PEATT Pilot Project
PFAS Testing
in the
Warrington, Warminster and Horsham areas
Pennsylvania Department of Health

Sharon Watkins, Ph.D.
Director, Bureau of Epidemiology
State Epidemiologist

PFAS Community Meeting  April 29, 2019
• Affected area = population of 84,184 (2010 census)
PFAS Exposure in Southeastern PA

- The Naval Air Warfare Center Warminster and the Horsham Air Guard Station (formerly Naval Air Station Joint Reserve Base Willow Grove)
  - Military and firefighter training
  - Aqueous Film Forming Foam (AFFF) used on bases
  - PFAS in the foam
  - Exact composition of AFFF is proprietary

- PFAS levels in community drinking water
  - 1,440 ppt - about 21 times higher than the Lifetime Health advisory Level (70 ppt) found in a municipal well in Warminster Municipal Authority (WMA) area
Participant Selection

- Total households contacted: 600
- Total households responded: 276
- Household level response rate: **46%**
- Number of eligible participants identified: 584 (including 113 kids aged 3-17 years)
- Number of eligible participants who completed the questionnaire and the informed consent form: 305
- Number of eligible participants who completed paperwork AND provided blood samples: 235 – from 118 households
- Individual participation rate: **40%** (235 out of 584)
- Household level participation rate: **19.6%** (118 out of 600 contacted)
**PEATT Project Timeline**

**April**
- April 30th: Weekly conference calls established between DOH and stakeholders in NY, BOL, Bucks County, Montgomery County

**May**
- May 1st: Initial Letters and Eligibility Forms sent to 350 households in affected water supply area
- May 16th: First Community Meeting to describe PEATT Pilot Project
- May 25th: Initial Letters and Eligibility Forms sent to additional 250 households in affected area
- May 29th: First Blood Draw clinic scheduled
  - Clinics continued through September 22nd
- May 30th: Community update with DOH presentation at Dept of Defense Restoration Advisory Board Meeting (RAB)

**June**
- June 7th: Began reminder emails and phone calls to participants who had not returned paperwork
- June 21st: Began reminder emails and phone calls to participants who returned paperwork, but had not scheduled clinic appointments
  - Reminders continued through September

**July**
- July 25th: DOH presentation at EPA community meeting
- Aug 5th: First test results received from laboratory
- Aug 22nd: Second round of test results received from laboratory

**August**
- Sept 5th: Final Notices sent to participants to return paperwork
- Sept 13th: Community update with DOH presentation at Dept of Defense Restoration Advisory Board Meeting (RAB)
- Sept 17th: Final Notices sent to participants for clinic appointments
- Sept 19th: PFAS Action Team created by PA Governor’s Office
- Sept 21st: Third round of test results received from laboratory
- Sept 25-26th: Individual Results sent to most participants

**September**
- Oct 18th: DOH presents to PFAS Action Team
- Oct 22nd: Fourth round of test results received from laboratory
- Oct 23rd: Individual Results sent to remaining participants
- Nov 19th: Community level analysis sent to participants
- Nov 30th: PFAS Action Team public meeting

**October**
- Dec 18th: Final call with AASTHO with feedback on PEATT Pilot Project
- Dec 19th: Final Project Report released to community
- Dec 19th: Final Community Meeting to present results/analysis to community
<table>
<thead>
<tr>
<th></th>
<th>Study Participants (%)</th>
<th>Community (%)</th>
<th>U.S. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 12 years</td>
<td>5.1</td>
<td>14.9</td>
<td>15.8</td>
</tr>
<tr>
<td>12 to 19 years</td>
<td>8.1</td>
<td>10.9</td>
<td>11.2</td>
</tr>
<tr>
<td>20+ years</td>
<td>86.8</td>
<td>74.2</td>
<td>73.0</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>44.3</td>
<td>48.8</td>
<td>49.2</td>
</tr>
<tr>
<td>Female</td>
<td>55.7</td>
<td>51.2</td>
<td>50.8</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>0</td>
<td>5.1</td>
<td>16.3</td>
</tr>
<tr>
<td>White</td>
<td>94.5</td>
<td>85.6</td>
<td>63.7</td>
</tr>
<tr>
<td>Black</td>
<td>0</td>
<td>3.0</td>
<td>12.2</td>
</tr>
<tr>
<td>Asian</td>
<td>0.4</td>
<td>4.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Other</td>
<td>5.1</td>
<td>1.5</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Education Level (18+ years old)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower than College</td>
<td>20.6</td>
<td>34.7</td>
<td>40.5</td>
</tr>
<tr>
<td>Some College or more</td>
<td>74.2</td>
<td>65.3</td>
<td>59.5</td>
</tr>
<tr>
<td>Other</td>
<td>5.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

- Study group determined by water service area, community determined by Warrington, Warminster, Horsham Twps, and Ivyland Borough
Results Overall

- Tested for 11 PFAS compounds (all perfluorinated)
  - 4 compounds were commonly detected
    - PFOS in 235 participants (100%)
    - PFHxS in 233 participants (99.1%)
    - PFOA in 232 participants (98.7%)
    - PFNA in 185 participants (78.7%)
  - All four detected in 79% of participants

Note: PFOS, PFOA and PFHxS are main components found in Aqueous Film Forming Foams (AFFF)
- PFHxS has longer half-life in the body
- PFNA is a biodegradation product during polyvinyl fluoride production/application
- PFNA blood levels are rising in the general population as PFOA, PFOS, and PFHxS levels decline

Das et al., (2015)
Results Overall

- Of the remaining 7 compounds-
  - PFDeA was found in 14 participants
  - MeFOSAA was found in 9 participants
  - PFUA in 8 participants
  - PFHpA in 1 participant
Results Overall—4 main compounds

- Average serum PFAS levels (level of PFAS in the blood) were higher compared to NHANES’s averages
  - 94% had higher levels of PFHxS
  - 81% had higher levels of PFOS
  - 75% had higher levels of PFOA
  - 59% had higher levels of PFNA

- Results are consistent with other studies on PFAS exposure through drinking water

<table>
<thead>
<tr>
<th>PFAS Compound</th>
<th>Average</th>
<th>95% Confidence Interval</th>
<th>Median</th>
<th>Range</th>
<th>Average</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOA</td>
<td>3.13</td>
<td>2.81-3.50</td>
<td>3.06</td>
<td>0.55-24.8</td>
<td>1.94</td>
<td>1.76-2.14</td>
</tr>
<tr>
<td>PFOS</td>
<td>10.24</td>
<td>8.86-11.83</td>
<td>9.86</td>
<td>1.02-105.00</td>
<td>4.99</td>
<td>4.50-5.52</td>
</tr>
<tr>
<td>PFHxS</td>
<td>6.64</td>
<td>5.51-7.99</td>
<td>6.61</td>
<td>0.54-116.00</td>
<td>1.35</td>
<td>1.20-1.52</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.74</td>
<td>0.67-0.80</td>
<td>0.76</td>
<td>0.50-2.56</td>
<td>0.68</td>
<td>0.61-0.74</td>
</tr>
</tbody>
</table>

• Results shown in ug/L. Range excludes <LOD
Results Overall – Univariate Analyses

- In general, PFAS levels increased with:
  - Age
  - Male gender
  - Residence time
  - BMI
  - Private well use
  - Quantity of tap water consumed
  - Water service area’s proximity to military base
Serum PFAS levels among participants in different PWS areas (includes all drinking water sources)

<table>
<thead>
<tr>
<th>PFAS Compound</th>
<th>HWSA (n=69)</th>
<th>WMA (n=98)</th>
<th>WTWSD (n=41)</th>
<th>WTWSD/NWWA (n=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>95% C.I.</td>
<td>Average</td>
<td>95% C.I.</td>
</tr>
<tr>
<td>PFOA</td>
<td>3.69</td>
<td>2.99-4.56</td>
<td><strong>3.17</strong></td>
<td>2.71-3.71</td>
</tr>
<tr>
<td>PFOS</td>
<td><strong>12.38</strong></td>
<td>9.47-16.19</td>
<td><strong>10.06</strong></td>
<td>8.06-12.57</td>
</tr>
<tr>
<td>PFHxS</td>
<td>8.81</td>
<td>6.28-12.37</td>
<td><strong>6.98</strong></td>
<td>5.32-9.16</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.79</td>
<td>0.68-0.92</td>
<td><strong>0.72</strong></td>
<td>0.62-0.84</td>
</tr>
</tbody>
</table>

- Results shown in ug/L
- Significant difference in levels of all four PFAS (P≤0.05 for all) among PWS areas
<table>
<thead>
<tr>
<th>PFAS Compound</th>
<th>HWSA (n=61)</th>
<th>WMA (n=83)</th>
<th>WTWSD (n=31)</th>
<th>WTWSD/NWWA (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average 95% C.I.</td>
<td>Average 95% C.I.</td>
<td>Average 95% C.I.</td>
<td>Average 95% C.I.</td>
</tr>
<tr>
<td>PFOA</td>
<td>3.65 2.89-4.60</td>
<td>3.24 2.73-3.84</td>
<td>3.63 2.76-4.78</td>
<td>1.63 1.25-2.11</td>
</tr>
<tr>
<td>PFHxS</td>
<td>8.90 6.11-12.96</td>
<td>7.19 5.31-9.73</td>
<td>7.69 5.41-10.92</td>
<td>2.42 1.55-3.79</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.76 0.65-0.89</td>
<td>0.72 0.60-0.85</td>
<td>0.81 0.66-0.99</td>
<td>0.56 0.51-0.61</td>
</tr>
</tbody>
</table>

- Results shown in ug/L
- Significant difference (P≤0.05) in levels of all four PFAS compounds
- Consumers in HWSA had higher mean serum levels for all 4 PFAS compounds except PFNA and PFOS
Serum PFAS Levels - Private Well Users – Current Address

<table>
<thead>
<tr>
<th>PFAS Compound</th>
<th>HWSA (n=1) Average 95% C.I.</th>
<th>WMA (n=10) Average 95% C.I.</th>
<th>WTWSD (n=3) Average 95% C.I.</th>
<th>WTWSD/NWWA (n=6) Average 95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOA</td>
<td>7.78 (7.78-7.78)</td>
<td>3.23 (2.30-4.55)</td>
<td>4.87 (2.43-9.79)</td>
<td>2.33 (1.27-4.28)</td>
</tr>
<tr>
<td>PFOS</td>
<td>23.60 (23.60-23.60)</td>
<td>12.59 (8.36-18.97)</td>
<td>15.94 (7.19-35.33)</td>
<td>7.55 (5.86-9.74)</td>
</tr>
<tr>
<td>PFHxS</td>
<td>25.90 (25.90-25.90)</td>
<td>8.05 (4.48-14.47)</td>
<td>11.75 (8.99-15.35)</td>
<td>2.29 (0.99-5.28)</td>
</tr>
<tr>
<td>PFNA</td>
<td>1.44 (1.44-1.44)</td>
<td>0.76 (0.58-0.99)</td>
<td>0.96 (0.68-1.35)</td>
<td>0.69 (0.37-1.31)</td>
</tr>
</tbody>
</table>

- Results shown in ug/L
- Significant difference in levels of all four PFAS compounds
- HWSA had higher PFAS serum levels
• Serum PFAS levels were higher for private well water users compared to public water users in all PWS areas (not statistically tested - small sample size)

• Both public water users and private well users in the area of HSWA had higher serum PFAS levels compared to study participants in the PWS area of WTWSD/NWWA
Serum PFOS levels by PWS area
Results—Multivariate analysis

- Multivariate analysis = when we analyze more than two variables (e.g. age, sex, water source, serum PFAS levels, etc.) at the same time.

- It lets us predict the effect a change in one variable will have on the outcome variable while controlling for the effects of other variables.

- Analysis determined that average serum levels for PFOA, PFOS, PFHxS and PFNA were **positively associated** with drinking water source, and total length of residence in the study area.
Multivariate analysis did not account for the location of private well/bottled water users.

- Public water users were geocoded to the correct PWS area based on their addresses.
Multivariate analysis

- Demographic characteristics
  - age
  - gender
  - education

- Exposure characteristics
  - water source at current address
    - HSWA, WMA, WTWSD, WTWSD/NWWA, private well, other
  - quantity of water consumed at current address
  - total length of residence in the study area
  - employment information - ever employed on the base, in the area

- Health information
  - health status, BMI
Multivariate analysis - Results

- Overall, serum PFAS (PFOA, PFOS, PFHxS and PFNA) levels were positively aligned with total length of residence in the study area.

- Those who lived in the area more than 10 years generally had higher PFAS serum levels compared to those who lived in the area less than 10 yrs).

<table>
<thead>
<tr>
<th>Total Length of Residence</th>
<th>PFOA percent higher</th>
<th>PFOS percent higher</th>
<th>PFHxS percent higher</th>
<th>PFNA percent higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-19 yrs</td>
<td>22.5%</td>
<td>89.1%</td>
<td>49.8%</td>
<td>17.3%</td>
</tr>
<tr>
<td>20-29 yrs</td>
<td>27.7%</td>
<td>66.0%</td>
<td>67.6%</td>
<td>5.8%</td>
</tr>
<tr>
<td>30-39 yrs</td>
<td>38.9%</td>
<td>77.9%</td>
<td>65.4%</td>
<td>46.1%</td>
</tr>
<tr>
<td>40+ yrs</td>
<td><strong>55.4%</strong></td>
<td><strong>124.3%</strong></td>
<td><strong>171.8%</strong></td>
<td>17.0%</td>
</tr>
</tbody>
</table>

Bold = statistically significant (p≤0.05)
Multivariate analysis - Results

- In general, PFAS levels were higher the closer the water source was to the military base.
- Water sources were compared to the source farthest from the military bases (WTWSD/NWWA reference group):

<table>
<thead>
<tr>
<th>Drinking water source</th>
<th>PFOA percent higher</th>
<th>PFOS percent higher</th>
<th>PFHxS percent higher</th>
<th>PFNA percent higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWSA</td>
<td>157.4%</td>
<td>168.5%</td>
<td>257.2%</td>
<td>33.6%</td>
</tr>
<tr>
<td>WMA</td>
<td>104.5%</td>
<td>88.5%</td>
<td>137.4%</td>
<td>15.3%</td>
</tr>
<tr>
<td>WTWSD</td>
<td>94%</td>
<td>98.7%</td>
<td>113.9%</td>
<td>10.4%</td>
</tr>
<tr>
<td>Other (bottled water, unknown)</td>
<td>78.1%</td>
<td>97.84%</td>
<td>77.2%</td>
<td>29.6%</td>
</tr>
<tr>
<td>Private Well</td>
<td>105.9%</td>
<td>101.24%</td>
<td>97.9</td>
<td>38.6%</td>
</tr>
</tbody>
</table>

Bold = statistically significant p ≤ 0.05

WTWSD/NWWA reference group
### Multivariate analysis - Results

- Higher serum levels associated with proximity to the base
- HWSA consumers compared to WTWSD/NWWA consumers
  - 157% higher PFOA
  - 169% higher PFOS
  - 257% higher PFHxS
  - 34% higher PFNA

<table>
<thead>
<tr>
<th>Comparison</th>
<th>PFOA (%)</th>
<th>PFOS (%)</th>
<th>PFHxS (%)</th>
<th>PFNA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMA compared to WTWSD/NWWA</td>
<td>105%</td>
<td>89%</td>
<td>137%</td>
<td></td>
</tr>
<tr>
<td>WTWSD compared to WTWSD/NWWA</td>
<td>94%</td>
<td>99%</td>
<td>114%</td>
<td></td>
</tr>
<tr>
<td>“Other” category compared to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WTWSD/NWWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private well users compared to</td>
<td>106%</td>
<td>101%</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>WTWSD/NWWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

[Map showing areas and percentages]
Multivariate analysis - Results

- Average PFHxS serum levels 32% higher in men than women

- Average PFHxS serum levels 35% higher in employed than never employed in study area (self-reported)

- Average PFOA serum levels of participants consuming 4-7 cups of tap water daily were 29% higher than participants consuming 0-3 cups daily

- Average serum levels of PFOA, PFOS and PFNA increased with participant age
Atlanta, March 18–19, 2019

- PA DOH and NY DOH presented PEATT findings
- New York saw similar results to ours
- New York had many more resources available to them
PEATT Expansion—Exposure Assessment

- Expansion project – Kickoff call April 15th
- Urine, dust, and water sampling of current participants
  - Will collect urine from all of our initial participants (235)
  - Will analyze 10% of samples
  - If geometric mean exceeds 95th percentile—all samples will be analyzed
- Dust and water sampling on 10% of current participating households
• PA DOH will collect and ship urine samples
• CDC will store and analyze urine (no cost)
• PA DOH will contract with outside lab to collect and analyze dust and water
  ▪ Initial announcement and letters to participants – May 2019
  ▪ Sample collection – June-July 2019
Multi-Site Health Study Opportunity

- CDC/ATSDR taking applications to participate in Multi-Site National Health Study
- Will study health implications of exposure to PFAS-contaminated drinking water
- Six sites will be accepted and given grants
- Goal is to enroll at least 6,000 adults and 2,000 children (in total across all sites)
- Research oriented, competitive grant
Multi-Site Health Study Opportunity

• Historical reconstruction of water and serum PFAS concentrations using models

• Will study health conditions including high cholesterol, immunity issues, and thyroid function

• Can propose additional research questions for study
  
  ▪ DOH is considering cancer-related investigator initiated (University) study

• Application due May 30th
Our Partners

- Centers for Disease Control and Prevention (CDC)
- Association of State and Territorial Health Officials (ASTHO)
- Agency for Toxic Substances and Disease Registry (ATSDR)
- Bucks County Health Department
- Montgomery County Health Department
- New York State Health Department Laboratory
- Pennsylvania Department of Environmental Protection
PEATT Pilot Project Team

• Dr. Sharon Watkins
• Dr. Anil Nair
• Dr. Farhad Ahmed
• Dr. Marshal Ma
• Susan Schrack Wood
Should you have any questions or concerns, feel free to contact us at env.health.concern@pa.gov or by phone at 717-787-3350

For more information:

https://www.health.pa.gov/topics/envirohealth/Pages/PFAS.aspx
Recommendations

• Selection Process
  - Option to include volunteer participants and special categories of exposure (i.e. veterans)
  - Create initial eligibility form to determine number of participants in a household. This facilitates sending the correct number of forms to a household, along with return postage-paid envelopes

• Questionnaires
  - Need to accommodate for long duration of exposure
  - Fewer open-ended questions and more structured, multiple choice questions for health conditions
  - Guidance for households with college-aged children (considered residents?)
  - Blood donation/transfusion/major surgeries
Recommendations

• Participant Drop-out
  - Paper questionnaire visually overwhelming- consider online survey options with built-in “skips” to lessen the perceived burden
  - Streamline the participation process- possible online scheduling for clinics
  - Consider visiting nurses/teams to collect information
  - Possible tokens of appreciation

• Results Process
  - Letter templates complete for information and numbers, but limited in psychological comfort for those with high levels

• Additional Guidance
  - Literature review and continuing education on PFAS studies and the current state of the science regarding this emerging contaminant