

# Exposure science can increase protection of workers and their families from exposure to asbestos and inform on the effects of other elongate mineral particles

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Exposure science is fundamental to refining our scientific understanding about the health effects arising from asbestos and other elongate mineral particles, as well as helping improve our public health protection and regulatory efforts to safeguard workers, their families, and community residents.

## BACKGROUND

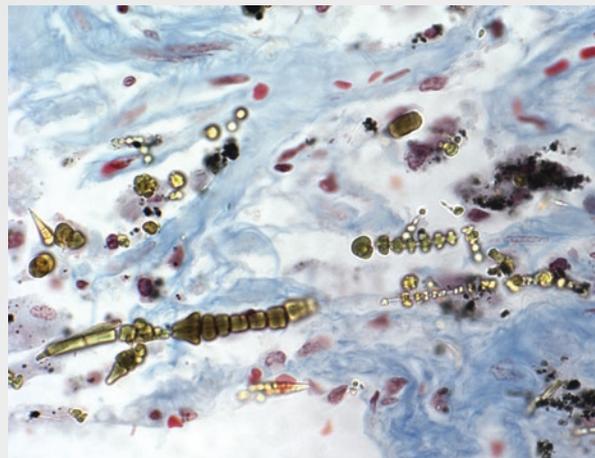
Asbestos has been a topic in environmental and occupational health for nearly half a century. The generic term “asbestos” is typically used to represent six naturally occurring mineral fibers. The asbestos minerals have been used in thousands of commercial products over many years. They can separate into very small fibers that can be inhaled and cause morbidity and mortality. As our knowledge increased, so did concern over other particles that share some (but not all) properties. This drew more attention to this larger class of “elongate mineral particles” (EMPs).

Even though asbestos no longer commands as much scientific attention as it once did, the public health burden from exposure continues. In fact, despite the facts that asbestos is no longer mined in the United States and imports are less than 3% of the peak in 1973, years of potential life lost (YPLL) due to asbestosis as a result of prior exposures are still increasing, from an average of 146.0 YPLL per year in 1968–1972 to 239.6 per year during 2001–2005 (CDC, 2008). Moreover, even though the number of deaths from all other forms of pneumoconiosis decreased from 1968 to 2000, asbestosis deaths increased from 77 deaths in 1968 (annual age-adjusted death rate: 0.54 per million population) to 1,493 deaths in 2000 (6.88 per million) (CDC, 2004). Because of reduced use of, and exposures to, asbestos in the United States since the 1970s, the incidence of new asbestosis cases may be at a peak.

As we close the first decade of the twenty-first century, there is still much more to learn about exposure to asbestos, especially to other EMPs. Efforts to understand, prevent, track, and eliminate related disease need to be updated and improved.

The very nature of occupational exposures to asbestos has changed over the past several decades. In the twentieth century, chronic exposures in textile mills, friction-product manufacturing, and cement-pipe fabrication dominated. Now, occupational exposures to asbestos in the United States occur primarily during maintenance activities or remediation of buildings containing asbestos (HEI, 1991). These current occupational exposure scenarios frequently involve intermittent short-term exposures. In addition, there are exposures to other asbestiform minerals, such as those found at the Libby vermiculite mine, and to “naturally occurring asbestos.” The large number of potentially exposed workers, these altered exposure scenarios, and new types of exposure give rise to the need to better understand whether appropriate protection is provided by the current occupational exposure recommendations and regulations.

Awareness of secondhand exposure has increased (McDonald, 1985). Mesothelioma and possibly lung cancer and structural changes in the lungs have been observed in family contacts of asbestos workers. For example, if a worker comes home with



Asbestos bodies in a human lung. Trichrome stain. Bar = 20  $\mu$ m. (Courtesy of Health Effects Laboratory Division, National Institute for Occupational Safety and Health.)

In the twentieth century, exposure science established that fibers of asbestos minerals, when inhaled, can cause serious diseases such as mesothelioma (cancer of the thin lining of organs and cavities, including the chest cavity), lung cancer, and asbestosis (irreversible scarring of the lungs). Despite minimal new uses of asbestos in the United States, severe illness and mortality from asbestos exposure continue to be a problem. The history of asbestos-related diseases clearly shows us the major impact of not knowing about exposures early enough to intervene to protect workers and their families. Exposure research is now even more necessary, to detect and prevent exposures and to understand the relative risks of mineral fibers, including asbestos and other “elongate mineral particles.”

contaminated clothing, others in the family may be exposed. Questions have been asked about more general public exposures resulting from maintenance and remediation activities.

The National Institute for Occupational Safety and Health (NIOSH) believes that a twenty-first-century “road map for research” is needed to resolve the existing scientific uncertainties and policy controversies surrounding asbestos and other EMPs and seeks to involve partners from government, academia, labor, and industry (NIOSH, 2010). When finalized, the “Roadmap” will set out a strategic research framework that encompasses activities in exposure assessment, epidemiology, toxicology, mineralogy, and analytical exposure-assessment methods.

We hope you will read the Roadmap and support its call for focused research efforts to expand our fund of knowledge about asbestos and EMPs and human health.

## IMPACT AND IMPLICATIONS FOR EXPOSURE SCIENCE

Improving the characterization of exposure to asbestos fibers and other EMPs is critical. Limited information is currently available on exposures to, and health effects of, other EMPs. The similarities to asbestos cause us to be concerned, but the differences cause us to be uncertain. Hence, additional knowledge is needed to develop accurate risk assessments and protection strategies. The NIOSH Roadmap presents recommendations for improving the science of asbestos and EMP exposure assessment.

- *Improved sampling and analytical methods are required to characterize exposures to asbestos fibers and other EMPs.* For example, the current analytical methods used for routine exposure assessment lack the capability to accurately count, size, and identify all EMPs collected on airborne samples.
- *The rich source of occupational exposure information should be mined to inform scientific understanding of exposures to EMPs.* This would include taking opportunities to (re)analyze (historically) collected samples using enhanced analytical methods to better characterize the exposures.
- *Ongoing characterization and surveillance of occupational exposures to EMPs should be systematically designed and implemented to protect workers' health throughout US industry.* Such exposure assessments should include workplaces in which a fraction of the dust is composed of EMPs (i.e., mixed-dust environments) and occupational environments in which EMPs may not meet the current regulatory criteria to be counted (e.g., “short” fibers). The resultant findings could lead to representative EMP exposure data that could help identify worker populations or particular types of EMPs warranting further study (i.e., more in-depth exposure assessment, medical surveillance; epidemiology studies of particular types of EMPs, processes, job tasks, occupations, or industries; toxicity studies of particular EMPs).
- *Occupational exposure data should be collected and stored in a comprehensive database.* Information similar to that described by Marchant et al. (2002) should be incorporated into the database to support these efforts. This could be accomplished in parallel with efforts to develop an occupational exposure database for nanotechnology (Miller et al., 2007) or efforts to develop a national occupational exposure database (Middendorf et al., 2007).

Advances in asbestos exposure science research can lead to better understanding of the health effects caused by exposures to other EMPs and to new elongate materials such as nanofibers. Engineered nanomaterials are being rapidly introduced into the workplace and into our homes. As a society, we need to apply lessons we have learned, and continue to learn, from the asbestos experience to be health protective as we engineer and use new elongate materials.

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