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Criteria for the Diagnosis of Asbestosis and Considerations in the Attribution of Lung Cancer and Mesothelioma to Asbestos Exposure

Prepared by the Medical Advisory Panel* to the Asbestos International Association

Section 1 — Asbestosis

Definition

Asbestosis is a diffuse fibrosis of the parenchyma of the lung caused by exposure to respirable airborne asbestos fibres. The fibrosis is irreversible and in some persons progresses even after exposure has ceased.

Criteria for Diagnosis

1.1. History. There should be evidence of substantial occupational exposure (or substantial para-occupational exposure) to asbestos fibres.

1.2. Clinical Signs and Symptoms. Persistent basal inspiratory crepitations characteristic of interstitial pulmonary fibrosis may be heard but are not invariably present. Breathlessness and finger clubbing occur but are not specific signs in themselves.

1.2.1. Crepitations (Crackles). These are fine basal inspiratory crepitations, usually bilateral which occur late in inspiration and persist after coughing or hyperpnoea. They are characteristically heard with each inspiration and on each occasion present very much the same pattern of sound. They are not essential to the diagnosis any more than they are pathognomonic of the disease. However, when not accounted for by another cause and when heard on at least two occasions a few months apart, given a history of exposure and radiological evidence of dust disease, they do provide valuable confirmation of the diagnosis. In the presence of

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equivocal radiological change, basal crepitations as here defined are a strong indication for the diagnosis of asbestosis.

1.2.2. Abnormal Breathlessness. This, occurring initially on exertion, is a symptom of asbestosis. There are, of course, many other causes of breathlessness and these must be excluded. In those under routine medical surveillance a provisional diagnosis would probably have been made before disabling dyspnoea occurs.

1.2.3. Clubbing. This is a sign seen in many lung and other diseases including asbestosis where it may be of late occurrence. It develops slowly but the rapid development of finger clubbing, particularly if painful, in a person with asbestosis suggests lung cancer.

1.2.4. Dry Cough and Ill-defined Chest Pain or Discomfort. These can occur in asbestosis, but infrequently, and then only late in the progression of the disease. They are not specific and of little diagnostic significance.

1.3. Radiological Aspects. Radiographic evidence of predominantly basal diffuse interstitial fibrosis is the characteristic change seen.

1.3.1. So that films are comparable they must be of good technical quality and of full size (approximately 350 mm × 430 mm and to include both costo-phrenic angles). Ideally, inspiration should be such as to have brought the diaphragm below the fifth rib anteriorly and the tenth rib posteriorly.

1.3.2. The recording of pulmonary changes on the radiograph follows the system used in the ILO Classification[1]. This system describes irregular or linear opacities as follows:

i) Small (s) — width up to about 1.5 mm.
ii) Medium (t) — width over 1.5 mm and under 3 mm.
iii) Large (u) — width over 3 mm and up to 10 mm.

The changes may be of such profusion as to obscure the normally clear margins of the bronchovascular structures. Small (p), medium (q), or rarely, large (r) rounded opacities may also be present. In advanced disease the sharpness of the cardiac and diaphragmatic borders are sometimes obscured.

1.3.3. Pleural changes are commonly present and are often the first radiological indicator of exposure to asbestos. Diffuse or localised pleural thickening or circumscribed pleural plaques, with or without calcification, may occur and need not be associated with parenchymal fibrosis. Transient pleural effusions have been reported. The pleural abnormalities can be sufficiently extensive to obscure the lung fields and may, in rare cases, lead to impairment of lung function.

1.3.4. In individual cases a narrative report by the reader of the radiograph as well as an interpretation of the relationship between the observed appearances and the occupational history is helpful.

1.3.5. Where possible comparison of the most recent film with earlier films is highly desirable.

1 The ILO International Classification of Radiographs of Pneumoconiosis (1980) is designed to ensure international comparisons of radiological data. This classification is purely descriptive and was specifically designed for epidemiological purposes and not for evaluating an individual. Sets of films are obtainable from ILO Publications, International Labour Office, CH-1211, Geneva 22, Switzerland

1.3.6. A dose response relationship has been demonstrated between the extent of asbestos exposure and the radiological parenchymal changes. Parenchymal change correlates in general with an adverse effect on the long-term prognosis of an individual. However, in the absence of mesothelioma, there is no adverse prognostic significance associated with pleural changes unless they are unusually severe.

1.3.7. Since pleural changes may occur in the absence of parenchymal fibrosis, the use of the term "pleural asbestosis" is undesirable.

1.3.8. Other causes of radiological changes must be carefully excluded prior to making the diagnosis of asbestosis. This is important in the early stages of the disease when the radiological changes are slight.

1.4. Other Investigations. 1.4.1. Asbestos (Ferruginous) Bodies. When a productive cough is present asbestos fibres or ferruginous bodies in the sputum are evidence of exposure to asbestos but are not diagnostic of asbestosis.

1.4.2. Biopsy is very seldom justified as a diagnostic procedure for asbestosis. The effects of exposure should already have been recognised on the grounds outlined in the foregoing criteria. Biopsy is justified if it is thought that an asbestos-exposed patient may be suffering from some other potentially treatable lung disease. Any surgeon about to conduct a throacic operation on a person known to have been exposed to asbestos should be asked to obtain a specimen of lung tissue for histological examination.

1.5. Lung Function Abnormalities. The characteristic abnormalities are those of restrictive lung disease.

1.5.1. It is recommended that the FVC, FEV_1 and FEV_1/FVC ratio be recorded routinely in standard fashion. A comparison of periodic lung function testing over a number of years is of much greater value than a single observation compared to the standard "normal" values. In assessing the results, allowance must be made for certain ethnic differences and the effects of smoking habits.

1.5.2. While a restrictive pattern is consistent with the diagnosis of asbestosis, it is not specific to this disease. Asbestosis may develop with little or no detectable restrictive defect in the early stages. A predominantly obstructive picture is uncommon in the absence of a smoking history.

1.5.3. More sophisticated measurements in the assessment of restrictive lung disease (e.g. the measurement of transfer factor and lung compliance) are diagnostically helpful, but are not essential to the routine medical surveillance of a group of asbestos-exposed workers.

1.6. Differential Diagnosis. When there are clinical, radiological, or lung function abnormalities in asbestos workers, the exclusion of simulative disease is necessary for the correct management of the individual. This is increasingly important as, with improving occupational hygiene standards, asbestosis becomes less common.

1.7. Comment. The art of diagnosis, always a matter of weighing probabilities and looking at the total evidence, demands expert judgement based on the interpretation of the above criteria. Each of them is on a scale of severity and it is possible to find high values in some, low values in others, or any permutation or

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combination of criteria in the individual cases. According to the circumstances the elements of the decision and action will vary.

Section 2 — **Mesothelioma**

2.1. Diffuse malignant mesothelioma of the pleura or peritoneum is a rare primary tumour in the general population. When attributable to asbestos the latent period between initial asbestos exposure and onset of the disease is usually 20 to 40 years or longer.

2.2. It must be emphasized that the definitive diagnosis of mesothelioma is not easy. In asbestos workers it may be associated with asbestosis though the level of fibrosis can be minimal. In some cases there is no evidence of fibrosis even at necropsy. Mesothelioma may occur after relatively brief but intense asbestos exposure. While pleural abnormalities are common in asbestos workers, there is no conclusive evidence that of themselves they predispose to mesothelioma. Early suspicion of the presence of pleural mesothelioma arises when pleural effusion or chest pain occurs in an asbestos worker. The tumour may completely encase the lung. Peritoneal mesothelioma may occupy a large amount of the abdominal cavity and produce ascites with or without abdominal pain. Metastases, although rare, can affect other organs, but local spread is the usual mode of progression. Hitherto no treatment has been successful, the outcome being invariably fatal.

2.3. Ideally, the diagnosis will be based on careful necropsy in which particular attention is given to excluding the possibility of a primary cancer at some distant site. Furthermore, the tumour tissue should be referred to one of the established mesothelioma reference panels so that histopathologists especially skilled in the diagnosis of this tumour may give their opinion. Such panels now exist in many countries.

2.4. While cases of mesothelioma may arise in the general population with no obvious cause, the majority of mesothelioma cases are related to asbestos exposure. The proportion of cases attributable to asbestos exposure varies; it is greatest in the more highly industrialised communities, especially those with a large shipbuilding or ship repairing industry. In industrial populations generally, most mesothelioma cases may be ascribed to asbestos although even in these communities no relationship with asbestos can be established in a proportion varying from 10% to over 30%. In other groups which have been adequately studied, the proportion of mesothelioma cases associated with asbestos exposure is lower but variable. Not all mesotheliomata are due to asbestos; e.g. endemic mesothelioma in some areas of Turkey is believed to be due to a fibrous form of zeolite.

2.5. Smoking habit plays no part in the genesis of mesothelioma as far as can be determined at the present time.

2.6. This tumour is relatively uncommon even among those who have had substantial asbestos exposure. Many believe that the risk of developing mesothelioma is greatest with crocidolite, less with amosite, and apparently less with chrysotile, while anthophyllite appears never to have caused mesothelioma in humans. This opinion, however, does not enjoy unanimous support and some authorities hold that there is no justification for differentiating between the various kinds of asbestos and their biological effects.

2.7. There is epidemiological and pathological evidence of an exposure-response relationship between inhaled asbestos and tumour formation. Recent work does not support the often stated idea that any slight, casual or brief asbestos exposure may lead to mesothelioma.

2.8. The long latency period between asbestos exposure and the development of the tumour makes elucidation of a dose-response relationship difficult. Thus, the effects of good dust control on the incidence of mesothelioma will only be determined in the future.

Section 3 — **Lung Cancer**

3.1. Cancer of the lung is the most common form of cancer in males in industrialised countries, and the primary cause is cigarette smoking. In asbestos workers who smoke, it is many times more common than in members of the general population who are not exposed to asbestos and who do not smoke.

3.2. Epidemiological studies have shown that the risk of bronchogenic cancer is greater at higher levels of asbestos exposure. Non-smoking asbestos workers under the conditions of past exposure appear to be at greater risk than non-smokers in the general population. Even so, these non-smoking asbestos workers are at less risk of bronchogenic cancer than cigarette smokers who have not been exposed to asbestos in the general population. There is also epidemiological evidence that the lower levels of past exposure to asbestos do not pose a detectable excess risk of bronchogenic cancer.

3.3. There are no specific pathological features by which an individual case of lung cancer can be attributed solely to asbestos exposure.

3.4. An adeno-carcinoma situated peripherally and particularly in a lower zone, is the type of tumour more likely to occur in a worker exposed to asbestos more than fifteen years previously. This is especially so in the presence of asbestosis.

Section 4 — **Cancer of Other Sites**

4.1. The evidence relating asbestos to cancer of other sites is equivocal and further data are awaited.

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SURVEILLANCE OF HIGH-RISK GROUPS EXPOSED TO ASBESTOS IN THE UNITED STATES

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I should like to define two of the items that appear in the title of this paper, namely, asbestos and risk. I would then like to discuss the need to keep persons exposed to asbestos under surveillance and shall conclude by attempting to outline the surveillance techniques available in the United States and their effectiveness.

There are two main types of asbestos in commercial use. Chrysotile asbestos, usually white in color, is the fibrous form of serpentine. The amphiboles are the fibrous varieties found in sedimentary banded ironstone, which contains ferruginous slate, quartzites, and jaspers. The two most commonly used varieties of amphiboles are amosite and crocidolite (blue in color). The other amphiboles, which are used less often and in smaller quantities, are anthophyllite, tremolite, and actinolite.

Amphibole and serpentine minerals are widely distributed in the earth's crust. Only a very small quantity of the amphibole and serpentine minerals occur as the asbestiform variety. Asbestos is therefore, by definition, a collective mineralogic term that encompasses the asbestiform varieties of various minerals, but the term is commonly used to describe an industrial product obtained by mining and processing primarily asbestiform minerals.[1]

Because of the wide distribution of amphiboles and serpentine in the earth's crust, it is not surprising to find asbestiform minerals in the general atmosphere. It is thus reasonable to assume that man has always been exposed to small amounts of asbestiform minerals and that they pose no immediate threat to health.

Asbestos exposure may occur as a result of an occupation and will be referred to subsequently as "direct exposure" or it may occur at work through proximity to an occupation directly involved with asbestos. This exposure, in the vicinity of an asbestos worker, will subsequently be referred to as "indirect exposure." A third type of exposure has been described due to domestic contact with asbestos workers, and, finally, many years ago, when dust emission controls to the environment were virtually nonexistent, exposure in the neighborhood of asbestos plants could occur.

Although it is not my purpose to define risk in this discussion on surveillance, it is essential for me to at least attempt to define my concept of what is meant by the term "high-risk group." The word "risk" has different meanings to different people. To some, it means a dangerous element or factor, while to insurance companies, it is synonymous with the chance of loss, the degree of probability of such loss, a person or thing that is a specified hazard to an insurer, or a hazard from a specified cause or source, such as war. To risk something may mean to expose to hazard or danger, and the term "risky" means that something is attended with risk or danger. All of the foregoing definitions are according to *Webster's New Collegiate Dictionary*.[2] Pochin reminds us that risks are among the facts of life, and we all accept daily risks.[3] He further points out that some risks are obvious, some are unsuspected, and some we conceal from ourselves. It is, therefore, true to state that risk acceptance depends on knowledge of risk and a reasoned judgment of its consequences, whether the judgment be individual in the case of an individual or societal in the case of an entire community. The decision whether to take a risk depends on making comparisons that allow an

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assessment of the degree of risk. If the danger appears slight, the risk is thought to be low; if it is great, the risk is considered to be high. To assess risk, an agreed scale has to be developed for its measurement.

The subject of this panel discussion is surveillance of high-risk groups, and I have presumed that we will concern ourselves with asbestos-exposed groups. Apart from the fact that the different varieties of asbestos may affect the issue of risk, measurement of risk is also dependent on other variables, such as type of industry, type of occupation, age, latency, smoking habits, individual susceptibility, knowledge of actual exposure in terms of measured concentrations of dust, and, finally, regulations and controls imposed at different periods of time in the light of social and economic trends.

At the present time, we have insufficient knowledge about the role of age, individual susceptibility, and exposure levels in the etiology of asbestos-related diseases, although we do know that asbestosis is dose-related, that age of entry does not appear to be a factor, and that in some countries where regulations have been present for many years and where they have been effectively enforced, this disease appears to be declining in incidence, at last. However, irrespective of the section of industry in which exposure led to the development of asbestosis, persons with this lesion are probably more likely to develop lung cancer as a complication than are similarly exposed individuals without clinical evidence of asbestosis. This is not a universally accepted point of view, and some authors do not draw any distinction between asbestosis cases and other exposed workers when attributing lung cancer to asbestos exposure. There is no adequately documented study that resolves this point, and, therefore, it is my opinion that the convention that attributes lung cancer in the presence of asbestosis to an occupational cause and lung cancer in the absence of asbestosis to "natural" causes is reasonable to obey until such time as published reports routinely examine the relationship between asbestosis and the occurrence of other asbestos-related diseases. By adopting this convention, the task of selecting at least one of the high-risk groups from among asbestos-exposed populations is simplified. This raises the issue of the reasons for, and objectives of, surveillance of asbestos workers.

There are many ways of subdividing "the asbestos industry"; therefore, for simplicity sake, I have used the following broad categories: mining and milling, manufacturing, insulation, and construction.

There is no clear-cut distinction between certain user industries and the insulation and construction industries. In shipyards, insulation workers abound, and many other workers can be exposed to the dust created. Buildings are continuously being constructed, repaired, altered, extended, and even totally demolished, thus exposing many people to asbestos and other dusts.

Determination of which persons constitute a high-risk group in an industry, or rather industries, with such a diversity of conditions as can be encountered when asbestos is used requires knowledge of the processes used, the dust controls employed, and the actual levels of exposure. Most industrial populations can be subdivided empirically into office staff who never enter a plant, plant management and supervision, production employees, maintenance and engineering personnel, and research and development staff.

As far as I am aware, no large-scale epidemiologic study has been undertaken in any section of industry that was designed to quantify the degree or risk attached to exposure in the varying levels encountered by these different and differently exposed groups of workers. The populations studied have usually been workers in the areas where exposure to the highest dust levels occurs. Little is known about the effects on the health of persons exposed to dust levels below those routinely monitored in

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industry, and no determinations are yet possible for those groups only recently exposed to the levels set by regulations developed since the British Occupational Hygiene Society first recommended its standard for chrysotile asbestos in 1968.[4]

Based on current knowledge, limited by the inadequacy of information available regarding exposure levels, fiber types used, baseline medical data, and criteria for diagnosis of disease, and lack of verification of causes of death when this information is available from death certificates, certain groups of workers appear to be more at risk than others.

In 1965, McVittie indicated that in the United Kingdom, 41.0% of new cases of asbestosis diagnosed by four Pneumoconiosis Medical Panels in the years 1955–63 arose in the insulation industry.[5] The next largest group of cases, 21%, occurred in textile workers. At the same time, Selikoff *et al.* in the United States confirmed that among the asbestos insulation workers examined by them, pulmonary asbestosis was present in almost 50%.[6] The incidence of cases in the asbestos cement industry in McVittie's series was 8%; in the manufacture of brake linings, the figure was 2%. A

TABLE 1

MORTALITY FROM CANCER IN THE MINING AND MILLING OF ASBESTOS, DERIVED FROM PUBLISHED REPORTS, 1973–4*

Reference	Population Studied	Number of Men	Total Deaths	Cancer Deaths	Percent of Deaths	Lung Cancer Deaths	Percent of Deaths
McDonald[7]	chrysotile miners & millers, Quebec	11,107	2950	519	17.6	129	4.4
Vigliani	chrysotile miners & millers, Italy	1098	270	30	11.1	6	2.2
Meurman *et al.*[8]	anthophyllite miners, Finland	1092	248	38	15.3	21	8.5
Totals		13,297	3468	587		156	
Deaths in total population (%)		100	26.1	4.4		1.2	
All deaths due to cancer (%)			100	16.9		4.5	
Cancer deaths due to lung cancer (%)				100		26.6	

*See References 7 and 8, Vigliani quoted by McDonald.

group that McVittie classes as "miscellaneous," which included maintenance workers, accounted for 11% of new cases in the period studied.

TABLES 1–6 are based on a review of some of the published studies in the period 1965–78 relating to mortality from cancer and from asbestosis in three sections of the asbestos industry; TABLE 7 represents an attempt to summarize the data. The trend in TABLE 7 may indicate that the worst health experience is in the insulation industry. These Tables are presented to illustrate that the definition of high risk must take into account the way in which the risk is incurred, that is, the industry and the job, in addition to the substance responsible for the hazard.[7-18]

Many surveillance programs have been devised for occupational groups, but few have been able to achieve the ultimate goal of combining surveillance of workers, surveillance of the work environment, and surveillance of the raw materials and final products. Surveillance programs must be the responsibility of many people, including medical workers, industrial hygienists, government inspectors, personnel managers, and workers representatives. In the United States, the current Occupational Safety

TABLE 2

MORTALITY FROM CANCER IN THE MANUFACTURE OF ASBESTOS PRODUCTS, DERIVED FROM PUBLISHED REPORTS, 1967–77*

Reference	Population Studied	Number of Men	Total Deaths	Cancer Deaths	Percent of Deaths	Lung Cancer Deaths	Percent of Deaths
Mancusco & El-Attar[9]	asbestos factory workers, United States	1265	330	84	25.5	35	10.6
Newhouse[10]	textile & insulation manufacturing, England	2657	121	34	28.1	12	9.9
Selikoff *et al.*[11]	amosite insulation manufacturing, United States	933	484	143	29.6	73	15.0
Enterline *et al.*[12]	retired asbestos workers, United States	1348	754	167	22.2	58	7.7
Peto *et al.*[13]	asbestos textile workers, England	1106	317	91	28.7	61	19.2
Weiss[14]	asbestos paper & millboard manufacturing, United States	264	66	13	19.7	4	6.1
Totals		7573	2072	532		243	
Deaths in total population (%)		100	27.4	7.0		3.2	
All deaths due to cancer (%)			100	25.7		11.7	
Cancer deaths due to lung cancer (%)				100		45.7	

*See References 9–14.

TABLE 3

MORTALITY FROM CANCER IN THE INSTALLATION OF ASBESTOS INSULATION, DERIVED FROM PUBLISHED REPORTS, 1976–8*

Reference	Population Studied	Number of Men	Total Deaths	Cancer Deaths	Percent of Deaths	Lung Cancer Deaths	Percent of Deaths
Selikoff[15]	insulation workers, New York	370	198	105	53.0	47	23.7
Elmes & Simpson[16]	insulation workers, Belfast	162	122	66	54.1	35	28.7
Selikoff & Hammond[17]	insulation workers, United States & Canada	17,800	2270	994	43.8	485	21.4
Totals		18,332	2590	1165		567	
Deaths in total population (%)		100	14.1	6.4		3.1	
All deaths due to cancer (%)			100	45.0		21.9	
Cancer deaths due to lung cancer (%)				100		48.7	

*See References 15–17.

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TABLE 4

MORTALITY FROM ASBESTOSIS IN THE MINING AND MILLING OF ASBESTOS, DERIVED FROM PUBLISHED REPORTS, 1973–4*

Reference	Population Studied	Number of Men	Total Deaths	Asbestosis Deaths	Percent of Deaths
Ahlman 1973	anthrophyllite miners, Finland	1249	222	24	10.8
McDonald 1973	chrysotile miners, & millers, Quebec	10,120	3270	34	1.0
Meurman 1974	anthrophyllite miners, Finland	1092	248	13	5.2
Totals		12,461	3740	71	
Deaths in total population (%)		100	30.0	0.6	
All deaths due to asbestosis (%)			100	1.9	

*See References 7, 8, and 18.

and Health Administration (OSHA) standard for asbestos (June 7, 1972) requires the employer to provide or make available at his cost preplacement, annual, and termination medical examinations.[19] These medical examinations must include as a minimum a chest roentegenogram (posteroanterior 14 × 17 in.), a respiratory symptom history, and lung function tests, which include forced vital capacity (FVC) and forced expiratory volume at 1 sec ($FEV_{1.0}$). This requirement must be fulfilled for any person in "an occupation exposed to airborne concentrations of asbestos fibers." In view of this requirement, no room is left for judgment in deciding which persons are at risk

TABLE 5

MORTALITY FROM ASBESTOSIS IN THE MANUFACTURE OF ASBESTOS PRODUCTS, DERIVED FROM PUBLISHED REPORTS, 1967–77*

Reference	Population Studied	Number of Men	Total Deaths	Asbestosis Deaths	Percent of Deaths
Mancuso & El-Attar[9]	asbestos factory workers, United States	1265	330	31	9.4
Enterline *et al.*[12]	retired asbestos workers, United States	1348	754	29	3.4
Selikoff *et al.*[11]	amosite insulation manufacturing, United States	933	484	27	5.6
Weiss[14]	asbestos paper & millboard manufacturing, United States	264	66	2	3.0
Totals		3810	1634	89	
Deaths in total population (%)		100	42.9	2.3	
All deaths due to asbestosis (%)			100	5.5	

*See References 9, 11, 12, and 14.

and need to be kept under surveillance, and the role of the occupational health physician is merely to do as he is told!

As part of the OSHA requirements, medical records have to be maintained by employers for at least 20 years, and the contents are available to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of the National Institute for Occupational Safety and Health (NIOSH), to authorized physicians and medical consultants of either of them, and, on the request of any employee or former employee, to his physician. The employer is also entitled to receive from "any physician who conducts a medical examination," as stipulated, "all the information specifically required . . . and any other medical information related to occupational exposure to asbestos fibers." Employees who are found by an examining physician to be unable "to function normally wearing a respirator" or who will impair the safety or health of themselves or other employees by "use of a respirator" may not be assigned to tasks that require the use of respirators.

Certain additional requirements were proposed in 1975, but the proposed new standard has not yet even been considered under the required rulemaking procedures and, therefore, cannot go into effect.[20] One of these requirements is that for employees with "10 or more years of exposure to airborne concentrations of asbestos fibers or who are 45 years of age or older, a sputum cytology examination shall be made available." Other changes deal with recording when employees refuse to be examined, the provision to the employer by the examining physician of his "opinion as to whether the examined employee has any medical conditions which would place the employee at increased risk of material impairment of his or her health from exposure to asbestos fibers, or which would, directly or indirectly, be aggravated by such exposure," and "any recommended limitations upon the employee's exposure to asbestos fibers, or upon the use of protective clothing and equipment, such as a respirator. . . ." The physician has to issue to the employee a statement informing him of "any medical conditions which require further examination or treatment." It is proposed that records be maintained for at least 40 years or for the duration of employment plus 20 years, whichever period is longer.

The deficiencies in this approach are numerous, but their remedies are unfortunately not always available and will have to emerge through trial and error. No

TABLE 6

MORTALITY FROM ASBESTOSIS IN THE INSTALLATION OF ASBESTOS INSULATION, DERIVED FROM PUBLISHED REPORTS, 1976–8*

Reference	Population Studied	Number of Men	Total Deaths	Asbestosis Deaths	Percent of Deaths
Selikoff[15]	insulation workers, New York	370	198	25	12.6
Elmes & Simpson[16]	insulation workers, Belfast	162	122	16	13.1
Selikoff & Hammond[17]	insulation workers, United States & Canada	17,800	2270	162	7.1
Totals		18,332	2590	203	
Deaths in total population (%)		100	14.1	1.1	
All deaths due to asbestosis (%)			100	7.8	

*See References 15–17.

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TABLE 7
MORTALITY IN VARIOUS SECTORS OF THE ASBESTOS INDUSTRY, DERIVED FROM PUBLISHED REPORTS, 1967–78*

Sector of the Asbestos Industry	Deaths from Cancer (%)	Deaths from Lung Cancer (%)	Deaths from Asbestosis (%)
Mining & milling	16.9	4.5	1.9
Manufacturing	25.7	11.7	5.5
Insulating	45.0	21.9	7.8

*See References 7–18.

criteria have been laid down for the qualifications required by examining physicians to enable them to comply with the law and reasonably interpret their findings in the light of it. No central record-keeping system has been devised to enable the storage and retrieval of linked records that relate to exposure, fiber type, occupation, industry, medical data, production data, and many other variables, such as smoking habit. No provision has been made for transfer of affected persons to other jobs, and the term "an occupation exposed to airborne concentrations of asbestos fibers" has not been defined in regard to liability of such concentrations to be hazardous to health.

There is a need to keep persons exposed to asbestos under surveillance to determine the degree of risk. Knowledge of fiber type and of industrial sector must be taken into account in assessing risk, because these factors appear to be important. Surveillance does not simply denote medical examination and record-keeping but the constant inspection of the workplace and workpractices, the constant measurement of exposure levels, a vigorous approach to conseling and education, and the training and retraining of selected persons, medical and others, in the recognition of hazards and disease with a view to proposing techniques for prevention.

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