LESSONS LEARNED
from the phasing out of asbestos in BULGARIA

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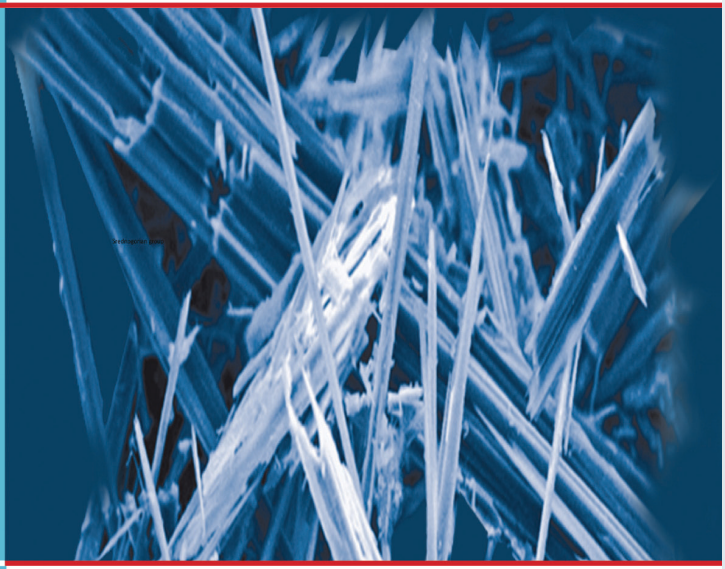

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Lessons learned from the phasing out of asbestos in Bulgaria

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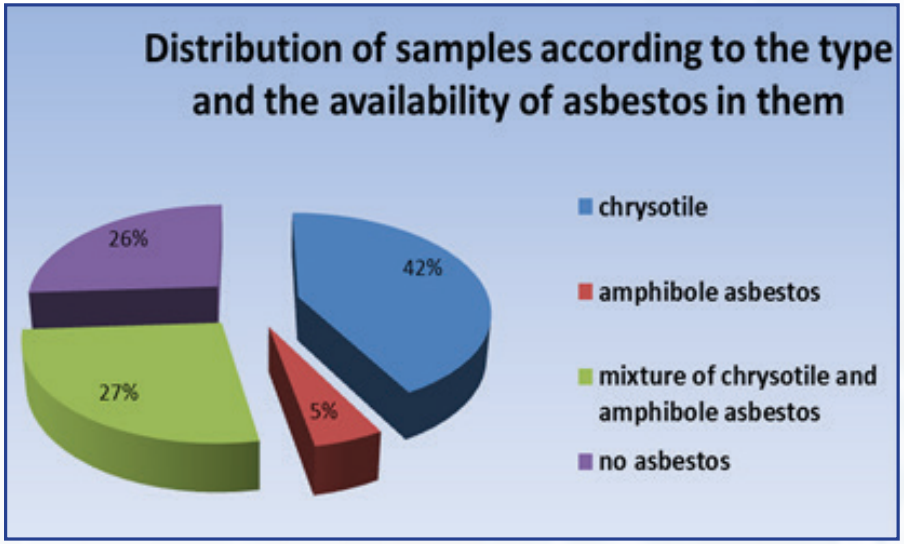
History of asbestos production and use in Bulgaria

Bulgaria is a country in South-Eastern Europe that totally banned the production, import and use of asbestos in 2005, but it was producing and using asbestos products in the last 3–4 decades of the last century. Compared with industrialized countries, the use of asbestos started later in Bulgaria (in around 1960) with exploitation of natural country deposits of anthophyllite – tremolite asbestos, which was input in insulation putties of pipelines, turbines, furnaces in energetics and metallurgy. Further asbestos was imported, mainly chrysotile for production of asbestos-cement products (pipes, plates, panels), asbestos-perlite insulation shells, blocks, segments, asbestos textile articles (ropes, cords, fillings, tissues), squirted insulations of industrial equipment, friction products, pressed materials for electronics, diaphragms for electrolysis in chemical industry, etc. The imported crocidolite was used as a component in some types of asbestos-cement pipes.

The amounts of asbestos consumed vary between the different sources (National Asbestos Profile, 2015), but all sources indicate that it was more intensive in the period 1970-1993, and almost ceased several years before the total ban in 2005. The calculated amounts of asbestos used in kg/capita/year by Kameda et al (2014) give possibility to compare countries consumption, for Bulgaria estimated to 1.31 kg/capita/year for the period 1971-2000.

Following the asbestos consumption by the type of asbestos, all data indicate that the consumption of chrysotile was the greatest, followed by anthophyllite – tremolite asbestos and crocidolite (National Asbestos Profile, 2015). These data were confirmed by the testing various products, insulation materials and waste for the availability and the type of asbestos after 2005, confirming in 74% of the suspected samples the presence of asbestos, chrysotile in 42%, mixture of chrysotile and amphibole asbestos in 27 % and amphibole asbestos in 5% of the samples (Figure 1).

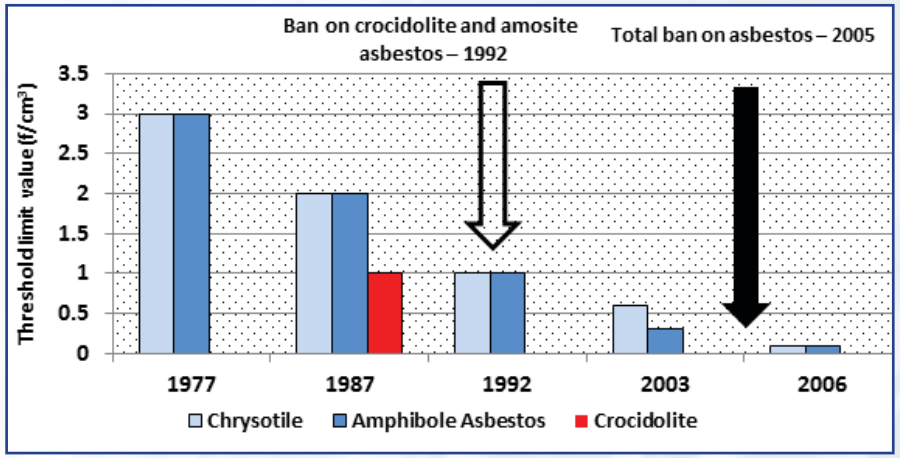
Figure 1. *Distribution of samples according to availability and type of asbestos*



Implementation of preventive actions

Preventive actions for asbestos-related diseases (ARDs) were initiated in 1973, about one decade after asbestos started to be used, with the establishment of health surveillance for asbestos-exposed workers. The second step was made in 1977, with a legislative requirement for a limit value for the average shift concentration of respirable asbestos fibres, initially set to 3f/cm^3 and further reduced to 1f/cm^3 in 1992 (Figure 2). In 1992, a ban on the import and use of the most hazardous types of asbestos (crocidolite and amosite) and products containing them, as well as the use of asbestos-containing materials and products in the building of hospitals, children's institutions, schools, houses and sport premises was introduced. Measurement of fibre concentrations in work environments and in asbestos-containing products was required and capacity was built to ensure this.

Figure 2. *Threshold limit values for asbestos in Bulgaria, 1977–2006*



In 2001, National programme for the gradual reduction and phasing out of asbestos use (2001–2008) was introduced, including the following actions:

- harmonization of Bulgarian legislation on asbestos with European Union (EU) legislation;
- improving the protection of workers from hazards related to asbestos; and
- prevention and reduction of environmental pollution by asbestos.

Bulgaria banned the import, production and use of all types of asbestos fibres from January 1, 2005 and harmonized Bulgarian legislation on asbestos with EU legislation by introducing amendments in the Health Act, Health and Safety at Work Law, Environmental Protection Act and Waste Management Act as well as setting up processes to ensure compliance with this legislation. Further Directive 2009/148/EC was implemented.

Occupational exposure to asbestos

Precise numbers of the workers at risk of asbestos exposure in the past are unavailable, but an overall number of 27000 is estimated for the 1973–2012 period, and 1188 individuals were exposed to asbestos in 2012 according employer statements (National Asbestos Profile, 2015).

During the period 1977–1989 the data of workers exposure indicate that the average shift asbestos fibre concentrations exceeded the limits for dust-releasing operations in nearly all major asbestos processors in Bulgaria, in some workplaces by 10 –15 times (Tcherneva and Lukanova, 2001; National Asbestos Profile, 2015); however, after 1993 most workplaces studied met the requirements. By that time the raw asbestos mining and production was stopped; and up to 2000 asbestos cement and asbestos textile production, and the use of asbestos-containing products had greatly diminished in Bulgaria.

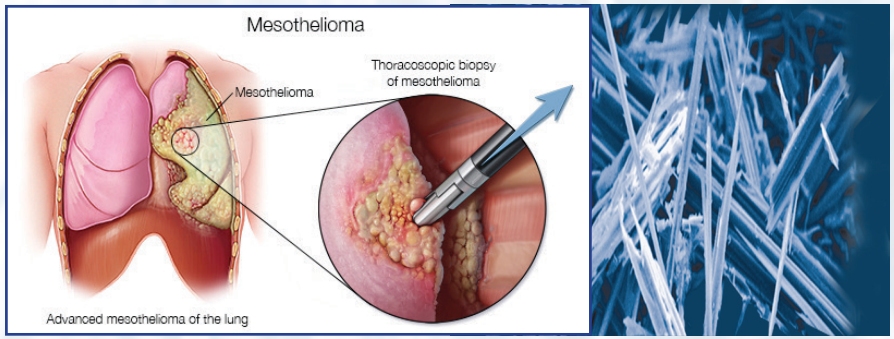
Table 1. *Average shift concentration of asbestos in the major asbestos industries in Bulgaria in the period 1977–1989 and 1994–2000*

Industry / Occupation	Average shift concentration (fibres/cm³) - min and max for the period 1977-1989	Average shift concentration (fibres/cm³) - min and max for the period 1994-2000
Limit value for average shift concentration (fibres/cm³)	***3 /2 * fibres/cm³***	***1 fibre/cm³***
Primary asbestos material processing	5–30	0.45–0.5
Asbestos-cement industry	2–24	<0.1–0.9
Asbestos-textile production	1–8	0.2–5.0
Asbestos brake production	2	0.2–0.6
Isolations for different in-dustries	1–6	0.1–1.4
Destroying asbestos insulations	4–12	0.3–6.5

**The limit value for average shift concentration was set to 3 fibres/cm³ in 1977 and to 2 fibres/cm³ in 1987*

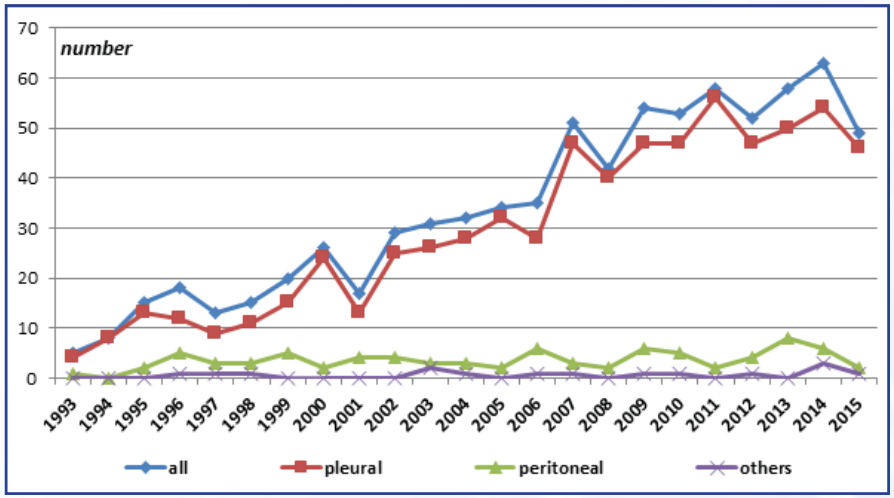
Asbestos-related diseases (ARDs)

Cancer and occupational cancer mortality is increasing in Europe and worldwide, but the burden of occupational factors is often perceived much lower than it really is (Takala et al, 2014). Epidemiological studies indicate that occupational exposures cause 5.3–8.4% of all cancers and among men 17–29% of all lung cancer deaths (Rushton et al, 2012). The 10 most important occupational carcinogens count for around 85% of all occupational deaths, and asbestos is number one occupational killer.



According to global estimates, pointed by WHO more than 107 000 people die annually from asbestos related cancers (WHO, 2016). All forms of asbestos are carcinogenic to humans and account for the largest proportion of occupational cancer in Europe (Espina et al, 2015). There is sufficient evidence of a carcinogenic effect of asbestos exposure against mesothelioma and cancers of the lung, larynx, and ovary, and limited evidence for an association with colorectal cancer, pharyngeal cancer and stomach cancer. Malignant mesothelioma is a rare but fatal form of cancer, known to be almost exclusively attributable to past asbestos exposure (Delgermaa et al, 2011; WHO, 2014). The latency period for mesothelioma after initial exposure to asbestos is typically longer than 30 years and the median survival time after the diagnosis is 9–12 months (Delgermaa et al, 2011). Asbestos is accounting for 55–85% of occupational lung cancers.

Figure 3. *Number of registered cases of mesothelioma, total and by location for the period 1993 – 2015*

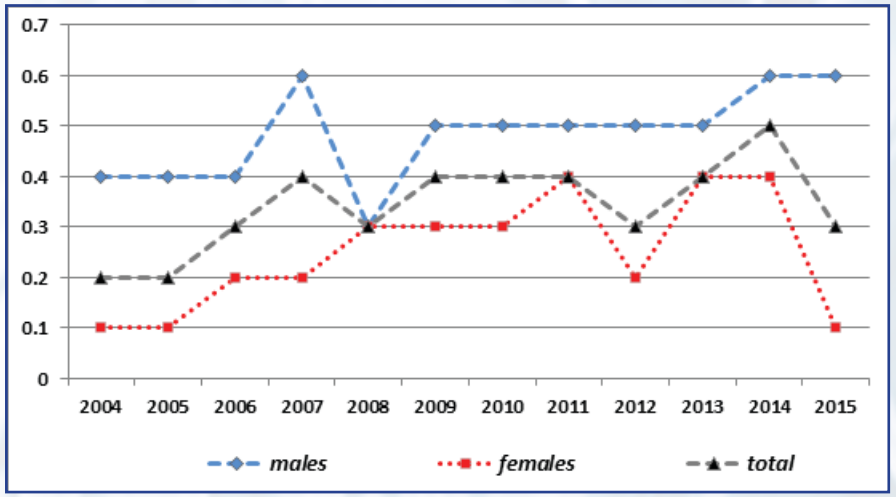


Source: Data provided by the National Cancer Register

The new cases of asbestosis, pleural plaques and thickening varied from 136 to 201 for the period 1980–2000 (Petrova et al, 1994, 1996), while nowadays the newly registered cases of asbestosis are 1-4 annually. There are no data on incidence of lung cancer among workers exposed to asbestos in Bulgaria, but according the National Cancer Register 3801 new cases of lung cancer of all reasons were reported in 2015, 2999 of males and 802 of females (Valerianova et al, 2017). In 2015 lung cancer takes first position in cancer mortality in males in Bulgaria with 26.3% and third position in females with 9.8% after breast cancer (17.6%) and colon cancer (9.9%).

The registered mesothelioma cases for period 1993–2015 in Bulgaria account for 836 cases, all morphologically and histologically confirmed, but not studied for occupational etiology. More mesothelioma cases were registered in males (502) in comparison to females (334), with male to female ratio 1.5:1. The data show increase in mesothelioma cases in both genders in the period 1993–2015, and following the cases by location pleural mesotheliomas are dominating (Figure 3). The age-adjusted (world standard per 100000) incidence rates of mesothelioma by gender and year of diagnosis (2004–2015) in Bulgaria is presented on Figure 4, with higher incidence in male population, and with trend of increase.

Figure 4. *Age-adjusted incidence rate of mesothelioma (world standard per 100000) by gender in Bulgaria for the period 2004-2015*



Source: Data provided by the National Cancer Register

A comparison of the mesothelioma incidence rate among EU countries for the period 2003–2007 shows that the rate in Bulgaria remains lower than in industrialized countries (Forman et al, 2014) and recently is discussed in relation to comparatively late start of asbestos use in the country (about 1960), lower consumption and preventive actions in place a decade after begin of production and use of asbestos and asbestos products (Vangelova and Dimitrova, 2017). Data on asbestos consumption, extracted from Kameda et al. (12) and incidence rates of mesothelioma in Bulgaria and several EU countries (2003–2007), extracted from Country reports in IARC Scientific Publication No. 164 (13) are presented on Table 2.

Table 2. *Status of asbestos consumption, extracted from Kameda et al. (12) and incidence rates of mesothelioma in Bulgaria and several EU countries (2003–2007), extracted from Country reports in IARC Scientific Publication No. 164 (13)*

Country	Asbestos consumption (kg / capita / year)		Mesothelioma incidence rate (per 100000), 2003–2007			
			Male		Female	
	1920 - 1970	***1971 - 2000***	*Crude rate*	***Age stand-ardized incidence***	*Crude rate*	***Age stand-ardized incidence***
Austria *	1.17	2.09	0.9-1.6	0.6-1.1	0.4-0.7	0.2-0.3
Belgium	3.08	3.02	4.0	2.2	0.8	0.4
Bulgaria	0.14	1.31	0.7	0.4	0.3	0.2
Croatia	0.78	3.57	2.4	1.5	0.5	0.3
Cyprus	6.41	2.36	1.6	1.1	0.6	0.3
Czech Republic	0.82	1.85	0.8	0.5	0.4	0.2
Denmark	2.16	1.97	3.1	1.8	0.6	0.3
Estonia	0.07	0.06	0.4	0.3	0.2	0.1
Finland	1.49	0.86	2.7	1.5	0.7	0.3
France *	1.08	1.44	1.1-4.4	0.6-2.5	0.2-1.3	0.1-0.5
Germany*	1.17	2.18	1.3-12.4	0.6-6.0	0.5-2.0	0.2-0.8
Italy *	0.83	1.61	0.9-15.1	0.5-5.6	0.2-4.0	0.1-1.3
Ireland	-	1.57	1.2	1.0	0.3	0.2
Latvia	0.26	0.66	0.7	0.5	0.6	0.3
Lithuania	0.05	0.14	0.4	0.3	0.2	0.1
Netherlands	0.84	0.87	3.0-5.0	1.8-3.0	0.6-0.7	0.3-0.4
Poland *	0.39	1.79	0.4-1.0	0.3-0.6	0.2-0.8	0.1-0.4
Slovakia	1.52	3.01	0.6	0.4	0.3	0.2
Slovenia	1.70	6.78	2.2	1.4	0.8	0.4
Spain *	0.51	1.35	0.3-2.3	0.2-1.2	0.0-1.1	0.0-0.6
Sweden	1.20	0.51	2.2	1.2	0.5	0.2
United Kingdom *	1.92	1.03	4.9-8.8	2.7-4.2	0.6-1.6	0.3-0.7

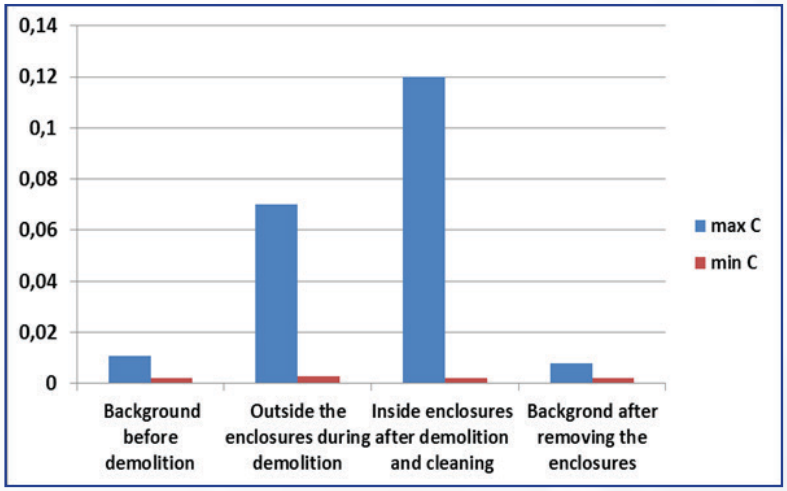
* *Mesothelioma incidence rate is presented as a range for countries presented by regions in IARC Scientific Publication (13)*

Prevention of ARDs after the ban of production and use of asbestos

In 2006, measures to protect workers from risks related to asbestos exposure at work were defined as: the permit system for removing asbestos-containing thermal insulation and demolishing buildings and other structures was strengthened; reduction of the exposure of workers below the threshold limit values (0.1 asbestos fibres/ cm^3) and controlling levels of contamination after asbestos-handling; implementing risk assessment; health surveillance; training workers on safe work and informing them about health risks; and providing suitable protective equipment.

NCPHA is developing and implementing methodology for control of asbestos exposure, carrying out training of occupational health professionals (OHPs), research on asbestos exposure during demolition of asbestos containing structures and materials. The results of the work place measurements after the ban of asbestos use show that during the activities there is transmission of asbestos dust outside the enclosures in 57% of the studied sites (Dimitrova S, 2017). After the cleaning the enclosures are removed after reaching compliance with the clearing indicator (0,01f/cm^3). The max and min detected asbestos concentrations in the monitored sites outside the enclosure during demolition and inside enclosures after demolition and cleaning are shown on figure 5.

Figure 5. *The max and min detected asbestos concentrations during demolition of asbestos containing structures (Dimitrova S, 2017).*



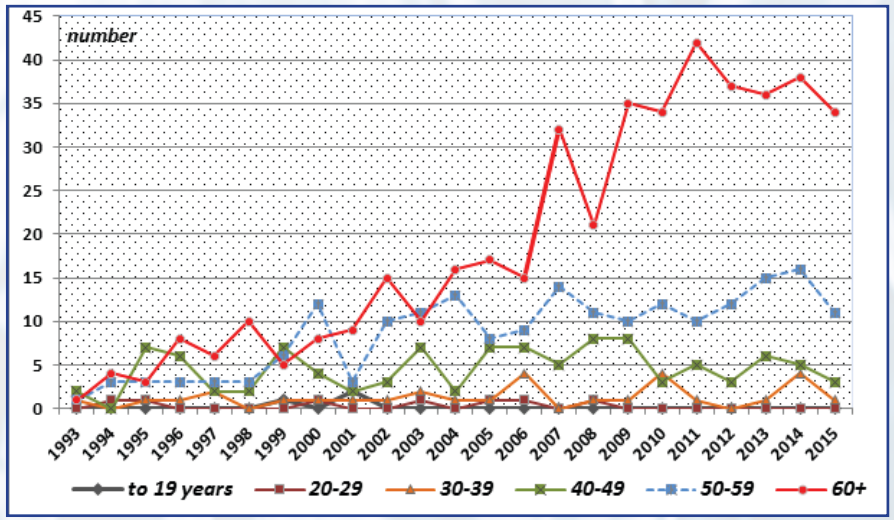
Health surveillance and compensations

The majority of workers currently at risk of exposure are working in demolition, reconstruction or maintenance industries involving work on asbestos containing buildings and installations and asbestos waste disposal. Health surveillance is required for asbestos-exposed workers in Bulgaria, but detection and reporting of occupational diseases is unsatisfactory, including ARDs. The following diseases caused by asbestos are included in the List of occupational diseases in Bulgaria:

- Asbestosis (bronco-pulmonary fibrosis), with or without complications: pulmonary emphysema, chronic bronchitis, respiratory failure, bronchiectasis, pulmonary hypertension, cardiac insufficiency, etc.;
- Pleural plaques (fibrous, hyaline, calcium), with or without complications: pulmonary emphysema, respiratory failure, pulmonary hypertension, cardiac insufficiency, etc.;

- Pleurisy;
- Lung cancer;
- Pleurisy (a complication of lung cancer)
- Malignant mesothelioma (pleura, peritoneum, pericardium);
- Cancer of the larynx;
- Ovarian Cancer;
- Cancer of the gastrointestinal tract;
- Skin changes (dermatitis, warts).

Figure 6. *Number of registered cases of mesothelioma by age for the period 1993 -2015*



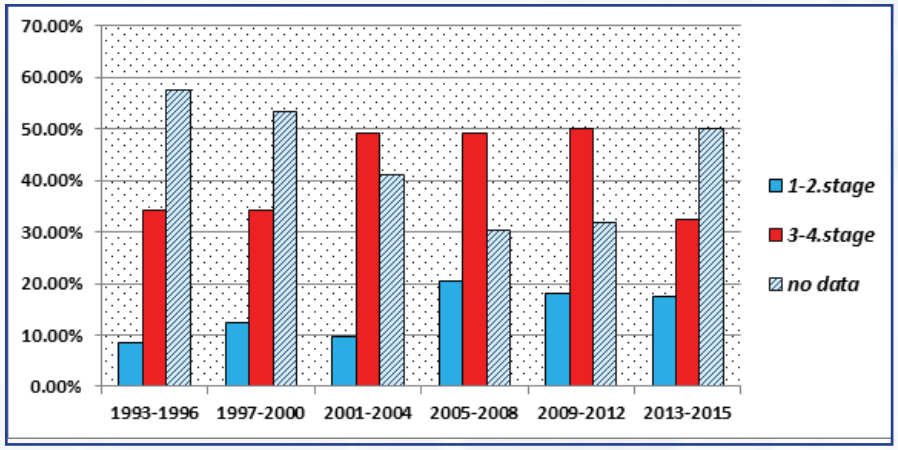
Source: Data provided by the National Cancer Register

Further there are no special requirements for health screening of the exposed after retirement or upon changing workplace. Delgermaa et al. (2014) reported that all forms of mesothelioma predominantly affect elderly individuals, and increase in mesothelioma cases in Bulgaria mainly involves individuals over 60 years old (Figure 6). Data from the National Cancer Register show that, more recently, the deal of unstaged cases

of mesothelioma has been decreasing up to 2008, remained nearly unchanged in the period 2009-2012 and increased in 2013-2015, which definitively needs attention.

Concerning the staged mesothelioma more cases are diagnosed at both early and late disease stages (Figure 7), indicating a need to establish a National Register of asbestos-exposed workers, who have to be monitored after retirement or upon changing workplace.

Figure 7. *Percentage of registered mesothelioma cases by stage, 1993–2015*

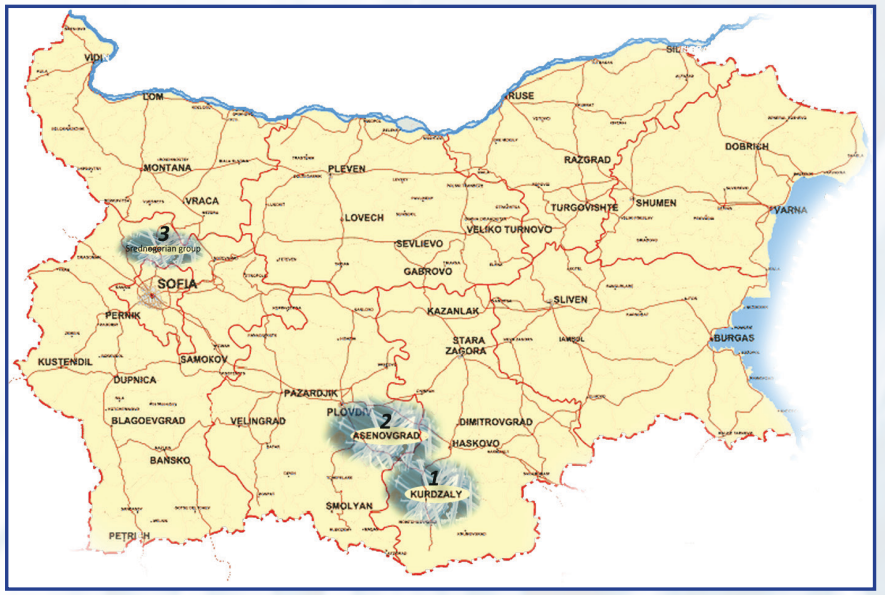


Source: Data provided by the National Cancer Register

Recent developments

National Asbestos Profile of Bulgaria (2015) was developed, following the structure proposed by WHO as an instrument, providing information and defining the baseline situation with regards to the elimination of asbestos related diseases, populations at risk from current and past exposures, the system for inspection and enforcement of exposure limits of asbestos and following the progress towards the main objective, elimination of ARDs.

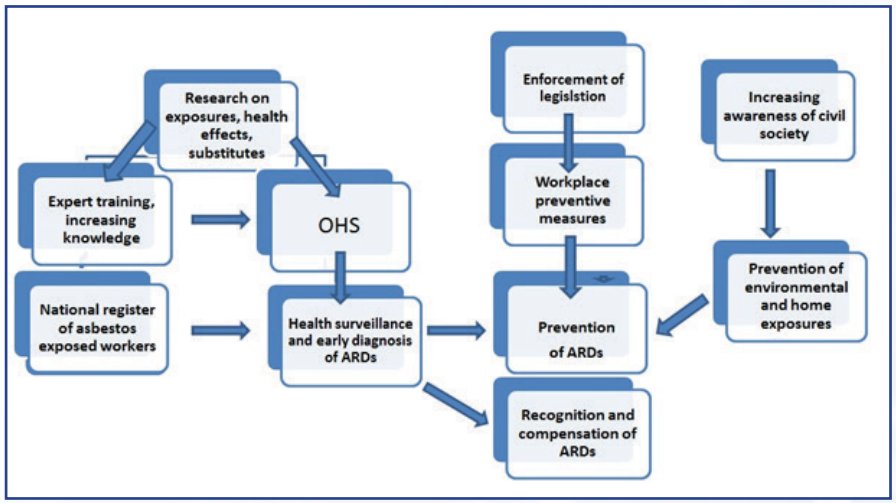
Map of Bulgaria with the regions where asbestos mining was located



Information from regional control authorities showed that permit regime for demolition/ removal of asbestos materials and the legislative requirements concerning asbestos were followed, but some inconsistencies were found and measures for improving prevention of asbestos related risks are discussed, as strengthening the control on asbestos exposures, establishment of register of asbestos exposed workers on national level, organizing health surveillance of asbestos exposed workers after retirement, improving the capacity of health and safety at work professionals, especially concerning low and incidental asbestos exposures.

Increasing awareness of civil society on asbestos related health risks and possible asbestos exposures is considered important in prevention of eventual environmental and home exposures with priority in the regions where asbestos industries were located.

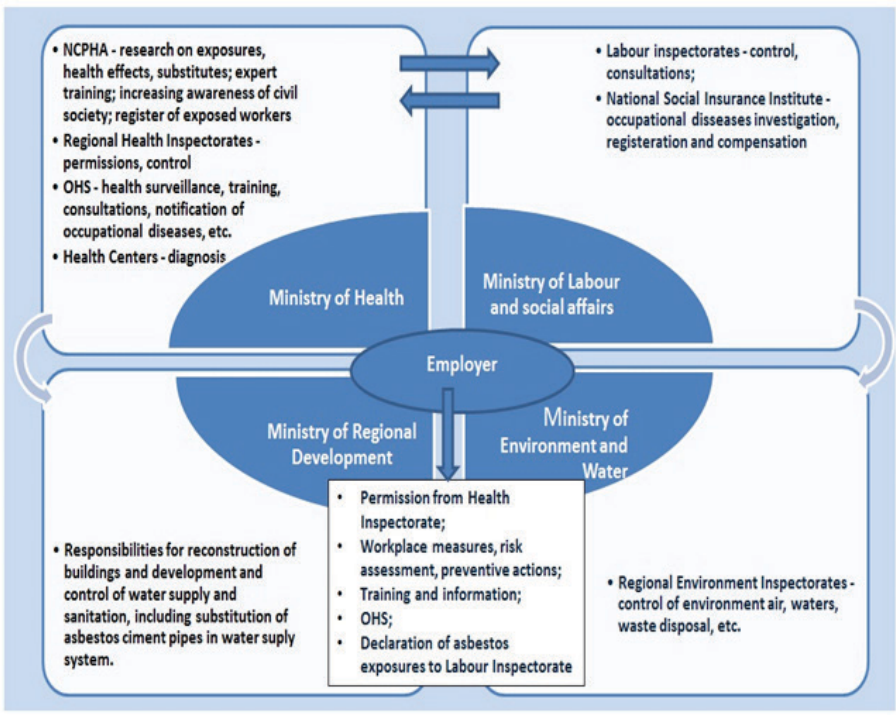
Figure 8. *Prevention, recognition and compensation of ARDs*



Lessons learnt

1. The mining, production and use of asbestos and asbestos containing materials was stopped; for years there is permit regime for work with asbestos-containing materials, including demolition or removal of asbestos-containing materials; strict control of asbestos concentrations and strong preventive actions have been undertaken to minimize health risks, but the problems with phasing out of asbestos and asbestos-related morbidity most probably will remain for decades.
2. The most effective prevention of ARDs is eliminating or limiting asbestos exposure via an immediate and total ban on the use of all types of asbestos fibres and strict control of exposure during the removal/demolition of asbestos-containing buildings and structures limiting both the number of exposed workers and number and magnitude of the exposures per worker.
3. Health surveillance of exposed workers and long-term follow-up at the national level is needed for the early detection of ARDs. Retired workers should be included because of the long latency period for development of malignant ARDs.
4. Establishment of National Register of asbestos exposed workers is a step towards inclusion of all exposed workers in health surveillance.
5. Although the total ban on asbestos, it remains a problem for occupational health.

Figure 9. *Responsibilities and activities in management of asbestos and prevention of ARDs*



Summary

Table 3. Chronology of asbestos use and preventive actions in Bulgaria

Time period	Action
1960-2000	Mining of anthophyllite – tremolite asbestos
1960-2004	Import of asbestos, mainly chrysotile asbestos, production and use of asbestos containing products.
1973	Health surveillance for asbestos-exposed workers was introduced.
1977	Legislative requirement for a limit value for average shift concentration of respirable asbestos fibers of 3 f/cm^3.
1987	Amendment of legislation reducing the limit value for average shift concentration of respirable asbestos fibers to 2 f/cm^3.
1992	• Ban on the import and use of the most hazardous types of asbestos – crocidolite and amosite, as well as of the products containing them; • The limit value for average shift concentration of respirable asbestos fibers of 1 f/cm^3; • Ban on the use of asbestos-containing materials and products in buildings of sanatoriums, children's and school institutions, housing and sport premises; • Permit regime on import, manufacture and use of asbestos; etc.
2001	Workshop on Asbestos Health Risks and Prevention
2001-2008	National program for gradual reduction and phasing out the use of asbestos (2001 - 2008) was introduced with the following actions: • Harmonization the Bulgarian legislation concerning asbestos with the EU legislation; • Strengthening the protection of workers from hazards related to asbestos; • Prevention and reduction of environmental pollution by asbestos.
2005	Ban of import, production and use of all types of asbestos
2006	Conference on phasing out asbestos and prevention of ARDs
2015	National Asbestos Profile of Bulgaria
2018-2020	National Program Health and Safety at Work: Actions to strengthen ARDs prevention were introduced as follows: • Strengthened control of work place asbestos exposures; • Establishment of National Register of asbestos exposed workers; • Activities to increase awareness of civil society on possible asbestos exposures and health risks.

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