



Research into Malignant and Non- malignant Respiratory Disease Prescriptions: Report for Asbestos and Lung Cancer

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Contents

1 Introduction	4
2 Methods	5
3 Results	6
3.1 IARC review of asbestos and lung cancer, 2012	6
3.2 Asbestos and lung cancer studies	12
4 Synthesis and Discussion	19
5 Conclusions	20
6 References	21
Appendix 1- Data Extraction Spreadsheet and List of All the References Considered	23
Appendix 2- Data Tables for cohort, case-control and meta-analyses of asbestos and lung cancer	24
Appendix 3- Current prescription for Asbestos and Lung Cancer	25

1 Introduction

Asbestos and lung cancer is one of 6 high-priority occupational exposure-disease combinations that were identified with IAC as being of highest priority for more detailed investigation (see Report of Phase 1 of this project).

This document contains a commentary on the extracted data for relevant occupational epidemiological studies relating to lung cancer and asbestos exposure and is meant to be read in conjunction with the associated spreadsheets containing the data extraction from these studies (Appendix 1). These data relate to both those studies reported in the most recent IARC Monograph (IARC Working Group, 2012) and more recent publications identified from literature searches by the IOM research team. A particular issue to be clarified, if possible, is the strength of evidence for associations in the absence of asbestosis (the latter generally regarded as a sign of heavy asbestos exposure).

2 Methods

In February 2023, an initial broad search (Exposure AND (lung AND cancer) AND asbestos) was run in the NLM PubMed database to determine how many studies would be retrieved: 1,631 references were returned. Due to this high volume of results, following a meeting with IIAC, it was agreed that the focus should be on occupations already included in the current [list of prescribed diseases](#):

The current prescriptions for D1, D8A and D9 list those occupational circumstances associated with high levels of exposure to asbestos. A search string was compiled for Web of Science (WoS) and NLM PubMed to cover D1, D8A and D9:

(Exposure AND (lung AND cancer) AND asbestos) AND ((manufacture AND textiles) OR (spray* OR insulation) OR ("ship building" AND materials AND (apply* OR remov* OR clean*)) OR (dust AND (machinery OR plant))).

The focus of the search was on asbestos and lung cancer and so we did not explicitly search using the term 'asbestosis'. This search was run in January 2024 and retrieved 11 PubMed references and 26 Web of Science references to cover the period 2017 to the present. The searches were run in PubMed in the title/abstract field in 'Advanced Search' and in Web of Science Core Collection in the topic field (title, abstract, keywords). Variations of this search were then tried to see the difference in the number of papers identified:

1. (Exposure AND (lung AND cancer) AND asbestos) AND ((manufacture AND textiles) OR (spray* OR insulation) OR ("ship building" AND materials AND (apply* OR remov* OR clean*)) OR (dust AND (machinery OR plant))) 2009 to present
2. (Exposure AND (lung AND cancer) AND asbestos) AND (textiles OR (spray* OR insulation) OR ("ship building" AND materials AND (apply* OR remov* OR clean*)) OR (dust AND (machinery OR plant))) both from 2017 and 2009 to present
3. (Exposure AND (lung AND cancer) AND asbestos) AND ((manufacture AND textiles) OR (spray* OR insulation) OR "ship building" OR (dust AND (machinery OR plant))) both from 2017 and 2009 to present
4. (Exposure AND (lung AND cancer) AND asbestos) AND (textiles OR (spray* OR insulation) OR "ship building" OR (dust AND (machinery OR plant))) both from 2017 and 2009 to present

Search no. 4 above, which had generated the most hits (47 Web of Science and 211 PubMed), was then extended to include some additional 'high risk' industries: (Exposure AND (lung AND cancer) AND asbestos) AND (textiles OR (spray* OR insulation) OR "ship building" OR shipbuilding OR ship builder* OR shipbuilder* OR (asbestos AND product AND manufacture) OR "metal plate worker*" OR riveter* OR coachbuilder* OR "coach builder" OR (vehicle AND (body-maker* OR builder*)) OR logger* OR (work* AND energy) OR "boiler attendant*" OR docker* OR navy OR plumber* OR electric* OR painter* OR decorator* OR carpenter* OR joiner* OR (dust AND (machinery OR plant))). The references from 2009 were exported to DistillerSR for screening, this being the latest date for publications included in the IARC monograph (2012).

3 Results

3.1 IARC review of asbestos and lung cancer, 2012

IARC (2012) concluded that the association between asbestos exposure and lung cancer has been “well established in numerous epidemiological investigations”, while noting that there are some limitations that may explain the heterogeneity of the findings across studies. In summary, these limitations were:

- Exposure to different types, fibre sizes and levels of asbestos between industries and across time
- Differences in how the issue of latency was accounted for in studies
- Differences in approaches taken to estimate asbestos exposure (these ranged from a binary indicator for employment in a specific industry to quantification of cumulative exposure indices).
- Potential misclassification of disease was also noted as a possible study limitation, but this was more likely to occur for diseases other than lung cancer, for example mesothelioma.

Table 3.1 summarises the results of the occupational cohort studies examined by IARC, broadly categorised by occupational group (classification done by IARC). The information in this table has been collated from Tables 2.2 and 2.3 in the IARC monograph (Appendix 2), non-occupational cohorts and studies for which no risk estimate is reported to have been excluded from the table. References are included in the IARC monograph and not the present report.

Table 3.1: Summary of occupational cohort studies assessed by IARC (2012)

Study population	Obs	Lung cancer		Type of exposure	Time period	Reference
		SMR/RR	95% CI			
MINING						
Australia	91	1.60	1.31-1.97	Crocidolite	1943-1966 (FU 1980)	Armstrong et al (1988)
Canada	646	1.37		Chrysotile	Born 1891-1920 (FU 1975)	Liddell et al (1997)
Finland	76M	2.88	2.27-3.60	Anthophyllite	1936-1967 (FU 1953-91)	Maurman et al (1994)
	1F	2.22	0.06-12.4			
Italy	22	1.1		Chrysotile & Balangeroite	1930-1965 (FU 1987)	Piolatto et al (1990)
South Africa	63	1.72	1.32-2.21	Crocidolite	1945-1955 (FU 1980)	Sluis-Cremer et al (1992)
USA	89	1.7	1.4-2.1	Tremolite	1982-2001	Sullivan (2007)
INSULATION MANUFACTURERS AND INSULATORS						
Canada	1168	4.35	P<0.001		In union 1967 (FU 1967-86)	Selikoff & Seidman (1991)
UK	57	2.0		Amosite	1947-1979 (FU 1947-80)	Acheson et al (1984)
UK	38	3.6		Crocidolite, amosite, chrysotile	1933-1964 (FU 1980)	Berry et al (2000)
USA	35	2.77	1.93-3.85	Amosite	1954-1972 (FU 1964-1993)	Levin et al (1998)

Table 3.1 (cont.)

Study population	Obs	Lung cancer		Type of exposure	Time period	Reference
		SMR/RR	95% CI			

ASBESTOS TEXTILE WORKERS

Italy	76	2.82	2.22-3.54		1946-1984 (FU 1996)	Pira et al (2005)
UK	132	1.31	P<0.01	Chrysotile, crocidolite	1916-1983 (FU 1983)	Peto et al (1985)
USA	198	1.95	1.68-2.24	Chrysotile, (crocidolite)	1940-1975 (FU 2001)	Hein et al (2007)
USA	277	1.96	1.73-2.20	Chrysotile, (amosite)	1950-1973 (FU 2003)	Loomis et al (2009)

ASBESTOS CEMENT

Denmark: to 1984	162	1.80	1.54-2.10	Chrysotile, amosite, crocidolite	1928-1984 (FU 1943-84)	Raffin et al (1989)
: to 1990		1.63	1.26-2.08	Chrysotile, amosite, crocidolite	1928-1984 (FU 1943-90)	Raffin et al (1996)
Italy	33	1.24	0.91-1.66	Chrysotile, crocidolite	1952-1987 (FU 1989)	Giaroni et al (1994)
Italy	110M 7F	2.71 3.96	2.23-3.27 1.59-8.16	Chrysotile, crocidolite	1950-1980 (FU 1965-93)	Botta et al (1991)

Table 3.1 (cont.)

Study population	Lung cancer			Type of exposure	Time period	Reference
	Obs	SMR/RR	95% CI			
Lithuania	29M 1F	0.90 0.70	0.7-1.3 0.1-4.6	Chrysotile	Pre-1978 (FU 2000)	Smailyte et al (2004a)
Sweden	35	1.8	0.90-3.7	Chrysotile, (amosite, crocidolite)	1907-1977 (FU 1986)	Albin et al (1990)
UK	35M 6F	0.9 1.4	0.6-1.3 0.5-3.1	Chrysotile	1941-1983 (FU 1984)	Gardner et al (1986)

USA	154	1.34		Chrysotile	Pre-1970 (FU 1980)	Hughes et al (1987)
FRICTION MATERIALS						
Canada	11	1.40			1950 (FU 1985)	Finkelstein (1989a)
UK	229M	1.03	0.9-1.18	Chrysotile	1941-1986 (FU 1986)	Berry (1994)
	12F	0.57	0.29-0.99			
USSR	1M	0.14		Chrysotile	1966 (FU 1984)	Kogan et al (1993)
	1F	0.33				
USA	15	0.95		Chrysotile	(FU 1937-1980)	Parnes (1990)

Table 3.1 (cont)

Study population	Obs	Lung cancer		Type of exposure	Time period	Reference
		SMR/RR	95% CI			
GENERIC 'ASBESTOS WORKERS'						
China	67	4.2	p<0.01	Chrysotile	(FU 1986)	Zhu & Wang (1993)
China	3M	5.1	p<0.01	Chrysotile	(FU 1994)	Pang et al (1997)
	6F	6.8	p<0.01			
Germany	26	1.70	p<0.05		Pre-1977 (FU 1977-82)	Woitowitz et al (1986)
	12	4.62	p<0.05			
UK	157M	2.55		Crocidolite, amosite, chrysotile	1933-1964 (FU 1980)	Berry et al (2000)
	37F	7.46				
UK	22	2.00		Chrysotile, crocidolite	1939 (FU 1951-80)	Acheson et al (1982)
UK	157	1.30	p<0.01	Various	(FU 1981)	Hodgson & Jones (1986)
USA	77	2.71	p<0.01	Amosite, chrysotile, crocidolite	1941-1967 (FU 1980)	Enterline et al (1987)

Study population	Obs	Lung cancer		Type of exposure	Time period	Reference
		SMR/RR	95% CI			
OTHER OCCUPATIONS WITH SUBSTANTIAL ASBESTOS EXPOSURE						
Canada Plumbers & pipefitters	393	1.27	1.13-1.42		1950-1999 (FU 1999)	Finkelstein & Verma (2004)
Finland Shipyard workers	227	1.18	1.03-1.35		1945-1960 (FU 1953-81)	Tola et al (1988)
Italy Railway carriage repair and construction	26	1.24	0.87-1.72	Chrysotile, crocidolite	1945-1969 (FU 1970-97)	Battista et al (1999)
Italy Ship repair, refit and construction	298	1.77	1.57-1.98		Pre-1952 (FU 1960-69)	Puntoni et al (2001)
Sweden Shipyard workers	11	1.12	0.56-2.0	Chrysotile	(FU 1978-83)	Sanden & Jarvholm (1987)

3.2 Asbestos and lung cancer studies

Our updated search of occupational exposure to asbestos and lung cancer studies since the most recent IARC report identified 26 studies, most of which (24) were cohort studies, with the remaining (2) using a case-control design.

The most common industry in the cohort studies was asbestos textile (11 studies), which included 5 studies from USA, 5 studies from China, and one study from Italy. The Chinese studies all examined the same cohort with variations on the analysis (e.g., use of internal, external, and occupational control populations). Smoking adjustments was included in these analyses, which appeared to be limited to classification as ever or never smokers.

There was significant overlap in the study population of the US textile studies, which included workers from subsets of the same facilities in North and South Carolina. It was not possible to include smoking status in the data analysis.

The main asbestos fibre of exposure in all studies was chrysotile. All of the included studies demonstrated statistically significant higher risks of lung cancer incidence/mortality or reduced survival time in those exposed to asbestos. Only one study included data on lung cancer deaths with respect to asbestosis status, which suggests a more than doubled rate in those with (17%) asbestosis compared to those without (7%).

The next most common sector was mining (6 studies), of which there were 4 studies from China and one study each from Italy and Finland. One of the Chinese studies produced risk estimates for both the textile industry (included above) and mining. All of the Chinese studies were from the country's largest chrysotile mine and indicated lung cancer risks that were at least 2.5 times higher in the exposed groups. Smoking (ever/never) and occupational histories were available for the cohort. The Italian study also suggested elevated risks, though the CI included the null value. Similar to the studies of the textile industry, the main exposure was chrysotile. Other than Wang et al. (2013a) stating that there was one case of asbestosis in the lung cancer deaths, the studies did not include information on the relationship between the presence of asbestosis and lung cancer.

The remaining 8 studies examined asbestos exposures in different settings, involving shipbuilding and shipyards (3 studies from Italy & Japan), navy workers (2 studies from Norway), insulation (1 study from USA), vehicle mechanics (1 study from Denmark), and mixed occupations (1 study from Italy), plus 1 Finnish study that also provided risk estimates for a mining cohort, included above. Some of these studies reported chrysotile and other asbestos fibres, such as amosite and crocidolite, but others did not report the fibre type at all. Most of the studies indicated elevated risks for those exposed to asbestos, with the exceptions of boiler repairers in Japan (n=8 cases) and male civilian navy personnel in Norway (n=185 cases), though central risk estimates were above the null in both instances. Only the Finnish study included a lung cancer risk estimate for asbestosis patients, which was highly elevated compared to the general population (i.e., SIR>8).

In addition to the cohort studies, two nested case-control studies were identified in the search: one study of the textile industry in China (chrysotile) and one study of workers at asbestos processing plants in Poland (asbestos fibres not reported). These studies each suggested significantly elevated risks in the highest exposed groups. The Chinese study also noted that the incidence of asbestosis was approximately twice as high in cases (39%) compared to controls (19%).

Table 3.2 a) to e) (below) summarises these studies using the occupational categorisation as those presented in the IARC report. 'Time period' includes both the periods of occupation and follow-up. We have also included any available information on asbestosis and lung cancer, though such studies were a small minority.

Table 3.2 a): Textile cohort studies.

Study population	Lung cancer cases/deaths	Effect	Lower CI	Upper CI	Type of exposure	Time period	Adjustment for smoking/Notes	Reference
TEXTILE								
China	51	Power model $\beta=0.53$ (SE=0.12) $p<0.001$	not reported	not reported	Chrysotile	1972-2006	Ever/never smokers	Deng et al (2011)
China	53	HR= 3.31	1.6	6.87	Chrysotile	1972-2008	Ever/never smokers	Wang et al., (2012b)
China	53	Hazard ratio=2.99	1.30	6.91	Chrysotile	1972-2008	Ever/never smokers	Wang et al., (2012c)
China	Males: 53 Females: 2	SMR=4.08 1.23	3.12 0.34	5.33 4.50	Chrysotile	1972-2008	No smoking adjustment; Males: Lung cancer deaths: 17% (22 / 127) in those with asbestosis 7% (31 / 450) in those without asbestosis Females: No lung cancer deaths in those with asbestosis	Wang et al (2013a)
China	46	SMR= 6.34	4.75	8.45	Chrysotile	1972-2008	Ever/never smokers	Wang et al., (2014)
USA	116	ERR fiber-year/ml (cumulative exposure)=0.015	0.007	0.0028	Chrysotile	1940-2001	None	Richardson (2009)
USA	277	RR per 100 fiber-year/ml =1.102	1.044	1.164	Chrysotile	1950-2003	None	Loomis et al (2009)

Study population	Lung cancer cases/deaths	Effect	Lower CI	Upper CI	Type of exposure	Time period	Adjustment for smoking/Notes	Reference
USA	180	Change in lung cancer risk (total fibers)=0.03 (3%)	p=0.002	p=0.002	Chrysotile	1950-2003	None	Loomis et al (2010)
USA	361	Change in log of lung cancer risk (total fibers)=0.039	0.020	0.057	Chrysotile	1940-2003	None	Loomis et al (2012)
USA	142	Survival time ratio=0.57	0.33	0.96	Chrysotile	1940-2001	None	Naimi et al., (2014)
Italy (Northern)	143	SMR=2.96	2.50	3.49	Chrysotile (mainly), some crocidolite	1946-2013	None	Pira et al (2016)

Table 3.2 b): Mining cohort studies

Study population	Lung cancer cases/deaths	Effect	Lower CI	Upper CI	Type of exposure	Time period	Adjustment for smoking/Notes	Reference
MINING								
China	1932	RR=2.57	1.35	4.88	Chrysotile	1981-2010	Smokers/non-smokers	Du et al., (2012)
China	50	SMR=4.71	3.57	6.21	Chrysotile	1981-2006	Ever/never smokers	Wang et al., (2012a)

China	56	SMR=4.69	3.61	6.09	Chrysotile	1981-2006	Smoking/ever smoking or non-smoking; 1 case of asbestosis in lung cancer deaths	Wang et al., (2013b)
China	56	SMR=4.25	3.27	5.52	Chrysotile	1981-2006	Ever/never smokers	Wang et al., (2014)
Italy	40	SMR=1.41	0.81	1.55	Chrysotile	1946-2013	None	Ferrante et al., (2019)
Finland	78	SIR=2.46	1.95	3.07	Anthophyllite	1967–2012	Smoking-specific risk estimates	Nynas et al (2017)

Table 3.2 c): Other cohort studies.

Study population	Lung cancer cases/deaths	Effect	Lower CI	Upper CI	Type of exposure	Time period	Adjustment for smoking/Notes	Reference
Other								
USA (Insulation workers)	89	SMR=2.44	196	300	Amosite	1954-2011	None	Levin et al., (2016)
Finland (Sprayers, construction, shipyard, other)	Asbestosis patients: 41	SIR=8.19	5.88	11.1	Unknown	1978–2012	Smoking-specific risk estimates	Nynas et al (2017)
	Asbestos sprayers: 22	11.3	7.10	17.2	Crocidolite	1967–2012		
	Screening cohort (mixed): 994	1.23	1.16	1.30	Chrysotile, crocidolite, unknown	1988–2012		
Italy (shipbuilding & other occupations)	66	SIR=1.61	1.26	2.04	Not reported	1995-2009	Smoking/ever smoking or non-smoking	Barbiero et al., (2018a)
Italy (shipbuilding & other occupations)	70	SMR=1.49	1.17	1.89	Unknown	1989-2011	Smoking/ever smoking or non-smoking	Barbiero et al., (2018b)
Italy (Mixed occupations)	Male: 3535 Female: 99	SMR: 1.28 1.26	1.24 1.02	1.32 1.53	Mixed	1970-2018	None	Ferrante et al., (2024)
Japan (Shipyard workers)	Laggers 7	2.64	1.06	5.44	Chrysotile, amosite	1947-2007	None	Tomioka et al., (2011)
	Boiler repairers 8	1.61	0.70	3.17				
Norway (navy workers)	107	SIR (Vessel ≥2 years)=1.24	1.03	1.50	Chrysotile (mainly), some crocidolite	1953-2007	None	Strand et al., (2010)

Study population	Lung cancer cases/deaths	Effect	Lower CI	Upper CI	Type of exposure	Time period	Adjustment for smoking/Notes	Reference
Norway (Navy workers)	Men 185	SIR=1.12	0.97	1.30	Not reported	1960-2015	None	Strand et al., (2018)
	Women 77							
Denmark (vehicle mechanics)	1815	Adjusted HR: 1.09	1.03	1.14	Chrysotile	1970-2012	None	Thomsen et al., (2021)

Table 3.2 e): Case-control studies

Study population	Lung cancer cases/deaths	Effect	LCI	UCI	Type of exposure	Time period	Adjustment for smoking/Notes Notes	Author
China (textile)	1139	OR (medium exposure)=1.25 OR (high exposure)=3.66	0.47 1.61	3.31 8.29	Chrysotile	1972-2001	Non-smokers and ever smokers; Asbestosis was diagnosed in 16 cases (39%) and 37 controls (19%)	Yano et al., (2010)
Poland (processing)	165	OR (highest cumulative exposure category)=1.99	1.22	3.25	Not reported	2000-2013	Pack-years of smoking	Świątkowska et al (2015)

4 Synthesis and Discussion

The current prescription for lung cancer from asbestos exposure (D8 & D8A) is presented in Appendix 3. D8 specifies the prescribed conditions for lung cancer with accompanying asbestosis: working with asbestos, manufacturing asbestos textiles, cleaning machinery involved in such operations, or being exposed to resulting dust. D8A specifies the conditions for the presence of lung cancer (i.e., no evidence of asbestosis), which includes, similar to D8, manufacture of asbestos tiles, spraying asbestos, asbestos insulation, or handling asbestos via shipbuilding. Temporal exposure criteria are also included in D8A.

Our search focussing on terms related to the presently prescribed diseases resulted in the identification of 26 relevant studies published since 2009 (i.e., the latest year for which the most recent IARC monograph had included studies). Nearly two thirds of the studies (17/26; 65%) pertained to asbestos mining or textile industries. Most of these studies were from China or USA, with significant overlap of participants within these sectors in each country. The remaining 9 studies mainly took place in Europe, covering shipbuilding, navy workers, and a mix of other occupations.

It is noteworthy that none of the identified studies took place in the UK. Since the search terms were based on the current prescriptions (to achieve a more manageable list of studies to review given resource and timeline constraints), it would be expected that the results would predominantly address these industries. There were also studies relating to mining exposure, but this is not relevant for occupational exposures in the UK.

The main results from each study indicated clear increases in lung cancer risks with asbestos exposure. Only four studies distinguished between lung cancer rates in those with asbestosis (though not in asbestosis-free individuals). A cohort study indicated lung cancer rates were more than doubled in individuals with asbestosis, and a case-control study found asbestosis rates were twice as high in cases compared to controls. Another one of the studies quantified very high risks of lung cancer in those with asbestosis. Based on this limited evidence, it was not possible to estimate lung cancer risk levels in those without asbestosis from different occupational exposure scenarios.

It is worth noting that there is now statistical evidence that the interaction between smoking and asbestos exposure on lung cancer risk, with no requirement for asbestosis (Klebe et al, 2020). In addition, the earlier Helsinki criteria for diagnosis of asbestos and asbestos-related cancer states that "A cumulative exposure of 25 fibre-years is estimated to increase the risk of lung cancer 2-fold, clinical cases of asbestosis may occur at comparable cumulative exposures (Wolff et al 2014).

Overall, the studies identified since the most recent IARC report continue to indicate strong lung cancer risks with occupational exposure to asbestos, with the possible exception of the removal of the requirement for job history information in the presence of asbestosis in PD D8. From this review, there is no evidence base to recommend revisions to the current IAC prescription. However, there may be additional occupational circumstances with relevance to the UK, which could be examined in a broader review of the literature: for example, studies of lung cancer risks in construction workers, navy personnel, and vehicle mechanics, etc. Risk levels in these occupations from our search did appear to be lower than those currently prescribed, but nevertheless, a broadened search focussing on specific occupational exposures may be warranted, and could be guided by the job categories that are known to be at risk of mesothelioma and or asbestosis. Alternatively, a review of exposure studies could identify specific occupational circumstances whereby exposure to asbestos is likely to be associated with an RR>2.

5 Conclusions

Our updated search of occupational exposure to asbestos and lung cancer studies since 2009, based on the current prescriptions, identified 26 studies. Most of the search results were cohort studies (24), with the remaining using a case-control design (2). The majority of studies examined the textile and mining industries, with the others involving shipbuilding, navy personnel, insulation workers, vehicle mechanics, and other occupations. The studies demonstrated substantially elevated lung cancer risks in those occupationally exposed to asbestos, with limited evidence differentiating risk levels only in those with asbestosis.

While there is no clear rationale to revise the current IIAC prescription definitions for lung cancer and asbestos exposure, a broader search including other occupational circumstances involving asbestos exposure may be warranted in order to ensure that there are not other groups of asbestos exposed workers with lung cancer currently being excluded by the current process. Alternatively, a review of exposure studies could identify specific occupational circumstances whereby exposure to asbestos is likely to be associated with an $RR > 2$.

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Appendix 1- Data Extraction Spreadsheet and List of All the References Considered



Data extraction Lung Asbestos_and_Lung_Cancer and Asbestos_Cancer_All papers.xlsx

Appendix 2- Data Tables for cohort, case-control and meta-analyses of asbestos and lung cancer



100C-06-Table2.1.pdf
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100C-06-Table2.2.pdf
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100C-06-Table2.3.pdf
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Appendix 3- Current prescription for Asbestos and Lung Cancer

- D8. Primary carcinoma of the lung where there is accompanying evidence of asbestosis.
- (a) The working or handling of asbestos or any admixture of asbestos; or
 - (b) the manufacture or repair of asbestos textiles or other articles containing or composed of asbestos; or
 - (c) the cleaning of any machinery or plant used in any of the foregoing operations and of any chambers, fixtures and appliances for the collection of asbestos dust; or
 - (d) substantial exposure to the dust arising from any of the foregoing operations.
- D8A. Primary carcinoma of the lung.
- Exposure to asbestos in the course of—
- (a) the manufacture of asbestos textiles; or
 - (b) spraying asbestos; or
 - (c) asbestos insulation work; or
 - (d) applying or removing materials containing asbestos in the course of shipbuilding,
- where all or any of the exposure occurs before 1st January 1975, for a period of, or periods which amount in aggregate to, five years or more, or otherwise, for a period of, or periods which amount in aggregate to, ten years or more.



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