Superfund: is it safe to go home?

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The Superfund law does not effectively address exposure of the residents surrounding a hazardous waste site before, during, and after cleanup.

BACKGROUND

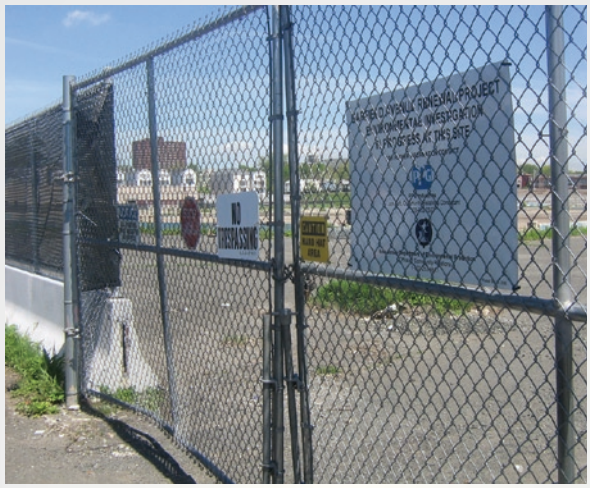
The Superfund process, from identification of sites through cleanup, deletion from the National Priority List (NPL) upon successful remediation, and reuse of the site, is very cumbersome and does not lead to a quick elimination of public health risks.

Hundreds of sites that were discovered and officially listed more than 20 years ago remain on the list at various stages of removal, remediation, and containment. Thus, people in some Superfund-site neighborhoods have lived with potential risks through several generations. As of December 2009, 1,270 sites were on the NPL, 340 had been delisted, and 63 new sites were proposed (US Environmental Protection Agency, 2009). Although the program has attained a number of milestones, restoration has proven to be an elusive goal.

The first step in the Superfund cleanup process is site discovery by various parties. As a result, the process is not consistent and includes no systematic evaluation of potential community exposures. This can lead to long delays in addressing hazards or, potentially, to an untold number of sites remaining undiscovered.

Once identified, a site is evaluated against certain criteria and, if the criteria are met, added to the official Superfund list. Investigations are then conducted, and a cleanup plan established and implemented. Usually these efforts provide qualitative information on health hazards and exposure pathways for the local residents. In most cases, however, they are void of actual personal-exposure data that quantitatively define the magnitude of the potential exposures derived from exposure routes (inhalation, dermal, or ingestion) or pathways (air, water, or soil). As a result, several high-profile sites, including Woburn, MA (Costas et al., 2002), Toms River, NJ (Maslia et al., 2005), and Camp Lejeune, NC (National Research Council, 2009), have underscored the need for improved characterization of community exposure.

The cleanup plan typically centers on expert judgment decisions to remove or contain the contaminants and on the goal of sufficient cleanup to permit deletion from the list and safe reuse of the site. However, exposure science is rarely used to determine optimal mitigation steps and evaluation of whether the cleanup actually worked to prevent future exposures.



Superfund is the environmental program established by the federal government in 1980 to address abandoned hazardous waste sites (http://www.epa.gov/superfund/index.htm). It directs the US Environmental Protection Agency (EPA) to clean up such sites and to force responsible parties to perform cleanups or reimburse the government for EPA-led cleanups. It is estimated that one in four Americans lives within 4 miles of a Superfund site; approximately 10 million of these people are under 12 years of age (Browner, 1996). The photograph shows a site in New Jersey. Cleanups are slow, resulting in some people being at potential risk for many years. Increased application of the principles of exposure science before, during, and after cleanup would greatly reduce the time and costs required for cleanup and, more importantly, determine whether the cleanup actually worked and the property can be safely reused by the public. (Photo courtesy of Eileen Murphy, NJ department of Environmental Protection.)

IMPACT AND IMPLICATIONS FOR EXPOSURE SCIENCE

Improving exposure characterization of Superfund sites will substantially increase efficacy, as well as speed up the entire process. Combining exposure information with chemical hazard information is likely to have led to some sites not being listed and other sites being listed. However, high-quality information on community exposure pathways (e.g., air, water, house dust) can direct mitigation plans. Exposure science also identifies the exposed population groups. For example, knowing whether children or the elderly are exposed can improve protection of vulnerable people around a site. Having scientifically robust estimates of exposure before and after cleanup informs the community about the cleanup. Without such knowledge, covert risk will persist.

Gathering high-quality exposure information has a cost in dollars and time, but that must be weighted against an increase in process efficiency. For example, a scientifically stronger process can reduce time- and cost-intensive litigation and elicit more community support. Knowing that public health goals were attained and reuse is safe is fundamental to Superfund's goals.

The cleanup of residential chromium sites in Hudson County, NJ, provides one case example of how exposure characterization can make a difference. During the first half of the twentieth century, northern New Jersey was the chromite–chromate industrial capital of the world. Two to three million tons of chromite ore processing waste were produced in Hudson County alone (Burke et al., 1991), with a legacy of more than 200 chromium waste sites in the county. One form of chromium can cause cancer.

In the 1990s, the Environmental and Occupational Health Sciences Institute (EOHSI) at Rutgers University, in collaboration with the state of New Jersey, performed exposure studies in Hudson County. The studies were conducted in two phases: residential areas prior to remediation and the same areas after remediation (Lioy et al., 1992). The EOHSI demonstrated that residential exposure to total chromium was caused by chromium that was resuspended outdoors and transported indoors from waste sites located in or near residential neighborhoods in Jersey City and Bayonne (Lioy et al., 1992; Stern et al., 1998). This information on pathways of exposure helped fine-tune the cleanup strategy. Urine screening before and after cleanup also identified exposure (Stern et al., 1998). The important conclusion was that the excavation and removal of chromium waste from these residential sites actually reduced chromium exposure in the previously sampled homes *to background levels (*Freeman et al., 2000). This clearly was a major success and is a guidepost for completion of such investigations.

Questions and concerns remain today regarding the adequacy and efficacy of interim remediation at the remaining sites in Hudson County. Although many of the sites are industrial, there is concern about their current state and the potential impact on future residential development. In 2006, the EOHSI repeated the first phase of the 1990s study at several of these locations to determine current exposures prior to permanent remediation. The results showed that interim remediation of industrial sites has not led to widespread high exposures, but that the land needs to be recovered for use by the community. Our current study provides a basis for comparison of exposures during and after cleanup.

The Hudson County experience demonstrated the value of community exposure characterization to site remediation and the evaluation of community health risks. As we consider the future of Superfund and our national response to the challenge of hazardous waste remediation, we offer the following approach to improving exposure characterization at Superfund sites:

1. Conduct exposure assessments during site discovery to better estimate the degree of health risk.
2. Perform systematic exposure characterization throughout the entire cleanup process to direct remediation to the most dangerous pathways.
3. Consider appropriate biological monitoring of exposure to identify personal exposures before and after remediation.
4. Develop historical community exposure characterization to help understand current health issues.
5. Perform postremediation evaluation of exposure reduction to ensure the effectiveness of remedial action and facilitate property reuse.

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