ASBESTOS IN CONTAMINATED SITES: OCCUPATIONAL AND ENVIRONMENTAL EXPOSURES, PRIORITIES FOR REMEDIATION

Roberto Pasetto
*Dipartimento di Ambiente e Connessa Prevenzione Primaria, Istituto Superiore di Sanità, Rome*

The World Health Organization (WHO), in a public health perspective, defined contaminated sites as “Areas hosting or having hosted human activities which have produced or might produce environmental contamination of soil, surface or groundwater, air, food-chain, resulting or being able to result in human health impacts” (1).

Asbestos has been largely used as a raw material in various industrial productions and has been present in the work environment in many places and for different uses. Today those applications are still present in many countries. Usually asbestos is among the risk factors in contaminated sites, especially in industrial areas. Asbestos can be the only or main risk factor in contaminated sites due to asbestos mines or industries where asbestos is used as a raw material.

Exposure to asbestos can be classified in the following categories:

- **Direct professional**
  - Miners tasked with direct extraction of the mineral, in serpentine and amphibole form (an increasingly decreasing cohort in western countries, but still present in countries that still carry out mineral extraction).
  - Miners tasked with extraction of minerals other than asbestos, but exposed to the presence of asbestos minerals contaminated by the rocks extracted.
  - Workers in the production of materials containing asbestos at different levels of friability, according to the matrix used (e.g. asbestos cement, asbestos glues, asbestos resins, braking systems).
  - Workers in the sector of application of materials containing asbestos for the insulation of buildings, means of transportation (e.g. ships, trains, buses, airplanes).
  - Workers in the sector of maintenance and demolition of buildings insulated with asbestos, means of transportation, systems (i.e. heating plants, insulated pipes), equipment (contactors), other devices (e.g. vehicle braking systems, cranes) including material with an asbestos content.
  - Workers tasked with removing insulation from materials containing asbestos (an important activity during the present phase of radical elimination of the asbestos risk).

- **Indirect professional**
  - Workers who do not perform activities requiring the handling or manipulation of materials containing asbestos, but who work alongside other departments that are not adequately separated and in which processes take place using materials containing asbestos. This situation in particular is found inside large industrial hangars with unseparated work units, in which there is neither effective form of primary prevention to trap asbestos fibers at the source nor adequate industrial cleaning of the departments.

- **Environmental professional**
  - Workers exposed to inhalation of asbestos fibers not from direct occupational exposure but from contamination by airborne fibers issuing from sprayed application
of asbestos, or from roofs of industrial hangars containing asbestos cement and/or other asbestos material found in the work environment.

Furthermore, asbestos fibres in the work environment can be an extra occupational risk in living environments, in two ways:

- diffusion to nearby living environments, when the dispersion of asbestos fibers in the work environment is such that it can be transmitted to the nearby ecosystem by air currents. This can lead to significant contamination, especially if the production plant is in a highly urbanized area;
- diffusion to domestic living environments and to family members of workers occupationally exposed to the asbestos risk, through contamination of work clothes brought into the home for cleaning.

Finally, exposure to asbestos or other asbestiform fibres can be environmental-residential:
- exposures due to naturally occurring asbestos or other asbestiform fibres in the general environment and their presence in various materials (e.g. in the local buildings).

The WHO, Department for Public Health and Environment, together with the International Labour Organization (ILO), Programme on Safety and Health at Work and the Environment, defined a framework for the development of National Programmes for Elimination of Asbestos-Related Diseases (2). Three are the main topics to identify priorities for interventions that can be found in the introduction to the framework for National Programmes:

- **Magnitude of the problem**
  The collection or production of the most relevant information about local asbestos use, its presence in the territory, and its health related impacts (i.e. the burden of asbestos-related diseases).

- **Economic aspect**
  The economic quantification of interventions, both those directly related to asbestos exposure, e.g., direct costs, such as avoiding treatments costs and compensation claims, costs for demolition of buildings containing asbestos, costs for ensuring adequate health protection when working with asbestos already in place, and indirect costs, such as loss of potential income from asbestos-containing tourist facilities, depreciation of house stock built with asbestos etc.

- **Social aspect**
  The current and expected social impacts of the use of asbestos and asbestos-containing materials that need to be taken into account to ensure a just transition during the conversion to non-asbestos substitutes and technologies. The environmental justice related evaluations are of particular relevance. Those inquiries draw to identify communities or population groups that, at the same time, are exposed to environmental risks (i.e. the most exposed to asbestos risk) and have disadvantaged health related social conditions (i.e. the most disadvantaged groups have the worst health conditions).

The interventions that are effective in terms of prevention should be preferential. Those interventions allow the eradication or reduction of the health risk (i.e. the number of cases of asbestos-related diseases). To achieve this goal, activities to define the magnitude of the problem are the most important. Those activities can be distinguished in:

a) **Identification of exposure sources**

Activities that allow the census of asbestos exposure sources. The sources of asbestos exposure can be distinguished in: i) main sources (i.e. mines, activities with the use of asbestos as a raw material), ii) secondary sources, that are those due to the presence of
asbestos in the work environment (e.g. as an insulator material for different uses) or in the
general environment (e.g. cement asbestos materials in buildings). These activities lead to
identify the most evident targets for interventions.

b) Verification of potential exposures
Activities that permit to verify what can be the most dangerous exposure sources. These
evaluations lead to identify the most likely exposure circumstances. For example,
deteriorated asbestos cement materials are more likely to be dangerous than solid asbestos
cement materials. These activities permit to define the risk probability and then the
remediation activities more effective in preventive terms.

c) Epidemiological surveillance
Activities to verify the actual risk. These activities allow quantifying the asbestos burden
of disease in the spatial and temporal dimensions. Risk arising from known exposure
circumstances can be evaluated, so helping in defining priorities for interventions.
Furthermore, the epidemiological surveillance helps in verifying the impact of unknown
sources of exposure (i.e. situations not identified with the census of asbestos exposure
sources – point a.).

The three kinds of activities described above should be implemented in parallel and the
priorities for interventions can be the result of combining their results.

Methods and applications
of the epidemiological surveillance

The main asbestos-related diseases must be mentioned before describing epidemiological
surveillance programmes. Concerning neoplasms, the International Agency for Research on
Cancer (3) classified as certain the causal association between asbestos exposure, for all
asbestos species (actinolite, amosite, antophillite, chrysotile, crocidolite, tremolite), and the
following neoplasms: mesothelioma (pleural, peritoneal, pericardial, and tunica vaginalis testis),
cancers of the lung, larynx and ovary. The evidence about the causal association was classified
as limited for pharyngeal, stomach and colon-rectum cancers. Other asbestos-related diseases
are asbestosis (a lung fibrosis with a chronic progressive course) and pleural plaques
(circumscribed thickenings of the pleura) (for details on asbestos-related diseases see the
chapter “Asbestos-related diseases”).

Mesothelioma and asbestosis are of particular interest because they are specifically
associated to asbestos exposure. Asbestosis is a disease exclusively due to asbestos, while
mesothelioma is a neoplasm for which the association with asbestos has been described in most
of the cases. These diseases are preferential indicators of risk associated to asbestos exposure.
Asbestosis is a disease due to heavy asbestos exposures in the occupational contexts. Mesothelioma, instead, is a disease without a safe threshold of asbestos exposure; moreover, it
is characterized by a correlation between cumulative exposure to asbestos and incidence, that is,
the risk is proportional to the dose of exposure and each exposure, even in different times,
contributes to increase risk (see the chapter “Asbestos-related diseases”).

Mesothelioma is the disease suitable for asbestos risk identification both in the occupational
and in the environmental contexts. For this reason, it is the disease most widely used in
epidemiological surveillance programmes.

The epidemiological surveillance of mesothelioma can be based on routinely collected data,
carried out using data from cancer registries or by creating ad hoc disease registries.
Surveillance with routinely collected data at country level is based on mesothelioma mortality data. Mortality data should be standardized and with a wide territorial coverage, possibly for the whole country. An effective use of mortality data is based on the quality of death certification, specifically on the quality of mesothelioma necroscopic certification. For the epidemiological surveillance, sensitivity (number of false positive cases) and specificity (number of false negatives cases) in diagnosis should be compensated so that the estimates at population level can be reliable. Therefore, the first step to do in implementing a surveillance system is to verify the quality of mesothelioma death certification. It should improve over time with increasing attention to the asbestos-related diseases and their diagnosis.

Mesothelioma is a lethal disease. Median survival is of about 1 year, that is, 50% of incident cases die before one year from diagnosis. Thus, mortality can be used as a proxy for incidence. Mortality data can be used for quantitative estimates of mesothelioma risk. Moreover, if long time series of data are available, they can be used to evaluate temporal trends. Mesothelioma mortality data can be geocoded to evaluate risk excesses in some areas.

In Italy, an epidemiological surveillance system based on mortality from mesothelioma at municipality level was activated. Periodically, data from this system are used to report the distribution of mesothelioma mortality for the whole national territory identifying areas with the highest risk (4) (for details, see the chapter “Mesothelioma mortality surveillance in Italy”). Mortality from mesothelioma can be analysed together with asbestosis data to identify unexpected professional or environmental exposure risks at area level (5).

The mesothelioma epidemiological surveillance can be based on data from pathology registries. Pathology registries are characterized by the collection of incident cases from pathological anatomy units. For each case, information on diagnosis and exposure to asbestos are collected. The diagnosis is defined on the basis of all diagnostic reports (X-rays, cytological and histological analyses). Exposure to asbestos is indirectly evaluated from the patient or his/her next of kin though an interview made using a standardized questionnaire. Data from registries are characterized by a good quality of information both to identify cases and to verify asbestos exposure circumstances. In Italy, five national reports on mesothelioma were published till 2012 using data from such a registry (http://www.ispesl.it/renam/Index.asp).

The Italian mesothelioma registry has a national central coordination, while the collection of data has a regional basis. The registry has had a progressive development in the territorial coverage. Data from such a registry can be used for descriptive statistics, like incidence estimates for different areas, and for description of exposure circumstances particularly in the occupational context (e.g. to describe the occurrence of cases by occupational sector). Information of single cases can also be used for compensation claims of professional disease. Some mesothelioma registries collect information on asbestos exposure by using quantitative evaluations of the fibre burden in histological samples. In this case, qualitative evaluations obtained through interviews can be combined with results of quantitative analysis. The latter can be used to evaluate the dose response functions for different asbestos species (i.e. the risk of disease in association with different dose of exposure to different asbestos species).

The pathology registries have many advantages in the quality and quantity of the collected information and their possible use in the context of epidemiological surveillance. Nevertheless, their implementation requires considerable technical and economic resources and long times, especially when the target is a wide territorial coverage.

References


