**Supplemental Exposure Investigation (EI) at Select PFAS Exposure Assessment Sites**

ATSDR Exposure Investigations (EI) Generic Information Collection Request

OMB No. 0923-0048

**Attachment 2: Supporting Statement Part B**

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# B. Collections of Information Employing Statistical Methods

This is no statistical methodology used for this investigation. Section B.1 of the submission (below) describes how the data will be collected.

## B.1. Respondent Universe and Sampling Methods

Since the Agency for Toxic Substances and Disease Registry (ATSDR) does not use the exposure investigation (EI) results to generalize or estimate the total exposed population, the respondent universe and statistical methods for determining sample size are not a factor.

The purpose of the “Supplemental Exposure Investigation (EI) at Select Exposure Assessment Sites” (called Environmental Sampling EI) is to evaluate non-drinking water sources of PFAS at two Exposure Assessment (EA) sites. The EAs were intended to evaluate the body burden of PFAS in communities known to have had drinking water impacted by PFAS. The results of the environmental sampling will be used along with the questionnaire results from the EAs and this EI to evaluate the serum PFAS results in participants. Two EA locations, Hampden County in MA and New Castle County in DE will be evaluated for this environmental sampling EI.

## B.2. Procedures for the Collection of Information

Recruitment for the EI will be conducted in the summer of 2021 and will include:

* Sending a letter to EA participants in MA and DE inviting them to participate. During the EA, the participants agreed to allow the results of the biological (serum, urine) and environmental sampling (tap water, dust) along with the EA questionnaire to be used for future PFAS evaluation in the community. They also agreed to allow ATSDR to retain their contact information and contact them in the future for PFAS work within the community.
* There are 247 households in MA and 134 households in DE that will be sent an invitation letter (Attachment 4). Participants are asked in the letter to call to make an appointment on a first-come-first serve basis: participation will be limited to 80 households in MA and 40 households in DE. Of the households to be sampled, 20 at each location will be identified for more robust sampling (indoor air, bulk dust, indoor wipes, soil, silicone wristbands) on a first-come-first serve basis; the remaining households will be have a filtered dust sample collected and all households will complete appropriate consent forms and questionnaires (Attachment 3).
* Households will be sent an appointment verification letter which will include appropriate consent forms and questionnaires for EA participants that live in the household. Sending the forms prior to the sampling will allow participants to complete consents and questionnaires without being required to be at home for the sampling.

On the day of the environmental sampling, the completeness of the consent forms and questionnaires will be verified and sampling will be completed. Samples will be sent to an accredited laboratory for analysis and participants will be sent their sampling results. ATSDR will complete and EI report for each location that will be presented to the community.

*Quality Control Procedures*

All environmental samples, data quality assurance and data quality control will be performed by an accredited laboratory in accordance with laboratory methods capable of quantifying PFAS in all sampled media since no EPA methods are available in the sampled media (see the SAP [Appendix D] in the protocol).

Questionnaire data will be collected on hard copy in the field and transferred to the Epi Info software tool and will be kept in a secure and encrypted electronic database.

All data will be transmitted via secure connections and methods to CDC/ATSDR for incorporation into a centralized data management repository protected by CDC/ATSDR network firewall and additional security access controls. All results will be electronically transmitted in spreadsheet format using a secured and password-protected network. Deidentified data will be transmitted to the US EPA Office of Research and Development (ORD) through a secured directory to allow for access by EPA.

Each participant is given information regarding the name of the EI, a telephone number to answer questions, and the address of the ATSDR website and a fact sheet that provides information on the EAs and this environmental sampling EI. Each participant receives a copy of their personal results (sample results letters provided in Attachment 6). Individual results will be protected to the full extent provided by law and will not be shared publicly in any published reports.

## B.3. Methods to Maximize Response Rates and Deal with Non-response

Two EA locations, Hampden County, MA and New Castle County, DE, were chosen for the additional environmental sampling. An “invitation to participate” letter will be sent to the households of all EA participants that agreed in the EA consent form to be contacted for future PFAS work at both locations: 247 households in MA and 134 households in DE (Attachment 4). CDC/ATSDR will request that EA participants contact us to make an appointment once the invitation letter is received.

CDC/ATSDR estimates a response rate of approximately 30% for this EI. For the EAs in MA, the response rate was approximately 8% (3000 household requests and 247 homes enrolled) and in DE, the response rate was approximately 4.5% (3000 requests and 134 homes enrolled). There were, however, many addresses that were not valid (e.g, invalid address, empty homes, commercial properties) and homes that were interested in participating, but were not eligible due to time of residency (participants had to be living in the sampling frame for at least a year prior to water mitigation). Given that the households we did enroll reflect an interested portion of the population, we are estimating a response rate of approximately 30% for this investigation.

## B.4. Test of Procedures or Methods to be Undertaken

The EI team will use the questions provided in Attachments 14, 15 and 16. Three questionnaires will be used for the EI: a household questionnaire that will be completed by one person for the household and will be applicable to all household residents, and personal exposure questionnaires for each household resident that provided a blood sample during the EA – there is a separate personal exposure questionnaire for adults and children.

## B.5. Individuals Consulted on Statistical Aspects and Individuals Collecting and/or Analyzing Data

Statistical calculations are not used to determine participation in EI. Statistical evaluation will, however, be used to evaluate the results.

ATSDR and EPA scientists will conduct statistical analysis to evaluate the collected data to allow for better interpretation of the serum PFAS results obtained during the PFAS EAs.

Descriptive statistics (mean or geometric mean, median, interquartile range, percentiles, minimum, maximum, % detected, etc.) will be prepared for each medium-analyte combination, as appropriate. Consistent with the procedures used to analyze the CDC/ATSDR PFAS Exposure Assessments, categorical responses with <10 values will be collapsed with other categorical responses. To meet the investigation objectives, we will perform several statistical analysis procedures (Table 1).

**Table 1: Investigation Objective Statistical Methodology**

|  |  |
| --- | --- |
| **Objective** | **Statistical Methodology** |
| Identify the presence/concentrations of PFAS in indoor and outdoor residential environmental media and estimate media and route specific intake doses, as appropriate. | We will generally follow procedures consistent with CDC/ATSDR’s exposure point concentration guidance document (ATSDR 2019) that describes the agency’s approach to handling of censoring and calculating summary values (in this case, median and interquartile range values), and confidence limits on these values. We will modify the procedures in the guidance to calculate two – sided, 95% confidence limits using percentile bootstraps. If censoring is present in the data, we will be following the CDC/ATSDR guidance and Helsel, 2011. If multiple observations are collected per household (e.g. dust microvacuum samples) they will be averaged by household prior to calculating summary statistics. |
| Evaluate association between sources of PFAS, their presence in environmental media, and exposure. | We have prepared a questionnaire (Appendix C) that relates several sources of PFAS to either environmental concentrations of PFAS in differing environmental media. Categorical questions with dichotomous responses will be evaluated for the effect on PFAS environmental media concentrations using two-sample Wilcoxon; Mann-Whitney (WRS) test. For instance, for question 16 in Appendix C1 (If you have carpet or rugs in your home, have you ever treated that carpet/rug with stain-resistant products?) , we will perform WRS to test the null hypothesis that the PFAS dust levels are the same in these homes.  Source questions with multiple categories will be evaluated with Kruskal-Wallis one-way analysis of variance, followed by pairwise comparisons using Dunn’s multiple comparisons with Benjamini and Hochberg as outlined in Helsel, Hirsch, Ryberge, Archfield and Gilroy 2020. The Dunn’s multiple contrast may be performed as a many – to – one comparison or all – pairs comparisons. For instance, question 23 in Appendix C1 (How often do you dust or wipe down surfaces in your home, including windowsills? ), we will test the null hypothesis that PFAS in dust in households with higher cleaning categories are lower than the lowest category (“Never”) using the Kruskal Wallis followed by Dunn’s one – to – many multiple contrast test. For questions such as Appendix C1 question 25, “Have you or do you currently use or have any of the following products in your home?” we will evaluate the null hypothesis of PFAS concentrations in household dust is the same across all usage levels for each product using the Dunn’s one – to – many multiple contrast test. Since there may be additive combinations of consumer product usage, we will use hierarchical clustering to look at combinations of consumer product usage and their effect on PFAS media levels. We will compare PFAS environmental media concentrations across these groups using Kruskal Wallis followed by Dunn’s test with all – pairs comparisons to identify if a cluster of consumer product usage is higher or lower than the others. |
| Use media specific concentration measurements to estimate media and route specific intakes; and  compare estimated intake doses to measured serum levels. | We will estimate route specific and media specific intake rates of PFAS. The total and route and media specific intake rates will be compared with serum measurements of PFAS from the Exposure Assessments. Because there is a high probability of censoring in both the dependent and the independent measurements, we will test the null hypothesis that there is no monotonic relationship between estimated intakes and serum PFAS using Kendall’s tau and the Akritas-Theil-Sen (ATS) line (Akritas, 1995, Helsel 2011).  For univariate and multiple regression analysis of the relationship of PFAS serum to the demographics, survey questions, and estimated exposure intake, we will use the R package “survey” (Lumley 2010) to account for household clustering (since there may be multiple observations of serum PFAS per household). For multivariate analysis, variable selection will follow backward stepwise procedures. To be consistent with the CDC/ATSDR Exposure Assessment, we will substitute nondetect values with the square root of two and use the log transformation to reduce the skew of the data. We will regress geometric means for PFAS with 60% or more detection rates. |

**References**

Akritas, M.G., Murphy, S.A., LaValley, M.P., 1995. The Theil-Sen Estimator With Doubly Censored Data and Applications to Astronomy. Journal of the American Statistical Association 90, 170–177. <https://doi.org/10.2307/2291140>

[ATSDR] Agency for Toxic Substances and Disease Registry. 2019. Exposure Point Concentration Guidance for Discrete Sampling. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, July 12.

Benjamini, Y., and Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. Journal of the Royal Statistical Society Series B, 57, 289–300. doi: 10.1111/j.2517-6161.1995.tb02031.x. <https://www.jstor.org/stable/2346101>.

Helsel D. 2011. Statistics for Censored Environmental Data using Minitab and R, second Edition. Hoboken, NJ: John Wiley and Sons.

Helsel, D.R., Hirsch, R.M., Ryberg, K.R., Archfield, S.A., and Gilroy, E.J., 2020, Statistical methods in water resources: U.S. Geological Survey Techniques and Methods, book 4, chapter A3, 458 p., https://doi.org/10.3133/tm4a3. [Supersedes USGS Techniques of Water-Resources Investigations, book 4, chapter A3, version 1.1.]

T. Lumley (2010) Complex Surveys: A Guide to Analysis Using R. John Wiley and Sons. Hoboken, NJ: John Wiley and Sons.