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The Human and Financial Burden of Asbestos in the WHO European Region

Meeting Report

5-6 November 2012, Bonn, Germany

ABSTRACT

The WHO European Centre for Environment and Health convened a Meeting in November 2012 of representatives of selected Member States and international experts for cooperative implementation of the Parma commitment regarding asbestos control. The scope of the Meeting was to provide technical support to national representatives for the development of national profiles on asbestos, as agreed during a meeting held in June 2011. The specific aims of the Meeting were to assess the national data available in Member States, which are essential for the preparation of national asbestos profiles according to the outline drawn up by WHO and the International Labour Organization, and to provide technical guidance in estimating the number of deaths, potential life-years lost, disability-adjusted life-years and the economic burden due to asbestos-related diseases (ARDs). An update of asbestos control policies in Member States was presented. The Meeting drew conclusions and made recommendations for the development of the national profiles as well as the development and implementation of national programmes for the elimination of ARDs. Useful information for policy-makers in Member States presented at the Meeting by WHO temporary advisers on the methodologies and tools for estimating the number of deaths, potential life-years lost, disability-adjusted life-years and economic burden due to ARDs are attached as annexes to this report.

Keywords

ASBESTOS adverse effects
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Abbreviations

AAMR	age-adjusted mortality rate
APYLL	average potential years of life lost
ARDs	asbestos-related diseases
CMR	crude mortality rate
DALY	disability-adjusted life-years
EU	European Union
FIVA	Fonds d'Indemnisation des Victimes de l'Amiante (Asbestos Victims Compensation Fund)
IARC	International Agency for Research on Cancer
ICD-10	International Classification of Diseases, 10th revision
ILO	International Labour Organization
PAF	population-attributable fraction
PYLLs	potential years of life lost
REACH	Registration, Evaluation, Authorization and Restriction of Chemical substances

Introduction

Background

The Fifth Ministerial Conference on Environment and Health held in Parma, Italy, in 2010 adopted the Parma Declaration on Environment and Health. One of the commitments made by the Member States of the WHO European Region in that Declaration was to develop by 2015 national programmes for the elimination of asbestos-related diseases (ARDs) in collaboration with WHO and the International Labour Organization (ILO).

Exposure to asbestos leads not only to asbestosis but also to cancers, in particular mesothelioma and lung cancer. In 2012, the International Agency for Research on Cancer (IARC) confirmed, in its monograph 100C, the previous classification of all forms of asbestos, including chrysotile, as carcinogenic to humans (Group 1) and added another two cancer locations related to asbestos exposure: the larynx and ovaries *(1)*.

With the aim of providing guidance to Member States for the elimination of ARDs, ILO and WHO published the *Outline for the development of national programmes for elimination of asbestos-related diseases (2)* in 2007. This recommended that countries should prepare a national asbestos profile, to be updated periodically, as the first step towards a national programme.

At the WHO Meeting on National Programmes for Elimination of Asbestos-Related Diseases: Review and Assessment, held in Bonn in June 2011, participants agreed to prepare national asbestos profiles based on an outline developed by ILO and WHO, and requested the WHO secretariat to provide Member States with any necessary technical support in preparing such profiles *(3)*.

A further Meeting was held in Bonn on 5 and 6 November 2012, opened by Elizabet Paunovic, Programme Manager, Environmental Exposures and Risks at the WHO European Centre for Environment and Health. She emphasized the importance of the Meeting in gaining the practical skills necessary to implement international commitments for the elimination of ARDs. The task of eliminating ARDs was fraught with difficulty, making it necessary to prevent and control exposure to carcinogens. Numerous commitments had been endorsed by international organizations and Member States concerning cooperative efforts to eliminate health problems related to asbestos hazards.

Dr Paunovic expressed her special thanks to the German Federal Ministry of Environment, Nature Conservation and Nuclear Safety, for supporting the project and providing the funds for organizing the Meeting.

Jorma Rantanen was elected chairperson and Nathalie Röbbel rapporteur. All comments and suggestions collected from the participants during the Meeting and after finalization of the draft report were addressed in the preparation of the final report by the WHO secretariat. The useful information and training materials for policy-makers in Member States presented at the Meeting are attached to this report as Annexes 1–7. Annex 8 contains written comments by participants from the Russian Federation presented before the concluding session of the Meeting (see section headed Russian Federation). The programme is at Annex 9 and the list of participants at Annex 10.

Scope and purpose

The scope of the Meeting was to provide technical support to national representatives for the development of national profiles on asbestos and to meet the commitments adopted at the Fifth Ministerial Conference on Environment and Health.

The specific aims of the Meeting were:

- to provide technical support to Member States by building capacity for preparing national asbestos profiles;
- to assess the national data available in Member States which are essential for the preparation of national asbestos profiles according to the ILO/WHO outline; and
- to provide technical guidance in estimating the number of deaths, disability-adjusted life-years (DALYs), potential years of life lost (PYLLs) and the economic burden attributable to ARDs.

Review of evidence

Based on the latest evaluations of IARC monograph 100C, it appears that there is sufficient evidence in humans for the carcinogenicity of all forms of asbestos (chrysotile, crocidolite, amosite, tremolite, actinolite and anthophyllite) *(1)*. All forms of asbestos cause mesothelioma and cancers of the lung, larynx and ovary. There are variations in the carcinogenic potency between the different forms of asbestos (chrysotile versus amphiboles) and sizes (long and thin fibres). These issues do not, however, alter the fundamental conclusion that the epidemiological evidence indicates that all forms of asbestos, including chrysotile, are carcinogenic to humans.

Exposure to chrysotile asbestos poses increased risks for asbestosis, lung cancer and mesothelioma in a dose–effect relationship. No threshold has been identified for carcinogenic risks. Asbestos exposure and cigarette-smoking have been shown to interact to increase the risk of lung cancer synergistically.

The collection, analysis and dissemination of global cancer data at national level, establishment of cancer registers and establishment of the links between occupational exposure and related cancers recognized as occupational diseases (and collected in occupational disease registries) are key instruments for planning and implementing programmes and plans to prevent ARDs. These data also allow for the calculation and analysis of the global burden of cancer and the burden of asbestos-related cancer at national level, providing additional tools for re-informing political commitments and action. Thus it is important for Member States to undertake national cancer registration, as recommended by IARC. Coverage of cancer registration varies widely among the countries in the eastern part of the Region. The European Network of Cancer Registries was established within the framework of the European Commission’s Europe against Cancer Programme, and has been in operation since 1990. The Network promotes collaboration between cancer registries, defines data collection standards, provides training for cancer registry personnel and regularly disseminates information on the incidence of and mortality from cancer in Europe. In order to support Member States in the collection of cancer data, WHO is requested to assist in any planned development or reorganization of a cancer registry by providing technical assistance.

Training workshops

The focus of the training workshops in the plenary sessions was on the human and financial burden of asbestos as essential information to be included in national asbestos profiles. Key methodologies and tools were presented and discussed. Background papers explaining in detail the approach, reference literature and methodology, as well as step-by-step guidance on how to calculate the human and financial burden of asbestos, are attached as Annexes 1–7.

PYLLs from asbestos exposure in European countries

According to WHO estimates, globally more than 107 000 people die each year from asbestos-related lung cancer, malignant mesothelioma and asbestosis due to occupational exposure with sufficient evidence of human carcinogen *(4)*. Data from the United Kingdom show that for 2010, 2347 deaths from mesothelioma and 412 deaths from asbestosis were reported and it was estimated that there were around 2000 asbestos-related lung cancer deaths.

Two measures were introduced as convenient ways to estimate the human burden of ARDs with a focus on malignant mesothelioma and asbestosis in the European Member States. These were: (i) the potential years of life lost from ARDs (PYLLs), that is, the number of years a death occurred earlier than it would have occurred in the absence of cancer; and (ii) the average potential years of life lost from ARDS (APYLL), that is, the average of the differences between the actual ages at death of those who died of cancer and the expected age at death (natural death) of those individuals.

Using the WHO mortality database *(5)*, the number of deaths recorded as due to mesothelioma and asbestosis during the period 1994–2010 were identified. Data for life expectancy at a specific age by country and sex were obtained from the WHO health statistics and health information systems for 1990, 2000 and 2009.

The PYLLs were analysed for the Member States (n=53 countries). The actual number of mesothelioma deaths at ages ≥30 years in the Region during the period 1994–2010 was 71 555, and an annual average of 6864 deaths was recorded with an overall average age at death of 66.1 years. The number of mesothelioma deaths during the period 1994–2010 accounted for 1.2 million PYLLs, or 0.1 million PYLLs annually, with 16.8 APYLLs per decedent.

The actual number of asbestosis deaths at ages ≥30 years during the period 1994–2010 was 5728, with an overall average age at death of 71.6 years. A total of 0.08 million PYLLs with 13.3 APYLLs per decedent was observed. The estimated APYLL was greater for mesothelioma (16.8 years) than for asbestosis (13.3 years) because of the younger age at death among mesothelioma cases.

The methodology presented is easy to apply with mortality and life expectancy data in Member States, and offers an opportunity for public health decision-makers to assess the burden of deaths from ARDs, in particular mesothelioma and asbestosis.

DALYs lost from asbestos exposure in European countries

This methodology considered the burden of ARDs in Europe arising from the occupational exposure of workers. This task is straightforward for mesothelioma, as virtually all cases can be presumed to be due to asbestos exposure and asbestosis. Alternatively, if the number of mesothelioma cases is not known, this can be estimated using information on the absolute asbestos exposure of persons (in fibres/ml- per years) and the absolute risk arising from various levels of cumulative exposure to asbestos. A similar approach can be taken for asbestosis if there is no available count of the number of cases. For other cancers, the task is more difficult, because there are no identifying characteristics of cancers that identify whether or not they have arisen due to asbestos exposure. For these, the only practical approach is to use the population-attributable fraction.[1]

The proportion of the exposed population can be estimated through population surveys or more indirect means. The relative risk is usually obtained from the published literature.

The burden of deaths arising from ARDs in a country (or sub-region) can, therefore, be estimated by identifying all deaths due to asbestosis, all deaths due to mesothelioma, and the proportion (and therefore the number) of cases of lung, ovarian and laryngeal cancers due to asbestos exposure. The overall burden arising from asbestos exposure can be calculated in the same way, but in DALYs rather than deaths. The DALYs need to be calculated specifically for the assessment or obtained from another study. The methodology used was based on the previously published data on comparative risk assessment and by using health statistics on deaths and disability for 2000. Asbestosis and mesothelioma deaths were estimated using measures of absolute exposure and absolute risk. Lung cancer deaths were estimated assuming a 1:1 ratio of asbestos-related lung cancer cases to mesothelioma cases. Other asbestos-related conditions could not be included.

Based on the analysis, total deaths in Europe for 2000 due to work-related asbestos exposure were estimated to be 14 600 and DALYs to be 186 500. Mesothelioma comprised approximately 50% of the deaths and 43% of the DALYs. The WHO Eur-C sub-region[2] accounted for 55% of deaths and 56% of the DALYs.

Owing to conservative assumptions in handling uncertainties in calculating DALYs, these estimates are considered underestimates of the total burden of disease arising from asbestos exposure. Nevertheless, the results showed that work-related exposure to asbestos remains an important cause of death and disability in Europe.

Economic costs of ARDs

Just as the recognition, diagnosis and recording of ARDs remain challenging, so does estimating the direct and indirect economic costs of ARDs. National analyses of the costs of occupational ill health frequently fail to provide data specifically on either ARDs or occupational cancers. Treatments and ARD drug regimens may also vary from country to country, and sometimes within countries, depending on compensation schemes and health service provision and practice.

A review was carried out underpinning the development of a step-by-step approach to costing ARDs (in particular mesothelioma, lung cancer, pleural plaques and asbestosis) in 12 European Union (EU)/European Free Trade Association countries that may have wider relevance across Europe. Key papers, reports and other publications on the evidence base and best methodological approach to calculating the economic costs of ARDs were reviewed.

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1 The population-attributable fraction is essentially the proportion of cases of a particular condition in a community that is due to a particular exposure or set of exposures. More correctly, the PAF is the proportion of cases that would no longer occur if the exposure did not occur.
2 Belarus, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine.

The review showed that relatively little has been published worldwide specifically on costing ARDs, and even less has been published on the medical costs of treating them. Studies flagged great variety in measuring the true economic costs of occupational diseases and injuries. Some used willingness to pay calculations, while others relied primarily on human capital approaches. Several neglected the social welfare costs to society, although such costs are difficult to calculate and hence lead to an underestimate of the total economic burden. Losses of earnings do not accurately reflect the social costs of illnesses: they distort calculations because some workers may accept or be forced to accept more risks than others, and they produce lower values for older workers who may live long lives but only have a limited time left in the workforce. The opportunity costs of capital need to be factored in; these vary from one economist to other, again affecting calculations. The obvious economic and human costs need to be calculated as well as the private and public costs and the financial and implicit costs (inferred or opportunity costs). The economic consequences of ill health have been relatively neglected but are increasingly pertinent to ARDs with regard to damage in the communities as well as in the workplaces. They could involve large cost calculations for remediation.

The review showed that several methods are, however, available for assessing the economic costs, including generic methods of occupational disease costing, specific methods using either a macro- or micro-economic approach, or the estimation of ARD disease burdens. Annex 5 contains examples. No single method will provide the best estimates, although methods can be refined to ensure better costing in the future. They can also inform a step-by-step approach to estimating costs across Europe, suitably adjusted to take account of different disease profiles, treatment patterns and social insurance and related policies.

Application of different measures of human and economic cost

The relevance of the approaches and methodologies presented for calculating the human and financial burden of asbestos was acknowledged by all the participants. The calculation of PYLLs and DALYs and the estimation of monetary impacts of asbestos on health are essential tools in the policy-making process, providing guidance to policy-makers for, among other things, taking appropriate steps to prevent and control the use of asbestos, stimulate surveillance, harmonize surveillance systems within and among countries and encourage other types of estimate to be made.

The calculation of PYLLs is the most straightforward approach as this methodology is based on real death numbers only. It is an easy method for quantifying ARDs at country level, and simple to use and explain to the public. It is particularly appropriate for calculating the burden of mesothelioma and asbestosis. PYLLs due to asbestos-related lung cancer would be more difficult to calculate because of the varying diagnostic criteria used by different countries and the involvement of various confounding factors such as smoking. A simple approach to the lung cancer burden is to assume a certain ratio between mesothelioma and asbestos-related lung cancer.

The method of estimating DALYs is more complicated and subject to uncertainties such as the absence or unreliability of data on exposure and health outcomes, the quality of evidence, assumptions about the disability weight and the latency period. It is, however, a valuable and necessary tool to incorporate both morbidity and mortality in one measure of the human burden. In countries where reliable national data are not available, assumptions can be made based on data and information from countries which have all the data needed for estimating DALYs. The DALY approach presented does not, however, take into account environmental, domestic and para-occupational exposures to asbestos. This is a shortcoming of the approach caused by the general lack of national data on such non-occupational exposures. The results of the DALYs estimation should, therefore, be regarded as a conservative estimate, leading to general underestimation of the total burden, although these data should be included (where they exist) when the DALYs to calculate should reflect the total burden of asbestos, not just the occupational exposure.

Calculations of PYLLs and DALYs have also been recognized as key approaches for some of the economic calculations presented. Generally, the economic arguments for the elimination of asbestos exposure need to be strengthened in most countries. Assessments of the economic costs of asbestos exposure, ARDs, and the replacement and abatement of asbestos are necessary to put asbestos on the political agenda.

In many countries, the elimination of the use of asbestos and its replacement by substitute materials were shown to be economically feasible. New technologies using substitutes that are safer for health have also been easier to handle. For example, in Finland the replacement of asbestos-containing brake materials and pipes with asbestos-free substitutes having a similar or better performance has not been very expensive. The profits made from the production of and trade in asbestos are much smaller than the societal costs of managing asbestos exposure and compensation for its consequences.

Some concerns have, however, been expressed about the availability of data regarding direct and indirect costs. Although many country representatives felt that calculations of direct and indirect costs would be possible, in some countries, particularly the newly independent states, the economic costs would be difficult to calculate due to the incompleteness or lack of reliable cancer registries and general under-reporting of occupational diseases. This lack of information indicates that a significant amount of occupationally caused diseases, including those caused by occupational exposure to all forms of asbestos, are not being properly diagnosed and recognized as occupational diseases. This is also leading to missing statistics on asbestos victims. Legal costs relating to compensation in cases of occupational diseases through court judgments and costs of lawyers vary widely between countries and are more difficult to calculate in many countries. Clearer definitions of different types of cost (direct, indirect and legal) are essential.

Asbestos policies in countries

The second part of the Meeting reviewed the situation regarding national programmes on asbestos, in particular the development of national asbestos profiles. Examples of good national asbestos profiles for effective national programmes for eliminating ARDs were shared and challenges and opportunities discussed. National asbestos profiles have been recognized as key tools for the development and management of asbestos policies and programmes. They support national priority-setting as well as the monitoring of national achievements. While several countries reported on the preparation of such profiles and of national programmes for the elimination of ARDs following the ILO/WHO outline, others have experienced difficulties in developing and implementing the programme/profile due to a lack of national political commitment, human resources and funds.

EU Directive 1999/77/EC banned all types of utilization of asbestos from 1 January 2005 *(6)*. In addition, Commission Directive 2003/18/EC banned the extraction of asbestos and the manufacture and processing of asbestos products *(7)*. Following the principles of primary prevention, a stop was placed on the exposure to asbestos of consumers of asbestos-containing products and materials.

EU Directive 2009/148/EC laid down provisions to protect workers from asbestos-related risks, mainly through preventive measures *(8)*.

The European Parliament is in the process of adopting stricter legal acts on asbestos as amendments to the existing asbestos-related directives. Most EU countries are also parties to the ILO Asbestos Convention *(9)* and have joined the Tokyo Declaration of 2004 on the banning of asbestos, the protection of workers and the public, the use of alternatives to replace asbestos and the need to exchange information about the risks posed by exposure to asbestos *(10)*.

Several activities and programmes have been implemented in recent years at EU level, and the EU Labour Inspectorate has drawn up a practical guide on the treatment of asbestos *(11)*. The European Federation of Building and Woodworkers is developing a European asbestos-free action plan in collaboration with the International Ban Asbestos Secretariat as an EU project. The Joint Policy Committee of the Societies of Epidemiology produced a position statement on asbestos in June 2012 *(12)*.

It should be noted that banning the new use of asbestos is only one essential measure to prevent the future occurrence of ARDs. Even after banning the use of all types of asbestos, many EU countries still face the problem of exposure to asbestos in the course of removal, demolition, servicing and maintenance activities. It is particularly important to prevent exposure to existing asbestos-containing materials in old buildings. Strict management of the removal of asbestos, education and training and respiratory protection have, therefore, been identified as new priorities for legislative amendments in some EU countries (such as Belgium and Finland).

Albania

Legislation
A wide range of regulations and laws mention asbestos but at present it is not covered by any specific law. The Ministry of the Environment is planning to develop such a law by 2014. Programmes to deal with asbestos were started in 2005.

The overall quantity of asbestos ever used in the country is estimated to be around 188 000 tons.

Most asbestos is used as friable asbestos in thermo-insulation materials and in building materials in the form of cement asbestos.

With the support of WHO, a five-day training workshop specifically on the elimination of ARDs was carried out for the basic occupational health services in April 2012. The aim was to take a concrete step towards the implementation of the Parma Declaration and the harmonization of Albanian asbestos policies and practices with European policies.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
There is no cancer register.

Lessons learned
With the help of the above-mentioned WHO workshop, the following priorities have been identified for the appropriate management of the asbestos situation in the country:

- creation of an urgent and complete inventory of asbestos exposure;
- development of a system for exchanging data on asbestos, national registries and data systems;
- creation of a legal framework transposing all related EU directives;
- identification of clear responsibilities for every actor in the areas of the environment, health, work, customs, education and research;
- economic evaluation of appropriate anti-asbestos techniques;
- establishment of an appropriate infrastructure for inspections; and
- continuing capacity-building.

Armenia

Legislation on asbestos
Armenia still has a small factory producing asbestos and is still importing it. After the earthquake of 1988, large amounts of waste containing asbestos were stored in the mountains. To date asbestos is not regulated by legislation. Armenia ratified the Rotterdam Convention, in which chrysotile asbestos is not listed in the list of pesticides and industrial chemicals.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Public health professionals have faced difficulty in accessing data on mesothelioma from national oncologists.

Lessons learned
In general, there is insufficient awareness of asbestos as a risk factor, although some progress has been made recently. Students have been trained in environmental science, including about asbestos. This training was, however, carried out on an ad hoc basis and does not represent an institutionalized curriculum.

Armenia has requested that programmes be developed at sub-regional level, such as for the newly independent states, which would enable countries to benefit from synergies and joint political commitments.

Azerbaijan

Legislation on asbestos
Azerbaijan ratified the Basel Convention, which recognizes asbestos as a toxic waste material. By law, asbestos waste should be buried in special places.

In accordance with the Parma Declaration in 2010, several governmental entities are in the process of approving a decree banning the import of asbestos materials. Future regulations should follow the EU directives on asbestos. Some restrictions already exist with regard to asbestos in cases where it cannot be stored safely.

Belarus

Legislation on asbestos
Legislation exists to regulate the safe use of asbestos at workplaces and the safe management of asbestos-containing wastes in the Sanitary Norms and Rules (SSR) 2/2/3/11-31–2002 Work in Contact with Asbestos and Asbestos-Containing Materials. Although there are no asbestos mining activities, two factories use asbestos for producing roofing materials and electronic products in the form of chrysotile asbestos imported from the Russian Federation. The country exports products containing asbestos to Latvia, the Republic of Moldova and the Russian Federation as well as to some EU countries. Work has begun on the preparation of a national profile on asbestos.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Cancer mortality is the second highest cause of mortality, after cardiovascular diseases. At an oncologists' congress in Minsk on 3 November 2011, the data presented showed that cancer incidence rose three times between 1971 and 2010, with a forecast of 78 000 cases of cancer per year by 2030. In particular, the incidence of mesothelioma is rising.
The cancer register could be used to investigate the health status of workers in asbestos factories. Data available so far, however, show that regions with factories using asbestos do not have more cases of mesothelioma. In this regard, more investigation into individual cases would be interesting.

Lessons learned
Since asbestos was only recently identified as a major public health concern, the Ministry of Health will need to set new priorities and take new action. The WHO meeting on asbestos held in Bonn in June 2011 triggered the development of new activities and raised awareness among public health professionals and policy-makers.

Belgium

Challenge from existing asbestos in countries where its use is banned
As a member of the EU, Belgium has banned the use of asbestos. However, as with all countries that have banned the further use of all forms of asbestos, Belgium is facing the challenge of dealing with existing asbestos.

Specific regulations have been laid down for handling existing asbestos in working environments, such as the prohibition on cleaning asbestos-containing roofs under high pressure and of using tools turning at high speed for work on asbestos.

An inventory of asbestos in the workplace is mandatory, although this does not apply to private housing.

Where asbestos is present in the workplace, a risk assessment is required and the application of the prevention measures set out in the EU Framework Directive *(13)*. Some specific rules are laid down for the removal and disposal of asbestos, for example, mandatory notification of asbestos removal works, mandatory work plans for removal work, and the use of specialized and certified enterprises for the removal of important quantities of asbestos.

Compensation schemes for asbestos victims
There are strict rules for the compensation of asbestos victims. Mesothelioma, asbestosis, bilateral diffuse pleural thickening, and other diseases to be determined by the government which are in a decisive way the consequence of asbestos exposure, are to be compensated from an asbestos fund set up for the purpose. This fund has specific rules for the type and amount of compensation. Applicants need to prove their exposure. The Belgian delegate stressed that there is a need to shorten the time needed for taking decisions about compensation as well as to expand compensation to self-employed workers.

Bosnia and Herzegovina

Legislation
There is no effective control measure for the use of asbestos products.

The government does not pursue an active policy to prevent health risks posed by asbestos exposure. Over the last decade, several steps have been taken to create a national legal framework, harmonized with the European directives on asbestos, and to implement other measures directed at handling the asbestos problem.

The requirements in force in national legislation for the protection of workers against exposure to asbestos are significantly less stringent than the provisions of Directive 2003/18/EC *(7)*. The maximum limit value for airborne concentrations of respirable asbestos fibre is 2 f/cm^3, which is 20 times higher than the limit value in force in the EU member states (Rule book 15/01-149/52, *Official Gazette SFRJ-MP*, No. 54/91).

An action plan is currently being developed as part of the project Capacity-Building for Banning and Phasing out Asbestos in West Balkan Countries. This has the aim of explaining the EU directives about asbestos and defining the measures that should be taken for the implementation of the directives at national level, including the costs of these activities.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Although there is a cancer register, the data are not accurate as family doctors often fail to recognize occupational diseases related to asbestos. In 2009, only one case of mesothelioma was registered. No information exists about the type and amount of occupational diseases induced by exposure to asbestos.

Data on occupational and environmental exposure to asbestos
There is no evidence of the number of workers in contact with asbestos during the use of asbestos products. No specific areas have been designated in the three landfills for the disposal of asbestos-containing waste. No data are available on asbestos use and the places where hazardous asbestos waste products are deposited. There is no funding for the proper handling of waste requiring special treatment, and workers carrying out activities involving the removal of asbestos and the collection, packaging, transport and disposal of asbestos waste by type, are not adequately trained.

Bulgaria

Challenge from existing asbestos in countries where its use is banned
Bulgaria banned the mining and use of asbestos in 2005. At that time, there was only one factory producing cement containing asbestos and a single workshop for the production of chrysotile-

based diaphragms for chlorine production, which was closed after the introduction of the ban. However, unsecured asbestos waste, creating a potential risk of exposure, can be found just outside the boundaries of waste dumps of some asbestos-producing plants which have been closed down.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
There was a rising trend in newly diagnosed cases of mesothelioma from 6 cases in 1991, 9 cases in 1992, 14 cases in 1993, 16 cases in 1997 to 47 cases in 2007 and then a decrease to 39 cases in 2008.

Data on occupational and environmental exposure to asbestos
Approximately 5000 workers may currently be at risk of exposure to asbestos during the maintenance and removal of asbestos-containing materials used in the past or while securing asbestos waste (workers engaged in the repair and maintenance of industrial machinery, removing insulation, plumbing, carrying out repairs, renovations and maintenance of old buildings, specialized dump personnel, car mechanics and others.) There is, however, no register of asbestos-containing buildings. The country representative underlined the need to build up such an inventory for the better protection of the working population and the population in general.

Croatia

Ban on the use of all forms of asbestos
All forms of asbestos, including chrysotile asbestos, were banned in 2006 by the List of Poisons whose Production, Transport and Use is Prohibited (*Official Gazette* 29/05). The 2007 regulation on the protection of workers from the risks related to exposure to asbestos at work defines and describes activities in which workers can be occupationally exposed to asbestos, defines the threshold value of asbestos in the air at work, defines valid methods for measurement of asbestos concentrations in the air, and establishes measures to reduce asbestos exposure at work or protect the exposed workers. The law regulating the obligatory health surveillance of workers occupationally exposed to asbestos since 2007 defines the activities and competent authorities for the implementation of health surveillance of workers occupationally exposed to asbestos and for the diagnosis of occupational diseases related to asbestos. This law also defines occupational exposure to asbestos and occupational ARDs, including asbestosis (pulmonary asbestos-related fibrosis), pleural ARDs (plaques, pleural thickening and benign effusion), lung and bronchial cancer and malignant mesothelioma of serous membranes. The 2008 regulation on conditions of health surveillance, diagnostic procedures and criteria for confirmation of occupational ARDs defines the terms and content of medical examinations of workers exposed to asbestos, and the criteria for the confirmation of occupational ARDs which are harmonized with the Helsinki criteria acknowledged by the EU and ILO, particularly concerning the level and length of exposure.
Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
There are strong surveillance data starting from 1957 on all occupationally exposed workers. In addition, there is an extensive follow-up programme of workers exposed to asbestos. Preventive health monitoring programmes are in place for the surveillance of the health status of workers exposed to asbestos every 3 years until 30 years after the last exposure.

Compensation schemes for asbestos victims
The Act on Compensation of Workers Professionally Exposed to Asbestos (*Official Gazette* 79/07) enables all occupationally exposed employees to submit claims to a committee established by the government (*Official Gazette* 90/07). This committee consists of nine

members drawn from different ministries, trade unions, the insurance sector and workers exposed. There are significant differences in establishing diagnoses of ARDs between radiologists and pulmonologists working in different hospitals. Problems have also been faced in addressing claims of ARDs from workers with asbestos exposure. In 2011, there were many more cases of people claiming asbestosis than in the period 1990–2010.

Finland

Ban on the use of all forms of asbestos
Finland has complied with legislation concerning the prevention of ARDs actively since the 1980s. There is a ban on the import or use of asbestos and asbestos-related products, as well as on the production of asbestos or asbestos-containing materials.

Challenge from existing asbestos in countries where its use is banned
The focus of new legislation has been the reform of legislation concerning the control of asbestos in occupational settings. The management of asbestos removal, education and training and respiratory protection have been identified as new priorities for legislative amendments.

Current regulations in place concerning the different forms of asbestos are the Statute of Council of State (1380/1994/318/2006) – (83/477/ETY)-(2009/148/EY) and the Registration, Evaluation, Authorisation and Restriction of Chemical Substances Statute with the national exception (2009) allowing the use of asbestos-containing structural parts of buildings installed before 2005 and some minor uses. The occupational exposure limits are set at 0.1 f/cm^3 after removal and 0.01 f/cm^3 after cleaning.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Widespread research activities have been carried out in recent decades and information on asbestos risks has been shared with stakeholders. There is a registry of occupational diseases, a cancer registry and statistics on compensation paid by insurance companies to asbestos patients and victims. The latest data show that the incidence of mesothelioma is not decreasing. This, however, is a consequence of the long history of the use of asbestos in Finland.

Data on occupational and environmental exposure to asbestos
In 1990, 200 000 workers were exposed to asbestos. Of them, 50 000 are still alive (mostly retired). According to the Registry of Workers Exposed to Carcinogenic Substances, about 1000 people are still exposed to asbestos at work, mainly in asbestos removal work, in the electricity, gas, water and heating maintenance sector, in maintenance/caretaker work, in recycling/waste treatment/renewal of old dumping grounds and in excavation work.

The main sources of ambient and indoor exposure are friable asbestos-containing materials in many buildings which cause exposure to asbestos fibres (50% of asbestos has been removed so far) together with failed dust control and/or lack of control of asbestos exposure in maintenance, alteration, removal or demolition work. There is a full list of industries with exposure to asbestos; it mainly concerns the construction industry (asbestos removal, plumbers), the military (potential exposure, vehicles) and the maintenance and repair of motors and appliances.

Lessons learned
Experience of asbestos regulation and control show that it is possible to remove asbestos safely. There are enough good practices, knowledge and experience, although training and awareness-raising still need to be improved.

France

Ban on the use of all forms of asbestos
France banned the use of asbestos in 1997, although its use in certain products had been restricted and labelling requirements set in 1977. The main regulations concerning asbestos today are:

- the Labour Code for the protection of workers;
- the Code of Public Health for the protection of the population;
- the Environmental Code and other environmental protection measures; and
- the decree of 24 October 2001 for compensating victims of asbestos.

The variety of regulations in force shows that national commitments for the elimination of ARDs are recognized and shared by various sectors.

Challenge from existing asbestos in countries where its use is banned
Special provisions are laid down for the containment and removal of asbestos, activities concerning materials or appliances that may release asbestos fibres and work on land containing asbestos. Asbestos waste management is the subject of several regulations. The most recent, regulating the storage of asbestos waste, was adopted in March 2012.

The main regulating principles for workers exposed to asbestos are:

- compliance with the occupational exposure limit, currently 100 f/litre;
- information and training of workers exposed;
- manual for employees and exposure record (a copy is given to the occupational physician);
- a certificate of exposure issued to employees leaving the company;
- reinforced medical surveillance of and work prohibited for young and temporary workers;
- limited duration of exposure with protective respiratory equipment.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
France has data on the incidence of pleural mesothelioma based on the national programme for mesothelioma surveillance. For the period 1998–2006, the crude incidence rates ranged, respectively, from 1.85 to 2.23 per 100 000 men and 0.5 to 0.68 per 100 000 women.

Some changes have been made recently in the labour regulations (Decree No. 2012-639 of 4 May 2012 on the risks of exposure to asbestos). The aims of the new reform are to lower the exposure limit, which is currently 100 f/litre, to 10 f/litre within three years and to control dust at workplaces.

Data on occupational and environmental exposure to asbestos
The impact on health of environmental exposure to asbestos is difficult to quantify. Some recent achievements have included mapping outcrops of mineral asbestos forms and implementing an action plan along four axes (health risk assessment, risk prevention, management of exposure situations and information for politicians, professionals and the public).

Compensation schemes for asbestos victims
An asbestos victim compensation fund was set up in 2001 with the underlying principle that people at risk of inhaling asbestos dust during the course of their professional or personal lives will, in cases of illness or non-occupational asbestos-related exposure, receive compensation.

Germany

Ban on the use of all forms of asbestos
Germany has prepared a national asbestos profile. Asbestos was phased out during the 1980s, and in 1995 a total ban (with the exception of its use for the production of diaphragms in two factories) was adopted. Many national and EU regulations have been adopted regulating the placing of asbestos on the market covering: classification, labelling and packaging; registration, evaluation, authorization and restriction of chemical substances; occupational health and safety (Hazardous Substances Ordinance, Technical Rules for Hazardous Substances and Ordinance for Medical Surveillance), consumer protection (Chemical Prohibition Ordinance, Guidelines for the Assessment and Demolition of Weakly Bound Asbestos Products in Buildings) and environmental protection (Technical Instructions on Air Quality Control, Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal).

Challenge from existing asbestos in countries where its use is banned
However, 20 years after the ban Germany is still facing the challenge of exposure to existing asbestos and the resulting need for protective measures for workers who are exposed as well as for the general population. Most asbestos cement products are still in place in many residential areas. National enforceable occupational exposure limits have been set for all fibrous forms of asbestos: 1000 f/m^3 is the occupational exposure limit for the production/use of diaphragms (in one factory) and the re-use of the building after asbestos removal, and 100 000 f/m^3 marks the upper limit of tolerable risk for workers.
Data on occupational and environmental exposure to asbestos
Between 1972 and 2011, more than 550 000 workers were listed in the Central Registration Agency for Employees Exposed to Asbestos Dust of the Statutory Accident Insurance Institutions, although other estimates range up to 2.5 million workers exposed.

Economic evaluations of ARDs
Economic evaluations can be made on the basis of compensation costs for ARDs. However, such an approach to the calculation of economic burden only takes direct costs into consideration.

Hungary

Ban on the use of all forms of asbestos
The use of asbestos was banned in 2004. Blue asbestos has not been used since 2002.

Challenge from existing asbestos in countries where its use is banned
As in all countries that have banned asbestos, existing asbestos poses a challenge. A national asbestos demolition programme was initiated in 2002 with the aim of removing a total of 120 000 m^2 asbestos-containing insulation by 2012. The programme is supported by the EC structural fund.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Mesothelioma cases have been identified since 1996, when the International Classification of Diseases, 10th revision (ICD-10) was introduced. Cluster analysis of mesothelioma shows four

geographical clusters, characterized either by industries or by houses built in the 1970s. The highest mortality due to mesothelioma was registered in areas with asbestos industries.

Occupational medical screenings have taken place in one asbestos factory since 1959.

Data on occupational and environmental exposure to asbestos
In the past, asbestos exposure has been due to occupational activities such as mining, textile manufacture, friction inlay, the car industry and manufacture of insulation materials. Today the sources are environmental, housing, or specific sources such as filters in the subway in Budapest.

Israel

Ban on the use of all forms of asbestos/legislation
Asbestos is regulated within the framework of the 2011 Prevention of Hazards from Asbestos and Harmful Dusts Law, which was created on the initiative of the Ministry of Environmental Protection and is implemented under the authority of the Ministry. The law bans the new use of asbestos and sets out a comprehensive regulatory framework for all environmental aspects of asbestos.

The aim of the law is to reduce and prevent public exposure to asbestos, based on the precautionary principle.

Challenge of existing asbestos
In the case of existing friable asbestos, the law requires mandatory general surveys, the closure of public buildings or industrial facilities where friable asbestos is exposed to air, and the signposting of the asbestos. Friable asbestos must be gradually phased out within a maximum period of 10 years (starting from August 2011). Where there is asbestos cement in public buildings, the provision requires proper maintenance and notification regarding the painting and a visual survey once a year. The law requires specific permits for the removal of asbestos-containing materials and the licensing of contractors, supervisors and laboratories working with any type of asbestos. It is estimated that about 100 million square meters of asbestos cement board can still be found throughout the country.

Data on and legislation for occupational exposure to asbestos
The protection of workers from the risks related to asbestos has been regulated since 1984 in the safety at work regulation (covering occupational hygiene, public health and health of workers in harmful dust). This regulation defines occupational exposure to asbestos, occupational exposure limits and occupational ARDs, and establishes measures to reduce asbestos exposure at work and protect workers who are exposed.

The regulation also requires the measurement of asbestos concentrations in the air at workplaces and obligatory health surveillance of workers occupationally exposed to asbestos. Surveillance of the health status of workers previously exposed to asbestos is also required.

Workplace exposure to asbestos takes place predominantly in the removal, demolition and maintenance of asbestos and in the treatment of asbestos waste.

The Ministry of Industry, Trade and Labour is preparing a new asbestos regulation that will focus on the control of exposure to asbestos in its removal and establish a new occupational exposure limit for asbestos of 0.1 f/cm^3 instead of 0.2 f/cm^3.

Cancer registers, occupational diseases registers
The Ministry of Health has the following three health databases related to ARDs.

- The Occupational Diseases Register is the responsibility of the Centre of Disease Control jointly with the Ministry of Industry, Trade and Labour. This database includes occupational information with previous places of work in addition to demographic information on every case of mesothelioma. The law requires occupational physicians to report according to a structured information form. The database has been functioning for one year at full capacity.
- The database of hospitalization cases enables relevant causes of hospitalization to be detected according to ICD codes and includes demographic information about all hospitalizations, with information about repeated hospitalizations for the same causes.
- The Israel National Cancer Registry includes information on pleural and peritoneal mesothelioma (by ICD) as well as demographic information and history of residential address.

Mesothelioma incidence increased in Israel between 1980 and 2007, with high rates in males.

Compensation schemes for asbestos victims
The National Insurance Institute is responsible for compensation for ARDs (mesothelioma, asbestosis, lung cancer).

Asbestos Waste Clean-up in the Western Galilee Project
Asbestos was widely used following the establishment of the Eitanit (formerly Isasbest) asbestos cement plant in 1952 in Nahariya in the north of the country. Although Eitanit was closed down in 1997, friable asbestos waste had already accumulated in both public and private areas in Western Galilee. In March 2011, the Ministry of Environmental Protection embarked on a five-year project to identify, remove and dispose of asbestos waste in Western Galilee. The project is being carried out with the full cooperation of the relevant local authorities. In the first phase, asbestos waste is being removed from public areas which were mapped during the course of two surveys commissioned by the Ministry. In the next phase, private areas with asbestos waste will be mapped and asbestos will be removed from these areas. By December 2012, 31 100 m^3 of asbestos had been removed from a total of 80 sites.

Italy

Challenge from existing asbestos in countries where its use is banned
Law No. 257 of 27 March 1992 outlawed the use of asbestos and banned the mining, import, export, sale and production of asbestos and other products containing asbestos. There are, however, still several million tonnes of compact material containing brittle asbestos in a large number of contaminated public and private, industrial and other sites. Despite the ban, asbestos is still allowed in materials in a good status of preservation that have already been installed up to the end of their lives.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
The actual pleural mesothelioma incidence rate is 3.6 per 100 000 men and 1.6 per 100 000 women; 10% of these cases are due to exposure in residential or family settings. The occupational sectors most involved are shipbuilding, construction and the fibre-reinforced cement industry.

The epidemiology of asbestos-induced lung cancer is more complex, but published studies agree on a 1:1 ratio with the incidence of mesothelioma.

Prime Ministerial Decree No. 308 of 10 December 2002 completed the rules for epidemiological surveillance of asbestos exposure defined in the national registration process for mesothelioma. This process works as a network in operative regional centres and collects active data from different sanitary services.

Lessons learned
The government has recognized that asbestos-related illnesses are a national emergency calling for a structured package of initiatives, starting with:

- remediation of the worst contaminated sites;
- screening of people who have been, and still are, exposed to asbestos;
- development of diagnostic and treatment programmes for patients;
- counselling for their families.

A second National Governmental Conference on Asbestos took place in Venice from 22 to 24 November 2012 (the first was held in 1999) with the aim of strengthening all national asbestos-related activities.

Montenegro

Legislation
In the last four years, regulations on asbestos use were introduced. The import of asbestos is not forbidden, but a new law is under development aiming at the transposition of EU regulations. The customs law concerning asbestos-containing materials is being harmonized with EU directives. The decision on the Control List for Export, Import and Transit of Goods (*Official Gazette* 10/2011) stipulates that the export and transit of waste asbestos (dust and fibres) require a licence from the Agency for Environmental Protection. The Waste Management Law (*Official Gazette* 80/2005) prohibits the importation of asbestos waste. Other imported products are under the responsibility of Ministry of Finance.

A national programme on asbestos is currently being developed, to be finalized by 2013, and the occupational health system will be re-established following the national strategy and action plan.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
In 2009, one case of asbestosis was reported and five cases were discharged from hospital and treated at home. There is a problem with the availability of statistics as most data are only available for the period between 2000 and 2009. In 2005, the organization of the Ministry of Health was changed and the occupational health services were closed. Since then, no information has been available on the health situation of workers. Many old workers have retired without any health control and surveillance.

Poland

Challenge from existing asbestos in countries where its use is banned
Poland has no asbestos deposits. About 85% of imported asbestos is found in construction materials.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Registers of all certified cases of occupational asbestos-related exposure and information on them are forwarded by the local sanitary inspector to the Central Register of Occupational Diseases located at the Nofer Institute of Occupational Medicine in Lodz. The current list of occupational diseases includes asbestosis, diffuse thickening of the pleura or pericardium, diffuse plaques of the pleura or pericardium, pleural exudate, chronic obstructive bronchitis and lung cancer, as well as pleural and peritoneal mesothelioma as the pathologies caused by exposure to asbestos. Over the period 1976–2010, 4253 cases of disease were recorded deriving from occupational exposure to asbestos dust. The most prevalent were asbestosis (64.0%), lung cancer (12.2%), diseases of the pleura (9.7%) and pleural mesothelioma (6.4%).

Basic regulations for protection against asbestos include the Act of June 19 1997 on the Ban on Use of Asbestos-Containing Products. To implement this Act, in 2000 the Ministry of Health launched the AMIANTUS Programme, financed from the national budget, to screen former workers in asbestos processing plants.

All the former workers in the 28 asbestos-processing plants specified in the Act are entitled to periodic medical examinations and free medications to treat ARDs. Voluntary medical examinations are performed once a year and include general medical examination, X-ray chest imaging, resting spirometry and additional testing (such as resting gasometry) or other diagnostic tests (such as a computerized tomography scan), if necessary. Diagnosis is based on the Helsinki (1997) criteria for diagnosis and attribution of asbestos diseases.

Compensation schemes for asbestos victims
Every case of lung cancer with documented occupational exposure to asbestos dust is compensated as an occupational disease, no matter whether asbestosis had been diagnosed beforehand or whether the person smoked.
Despite the low number of cases of occupational lung cancer diagnosed as due to asbestos exposure, they accounted for about 40% of the total cases of occupational lung cancer recorded during the period 1978–2010.

Lessons learned
According to some key recommendations drawn up, based on the implementation of the AMIANTUS Programme, there should be:

- a legal obligation, prior to the closure of a plant producing asbestos-containing products, to draw up a profile of the plant, including a list of people who have ever been employed there, asbestos exposure assessment data and data on the production, type and usage of asbestos in the plant;
- information for employees of companies where the production of asbestos-containing materials has been terminated on their entitlement to prophylactic medical examinations;
- development and implementation of a prophylactic examinations programme for the former workers of closed plants;
- establishment of a coordination centre to allow the standardization of medical records and to create a database for epidemiological analysis;
- definition of the asbestos-related pathology being studied (the adoption of well-defined basic criteria for diagnosis of ARDs and assessment of asbestos exposures is advised);

- development of a questionnaire and a range of medical examinations so as to determine the radiological criteria that significantly determine the early diagnosis of the radiological changes caused by asbestos;
- designation and observation of a cohort of workers exposed to asbestos to determine the health effects and death risk assessment.

Republic of Moldova

Legislation
There is no legislation regulating asbestos.

Data on occupational and environmental exposure to asbestos
According to a study carried out by the national Institute of Public Health, the delegate stated that the use of asbestos is much higher in the south of the country than in the north. Three hundred and forty thousand children are exposed to asbestos in schools, fifty thousand of them in the capital, Chisinau. There is a need for more epidemiological surveillance.

There are no factories producing asbestos, but asbestos-containing materials are used in some factories.

Economic evaluation of ARDs
Calculation of the economic costs of ARDs is an important and necessary tool for further asbestos programmes. The Ministry of the Economy requires financial justification for any political document and programme. Economic evaluation of the burden would, therefore, be a strong argument for action.

Lessons learned
The Ministry of Health has taken the first steps by conducting a study of the disposal of asbestos and of the presence of asbestos in schools and the housing stock. The Parma Declaration has been an important commitment for triggering activities relating to asbestos. Support for the Ministry of Health from other relevant ministries, such as the Ministry of the Environment, would help in the endorsement and implementation of programmes aimed at the elimination of ARDs. These sectors should be present at WHO meetings so as to agree to national processes and commitments.

Russian Federation[3]

Policy developments
In November 2007, taking into account the positions of ILO and WHO, the Ministry of Health and Social Development of the Russian Federation (from 2012, the Ministry of Health) issued an order to develop a National Programme For Elimination of Asbestos-Related Diseases. No formal process has, however, been established.

In 2012, a draft of the Concept of State Policy aimed at the Elimination of Diseases Related to Exposure to Asbestos-Containing Dust was approved by Ministry of Health of the Russian Federation with the Russian Tripartite Commission for Regulation of Social and Labour Relations

[3] The participants from the Russian Federation did not agree with the assessment of the results of exposure to different forms of asbestos and asbestos-containing materials made at the meeting in Bonn in 2011 and discussed at this Meeting. They submitted a written statement which is attached as Annex 8.

and was presented for consideration and approval to the government of the Russian Federation. To date it is going through the approval process.

Diagnostic criteria for occupational cancer
New training materials on the safe handling of asbestos have been developed for labour and sanitary inspectors and several analyses/studies have been undertaken. The first was a retrospective analysis of Russian scientific research on asbestos, which collected and analysed over 2000 studies published between 1902 and 2010. The results of the review showed that in certain cases, all types of asbestos can be dangerous for human health.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
The asbestos-related pathologies included in the official list of occupational diseases in the Russian Federation are: various pathologies of the upper airways (including cancer), chronic bronchitis, pneumoconiosis (asbestosis), lung cancer, mesothelioma and some other diseases. Practically all cases detected in the Russian Federation were the result of long-lasting occupational exposure to asbestos-containing dust in extremely high concentrations.

Lessons learned
Based on national experience and studies, additional work should be done. Country representatives felt that there is a need to complete the evaluation of the main sources of exposure (including occupational and environmental exposure). In addition, the following work should be done on the estimation of:

- the total number of persons exposed from occupational, non-occupational and environmental sources;
- preparation of a formal register of industries where exposure exists and industries with the largest numbers of workers potentially exposed; and
- a register of industries with a high risk of exposure and the estimated total number of workers at high risk.

Other important tasks that should be carried out are the mapping of:

- existing and closed enterprises producing and/or using asbestos-containing materials;
- deposits of all types of asbestos;
- deposits of erionite, vermiculite, talc and other natural fibrous minerals.

Serbia

Ban on the use of all forms of asbestos
As a candidate country to the EU, Serbia banned the use of all forms of asbestos in 2011. Historically, there were factories producing asbestos-containing products, but production stopped in 2006. Workers who have been, are or might be exposed to asbestos are obliged to undergo examinations once a year.

Challenge from existing asbestos in countries where its use is banned
Although asbestos has been banned, existing asbestos is still posing a significant professional and environmental health risk. A number of companies, especially bigger ones, have already started asbestos removal activities.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
There is a cancer register as well as a register of occupational diseases, but the capacities for the diagnoses of ARDs should be improved. For example, all X-rays submitted to radiologists are read based on previous experience and expertise, but the standardized training which was carried out for decades is no longer available. No links have been made between the cancer register and exposure data for occupational exposures.

Lessons learned
The government is in the process of forming an intersectoral body for the development of the national profile. All sectors involved have expressed their full commitment to all the activities necessary for the development of the profile. In 2011, the Ministry of the Environment carried out a survey of industry in order to collect data for the asbestos inventory. The occupational health services and the Directorate for Occupational Safety and Health have prepared a regulation on preventive measures and employers' responsibilities during asbestos removal activities.

Slovenia

Ban on the use of all forms of asbestos
The use of all forms of asbestos has been banned in 1996 and a national asbestos profile (national directive for asbestos) developed with the aim of collecting data about the production and consumption of and exposure to asbestos, morbidity and mortality caused by asbestos, air measurements and asbestos hazard sites (dumping sites and waste material).

Cancer registers, occupational diseases register, diagnostic criteria for occupational cancer
Cases of mesothelioma are most common in three regions of the country characterized by the presence of industries that have used asbestos.

Data on occupational and environmental exposure to asbestos
Many efforts have been undertaken to collect information by directly approaching national companies importing and using asbestos. A questionnaire has been used to quantify the products containing asbestos and such products sold inside and outside the country and to collect information about workers' exposure. In addition, information has been obtained from the customs records regulating permits for the import of asbestos, the national cancer registry containing a cluster analysis of mesothelioma for the period 1959–1994 (ongoing), and the Ministry of Health for information about companies requesting export permits for asbestos products in 1998. Extensive information has also been gathered on the presence of asbestos in schools and buildings where children spend their time. National trends show that annual consumption of asbestos decreased between 1965 and 1997.

Compensation schemes for asbestos victims
Compensation is possible for such ARDs as pleural diseases, asbestosis, mesothelioma, lung cancer, environmental mesothelioma and other diseases.

Lessons learned
Awareness-raising campaigns are being restarted to inform the public health, environmental and occupational health services about the health risks related to asbestos exposure.

Spain[4]

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
The Ministry of Health and Social Policy has developed the multi-stakeholder National Health Surveillance Programme of Asbestos-exposed Workers in order to ensure appropriate, uniform and harmonized action throughout the country. This was approved by the health and labour authorities in 2003. Occupational health professionals were included in the programme by administrative and political agreement. Within the National Commission of Occupational Safety and Health, a working group composed of representatives of the national and regional governments, employers' organizations and workers' organizations is working on asbestos.

The Programme is organized around seven main activities:

- preparation of a register of workers exposed to asbestos;
- establishment and facilitation of access to health examinations after exposure to asbestos;
- application of the approved specific health surveillance protocol;
- establishment of follow-up of post-exposure health surveillance;
- legal recognition of ARDs;
- assignment of the necessary human and equipment resources; and
- evaluation of the health surveillance programme.

Data on occupational and environmental exposure to asbestos
The main limitations of the Programme lie in the lack of information on the level, type and duration of exposure. No information on workers' birth dates is available, which impedes the linkage with death statistics and the obtaining of vital status and cause of death. The lack of information on age makes it impossible to control for age in the analysis of health problems or to identify "lost" individuals, who could have retired.

Compensation schemes for asbestos victims
Agreements are being made with the social security system to increase legal compensation for workers.

Lessons learned
The lack of previous experience and of effective mechanisms for coordination between institutions, health care levels and systems make data collection difficult, leading to inconsistent and incomplete coverage. There is also no legal recognition of ARDs as occupational diseases. Participation in the consensual Programme has, however, allowed the country to develop occupational prevention policies more efficiently than was possible under the formal legal requirements. The number of workers covered doubled during the first year the Programme was implemented; currently, nine times more workers are covered than when the Programme started.

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[4] Received after the Meeting.

Tajikistan

Legislation
The production, use, import and export of asbestos are not regulated by legislation. There is an asbestos cement company and a factory producing asbestos roofing built in 1980. All production facilities have ventilation, and occupational health services make regular check-ups.

Turkey

Legislation
The import, export and use of asbestos were totally banned under regulatory legislation of the Ministry of Environment in December 2010. Exposure to asbestos in any kind of work has been limited since 2003 to 0.1 f/c^3 (average for an eight-hour work shift) under the Legislation about Preventive and Protective Measures in Asbestos Workers, 26.12.2003, No. 25328, of the Ministry of Labour and Social Security.

Although several governmental and private sector institutes or bodies employ professionals to characterize and measure the type and quantity of asbestos, the Ministry of Labour and Social Security has employed additional staff for the detection and analysis of asbestos.

The Ministry of Health started a national asbestos control programme in November 2012. This programme aims to implement environmental control by taking samples of soil and buildings in cities or villages where mesothelioma cases are detected. It is planned to finalize the programme by the end of 2013. In addition, an occupational asbestos control programme is being prepared with the aim of formulating recommendations and guidelines.

Turkmenistan

There is no legislation regulating the production, use, import and export of asbestos. There are some small private facilities that produce insulation materials using asbestos. Asbestos scrap is used to insulate pipes in the oil industry. The country does not export asbestos-containing products. Workers handling asbestos use personal protective equipment.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Occupational diseases related to asbestos have not been registered.

United Kingdom

Ban on the use of all forms of asbestos
The import and use of asbestos is banned. In 1969, an asbestos regulation banning crocidolite was introduced. Several regulations followed, such as the bans on amosite and chrysotile, licensing for the removal of asbestos and introduction of the duty to manage asbestos.

Challenge from existing asbestos in countries where its use is banned
The regulatory approach is based on risk assessment. Although the import and use of all forms of asbestos is now banned, substantial quantities remain in many buildings. The focus of current regulation is on abatement work and prevention of disturbance and release of asbestos fibres by building maintenance workers. The Control of Asbestos Regulations 2012 were introduced to

implement EC Directive 2009/148/EC. This lays the duties on: employers and self-employed people to manage properly the risks arising from asbestos in the course of work; those responsible for the repair and maintenance of non-domestic buildings to manage asbestos in such buildings; and the relevant people to be licensed for high-risk asbestos abatement work such as the removal of asbestos insulation board or sprayed insulation.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
The peak for mesothelioma is predicted to be reached around 2020. The highest exposure is recorded in heavy industry. Domestic exposure to asbestos has also been increasing.

As there is no direct population-based evidence either on the amount of asbestos that is inhaled by different occupational groups or on its effects on their future mesothelioma risks, several research projects are currently being implemented. The relationship between mesothelioma risk, asbestos burden and lifetime occupational history will be documented. Lung tissue samples from younger pneumothorax patients form a population sample in whom the lung burden from asbestos will be a reflection of more recent or current working and environmental conditions. Lifetime occupational histories are obtained and asbestos lung content analysed by transmission electron microscope. This will allow the lung burden associated with more recent occupational conditions in different jobs and environmental exposures to be characterized and future mesothelioma risks associated with these lung burdens to be estimated. So far, 100 pneumothorax lung samples have been analysed and at least a further 200 will be analysed over the next two years.

Economic evaluations of ARDs
The Health and Safety Executive is carrying out research to estimate the economic burden of occupational cancer in Great Britain,[5] a substantial proportion of which is asbestos-related. Final results are not yet available, but the estimates for asbestos-related cancers are likely to be in the order of tens of billions of pounds per year.

The former Yugoslav Republic of Macedonia

Legislation
The former Yugoslav Republic of Macedonia is in the process of preparing a national asbestos programme. As a candidate to the EU, the legislation is being amended.

Cancer registers, occupational diseases registers, diagnostic criteria for occupational cancer
Mesothelioma is recognized as an ARD and cases of asbestosis and pleural plaques have been recorded.

Workers employed by factories still using asbestos undergo regular health check-ups.

Data on occupational and environmental exposure to asbestos
There is good evidence on current occupational exposure to asbestos but only limited evidence about past exposure. Asbestos is still being used by one factory producing wheels. Data are lacking for occupational and environmental exposure.

Compensation schemes for asbestos victims
Although there is legislation for compensation of asbestos victims, no cases were compensated.

[5] England, Scotland & Wales but not Northern Ireland.

Conclusions and recommendations

Following an open discussion, the Meeting drew up the following conclusions and recommendations.

1. *Scientific evidence has been further consolidated by the IARC on the carcinogenicity of all types of asbestos and occurrence of non-malignant ARDs* and on the importance of ARDs as one of the most severe and widespread occupational and environmental health hazards in the Region.

2. *Key international committal documents have supported Member States in the development of national asbestos programmes*. The Parma Declaration, adopted at the Fifth Ministerial Conference for Environment and Health in 2010, has given strong support for national activities relating to asbestos. The EU, ILO and WHO have provided policy guidance and internationally approved legal and practical instruments for the elimination of ARDs, and supported the implementation of asbestos policies throughout the Region.

3. Many countries in the Region have *successfully implemented internationally guided policies, transposed the EU directives on prevention of asbestos hazards and taken action to eliminate ARDs*. In many countries in the central and eastern parts of the Region, however, the implementation of asbestos policies is still being developed. The lack of strong legal frameworks regulating the production and use of asbestos intensifies existing inequalities in the Region as regards exposure to health risks. Countries without adequate policies to address ARDs need reinforced strategic guidance and practical support from WHO in order to *develop and implement national asbestos programmes by 2015*, as mandated by the Parma Declaration. Participants suggested that the existing outline for the development of national programmes for the elimination of ARDs developed by ILO and WHO should be supported by a practical manual based on successful country experiences.

4. *National asbestos profiles have been recognized as key tools* for integrating the development and management of asbestos policies and programmes. They support national priority-setting as well as the monitoring of national achievements. Several countries reported on the preparation of national asbestos profiles and national programmes for elimination of ARDs following the ILO/WHO outlines. Some Member States have, however, experienced difficulties in developing and implementing the programme and/or the profile. Participants suggested that programmes should be developed at sub-regional level, such as south-eastern Europe and the newly independent states, which would enable countries to benefit from synergies and joint political commitments.

5. *Countries have shared examples of good practice and the challenges and opportunities* of developing national profiles and programmes on asbestos. These examples provide opportunities for other countries in different situations and give the capacity to learn from each other. *Countries are encouraged to make use of the experience of other Member States in the Region and to share the strengths and weaknesses of their own national programmes.*

6. The training workshops on *health and the financial burden in terms of PYLLs, DALYs and economic costs* underscored the overall magnitude of the problems and the importance of training the participants in the subject. PYLLs and DALYs are good measures for raising awareness, stimulating surveillance and prioritizing the elimination of ARDs in national

political agendas. The methods presented for the economic appraisal of direct and indirect costs of ARDs at national level provide an opportunity for the assessment of costs related to ARDs and the economic benefits resulting from their elimination. The concepts and methodologies presented are user-friendly and easy to understand. WHO agreed to collaborate with international experts to prepare the necessary technical documents for applying these methodologies (hands-on guidance documents, excel sheets containing macros, additional training in the calculation of PYLLs, DALYs and economic appraisals, and virtual meetings) at national level, and to organize a training workshop at international level. *Member States are encouraged to make use of these documents and training materials for capacity-building to develop national asbestos profiles*. PYLLs, DALYs and economic calculations should, where enough data are available, form part of national asbestos profiles.

7. Reliable information on the use and distribution of asbestos as well as asbestos-related morbidity and mortality is critical for the design of national asbestos profiles and programmes. Well-established national cancer registers and national registers of occupational diseases are the key resources for registering asbestos-related morbidity. Awareness, diagnostic procedures and criteria, notification and registration of ARDs vary between countries and are in need of strengthening and harmonization. *National cancer registers, including the registration of mesothelioma and other ARDs, are important to monitor the burden* and the effectiveness of national programmes for the elimination of ARDs.

8. The following should be priorities for data collection:

- registration of ARDs and occupational/environmental exposures to asbestos;
- taking of inventories, labelling and mapping sources of exposure to asbestos and the presence of exposure;
- use of the geographic information system for the spatial mapping of asbestos sources, exposures and ARDs;
- estimation of the direct and indirect economic costs of ARDs.

The IARC offered support for strengthening national cancer register systems and invited Member States to join the CAREX 2 project on an information system on occupational exposure to carcinogens. *Member States are encouraged to seek support from the IARC.*

9. *Awareness and training about ARDs* are still lacking in almost all countries in the central and eastern part of the Region. Training and education should be increased for health and occupational health professionals, employers, workers and policy-makers. In particular, clinicians would benefit from special training in the diagnosis and treatment of ARDs. The general public needs to be informed about the health risks posed by exposure to asbestos and about existing national, regional and local authorities in charge of asbestos-related legislation. Special attention should be given to the training of professionals in charge of the handling and disposal of asbestos waste as well as of demolition work.

10. Preventing and controlling exposure to asbestos, and subsequently the development of ARDs, need the *involvement of multiple actors*. As well as policy-makers, all relevant stakeholders (civil society and nongovernmental organizations, social partners, social security institutions, provincial and municipal associations, patients and their advocacy groups, academics and scientists) are essential to the efficient development and

implementation of prevention and control measures. *Special attention should be paid to asbestos victims by providing them with the necessary care and social security and involving them in the decision-making process.*

11. Since asbestos -related legislation falls under the responsibility of multiple actors and sectors (such as the environment, labour, health, construction and social welfare), it is recommended that a government body should be tasked with developing a strategic plan for asbestos management and coordinating national efforts. This coordinating body should be supported by a *national centre of excellence for ARDs*, providing leadership and collaborative structures for research programmes and health care issues as well as advice and support to policy-makers.

12. There is still a need to *strengthen research* on the prevention, diagnosis and treatment of ARDs. The main areas identified were:
    - active surveillance of ARDs;
    - better diagnoses of ARDs;
    - epidemiological investigation of individual cases of ARDs in addition to ecological links between exposures and ARDs;
    - medical research into the treatment of mesothelioma to improve the quality of life and the survival rate;
    - effective early intervention followed by early detection of ARDs.

13. The development of national programmes for the elimination of ARDs will be reported on at the sixth Ministerial Conference on Environment and Health, to be held in 2016. Member States *confirmed the roadmap* presented and adopted at the meeting held in June 2011 setting the following milestones for asbestos policy development at national and international levels:
    - milestone 1: burden of ARDs in Europe (2012) (presented in this report);
    - milestone 2: national asbestos profiles (2013);
    - milestone 3: regional asbestos profile (2014);
    - milestone 4: national programmes and action plans (2015);
    - milestone 5: report to the Sixth Ministerial Conference on Environment and Health (2016).

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Annex 1

PYLLS FROM ARDS IN EUROPEAN COUNTRIES[1]

Introduction

The typical image of ARDs is of a rare and frightening disease occurring mainly in occupational settings. Typical asbestos-related malignancies are mesothelioma and lung cancer. Asbestos exposure also causes benign asbestos-related disorders, including asbestosis, diffuse pleural thickening, pleural effusion and pleural plaques, which are commonly seen in clinics and whose incidence continues to increase worldwide. According to the most recent WHO estimates, more than 100 000 people die each year globally from asbestos-related lung cancer, malignant mesothelioma and asbestosis due to occupational exposure with sufficient evidence of human carcinogen *(1,2)*. However, in many cases of mesothelioma there had been no known occupational exposure to asbestos; the mesothelioma could, therefore, have been due to domestic and neighbourhood exposure to asbestos, or even environmental exposure to naturally occurring asbestos *(3–5)*. It is clear that mesothelioma incidence due to non-occupational exposure to asbestos is continuing to rise.

A recent study using 92 253 mesothelioma deaths in 83 selected countries during the period 1994–2008 reported a crude mortality rate (CMR) and age-adjusted mortality rate (AAMR) of 6.2 and 4.9 per million population, respectively, and a mean age at death of 70 years with a male to female ratio of 3.6:1 *(6)*. The AAMR increased by 5.4% per year and consequently more than doubled during this period. Both indicators (CMR and AAMR) are conventionally used for quantifying the burden of cancer. A definition of CMR is the mortality rate among all age groups. AAMR is defined as the mortality rate that takes into account the age structure of the population to which it refers *(7)*. The AAMR has usually been used to compare mortality in populations with very different age structures. Another indicator relevant to quantifying the burden of cancer incidence is the incidence rate, that is, the number of new cases per population in a given time period.

An additional approach to determining the burden of cancer is the measurement of premature death, which is a death occurring before average life expectancy. The well-known measures of premature death are PYLLs and average potential years of life lost (APYLL) *(8)*. PYLLs are the number of years a death occurred earlier than it would have occurred in the absence of cancer. APYLL is the average of the differences between the actual ages at death of those who died of cancer and the expected age at death (natural death) of those persons. In general, the PYLLs emphasize the processes underlying premature mortality in a population. The PYLLs and APYLL give more weight to death at younger ages but also give a clear picture of mortality patterns among a population with malignancies.

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[1] The draft of this guidance document was prepared by Associate Professor Eun-Kee Park of the Department of Medical Humanities and Social Medicine, College of Medicine, Kosin University, Busan, Republic of Korea and Ken Takahashi, Ying Jiang, Mehrnoosh Movahed of the Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Kitakyushu, Japan, as a background document for the Meeting. In no event shall this paper be considered an official paper endorsed by WHO. The responsibility for the interpretation and use of the material lies with the reader. The views expressed by the author do not necessarily represent the decisions or the stated policy of WHO.

It is obvious that the number of ARDs continues to rise worldwide because of a long incubation period after first exposure to asbestos. There are no curable treatments to eradicate them, especially malignant mesothelioma. It is, therefore, necessary to establish effective strategies to eliminate ARDs which require alternative approaches to investigate the ARDs patterns. For a better understanding of the burden of ARDs in the European Member States, the PYLLs and APYLL of malignant mesothelioma and asbestosis were estimated.

Methods

Mortality, life expectancy and population database

Using the WHO mortality database *(9)*, the number of deaths recorded as ‘mesothelioma (C45, International Classification of Diseases, 10th Revision, or ICD-10 or any subcategories thereof)’, and ‘asbestosis (J61, ICD-10)’ during the period 1994–2010. Note that the disease category was introduced into the ICD-10 *(10)* in 1993 and data actually appeared in 1994, so the period of 1994–2010 maximizes the use of available data for mesothelioma and asbestosis. The number of deaths was stratified according to gender and anatomical disease sites. Of the 53 Member States, special treatment of mesothelioma data was applied due to political transition with other countries by the WHO mortality database. Mesothelioma mortality (C45, ICD-10) in the United Kingdom (2000–2010) was combined with data reported as United Kingdom (Scotland) (2000) and United Kingdom (2001–2010). We treated Serbia and Montenegro as one entity (reporting years, 1997–2010) so that data reported as Serbia and Montenegro (1997–2002) and Serbia (2003–2010) were combined.

Data for life expectancy at a specific age by country and sex available for 1990, 2000 and 2009 were obtained from the WHO health statistics and health database *(11)*. Data for life expectancy were interpolated for the in-between years. Countries with data available on mortality (C45, ICD 10) and life expectancy were included in the analysis. Given the predominantly occupational etiology and long latency of ARDs, this report was restricted to deaths at ages ≥30 years. Ten age groups are defined in this report: 30~34 years, 35~39 years, 40~44 years, 45~49 years, 50~54 years, 55~59 years, 60~64 years, 65~69 years, 70~74 years and ≥75 years.

To determine mortality rates, national population data were obtained from the WHO health statistics and health information systems *(12)*.

Calculation of PYLL and APYLL

The PYLLs/APYLL were calculated in 53 European Member States. PYLLs were determined in reference to life expectancy. Calculations were based on summing the difference between age at death of each deceased case and life expectancy, that is: PYLLs = sum [(deaths at a given age) × (remaining life expectancy for that age)].

APYLL was simply calculated by taking the PYLLs divided by the total number of deaths (unit: year), that is: APYLL = PYLLs/number of deaths.

The annual average of PYLLs was simply determined by taking PYLLs divided by reporting years, that is: annual average of PYLLs = PYLLs/number of reporting years.

Calculation of AAMR

The AAMR was calculated using a direct age-adjustment method, with reference to the world population in 2000. The age-specific rate for each age group in the study population (≥30 years) was multiplied by the appropriate weight in the standard population; that is, the AAMR weights the age-specific rates observed in a population of interest by the proportion of each age group in a standard population. The formula is as follows:

$$AAMR = \sum_{i=1}^{k} D_{g_i} \times SP_{g_i} \times 10^4 / POP_{g_i}$$

POP_{gi}: population at age group g_i. SP_{gi}: standard population distribution at age group g_i.

Calculation of average age at death

For calculation of the average age at death, it is necessary to have the aggregate distribution of deaths by age group defined in this report. The formula is as follows;

age group: g_i: $age_{ia} \sim age_{ib}$ $(g_1: 30\sim34, g_2: 35\sim39, \cdots, g_k: 75\sim)$

$$\frac{\sum_{i=1}^{k} w_i \times D_{g_i}}{\sum_{i=1}^{k} D_{g_i}}, \qquad w_i = age_{ia} + \underline{(age_{ib} - age_{ia} + 1)/2}$$

← constant = 2.5

where D_{gi} is the number of deaths at age group g_i.

Statistical analysis

All data were compiled and descriptive statistics conducted using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). The numbers of deaths in the WHO mortality database were determined using SAS Version 9.1 (SAS Institute Inc., Cary, NC, USA).

Results and conclusions

ARDs mortality, malignant mesothelioma coded as C45 (ICD-10) and asbestosis coded as J61 (ICD-10) in 53 WHO European Member States were extracted from the WHO mortality database. It is noted that 37 countries reported their mesothelioma mortality coded as C45 (ICD-10) into the WHO mortality database. In addition, 32 Member States reported their asbestosis mortality coded as J61 (ICD-10) (Tables 1.1 and 1.2).

The actual number of mesothelioma deaths at ages ≥30 years in the Region during the period 1994□2010 shown in the WHO mortality database was 71 555, and the annual average of 6864 deaths was recorded with an overall average age at death of 69.4 years (Table 1.1). The overall age-adjusted mortality rate was 7.5 per million. With regard to anatomical sites based on ICD-10 code in the mortality database, the pleura (C45.0) accounted for 53.5% of all mesothelioma deaths and the peritoneum (C45.1) for 4.2%. Others (mesothelioma (C45), pericardium (C45.2), other sites (C45.7) and unspecified (C45.9)) accounted for 42.3 % of deaths (Table 1.3). The numbers of mesothelioma deaths for males and females were 56 327 (78.7%) and 15 228 (21.3%), respectively. The mean age at death by anatomical site was high for pleural sites at 69.6 years, while it was 69.5 years for the category of other sites and 66.3 years for subjects with peritoneum mesothelioma. The number of mesothelioma deaths during the period 1994□2010 accounted for 1.2 million PYLLs, or 0.1 million PYLLs annually with an overall APYLL of 16.8 years earlier than life expectancy. The majority of PYLLs attributed to mesothelioma deaths were male, with 0.9 million person-years (75.9%) with an APYLL of 15.2 years and pleural mesothelioma with 0.6 million person-years (53.3%) with an APYLL of 16.7 years (Table 1.3).

Table 1.1. Impact on WHO European countries of deaths due to mesothelioma (C45, ICD-10), 1994-2010[a]

Country	Average age at death	No. of reporting year	Cumulative No. of deaths	Annual average of deaths[b]	AAMR	Cumulative PYLL	Annual average of PYLL[c]	APYLL[d]
Andorra	–	0	–	–	–	–	–	–
Armenia	–	0	–	–	–	–	–	–
Austria	–	0	–	–	–	–	–	–
Azerbaijan	–	0	–	–	–	–	–	–
Belarus	–	0	–	–	–	–	–	–
Belgium	68.4	9	741	82	6.0	13 310	1 479	18.0
Bosnia and Herzegovina	69.0	5	846	169	9.2	14 246	2 849	16.8
Bulgaria	–	0	–	–	–	–	–	–
Croatia	65.9	6	54	9	1.2	883	147	16.4
Cyprus	65.2	16	678	42	7.0	12 005	750	17.7
Czech Republic	69.0	7	41	6	7.7	689	98	16.9
Denmark	65.4	17	697	41	2.9	12 368	728	17.8
Estonia	67.2	13	916	70	8.7	15 937	1 226	17.4
Finland	65.6	14	51	4	4.9	887	63	17.4
France	68.2	15	1 125	75	8.7	19 775	1 318	17.6
Georgia	70.5	10	8 521	852	7.7	146 343	14 634	17.2
Germany	59.2	8	15	2	1.5	325	41	21.7
Greece	69.7	13	14 701	1 131	6.9	241 688	18 591	16.4
Hungary	–	0	–	–	–	–	–	–
Iceland	63.7	14	483	35	2.5	8 816	630	18.3
Ireland	70.3	13	32	2	24.6	520	40	16.2
Israel	69.3	4	125	31	5.8	2 084	521	16.7
Italy	66.3	12	324	27	4.4	6 400	533	19.8
Kazakhstan	–	0	–	–	–	–	–	–
Kyrgyzstan	59.0	7	13	2	2.6	246	35	18.8
Latvia	70.1	5	6 407	1 281	10.3	109 943	21 989	17.2
Lithuania	65.4	15	125	8	4.7	2 110	141	16.9
Luxembourg	65.1	13	151	12	3.5	2 701	208	17.9
Malta	68.9	12	54	5	13.6	936	78	17.4
Monaco	68.1	15	70	5	18.8	1 213	81	17.4
Netherlands	–	0	–	–	–	–	–	–
Norway	69.2	15	6 090	406	15.7	100 741	6 716	16.5
Poland	70.2	15	841	56	7.7	13 428	895	16.0
Portugal	64.1	12	1 306	109	2.1	25 097	2 091	19.2
Republic of Moldova	56.3	15	59	4	3.3	1 253	84	21.3
Romania	67.4	6	191	32	2.0	3 486	581	18.3
Russian Federation	–	0	–	–	–	–	–	–
San Marino	63.8	12	686	57	1.9	12 416	1 035	18.1
Serbia & Montenegro[f]	–	0	–	–	–	–	–	–
Slovakia	63.0	14	360	26	2.5	6 426	459	17.8
Slovenia	63.2	17	206	12	2.6	3 849	226	18.7
Spain	64.8	14	320	23	9.1	6 332	452	19.8
Sweden	67.9	12	3 517	293	4.0	66 285	5 524	18.8
Switzerland	69.4	14	1 704	122	7.5	29 033	2 074	17.0
Tajikistan	–	0	–	–	–	–	–	–
The former Yugoslav Republic of Macedonia	–	0	–	–	–	–	–	–
Turkey	66.6	4	11	3	2.3	167	42	15.4
Turkmenistan	–	0	–	–	–	–	–	–
Ukraine	–	0	–	–	–	–	–	–
United Kingdom of Great Britain and Northern Ireland	–	0	–	–	–	–	–	–
Uzbekistan	54.5	2	10	5	0.4	235	117	23.4
Total[e]	69.4	17	71 555	6 864	7.5	1 202 333	115 582	16.8

[a] Analyses were restricted to death at ages >30 years.
[b] Cumulative number of deaths divided by number of reporting years.
[c] Cumulative PYLLs divided by number of reporting years.
[d] Cumulative PYLLs divided by number of deaths.
[e] For AAMR and APYLL, averages were provided.
[f] Serbia and Montenegro were combined.
— Data not available.

Table 1.2. Impact on WHO European Member States of deaths due to asbestosis (J61, ICD-10), 1994-2010[a]

Country	Average age at death	No. of reporting year	Cumulative No. of deaths	Annual average of deaths[b]	AAMR	Cumulative PYLL	Annual average of PYLL[c]	APYLL[d]
Albania	–	0	–	–	–	–	–	–
Andorra	–	0	–	–	–	–	–	–
Armenia	–	0	–	–	–	–	–	–
Austria	73.2	8	23	3	0.4	314	39	13.7
Azerbaijan	–	0	–	–	–	–	–	–
Belarus	–	0	–	–	–	–	–	–
Belgium	72.7	5	101	20	1.3	1 368	274	13.5
Bosnia and Herzgovina	–	0	–	–	–	–	–	–
Bulgaria	67.7	6	64	11	1.3	952	159	14.9
Croatia	66.5	11	26	2	0.9	419	38	16.1
Cyprus	77.5	1	1	1	0.7	9	9	9.0
Czech Republic	68.6	12	14	1	0.4	210	17	15.0
Denmark	73.6	13	172	13	1.9	2 083	160	12.1
Estonia	77.5	1	1	1	0.4	8	8	8.0
Finland	73.5	15	314	21	2.4	4 069	271	13.0
France	74.4	10	985	99	0.8	13 437	1 344	13.6
Georgia	61.3	2	4	2	0.8	79	40	19.5
Germany	72.4	13	1 553	119	0.7	21 887	1 684	14.1
Greece	–	0	–	–	–	–	–	–
Hungary	69.4	6	8	1	0.2	113	19	14.1
Iceland	75	2	2	1	4.6	24	12	12.5
Ireland	73.6	3	14	5	1.0	179	60	12.7
Israel	74.6	6	7	1	0.4	87	14	12.6
Italy	74.7	5	202	40	0.3	2 588	518	12.8
Kazakhstan	–	0	–	–	–	–	–	–
Kyrgyzstan	–	0	–	–	–	–	–	–
Latvia	–	0	–	–	–	–	–	–
Lithuania	–	0	–	–	–	–	–	–
Luxembourg	75	2	2	1	2.4	23	12	12.0
Malta	75.7	7	14	2	6.3	149	21	10.6
Monaco	–	0	–	–	–	–	–	–
Netherlands	73.8	15	138	9	0.5	1 722	115	12.5
Norway	74	15	181	12	2.1	2 252	150	12.5
Poland	69.3	12	40	3	0.2	605	50	15.2
Portugal	73.2	4	7	2	0.2	89	22	12.7
Republic of Moldova	–	0	–	–	–	–	–	–
Romania	68.8	5	8	2	0.1	116	23	14.6
Russian Federation	–	0	–	–	–	–	–	–
San Marino	–	0	–	–	–	–	–	–

Country	Average age at death	No. of reporting year	Cumulative No. of deaths	Annual average of deaths[b]	AAMR	Cumulative PYLL	Annual average of PYLL[c]	APYLL[d]
Serbia & Montenegro[f]	74.8	4	11	3	0.6	97	24	8.9
Slovakia	65.7	9	22	2	1.4	365	41	16.6
Slovenia	71.4	14	48	3	2.8	683	49	14.2
Spain	73.7	12	161	13	0.2	2 208	184	13.7
Sweden	76	14	152	11	0.6	1 673	120	11.0
Switzerland	–	0	–	–	–	–	–	–
Tajikistan	–	0	–	–	–	–	–	–
The former Yugoslav Republic of Macedonia	47.5	1	1	1	0.4	31	31	31.0
Turkey	–	0	–	–	–	–	–	–
Turkmenistan	–	0	–	–	–	–	–	–
Ukraine	–	0	–	–	–	–	–	–
United Kingdom of Great Britain and Northern Ireland	74.3	11	1 452	132	1.2	18 220	1 656	12.5
Uzbekistan	–	0	–	–	–	–	–	–
Total[e]	73.5	17	5 728	539	0.9	76 056	7 162	13.3

[a] Analyses were restricted to death at ages >30 years.
[b] Cumulative number of deaths divided by number of reporting years.
[c] Cumulative PYLLs divided by number of reporting years.
[d] Cumulative PYLLs divided by number of deaths.
[e] For AAMR and APYLL, averages were provided.
[f] Serbia and Montenegro were combined.
— Data not available.

Table 1.3 Characteristics for decedents of malignant mesothelioma (ICD-10, C45) and asbestosis (ICD-10, J61) in the European Region, 1994-2010

Disease	Attribute		Average age at death (year)	Number of deaths			PYLL			APYLL per decedent (year)
				Total	(%)	Annual average	Total	(%)	Annual average	
Mesothelioma	All		69.4	71 555	(100.0)	6 864	1 202 333	(100.0)	115 582	16.8
	Gender	Male	69.4	56 327	(78.7)	5 352	855 171	(75.9)	81 457	15.2
		Female	69.6	15 228	(21.3)	1 521	271 495	(24.1)	27 174	17.8
	Type	Pleural	69.6	38 265	(53.5)	3 837	640 435	(53.3)	64 406	16.7
		Peritoneum	66.3	3 038	(4.2)	309	58 584	(4.9)	6 062	19.3
		Others	69.5	30 252	(42.3)	2 776	503 314	(41.9)	46 200	16.6
Asbestosis	All		73.5	5 728	(100.0)	539	76 056	(100.0)	7 162	13.3
	Gender	Male	73.4	5 333	(93.1)	498	63 259	(92.3)	5 935	11.9
		Female	73.8	395	(6.9)	59	5 273	(7.7)	794	13.4

Note. Analyses were restricted to deaths at ages >30 years.

The actual number of asbestosis deaths at ages ≥30 years in the Region during the period 1994–2010 shown in the mortality database is 5728, and the annual average of 539 deaths is recorded with an overall average age at death of 73.5 years (Table 1.2). The overall AAMR was 0.9 per million. The numbers of asbestosis deaths for males and females are 5333 (93.1%) and 395 (6.9%), respectively (Table 1.3). A total of 0.08 million PYLLs with an average of 13.3 years (APYLL) lost per decedent was observed. The annual average of PYLLs is 7162. The majority of PYLLs attributed to asbestosis deaths were in males, with 0.06 million person-years (92.3%) with an APYLL of 11.9 years (Table 1.3).

The ratio of mesothelioma and asbestosis mortality is 13:1 in the Region. Average age at death is 73.5 for asbestosis and 69.4 for mesothelioma. The PYLL ratio of mesothelioma (1 202 333 person-years) and asbestosis (76 056 person-years) is 16:1. The APYLL was greater for mesothelioma (16.8 years) than for asbestosis (13.3 years) in the Region because of a lower age at death among mesothelioma cases. Generally, PYLLs and APYLL reflect premature death, indicating by how many years earlier than the expected age a person died. ARDs mortality data are needed to calculate PYLLs and APYLL in a sufficiently straightforward manner to provide a quantitative aspect of the burden of ARDs. PYLLs and APYLLs reported in this report show the impact of mesothelioma and asbestosis in the Region. Public health decision-making may benefit from adaptation of PYLLs and APYLL to establish a useful strategy to eliminate ARDs.

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Annex 2

STEP-BY-STEP GUIDANCE ON CALCULATING PYLLS FROM ARDS IN EUROPEAN COUNTRIES[1]

Introduction to calculating PYLLs and APYLLs

The training workshop begins with a quick tour through the WHO mortality database *(1)*. The emphasis will be on the calculation of PYLLs and APYLL, using mortality due to mesothelioma (C45, ICD-10) and asbestosis (J61, ICD-10).

Accessing data

The first step in an analysis is to get data to work with. The data for this workshop come from the WHO mortality database. Three data sets are used: (i) mortality from mesothelioma and asbestosis, (ii) life expectancy and (iii) population. All data sets will be stored in Excel.

Mortality database (mesothelioma and asbestosis)

Download the WHO mortality database from the WHO Statistical Information System (WHOSIS) web site, ICD-10 (C45, mesothelioma and J61, asbestosis, last updated: 9 July 2012) *(1)*.

Fig. 2.1. WHO Statistical Information System (WHOSIS) web site: guidance

[1] The draft of this guidance document was prepared by Associate Professor Eun-Kee Park of the Department of Medical Humanities and Social Medicine, College of Medicine, Kosin University, Busan, Republic of Korea and Ken Takahashi, Ying Jiang, Mehrnoosh Movahed of the Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Kitakyushu, Japan, as a background document for the Meeting. In no event shall this paper be considered an official paper endorsed by WHO. The responsibility for the interpretation and use of the material lies with the reader. The views expressed by the author do not necessarily represent the decisions or the stated policy of WHO.

Life expectancy by age group

From the WHO Health statistics and health information systems web site, download life tables for WHO European Member States *(2).*

From the WHO Global Health Observatory Data Repository web site, download Data Repository, Mortality and burden of disease, Life expectancy, Life tables *(3)*.

Fig. 2.2. WHO Statistical Information System (WHOSIS) web site: life tables

Population data

Download the WHO database (1994□2010) from the WHO Statistical Information System (WHOSIS) web site *(1)* (as for the mortality database).

Data compilation

Given the predominantly occupational etiology and long latency of ARDs, this study is restricted to deaths at ages ≥30 years. People aged over 75 years were treated as one group.

Change the age group format on the mortality data (ICD-10, C45 & J61) and population data with a five-year interval in this analysis (Table 2.1).

Table 2.1. Age groups

Format name	Mortality data
Death	Age group (≥30 years)
Death30	30□34 years
Death35	35□39 years
Death40	40□44 years
Death45	45□49 years
Death50	50□54 years
Death55	55□59 years
Death60	60□64 years
Death65	65□69 years
Death70	70□74 years
Death75	75+ years

Data management

Life expectancy data

Life expectancy data are reported for 1990, 2000 and 2009 in the mortality database. Life expectancy for the in-between years (1991□1999, 2001□2008) is interpolated. Life expectancy in 2010 uses 2009 data because the mortality data (ICD-10) are reported between 1994 and 2010.

The rule for combining the life expectancy of age group 75+ (LE75) is shown in Table 2.2.

Table 2.2. Rule for combining the life expectancy of the group aged 75+ years (LE75)

Age group (years)	Life expectancy	Standard population distribution (%)	Percentage in the group aged 75+ years		75+ years
75□79	e1	1.52	p1	0.496	u1 = e1 × p1
80□84	e2	0.91	p2	0.297	u2 = e2 × p2
85□89	e3	0.44	p3	0.144	u3 = e3 × p3
90□94	e4	0.15	p4	0.049	u4 = e4 × p4
95□99	e5	0.04	p5	0.013	u5 = e5 × p5
100+	e6	0.005	p6	0.002	u6 = e6 × p6
		3.065	Sum (p1:p6)	1	LE75 = sum (u1:u6)

The rule for interpolation of life expectancy is shown in Table 2.3.

Table 2.3. Rule for interpolation of life expectancy (LE)

Year	Reported data for the age group g_i	Interpolated value (IV)	Life expectancy data for the age group g_i
1990	LE_1990	IV1 = (LE_2000-LE_1990) /	LE_1990
1991		(2000□1990)	LE_1991= LE_1990 + IV1×1
1992			LE_1992= LE_1990 + IV1×2
1993			LE_1993= LE_1990 + IV1×3
1994			LE_1994= LE_1990 + IV1×4
1995			LE_1995= LE_1990 + IV1×5
1996			LE_1996= LE_1990 + IV1×6
1997			LE_1997= LE_1990 + IV1×7
1998			LE_1998= LE_1990 + IV1×8
1999			LE_1999= LE_1990 + IV1×9
2000	LE_2000	IV2 = (LE_2009-LE_2000) /	LE_2000
2001		(2009□2000)	LE_2001= LE_2000 + IV2×1
2002			LE_2002= LE_2000 + IV2×2
2003			LE_2003= LE_2000 + IV2×3
2004			LE_2004= LE_2000 + IV2×4
2005			LE_2005= LE_2000 + IV2×5
2006			LE_2006= LE_2000 + IV2×6
2007			LE_2007= LE_2000 + IV2×7
2008			LE_2008= LE_2000 + IV2×8
2009	LE_2009		LE_2009
2010			LE_2009

Table 2.4 gives an example showing the interpolation of life expectancy for ages 30~34 years.

Table 2.4. Interpolation of life expectancy for ages 30~34 years

Year	Life expectancy for ages 30~34 years	Interpolated value (IV)	Interpolated life expectancy data for ages 30~34 years
1990	48.9	IV1 = 0.15	48.9
1991			49.1
1992			49.2
1993			49.4
1994			49.5
1995			49.7
1996			49.8
1997			50.0
1998			50.1
1999			50.3
2000	50.4	IV2 = 0.2	50.4
2001			50.6
2002			50.8
2003			51.0
2004			51.2
2005			51.4
2006			51.6
2007			51.8
2008			52.0
2009	52.2		52.2
2010			52.2

Calculation of PYLLs, APYLLs, average age at death, AAMR

To calculate PYLLs and APYLLs, the following simple equations are proposed.

PYLLs

$$\text{PYLL} = \sum_{i=1}^{k} D_{g_i} \times LE_{g_i}$$

D_{gi}: the number of deaths at age group g_i. LE_{gi}: life expectancy at age group g_i.

Simply, PYLL = sum [(deaths at a given age) × (remaining life expectancy for that age)].

Annual average of PYLLs

$$\sum_{i=1}^{N} \frac{\text{PYLL}_i}{NY_i}$$

PYLL_i: the PYLL of country i. NY_i: the number of the reporting years of country i.

Simply, annual average of PYLL = PYLL/number of reporting years

APYLL (for each decedent)

APYLL = PYLL/number of deaths

Average age at death (year)

Age group: $g_i: age_{ia} \sim age_{ib}$ $(g_1: 30\sim34, g_2: 35\sim39, \cdots, g_k: 75\sim)$

$$\frac{\sum_{i=1}^{k} w_i \times D_{g_i}}{\sum_{i=1}^{k} D_{g_i}}, \qquad w_i = age_{ia} + \underbrace{(age_{ib} - age_{ia} + 1)/2}_{\text{constant} = 2.5}$$

where D_{gi} is the number of deaths at age group g_i.

AAMR

AAMR was calculated using a direct age-adjustment method, with reference to the world population in 2000. The formula is as follows:

$$AAMR = \sum_{i=1}^{k} D_{g_i} \times SP_{g_i} \times 10^4 / POP_{g_i}$$

POP_{gi}: population at age group g_i. SP_{gi}: standard population distribution at age group g_i.

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Annex 3

REPORT ON DALYS LOST FROM ASBESTOS EXPOSURE IN EUROPEAN COUNTRIES[1]

Abstract

Introduction
This paper considers the burden of ARDs in Europe arising from the occupational exposure of workers.

Methods
The data presented are based on results of the WHO comparative risk assessment study which focused on deaths and disability in 2000. Asbestosis and mesothelioma deaths were estimated using measures of absolute exposure and absolute risk. Lung cancer deaths were estimated assuming a 1:1 ratio of asbestos-related lung cancer cases to mesothelioma cases. Other asbestos-related conditions could not be included.

Results
Total deaths in Europe in 2000 due to work-related asbestos exposure were estimated to be 14 600 and DALYs to be 186 500. Mesothelioma comprised just under 50% of the deaths and 43% of the DALYs. The Eur-C subregion comprised 55% of deaths and 56% of the DALYs.

Conclusions
Despite these estimates being underestimates of the total burden of disease arising from asbestos exposure, it is clear that work-related exposure to asbestos remains an important cause of death and disability in Europe.

Introduction

Asbestos is known to increase the risk of a number of malignancies, the most well-known being malignant mesothelioma and lung cancer. Cancer of the larynx and ovarian cancer can also be caused by exposure to asbestos. The IARC has determined that there is sufficient evidence that all these cancers can be caused as a result of asbestos exposure. There is also reasonable evidence (although not enough to confirm a causal link) that asbestos increases the risk of cancer of the stomach, pharynx and bowel. The IARC has determined there is limited evidence that these cancers can occur due to asbestos exposure *(1)*. Asbestos is also the only known cause of asbestosis, a fibrotic lung disease that can arise following exposure (usually prolonged) to asbestos *(2)*.

Asbestosis is by definition caused only by exposure to asbestos, and asbestos is essentially the only known cause of mesothelioma. All the other cancers listed above can be caused by other

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[1] The draft of this review was prepared by Associate Professor Tim Driscoll as a background document of the Meeting. In no event shall this paper be considered an official paper endorsed by WHO. The responsibility for the interpretation and use of the material lies with the reader. The views expressed by the author do not necessarily represent the decisions or the stated policy of WHO.

exposures or be due to other factors. In fact, asbestos would only cause a minor proportion of the cases of these disorders. This poses difficulties when attempting to identify the burden of disease arising from asbestos exposure. This task is straightforward for mesothelioma, as long as the mesothelioma cases can be identified, as all cases can be presumed to be due to asbestos exposure. Alternatively, if the number of mesothelioma cases is not known, this can be estimated using information on the absolute asbestos exposure of persons (in fibres/ml/year) and the absolute risk arising from various levels of cumulative exposure to asbestos. A similar approach can be taken for asbestosis if there is no available count of the number of cases. For other cancers, the task is more difficult because there are no identifying characteristics of cancers that identify whether or not they have arisen due to asbestos exposure. For these, the only practical approach is to use the population-attributable fraction (PAF).

The PAF is essentially the proportion of cases of a particular condition in the community that is due to a particular exposure or set of exposures. More correctly, the PAF is the proportion of cases that would no longer occur if the exposure did not occur. It can be a number between 0 and 1. If the number of cases of a particular condition is known, and this is multiplied by the PAF for a given exposure, the number of cases due to that exposure can be estimated.

The PAF can be calculated using one of several formulae, one of the most common being:

$$PAF = F \times (RR - 1) / [1 + F \times (RR - 1)]$$

where F = the proportion of the population exposed and RR = relative risk.

The proportion of the population that is exposed can be estimated through population surveys or more indirect means. The relative risk is usually obtained from the published literature.

The burden (number) of deaths arising from ARD in a country (or sub-region) can, therefore, be estimated by identifying all deaths due to asbestosis, all deaths due to mesothelioma, and the proportion (and therefore the number) of cases of lung, ovarian and laryngeal cancers in the country that is due to asbestosis exposure. The overall burden arising from asbestos exposure can be calculated in the same way, but using DALYs rather than deaths. The DALYs need to be calculated specifically for the assessment or obtained from another study.

Another factor to consider when attempting to estimate the burden is whether the focus is on all the cases arising from asbestos exposure or only on those cases arising from occupational exposure. A further refinement is whether the focus is on the work-related exposure of workers, or whether to include persons who are exposed to asbestos as a result of another person's work (for example, children playing on an asbestos tailings mound or someone washing the asbestos-contaminated clothes of an asbestos worker).

This paper considers the burden of ARDs in Europe arising from the occupational exposure of workers. The data presented here are based on results of the comparative risk assessment (CRA) study conducted by WHO from 2001 to 2004 which focused on deaths and disability in 2000 *(3,4)*. That study did not directly estimate the burden arising from work-related asbestos exposure, neither did it estimate the entire burden. The relevant disorders included in the study were mesothelioma, lung cancer and asbestosis. Lung cancer due to asbestos was not calculated separately, but instead calculated as part of the burden arising from eight occupational lung carcinogens. Nevertheless, the burden of lung cancer arising from asbestos can be estimated from the results.

Methods

The methods used in the CRA project are summarized in the relevant publications that arose from the study *(3 5)*. The study is summarized briefly here. Estimates were made for the three WHO European sub-regions (Eur-A, Eur-B and Eur-C) for 2000.

Asbestosis

There were insufficient estimates of the number of asbestosis cases to allow the cases simply to be counted. Instead, the number of cases of asbestosis was estimated by developing estimates of absolute cumulative exposure to asbestos and applying these to estimates of the absolute risk of developing asbestosis for the given cumulative exposure to asbestos. Estimates of DALYs came from the overall CRA study, with all DALYs due to asbestosis being included in the estimate of the overall burden arising from exposure to asbestos.

Mesothelioma

As with asbestosis, there were insufficient estimates of the number of mesothelioma cases to allow the cases simply to be counted. Instead, the number of cases of mesothelioma was estimated by developing estimates of absolute cumulative work-related exposure to asbestos and applying these to estimates of the absolute risk of developing mesothelioma for the given cumulative exposure to asbestos. This provided information on the number of work-related deaths due to mesothelioma. Estimates of DALYs came from the overall CRA study, with all DALYs due to mesothelioma being included in the estimate of the overall burden arising from exposure to asbestos.

Lung cancer

The CRA study did not separately estimate the PAF for lung cancer arising from asbestos exposure. Instead, the number of cases of lung cancer arising from exposure to the eight lung carcinogens included in the study was estimated together using the PAF approach. For the purposes of the current estimate, it was not possible to repeat the calculations to estimate the number of lung cancer cases arising specifically from asbestos exposure. Therefore, this number has been estimated using the commonly cited estimate of there being between one and two asbestos-related lung cancer cases for every case of mesothelioma (in this instance, a 1:1 ratio was assumed) *(6,7)*.

Other asbestos-related cancers

The CRA study did not include estimates of laryngeal or ovarian cancers, nor of cancer of the pharynx, stomach or bowel. These could not, therefore, be included in the estimate presented here.

Estimates of DALYs come from the CRA study. Estimates of DALYs from lung cancer were determined by dividing the estimated number of asbestos-related lung cancer cases by the total number of lung cancer cases, and multiplying that proportion by the total number of DALYs for lung cancer for each sub-region.

Results

Total deaths in Europe for 2000 due to work-related asbestos exposure were estimated to be 14 600, with mesothelioma and lung cancer each comprising about half of this total and asbestosis less than 5%. About 55% of the deaths were in the Eur-C sub-region (Table 3.1).

Table 3.1. Estimated number of deaths due to work-related asbestos exposure in Europe, 2000

Sub-region	Mesothelioma	Lung cancer	Asbestosis	Total
Eur-A	1 100	1 100	100	2 300
Eur-B	2 000	2 000	200	4 200
Eur-C	3 900	3 900	300	8 100
Total	7 000	7 000	600	14 600

Total DALYs in Europe for 2000 due to work-related asbestos exposure were estimated to be 186 500, with mesothelioma comprising 43%, lung cancer 37% and asbestosis 20%. The proportions of DALYs by sub-region were very similar to the proportions of deaths, with 56% of the DALYs being in the Eur-C sub-region (Table 3.2).

Table 3.2. Estimated number of DALYs due to work-related asbestos exposure in Europe, 2000

Sub-region	Mesothelioma	Lung cancer	Asbestosis	Total
Eur-A	12 000	8 900	5 000	25 900
Eur-B	24 000	20 600	11 000	55 600
Eur-C	44 000	39 000	22 000	105 000
Total	80 000	68 500	38 000	186 500

Discussion

The estimates of disease arising from work-related asbestos exposure in the three WHO European sub-regions show that ARDs remain an important cause of death and disability in Europe. The results presented in this paper are almost certainly underestimates because it was not possible to include all asbestos-related cancers. In addition, the analysis focused on work-related asbestos exposure, whereas some asbestos exposure would not have been related to work, typically that in a domestic setting. However, note that all mesothelioma cases were included and the same number of lung cancer cases, whereas some mesothelioma cases can be expected to arise from asbestos exposure other than of workers in work-related settings. To that extent, non-work-related exposure to asbestos is included in the results presented here.

Uncertainties arise from a number of factors. The estimates of absolute exposure required several significant assumptions (as described in the relevant CRA papers) *(3–5)*. In addition, estimates of the ratio of lung cancer to mesothelioma vary *(6,7)*, but 1:1 was deemed the most appropriate estimate for this analysis.

Conclusions

Work-related exposure to asbestos remains an important cause of death and disability in Europe.

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Annex 4

STEP-BY-STEP GUIDANCE ON CALCULATING DALYS LOST FROM ASBESTOS EXPOSURE IN A COUNTRY FOR A NATIONAL ASBESTOS PROFILE[1]

Introduction

This brief workbook outlines how to calculate the burden arising from various ARDs. Parts of it are modelled on a WHO publication from the Environmental Burden of Disease Series *(1)*.

The population-attributable fraction

Some disorders causes by asbestos are only caused by asbestos. The burden arising from these disorders is, therefore, easily determined by just counting the cases of those disorders. Other disorders caused by asbestos can be caused by other exposures as well. The asbestos-related burden due to these disorders must be determined indirectly, using the concept of the PAF. The PAF is essentially the proportion of cases of a particular condition in the community that is due to a particular exposure or set of exposures. It can be any number between 0 and 1. If the number of cases of a particular condition is known, and this is multiplied by the PAF for a given exposure, an estimate of the number of cases due to that exposure can be derived.

The PAF can be calculated using one of several formulae, the most common being:

$$PAF = F \times (RR - 1) / [1 + F \times (RR - 1)]$$

where F = the proportion of the population exposed, and RR = relative risk.

Where there is more than one level of exposure (for example, high and low), the overall PAF can be calculated using the formula:

$$PAF = \sum [(F_i \times RR_i) - 1]) / \sum (F_i \times RR_i)$$

where Fi = the proportion of the population exposed in exposure category i, and RR = relative risk for exposure category compared to the baseline (reference) exposure level.

Scope of the assessment

Asbestos exposure can occur in various settings or circumstances. When estimating the burden arising from exposure it is important to decide which circumstances are of interest. The most common individual circumstance is work-related exposure. This training session focuses on the burden arising from occupational exposure of workers to asbestos. Calculating the burden from all sources of asbestos exposure is more difficult for some of the disorders mentioned above.

Determining which conditions to include

Asbestos is known to increase the risk of a number of cancers □ malignant mesothelioma, lung cancer, laryngeal cancer and ovarian cancer *(2)*. Asbestosis is a fibrotic lung disease that can arise following exposure to asbestos *(3)*. These diseases should be included in any study of the ARDs burden.

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[1] The draft of this guidance was prepared by Associate Professor Tim Driscoll as a background document for the Meeting. In no event shall this paper be considered an official paper endorsed by WHO. The responsibility for the interpretation and use of the material lies with the reader. The views expressed by the author do not necessarily represent the decisions or the stated policy of WHO.

Asbestos is also suspected of increasing the risk of cancer of the stomach, pharynx and bowel, but there is insufficient evidence to confirm a causal link. These conditions do not have to be included in a study of the ARDs burden, but it would be reasonable to include them.

The burden of disease

The burden (number) of deaths arising from ARDs in a country (or sub-region) can be estimated by identifying all deaths due to the conditions described above. The overall burden arising from asbestos exposure can be calculated in the same way, using DALYs rather than deaths. The DALYs need to be calculated specifically for the assessment or obtained from another source, such as WHO or one of the global burden of disease project studies *(4)*.

Calculating the PAF

Estimation of exposure

The approach presented here assumes work-related asbestos exposure can occur at a high, low or background level. To estimate the proportion of the population exposed to asbestos at a particular level, information is needed on:

- the proportion of the workforce employed in each sector
- the proportion of workers exposed
- occupational turnover
- exposure intensity, and
- the proportion of the population in the workforce.

The proportion of the workforce employed in each sector

Workers in different industrial sectors have different likelihoods of being exposed to asbestos. It is, therefore, useful to take this into account in the calculations. The proportion of workers in each industrial sector should be available from administrative information published by the government and/or from the International Labour Organization.

The proportion of workers exposed

The proportion of workers exposed to asbestos may be available from country-specific surveys. If not, such exposure information is available from CAREX, which reflects exposure in western Europe and North America in 1993 *(5)*. The CAREX information covers the proportion of workers exposed but not the exposure intensity. The CAREX values for exposure proportions are shown in Table 4.1.

Table 4.1. Proportion of workers exposed to asbestos, by industry sector

Agriculture	Mining	Manufacturing	Electrical	Construction	Trade	Transportation	Finance	Services
0.012	0.102	0.006	0.017	0.052	0.003	0.00684	0.000	0.003

Source: based on CAREX *(5)*.

Occupational turnover

Most cancers have a prolonged latency (the period between exposure and when the person is first at risk of developing cancer due to that exposure). In addition, exposed people remain at risk well after exposure ceases and well after the minimum latency is reached. For any job, there is a turnover of people leaving jobs and being replaced by others. At any one time, therefore, the people at risk of developing cancer from a certain exposure are not the people who are currently exposed, but all the people who have been exposed beyond the minimum latency period. The number (or proportion) of these people can usually be estimated from the number of currently exposed people and multiplying this number by a turnover factor. This turnover can be estimated using national data, but the calculation is not straightforward and varies depending on the ages of the individuals, the annual turnover in each sector and the life expectancy of the population in the country. Based on calculations used in the global burden of disease 2010 study, a reasonable overall turnover factor is 3.0 for men and 5.2 for women.[2] Alternatively, a single value of 4.0 can be used *(6).*

Exposure intensity

The approach proposed here uses two levels of exposure, described as high and low. The intensity (or level) of exposure may be available from country-level surveys, but often this information may not be available. In that instance, it would be reasonable to use the approach adopted in the comparative risk assessment 2000 study *(7)*. This approach assumed that high exposure represented exposure above the permissible exposure level in the United States of America and low exposure was exposure below the permissible exposure level. Developed countries (such as Eur-A countries) were assumed to have 90% of exposed people at the low exposure level and 10% at the high exposure level. For developing countries (such as Eur-B and Eur-C countries), the low exposure to high exposure ratio was assumed to be 50:50.

The proportion of the population in the workforce

The proportion of the population in the workforce (usually termed the economically active population) should be available from administrative data sources. It will vary by age group. In the simple approach proposed below, a single value for the economically active population is used. This is the average economically active population for the whole population aged 15 years or over.

Determining the relative risks

The relative risks can be obtained from the literature. Where possible, these should be obtained from high quality meta-analyses. If an appropriate meta-analysis is not available, a good quality individual study may be used. Recommended relative risks for the outcomes considered in this training are shown in Table 4.2. (Note: these are conservative estimates; higher estimates of the relative risk for some outcomes would also be reasonable.)

Table 4.2. Recommended relative risks for relevant cancers that can be caused by asbestos exposure

Type of cancer	High exposure			Low exposure			Source
	Relative risk	Lower limit[a]	Upper limit[b]	Relative risk	Lower limit	Upper limit	
Lung cancer	1.48	1.44	1.52	1.18	1.13	1.23	Goodman et al, 1999 *(8)*
Ovarian cancer	1.77	1.37	2.28	1.00			Camargo et al, 2011 *(9)*
Laryngeal cancer	1.38	1.17	1.60	1.00			Rushton et al, 2011[c]
Pharyngeal cancer	1.44	1.04	2.00	1.00			Rushton et al, 2011[c]
Stomach cancer	1.66	1.49	1.86	1.21	1.06	1.38	Rushton et al, 2012[c]
Colorectal cancer	1.15	1.01	1.31	1.00			Rushton et al, 2011[c]

[a] Lower limit of the 95% confidence interval.
[b] Upper limit of the 95% confidence interval.
[c] Unpublished meta-analysis.

2 Hutchings S, Driscoll T, 2012 (unpublished data).

Estimating deaths

The total number of deaths for a particular disorder should be obtainable from national registers of deaths. Alternatively, this information should be available from WHO: for example, for deaths and DALYs by sub-region, see the global burden of disease 2000: version 3 estimates *(10)*. The number of deaths for a particular condition can be estimated by multiplying the total deaths for a disorder by the relevant attributable fraction due to asbestos for that disorder. Where all cases of the disorder are due to asbestos (such as for cases of asbestosis and malignant mesothelioma), the relevant number of deaths is just the total deaths for that disorder in the year in question. In the 9th revision of the International Classification of Diseases (ICD-9), malignant mesothelioma was not identifiable as a separate disease category. Countries that code their data to ICD-9 may not, therefore, be able to identify the number of malignant mesothelioma cases directly. In such instances an alternative would be to make use of the finding in many studies of a reasonably consistent relationship between the number of cases of malignant mesothelioma and the number of cases of lung cancer caused by asbestos. This relationship has various values in the literature, but it would be reasonable to assume a conservative ratio of 1:1 *(11,12)*. If the number of asbestos-related lung cancer deaths can be identified using the PAF approach, the number of malignant mesothelioma deaths can be estimated.

Estimating DALYS

To calculate DALYs, knowledge is required of life expectancy at different ages □ the age at death or, for non-fatal conditions, the age at onset, the length of time with the disorder, and an estimate of the disability weight (a number between 0 (full health) and 1 (death)) for each disease. Where a country has already undertaken a burden of disease study, the DALYs for the relevant disorders can be used. If no specific burden of disease studies have been undertaken, information on DALYs may be available from WHO sources *(10)*. This information will soon be available from the global burden of disease 2010 study. The number of DALYs for a particular condition can be estimated by multiplying the DALYs for a disorder by the relevant attributable fraction due to asbestos for that disorder. Where all cases of the disorder are due to asbestos (such as for cases of asbestosis and mesothelioma), the total number of DALYs is just the total number of DALYs for that disorder.

Example: calculating the burden of lung cancer related to asbestos exposure for Eur-C countries for 2000

The initial calculations are shown for males (Tables 4.3, 4.4 and accompanying text). The final calculations are also shown for females (Tables 4.6, 4.7 and accompanying text).

Calculating the exposure prevalences

The proportion of the male workforce employed in each sector can be obtained from the ILO web site data search engine LABORSTA *(13)* (Table 4.3).

Table 4.3. Proportion of male workers by industrial sector, Eur-C countries, 2000

Agriculture	Mining	Manufacturing	Electrical	Construction	Trade	Transportation	Finance	Services	Total
0.111	0.026	0.209	0.039	0.096	0.140	0.128	0.081	0.170	1.000

Source: Laborsta *(13)*.

The proportion of workers exposed in each sector of industry can be obtained from CAREX, as shown in Table 4.1.

The proportion of the workforce currently exposed to asbestos is obtained by multiplying the number in Table 4.1 by the number in Table 4.3 and adding the total. Here it is equal to 0.0127 (Table 4.4).

Table 4.4. Proportion of male workers exposed to asbestos, by industrial sector, EUR-C countries, 2000

Agriculture	Mining	Manufacturing	Electrical	Construction	Trade	Transportation	Finance	Services	Total
0.0014	0.0027	0.0012	0.0007	0.0050	0.0004	0.0009	0.0000	0.0005	0.0127

Source: based on CAREX *(5)*.

The occupational turnover is assumed to be 3.0.

Therefore, the proportion of the male workforce that is ever exposed is 0.0127 multiplied by the turnover factor of 3.0, which equals = **0.0381.**

The low:high proportion is assumed to be 50:50 (see above).

The proportion of the male workforce that is exposed is then separated into low and high exposure by multiplying the overall proportion by 0.5 (for low) and 0.5 (for high):

proportion of the male workforce occupationally exposed to low levels of asbestos
= 0.0381 × 0.5 = **0.019**
proportion of the male workforce occupationally exposed to high levels of asbestos
= 0.0381 × 0.5 = **0.019**.

The proportion of the male population in the workforce obtained from the ILO database equals **0.68.**

Therefore, the proportions of the male population at the two exposure levels are obtained by multiplying the low exposure proportion by the proportion of the male population in the workforce and the high exposure proportion by the proportion of the male population in the workforce:

proportion of the male population occupationally exposed to low levels of asbestos
= 0.019 × 0.68 = **0.013**
proportion of the male population occupationally exposed to high levels of asbestos
= 0.019 × 0.68 = **0.013**.

The proportion of the male population that is not occupationally exposed to asbestos is 1 minus the proportion that is so exposed. That is, the proportion of the male population not occupationally exposed to asbestos:

= 1 –(low exposure proportion plus high exposure proportion)
= 1 –(0.013 + 0.013)
= 1 –0.026 = **0.974.**

Relative risk for lung cancer

The relative risk for lung cancer is taken from Table 4.2:

relative risk (low) = **1.18 (95% CI 1.13–1.23)**
relative risk (high) = **1.48 (95% CI 1.44–1.52)**.

Calculating the PAF

The PAF can now be easily calculated using the formula above. This is most easily done in a spreadsheet. A typical output is shown below in Table 4.5 (for males) and Table 4.6 (females) using appropriate data on industry sector and turnover.

Table 4.5. Calculation of the PAF for lung cancer due to occupational exposure to asbestos for males, Eur-C countries, 2000

Males	Proportion of workers currently exposed	Proportion of workers ever exposed	Proportion of population ever exposed	Relative risk	Pi × RRi
	0.013	0.038			
Background			0.974	1.00	0.974
Low		0.019	0.013	1.18	0.015
High		0.019	0.013	1.48	0.019
∑Pi × RRi					1.009
PAF					0.009

Table 4.6. Calculation of the PAF for lung cancer due to occupational exposure to asbestos for females, Eur-C countries, 2000

Females	Proportion of workers currently exposed	Proportion of workers ever exposed	Proportion of population ever exposed	Relative risk	Pi × RRi
	0.006	0.032			
Background			0.982	1.00	0.982
Low		0.016	0.009	1.18	0.010
High		0.016	0.009	1.48	0.013
∑Pi × RRi					1.006
PAF					0.006

The PAFs for males and females can then be multiplied by the relevant number of deaths and DALYs for males and females for Eur-C countries in 2000, obtained in the example from WHO (Table 4.7) *(10)*. In this example, it is estimated that in Eur-C countries in 2000, there were about 800 deaths and 8000 DALYs due to occupational exposure to asbestos. It is likely that the final numbers in this example considerably underestimate the actual number of asbestos-related lung cancer deaths because of some of the assumptions made in terms of relative risk and the use of CAREX data as an estimate of prevalence of occupational exposure in various industry groups. The same approach can, however, be used with different assumptions as countries deem appropriate for their circumstances. Similar calculations can be undertaken for the other cancers of interest. If there were no direct counts of deaths from malignant mesothelioma, the number would be estimated to be similar to the number of deaths from lung cancer, although the exact ratio of lung cancer deaths to mesothelioma deaths is debated. The DALYs would be expected to be different because people might die at the same age and the disability associated with individual cases of the two disorders might be different.

Table 4.7. Estimated deaths and DALYS for lung cancer due to occupational exposure to asbestos for males, females and total, Eur-C countries, 2000

Deaths and DALYs	**All lung cancer**	**Occupational lung cancer**		
		Number	**Lower limit**[a]	**Upper limit**[b]
Deaths				
Male deaths	83 937	714	617	810
Female deaths	16 000	93	80	105
Total deaths	99 937	807	697	916
DALYs				
Male DALYs	842 490	7 167	6 196	8 134
Female DALYs	147 293	853	737	968
Total DALYs	989 783	8 019	6 934	9 103

[a] Lower limit of the 95% confidence interval.
[b] Upper limit of the 95% confidence interval.

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Annex 5

ECONOMIC COSTS OF ARDs[1]

Introduction

Asbestos continues to present public health threats in Europe despite bans on its import and use. Recognition, diagnosis and recording of ARDs remain challenging, as does estimating the number of people with asbestos-related diseases. Estimating the direct and indirect economic costs of ARDs continues to be problematic *(1,2)*. National analyses of the costs of occupational ill health frequently fail to provide data specifically on either ARDs or occupational cancers *(3,4)*. Treatments and ARDs drug regimens may also vary from country to country and sometimes within countries, depending on compensation schemes and health service provision and practice *(5,6)*. WHO is currently exploring the incidence, prevalence, costs, consequences and prevention of ARDs (especially mesothelioma, lung cancer, pleural plaques and asbestosis) across Europe. This rapid review aims to contribute to that process by focusing on these four diseases, although several other ARDs are recognized in Europe *(7)*. The review underpins the development of a step-by-step approach to costing ARDs in 12 EU/European Free Trade Association countries that may have wider relevance across Europe.

Methods

A rapid review was conducted to identify relevant papers, reports and other publications that would inform both the best methodological approach to calculating the economic costs of ARDs and the evidence bases for those calculations. The searches focused primarily on research and policy outputs in the last 20 years and included literature on costing occupational illnesses generally, occupational cancers specifically and, within that category, asbestos-related occupational cancers. Country-specific, regional and global results were generated. Relevant information was gathered and evaluated about the economic costs (medical, social and legal) of ARDs primarily in the EU and European Free Trade Association countries and, where relevant, elsewhere in the world. The search strategy included Medline, Web of Science, Sociological Abstracts and Google as well as grey literature and textbooks. Abstracts were assessed for initial relevance and then full papers obtained. Key researchers in the field were contacted to check if other sources or literature existed beyond those identified in Medline and related databases. Searches were not limited to any country or language or to any specific dates in the first sweep. In the second sweep, if large numbers of references were generated, only the last 10 years were searched. For Google, the last year's references were searched. Frequently the different databases produced the same key references. MESH search terms used included economic costs, calculating economic costs, asbestos costing, occupational disease/s, asbestos-related diseases, economic factors, occupational disease/s, industrial disease/s, worker compensation, mesothelioma and asbestos-related cancers. All languages were included in the first searches. For Medline, no restriction was placed on the dates. Specific searches were conducted on 13 European countries.

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[1] The draft of this review was prepared by Professor Andrew Watterson, Centre for Public Health, Occupational and Environmental Health Research Group of the University of Stirling, as a background document for the Meeting. In no event shall this paper be considered an official paper endorsed by WHO. The responsibility for the interpretation and use of the material lies with the reader. The views expressed by the author do not necessarily represent the decisions or the stated policy of WHO.

Results and discussion

The search results are provided in Appendix 1 to this Annex. Relatively little has been published worldwide specifically on costing ARDs, and even less has been published on the medical costs of treating them. The first studies flagged how asbestos producers quickly shifted the economic burden of ARDs to taxpayers *(8,9)*. Some early studies explored the costs and effects of screening for cancer in exposed workers *(10)*. Countries have worked up different methodologies for costing occupational diseases, although most recognized that this was more complex than calculating the costs of occupational injuries *(4,11,12)*). Very few studies specifically explored occupational cancer costs *(13 17)*. One detailed study on ARDs medical costs exists *(6)*. Relatively few studies examined specific ARDs cost treatment options *(5,18 21)*. The criteria used and sensitivity analyses applied all varied.

Studies flagged great variety in measuring the “true” economic costs of occupational diseases and injuries. Some used willingness to pay cost calculations *(14)*; others did not, flagged their limits or relied primarily on human capital approaches *(15,17,22,23)*. Several neglected the social welfare costs to society (such costs are difficult to calculate) and hence under-estimated the economic burden of ARDs *(24)*. Loss of earnings does not accurately reflect the social costs of illnesses. It distorts calculations because some workers may accept, or be forced to accept, more risks than others, and it produces lower values for older workers who may live long lives but only have a limited time left in the workforce. The opportunity costs of capital need to be factored in; they vary from one economist to another, which again affects calculations *(24 p. 419,25)*. The obvious economic and non-economic (human) costs need to be calculated as well as private and social costs and financial and implicit costs (inferred or opportunity costs) *(22 pp.2 4)*. The environmental consequences for businesses of ill health at and beyond work have been relatively neglected but are increasingly pertinent to ARDs with regard to damage in communities as well as in workplaces. They could involve large cost calculations with regard to remediation.

Generic methods of occupational disease costings

These drew on established approaches containing direct (medical and related costs) and indirect costs with a range of variations *(22,24 30)*. An occupational cancer study in Alberta, Canada, was most relevant in terms of subject matter, with a well-worked out approach based on attributable fractions of disease and related hospital and social costs *(17)*. A study by the Australian National Occupational Health and Safety Commission offered the most comprehensive approach to the subject that could be used in a European context *(23,31 33)*. It contained a detailed cost methodology for employers, workers and the community drawing on incidence rather than prevalence data and on human costs. Future disease costs were discounted to present values in a lifetime cost approach that made assumptions about the level and structure of current costs accurately reflecting future continuing costs. Advances in health care technology and treatments could affect the level and structure of costs, hence the lifetime cost approach may distort the estimate of future costs. The conservative methodology revealed that in 2001□2002, costs that excluded pain and suffering were estimated at over Australian $ 31 billion. If pain and suffering costs were added, they totalled an additional $ 48.5 billion. Total costs comprised 3:1 indirect to direct costs *(23 p.3)*. Some, although not all, European countries make similar calculations. The Australian Commission also used an approach to estimating the cost of suffering and early death based on the willingness to pay approach and the statistical value of a life-year. Pain and suffering for severity categories leading to death were based on the time period covered between the age at the time of typical incidence and average life expectancy, using the present value of future life years to determine the total cost *(23 p.28)*. Such a method could be used as a basic guide to costing ARDs in Europe, supplemented by more specific studies. Other studies primarily focused on accessing available data sets that either recorded ARDs through worker compensation schemes or in health service records *(7)*. Sometimes both sources of data were used.

Specific methods

Two major methods were used in the literature that may be complementary.

The first was a macro approach, calculating costs on the basis of international research that indicated the attributable fraction of cancers due to occupation, sometimes linked to particular employment sectors and the use of a specific carcinogen such as asbestos *(34)*. This fraction then provided the numbers that were used with data gleaned on typical medical and social insurance costs for a cancer. Multiplying the former by the latter provided the economic costs of an occupational disease *(17,25 28)*. A number of major difficulties emerge with this method. Problems occurred with accuracy of attributable fraction, with disease causation, diagnosis and reporting, and lack of typical cases in costings with regard to age, gender, social insurance and legal payments, progression and severity of disease, variations in treatment and differences in survival rate across nations *(17,35 38)*.

The second method entailed what might be termed micro studies, particularly of specific ARDs *(6)*. These can provide a much more accurate picture of both disease numbers and medical and related costs where an occupational disease is relatively easily recognized and recorded. This should be the case for mesothelioma, pleural plaques and asbestosis but not for asbestos-related lung cancer. Yet it is still estimated that one mesothelioma case globally is overlooked for every four or five reported cases *(34 p.514)*. Problems with social insurance and differences in medical treatment costs also remain with this method.

Estimating the disease burden of ARDs

Debate continues about the ratio of asbestos-related lung cancers to mesotheliomas *(38 42)*. Figures range from a ratio of 1:1 to 3:1, primarily due to disagreements about the number of mesothelioma cases recorded in populations exposed to chrysotile. Serious under-reporting of asbestos-related lung cancer has long been identified *(43)*. McCormack et al. *(38)* recently concluded that: “All types of asbestos fibres kill at least twice as many people through lung cancer than through mesothelioma, except for crocidolite. For chrysotile, widely consumed today, asbestos-related lung cancers cannot be robustly estimated from few mesothelioma deaths and the latter cannot be used to infer no excess risk of lung or other cancers”. Conservative calculations for the economic costs of lung cancer deaths could therefore fall between a ratio of 3:1 to 1:1 of mesothelioma cases reported. Asbestos causes both small cell and non-small cell lung cancer, although 80% of all lung cancers are non-small cell and small cell cancers cost more to treat. ARD numbers continue, therefore, to be under-reported and the economic costs, especially in terms of calculating the economic value of human pain, suffering and social damage, remain imprecise and often under-valued *(23,31 33)*. Debate continues, too, with regard to the social and psychological impacts of pleural plaques *(44)*. Different countries cost such impacts differently. Nevertheless, the first methodology may offer the most practical means to calculate cross-national economic costs, and modelling can take account of some of the variables *(7,17,34)*.

Calculations of health service costs cover primary, secondary and tertiary services. The latter two groupings may be considered relatively unproblematic but the first is not necessarily straightforward. Health service costs in the primary sector can include social care or involve ancillary workers and support workers who may not be health professionals. Assessments triggering health service costs could be conducted by welfare and social services staff. Heating costs for occupational cancer patients vary from country to country and may affect the health status of the patient at home. Such payments could, therefore, be requested by health service staff on the basis of clinical need but may be authorized or processed by local authority social services or civil society bodies. There would thus be direct costs from payments for electricity or gas and administrative and labour costs for those processing and activating the claims *(45)*. With the increasing standardization of medical and surgical treatments for mesothelioma and a greater understanding of patients' home needs, the economic costs of health-related treatments should be much easier to calculate than in the past *(46,47)*.

Conclusion

Methods are available for assessing the economic costs of ARDs (Appendix 2). Although no one method will provide the best estimates, methods can be refined to ensure better costings in the future. They can also inform a step-by-step approach to estimating costs across Europe, suitably adjusted to take account of different disease profiles, treatment patterns and social insurance and related policies.

Appendix 1. Search results on the economic costs of ARDS

Introduction

Table 5.1.1 shows the results of the search, which was devised to identify the following:

(1) papers, reports and other publications that would inform the methodological approach to carrying out a step-by-step examination of the economic costs of ARDs, and what methods had been used to cost occupational illnesses generally, occupational cancers specifically and, within that category, occupational cancers due to exposure to asbestos; country-specific, regional and global results were generated;

(2) relevant information about the treatment costs and economic costs of ARDs primarily in the EU and European Free Trade Association countries but, where pertinent, elsewhere in the world.

Methodology

Search of Medline – Yes
Google – Yes
CINHAL – Pilot search. No new references were identified using this search beyond those in Medline and Google.
Sociological Abstracts – Yes
Web of Science abstracts – Yes
Grey literature – Yes
Text books – Yes

Searches were conducted in Medline and related databases. Abstracts were checked for initial relevance and then full papers were obtained. Key researchers in the field were also contacted to check whether other sources or literature existed beyond those identified in Medline and related searches. The relevant literature was then assessed for relevance to developing steps for assessing the economic impacts of ARDs.

Table 5.1.1. Search results on the economic costs of ARDs

Key words	References generated	Relevant references
Medline		
Economic costs occupational diseases	1208	?
Costing occupational disease	20	2
Costing occupational diseases	17	0
Calculating economic costs of occupational diseases	9	3
Calculating economic costs of industrial diseases	8	0
Methods costing occupational diseases	6	0
Methods costing occupational disease	7	0
Economic costs occupational diseases 2002–2012	533	?
Economic costs mesothelioma	29	28
Economic costs asbestos	39	21
Economic costs asbestos-related diseases	5	3
Costing asbestos-related diseases	0	0
Costing asbestos diseases	0	0
Economic costs lung cancer asbestos	16	13
Economic costs asbestos-related lung cancer	3	3
Economic costs cancer	20	18
Economic costs occupational cancer	132	12
Economic costs cancer larynx asbestos	0	0
Economic costs laryngeal cancer asbestos	0	0
Economic costs cancer larynx, asbestos-related	0	0
Economic costs cancer pharynx asbestos	0	0
Economic costs cancer pharyngeal asbestos	0	0
Economic costs cancer pharyngeal asbestos	1	1
Economic costs cancer colon asbestos-related	0	0
Economic costs cancer colo-rectal asbestos-related	0	0
Economic costs cancer kidney asbestos	0	0
Economic costs cancer kidney asbestos-related	0	0
Economic costs cancer ovary asbestos	0	0
Economic costs cancer ovary asbestos-related	0	0
Economic costs cancer ovarian asbestos	0	0
Economic costs cancer bladder asbestos	1	0
Economic costs cancer bladder asbestos-related	0	0
Economic costs cancer stomach asbestos-related	0	0
Economic costs cancer stomach asbestos-related	1	1
Economic costs pleural plaques	2	0
Country-specific (13 countries) economic costs of ARDs Austria/Belgium/Denmark/Finland/France/Germany/Italy/ Netherlands/Norway/Portugal/Spain/Sweden/Switzerland	0	0
Google		
Economic costs occupational diseases	3 150 000	?
“Economic costs occupational diseases”	10	2
Economic costs occupational diseases August 2011–August 2012	214 000	?
Costing occupational disease	0	0
Costing occupational diseases	0	0
Calculating economic costs of occupational diseases	0	0
Calculating economic costs of industrial diseases	0	0
Methods costing occupational diseases	4 270 000	?
“Methods costing occupational diseases”	0	?
Methods costing occupational disease/s	6/8	0/0

Key words	References generated	Relevant references
Costing asbestos diseases	0	0
“Economic costs of occupational cancer(s)”	4	4
Economic costs pleural plaques	0	0
Economic costs mesothelioma	2	2
“Economic costs mesothelioma”	0	0
Economic costs lung cancer asbestos	0	0
Economic costs asbestos-related lung cancer	0	0
Economic costs cancer	?	?
Economic costs cancer larynx asbestos	0	0
Economic costs laryngeal cancer asbestos	0	0
Economic costs cancer larynx, asbestos-related	0	o
Economic costs cancer pharynx asbestos	0	0
Economic costs cancer pharyngeal asbestos	0	0
Economic costs cancer pharyngeal asbestos	0	0
Economic costs cancer colon asbestos-related	0	0
Economic costs cancer colo-rectal asbestos-related	0	0
Economic costs cancer kidney asbestos	0	0
Economic costs cancer kidney asbestos-related	0	0
Economic costs cancer ovary asbestos	0	0
Economic costs cancer ovary asbestos-related	0	0
Economic costs cancer ovarian asbestos	0	0
Economic costs cancer bladder asbestos	0	0
Economic costs cancer bladder asbestos-related	0	0
Economic costs cancer stomach asbestos-related	0	0
European figures on asbestos-related diseases	1 480 000	?
European figures on asbestos-related diseases: Past year	42 900	?
European estimates of asbestos-related diseases	126 000	?
Country-specific (13) search for “economic costs of ARDS”. Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland	3	3
Sociological abstracts		
Economic costs occupational diseases	13	2
Costing occupational disease/s	0	0
Costing industrial diseases	0	0
Calculating economic costs of occupational diseases	0	0
Calculating economic costs of industrial diseases	0	0
Methods costing occupational diseases	0	0
Methods costing occupational disease	0	0
Web of Science (all years) (includes Science and Social Science citations and conferences)		
Economic costs occupational diseases	127	6
Costs occupational diseases	564	13
Costing occupational disease/s	564	13
Costing industrial diseases (results were primarily environmental pollution)	251	4
Calculating economic costs of occupational diseases	0	0
Calculating economic costs of industrial diseases	0	0
Methods costing occupational diseases	0	0
Methods costing occupational disease	0	0
Costing asbestos-related diseases	16	5
Economic costs asbestos-related diseases	1	1
Economic costs mesothelioma	8	3

Note. ? = as the numbers were too large to search, the search terms were refined and are included elsewhere in the table.

Inclusion and exclusion criteria

Searches were not limited to any country or language in the first sweep nor to any specific dates. In the second sweep, if large numbers of references were generated, then the last 10 years of papers were searched. For Google, the last year's references were searched. Frequently, and as expected, the databases produced the same key references.

MESH terms used included: Economic costs calculating economic costs asbestos costing occupational disease/s asbestos-related diseases Economic factors occupational disease/s industrial disease/s worker compensation mesothelioma asbestos-related cancers

CINHAL produced no additional results to those already generated in Medline (PubMed).

All languages were included in the first searches. For Medline, no restriction was placed on the dates.

Searches in Google were as for Medline. However, where searches produced hundreds of thousands of results, the searches were restricted to key papers in the last 12 months.

Appendix 2. Preliminary estimation of the economic costs of ARDs

Data exist from various European countries estimating mesothelioma and lung cancer economic costs. As each country has a different social insurance system, prescribed occupational disease listing and different payments, exact cross-European comparisons are difficult. For example, the French costs for mesothelioma cases sometimes appear low when compared to United Kingdom costs but this is partly explained by civil court compensation payments. Conservative estimates were deliberately used in Table 5.2.1 and hence the French figure has been applied across Europe for mesothelioma. Since few estimates exist for occupational and environmental lung cancer costs, the main one available (the United Kingdom REACH estimate for lung cancers, both large- and small-cell) has been applied across the selected European countries.

Table 5.2.2 uses conservative estimates of mesothelioma cases (discussed above) and focuses on acute medical costs based on United Kingdom data. The medical, surgical and palliative care treatment costs change depending on the drugs available and advances in interventions. They vary (for reasons again discussed above) from country to country because of resources such as equipment and drug budgets, health service staffing, clinical knowledge and education. The costs do not include primary care or social care, which are considerable.

In addition to the United Kingdom acute medical costing estimates applied across the selected countries, Table 5.2.3 also includes the average German pensions cost (social insurance payments) for those with mesothelioma and their families. The German data are the most detailed available in Europe, although again the payment system may vary in other countries.

Table 5.2.4 combines all the estimated costs, excluding primary and social care costs, for mesothelioma cases in one year across selected European countries. The total estimated economic costs for one average year's mortality from mesothelioma across 15 European countries is €1 684 124 295. The figures may well seriously underestimate the costs in northern Europe for reasons discussed above, but may overestimate the costs in central, eastern and southern Europe. Central and eastern European estimates of the numbers of mesothelioma cases are, however, likely to be seriously underestimated.

Table 5.2.1. Estimates of mesothelioma costs based on French and European figures

Country	No. of mesothelioma cases	Costs, 2009[a] (€)	No. of lung cancer cases	Costs, 2012[b] (€)
Austria	80	10 000 000	160	487 001 280
Belgium	156	19 500 000	2 512	7 645 920 096
Denmark	71	8 875 000	142	432 213 636
Finland	75	9 375 000	150	456 563 700
France	826	103 250 000	1 652	5 028 288 216
Germany	1 063	132 875 000	2 126	6 471 029 508
Italy	1 235	15 437 500	2 470	7 518 082 260
Netherlands	395	49 375 000	790	2 404 568 820
Norway	54	6 750 000	108	328 725 864
Poland	96	12 000 000	192	584 401 536
Portugal	19	2 375 000	38	115 662 804
Romania	58	7 250 000	116	353 075 928
Spain	263	32 875 000	526	1 601 016 708
Sweden	123	15 375 000	246	748 764 468
United Kingdom	1 891	236 375 000	3 782	11 511 492 756

Sources: data from Park et al *(34)*, WHO (citing FIVA for ARDs) *(2)* and the Department for Environment, Food and Rural Affairs (for lung cancer) *(15)*.

[a] Based on the €125 000 estimated cost of one average case of mesothelioma in France. The French figures are atypical and appear to exclude several elements of a fully costed case of ARDs.
[b] Based on the €3 043 758 average cost of a case of lung cancer due to chemical exposures estimated under REACH. The REACH figures for a typical case of occupational cancer are more comprehensive and include elements for pain and suffering.

Table 5.2.2. Estimated total acute medical costs for those dying from mesothelioma each year in 15 European countries

Country	No. of mesothelioma cases (underestimates)	Acute medical treatment costs only, 2012[a] (€)
Austria	80	1 271 948
Belgium	156	2 480 298
Denmark	71	1 128 854
Finland	75	1 192 451
France	826	13 132 855
Germany	1063	16 900 999
Italy	1235	19 635 685
Netherlands	395	6 280 240
Norway	54	858 565
Poland	96	1 526 337
Portugal	19	302 088
Romania	58	922 162
Spain	263	4 181 527
Sweden	123	1 955 619
United Kingdom	1891	30 065 652

[a] Based on average United Kingdom costs per case of €15 899.34, adjusted to 2012 prices.

Sources: data from Park et al *(34),* Watterson et al *(6)*.

Table 5.2.3. Costs of acute medical treatment and pensions for mesothelioma deaths in an average year in 15 European countries

Country	No. of mesothelioma cases (under-estimates)	Acute medical treatment costs (€)[a]	Average mesothelioma pension costs[b]
Austria	80	1 271 948	19 763 200
Belgium	156	2 480 298	38 538 240
Denmark	71	1 128 854	17 539 840
Finland	75	1 192 451	18 528 000
France	826	13 132 855	204 055 040
Germany	1063	16 900 999	262 603 520
Italy	1235	19 635 685	305 094 400
Netherlands	395	6 280 240	97 580 800
Norway	54	858 565	13 340 160
Poland	96	1 526 337	23 715 840
Portugal	19	302 088	4 693 760
Romania	58	922 162	14 328 320
Spain	263	4 181 527	64 971 520
Sweden	123	1 955 619	30 385 920
United Kingdom	1891	30 065 652	467 152 640

[a] Based on United Kingdom acute medical cost per mesothelioma patient who died *(6)*. The average cost in 2000 was £9420.38, which at 2012 prices totals £12 811.72. This converts to €15 899.34 in 2012. The figure will underestimate current acute costs

[b] Based on 2010 German pensions figures for mesothelioma of €247 040 per case *(38)*. Again, the figures may underestimate current costs.

Table 5.2.4. Total costs of mesothelioma cases in 15 European countries in one year

Country	No. of mesothelioma cases (underestimates)	Total costs[a] (€)
Austria	80	21 035 120
Belgium	156	41 018 484
Denmark	71	18 668 669
Finland	75	19 720 425
France	826	217 187 614
Germany	1 063	279 504 157
Italy	1 235	324 729 665
Netherlands	395	103 860 905
Norway	54	14 198 706
Poland	96	25 242 144
Portugal	19	4 995 841
Romania	58	15 250 462
Spain	263	69 152 957
Sweden	123	32 341 497
United Kingdom	1 891	497 217 649
Total		1 684 124 295

[a] Pensions and acute medical costs, excluding primary/palliative care = €262 939 per case. The total costs assume that German pensions do not include medical treatment costs.

Tables and country-specific costings for ARDS

Additional data below provides some snapshots, firstly on social insurance costs across specific European countries, secondly on estimated mesothelioma and lung cancer cases (Table 5.2.5) and thirdly on the different costs that may be compensated for in some of those. Data from Canada and New Zealand are included as they provide some useful comparisons with the European position. Canada is one of only a small number of countries to calculate the costs of occupational lung cancer and so provides some sort of bench mark for ARDs-related lung cancer costs elsewhere. However, in Canada, medical costs may be higher because of the nature of the health care system and the treatment protocols operating in North America.

Table 5.2.5. European modelling of ARDs with reference to lung cancer due to asbestos exposure[a]

Country	Total costs per case (€)	Type of compensation	Breakdown
Austria	7 199.5	Loss of earnings capacity	
Belgium	1 500	Loss of earnings capacity	Can drop to €500
Denmark	12 965 lump sum only	Benefits reduced by 50% because a smoker	
Germany	12 000 per year	Loss of earnings capacity	Can drop to €600
France	9 000	Loss of earnings capacity	Plus full compensation from FIVA[b]
Italy	6 096	Loss of earnings capacity	€3576
		Biological damage	€2529
Netherlands	0		
Norway	17 983 lump sum	Not specified	€11 003 lump sum
		Physiological damage	€6980 lump sum
Spain	0	None because disability less than 33%	
Sweden	0	No loss of earnings so no payment	
Switzerland	14 000–35 000	Assessed on harm done	

[a] Based on a 50-year-old man diagnosed in 2000, smoking 20 packs a year, with no asbestosis or pleural plaques, lung capacity reduced by 25% after surgery, gross wage €18 000 per year.
[b] Fonds d'Indemnisation des Victimes de l'Amiante [Asbestos Victims Compensation Fund].

Source: European Forum of the Insurance against Accidents at Work and Occupational Diseases *(7)*.

France

It is predicted that 50 000□100 000 deaths will be caused by asbestos in 2005□2030 in France. As of 2009, FIVA had paid €359 million to 6650 claimants. The total cumulated cost of compensation reached €2.4 billion (Table 5.2.6). On average, payments are €125 000 to each mesothelioma case and €19 000 to each asbestosis case *(2, p.14)*.

Table 5.2.6. Economic costs of ARDs paid by FIVA, France, 2008□2009

Disease	Total cumulated cost as of 2008 (€)	Expenses in 2009 (€)	Total cumulated cost in 2009 (€)
Minor illness	609 637 000	88 543 000	698 180 000
Asbestosis	81 513 000	14 763 000	96 275 000
Lung cancer	732 720 000	165 494 000	898 214 000
Mesothelioma	501 547000	78 962 000	580 508 000
Other diseases	112 382 000	11 687 000	124 068 000
Total	2 037 797 000	359 447 000	2 397 243 000

Source: WHO *(2)*.

Germany

Occupational diseases are listed in the German Occupational Diseases Ordinance. The Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung has estimated ARDs costs. The Institut has also estimated the total pension cost per case of asbestosis as US$ 130 000, of lung cancer as $ 320 000 and of mesothelioma as $ 320 000 *(38)*. (In April 2010, €1 = US$ 1.33.)

The estimated mean duration of pension payment per case is 13 years.

United Kingdom

In the United Kingdom, it is estimated that compensation through the courts for mesothelioma can vary from £69 000 up to £350 000 *(39)*. It is easier to calculate court costs nationwide, but only for the United Kingdom (Scotland) for pleural plaques because the range in compensation is much smaller (Table 5.2.7).

Table 5.2.7. Costs for cases of pleural plaques in the United Kingdom in the last decade

Country	Total costs per case	Type of compensation	Breakdown
United Kingdom (Scotland); under a specific law[a] (the rest of the United Kingdom does not legally compensate for pleural plaques)	£22 000 at 2003–2004 prices	Legal. Through courts. Monies from insurance companies	£8000 victim £8000 prosecution £6000 defendant
United Kingdom[b]	£35 000 gross damages (2011)		

Sources: [a]Scottish Government *(40);* [b]Humphreys & Co. Solicitors *(39)*.

Under-recording and under-reporting of ARDs continue, especially for lung cancers. Estimates of lung cancers caused by asbestos vary and the Health and Safety Executive presents highly conservative figures (Table 5.2.8). Law firms in the United Kingdom may also obtain damages for individual ARDs cases that can be extremely high – up to £4.37 million (see Table 5.2.8, footnote [a]).

Table 5.2.8. Health and Safety Executive estimates for ARDs, 2009

Deaths from mesothelioma (2009)	2321
Estimated asbestos-related lung cancer deaths	2000[a]
Deaths from asbestosis without mention of mesothelioma (2009)	411
Newly assessed cases of asbestosis	1015
Newly assessed cases of diffuse pleural thickening	505
Cases of non-malignant pleural disease reported to specialist physicians	778

Source: Health and Safety Executive *(9).*

[a] *This figure has been rounded because it is an estimate rather than the number of actual deaths.* Civil compensation awards are based on lost years of life and suffering and range between £45 000 and £75 000 for general damages plus care costs and financial losses. In exceptional cases, the award was £4.37 million (*42 p.445, 43 p.43)*. Indicative figures have also been produced for pain and suffering.

The complexity and, it could be argued, the arbitrary nature of calculations for ARDs in the United Kingdom are further demonstrated in terms of payments for pain and suffering, with very low minimum payments for mesothelioma, lung cancer and asbestosis in comparison with those for pleural plaques (Table 5.2.9).

Table 5.2.9. English Judicial Studies Board guideline rates for pain and suffering alone, 2007

Disease	Sterling	US $	Japanese ¥
Mesothelioma	£47 850–74 300	97 474–151 356	11.4m–17.8m
Lung cancer	£45 800–58 500	93 300–119 165	11m–14m
Asbestosis	£28 000–61 500	57 045–125 296	6.7–14.7m
Pleural thickening	£22 400–45 800	45 638–93 313	5.3m–11m

Source: Kazan-Allen *(44 p.4)*.

Canada

The medical costs of lung cancer in Alberta in the 2000s were calculated as follows. A total of 13 389 health service events were captured with an estimated total cost of 8.4 million Canadian dollars. Laboratory tests, diagnostic imaging and ambulatory visits constituted 86% of the service events while patient admissions and therapy constituted 76% of the costs. The vast majority of overall costs occurred just before, or within, three months of diagnosis. The median costs for cases of non-small cell lung cancer and small cell lung cancer were $10 928 (range $9 234–11 047) and $15 350 (range $13 033–21 436), respectively.

New Zealand

In New Zealand in 2006, "financial costs per case for cancer are nearly $700 000, with total costs per case (including suffering) of $2.9 million, far higher than any other category" *(45 p. xii)*. Only 5.2% of the financial costs of cancer and 1.3% of the total costs are compensated for *(45 p.81)*.

General notes on the tables

a. The EU REACH calculations of the health benefits of risk reduction were based on the following assumptions *(15 p.29)*:

- the proportion of all disease (based on WHO figures and measured in DALYs) due to agro-industrial chemicals and chemical pollution from diffuse sources is between 0.6% and 2.5% in developed market economies; a conservative figure of 1.0% is therefore taken from this range;
- the proportion of this disease that will be identified and tackled by REACH is 10%;
- 10 DALYs are equivalent to 1 life saved;
- in line with an experts' workshop on valuing health impacts, a value per statistical life estimate of €1 million (£710 000) was adopted.

b. The EU value per statistical life was estimated at €1 million which it acknowledged was conservative and excluded pain and suffering related to cancer case *(13 p.30)*

c. The RPA's 2003 assessment for the EU of the costs of occupational cancers under REACH included costs of medical treatment, the value of lost output and human costs, where these reflect an individual's willingness to pay to avoid a particular health effect. In the case of cancer, lower- and upper-bound valuations were adopted, based on recommended figures for the value of preventing a fatality in cost□benefit analyses carried out for or by the Directorate-General for the Environment. Both the lower- and upper-bound figures represent individuals' willingness to pay to avoid the risk of death (with this being the value of a statistical life) *(14 p.iii)*. This produced costs, based on 2000 prices, of a lower estimates of €1.39 million per cancer death each year and an upper estimate of €2.14 million *(15)*.

Although REACH would not reduce ARDs, the REACH estimates of occupational cancer costs have some validity *(15 p.31)*.

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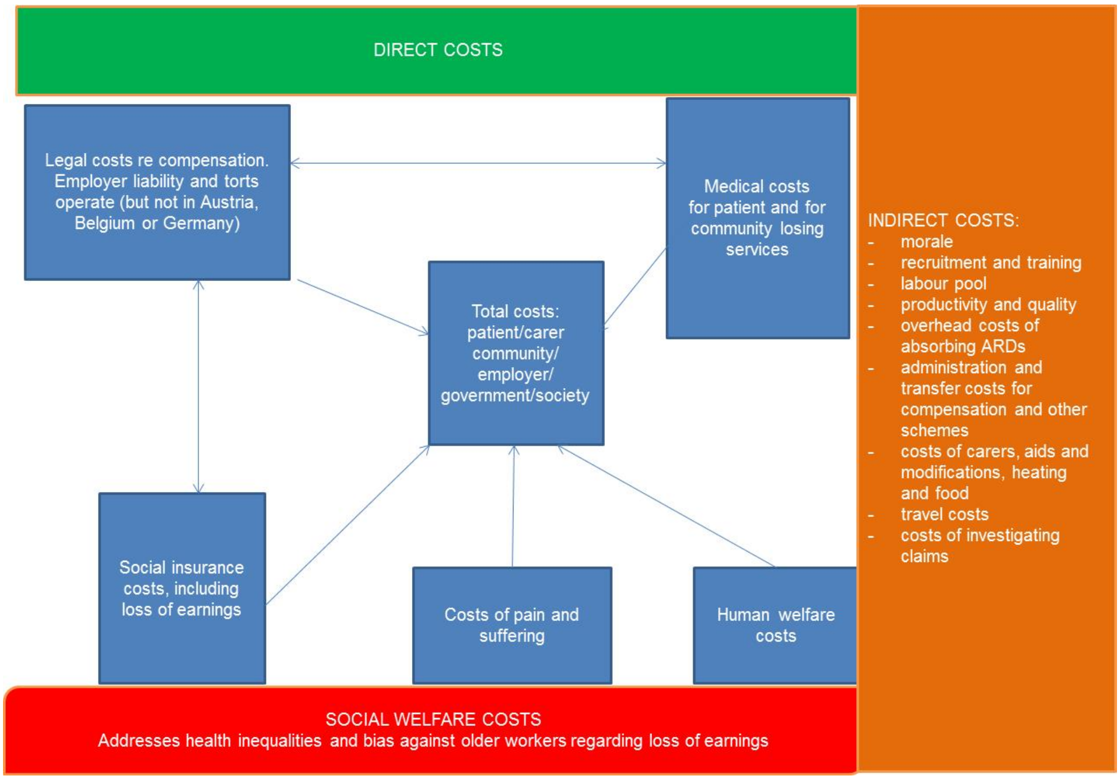
ANNEX 6

STEP-BY-STEP GUIDANCE ON CALCULATING THE ECONOMIC COSTS OF ARDS IN A COUNTRY FOR A NATIONAL ASBESTOS PROFILE[1]

Introduction

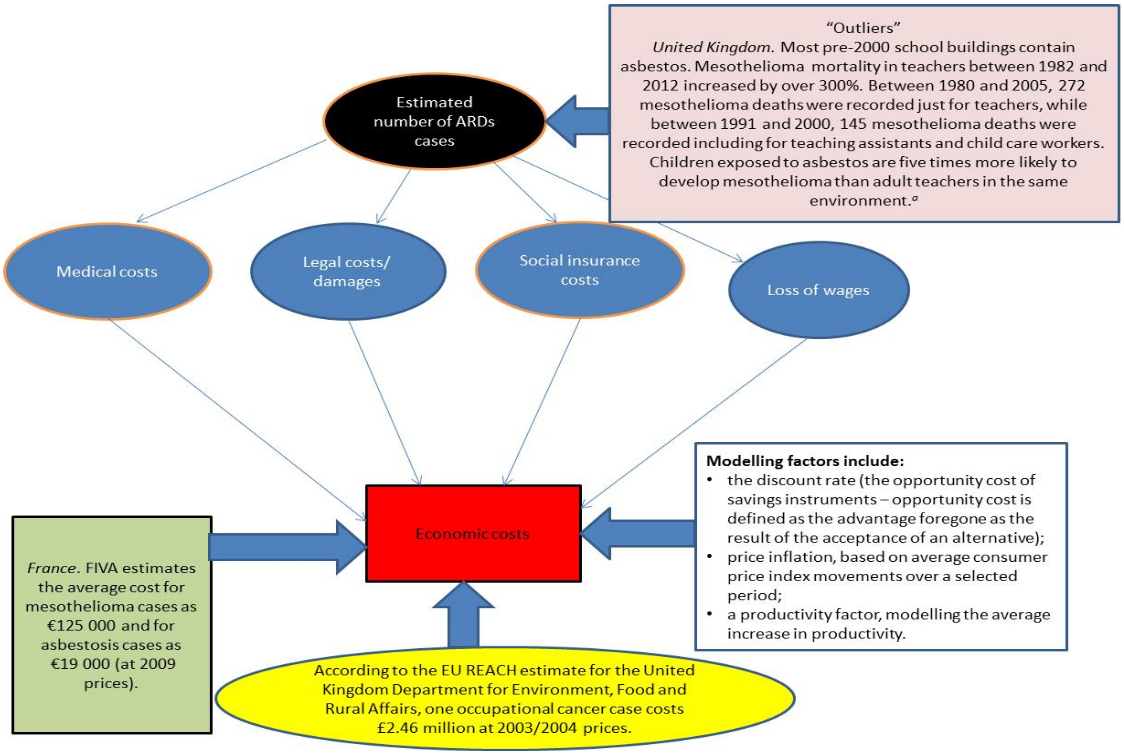
Detailed and accurate calculations of the economic costs of ARDs depend on the recording and accuracy of disease reporting and medical and social insurance costs kept by each European country. These may vary from country to country, as may the specific ARDs: 11 are recognized in some European countries. More difficult to estimate are calculations about the economic costs to employers and government and the human costs to communities of ARDs. They may be linked to estimates of human capital, willingness to pay (or value of statistical life) or combinations of all these. Where data are lacking, it may be possible to begin to estimate medical and social insurance and related worker compensation costs for ARDs drawing on Europe-wide or international data. The key elements of costings are illustrated in Fig. 6.1 and 6.2 and indicate the type and range of data needed. DALYs and PYLLs could be linked and estimates may draw on the new WHO global burden of disease project publication that will shortly be available.

Fig. 6.1. Key elements of economic and human costings of ARDs



[1] This paper was prepared by Professor Andrew Watterson of the Centre for Public Health, Occupational and Environmental Health Research Group of the University of Stirling as a background document for the Meeting. In no event shall this paper be considered an official paper endorsed by WHO. The responsibility for the interpretation and use of the material lies with the reader. The views expressed by the author do not necessarily represent the decisions or the stated policy of WHO.

Fig. 6.2. Some cost estimates, influences and neglected sectors in assessing ARDs



[a] Asbestos in Schools Group *(1)*.

Step 1. Asbestos disease data

Identify most accurate ARD cases from existing sources (insurance, government, trade union records or specific records such as school records) or, if these are limited, use the best estimates of ARDs available from international studies and the global burden of disease project 2010 *(2)* based on asbestos usage. Identify diseases that will either result in illnesses or compensation or both. Across Europe, these will be for compensation purposes: mesothelioma, asbestosis and lung cancer. In some countries they may also include pleural plaques and cancers of the larynx, pharynx, trachea, sinus, oesophagus, stomach, colon and rectum. Where the latter diseases are not recognized, the economic costs of the diseases do not vanish but are externalized. These data have been examined elsewhere in the WHO workshop.

Assess the accuracy of classification, recording and reporting. Adjust for known under- or over-estimates. Data presented here are deliberately very conservative and will underestimate the disease burden. Calculate the likely disease figures from exposed populations based on historical data (long latency periods for cancers) and, if available, relevant exposure and other data indicating the likely incidence and prevalence of disease in particular populations and countries. These should include para-occupational, bystander and environmental exposures, for example linked to contaminated clothes in homes, asbestos in buildings and schools, and asbestos pollution from nearby factories and waste dumps. Use established or best validated proxy figures to calculate cases of ARDs that may not be recorded and/or reported in official figures. Lung cancer cases will fall into this category as may pleural plaques. Note any gaps in data and areas of uncertainty that may affect figures and refer to any relevant models that may indicate likely figures if the data are incomplete.

Step 2. Medical costs possibly linked to or overlapping with wider social care costs

For each European country, the following data should, if possible, be collected.

(a) Identify types of treatment that apply in your country for these diseases.

(b) (i) Identify medical and related health and social care costs related to those diseases.

(ii) This should include a calculation relating to take-up of services not available elsewhere in the health delivery system because of the treatment needs for ARDs.

For (a) and (b) (i), data should be easily available. For (b) (ii), this may prove more problematic and the costs of ARDs to communities have not yet been accurately calculated anywhere. Identify diseases that will either result in illnesses or compensation or both. These may include mesothelioma, asbestosis, lung cancer and pleural plaques. In some European countries, they may also include cancers of the larynx, pharynx and other organs. The European Society of Medical Oncology has produced a standard protocol for treating diseases such as mesothelioma and guidelines have been produced by respiratory physicians' groups internationally *(3)*. In the absence of country-specific data on ARDs, such protocols may serve as an alternative and probably quite accurate model for costing mesothelioma.

Direct medical costs will include: (i) primary care – technology, primary care staff time, drugs (primary care and private prescribing costs and staff time), facilities and overheads;
(ii) secondary care (acute /hospital care),technology, hospital staff time, drugs and staff time, facilities and overheads, administration; (iii) specialist unit care, technology, primary care staff time, drugs (unit and private prescribing costs and staff time), facilities and overheads;
(iv) palliative care, technology, primary care staff time, drugs (unit and private prescribing costs and staff time), facilities and overheads. Canada and the United Kingdom have also costed typical occupational lung cancer costs, albeit not specifically for ARDs. In the absence of more accurate figures, these may provide an approximate guide to asbestos-related lung cancer medical costs. Several countries have data that do not disaggregate the medical and social insurance costs of ARDS; these costs can vary widely from country to country but may prove the best means of calculating national costs, assuming social insurance systems are similar (Fig. 6.2–6.4). Table 6.1 shows a detailed example of United Kingdom costing of medical treatment of mesothelioma.

Step 3. Social insurance/worker compensation, pensions, disability and other related costs

The data needed relate to the economic costs of ARDs to employees and ex-employees, employers, government and society generally. Identify and scope out the social insurance system relating to all ARDs in your country. This may include weekly or monthly payments to compensate for loss of wages, lump sum payments and pensions with associated allowances or additional payments for disability and living expenses. Hence, identify social insurance, pensions, loss of earnings, legal and state benefits and costs, including administration, that may apply to those suffering from ARDs linked to disease type and onset. Identify indirect costs that may occur, such as loss of productivity, quality and recruitment and training of replacement workers, which can apply to the first three listed diseases. Identify any civil or criminal court payments (or treatment costs) that may be reclaimed from employers by the state.

Fig. 6.3. Examples of ARDs compensation schemes in Europe

France
The FIVA social security fund compensates all ARD victims, including an early retirement fund. Legal claims may still be possible including anxiety/ environment; €3 billion has been paid out since FIVA started in 2000.

Austria
In 2006, the social insurance system applied, including for widows and children.

Italy
Compensation is payable for both illnesses and exposure. Legal claims are allowed. The Istituto Nazionale per L'Assicurazione control gli Infortuni sul Lavoro allows for early retirement. In 2011, a government fund was created for asbestos victims with government/employer funding and lump sum payments.

Netherlands
Social security allows for legal action to be taken by employees and environmental victims with damages payable. Institute for Asbestos Victims (just for mesothelioma) oversees and Dutch Asbestos Victims Compensation Scheme and regulations apply.

Belgium
In 2006, no ARDs legal claims were allowed against employers. Social insurance payments were allowed.

Switzerland
In 2006, the social insurance system applied, including for widows and children.

Finland
Compensation covers medical treatment, daily allowances, pensions, disability pensions, survivors' pensions and funerals.

Portugal
In 2006, the social insurance system applied, including pensions for widows and children.

Denmark
In 2006, the social insurance system applied, including for widows and children. The Labour Market Occupational Diseases Fund deals with occupational diseases and covers all public and private employees.

Sweden
No distinction is made between work and other cancers in payments for loss of earnings. Compensation for ARDs is from the state via general insurance and consists basically of compensation for lost income and medical costs.

Norway
In 2006, the social insurance system applied, including for widows and children.

Germany
All claims are compensated by specific statutory insurance. Employers make contributions. Legal claims are not usually allowed.
Pain and suffering are not compensated because the insurance scheme is generous.

United Kingdom
Payments for industrial diseases include social insurance (social security, pensions, government lump sum, widows) and perhaps legal elements. Insurance claims estimate is £33 billion.

Poland
There is no special liability regarding asbestos. Claims are dealt with under civil and labour codes. The civil code covers medical costs and annuities and can cover family compensation. Payment under the labour code is triggered by acceptance of illness as an occupational disease.

Spain
Social security handles most claims as occupational diseases and can reclaim some monies from employers. Employees may gain 30–50% extra benefits if laws are breached through civil and criminal actions.

Source: European Forum of the Insurance against Accidents at Work and Occupational Diseases *(4).*

Fig. 6.4. A worked example of costing medical treatment for ARDs: the United Kingdom

- General Register Office death records were consulted to identify all Scottish deaths.
- Mesothelioma and asbestosis are coded in these records according to ICD-10 as follows:

  C45.0 Mesothelioma of pleura
  C45.1 Mesothelioma of peritoneum
  C45.2 Mesothelioma of pericardium
  C45.7 Mesothelioma of other sites
  C45.9 Mesothelioma, unspecified
  J61 Pneumoconiosis due to asbestos and other mineral fibres or asbestosis

- The Scottish Morbidity Record (SMR) registers information on all admissions of Scottish inpatients, including patient demographics and clinical details relating to the patient's hospital stay.
- Information stored on the SMR database includes the medical specialty under which the individual received care (defined as the division of medicine covering a specific area of clinical activity), type of admission (booked, transfer, emergency), length of stay (days), diagnosis and any operations performed.
- The Historic SMR1 (general/acute inpatient and day case records 1981 – March 1997) and the COPPISH SMR01 (general/acute inpatient and day case records April 1997 onwards) databases were used to gather information relating to patients' care in hospital.

An estimate of costs was applied to each inpatient and day case admission to hospital using the Scottish Health Service Costs (NHS Scotland) 2001, which provides details of day case and inpatient costs by medical specialty.

General practitioner
Chest physician
Cardiac surgeon
Consultant oncologist
Lung specialist nurse
Community nursing
Palliative care
Allied health professionals
Histopathologists
Social services
Hospice services
Coroner
Benefits advisers
Social workers

Source: Watterson *(5).*

Table 6.1. Medical and related costs for mesothelioma cases in the United Kingdom

Category of cost	Costs (£)
Medical and surgical treatment	*Costs not known*
• Inpatient care	
• Surgical treatments:	
▫ video-assisted thoracoscopic surgery	
▫ pleurodesis	
• Outpatient treatments:	
▫ chemotherapy	
▫ radiation	
Inpatient costs by medical specialty and occupied bed-day, 2000	*Cost per day*
General surgery	325
Orthopaedics	316
Ear, nose and throat	480
Urology	321
Cardiothoracic surgery	589
Medical	222
Dermatology	222
Nephrology	384
Respiratory medicine	187
Communicable diseases	272
Radiotherapy	378
Geriatric assessment	129
Gynaecology	424
Intensive care unit	1279
Coronary care unit	529
General practice	161
Incidental costs	*Costs not known*
Nursing equipment	
Mobility aids and adaptations	
Transport	
Investigations	
Medical supplies	
Sitting services	
Chest drains	
Drugs	
Other costs and consequences for mesothelioma patients not included in these cost estimates	
Carers / *Other*	
Loss of employment / Legal advisers	
Career break / Welfare benefits	
Loss of income and job advancement / Inquest	
Psychological support needs / Post mortem	
Physical support for nursing care / Burial/cremation	
Bereavement support	
Total number of days of hospital treatment + total costs of hospital treatment for 119 cases of mesothelioma and asbestosis from diagnosis until death in the United Kingdom, 2000	*Total costs*
Day cases – 111 days	37 515
Inpatients – 4042 days	983 985
Total – 4153 days	1 021 500
Total costs for mesothelioma cases alone (United Kingdom (Scotland))	942 038
Estimated costs for mesothelioma cases (United Kingdom)	16 014 646

Source: Watterson *(5).*

The following will contribute to, receive or be affected by Step 3 costs.

Patients

Calculations for patient costs may or may not be covered by social insurance and related payments, for example, heating costs. They would include loss of earnings linked to age-related life expectancy, loss of pensions for family through earlier death, emotional and mental health, physical effects and travel. Macmillan Cancer UK estimates cancer patients spend, on average, £325 a year on travel and associated costs *(6)*. Patients and families report an average of 53 trips to hospital over their treatment course with petrol and parking being the biggest costs. The costing model is generally weighted towards working-age men rather than women, the young, ethnic minorities and the old. It should be noted that mesotheliomas have occurred in people aged 30 and 40 years, and other ARDs have occurred in many workers prior to normal retirement.

Government

Costs to governments include payments to health and social services, and loss of tax and pensions revenue and social insurance payments from people either on reduced income or no longer working. Increases in payments due to illness (for example, increased heating, housing and other payments for greater costs to cancer patients) may also apply. Pensions paid earlier will be a loss to governments, and although savings in pensions resulting from earlier deaths may occur they will be offset in several countries by payments to partners and children. End-of-life costs (palliative costs have been added to cost recovery costs) plus funeral/home expenses also apply. Costs to government and society can be calculated by: (i) summing retrospective payments, (ii) calculating average yearly payments based on incidence and rolling forward likely costings adjusted for discounting, inflation and economic growth or decline, or (iii) calculating payments on the basis of prevalence of disease.

Carers

These costs include time and loss of earnings, travel and impact on emotional and mental health (the United Kingdom Health Service estimates for 2011 estimate these as “non-financial costs or values”). No good data exist with regard to losses for informal/family carers.

Employers

These costs include lost time, lost production, work re-organization, recruitment and induction costs of replacement staff (temporary or permanent), occupational health and safety services, administration, legal and insurance costs, private health insurance premiums, fines and penalties that may involve prison, reputational damage and recovery of treatment costs (which applies in some countries).

Society

These costs include: indirect costs, direct costs already listed (such as health service costs), lost wages and hence lost tax, displacement by ARDs patients of other patients through use of health and social services that others cannot then access, costs of processing patients, costs of processing claims for legal damages and costs of insurance claims

Communities

These costs are usually not monetized and are ignored in terms of pressure on resources and damage to community viability, both economic and social. Not only may they entail the loss of members of the community because of ARDs; they may also have indirect impacts on the community through caring, which is often compounded across Europe by de-industrialization and other adverse effects on geographical communities where heavy industry developed and where most ARDs occur. The effects would be especially marked in towns and cities where shipbuilding and heavy engineering flourished, and contribute to social deprivation and health inequalities.

Step 4. Legal costs

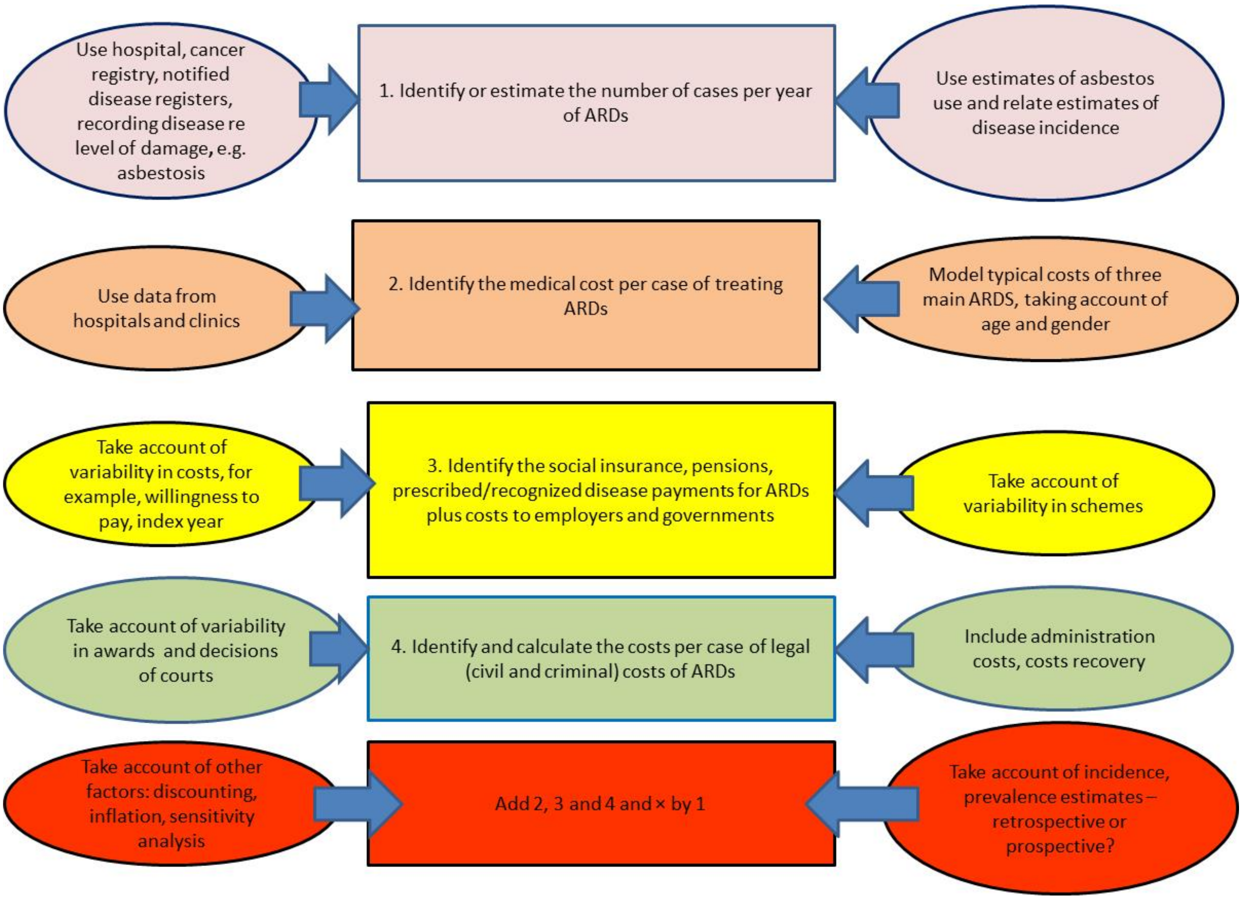
These may be civil or criminal or both. In some countries, the social insurance systems effectively deal with all ARDs cases and it is unusual (but not impossible) for civil or criminal damage actions to be brought. Germany has a system where torts or negligence actions by employers are rarely taken. The United Kingdom has both a social insurance system and one where civil and criminal cases relating to ARDs frequently occur. France and Italy also pursue legal claims. A further complication exists when the state may be granted cost recovery powers to reclaim monies spent on ARDs due to negligent employers. This step will usually entail very small sums for most but not all countries.

Step 5. Total costs

Take the number of ARDs cases identified in any year or years, add the medical, social insurance, legal and human costs together for employees, employers, government and wider society and multiply the total costs by the cases (see Annex 5, Table 5.2.4 for worked examples).

A summary of the key steps is in Fig. 6.5.

Fig. 6.5. Summary of the key steps



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Annex 7

PREPARATION FOR THE WORKSHOP ON ECONOMIC COSTS OF ARDS

1. If possible, collect data on the last full year's records from governmental, health body, social insurance, pensions sources your country has for ARDs and any time series data available on ARDs for the last 10 or 20 years. These would include data on mesotheliomas, lung cancers compensated for due to asbestos exposure, asbestosis, pleural plaques and other cancers listed in your country's schedules as due to asbestos exposure in your country.

2. If possible, establish if there are standard medical and related treatment costs for the different types of ARD identified above. These would cover primary, secondary and tertiary health care costs and include palliative care. Can these costs be totalled for the last full year for which there are records and for the last 10- and/or 20-year periods? Are such costs recovered, where possible, from employers or paid by the government or insurers?

3. If possible, collect data about the costs of social insurance or similar schemes for the patients and carers who contract the categories of disease listed in point 1 (total costs for all disease cases identified in point 1 and typical average costs per case). These would include data for the latest year and for any 10- and 20-year periods available.

4. If possible, collect data from employers or employers' associations about their direct and indirect costs incurred by ARDs in their employees.

5. If possible, collect data from your country's civil and criminal courts about ARDs compensation cases and fines levied against enterprises where employees contracted and died from ARDs. Check if such payments include full cost recovery from employers for social insurance and medical treatments and if all or part of any court awards to patients or their carers are then taken into account in any reduced social insurance payments.

ANNEX 8

WRITTEN COMMENTS BY PARTICIPANTS FROM THE RUSSIAN FEDERATION PRESENTED BEFORE THE CONCLUDING SESSION OF THE MEETING

Российская Федерация отметила, что при при составлении документов ВОЗ следует тщательно следовать текстам документов, определяющих политику ВОЗ (в частности, резолюций Всемирной ассамблеи здравоохранения), избегать вольного толкования заключений Международного агентства по исследованиям рака (Монографий и отчетов совещаний по тем или иным вопросам). Так же, при рассмотрении проблемы асбеста обобщённый подход к оценке последствий воздействия различных форм асбеста и использования асбестсодержащих материалов приводит к искажению действительного положения дел и принятию необоснованных решений. При оценке рисков асбестобусловленных заболеваний необходимо учитывать исторически сложившиеся особенности использования асбеста в различных странах (тип асбеста, основные направления его использования, виды материалов, в которых использовался асбест).

The Russian Federation noted that the preparation of the WHO document should carefully follow the texts of the documents that determine WHO policy (in particular, the resolutions of the World Health Assembly), and avoid free interpretation of the materials of the International Agency for Research on Cancer (monographs and reports of meetings on various issues).

In addition, when considering the problem of asbestos, a generalized approach to the assessment of the results of exposure to different forms of asbestos and asbestos-containing materials leads to a distortion of the true situation and unbalanced decisions. Risk assessment of asbestos-related diseases must take into account the historical features of asbestos use in various countries (type of asbestos, the main directions of its use, predominant types of asbestos-containing material).

We also recognize as incorrect all attempts to predict the incidence of diseases related to exposure to asbestos in countries where amphiboles have never been used and where up to 85% of chrysotile asbestos was used for the production of non-friable asbestos cement and friction materials, by using the results of studies in countries where amphiboles have been widely used in the most dangerous loose, friable insulating materials.

Annex 9

PROGRAMME

Monday, 5 November 2012

09:00–09:40	Opening and introduction

Review of evidence and WHO's recommendations for elimination of asbestos-related diseases

09:40–10:00	IARC recommendations on national cancer registry in relation to asbestos-related cancers. *Kurt Straif*
10:00–10:20	WHO recommendations on the national programme for elimination of asbestos-related diseases. *Ivan Ivanov*
10:20–10:40	WHO recommendations on the national asbestos profile. *Rokho Kim*

Training workshop 1. How to estimate the burden of asbestos-related diseases in terms of potential years of life lost (PYLL)

11:10-11:30	Potential years of life lost in European countries. *Eun-Kee Park*
11:30-12:30	Hands-on training on calculating PYLL: step-by-step guidance. *Facilitated by Eun-Kee Park*

Training workshop 2. How to estimate burden of asbestos-related diseases in terms of disability-adjusted life years (DALYs)

13:30–13:50	Disability-adjusted life years lost in European countries. *Tim Driscoll*
13:50–14:50	Hands-on training on calculating DALYs: step-by-step guidance. *Facilitated by Tim Driscoll*

Training workshop 3. How to estimate economic costs of asbestos-related diseases

15:20–15:40	Economic costs of health service treatments for asbestos-related diseases in European countries. *Andrew Watterson and Frank George*
15:40–16:40	Hands-on training on calculating economic costs: step-by-step guidance. *Facilitated by Andrew Watterson and Frank George*

Training workshop 4. Good practices in preparing national asbestos profiles

16:40–18:00	Examples of good national asbestos profile for effective national programmes for elimination of asbestos-related diseases *Facilitated by Jorma Rantanen*

Tuesday, 6 November 2012

Country reports on preparation of national asbestos profiles

09:00–10:30	Panel 1. Challenges and opportunities of preparing national asbestos profile in the countries where use of all forms of asbestos is phased out
11:00–12:15	Panel 2. Challenges and opportunities of preparing national asbestos profile in newly independent states. *Participants from newly independent states*

12:15–13:30	Panel 3. Challenges and opportunities of preparing national asbestos profile in south eastern European countries. *Participants from south-eastern European countries*

Conclusion and recommendations

14:30–15:30	Plenary discussion. Roadmap of international collaboration to eliminate asbestos-related disease. *Chaired by Elizabet Paunovic*
15:30–16:00	Conclusion and recommendations

Annex 10

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