November 2021 Meeting of the Scientific Guidance Panel for Biomonitoring California

Summary of Input and Recommendations

The Scientific Guidance Panel (SGP) for the California Environmental Contaminant Biomonitoring Program (also known as Biomonitoring California) met virtually on November 8, 2021. This document briefly summarizes input and recommendations received from the Panel, as well as the range of topics discussed with guest speakers and the audience. Visit the November 2021 SGP meeting page to access the presentations, complete transcript, written public comments, and other meeting materials.

Program Update and Overview of California Activities on Perfluoroalkyl and Polyfluoroalkyl Substances

Presentation: Nerissa Wu, PhD, MPH, California Department of Public Health (CDPH)
Presentation: Karl Palmer, Department of Toxic Substances Control (DTSC)
Presentation: Kathleen Attfield, ScD, CDPH

Panel members discussed the following topics with staff presenters:

- Using biomonitoring and exposure pathway analysis to understand cumulative exposures to perfluoroalkyl and polyfluoroalkyl substances (PFASs) and inform regulatory action.
    - Biomonitoring provides a measure of cumulative exposures to PFASs.
    - Exposure questionnaires administered in Program studies are limited in terms of identifying specific sources.
    - Collecting complementary data on PFAS levels in drinking water, dust, food, and consumer products would improve exposure pathway analysis.
    - Modeling of cumulative/multiple pathway exposures linked to pharmacokinetics could help illuminate determinants of PFAS exposures (e.g., work by Matt MacLeod, with whom the Program is collaborating).
    - Regulatory language often does not address cumulative exposures.
    - We have a robust cross-agency collaboration in California on PFASs and are working to coordinate efforts to address these important compounds.
- Extent of questionnaire data collected in Program studies on seafood consumption to inform analyses of biomonitoring data on PFASs, arsenic, and mercury.
    - The California Regional Exposure (CARE) Studies collected general information on seafood consumption.
    - The questionnaires for the Asian/Pacific Islander Community Exposures (ACE) Project included detailed questions on the types of fish and shellfish that participants consumed (visit the November 2018 SGP meeting page to view these).

- Biomonitoring California's contribution[1] in identifying chemical classes (defined by chemical structure/function) for consideration as designated chemicals, which has benefited other programs inside and outside of government.
- Options for addressing PFAS contamination in the California environment.
    - The US Environmental Protection Agency (US EPA) has begun the process of proposing to list certain PFASs as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which would bring these into the domain of state and federal clean-up authorities.
    - US EPA has also been petitioned to add PFAS-containing waste as a hazardous waste under the Resource Conservation and Recovery Act (RCRA).
    - DTSC's Safer Consumer Products program aims to tackle this problem upstream by encouraging safer alternatives.
- Improving access to the Program's biomonitoring data, currently posted as tables in the online results database.
    - Displaying the data in an interactive format could be helpful for communities. (This would require additional Program resources to implement.)
    - Describe on our website which Program data could be made available to researchers for analyses (e.g., investigating predictors of PFAS exposures) as a way to facilitate these external collaborations.
- The importance of consulting with communities to learn about their priorities and inform Program directions.
- Challenges with establishing temporal trends in chemical exposures, which is important for evaluating policy interventions aimed at reducing chemical exposures.
    - This would require repeated measurements of chemicals in populations over time, which would require a level of effort and resources comparable to NHANES.[2]
- The importance of monitoring exposure disparities and how they change over time.
    - For example, there have been continuing/increasing exposures to flame retardants in some populations versus exposure reductions in other populations.

Public comment:

- Nancy Buermeyer of Breast Cancer Prevention Partners expressed appreciation for Biomonitoring California's listing of the class of PFASs as priority chemicals. The class approach supported passage of bills to ban PFASs in food packaging, juvenile products, and firefighting foam, and facilitated requirements to disclose PFASs in

[1] Krowech G, Hoover S, Plummer L, Sandy M, Zeise L, Solomon G (2016). Environ Health Perspect 124(12):A219-226. Free full text article.
[2] National Health and Nutrition Examination Survey conducted by the Centers for Disease Control and Prevention.

various consumer product sectors, such as cleaning products, fragrances and flavors, personal care products, and cookware.
- Sharyle Patton, Director of the Commonweal Biomonitoring Resource Center, commented that the pesticides hexaflumuron and novaluron contain PFASs and are registered for use in California.

Methods for PFAS Analysis: Possibilities and Challenges

Presentation: Anna Kärrman, PhD, Örebro University

Topics discussed in the question period after this presentation included:
- Differences in methods required to measure PFASs in drinking water versus consumer products (e.g., need to concentrate/extract the organofluorine and address inorganic fluorine in drinking water, neither of which should apply for consumer products).
- Methods for measuring PFASs and total fluorinated compounds, including:
    - Combustion ion chromatography
    - High resolution mass spectrometry (MS), such as orbitrap MS
    - Ion mobility MS
    - Mass defect plots
- The finding that total organofluorine was higher in women than men, while men had higher levels of targeted PFASs.
    - Differing use of certain personal care products or pharmaceuticals might account for the higher organofluorine levels in women, but these findings are still under investigation.

Relative Importance of PFAS Exposure Sources for the General U.S. Population

Presentation: Tom Webster, DSc, Boston University School of Public Health

Topics discussed in the question period after this presentation included:
- Approaches for better understanding the complexities of PFAS exposure pathways.
    - To really sort this out, detailed sampling of exposures sources, particularly diet, would need to be carried out. The resources to fund such an effort are unlikely to be available.
    - Pharmacokinetic modeling was discussed as another option, with the work by Matt MacLeod again highlighted.
- Testing biological samples for potential indicators of PFAS exposure sources.
    - For example, mercury is strongly associated with fish consumption, so testing that along with PFASs could help evaluate that exposure source.
- Potential cross-contamination of biological samples during sample collection or storage, given the ubiquitous presence of these compounds.
    - PFASs can adsorb to glass containers and low density polyethylene.
    - Blanks are used to assess potential contamination; for traditionally analyzed PFASs this has generally not been a problem.

- Possible approaches for evaluating the impact on human exposures of phasing out PFASs in carpets.
    - Intervention studies in which carpets are replaced and exposure levels are tracked over time could be considered.
    - Tracing back compounds found in indoor air or dust to their actual sources in the home is very challenging, and there has not been a lot of work done on that.
        - PFASs may not be simply released from carpets, there may also be abrasion mechanisms that should be accounted for.
        - There are known examples of high PFAS exposure levels associated with the use of protective sprays on furniture or carpet.
- Data gaps that need to be addressed when evaluating possible policy approaches to reduce or prevent exposures to PFASs.
    - One of the most important questions is the presence of unexplained organic fluorine.
        - If there are important PFASs that do not have available standards, this could be a significant problem.
        - If the unexplained organic fluorine can be traced to pharmaceuticals or pesticides, that raises very different implications for policy.
    - Understanding PFAS exposures from diet, which appears to be a major route, is essential.
        - Removing PFASs from food packaging is an important step to take in the meantime.

PFAS in Indoor Environments and Drinking Water: Relevance for Human Exposure

Presentation: Kate Hoffman, PhD, Duke University

Topics discussed in the question period after this presentation included:

- Associations between maternal and child PFAS exposure.
    - The TESIE (Toddlers' Exposure to SVOCs [semi-volatile organic contaminants] in the Indoor Environment) study found associations between maternal serum and children's PFAS levels.
    - Disentangling whether the association is due to prenatal exposures (PFASs can cross the placenta), post-natal exposures via breastmilk, the shared environment, or a combination of these factors, is challenging.
- Examining exposure sources for one PFAS congener compared to another, given that they are so correlated.
    - Finding a clear pattern in these correlations is difficult.
    - Some factors to evaluate include use of common products, presence of similar types of items in homes, and socioeconomic status that influences consumer purchasing and diet.
- Methods to reduce PFASs in drinking water.
    - Some municipal locations will stop using a contaminated well, while others may dilute water from a contaminated source or use carbon filtration.

    - The effectiveness of home-based filtration methods for removing PFASs was variable; discarding or recycling those filters puts the PFASs back into the environment.
- Variability in PFAS levels by race/ethnicity.
    - PFAS biomarkers were generally higher in non-Hispanic white participants compared to the non-Hispanic Black and Hispanic participants in the TESIE cohort.
- Best practices when collecting indoor dust samples.
    - Need to consider variability of compounds within different areas of the home.
    - Home characteristics (e.g., ventilation, presence of carpets) are also important to consider.
    - Might be beneficial to sample in multiple rooms throughout the home.
- Sources of airborne PFAS precursors in the home.
    - Carpets are a potential source.
    - The outdoor environment is unlikely to be the source, since PFAS levels are generally higher indoors.
    - There is some seasonal variability with lowest levels occurring during spring and fall, which could be due to differences in ventilation (windows being open).
    - Limited data can be gathered through questionnaires.
- Correlations between levels of PFAS in air and dust in the home are not well understood.
- The potential for natural experiments given increased ventilation during the COVID-19 pandemic.
    - This is a unique period when many people were in their own homes for long periods of time, and not at school or work.
    - Differences in behavior by socio-economic status must be considered as many people were unable to stay home due to the nature of their work.

PFAS Biomonitoring to Support Exposure Reduction Efforts: Next Steps

Background document: Selected references on PFASs

Additional background reference: Krowech et al. (2016). Identifying chemical groups for biomonitoring

Introduction: Meg Schwarzman, MD, MPH, SGP Chair

The Panel, guest speakers, and audience discussed a range of topics, including:

- Locations of potentially significant sources of PFAS exposures in California:
    - There are no known large manufacturers of PFAS in California, however the Program could look into possible locations which might be of concern for PFAS exposures.
    - Wastewater treatment plants could be a source of concern.
    - Take into account environmental justice issues in evaluating communities with potentially higher PFAS exposures.

- The importance of identifying specific PFASs used in products of interest and other applications.
    - Bills requiring public disclosure of PFAS ingredients is one way this is being tackled.
    - This would allow for more precise monitoring of relevant PFASs, support the evaluation of regulatory actions to reduce exposures, and inform the identification of safer alternatives.
- Assessing PFAS trends and evaluating impacts of regulatory or other actions designed to reduce exposures.
    - Look at shifting market trends in PFASs, driven by changes such as reformulation of consumer products or removal of PFASs from food contact materials, and see how that plays out in biomonitoring data.
    - Identify municipalities with different PFAS policies and compare biomonitored levels of PFASs.
        - One example would be to see how temporal trends in Orange County compare with elsewhere, since they started water treatment for PFASs in 2020.
    - Biobank samples could be used to look back at historical PFAS levels and track whether those levels have decreased over the relevant time period (e.g., before and after a particular market shift or regulatory action).
    - Underscores the importance of PFAS surveillance.
- Identifying the most important determinants of PFAS exposures, which could include:
    - Socioeconomic status
    - Race/ethnicity
    - Diet (e.g., fish)
    - Geography
    - Parity
- Studying occupational groups at greater risk of PFAS exposures, which could include:
    - Workers at certain chemical manufacturing facilities (e.g., fluoropolymer facilities)
    - Workers at chrome plating facilities
    - Firefighters
    - Workers in the carpet industry (manufacturing, sales, and/or recycling)
    - Military personnel or people who live on military bases
    - Workers involved in manufacture and/or use of food packaging
    - Workers that use PFAS-containing products (e.g., ski wax; protective sprays for furniture)
- Dust as a potential reservoir for PFAS.
    - May be responsible for some of the variability in air levels due to the partitioning of PFAS.
- Sources of background PFAS levels in laboratory analyses
    - DTSC's laboratory found that a newly installed instrument was the primary source of PFAS background levels (6:2 fluorotelomer sulfonate).

- Possible update of Biomonitoring California definition of PFASs.
    - The Program will review Buck et al. (2011) and discuss further at a future SGP meeting.
- Engaging with external researchers to analyze existing Biomonitoring California data on PFASs and other chemicals.

Plan for 2022 SGP Meetings

Presentation: Sara Hoover, MS, OEHHA

The presentation outlined the simplified plan for 2022 SGP meetings, which Panel members supported.

Open Public Comment

Submissions from Dr. Ahimsa Porter Sumchai

Unraveling the Breast Cancer Conundrum in San Francisco
Biomonitoring Saves A Life
Environmental Justice: Signed…Sealed…and Delivered