Overview of Minnesota PFAS Response

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Pennsylvania PFAS Action Team Meeting
Minnesota’s Experience: Early Discovery of PFAS Legacy Sites

- 3M first disclosed PFAS manufacturing activities to state officials in 2002
- Major manufacturing plant, 3 major disposal sites, WWTP sludge disposal at small city landfill
- PFAS activities dated back to the late 1940s
- All sites were in various stages of remediation due to other contaminants
Historical Overview of Contamination

• 2002: PFAS contamination found at water supply at 3M plant; request for development of health-based guidance values for PFOS & PFOA

• 2004: investigation of legacy disposal areas found PFOS & PFOA contamination in drinking water supplies of several suburbs - - initiating an extensive effort to test public & private wells in the area

• 2006: new analytical methods, adding PFBA, PFPeA, PFHxA, PFBS & PFHxS. Resulted in uncovering much larger area of contamination

• 2007 – 2017: derived/revised guidance values for PFBA, PFBS, PFOA & PFOS; used PFOS as a surrogate for PFHxS
To date:

- Multiple public water supplies and >3,000 private wells have been sampled
- 5 public water systems have wells > current guidance
- > 1,000 private wells > current guidance
- East Metro plume covers > 150 square miles, affecting drinking water of >140,000 Minnesotans ("Megaplume")
- Remedial actions at PFAS disposal sites; including complete excavation and re-burial of waste
- Carbon filtration installed at affected public water systems, residents with contaminated private wells provided whole-house carbon filtration or moved to city water
- Statewide evaluations of other potential sources (e.g. fire-training facilities, chrome plating operations, WWTP)
Responding to Community Concerns

• Water Filtration Testing
  • Very little information at first
  • Laboratory and field testing confirmed viability of GAC, reverse osmosis, and small consumer units

• Garden Produce Study
  • Identified uptake of PFAS in produce grown in gardens irrigated with PFAS contaminated water
  • Primarily PFBA
  • Below levels of health concern
    (Scher et al., 2018, Chemosphere, v. 196)
• Consent Decree between MPCA and 3M in 2007 guides investigation, remediation and response activities at legacy sites

• Minnesota AG filed Natural Resource Damages lawsuit in 2010

• Lawsuit settled in February of 2018 for $850 Million to focus on drinking water and natural resource improvements

• One to two year process to determine priorities for funding; short-term funds available for immediate actions

• https://3msettlement.state.mn.us/
East Metro PFAS Biomonitoring Projects

• Directed by Minnesota Legislature in 2007 to test blood levels in East Metro communities (MN Statutes 144.995-144.998)

• Focused on adults in 2 communities: municipal water and private well users


• Questions addressed
  • Are residents in affected communities having unusual PFAS exposures?
  • Have efforts to reduce drinking water exposure to PFAS worked?
  • Do other factors (such as diet, consumer products, occupation) help explain PFAS levels?
How biomonitoring studies worked

• Participants randomly selected
  • Water utility billing records
  • Lists of people with contaminated private wells

• Contacted participants by mail, asked for informed consent, sent questionnaire

• Gave blood sample at local health clinics

• MDH Public Health Laboratory analyzed blood samples for 7-8 PFAS

• Returned individual and group results to participants

(Landsteiner et al., 2014, Journal of Environmental Health, v. 77)
PFAS blood levels in long-term East Metro Residents (n=149)
PFAS in New Oakdale Residents (2014, n=156)

- **PFOS Geometric mean (ng/mL)**: 7.2 (New Oakdale residents), 6.3 (US population)
- **PFOA Geometric mean (ng/mL)**: 1.8 (New Oakdale residents), 2.1 (US population)
- **PFHxS Geometric mean (ng/mL)**: 1.6 (New Oakdale residents), 1.3 (US population)
Overview of PFAS Health Effects

• Epidemiology Studies (associations, not causal)
  • Developmental (e.g., ↓ birth weight)
  • Endocrine (e.g., thyroid homeostasis)
  • Immune (e.g., ↓ vaccine response, ulcerative colitis)
  • Kidney (e.g., ↑ uric acid)
  • Liver (e.g., ↑ serum lipids and liver enzymes)
  • Cancer (e.g., testicular, kidney)

• Laboratory Animal Studies (causal)
  • Developmental Effects (e.g., ↓ body weight, delayed puberty & mammary gland development ♀, accelerated puberty ♂, changes in lipid metabolism & liver histology)
  • Endocrine (e.g., ↓ thyroid hormones)
  • Immune (e.g., ↓ immune response, ↓ spleen & thymus weight)
  • Kidney (e.g., ↑ organ weight)
  • Liver (e.g., ↓ cholesterol, ↑ organ weight, evidence of cellular damage)
  • Cancer?
# MDH – 2017 PFAS Water Guidance

<table>
<thead>
<tr>
<th>PFAS</th>
<th>Health Endpoints¹</th>
<th>Mean Human Half-life² (~5 – 95th percentile range)</th>
<th>Water Guidance (µg/L) 2017</th>
<th>Previous</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFBA</td>
<td>Liver, Thyroid</td>
<td>3 days (1.2 – 4.6 days)</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>PFBS</td>
<td>Developmental, Female Repro system, Thyroid</td>
<td>27.7 days (13.1 – 45.7 days)</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>PFHxS</td>
<td>(see PFOS)</td>
<td>5.3 years (2.2 – 14.6 years)</td>
<td>(PFOS as surrogate)*</td>
<td></td>
</tr>
<tr>
<td>PFOA</td>
<td>Developmental, Immune, Liver, Kidney</td>
<td>2.3 years (1.5 – 7.0 years)</td>
<td>0.035</td>
<td>0.3</td>
</tr>
<tr>
<td>PFOS</td>
<td>Developmental, Immune, Liver, Thyroid</td>
<td>5.4 years (2.2 – 8.5 years)</td>
<td>0.027*</td>
<td>0.3</td>
</tr>
</tbody>
</table>

¹Used in additivity (mixtures) assessments
²Extreme values removed
*PFOS currently under re-evaluation and PFHxS under review

More information can be found at: [http://www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html](http://www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html)
Standard Health-Based Guidance (HBG) is based on:

- Reference Dose (RfD) – represents a dose at which there is little or no risk of health effects (for PFOA and PFOS this dose is best represented by a serum concentration)
- Water Intake Rate – how much water someone drinks per day on a per-body weight basis. Chronic intake rates typically used.
- Relative source contribution (RSC) – Multiple sources of exposure can come from water so that total exposure does
Additional Exposure Concerns

• Impact of Bioaccumulation Potential
  • Long half-life results in exposures, even short duration, to stay in body for years beyond period of external exposure
  • Repeated exposures lead to accumulation (build-up) within the body
  • Water concentrations in ppt result in serum concentrations in ppb
  • Accumulated levels can be transferred to offspring
    • Placental transfer and Breastmilk transfer
  • Much higher fluid intake rates in infants & young children
Additional (indirect) Exposure Concerns

- PFOA

Direct Water Intake Only Value = 0.15 µg/L
Placental, Breastmilk + Direct Water Ingestion Value = 0.035 µg/L
MDH Guidance Summary

• Based on protection of susceptible & highly exposed populations
• Protective for tap water used for drinking, cooking, showering, and other uses
• Cumulative – additivity assessment of chemicals with similar health endpoints

Breastfeeding can be a significant exposure pathway for PFHxS, PFOS, and PFOA. However, breastfeeding is important for the short and long term health of both a mother and infant. MDH recommends that women currently breastfeeding, and pregnant women who plan to breastfeed, continue to do so.
Conclusions

• Response takes many years (+ 10 years here)

• Response across programs and agencies was crucial, required good coordination

• Significant capacity needed for effective response
  • Just within MDH: Toxicology/risk assessment, hydrogeology/water sampling, health education/communications, lab analysis, biomonitoring/epidemiology

• Can be very concerning for affected communities

• Increase in awareness and data will help future efforts
Questions?

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