Trends and Findings: Human Blood Serum Levels of PFAS in Relation to Regulatory Target Levels

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Background/Objectives. Human health-based criteria and standards for PFAS in drinking water and groundwater are remarkable for their low magnitude of concentrations, ranging from USEPA's drinking water health advisory values for PFOS and PFOA (70 parts per trillion [ppt]; USEPA, 2016) to individual state values that are as low as Illinois state's 2 ppt standards (IEPA, 2021), with more recent criteria becoming increasingly stringent. Several of the state-specific PFAS drinking water standards are based on target blood serum levels of individual PFAS compounds that are assumed to be health-protective. The water-based criteria are then developed to correspond to a target blood serum level of PFAS, under the assumed exposure and toxicity values used in the guideline development. On the other hand, biomonitoring data for PFAS in blood serum are also available for the general population and many sub-populations in the US and other countries. Substantial declines in concentrations of long-chain PFAS have been noted in the last two decades but the regulatory significance of this decline is not clear. This study evaluates blood serum biomonitoring data for selected PFAS in relation to the blood serum target levels.

Approach/Activities. This study reviews the available blood serum biomonitoring data for a range of populations in the US in relation to target blood serum levels associated with regulatory values for selected PFAS compounds and shows that some target serum levels may have already been attained or are likely to be attained, considering on-going trends. Target blood serum levels associated with drinking water criteria for PFOS and PFOA were extracted or calculated from the technical support documents accompanying the criteria for several agencies including USEPA's Lifetime Health Advisories (LHAs) (USEPA, 2016), and several states including California, Massachusetts, Michigan, New Hampshire and New Jersey (OEHHA, 2019, 2021; Mass DEP, 2020; EGLE, 2020; NHDES, 2019; NJDEP, 2017, 2018). The derived target serum concentrations for each agency or state were compared and differences in heath-based criteria and methodology were noted. The target serum levels were compared to population-level serum levels reported in biomonitoring studies including National Health and Nutrition Examination Survey (NHANES) and state-specific biomonitoring programs. Trends in serum concentrations relative to the target serum levels were evaluated.

Results/Lessons Learned. The surprising findings and implications of the relative effectiveness of product phase-outs and/or environmental controls in attaining population-wide target serum levels are discussed in relation to different types of PFAS groups. Recommendations are presented for using this approach to illuminate PFAS management strategies. Some initial findings include: a decreasing trend in blood PFAS concentrations at the national level coupled with a trend of more stringent PFAS water standards. Regulatory levels differ substantially based on the methodology, target receptors, exposure parameters, and health-based criteria used. Non-cancer-based target serum levels have been met for the general population in many states. However, the more stringent target serum levels based on cancer endpoint, or the lowest non-cancer endpoint may be exceeded by up to an order of magnitude in some states. The importance of continuing biomonitoring for PFAS serum levels is to elucidate trends in compliance that provide perspective for a complex emerging chemical class is demonstrated.