analysis at CDC

**May 2018**
- Water and blood sample analysis at CSM

**June 2018**
- Data Analysis, reporting and manuscript preparation (throughout 2019)

**July 2018**
- Continued: Water/Blood sample analysis at CSM and Data Analysis/Community Presentations

**August 2018**
- Recruit 50 participants beginning March for follow-up sampling

**September 2018**
- Blood sampling/questionnaires/water Sampling in F-S-W

**October 2018**
- Water and blood sample analysis at CDC and CSM

**November 2018**
- Data Analysis, reporting and manuscript preparation (throughout 2019)

**December 2018**
- Data Analysis, reporting and manuscript preparation (throughout 2019)

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**July 2019**
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**August 2019**
- Data Analysis, reporting and manuscript preparation (throughout 2019)

**September 2019**
- Data Analysis, reporting and manuscript preparation (throughout 2019)

**October 2019**
- Data Analysis, reporting and manuscript preparation (throughout 2019)

**November 2019**
- Data Analysis, reporting and manuscript preparation (throughout 2019)

**December 2019**
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Study Progress

• Year 1: 2018
  – Water Sampling
  – Blood Sampling
  – Participant Questionnaires

• Year 2: 2019
  – Blood Sampling
  – Questionnaires
Preliminary Water Sampling Results
Preliminary Water Sampling Results:

- We measured PFASs in the untreated wells that were used by Security, Widefield, and Fountain before the PFAS issue was known.
- Since PFASs were discovered in these systems, each water supplier either changed water sources or added treatment systems specifically to remove PFASs.
- We also measured PFASs in private well water samples.

Objective: to understand what residents might have been exposed to in the past, before EPA health advisories were in effect and additional steps were taken to remove PFASs.
Preliminary Water Sampling Results:

- Measured PFASs in *untreated* water from *private wells* and *public wells* in April-June, 2018
  - 3 in Fountain
  - 3 in Widefield
  - 22 in Security
  - 10 private wells

- **Why *untreated* water?**
  While PFASs are now being removed from drinking water, concentrations in blood likely reflect *past exposure*
Example Result

These are the water supplies sampled

Filled Shapes are Median (middle) concentrations for each water supply:
50% of values are lower
50% of values are higher

This reflects all the concentrations measured across the sampled water supply

ppt (ng/L)
Perfluorocarboxylates in Untreated Well Water

Private wells: black circles; Fountain: green triangles; Security: blue diamonds; Widefield: red squares

Generally, Private wells < Fountain < Widefield < Security

*Note scales are different depending on compound

Filled Shapes are Median: 50% of values are lower, 50% are greater, than this value
Perfluorosulfonates in Untreated Well Water

Private wells: black circles; Fountain: green triangles; Security: blue diamonds; Widefield: red squares

Generally, Private wells < Fountain < Widefield < Security

*Note scales are different depending on compound

[Graphs showing distribution of perfluorosulfonates (PFPrS, PFHxS, PFBs, PFHpS, PFPeS, PFOS) in untreated well water from different locations.]
Data Summary: PFASs in Untreated Well Water

Total PFASs in untreated well water ranged from 18 – 2300 ppt (ng/L)
- PFASs detected are typical of fire-fighting foam-impacted groundwater
- Combined PFOS+PFOA in untreated well water ranged from 0 – 870 ppt (ng/L)

10 PFASs frequently detected (found in > 80% of samples):
- C5-C8 perfluorcarboxylates – PFPeA, PFHxA, PFHpA, PFOA
- C3-C8 perfluorosulfonates – PFPrS, PFBS, PFPeS, PFHxS, PFHpS, PFOS
  - PFHxS and PFOS were present at the greatest concentrations

What was sporadically detected?

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Percent Detection</th>
<th>Concentration Range ppt (ng/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4, C10, C11 perfluorcarboxylates</td>
<td>3-20%</td>
<td>0.47 - 50 ppt (ng/L)</td>
</tr>
<tr>
<td>PFNS</td>
<td>13%</td>
<td>0.33 - 2.1 ppt (ng/L)</td>
</tr>
<tr>
<td>FOSA (perfluoroctane sulfonamide)</td>
<td>10%</td>
<td>0.19 - 2.0 ppt (ng/L)</td>
</tr>
<tr>
<td>6:2 and 8:2 FTS (fluorotelomer sulfonate)</td>
<td>5-28%</td>
<td>0.88 - 15 ppt (ng/L)</td>
</tr>
<tr>
<td>Cl-PFOS</td>
<td>10%</td>
<td>0.64 - 1.3 ppt (ng/L)</td>
</tr>
</tbody>
</table>

What was NOT detected above limit of quantitation*?
- GenX; C9, C12-C14, C16, C18 perfluorcarboxylates; C10 and C12 perfluorosulfoantes; Fluorotelomer acids; Sulfonamides besides FOSA; Sulfonamido acetic acids; 4:2 and 10:2 fluorotelomer sulfonates

*Limit of quantitation: The lowest concentration the instrument can measure with confidence
Water Conclusions

• We found 10 different PFASs in more than 80% of the samples.
• The range of concentrations is large.
• The compounds measured are consistent with PFASs derived from fire fighting foam use.
Preliminary Blood Sampling Results
Preliminary Blood Sampling Results

• In each of 220 Blood Samples we collected we measured or are measuring:
  – 48 PFAS Compounds → Presenting on 18 today
  – Total Cholesterol, Triglycerides, HDL Cholesterol and LDL Cholesterol
  – Liver Enzymes: AST, ALT, GGT

• Results to share in a future letter and public meeting:
  – Interleukins and Other Cytokines: IL-1β, IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, GM-CSF, IFN-γ and TNF-α
  – Additional PFASs in serum and water
  – Letters/Presentations in first half of 2019
What Are CDC & NHANES Reference Ranges?

• CDC is the “Centers for Disease Control”
• NHANES is the “National Health and Nutrition Examination Survey”
  – Designed to assess the health and nutrition status of adults and children in the U.S. using interviews, examinations and laboratory testing
  – A nationally representative selection of people participate every other year
  – Helps to determine U.S. population averages for both diseases and PFAS and other exposures.
<table>
<thead>
<tr>
<th>Current Acronym</th>
<th>This Study 50th Percentile</th>
<th>U.S. 50th Percentile</th>
<th>This Study 90th Percentile</th>
<th>U.S. 90th Percentile</th>
<th>Percent Measurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFHxS</td>
<td>14.8</td>
<td>1.4</td>
<td>49.7</td>
<td>4.1</td>
<td>100</td>
</tr>
<tr>
<td>Total PFOS</td>
<td>9.7</td>
<td>5.2</td>
<td>28.1</td>
<td>13.9</td>
<td>100</td>
</tr>
<tr>
<td>Total PFOA</td>
<td>3.0</td>
<td>2.1</td>
<td>7.4</td>
<td>4.3</td>
<td>100</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.4</td>
<td>0.7</td>
<td>0.8</td>
<td>1.6</td>
<td>100</td>
</tr>
<tr>
<td>PFHpS</td>
<td>0.2</td>
<td>N/A</td>
<td>0.6</td>
<td>N/A</td>
<td>82</td>
</tr>
<tr>
<td>PFDA</td>
<td>0.1</td>
<td>0.20</td>
<td>0.3</td>
<td>0.5</td>
<td>45</td>
</tr>
<tr>
<td>Me-FOSAA</td>
<td>0.1</td>
<td>&lt; LOD</td>
<td>0.4</td>
<td>0.4</td>
<td>35</td>
</tr>
<tr>
<td>PFHxA</td>
<td>&lt; LOD</td>
<td>N/A</td>
<td>0.2</td>
<td>N/A</td>
<td>25</td>
</tr>
<tr>
<td>PFUndA</td>
<td>0.1</td>
<td>&lt; LOD</td>
<td>0.1</td>
<td>0.3</td>
<td>17</td>
</tr>
<tr>
<td>PFHpA</td>
<td>&lt; LOD</td>
<td>&lt; LOD</td>
<td>0.1</td>
<td>0.1</td>
<td>9</td>
</tr>
<tr>
<td>PFDdoDA</td>
<td>&lt; LOD</td>
<td>&lt; LOD</td>
<td>0.1</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Et-FOSAA</td>
<td>&lt; LOD</td>
<td>&lt; LOD</td>
<td>0.1</td>
<td>&lt; LOD</td>
<td>2</td>
</tr>
</tbody>
</table>

<LOD stands for below the limit of detection. This means that the value was somewhere between 0 and 0.1 ng/ml. Below 0.1 ng/ml the instrument cannot give a confident answer for the actual value.
### Your Letter

The full name of the compound.

Shortened name of the compound.

The point at which half the values are above and half are below.

The point at which 95% of the values are below.

The number and percent of people in this study who had greater than 0.1 ng/ml of PFAS detected in blood.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Abbreviation</th>
<th>Your Result</th>
<th>Lowest Result found in this Study</th>
<th>50th percentile* for this Study</th>
<th>Highest Result found in this study</th>
<th>Number (%) of participants with detectable levels in this study</th>
<th>50th Percentile* for general U.S. Population</th>
<th>95th Percentile** for general U.S. Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfluoro-n-butanoic acid</td>
<td>PFBA</td>
<td>Below Limit of Detection^</td>
<td>Below Limit of Detection^</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Perfluoro-n-pentanoic acid</td>
<td>PFPeA</td>
<td>Below Limit of Detection^</td>
<td>Below Limit of Detection^</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Perfluoro-n-hexanoic acid</td>
<td>PFHxA</td>
<td>Below Limit of Detection^</td>
<td>Below Limit of Detection^</td>
<td>0.5</td>
<td>55 (25%)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Perfluoro-n-heptanoic acid</td>
<td>PFHpA</td>
<td>Below Limit of Detection^</td>
<td>Below Limit of Detection^</td>
<td>0.5</td>
<td>20 (9%)</td>
<td>Below Limit of Detection^</td>
<td>0.200</td>
<td>--</td>
</tr>
<tr>
<td>Perfluoro-n-octanoic acid</td>
<td>PFOA</td>
<td>Below Limit of Detection^</td>
<td>2.9</td>
<td>13.8</td>
<td>219 (99.5%)</td>
<td>2.07</td>
<td>5.57</td>
<td>--</td>
</tr>
<tr>
<td>Perfluoro-n-nonanoic acid</td>
<td>PFNA</td>
<td>Below Limit of Detection^</td>
<td>0.4</td>
<td>4.2</td>
<td>219 (99.5%)</td>
<td>0.700</td>
<td>2.00</td>
<td>--</td>
</tr>
</tbody>
</table>
PFHxS Results

NHANES 90th Percentile: 4.1 ng/ml
NHANES 50th Percentile: 1.4 ng/ml

Study Population 90th Percentile: 49.7 ng/ml
Study Population 50th Percentile: 14.8 ng/ml
PFHxS Results

• The median is the same as the 50\textsuperscript{th} percentile. The median is the point where half the values are above and half are below.

• The study population had a median serum PFHxS level of 14.8 ng/ml \textbf{this is approximately 10 times as high} as the U.S. median serum PFHxS level of 1.4 ng/ml.

• Similarly, the 90\textsuperscript{th} percentile serum PFHxS level \textbf{is approximately 12 times as high} as the U.S. 90\textsuperscript{th} percentile serum PFHxS level.
Geographic distribution of serum PFHxS results, which is likely a result of drinking contaminated water:

<table>
<thead>
<tr>
<th>Water District</th>
<th>Range (Median) of PFHxS Serum Levels (ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td>0.1-199.5 (21)</td>
</tr>
<tr>
<td>Widefield</td>
<td>1.7-97.5 (13.5)</td>
</tr>
<tr>
<td>Fountain</td>
<td>0.5-58.4 (8.85)</td>
</tr>
<tr>
<td>Private Well</td>
<td>2.4-139.7 (19.15)</td>
</tr>
</tbody>
</table>

Study Area
PFOS Results

NHANES 90th Percentile: 13.9 ng/ml
NHANES 50th Percentile: 5.2 ng/ml

Study Population 90th Percentile: 28.1 ng/ml
Study Population 50th Percentile: 9.7 ng/ml
PFOS Results

• The study population had a median serum PFOS level of 9.7 ng/ml this is approximately 1.8 times as high as the U.S. median serum PFOS level of 5.2 ng/ml.

• Similarly, the study population 90th percentile serum PFOS level is approximately 2 times as high as the U.S. 90th percentile serum PFOS level.
PFOA Results

NHANES 90th Percentile: 4.3 ng/ml
NHANES 50th Percentile: 2.1 ng/ml

Study Population 90th Percentile: 7.4 ng/ml
Study Population 50th Percentile: 3.0 ng/ml
PFOA Results

• The study population had a median serum PFOA level of 3.0 ng/ml this is approximately 43% higher than the U.S. median serum PFOA level of 2.1 ng/ml.

• Similarly, the study population 90th percentile serum PFOA level is approximately 72% higher than the U.S. 90th percentile serum PFOA level.

• Overall, the PFOA results from this study population are comparable to the U.S. Reference Levels
PFNA Results

NHANES 90th Percentile: 1.6 ng/ml
NHANES 50th Percentile: 0.7 ng/ml

Study Population 90th Percentile: 0.8 ng/ml
Study Population 50th Percentile: 0.4 ng/ml
PFNA Results

• The study population had a median serum PFNA level of 0.4 ng/ml this is approximately 43% lower than the U.S. median serum PFNA level of 0.7 ng/ml.

• Similarly, the study population 90th percentile serum PFNA level is approximately 50% lower than the U.S. 90th percentile serum PFNA level.

• Overall, the PFNA results from this study population are slightly lower than the U.S. reference levels.
Geographic distribution of serum PFNA results, which is likely **not** a result of drinking contaminated water:

<table>
<thead>
<tr>
<th>Water District</th>
<th>Range (Median) of PFNA Serum Levels (ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td>&lt;LOD-2.2 (0.4)</td>
</tr>
<tr>
<td>Widefield</td>
<td>0.1-2.4 (0.5)</td>
</tr>
<tr>
<td>Fountain</td>
<td>0.1-4.2 (0.4)</td>
</tr>
<tr>
<td>Private Well</td>
<td>0.2-1.3 (0.45)</td>
</tr>
</tbody>
</table>
Summary: PFOS, PFOA, PFHxS and PFNA Numbers in F-S-W vs. CDC Reference Values

• PFHxS:
  – Median/90th percentile levels in F-S-W are ~10 times as high as the U.S. population reference levels

• PFOS:
  – Median/90th percentile levels in F-S-W are ~2 times as high as the U.S. population reference levels

• PFOA:
  – Median/90th percentile levels in F-S-W are ~40 to 70% higher than the U.S. population reference levels

• PFNA:
  – Median/90th percentile levels in F-S-W are ~40 to 50% lower than the U.S. population reference levels
## Blood Sampling-PFAS Results

How do the levels in F-S-W compare to the levels found in other highly exposed U.S. communities?

<table>
<thead>
<tr>
<th>Community</th>
<th>Primary Exposure Source</th>
<th>PFHxS 50th Percentile (ng/ml)</th>
<th>PFOS 50th Percentile (ng/ml)</th>
<th>PFOA 50th Percentile (ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fountain, Security &amp; Widefield, CO</td>
<td>Water contamination from AFFF</td>
<td>14.8</td>
<td>9.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Portsmouth, NH</td>
<td>Water contamination from AFFF</td>
<td>4.16</td>
<td>9.17</td>
<td>3.1</td>
</tr>
<tr>
<td>Warminster, Warrington &amp; Horsham, PA</td>
<td>Water contamination from AFFF</td>
<td>7.63 (average)</td>
<td>11.5 (average)</td>
<td>3.3 (average)</td>
</tr>
<tr>
<td>Communities in Ohio and West Virginia</td>
<td>Water contamination from chemical manufacturing plant</td>
<td>Not Measured</td>
<td>20.2</td>
<td>27.9</td>
</tr>
<tr>
<td>Wilmington, NC</td>
<td>Water contamination from chemical manufacturing plant</td>
<td>3.2</td>
<td>9.0</td>
<td>4.4</td>
</tr>
</tbody>
</table>
Summary of Community Serum Level Comparisons

• Median **PFHxS** levels are **higher** in PFAS-AWARE participants than in other AFFF impacted U.S. communities.

• Median **PFOS/PFOA** levels are **similar** to other impacted communities in NH/PA/NC, but lower than in the West Virginia (C8) study.

• **Important Point to Note:** there are no health-based standards or guidance for PFAS levels in blood
Blood Sampling-PFAS Results:

• How can I avoid additional exposure to PFAS?
  – If you are on a private well have it checked for PFAS contamination.
  – Limit eating at fast food restaurants or eating microwave meals that use packaging that may be grease repellent.
  – Avoid buying stain- and water-resistant products where possible.
  – Wash hands before eating and keep floors and surfaces clean to reduce possible exposure from PFASs in dust.
Clinically Actionable Results: Cholesterol and Liver Enzymes
Blood Sampling-Cholesterol Results:

<table>
<thead>
<tr>
<th>Total Cholesterol</th>
<th>LDL Cholesterol</th>
<th>HDL cholesterol</th>
<th>Triglycerides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced and stored in the liver, released into bloodstream as needed</td>
<td>LDL = low density lipoprotein = “bad” cholesterol</td>
<td>HDL = high density lipoprotein = “good” cholesterol</td>
<td>Main form of fat in the body</td>
</tr>
<tr>
<td>May also be introduced to the body via diet</td>
<td>Can lead to fat buildup in arteries</td>
<td>Carries cholesterol back to liver to prevent buildup along artery walls</td>
<td>Unused calories are converted into triglycerides</td>
</tr>
<tr>
<td>Can build up along artery walls narrowing the arteries</td>
<td></td>
<td></td>
<td>Can provide your body with energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High levels can contribute to hardening of the arteries</td>
</tr>
</tbody>
</table>

Narrowing and hardening of the arteries increases the risk of cardiovascular disease and stroke.

Source: American Heart Association
Blood Sampling-Cholesterol Results:

<table>
<thead>
<tr>
<th></th>
<th>Total Cholesterol (mg/dL)</th>
<th>LDL (mg/dL)</th>
<th>HDL (mg/dL)</th>
<th>Triglycerides (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study 50th Percentile</strong></td>
<td>178</td>
<td>103</td>
<td>44</td>
<td>133</td>
</tr>
<tr>
<td><strong>Study Range</strong></td>
<td>Min: 99</td>
<td>Min: 38</td>
<td>Min: 0</td>
<td>Min: 34</td>
</tr>
<tr>
<td></td>
<td>Max: 302</td>
<td>Max: 207</td>
<td>Max: 129</td>
<td>Max: 499</td>
</tr>
<tr>
<td><strong>Expected Range</strong></td>
<td>Healthy: Below 200</td>
<td>Healthy: Below 100</td>
<td>Low: Below 40</td>
<td>Healthy: Below 150</td>
</tr>
<tr>
<td></td>
<td>Borderline High: 200-239</td>
<td>Borderline High: 100-159</td>
<td>Borderline Low: 40-59</td>
<td>Borderline High: 150-199</td>
</tr>
<tr>
<td></td>
<td>High: 240 and above</td>
<td>High: 160-189</td>
<td>Healthy: 60 and above</td>
<td>High: 200-499</td>
</tr>
<tr>
<td></td>
<td>Very High: 190 and above</td>
<td>Very High: 190 and above</td>
<td>Healthy: 60 and above</td>
<td>Very High: 500 and above</td>
</tr>
</tbody>
</table>

If you are concerned about your results you should consult your physician.

We are still working on the analysis of any potential relationships between PFAS exposure and Cholesterol.
Blood Sampling-Liver Enzyme Results:

**ALT (alanine transaminase):**
- Enzyme produced by liver cells

**AST (aspartate transaminase):**
- Enzyme produced by liver cells
- Can also be found in many different organs including the liver, muscles, heart, kidney and red blood cells

**GGT (gamma-glutamyl transpeptidase):**
- Enzyme produced by liver cells
- Can be found in many different organs including the liver, bile ducts, heart, kidney and pancreas

Elevated levels of any of these enzymes in the blood may indicate damage or inflammation of the liver or bile ducts.

Source: Mayo Clinic
**Blood Sampling-Liver Enzyme Results:**

<table>
<thead>
<tr>
<th></th>
<th>ALT (Units/L):</th>
<th>AST (Units/L):</th>
<th>GGT (Units/L):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study 50th Percentile Liver Enzyme Levels</strong></td>
<td>Men: 16</td>
<td>Men and Women: 20</td>
<td>Men: 24</td>
</tr>
<tr>
<td></td>
<td>Women: 12</td>
<td></td>
<td>Women: 15</td>
</tr>
<tr>
<td><strong>Study Range Liver Enzyme Levels</strong></td>
<td>Men: 3 to 62</td>
<td>Men and Women: 10 to 60</td>
<td>Men: 6 to 151</td>
</tr>
<tr>
<td></td>
<td>Women: 3 to 64</td>
<td></td>
<td>Women: 6 to 79</td>
</tr>
<tr>
<td><strong>Laboratory Reference Values for Liver Enzymes</strong></td>
<td>Men: 0 to 44</td>
<td>Men and Women: 0 to 40</td>
<td>Men: 0 to 65</td>
</tr>
<tr>
<td></td>
<td>Women: 0 to 32</td>
<td></td>
<td>Women: 0 to 60</td>
</tr>
</tbody>
</table>

If you are concerned about your results you should consult your physician.

We are still working on the analysis of any potential relationships between PFAS exposure and Liver Enzymes.
What is Involved if I Participate in Year 2?

- **Year 1:** 200 Participants
  - Water Sampling
  - Blood Sampling
  - Questionnaires

- **Year 2:** 50 Participants
  - Blood Sampling
  - Questionnaires
  - Further reporting of study results
Future Directions

• We will be back in the first half of 2019 to present other results and analyses
• Will begin recruiting and scheduling for Year 2 blood sampling in April, 2019
• We will be doing detailed residential histories for as many participants as possible to help understand when the exposure may have started
• Currently doing data analysis and developing manuscripts for future presentations and publication in the scientific literature
• We are seeking funding for additional studies from Federal sources
Thank you for Coming!

If you are interested in getting updates related to this study, or learning about participation in future research, please enter your contact information on the sign-in sheet.

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For further questions:

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Phone: (719) 301-9733
Resources

See www.PFAS-AWARE.org for links

- https://www.epa.gov/pfas
- https://www.colorado.gov/pacific/cdphe/pfcs
- https://www.pfas-aware.org/