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Spotlight on ATSDR: Exposure Investigations

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One way that the Agency for Toxic Substances and Disease Registry (ATSDR) accomplishes its mission of serving the public by promoting healthy and safe environments and preventing harmful exposures is by investigating and evaluating the potential public health consequences of exposures to environmental contamination at a community or site-specific level (ATSDR, 2013a). The first step in this process often involves reviewing and analyzing existing environmental and exposure-related data to find out whether people have been, are being, or may be exposed to environmental contaminants. ATSDR typically relies on environmental and exposure-related data provided by state and federal partners. In cases where critical data are not available and may not be forthcoming from another agency, ATSDR can conduct a site-specific exposure investigation to fill an identified data gap. Exposure investigations may include collection of (1) environmental samples of soil, water, air, or biota (e.g., fish, crab, fruits, or vegetables that people consume) and/or (2) biological samples of a person's urine or blood that may contain biomarkers suggesting exposure to a specific contaminant.

ATSDR uses the following criteria to determine whether a proposed exposure investigation is feasible:

- Can an exposed population be identified?
- Does a critical data gap exist that affects our ability to determine if a health hazard exists?
- Can an exposure investigation be designed that will address the critical data gap?
- Will the results of the exposure investigation affect the public health decision(s) for the site?

Additionally, during the planning stages, specific and detailed attention must be given to the design of an exposure investigation to ensure that it is grounded in published scientific methods. In practical terms, this means that for exposure investigations involving environmental sampling, valid sample collection, sample analytical methods, and health-based comparison values for the environmental media being tested must be available. Similarly, for exposure investigations involving biological sampling, appropriate exposure biomarker methods and blood or urine reference ranges for the biomarker must be defined.

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ATSDR has completed approximately 250 exposure investigations since the program began in 1995; almost half (45%) involved biological sampling and two-thirds (68%) involved some type of environmental sampling. The top three most frequently detected contaminants at exposure investigation sites were lead (found at 73 sites), arsenic (53 sites), and mercury (34 sites) (Figure 1). Those three metals were most often associated with mining or smelting operations. The most common volatile organic compounds were benzene-related compounds such as benzene, toluene, ethylbenzene, and xylenes, found at 28 sites. Of note, ATSDR conducted 20 exposure investigations for hydrogen sulfide in air; 15 exposure investigation sites involved polychlorinated biphenyls (PCBs); and 13 exposure investigation sites involved dioxins in various sample media.

ATSDR performed exposure investigations in rural, semirural, and urban areas with diverse local settings ranging from residential neighborhoods and public parks to municipal landfills and commercial oil/gas operations. The number of samples collected during an exposure investigation varied depending on site-specific factors such as the exposure pathway, sample media, and the number of persons potentially exposed. The number of participants for biological exposure investigations has ranged from less than 10 to more than 100 people.

The results of an exposure investigation may inform decisions about prioritization of public health actions, changes in policy, the allocation of resources, and the type or extent of environmental cleanup activities. In that sense, an exposure investigation can be used to support actions of both public health and regulatory agencies. Exposure investigation results have prompted changes in state regulations. For example, in Ohio, regulations governing the siting of construction and demolition landfills were revised (ATSDR, 2009) and in Minnesota, regulations regarding concentrated animal feeding operations were modified (Minnesota Department of Health, 2009). Exposure investigations have also led to public health actions that directly prevented human exposure. After an exposure investigation in South Carolina, public water lines were installed (Orloff et al., 2004) and in Alabama, officials began monitoring unregulated contaminants (ATSDR, 2013b). In some cases, exposure investigations have led to health studies such as the large-scale evaluation of residents living near a former PCB plant in Alabama (Silverstone et al., 2012).

An exposure investigation is one approach ATSDR can use to better characterize and evaluate past, current, and future human exposures to environmental contaminants at a site-specific level, particularly when such evaluations are constrained by critical data gaps. It is important, however, to acknowledge that not all sites are good candidates for this approach. Careful consideration of the feasibility and scientific design aspects of an exposure investigation are necessary for successful implementation at a site. Over the years, ATSDR has developed expertise in conducting a variety of different types of exposure investigations (Figure 1) and demonstrated a number of successes in terms of promoting healthy and safe environments at the community level.

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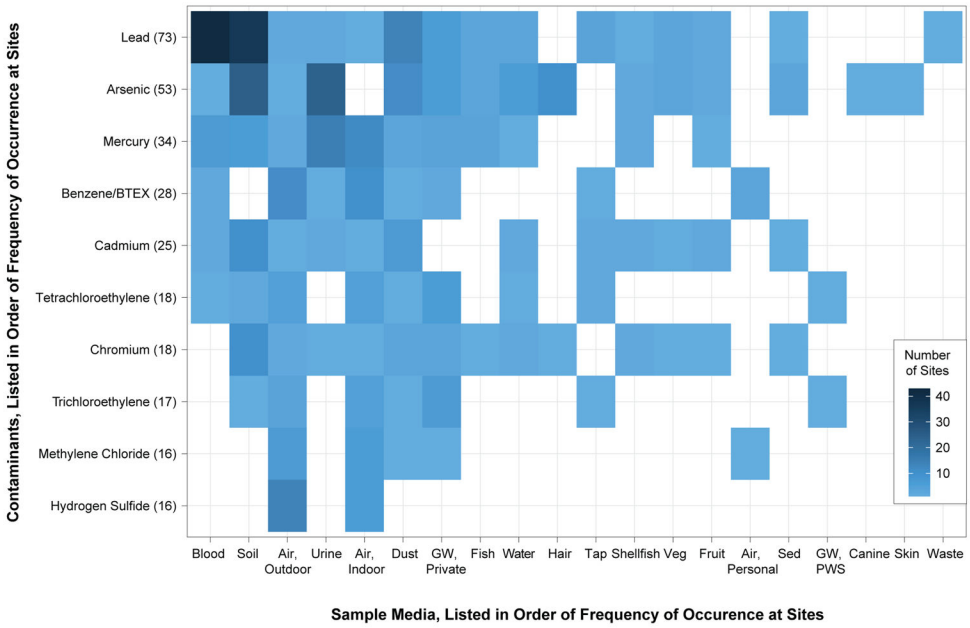

BTEX = benzene, toluene, ethylbenzene, xylenes; GW = groundwater; Veg = vegetables; Sed = sediment; PWS = public water supply.

FIGURE 1. Top 10 Contaminants, Associated Sample Media, and Site Counts for Agency for Toxic Substances and Disease Registry Exposure Investigation Sites, 1995–2013