COMMERCIAL IN CONFIDENCE

FINAL REPORT

The economic burden of asbestos-related disease

Prepared for
Asbestos Safety and Eradication Agency

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THE CENTRE FOR INTERNATIONAL ECONOMICS
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Summary

Asbestos is part of Australia's built environment, reflecting a long history of the use of asbestos as a building material. Due to this legacy, it is now a confirmed cause of multiple asbestos-related diseases (ARDs), making it an important, potentially avoidable, public health issue in Australia.

This study quantifies some of the economic and social costs of ARD in Australia for 2015, and finds that there are large health system and productivity costs associated with the disease.

The population of ARD sufferers is not limited to current patients, due to long latency periods and a third wave of people contracting the disease from non-occupational exposure.

This report contributes to the evidence base for asbestos policy development, and by drawing on all relevant data available at the time of drafting, points to future research that would expand the understanding of the economic and social costs that ARDs leave on patients, their families and carers, and the wider community and economy.

Deaths and disability in Australia due to asbestos-related disease

In 2015, there were an estimated 4 152 deaths in Australia due to ARDs, and 10 444 prevalent cases of disease.[1] This accounts for mesothelioma in addition to a broader range of ARDs such as lung cancer. While the majority of these cases are due to past occupational exposure, there is still a large number of people living with disease that have not had any workplace contact with asbestos.

The most common form of ARD is lung cancer. This study estimates that there are 4.2 lung cancer deaths for each mesothelioma death.[2] Data limitations make it more difficult to estimate the number of prevalent cases of lung cancer for each case of mesothelioma, although this study has estimated this to be 5.2.

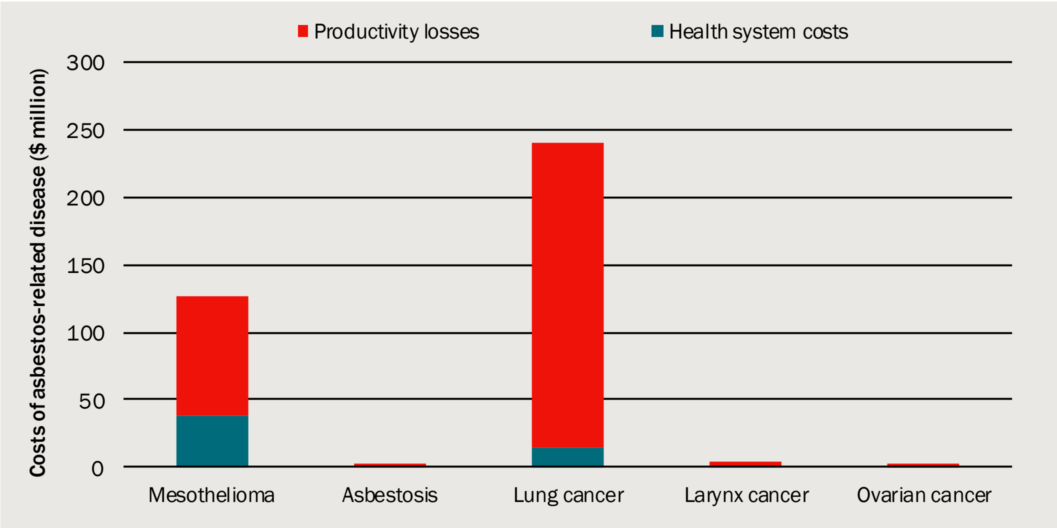
1 CIE analysis using GBD data. See Appendix A for an explanation of the methodology for estimating the number of deaths due to lung cancer associated with asbestos exposure and mesothelioma based on data from the Global Burden of Disease Study: Institute for Health Metrics and Evaluation (IHME). GBD Compare Data Visualization. Seattle, WA: IHME, University of Washington, 2016. Available from http://vizhub.healthdata.org/gbd-compare.

2 The ratio of asbestos-related lung cancer deaths to mesothelioma deaths has been estimated using a combination of GBD data and CIE analysis. There is some uncertainty around this figure in the literature. Studies such as McCormack, et al. (2012) finding variation in this ratio among asbestos exposure cohorts and highlighting the difficulty of quantifying the asbestos-related lung cancer burden in the presence of this disease's multiple causes.

Given its long latency period, ARDs tend to come in 'waves'. From its initial wave of exposure due to asbestos mining through to the current third wave of cases expected to be associated with non-occupational exposure as home renovators in particular are exposed.

Chart 1 presents estimates of the health system and productivity costs of ARD in 2015.

1 Summary of health system costs and productivity losses



Note: This chart does not show our estimates of the monetary value of lost quality-of-life because these estimates should not ba added to estimates of the value of lost productivity.

Source: CIE.

Direct health system costs

Hospital and primary healthcare costs associated treating ARDs are estimated at **$192 million** for 2015. The largest expenditure item is costs for patients admitted to hospital, costing $53.7 million in 2015.[3] Average costs per separation are highest for patients with asbestosis ($20 562) and lowest for patients with mesothelioma ($4 893). Outpatient costs are also sizeable, valued at $9.5 million, mostly relating to the treatment of lung cancer (73 per cent).

In the community, costs associated with General Practitioner (GP) consultations are estimated to be $21.5 million, and spending on specialists and other health practitioners is valued at $48.4 million, again predominantly associated with care for lung cancer patients.

Spending on pharmaceuticals is estimated at $59.0 million, 83 per cent of which is due to Australian Government subsidies offered through the Pharmaceutical Benefits Scheme (PBS),[4] with the remainder incurred by patients in out-of-pocket costs.

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3 Australian Institute of Health and Welfare (AIHW) data request, based on data from National Hospital Morbidity and Health Expenditure databases.

4 PBS Information Management Section, 2015, *Expenditure and prescriptions twelve months to 30 June 2015*, p.V, available at: http://www.pbs.gov.au/statistics/2014-2015-files/exp-prs-book-01-2014-15.pdf

Costs to the workforce and broader economy

Living with an ARD compromises an individual's ability to participate in the paid and unpaid workforce. Productivity losses also flow through to carers who are no longer able to participate in work and the community as they otherwise would.

These **indirect effects** are estimated at **$321 million** in 2015. Most losses (85 per cent) are due to disease caused by occupational exposure, with losses evenly shared between paid and unpaid work. Overwhelming, these costs arise due to the premature death of a person, rather than their disability.

The burden to individuals living with an asbestos-related disease

Living with an ARD is a burden for patients and their families, who experience a compromised quality of life. The losses associated with reduced quality of life can be represented in Disability-Adjusted Life Years (DALYs), which measure the sum of years lost to disability and years of life lost due to death. Over the lifetime of all patients with an ARD, **burden of disease** losses are estimated to be **58 077 Disability-Adjusted Life Years (DALYs)**.[5] This excludes losses associated with asbestosis, for which prevalence or DALY data is not available. The estimated monetary value of lost quality of life is $10.8 billion in 2015.[6] However, this estimate relies on a value for the value of a year of lost life which may be overstated for elderly sufferers of disease.

Compensation for monetary losses for individuals

Sufferers of ARDs often have a right to obtain monetary compensation for their loss due to the disease.

There are two main sources of compensation:

- Statutory entitlements fulfilled by bodies such as icare Dust Diseases Care (in NSW) which provide a no fault workers compensation scheme following occupational exposure in NSW to scheduled dusts under the legislation.
- Common law damages, subject to burden of proof requirements.

Compensation payments act as a lower bound estimate of the costs of ARD, as they are curtailed by statutory limits on payments, and difficultly in providing evidence of exposures that occurred many years ago. There are also much fewer settlements than instances of ARD.

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5 CIE analysis using GBD data: Institute for Health Metrics and Evaluation (IHME). GBD Compare Data Visualization. Seattle, WA: IHME, University of Washington, 2016. Available from http://vizhub.healthdata.org/gbd-compare.

6 Assuming a Value of a Statistical Life Year (VSLY) of $186 640 (indexed to $2015-16) based on: Abelson, P. 2008, *Establishing a Monetary Value for Lives Saved: Issues and Controversies*, Working papers in cost-benefit analysis, WP 2008-02, Office of Best Practice Regulation, Department of Finance and Deregulation.

Nonetheless, the amounts of compensation payments are a useful crosscheck on estimated costs associated with ARD. Not surprisingly, compensation costs are below the estimated costs of ARD derived in this study.

Mesothelioma claimants have received the highest average compensation payment at $31 960, followed by lung cancer ($19 517) and asbestosis claimants ($12 418), although there is a wide range in actual amounts paid.[7] The claims are paid through icare and do not prohibit larger common law claims.

Common law claims from companies such as James Hardie can be much larger. Average compensation payments by James Hardie were $295 000 for mesothelioma, $100 000 for asbestosis and $115 000 for lung cancer in 2015–16.[8] Additionally, a number of claims paid by James Hardie have been in the multi-millions. However, James Hardie is only one defendant and many claims are settled and confidential.

Implications for future research and policy development

ARDs impose a substantial burden on suffers and the wider community and economy. Not all costs associated with ARD are known, and certainly not all costs are measurable based on data that is available today. Hence, this report provides a lower bound estimate of the financial burden of ARD in the Australian community.

Key areas where costs have not been quantified include the costs of mental ill health associated with ARDs, and the costs of the governance and reporting framework that surrounds the current footprint of asbestos in the Australian community. Further research in these areas would expand the understanding of the costs of ARD and contribute to asbestos policy development.

Policies that are able to reduce asbestos exposure and the incidence of ARDs would reduce health system and productivity costs associated with the disease and free up valuable resources for other health priorities.

There are a wide range of policy options, all of which impose different costs and have different funding implications. The costing work understanding as part of this study, and potential future work on other identifiable costs, will help guide policy analysis that seeks to establish whether changes in asbestos policy will deliver net benefits for society.

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7 Based on data provided by icare Dust Diseases Care.

8 KPMG, 2016, Valuation of asbestos-related disease liabilities of former James Hardie entities (“the liable entities”) to be met by the AICF Trust, prepared for Asbestos Injuries Compensation Fund Limited (“AICFL”), May, 2016, available at: http://www.ir.jameshardie.com.au/public/download.jsp?id=5839&showOrig=t

1 Measuring the problem of asbestos-related diseases

Asbestos is part of Australia's built environment, reflecting a long history of the use of asbestos as a building material. Asbestos is now confirmed as a cause of various ARDs including benign pleural disease, asbestosis, lung cancer, and mesothelioma.

The number of new cases has been trending upwards and it remains an important, potentially avoidable, public health issue in Australia.

About asbestos

Asbestos has been around for thousands of years, used extensively for its insulation and fire retardant properties in domestic and industrial products. In the 1950s, Australia had the highest per capita use of asbestos in the world. Asbestos has been suspected of being associated with respiratory illness since the beginning of the twentieth century, and by the mid twentieth century, the evidence on the health risks of asbestos was indisputable.[9]

To prevent further exposure to asbestos fibres and asbestos containing materials, strict regulations are in place to regulate its use. Asbestos mining ceased in 1983, yet undiagnosed cases of ARD are likely to still exist, and asbestos products in the community remain potentially harmful.

There are three mineralogical groups of asbestos:

- chrysotile (white asbestos)
- amphibole made of crocidolite (blue asbestos), and
- amosite (brown asbestos).

The mechanism by which asbestos fibres cause diseases is not fully understood. It can take 40 years or more after initial asbestos exposure for disease caused by asbestos to become evident.

Overview of asbestos-related diseases

Different data sources and research in the literature use different definitions of ARD, which can make economic analysis difficult. The main types of conditions that are related to asbestos include:

- **mesothelioma**, which has the longest latency of any ARD, taking on average between 20 and 40 years to develop.[10] There are three types of mesothelioma – mesothelioma

9 Asthma Foundation of SA, 2010.

10 Safe Work Australia 2010, Asbestos-related disease indicators, August 2010.

of the pleura (chest), peritoneum (abdomen) and pericardium (heart). Pleural mesothelioma is the most common (94 per cent of all reported Australian cases since 1982).

- **asbestosis**, which is a chronic rather than fatal disease but can cause death from respiratory or cardiac failure, and puts patients at risk of lung cancer or mesothelioma
- asbestos-related **cancer** of the **lung, larynx, and ovaries**
- asbestos-related pleural disease (ARPD) – also known as diffuse pleural thickening caused by asbestos
- pleural plaques (is not thought to cause any disability or impairment)
- pleural effusion, and
- rounded atelectasis.

There is a distinction between diseases associated with the workplace and those outside of it, as well as cancer and non-cancer conditions.

Those highlighted in bold type are the ARDs considered in this study, as there is sufficient evidence to justify a causal link between them and asbestos exposure and they have significant costs to sufferers and society.

The inclusion of lung cancer, laryngeal cancer,[11] and ovarian cancer[12] is consistent with studies such as Pasetto, et. al. (2014).[13] We have not included benign pleural plaques, as they are an indicator of asbestos exposure rather than a disease that itself causes death.

Because of its long latency period, ARDs are most commonly present among older people. There is an upward trend in the number of people reported as diagnosed with mesothelioma: from 152 reported as diagnosed in 1982 to 649 in 2006. Several studies predict that the number of new cases will rise post 2010.[14] [15]

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11 There is sufficient evidence to infer a causal relationship between asbestos exposure and laryngeal cancer. *Institute of Medicine (US) Committee on Asbestos: Selected Health Effects. Asbestos: Selected Cancers*. Washington (DC): National Academies Press (US); 2006. 8, Laryngeal Cancer and Asbestos. Available from: https://www.ncbi.nlm.nih.gov/books/NBK20323/

12 Camargo, M. C., Stayner, L. T., Straif, K., Reina, M., Al-Alem, U., Demers, P. A., & Landrigan, P. J., 2011, 'Occupational Exposure to Asbestos and Ovarian Cancer: A Meta-analysis', *Environmental Health Perspectives*, 119(9): p.1211–1217. Available from: http://doi.org/10.1289/ehp.1003283

13 Pasetto, R., Terracini, B., Marsili, D. & Comba, P., 2014, 'Occupational burden of asbestos-related cancer in Argentina, Brazil, Colombia, and Mexico'

14 Clements, Berry and Shi (2007), Actuarial projections for mesothelioma: an epidemiological perspective, presented to the Actuaries of Australia 11th Annual Compensation Seminar.

15 Finity Consulting, *The Third Wave: Australian Mesothelioma Analysis & Projection*, March 2016, prepared for the Asbestos Safety and Eradication Agency, available at: http://www.finity.com.au/wp-content/uploads/2016/04/R_ASEA-Aust-Meso-Projection-2015_FullReportl.pdf

Approach to measuring the costs of asbestos-related diseases

This study measures the cost of ARDs in Australia in 2015. Where data for 2015 is not available we have used data for earlier years.

The main categories of costs of asbestos and ARDs are illustrated in chart 1.1, which highlights those which are quantified in this report.

1.1 Summary of the personal and financial costs of ARDs

Source: CIE.

Other studies to date tend to focus on one type of cost, or direct costs only. One example is a study by the Institute of Health and Welfare in Canada, which estimated the cost of new cases of mesothelioma in Canada in 2011 was CAD1.9 billion.[16] In Australia, the

16 Tompa, E. et al. 2015, 'The economic burden of lung cancer and mesothelioma in Canada due to occupational asbestos exposure', *At Work*, Issue 85, Summer 2016: Institute for Work and Health, Toronto, see http://www.iwh.on.ca/at-work/85/new-cases-of-mesothelioma-and-

Australian Institute of Health and Welfare (AIHW) estimated the burden of mesothelioma in Australia in 2011 was 10 473 lost DALYS.[17]

Our report estimates the total cost of ARDs in a given year (2015) for all people with the disease during that year. This includes health system costs, productivity losses and the cost of reduced quality of life.[18]

While many market and non-market cost items are valued, the costs estimated in this report should not be summed, or compared to GDP. For instance, health resource costs represent additional production that occurs because of the disease, which positively affects GDP. Conversely, productivity losses refer to the loss of production in the economy because of the disease, which negatively affects GDP. Hence, the total costs of asbestos-related disease can be interpreted as the monetary value of additional resources that are consumed (health system costs) or the value of which is lost (productivity losses) due to ARDs.

There is some evidence that stroke is associated with ARD. However, it is not clear to what extent the cost of strokes should be attributed to ARD in the situation where a sufferer of ARD has a stroke.

For this review, no estimate of stroke costs is included.

Other costs of ARD have been identified but not quantified as methodological and data limitations prevent robust valuation. For instance:

- ARD have a considerable impact on patient and family mental health, although the costs of mental ill-health are not estimated as data is not available on the number, type and severity of cases of ill-health.
- Later in this report we estimate the amount of lost quality-of-life in terms of Years of Life Lost (YLL) and Years Lived with Disability (YLD). However, the monetary value of lost-quality of life needs to be heavily qualified due to methodological limitations around the valuation of years of life for elderly people, who are the most common sufferers of ARD.
- Costs for lung, larynx and ovarian cancer associated with non-occupational exposure are difficult to estimate because attribution of disease to non-occupational exposure is difficult in the presence of other risk factors such as smoking.

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asbestos-related-lung-cancer-in-one-year-cost-19b and https://www.iwh.on.ca/system/files/at-work/at_work_85.pdf

17 Australian Institute of Health and Welfare 2016. Australian Burden of Disease Study: Impact and causes of illness and death in Australia 2011. Australian Burden of Disease Study series no. 3. BOD 4. Canberra: AIHW, available at: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129555476

18 This study adopts a prevalence approach – the prevalence of a disease is the number of people who have a disease during a year or part thereof. The prevalence approach to estimating the cost of disease involves estimating the total cost in a given year of the disease for all people with the disease during that year. An alternative method would be an incidence approach – the incidence of a disease is the number of new cases of a disease in a given year. The incidence approach to estimating the cost of disease involves estimating the projected total cost of the disease for all people who are newly diagnosed with the disease during that year.

- Costs associated with carers have not been robustly estimated due to a lack of data indicating the number of carers and time spent with suffers of ARDs.[19] We present an indicative estimate of these costs in Chapter 5.

19 PWC (2010) estimated the costs of paid and unpaid carers associated with atrial fibrillation, for which more data is available: PricewaterhouseCoopers, 2010, *The economic costs of atrial fibrillation*, prepared for the National Stroke Foundation, p.34, available at: http://www.atrialfibrillation-au.org/files/file/Publications/121126-Economic%20costs%20of%20atrial%20fibrillation%20in%20Australia.pdf

2 Population with asbestos-related diseases

There were 4 152 deaths in 2015 due to ARDs, and 10 444 prevalent cases, 92 per cent of which were due to occupational exposure to asbestos.

The proportion of prevalent cases associated with non-occupational exposure is expected to rise as the third wave of diseases continues and home renovators and community members are exposed to asbestos when the existing asbestos stock is damaged or unsafely removed, replaced and disposed of over time.

Summary of prevalence of disease and deaths

The prevalence of a disease is the number of people suffering from the disease in a given year. The population of people with ARDs is generally monitored, with state-based cancer registries tracking the number of sufferers and deaths. A notable exception is asbestosis, for which no prevalence data is available. Table 2.1 summarises the main indicators of prevalence and deaths for each ARD. There were over 4 000 deaths among 10 444 people with ARD in 2015.

2.1 Summary of deaths and prevalence of asbestos-related disease in 2015

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
ARD-related deaths						
Male	639	61	2 847	55	0	3 601
Female	133	1	397	0	19	551
Both	772	62	3 244	55	19	4 152
ARD-related prevalence						
Male	1 260	b	6 845	646	0	8 752
Female	302	b	1 265	5	120	1 693
Both	1 562	b	8 111	651	120	10 444

[a] Includes tracheal, bronchus, and lung cancer.

[b] The prevalence of asbestosis is not known because cases of asbestosis are not mandatorily reported (unlike, for example, mesothelioma which is monitored by the Australian Mesothelioma Registry).

Source: Global Burden of Disease project (‘GBD Compare’ tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Estimating the population with asbestos-related disease

Detailed data about the population of sufferers and deaths due to ARD is available and is disaggregated by age and sex. These data have been obtained from the Global Burden of Disease study, through the GBD Compare online tool.[20]

Data on the number of prevalent cases and deaths from lung, larynx and ovarian cancer are routinely collected by state cancer registries such as the NSW Cancer Registry. Additionally, the Australian Mesothelioma Registry provides information about the population with mesothelioma including some information about asbestos exposure.[21]

The GBD dataset collates various data sources to provide one consistent source for data about the population with ARDs. This gives a consistent set of death, prevalence and other measures of the impact of the disease for a given year. Not all data is available from this source. For example, while the number of deaths associated with lung, larynx and ovarian cancer caused by occupational asbestos exposure is known, data is not available indicating deaths associated with these diseases where caused by non-occupational exposure. We estimate the number of deaths associated with these diseases where caused by non-occupational exposure to asbestos. We assume that the ratio of deaths due to mesothelioma caused by occupational and non-occupational exposure is equal to the ratio of deaths caused by occupational and non-occupational exposure for these other diseases.

Table 2.2 shows what data is available and where estimates have been made based on other assumptions or sources. The methodology and assumptions used to estimate prevalence and deaths where data is unavailable are explained in Appendix A. The number of deaths associated with ARDs is not known with certainty, and the GBD estimates lower and upper bounds for the number of deaths associated with ARDs.

2.2 Data available about population with asbestos-related diseases

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer
Deaths	Yes	Yes	Yes	Yes	Yes
▪ Total asbestos-related and non-asbestos related	Yes	Yes	Estimated [b]	Estimated [b]	Estimated [b]
▪ Occupational exposure	Yes	Yes	Yes	Yes	Yes
▪ Non-occupational exposure	Yes	Yes [c]	Estimated [b]	Estimated [b]	Estimated [b]
Prevalence	Yes	N/A	Yes	Yes	Yes
▪ Total asbestos-related and non-asbestos related	Yes	N/A	Estimated	Estimated	Estimated
▪ Occupational exposure	Estimated	N/A	Estimated	Estimated	Estimated

20 Institute for Health Metrics and Evaluation (IHME). GBD Compare Data Visualization. Seattle, WA: IHME, University of Washington, 2016. Available from http://vizhub.healthdata.org/gbd-compare.

21 See https://www.mesothelioma-australia.com/home/

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer
▪ Non-occupational exposure	Estimated	N/A	Estimated	Estimated	Estimated

[a] Includes tracheal, bronchus, and lung cancer.

[b] The GBD Compare dataset indicates the number of deaths that are associated with occupational exposure to asbestos. The assumptions used to estimate the proportion of death associated with non-occupational exposure are discussed in Appendix A.

[c] It is assumed that the number of deaths and cases of asbestosis associated with non-occupational exposure are zero. This is because asbestosis is caused by heavy exposure to asbestos, usually in workplace environments (see Appendix A).

Note: 'Yes' indicates that this data is available. 'Estimated' indicates that this data has been estimated based on the other data that is available. N/A indicates that the data is not available and has not been estimated.

Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Global Burden of Disease 2015 methods

Data from the GBD provides useful information on broad relativities of disease burden, on the relative importance of different causes of death and disability, and on regional patterns and inequalities.

In calculating Disability-Adjusted Life Years (DALYs), the GBD:

- uses a new normative standard life table for the loss function used to compute Years of Life Lost (YLL) (which was updated in the 2015 version of the GBD)
- calculates Years Lived with Disability (YLDs) simply as the prevalence of each sequela multiplied by the relevant disability weight
- makes adjustment for comorbidity in the calculation of YLD
- does not including discounting for time or unequal age weights

The most recent version of the GBD included an updated loss function for the computation.

Non-fatal health states are quantified using disability weights, which capture impacts on different functions, capacities or aspects of living, where loss of functioning is measured on a scale where 1 (perfect health) and 0 (a state equivalent to death).

The World Health Organisation (WHO) Global Health Estimates (GHE) 2015 and GBD 2015 use different disability weights for certain diseases.[22] However, for all stages of cancer including diagnosis and primary therapy, metastatic and the terminal phase the disability weight for GHE 2015 and GBD 2015 is the same. For example, the disability weight for the terminal phase of cancers with medication is 0.540. Likewise, both GHE 2015 and GBD 2015 use the same disability weights for Chronic Obstructive Pulmonary Disease (COPD) and other chronic respiratory problems.

Deaths due to asbestos-related disease

Deaths due to ARD are monitored by state-based cancer registries, the Australian Mesothelioma Registry (AMR) and the state-based Registrars of Births, Deaths and

22 See the WHO GHE technical paper, which discusses the methodologies of the GHE 2015 and GBD 2015: World Health Organisation, 2017, *WHO methods and data sources for global burden of disease estimates 2000–2015*, Annex Table D.

Marriages (reported by the Australian Bureau of Statistics).[23] Table 2.3 summarises the estimated number of deaths due to ARD. Approximately 87 per cent of people who die from ARDs are male. These figures have generally been obtained from the GBD Compare tool, and rely on Cause of Death data for 2015 reported in 2016.[24] Where data was not available on the number of deaths due to an ARD associated with non-occupational exposure to asbestos, we have estimated this figure (see table 2.2 and Appendix A).

2.3 Deaths due to asbestos-related diseases in 2015

Patient category	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
Occupational exposure						
Male	592	61	2 726	53	0	3 431
Female	98	1	318	0	15	432
Both	689	62	3 044	53	15	3 864
Non-occupational exposure						
Male	47	0	121	2	0	169
Female	36	0	79	0	4	119
Both	83	0	200	2	4	288
All sources of exposure						
Male	639	61	2 847	55	0	3 601
Female	133	1	397	0	19	551
Both	772	62	3 244	55	19	4 152

[a] Includes tracheal, bronchus, and lung cancer.

Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Most people with ARD are over 65, due to the lag time between exposure and contraction, which may be 20-40 years for a disease such as mesothelioma. Chart 2.4 shows the number of deaths due to all ARD by age and sex.

The share of deaths that are due to occupational exposure to asbestos is higher for older people. Chart 2.5 shows the number of deaths associated with occupational and non-occupational exposure, and the share of deaths due to each exposure source.

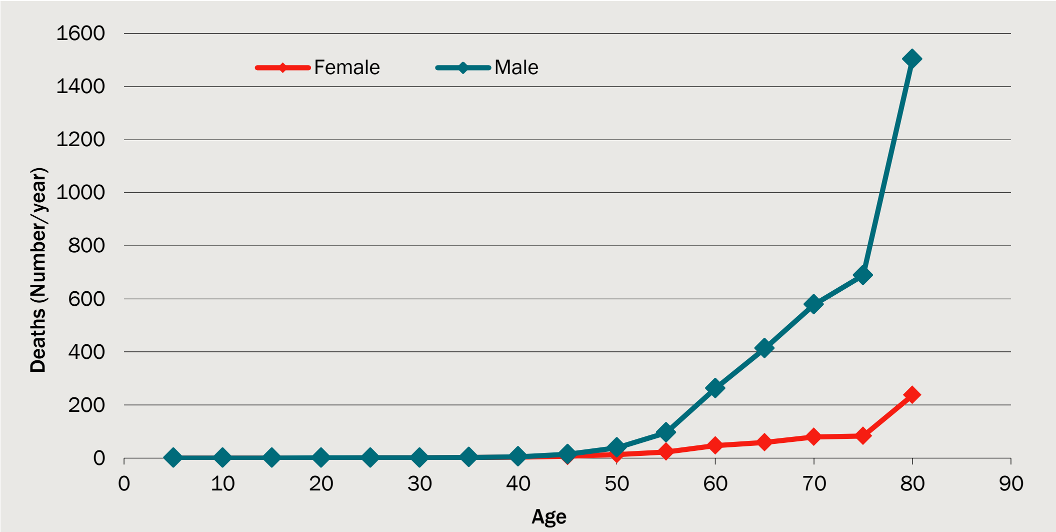
This observation aligns with the explanation of the three waves of exposure. The first wave (asbestos mining and manufacturing) mainly affected men because workers in these

23 The ABS publishes 'Causes of Death' data, for example: ABS, *Causes of Death, Australia, 2015*, Cat. No. 3303.0, Canberra, Australia.

24 While Cause of Death data for 2015 may be revised slightly in subsequent years, differences are not expected to be significant. Mesothelioma and other ARD deaths are not processed through the coronial information system. Coroners generally examine unnatural and suspicious deaths or serious injury/damage due to fires and explosions, and coronial data is subject to more significant revisions are coronial cases may take a few years to finalise. Therefore, we believe the GBD Study data relying on Cause of Death records is robust and accurate.

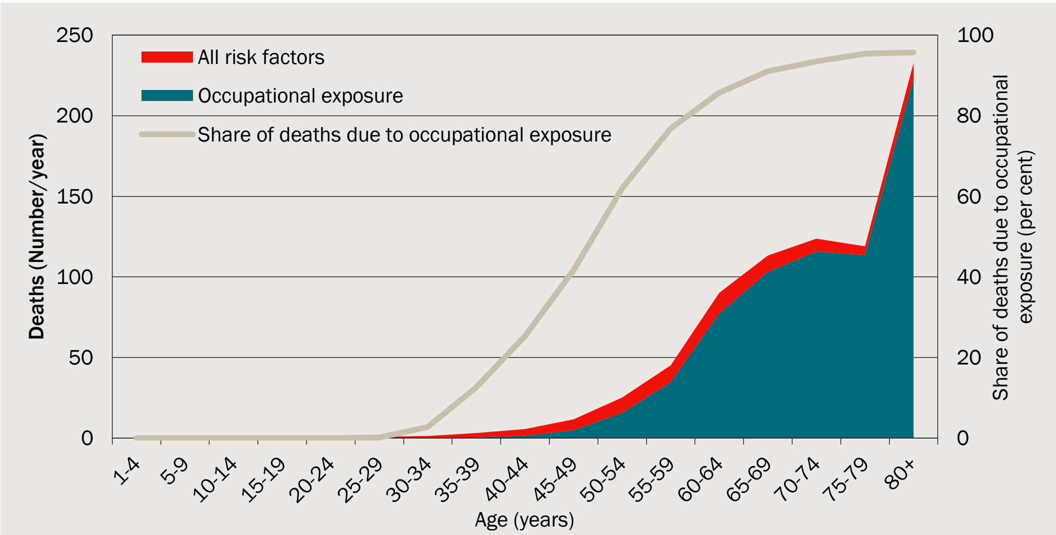
environments were more commonly men. The second and third waves affected proportionally more women, who were more likely to be in these environments than the asbestos mining environment.

2.4 Deaths due to asbestos-related disease by age and sex in 2015



Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

2.5 Deaths due to mesothelioma caused by occupational and non-occupational exposure in 2015



Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

The number of deaths associated with ARDs is not known with certainty, and the GBD estimates lower and upper bounds for the number of deaths associated with ARDs in 2015. Table 2.6 shows the central, lower and upper estimates from the GBD study for each ARD. The total number of deaths associated with ARD is estimated to be between a lower bound of 3000 and an upper bound of 5 483. These figures are 28 per cent below and 32 per cent above the central estimate respectively. The number of asbestosis deaths is highly uncertain, with a lower bound 87 per cent below and an upper bound 120 per cent above the central estimate.

2.6 Lower and upper bounds for number of deaths due to ARDs in 2015

Patient category	Mesothelioma	Asbestosis	Lung cancer	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
Central Estimate						
Male	639	61	2 847	55	0	3 601
Female	133	1	397	0	19	551
Both	772	62	3 244	55	19	4 152
Lower bound						
Male	440	8	2 122	27	0	2 596
Female	90	0	304	0	10	404
Both	530	8	2 425	27	10	3 000
Upper bound						
Male	895	132	3 600	90	0	4 718
Female	193	3	536	1	33	765
Both	1 088	135	4 136	91	33	5 483

Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

A further source of uncertainty is related to the attribution of cases where there are multiple causes of death. Misclassification of the 'underlying cause' of death may lead to inaccuracy in measures of ARD mortality. For example, the GBD Compare tool reports 206.26 deaths due to asbestosis for Great Britain (England, Wales and Scotland), while the equivalent data in the national asbestosis register for Great Britain indicated 431 times where asbestosis was mentioned on the death certificate and 198 instances where it was recorded as the cause of death. This illustrates that mortality measures depend on attribution of cases where an ARD is mentioned on the death certificate but not determined to be the underlying cause of death. It also shows that the GBD Study may be somewhat conservative in its estimates of ARD mortality (particularly for asbestosis, where attribution of the underlying cause of death may be more difficult than for mesothelioma or other cancers).

There are other sources for ARD mortality estimates such as the World Health Organisation (WHO), as discussed in Odegerel et al. (2017).[25] This recent study estimates the global mesothelioma burden and presents estimates of mortality which are higher than the GBD Study. Other estimates produced by the WHO and others are also higher than the GBD estimates. The GBD study is a reputable, accurate and robust

25 Odgerel C-O, Takahashi K, Sorahan T, et al. 2017, 'Estimation of the global burden of mesothelioma deaths from incomplete national mortality data', *Occup Environ Med*, Published Online First: 02 September 2017. doi: 10.1136/oemed-2017-104298, available at: http://oem.bmj.com/content/early/2017/09/02/oemed-2017-104298

source of data, however this comparison highlights that our estimates of ARD mortality may be conservative.

Prevalence of asbestos-related diseases

The amount of data available indicating prevalence of ARD varies by disease:

- Prevalent cases of mesothelioma diagnosed since 1st July 2010 are monitored by the Australian Mesothelioma Registry.[26]
- While the prevalence of lung, larynx, and ovarian cancer is monitored by state cancer registries, the proportion of these cases that are associated with asbestos exposure is not known.
- Asbestosis prevalence is not monitored by these bodies since it is not a notifiable disease.[27]

Prevalence data has been obtained through the Global Burden of Disease Compare tool. The GBD Study uses a Population Attributable Fraction (PAF) approach. Table 2.7 shows the prevalence of ARD excluding asbestosis.

Additionally, data is not available from the GBD Compare tool that identifies the type of exposure (occupational or non-occupational) for prevalent cases of ARD. Occupational and non-occupational prevalence is assumed to be the same as the proportion of deaths from mesothelioma arising from occupational and non-occupational exposure.

2.7 Prevalence of asbestos-related diseases in 2015

Patient category	Mesothelioma	Asbestosis	Lung cancer a	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
Occupational exposure						
Male	1 168	N/A	6 530	625	0	8 323
Female	223	N/A	995	4	90	1 311
Both	1 391	N/A	7 525	629	90	9 634
Non-occupational exposure						
Male	92	N/A	315	21	0	429
Female	79	N/A	271	1	31	382
Both	172	N/A	586	22	31	811
All sources of exposure						
Male	1 260	N/A	6 845	646	0	8 752
Female	302	N/A	1 265	5	120	1 693

26 See https://www.mesothelioma-australia.com/home/

27 Safe Work Australia, 2014, *Asbestos-related disease indicators*, p. 8, available at: https://safeworkaustralia.gov.au/system/files/documents/1702/asbestos_related_disease_indicators_2014.pdf

Patient category	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
Both	1 562	N/A	8 111	651	120	10 444

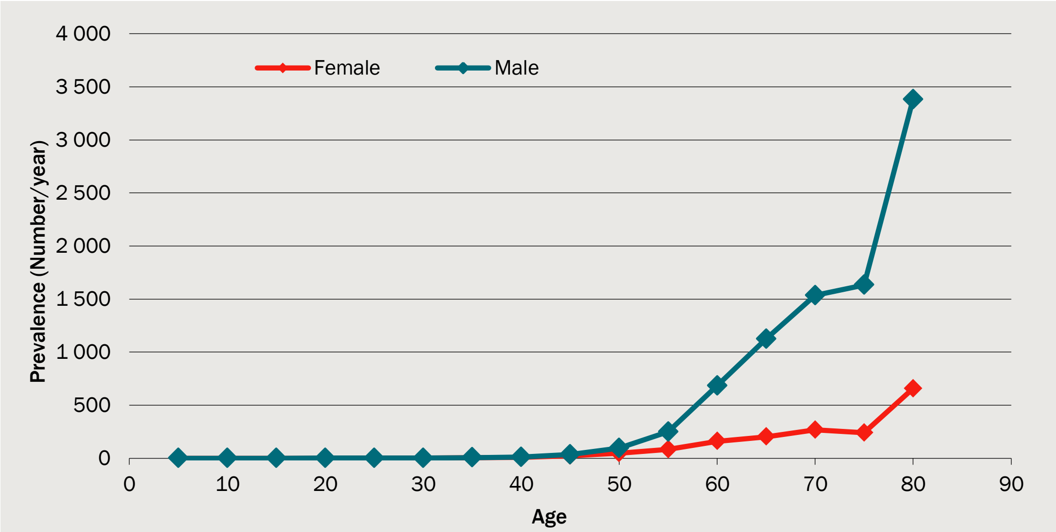
[a] Includes tracheal, bronchus, and lung cancer.

Note: Totals may not add due to rounding.

Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Similarly to deaths, prevalence of ARD is higher among older people and males. Chart 2.8 shows the prevalence of ARDs by age and sex.

2.8 Prevalence of asbestos-related disease by age and sex in 2015



Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Table 2.9 presents the central, lower and upper estimates of prevalence from the GBD study for each asbestos-related disease. The total number of prevalent cases associated with asbestos-related disease is estimated to be between a lower bound of 7 526 and an upper bound of 13 903.

2.9 Lower and upper bounds for prevalence of ARDs in 2015

Patient category	Mesothelioma	Asbestosis	Lung cancer	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
Central Estimate						
Male	1 260	N/A	6 845	646	0	8 752
Female	302	N/A	1 265	5	120	1 693
Both	1 562	N/A	8 111	651	120	10 444
Lower bound						
Male	869	N/A	5 096	301	0	6 267
Female	205	N/A	988	2	65	1 259
Both	1 074	N/A	6 084	304	65	7 526

Patient category	Mesothelioma	Asbestosis	Lung cancer	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
Upper bound						
Male	1 766	N/A	8 693	1 106	0	11 565
Female	437	N/A	1 691	9	201	2 338
Both	2 203	N/A	10 384	1 115	201	13 903

Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Hospital usage

Usage of hospitals may give an indication of the number of people suffering from asbestosis. This is one approach to determining the prevalence of asbestosis discussed by Safe Work Australia (2014).[28] The term 'hospital separation' refers to an 'episode of care'[29] at a hospital. This may be a full hospital stay, or a portion of a hospital stay associated with a particular type of care (e.g. acute, rehabilitation).

The number of hospital separations gives a general indication of the number of people suffering from asbestosis. The number of hospital separations is not an accurate measure of the number of sufferers in a given year, as a single sufferer may visit a hospital multiple times. In addition, some sufferers may receive care outside hospitals, or not receive ongoing care for their illness.

Asbestosis can be categorised according to the ICD-10-AM diagnosis code 'J61' that is named 'Pneumoconiosis due to asbestos and other mineral fibres'. Hospital separation data for 2014/15 has been obtained from AIHW.[30] There were 128 separations for males and 6 separations for females associated with this code in 2014/15.

28 Safe Work Australia, 2014, *Asbestos-related disease indicators*, p. 8, available at: https://safeworkaustralia.gov.au/system/files/documents/1702/asbestos_related_disease_indicators_2014.pdf

29 For a description of how separations are defined in the AIHW data used in this analysis, see the following: http://www.aihw.gov.au/hospitals-data/national-hospital-morbidity-database/

30 AIHW Principal Diagnosis data cubes for 2014-15, available at: http://www.aihw.gov.au/hospitals-data/principal-diagnosis-data-cubes/

3 Health system costs

Patients and Government incur healthcare costs associated with ARDs. Total health system costs related to ARD are estimated at $192 million in 2015-16 (shown in table 3.1 and figure 3.2).

- **Admitted patient hospital expenditure is estimated at $53.7 million. Average costs per separation are highest for patients with asbestosis ($20 562) and lowest for patients with mesothelioma ($4 893).**
- **Non-admitted patient expenditure on hospital costs is valued at $9.5 million, with most incurred for patients with asbestos-related lung cancer (73 per cent).**
- **General Practitioner (GP) expenditure related to ARDs is estimated at $21.5 million, and spending on specialists and other health practitioners is valued at $48.4 million, predominantly associated with lung cancer.**
- **Spending on pharmaceuticals is estimated at $59.0 million in 2015-16, 83 per cent of which is Australian Government subsidies offered through the Pharmaceutical Benefits Scheme (PBS), and the remainder incurred by patients in out-of-pocket costs.**

3.1 Total health system costs by ARD in 2015-16

Health system cost category	Mesothelioma	Asbestosis	Lung cancer	Larynx cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Hospital - admitted patients	9.5	2.8	39.4	1.7	0.3	53.7
Hospital - non-admitted patients	1.7	0.5	7.0	0.3	0.1	9.5
GP services	3.8	1.1	15.8	0.7	0.1	21.5
Specialists and other practitioners	8.6	2.5	35.5	1.5	0.3	48.4
Pharmaceutical	38.2	0.5	18.6	1.5	0.3	59.0
Total	**61.7**	**7.3**	**116.2**	**5.7**	**1.1**	**192.0**

Source: CIE.

3.2 Summary of health system costs

Source: CIE

Estimating health resource costs

Several expenditure items have been costed as part of this study to estimate the total cost incurred to treat patients with ARDs.

These costs relate to health resources for the following ICD-10-AM diagnosis codes:

- Mesothelioma – C45
- Asbestosis – J61
- Lung cancer – C34
- Larynx cancer – C32
- Ovarian cancer – C56

Each ICD-10 code can be aligned to a number of AR-DRG codes (Diagnostic-related group procedure codes).[31]

Admitted hospital patient expenditure

Admitted hospital patient expenditure is the majority of hospital expenditure (approximately 85 per cent). It includes all hospital expenditure where the patient is admitted as a patient.

Recent data on admitted patient expenditure by disease is not publicly available and has been sourced directly from Australian Institute of Health and Welfare (AIHW) through a data request. The most recently available data is for 2012-13.

The data supplied by AIHW have been extracted from the AIHW Admitted Patient Expenditure database, which was primarily constructed from the AIHW's National Hospital Morbidity and Health Expenditure databases. The database contains admitted patient hospital activity from public and private hospitals within Australia. This data was used by AIHW to estimate the expenditure associated with each hospital separation, and then further broken down to estimate the expenditure on each diagnosis code (classified according to the ICD_10-AM 8th edition) recorded for the separation.

This data was converted from 2012–13 dollars to 2015–16 dollars using two different data sources:

- The *NHCDC Public Hospitals Cost Report Round 17* (2012–2013) and *Round 19* (2014–15) provide the most accurate data about the casemix-adjusted cost per public hospital separation, which increased 9.1 per cent between 2012–13 to 2015–16. The *Round 18 Private Sector Overnight NHCDC*[32] does not provide data on changes in private hospital separations over time, so we assume that the casemix-adjusted cost per private hospital separation also increased 9.1 per cent between 2012–13 to 2015–16.
- Australian Bureau of Statistics (ABS) data on changes in the prices of medical and hospital services across Australia[33] indicate the change in prices was 5.9 per cent between 2014–15 and 15–16.

Combining these data sources suggests that the casemix-adjusted cost per hospital separation increased 15.5 per cent between 2012–13 and 2015–16. However, total admitted patient expenditure has likely increased more than 15.5 per cent since 2012–13 due to increases in the population with ARDs. Data relating to the prevalence and deaths due to ARDs is only available in 5-year intervals from the GBD study, making it difficult

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31 There are many ICD-10 codes applicable to many DRG codes, meaning that it is not possible to identify the number of mesothelioma-related separations by DRG, since separations for the applicable DRGs include other diseases than just mesothelioma.

32 NHCDC, 2015, *Round 18 Private Sector Overnight NHCDC*, available at: https://www.ihpa.gov.au/sites/g/files/net636/f/publications/nhcdc_r18_-_private_overnight.pdf

33 ABS, *Consumer Price Index, Australia,* Table 9. CPI: Group, Sub-group and Expenditure Class, Index Numbers by Capital city, Series: Medical and hospital services, Australia (series ID A2329041T).

to reliably update costs since this time. Thus, we conservatively assume that total admitted patient expenditure increased 15.5 per cent since 2012–13.

Table 3.3 summarises estimated admitted patient expenditure attributable to ARDs for 2015/16. It shows that expenditure on lung cancer ($39.4 million) is more than four times the amount of expenditure on mesothelioma ($9.5 million).

3.3 Admitted patient expenditure in 2015-16 attributed to asbestos-related diseases

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Occupational						
Public hospitals	5.9	2.2	29.3	1.2	0.1	38.8
Private hospital	2.6	0.5	7.1	0.4	0.1	10.8
Non-occupational						
Public hospitals	0.7	0.0	2.4	0.0	0.1	3.2
Private hospital	0.3	0.0	0.6	0.0	0.0	0.9
All exposure						
Public hospitals	6.6	2.2	31.7	1.3	0.2	42.0
Private hospital	2.9	0.5	7.7	0.5	0.1	11.7
Total	**9.5**	**2.8**	**39.4**	**1.7**	**0.3**	**53.7**

[a] Includes tracheal, bronchus, and lung cancer.

Note: Expenditure by disease has been attributed to cases where the cause of the disease was asbestos exposure based on the ratio of ARD deaths to non-ARD deaths for each disease.

Source: AIHW Admitted Patient Expenditure custom data request, CIE.

Hospital cost estimates rely on data collected by hospitals using the ICD_10-AM system. Cost and hospital usage estimates may be understated if pre-diagnosis hospitalisation and surgery time is not captured. Mesothelioma patients may only be diagnosed after pleural effusions and surgery have been performed, and while we expect these costs will still be allocated to the mesothelioma ICD_10 code, there may be imperfections in data collection. Nonetheless, AIHW data is high quality, robust and the best available.

In cases where there are multiple diagnoses for a separation, each diagnosis recorded on the hospital record is compared to a list of cost-relevant diagnoses developed by the AIHW in conjunction with the IHPA. All cost-relevant diagnoses within a separation are weighted equally. That is, the cost of the separation is divided equally across all cost-relevant diagnoses.

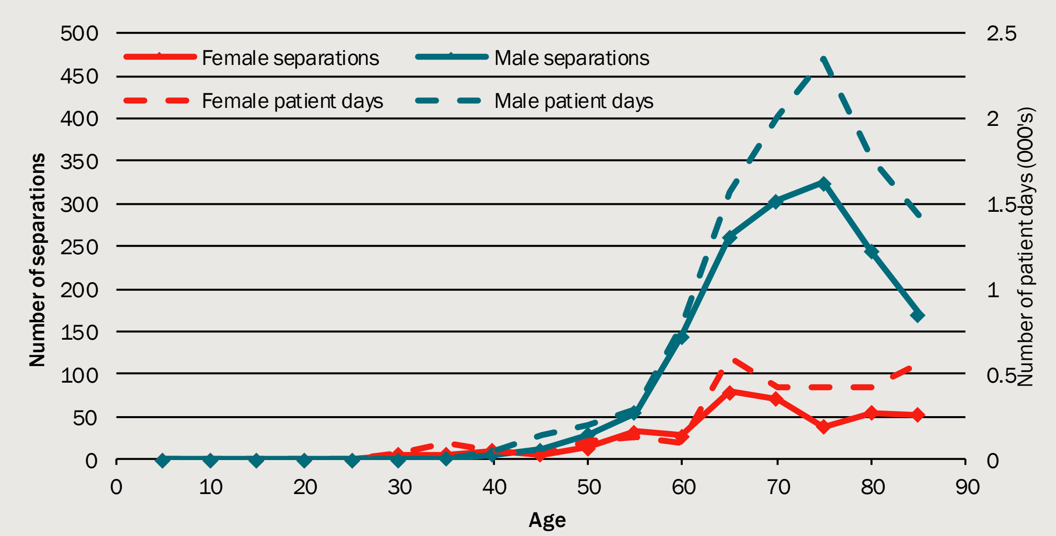
Hospital usage statistics are publicly available from AIHW by disease code for 2014-15.[34] These statistics measure the:

34 AIHW Principal diagnosis data cubes, 'Separation statistics by principal diagnosis in ICD-10-AM, Australia 2012-13 to 2014-15', available at: http://reporting.aihw.gov.au/Reports/openRVUrl.do?rsRID=SBIP%3A%2F%2FMETASER

- number of hospital separations
- number of patient days, and
- average patient days per separation.[35]

Chart 3.4 presents the number of separations and patient days by age and sex for mesothelioma. It shows that mesothelioma separations are higher for men than women, and that the number of patient days increases more rapidly with age than the number of separations. The number of average patient days per separation increases with age.

3.4 Number of mesothelioma separations (2014/15)



Data source: AIHW data cubes, CIE.

Table 3.5 summarises the measures of hospital usage across all ARDs. Average patient days is relatively similar across diseases; however, it is somewhat higher for Larynx cancer.

3.5 Measures of hospital usage by admitted ARD patients in 2014-15

Measure of hospital usage	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer
	Number/year	Number/year	Number/year	Number/year	Number/year
Patient days	13 558	857	41 214	1 878	192
Separations	1 945	134	5 538	198	24
Average patient days	7.0	6.4	7.4	9.5	7.9

[a] Includes tracheal, bronchus, and lung cancer.

Source: AIHW data cubes, CIE.

VER%2FAIHW%2FReleasedPublic%2FHospitals%2FReports%2FHDU_PDX%201315%20suppressed.srx%28Report%29

35 A hospital separation is a process by which an episode of care for an admitted patient ceases, which may be due to death, discharge or other events.

Table 3.6 converts measures of total admitted patient expenditure (in 2015-16) attributable to ARDs into unit costs per patient day and separation (based on 2014-15 hospital usage data).

There is significant variation in the cost per prevalent case across diseases, with the cost being highest for mesothelioma and lung cancer. This may reflect different patterns of separations, and so the cost per separation is the most useful 'unit cost' to assess the relative cost of each disease. The cost per separation is highest for asbestosis.

Cost per death has not been included because it does not have a sensible interpretation. The cost per death for asbestosis suffers is very high, however this reflects the fact that a low proportion of asbestosis sufferers die each year relative to the number of separations.

3.6 Unit costs of admitted patient care attributable to asbestos-related diseases in 2015-16

Measures of cost	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer
	$	$	$	$	$
Cost per prevalent case	6 091		4 855	2 627	2 628
Cost per separation	4 893	20 562	7 111	8 646	12 923
Cost per patient day	702	3 215	955	910	1 644

[a] Includes tracheal, bronchus, and lung cancer.

Note: These unit costs use health system costs for 2015-16, prevalence data from 2015, and hospital usage (separations and patient days) data from 2014-15. Therefore, these unit cost estimates rely on the implicit assumption that hospital usage does not increase between 2014-15 and 2015-16. AIHW hospital usage data suggests that the number of separations across all ARDs increased 2.5 per cent from 2013-14 to 2014-15 but the number of patient days decreased 1.3 per cent. We have assumed hospital usage remains at its 2014-15 level rather than projecting growth in hospital usage to allow for these offsetting impacts.

Source: CIE.

Non-admitted hospital patient expenditure

There is no data about non-admitted patient expenditure associated with ARD.

The NHCDC Public Hospitals Cost Report (2014-15) provides data on aggregate admitted and non-admitted patient expenditure. Total non-admitted patient expenditure was $4.67 billion while admitted patient expenditure was $26.38 billion in 2014–15.[36] The NHCDC uses quality-controlled data submitted by hospitals accounting for almost 94 per cent of all admitted acute separations.

Based on the ratio of admitted to non-admitted patient expenditure in aggregate and the amount of admitted patient expenditure estimated earlier in this chapter, we have estimated the amount of total non-admitted patient expenditure that is associated with ARDs.[37] This calculation can be represented by the following equation:

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36 National Hospital Cost Data Collection, Public Hospitals Cost Report, Round 19 (Financial year 2014-15), see: https://www.ihpa.gov.au/publications/national-hospital-cost-data-collection-public-hospitals-cost-report-round-19-financial

37 This is similar to the approach used by PwC to estimate the costs of non-admitted hospital services attributable to Atrial Fibrillation, PricewaterhouseCoopers, 2010, *The economic costs of*

$$Non - admitted\ exp_{ARD} = \frac{Non - admitted\ exp_{aggregate}}{Admitted\ exp_{aggregate}} \times Admitted\ exp_{ARD}$$

where

- $Non - admitted\ exp_{ARD}$ is the amount of non-admitted patient expenditure attributable to each ARD,
- $Non - admitted\ exp_{total}$ and $Admitted\ exp_{total}$ refer to aggregate non-admitted patient expenditure ($4.67 billion in 2014/15) and aggregate admitted patient expenditure ($26.38 billion in 2014/15), and
- $Admitted\ exp_{ARD}$ refers to the admitted patient expenditure attributable to each ARD estimated earlier in this chapter using AIHW data.

Stated in other terms, these estimates rely on the assumption that the ratio of aggregate non-admitted to admitted patient expenditure is equal to the ratio of non-admitted to admitted patient expenditure for ARD patients.

Based on the NHCDC data, the ratio of aggregate non-admitted to admitted patient expenditure is 0.18. Table 3.7 presents our estimates of non-admitted patient expenditure for 2015–16 attributable to each ARD. For comparison, it also includes our estimate of admitted patient expenditure attributable to ARD.

3.7 Non-admitted patient expenditure attributable to asbestos-related diseases in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Admitted patient expenditure	9.5	2.8	39.4	1.7	0.3	53.7
Non-admitted patient expenditure	1.7	0.5	7.0	0.3	0.1	9.5

[a] Includes tracheal, bronchus, and lung cancer.

Note: All values in $2015–16 because non-admitted patient expenditure is estimated as a proportion of admitted patient expenditure in $2015–16.

Source: CIE.

General practice expenditure

ARD patients may initially seek help for symptoms from Emergency Departments or via a GP or respiratory physician.[38]

While data is available that indicates expenditure on GPs for some diseases, this data is not available for mesothelioma or other ARDs.

atrial fibrillation, prepared for the National Stroke Foundation, p.34, available at: http://www.atrialfibrillation-au.org/files/file/Publications/121126-Economic%20costs%20of%20atrial%20fibrillation%20in%20Australia.pdf

38 Mclean, J. & McCaughan, B., 2013, *Diagnosis and treatment: The journey of a patient with malignant pleural mesothelioma*, Sydney: The Baird Institute.

Data is available about aggregate expenditure on GP services, which indicates that aggregate government spending on GP services was $6.8 billion in 2015-16.[39] Government spending represented 83.6 per cent of aggregate health spending on unreferred medical services in 2014-15, with the remainder paid by the non-government sector and individuals.[40] Therefore, we estimate that total public and private spending on GP services was $11.2 billion in 2015/16.

We scale this amount of total GP spending to estimate the amount that is attributable to ARDs. The scaling of this amount is based on the ratio of admitted patient expenditure for each ARD to aggregate admitted patient expenditure. Therefore, we are assuming that the proportion of GP costs attributable to ARDs is equal to the proportion of attributable hospital costs. The accuracy of these estimates will be dependent on the validity of this assumption.

This calculation can be represented by the following equation:

$$GP\ exp_{ARD} = \frac{Admitted\ exp_{ARD}}{Admitted\ exp_{aggregate}} \times GP\ exp_{aggregate}$$

where

- $GP\ exp_{ARD}$ is the amount of GP expenditure attributable to each ARD
- $Admitted\ exp_{ARD}$ ($53.7 million) and $Admitted\ exp_{aggregate}$ ($27.9 billion in $2015/16)[41] are the amounts of admitted patient expenditure attributable to each ARD and in aggregate respectively, and
- $GP\ exp_{aggregate}$ refers to total government and private expenditure on GP services.

Table 3.8 presents our estimates of total GP spending.

3.8 General practice expenditure associated with ARDs in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
Admitted patient expenditure associated with ARDs	$9.5mn	$2.8mn	$39.4mn	$1.7mn	$0.3mn	$53.7mn
Ratio to aggregate admitted patient expenditure	0.034%	0.010%	0.141%	0.006%	0.001%	0.192%

39 This includes total non-referred attendances including GP/vocationally recognised GP, Enhanced Primary Care, other, and practice nurse items. See Britt, H. et. al, 2016, *General practice activity in Australia 2015-16*, BEACH, p.1.

40 Australian Institute of Health and Welfare 2016. *Health expenditure Australia 2014–15. Health and welfare expenditure* series no. 57. Cat. no. HWE 67. Canberra: AIHW. Table A3, available at: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129557188

41 This value has been converted from $2014–15 (sourced from AIHW *NHCDC Round 19 2014/15*) to $2015–16 using inflation data for Medical and Hospital services. This includes other medical services in addition to hospital services, however hospital-specific price data (from the *NHCDC*) is not yet available for 2015–16. The source of inflation data is: ABS, *Consumer Price Index, Australia,* Table 9. CPI: Group, Sub-group and Expenditure Class, Index Numbers by Capital city, Series: Medical and hospital services, Australia (series ID A2329041T).

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
GP expenditure associated with ARDs	$3.8mn	$1.1mn	$15.8mn	$0.7mn	$0.1mn	$21.5mn

[a] Includes tracheal, bronchus, and lung cancer.

Source: CIE.

Specialist and other health practitioner expenses

Specialist medical services may include services such as those provided by a respiratory disease specialist. Additionally, sufferers of ARDs may require primary health care from other health practitioners that are not GPs and are not provided at hospitals.

No data is available on usage of specialist or other health practitioner services by sufferers of ARD.

However, data is available about aggregate expenditure on these areas of health expenditure. This includes the following areas of expenditure, with total government and non-government spending from the AIHW *Health Expenditure* report[42] shown in brackets (in $2014–15):

- primary health care – 'Other health practitioners' ($5.5 billion), and
- referred medical services ($16.9 billion).

The sum of this expenditure equates to $23.8 million in $2015–16.[43]

We scale this amount of total specialist/other spending to estimate the amount that is attributable to ARDs. The scaling of this amount is based on the ratio of admitted patient expenditure for each ARD to aggregate admitted patient expenditure. We assume that a similar proportion of aggregate spending on specialist medical services is attributable to ARD patients as the proportion of admitted patient expenditure attributable to ARD patients.

This calculation can be represented by the following equation:

$$Specialist\ exp_{ARD} = \frac{Admitted\ exp_{ARD}}{Admitted\ exp_{aggregate}} \times Specialist\ exp_{total}$$

where

- $Specialist\ exp_{ARD}$ is the amount of specialist expenditure attributable to each ARD

42 Australian Institute of Health and Welfare 2016. *Health expenditure Australia 2014–15. Health and welfare expenditure* series no. 57. Cat. no. HWE 67. Canberra: AIHW. Table A3, available at: https://www.aihw.gov.au/getmedia/a13427b8-d5de-495d-8b8f-4fd114f135d0/20279.pdf.aspx?inline=true

43 These values have been converted from $2014–15 to $2015–16 using inflation data for Medical and Hospital services: ABS, *Consumer Price Index, Australia,* Table 9. CPI: Group, Sub-group and Expenditure Class, Index Numbers by Capital city, Series: Medical and hospital services, Australia (series ID A2329041T).

- $Admitted\ exp_{ARD}$ ($53.7 million) and $Admitted\ exp_{aggregate}$ ($27.9 billion in $2015/16) are the amounts of admitted patient expenditure attributable to each ARD and in aggregate respectively, and
- $Specialist\ exp_{total}$ refers to total government and private expenditure on GP services.

Table 3.12 presents our estimates of total specialist and other health practitioner spending.

3.9 Specialist and other health practitioner expenditure associated with ARDs in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
Admitted patient expenditure associated with ARDs	$9.5mn	$2.8mn	$39.4mn	$1.7mn	$0.3mn	$53.7mn
Ratio to aggregate admitted patient expenditure	0.034%	0.010%	0.141%	0.006%	0.001%	0.192%
Specialist and other health practitioner expenditure associated with ARDs	$8.6mn	$2.5mn	$35.5mn	$1.5mn	$0.3mn	$48.4mn

[a] Includes tracheal, bronchus, and lung cancer.

Source: CIE.

Pharmaceutical expenditure

Patients of ARDs are prescribed or purchase over-the-counter pharmaceuticals for reasons such as relieving pain and nausea, or as part of a course of treatment. This can include lower cost drugs such as over-the-counter paracetamol or expensive drugs such as those prescribed for chemotherapy patients.

There are two approaches to estimating the total expenditure on pharmaceuticals:

- bottoms-up estimate of the quantity and price of pharmaceuticals for ARD, and the attribution of this expenditure to ARD compared to other diseases for which the medication is also prescribed, or
- tops-down estimate of the total expenditure on pharmaceuticals for patients of ARDs.

A bottoms-up approach is not feasible without data on the following:

- types of drugs prescribed to ARD patients
- proportion of usage of this drug that is attributable to ARD patients (rather than sufferers of other diseases), and
- quantity and cost per prescription.

There is information available from clinicians about the types of drugs prescribed to ARD patients and data available about the quantity of cost of prescriptions.[44] However, there is insufficient data to identify what proportion of these pharmaceuticals are

44 The Department of Health publishes Pharmaceutical Benefits Scheme statistics, see: https://www.pbs.gov.au/info/browse/statistics

prescribed to ARD patients rather than sufferers of other diseases. Therefore, a bottoms-up approach is not feasible without a more detailed dataset, such as one disaggregating pharmaceutical usage/expenditure by ICD-10-AM code.

Therefore, we have followed a tops-down approach. This approach relies on data about compensation payments to ARD sufferers for spending on pharmaceuticals to determine total patient spending on drugs. This is then scaled up to estimate government spending through the Pharmaceutical Benefits Scheme (PBS) for this spending.

Tops-down estimate of pharmaceutical expenditure

Table 3.10 shows the average claim value for pharmaceuticals based on icare data. This data only relates to compensation for asbestos-related disease associated with occupational exposure. The ratio of claimants to claims is calculated to convert the average value per claim to the average value of compensation per claimant, which can be represented by the following formula.

$$\overline{Compensation\ per\ claimant} = \frac{C}{N_{claims}} \times \frac{N_{claims}}{N_{claimants}}$$

We have estimated the average cost of pharmaceuticals based on this data for each of the disease categories used elsewhere in this report.

There is no compensation data for larynx cancer or ovarian cancer because no claims were made for these diseases through icare. Thus, we have assumed that the costs of pharmaceuticals for these diseases are equal to the costs for lung cancer ($314 per patient per year). The sample size for this estimate is small (19 claims in 2015/16) and the pharmaceuticals required for ovarian cancer and larynx cancer may differ from those required for lung cancer. Therefore, this estimate is subject to considerable uncertainty.

3.10 Spending on pharmaceuticals by asbestos-related disease in 2015-16

	Mesothelioma	Asbestosis	Lung cancer
Number of claims	267	36	19
Total value of claims ($)	524 000	10 000	4 000
Ratio of claims to claimants	2.15	2.27	1.88
Average value of compensation per claimant ($)	4 224	630	396

Note: This data is sourced from icare and relates to NSW for 2015-16.

Source: CIE, icare data request.

Total spending by ARD patients on pharmaceuticals is determined by multiplying the number of prevalent cases of each disease (shown in Chapter 2) by the pharmaceutical spending per patient given in table 3.11. While there are a greater number of prevalent cases of lung cancer, total spending by mesothelioma patients is greater because each mesothelioma patient spends more on pharmaceuticals.

3.11 Estimated pharmaceutical spending by sufferers of asbestos-related diseases in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx Cancer	Ovarian cancer
Average value of compensation per claimant ($)	4 224	630	396	396	396
Prevalent cases (Number)	1 562	131 [b]	8 111	651	120
Total patient spending on pharmaceuticals ($million)	6.6	0.1	3.2	0.3	0.0

[a] Includes tracheal, bronchus, and lung cancer.

[b] This is based on the number of hospital separations for asbestosis in 2013/14 (see chapter 2).

Note: Total patient spending is shown in millions of dollars. Where 0.0 values are show, patient numbers are too low to express costs in millions of dollars.

Source: CIE.

These estimates of patient spending represent out-of-pocket expenditure, for which icare provides compensation. However, the total cost of pharmaceuticals is the sum of private (over-the-counter) and public (PBS) expenditure. Therefore, we must estimate the amount of government spending on pharmaceuticals attributable to ARDs.

We estimate government spending on pharmaceuticals using data on the ratio of aggregate PBS expenditure on drugs compared to patient spending. The Department of Health reports that government expenditure for 2014/15 amounted to 82.7 per cent of the total cost of PBS prescriptions.[45] The remaining 17.3 per cent of the cost of PBS prescriptions can be attributed to out-of-pocket spending by patients. This implies that government spending is about 4.8 times the amount of out-of-pocket spending.

We have estimated out-of-pocket spending on medications in table 3.11, and these figures can be used to estimate government expenditure on pharmaceuticals. We multiply out-of-pocket spending associated with ARDs by 4.8 to determine government spending. Estimates of government spending are presented in table 3.12.

3.12 Out-of-pocket, government and total spending on pharmaceuticals associated with asbestos-related diseases in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx Cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Out-of-pocket spending associated with ARDs	6.6	0.1	3.2	0.3	0.0	10.2
Government spending associated with ARDs	31.6	0.4	15.4	1.2	0.2	48.8
Total ($million)	38.2	0.5	18.6	1.5	0.3	59.0

[a] Includes tracheal, bronchus, and lung cancer.

Source: CIE.

This approach assumes that all ARD patient spending on pharmaceuticals for which compensation is received is associated with PBS medications. However, some proportion

45 PBS Information Management Section, 2015, *Expenditure and prescriptions twelve months to 30 June 2015*, p.V, available at: http://www.pbs.gov.au/statistics/2014-2015-files/exp-prs-book-01-2014-15.pdf

of patient spending on drugs will be for over-the-counter medications, which do not require a prescription. The cost of these medications is expected to be low relative to the cost of prescription medications. Therefore, it is reasonable to assume that the spending on pharmaceuticals shown in table 3.12 is appropriate.

Data quality for health system costs

Hospital costs for ARDs have been estimated using data supplied by AIHW. There are some sources of uncertainty in these figures in relation to data quality:

- Doctors are responsible for recording the condition that patients present with and any contributing factors. Given the rarity of ARDs such as asbestosis, there is a risk that doctors record the condition as being Chronic Obstructive Pulmonary Disease (COPD) or pneumoconiosis more broadly.
- States and territories are primarily responsible for the data quality of the *National Hospital Morbidity Database*, however AIHW undertakes extensive data validation to ensure accuracy.[46]

Overall, the hospital costs data available is high quality and has been rigorously collected and checked. It provides a robust foundation for the estimates of hospital cost we have reported above.

Health system costs per person

We estimate the health system costs per person by dividing estimated costs by the number of deaths or the number of prevalent cases. Table 3.13 shows the estimated health system costs per death and per prevalent case.

The costs per death of mesothelioma are more than double the costs of lung cancer per death. Similarly, the costs per prevalent case of mesothelioma are almost triple the costs of lung cancer per prevalent case.

The cost per prevalent case is not estimated for asbestosis because prevalence data is not available. The cost per death is higher for asbestosis given there are relatively few deaths, however, this is unlikely to be a useful measure of costs since asbestosis is typically a non-fatal disease.

3.13 Health system costs per death and per prevalent case in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$000's	$000's	$000's	$000's	$000's	$000's
Cost per death						
Hospital - admitted patients	12.3	44.8	12.1	31.1	16.6	12.9
Hospital - non-admitted patients	2.2	7.9	2.1	5.5	2.9	2.3

46 For a discussion of data quality issues, see AIHW's Data Quality Statement for the *National Hospital Morbidity Database 2014-15*, available at: http://meteor.aihw.gov.au/content/index.phtml/itemId/638202

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$000's	$000's	$000's	$000's	$000's	$000's
GP services	4.9	17.9	4.9	12.5	6.6	5.2
Specialists and other practitioners	11.1	40.3	10.9	28.0	14.9	11.6
Pharmaceutical	49.4	7.8	5.7	27.1	14.4	14.2
Total	**80.0**	**118.7**	**35.8**	**104.2**	**55.5**	**46.3**
Cost per prevalent case						
Hospital - admitted patients	6.1	N/A	4.9	2.6	2.6	4.9
Hospital - non-admitted patients	1.1	N/A	0.9	0.5	0.5	0.9
GP services	2.4	N/A	1.9	1.1	1.1	2.0
Specialists and other practitioners	5.5	N/A	4.4	2.4	2.4	4.4
Pharmaceutical	24.4	N/A	2.3	2.3	2.3	5.6
Total	**39.5**	**N/A**	**14.3**	**8.8**	**8.8**	**17.7**

[a] Includes tracheal, bronchus, and lung cancer.

Source: CIE.

There is uncertainty around the total costs of and population with ARD. Thus, the cost per death and per prevalent case is uncertain. Table 3.14 presents total health system costs per death and per prevalent case under lower and upper bound estimates of the population with ARDs, holding total health system costs constant between scenarios.. Estimated uncertainty is very high for asbestosis, reflecting that the lower bound for asbestosis deaths is 8 while the upper bound is 135.

3.14 Uncertainty associated with health system costs per patient

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx Cancer	Ovarian cancer	All diseases
	$000's	$000's	$000's	$000's	$000's	$000's
Cost per death						
Central estimate	80.0	118.7	35.8	104.2	55.5	46.3
Low estimate (upper bound of population)	56.7	54.0	28.1	63.0	32.4	35.0
High estimate (lower bound of population)	116.4	939.5	47.9	213.6	109.5	64.0
Cost per prevalent case						
Central estimate	39.5	N/A	14.3	8.8	8.8	17.7
Low estimate (upper bound of population)	23.2	N/A	9.2	3.7	4.4	10.8
High estimate (lower bound of population)	67.2	N/A	22.1	26.0	19.2	28.7

[a] Includes tracheal, bronchus, and lung cancer.

Note: The low and high estimates of cost per death are based on the upper and lower bound of population respectively. A higher population results in lower health costs per death, but a higher pharmaceutical cost, and thus the net impact on costs is ambiguous.

Source: CIE.

Understanding the treatment pathway for asbestos-related diseases

The health system costs of ARD depend on how a sufferer of ARDs progresses through the health system. Chart 3.15 shows the typical treatment pathway for mesothelioma sufferers and types of costs incurred based on clinical guidelines for the management of mesothelioma.

It shows the five stages of care for mesothelioma sufferers, which are:

- first line diagnosis
- diagnosis of malignant pleural mesothelioma
- prognosis
- treatment, and
- Palliative and support care.

Estimated unit costs are included in the diagram to illustrate how these costs may be accumulated throughout the care pathway.

3.15 Care pathways for mesothelioma sufferers

Clinical pathway

First line diagnosis

- CT-guided core biopsy → Imaging CT scan → Aspiration of effusion fluid → VAT-guided biopsy
- OR
- VAT-guided pleural biopsy
- OR
- Cytological recognition of an atypical proliferation in pleural effusion fluid

Diagnosis of malignant pleural mesothelioma

- Immuno-histochemistry
- Molecular approaches to diagnoses
- CT and FDG – PET imaging

Prognosis

Baseline prognosis assessment of patient, clinical, biological, and imaging factors:

- Epithelioid histological type and performance status
- Elevated white cell testing
- Testing of inflammation markets
- Measurement of SUVmax or TGV

Treatment

Pre-treatment evaluation

- Consultation
- Radiological investigation via plain chest x-ray
- Blood tests: haemoglobin, leucocytes, platelets, basic biochemistry
- Historical confirmation via biopsy
- CT scan of chest and upper abdomen after drainage of pleural fluid
- Pulmonary function testing
- Measurement

Active anti-cancer treatment

- Chemotherapy
- Cytoreductive surgery
- Multimodality therapy (surgery, chemotherapy, radiotherapy)
- Radiotherapy
- Palliative radiotherapy
- Immunotherapy

Palliative and support care

- Referral to palliative care specialists
- Pleurodesis
- Regular oral low dose, sustained release opioids
- Screening for psychological distress and unmet needs
- Counseling

Cost of care

First line diagnosis

Cytology

- PST 73 051 = $170.35

Histology

- Biopsy and drainage of pleural effusion

Diagnostic imaging

- Initial CT scan (63 301 = $380.80)
- Computed tomography (56 225 = $351.40)
- Specialist consultation (110 = $150.90 x no. of visits)
- General practitioner consultation (57 = $61 x no. of visits)

Diagnosis of malignant pleural mesothelioma

Diagnostic imaging

- CT of thorax and abdomen (56 225 = $351.40)
- New generation spiral CT for malignant pleural mesothelioma (37 350 = $510)
- Specialist consultation (110 = $150)

Prognosis

Diagnostic imaging

- FTG – PET imaging (61 523 = $953)
- Specialist consultation (110 = $150.90)

Treatment

Admitted patient and non-admitted patient expenditure estimated in this report

Palliative and support care

Place of death	Average annual cost per person who died
	$
Acute inpatient	47 142
Sub-acute	10 293
Residential care	45 807
Community care	16 541
Other	-
Total average	**34 492**

VAT = Video-assisted thoracoscopy
CT = Computed-tomography

Source: The CIE, and various.

4 Productivity impacts

ARDs compromise the ability of patients to participate in the paid and unpaid workforce. 'Productivity losses' can also flow through to carers who are no longer able to participate in paid and unpaid work as they would otherwise be.

Productivity losses for patients and carers in 2015-16 because of ARDs are estimated at $321 million. Most losses (85 per cent) are due to occupational exposure, distributed evenly across paid and unpaid work, and the overwhelming majority are due to premature death rather than disability.

Understanding productivity losses

'Productivity losses' associated with ARD measure the change in the productive capacity of the economy because individuals (and their carers) are living with disease.

In some cases, individuals are unable to participate in the labour market at all because of premature death or an inability to participate, and in other cases, individuals (and their carers) might continue to work, but with lower productivity.

The approach used to estimate productivity losses associated with ARD is shown in box 4.1.

4.1 Methodology for measuring productivity losses

Productivity impacts can be quantified based on a friction, or human-capital approach.

A friction approach considers the impact of intermittent and time limited displacements in labour, recognising that over time, workforce absences are overcome by substituted employment.

A human capital approach measures the loss of productivity over current and future years associated with newly diagnosed cases of the disease in a given year. However, it is limited in accuracy when unemployment and underemployment exist.[47]

Given that one approach overestimates, and one underestimates productivity impacts, this study uses a mid-point of the two to estimate the economic burden of disease.

[47] Lal, A., Moodie, M., Ashton, T., Siahpush, M. and Swinburn, B., 2012, 'Health care and lost productivity costs of overweight and obesity in New Zealand', *Aust N Z J Public Health*, 36(6): p.550-556, available at: https://www.ncbi.nlm.nih.gov/pubmed/23216496

Productivity losses associated with ARD arise with respect to both paid work and unpaid work. Productivity in paid work is measured by reduced wages and other forms of income (excluding government payments).

Allowance is made to recognise differences in income by age and sex to reflect that ARD sufferers are generally older and more likely to be male than the average person.

Adjustments are also made to personal income to reflect the employment status of individuals (and their carers) with ARD, who may be employed, working full-time, working part-time, or employed but away from work (including, for example, income from leave entitlements).

Income that is excluded from this analysis includes that earnt by individuals classified as unemployed, but looking for full-time or part-time work, and individuals that are not in the labour force. While these individuals may earn income from government payments, monetary transfers within the family, or other sources, they are excluded because they are essentially income transfers and do not measure the productivity of the individual.

To determine the average income including people who are unemployed, we divide the total income from employed persons by the total number of people (including people in and out of the labour force). That is, the assumed income for each age cohort and sex combination is given by the following equation.

$$\overline{Income_{as}} = \frac{\sum_e (\overline{Income_{ase}} \times N_e)}{\sum_e N_e + N_{unemployed} + N_{not\ in\ labour\ force}}$$

where

- e denotes the categories of employed people (full-time, part-time, away from work),
- $\overline{Income_{ase}}$ refers to the average annual income of an employment category (e),
- N_e, which is the number of people in that employment category (e),

$N_{unemployed}$ and $N_{not\ in\ labour\ force}$ is the number of people unemployed or not in the labour force.

Measuring the impacts associated with premature death

Friction approach

The friction approach measures the loss of production associated with the period during which a worker who leaves the labour force due to ARD has not yet been replaced. This approach assumes that the economy is not at full employment, and that there is no long run impact to the number of employed people in the economy. That is, a worker who leaves the labour force due to death or disablement associated with an ARD is replaced, and the total number of workers does not change. Estimates based on this approach will be a lower bound to the total productivity impact in a given year.

The productivity losses for a particular age cohort and sex combination are calculated by multiplying the number of people in that cohort who died in the current year by the amount of income they would have earned over the period they take to be replaced.

This period is referred to as the 'friction period'. We have assumed that the friction period is six months in duration, which is consistent with the duration assumed in Tompa et. al. (2015)[48] and Van den Hout (2010).[49] The friction approach to estimating productivity losses can be represented by the following equation:

$$Productivity\ loss_d = \sum_{s}\left(\sum_{a=0}^{100}[deaths_{asd} \times \overline{Income_{as}} \times f]\right)$$

where

- d refers to the set of ARDs,
- *deaths* is the number of deaths in the current year,
- a refers to an age cohort (e.g. seventy-year-olds),
- s refers to sex,
- $\overline{Income_{as}}$ refers to average yearly income, and
- f refers to the duration of the friction period (in years) during which the person goes unreplaced. We assume $f = 0.5$.

Taken on its own, a friction approach underestimates productivity impacts because there may be multiple friction periods, and for certain industries, the economy may be at full employment and so a vacancy cannot be filled. This analysis assumes that workers who are removed from work because of ARD are replaced after 6 months.

Human capital approach

The human capital approach estimates the value of production losses due to illness, disability or premature death over the remaining working life of a person had they not been ill. This approach assumes that the economy is at full employment, and that the loss of a worker results in permanently lower economic output.

It is noted that this approach does not account for the effects of shifting labour supply and overstates the productivity impacts, as in practice, an unemployed person may take the job of the ill or diseased person, mitigating the net impact on productivity.[50]

However, this approach also does not account for other benefits of improved health status, such as increased capital formation. This source of inaccuracy is likely to be smaller than the effect of assuming full employment. Therefore, we consider the human capital approach an upper bound on the likely productivity impacts.

48 Tompa, E. et al. 2015, 'The economic burden of lung cancer and mesothelioma in Canada due to occupational asbestos exposure', *At Work*, Issue 85, Summer 2016: Institute for Work and Health, Toronto, see http://www.iwh.on.ca/at-work/85/new-cases-of-mesothelioma-and-asbestos-related-lung-cancer-in-one-year-cost-19b

49 Van den Hout, W.B., 2010, 'The value of productivity: human-capital versus friction-cost method', *Annals of Rheumatic Disease* 69 (Suppl I), p.i89–i91, available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.959.5340&rep=rep1&type=pdf

50 See http://www.who.int/choice/publications/d_economic_impact_guide.pdf

The human capital approach allows for a forward-looking estimate of the loss of productivity capacity to be estimated. This does not neatly align with the prevalence approach to estimating economic burden of disease, which would only measure the loss of productivity in a given year from people with the disease in that year.

Approach adopted in this study

To acknowledge some long run impacts of reduced productive capacity of the economy associated with workers who are unable to be replaced, consideration can be given to:

- a forward-looking approach, by estimating the present value of lost productivity in current and future years associated with people who are removed from the labour force in the current year, or
- a backward-looking approach by estimating the value of lost productivity in the current year associated with people who were removed from the labour force in current and past years.

The forward-looking approach has been followed for this study. While this is not strictly consistent with a prevalence approach, it avoids obtaining results that persistently understate productivity losses that are felt in the long-term.

The productivity losses for a particular age cohort and sex combination are calculated by multiplying the number of people in that cohort who died in the current year by the present value of their future income stream until their expected death. This income stream is determined by their current age and their life expectancy (to the nearest year).

This human capital approach to estimating productivity losses can be represented by the following equation:

$$Productivity\ loss_d = \sum_s \left(\sum_{a=0}^{100} \left[deaths_{asd} \times \sum_{y=a}^{e_{as}} \frac{\overline{Income_{asy}}}{1+r} \right] \right)$$

where

- d refers to the set of ARDs,
- *deaths* is the number of deaths in the current year,
- a refers to an age cohort (e.g. seventy-year-olds),
- s refers to sex,
- $\overline{Income_{asy}}$ refers to average yearly income,
- e_{as} refers to the expected age at death for an individual of age a and sex s, and
- r is the real discount rate.

The real discount rate used in this analysis is 7 per cent and we present the results using discount rates of 3 and 10 per cent, consistent with the Department of Prime Minister and Cabinet Cost-benefit analysis guide[51] and Harrison (2010).[52]

Income data are disaggregated by age (in years) while deaths are disaggregated by group of five-year age bands (e.g. 70-74 years of age). These disaggregations must be aligned to enable the calculation of productivity losses according to the formula above. Therefore, we disaggregate deaths into age (in years) by dividing the number of deaths in each five-year band by 5. For example, if there were 50 deaths among 70-74-year-olds, we assume that there are 10 deaths of 70-year-olds, 10 deaths of 71-year-olds, and so on.

Measuring the impacts associated with disability

Measuring the productivity losses associated with reduced capacity to work while suffering from ARDs is more straightforward.

We use data on the total Years Lived with Disability (YLD) in the current year for all people suffering from each ARD in that year. YLD equals the number of people who are disabled or who suffer due to disease in the relevant year, multiplied by a 'discount factor' that captures the harshness of their disability or suffering, multiplied by a factor that captures the duration of the suffering over the year.

We assume the productivity loss from paid work associated with each year lived with disability is equal to the lost income from that year. Productivity losses associated with years lived with disability (prior to death) can be represented by the following equation:

$$Productivity\ loss_d = \sum_s \left(\sum_{a=0}^{100} [YLD_{asd} \times \overline{Income_{as}}] \right)$$

where

- d refers to the set of ARDs,
- YLD is the number of years lived with disability,
- a refers to an age cohort (e.g. seventy-year-olds), and
- s refers to sex, and
- $\overline{Income_{asy}}$ refers to average yearly income.

The YLDs associated with ARDs are presented in table 4.2. In total, 1 541 YLDs are associated with ARDs, the majority of which are due to lung cancer.

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51 Available at: https://www.dpmc.gov.au/sites/default/files/publications/cosst-benefit-analysis.docx

52 Harrison, M., 2010, *Valuing the future: the social discount rate in cost-benefit analysis*, available at: http://www.pc.gov.au/research/supporting/cost-benefit-discount/cost-benefit-discount.pdf

4.2 Years Lived with Disability associated with asbestos-related disease in 2015-16

Exposure category	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	Number
Occupational exposure						
Male	228	0	959	57	0	1 244
Female	42	0	121	0	11	175
Both	**270**	**0**	**1 080**	**57**	**11**	**1 419**
Non-occupational exposure						
Male	19	0	48	2	0	69
Female	15	0	34	0	4	54
Both	**34**	**0**	**82**	**2**	**4**	**122**
All sources of exposure						
Male	247	0	1 006	59	0	1 312
Female	58	0	156	1	15	229
Both	**304**	**0**	**1 162**	**60**	**15**	**1 541**

[a] Includes tracheal, bronchus, and lung cancer.

Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Measuring the loss of unpaid work

The loss of productive capacity among those who suffer from ARDs may affect both their capacity to do paid work and unpaid work. However, while the value of paid work can be directly observed through the market price for that work, the value for unpaid work is not observed in a market.

Alternative approaches to quantify the value of unpaid work include:

- an opportunity cost approach – measuring the amount of output produced in unpaid work (e.g. number of meals cooked, lawns mowed), and then estimate the price of obtaining this level of output in the market, and
- a replacement cost approach – measuring time spent performing unpaid work, times a market wage rent for that type of work (e.g. wages for cleaning work).[53]

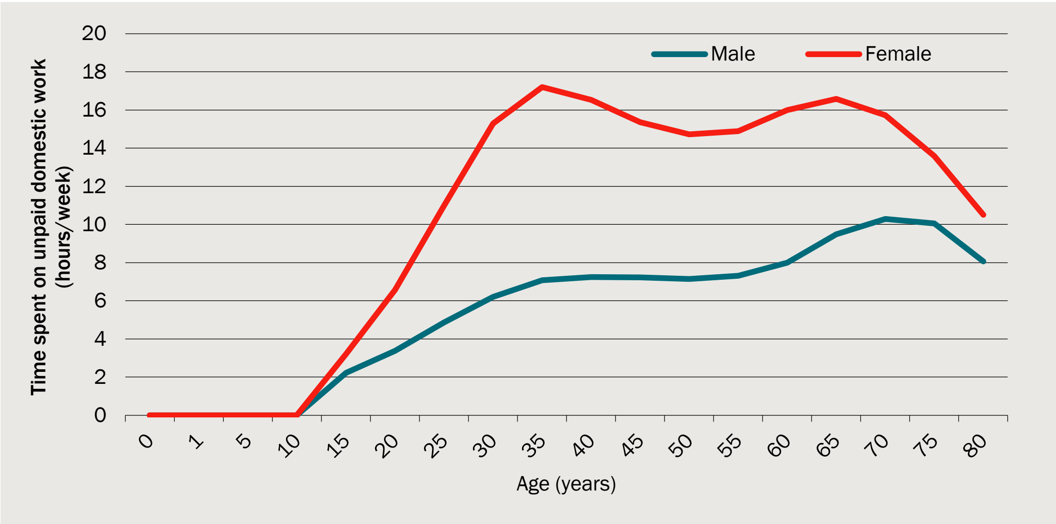
Both approaches are challenging in the context of ARD. The opportunity cost approach is not feasible in the absence of data about output from unpaid work. The market value approach does not specify how to determine the standard market wage.

Failure to include estimates of lost unpaid domestic work downwardly bias estimates of the lost productivity due to ARD. Accounting for lost unpaid work due to ARD is important as sufferers are generally older and may have retired from the paid workforce yet continue to supply unpaid work.

53 Miranda, V., 2011, 'Cooking, caring and volunteering: unpaid work around the world', *OECD Social, Employment and Migration Working Papers*, No. 116, OECD Publishing, Paris, available at: http://dx.doi.org/10.1787/5kghrjm8s142-en

We have estimated the loss of unpaid work due to ARDs using the market value approach. We use the minimum wage for a Level 1 Cleaning Service Employee as defined by the Cleaning Services Award 2010, which is $18.91 per hour.[54] The amount of time spent on unpaid work is derived from the 2011 Census, where respondents indicated how many hours of unpaid domestic work they performed in a week. Chart 4.3 shows the average hours of unpaid domestic work conducted in a week by age and sex.

4.3 Average hours per week spent performing unpaid domestic work



Data source: 2011 Census, 'Unpaid domestic work: number of hours (DOMP) by age and sex, CIE.

Estimates of lost productivity due to asbestos-related diseases

Productivity losses associated with ARD measure the costs of death and disability on reduced paid and unpaid work. Total productivity losses associated with ARD are estimated at $321.4 million for 2015-16 (table 4.4). These losses are largely driven by occupational exposure (85 per cent), almost in equal measure for losses associated with reduced productivity in paid and unpaid work.

When comparing productivity losses associated with death (tables 4.5 and 4.6) and disability (tables 4.7 and 4.8), overwhelmingly the majority of losses are associated with premature death.

Tracheal, bronchus and lung cancer apply to the most people within ARD, and these diseases account for most of the productivity losses (70 per cent). Aside from just the volume of people living with asbestos-related tracheal, bronchus and lung cancer, the age profile for these cancers is also younger than the average person with ARD, which further accounts for the size of the burden attributable to these particular disease types.

54 www.fwc.gov.au/documents/documents/modern_awards/award/ma000022/default.htm

4.4 Total lost productivity due to asbestos-related disease in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Occupational exposure						
Paid work	40.0	1.2	95.1	1.0	0.6	137.8
Unpaid work	28.1	1.5	103.9	1.8	0.6	135.9
Total	**68.0**	**2.8**	**198.9**	**2.8**	**1.2**	**273.7**
Non-occupational exposure						
Paid work	15.9	0.0	17.7	0.1	0.4	34.1
Unpaid work	4.4	0.0	9.0	0.1	0.2	13.7
Total	**20.3**	**0.0**	**26.7**	**0.2**	**0.6**	**47.8**
All exposure						
Grand total	**88.3**	**2.8**	**225.6**	**2.9**	**1.8**	**321.4**

[a] Includes tracheal, bronchus, and lung cancer.

Source: CIE.

4.5 Lost paid work due to premature death in 2015-16

Exposure category	Sex	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
		$million	$million	$million	$million	$million	$million
Friction approach - lower bound							
Occupational exposure	Male	2.4	0.1	6.3	0.1	0.0	8.9
	Female	0.4	0.0	0.8	0.0	0.0	1.2
Non-occupational exposure	Male	0.5	0.0	0.7	0.0	0.0	1.2
	Female	0.3	0.0	0.4	0.0	0.0	0.8
Human capital approach - upper bound							
Occupational exposure	Male	54.9	2.2	131.6	1.0	0.0	189.7
	Female	9.5	0.1	16.3	0.0	0.8	26.7
Non-occupational exposure	Male	17.0	0.0	18.4	0.1	0.0	35.5
	Female	11.3	0.0	11.0	0.0	0.6	22.9
Estimated impact - midpoint							
Occupational exposure	Male	28.7	1.2	69.0	0.5	0.0	99.3
	Female	4.9	0.1	8.5	0.0	0.4	14.0
Non-occupational exposure	Male	8.7	0.0	9.6	0.0	0.0	18.4
	Female	5.8	0.0	5.7	0.0	0.3	11.9
All exposure to asbestos	Male	37.4	1.2	78.5	0.6	0.0	117.7
	Female	10.7	0.1	14.2	0.0	0.8	25.8
	Both	48.1	1.2	92.8	0.6	0.8	143.5

[a] Includes tracheal, bronchus, and lung cancer.

Source: The CIE.

4.6 Lost unpaid domestic work due to premature death in 2015-16

		Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
		$million	$million	$million	$million	$million	$million
Friction approach - lower bound							
Occupational exposure	Male	2.3	0.2	10.1	0.2	0.0	12.8
	Female	0.4	0.0	1.1	0.0	0.1	1.5
Non-occupational exposure	Male	0.2	0.0	0.5	0.0	0.0	0.7
	Female	0.1	0.0	0.3	0.0	0.0	0.5
Human capital approach - upper bound							
Occupational exposure	Male	41.9	2.8	157.8	2.2	0.0	204.7
	Female	6.3	0.0	17.4	0.0	0.8	24.6
Non-occupational exposure	Male	4.5	0.0	9.6	0.1	0.0	14.1
	Female	3.2	0.0	5.9	0.0	0.3	9.4
Estimated impact - midpoint							
Occupational exposure	Male	22.1	1.5	83.9	1.2	0.0	108.7
	Female	3.3	0.0	9.3	0.0	0.4	13.1
Non-occupational exposure	Male	2.3	0.0	5.0	0.0	0.0	7.4
	Female	1.7	0.0	3.1	0.0	0.2	4.9
All exposure to asbestos	Male	24.4	1.5	88.9	1.2	0.0	116.1
	Female	5.0	0.0	12.3	0.0	0.6	18.0
	Both	29.4	1.5	101.3	1.2	0.6	134.1

[a] Includes tracheal, bronchus, and lung cancer.

Source: CIE.

4.7 Lost paid work due to disability in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Occupational exposure						
Male	5.9	0.0	16.5	0.5	0.0	22.9
Female	0.5	0.0	1.0	0.0	0.1	1.6
Both	6.4	0.0	17.6	0.5	0.1	24.6
Non-occupational exposure						
Male	1.0	0.0	1.7	0.0	0.0	2.8
Female	0.4	0.0	0.6	0.0	0.1	1.1
Both	1.4	0.0	2.4	0.0	0.1	3.9
All sources of exposure						
Male	6.9	0.0	18.3	0.5	0.0	25.7
Female	0.9	0.0	1.7	0.0	0.2	2.7
Both	7.8	0.0	19.9	0.5	0.2	28.5

[a] Includes tracheal, bronchus, and lung cancer.
Source: CIE.

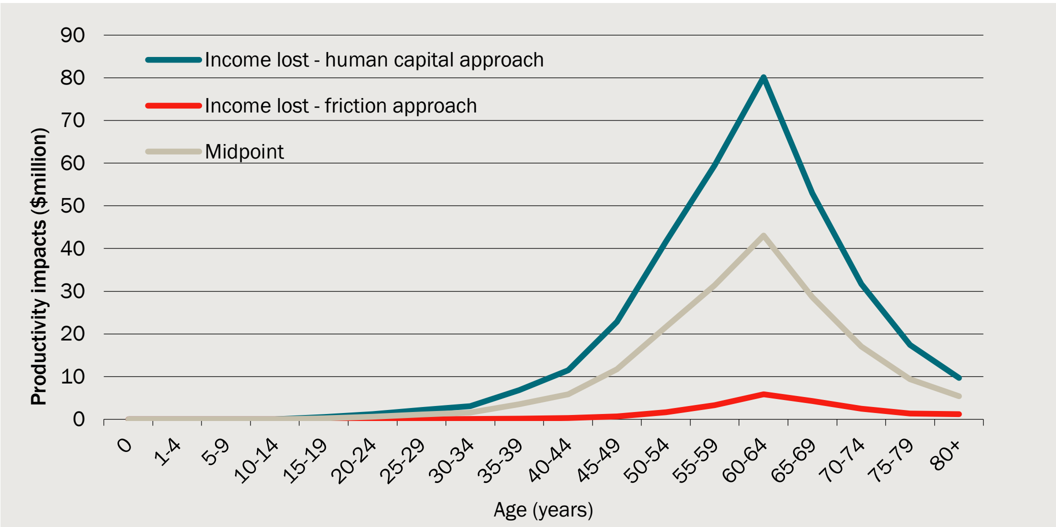
4.8 Lost unpaid domestic work due to disability in 2015-16

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Occupational exposure						
Male	2.0	0.0	8.9	0.6	0.0	11.5
Female	0.6	0.0	1.8	0.0	0.2	2.5
Both	2.6	0.0	10.7	0.6	0.2	14.1
Non-occupational exposure						
Male	0.1	0.0	0.4	0.0	0.0	0.6
Female	0.2	0.0	0.5	0.0	0.1	0.8
Both	0.4	0.0	0.9	0.0	0.1	1.4
All sources of exposure						
Male	2.2	0.0	9.3	0.6	0.0	12.1
Female	0.8	0.0	2.3	0.0	0.2	3.3
Both	3.0	0.0	11.6	0.6	0.2	15.4

Data source: CIE.

Productivity impacts by age are shown in chart 4.9.

4.9 Productivity impacts of asbestos-related disease –by age



Data source: CIE.

Uncertainty around estimated productivity impacts

Our estimates of the productivity losses associated with ARDs are uncertain. This is mainly associated with uncertainty in estimates of

- the number of deaths associated with ARDs
- the number of YLDs associated with ARDs, and

- the value placed on paid and unpaid work.

Table 4.10 presents estimates of productivity losses using the upper and lower bounds of YLDs and deaths estimated by the GBD Study[55] (see table 2.6 which shows lower and upper bounds of deaths due to ARDs). The range of total productivity losses is estimated to be $225.3–451.2 million in 2015.

4.10 Productivity losses using lower and upper bounds of prevalence and deaths due to asbestos-related diseases

	Central estimate	Lower bound	Upper bound
	$million	$million	$million
Paid work	171.9	120.1	246.1
Unpaid work	149.5	105.2	205.2
Total	321.4	225.3	451.2

Source: CIE

Our approach of estimating productivity losses under both the human capital and friction approaches provides upper and lower bounds for productivity losses associated with paid work.

55 Global Burden of Disease Study: Institute for Health Metrics and Evaluation (IHME). GBD Compare Data Visualization. Seattle, WA: IHME, University of Washington, 2016. Available from http://vizhub.healthdata.org/gbd-compare.

5 *Individual and community outcomes*

Living with ARD is a burden for patients and their families, beyond the adverse effects on workforce participation and the costs required to treat medical conditions.

The 'burden of disease' framework measures the compromised quality of life experienced by people with an ARD, by measuring the loss of disability-adjusted life years (DALYs). Ninety per cent of DALYs lost are associated with disease caused by occupational exposure.

Studies on the human impacts of ARD are substantially focused on compromised physical health. This is largely because of the relatively narrow focus of studies to date, and research gaps around mental health in particular. There is also scant attention paid to the impacts of asbestos in the community on fear and anxiety, irrespective of whether ARD's are contracted. Table 5.1 summaries the state of the literature in terms of the impact of ARDs on individuals and communities.

5.1 Summary of the literature on individual and community impacts of ARDs

Key issues	Details
What data is available for individual and community impacts?	Reasonable data (including assumptions from the literature) on impact of ARDs on physical health Limited/no data on impact of mental health, social cohesion Detailed data by age and sex on lost DALYs due to ARDs in 2015/16
What work has been done so far?	NOHSC (2001) look at the cost of ARDs in terms of the value of human life ACG 2013 look at the cost of ARDs in terms of cost of disability and death Tompa et al (2015) include quality of life/loss of life
Approach of existing work	Key parameters (morbidity, mortality of ARDs) were assumed to be constant over time Studies implicitly assume each death due to an ARDs is an 'average death'. However, ARD patients are usually older than average, and lose fewer years when they die. Other impacts: mental health costs, social cohesion, etc. have not been considered. These are likely to be particularly important for older patients that are no longer in the workforce and have a greater need for community participation.

Source: CIE.

Impacts on quality of life and premature death

Burden of disease analysis quantifies the impact of health problems and premature deaths on a society. In a single year, the 'burden of disease' is the extent to which disease has caused the nation's 'health capital' to be below 'healthy'.

This burden is measured with loss of DALYs (loss of Disability Adjusted Life Years), which equals Years of Life Lost (YLL) plus (discounted) Years of Life lost due to Disability (YLD).

Disability weights are used to adjusted life years for the patient to reflect their health status. For example, life expectancy of a patient with ARD needs to reflect the fact that the patient will be not be at full health during this period. Disability weights range from 0 (perfect health) to 1 (equivalent to death). Weights used can be those recommended by the WHO Global Burden of Disease or others found in the literature. Disability weights for each ARD are shown in table 5.2. A disability weight of 0.2 indicates that a year lived with that disability is equivalent to the loss of 0.2 years of healthy life.

5.2 Disability weights for asbestos-related diseases

Phase/severity	Healthstate name	Healthstate description	Disability weight
Mesothelioma / Lung cancer[a] / Larynx cancer / Ovarian cancer			
Diagnosis and primary therapy phase	Cancer, diagnosis and primary therapy	has pain, nausea, fatigue, weight loss and high anxiety.	0.288
Controlled phase	Generic uncomplicated disease: worry and daily medication	has a chronic disease that requires medication every day and causes some worry but minimal interference with daily activities.	0.049
Metastatic phase	Cancer, metastatic	has severe pain, extreme fatigue, weight loss and high anxiety.	0.451
Terminal phase	Terminal phase, with medication (for cancers, end-stage kidney/liver disease)	has lost a lot of weight and regularly uses strong medication to avoid constant pain. The person has no appetite, feels nauseous, and needs to spend most of the day in bed.	0.54
Laryngectomy due to Larynx cancer	Speech problems	has difficulty speaking, and others find it difficult to understand.	0.051
Asbestosis			
Asymptomatic	--	--	--
Mild	COPD[b] and other chronic respiratory problems, mild	has cough and shortness of breath after heavy physical activity, but is able to walk long distances and climb stairs.	0.019
Moderate	COPD[b] and other chronic respiratory problems, moderate	has cough, wheezing and shortness of breath, even after light physical activity. The person feels tired and can walk only short distances or climb only a few stairs.	0.225
Severe asbestosis without heart failure	COPD[b] and other chronic respiratory problems, severe	has cough, wheezing and shortness of breath all the time. The person has great difficulty walking even short distances or climbing any stairs, feels tired when at rest, and is anxious.	0.408

[a] Includes tracheal, bronchus and lung cancer.

[b] COPD refers to Chronic Obstructive Pulmonary Disease.

Source: Global Burden of Disease Study 2015 (available at: http://ghdx.healthdata.org/record/global-burden-disease-study-2015-gbd-2015-disability-weights), CIE.

Quantifying the impacts of lost quality of life

Data on the number of DALYs lost due to ARDs was collated by the Global Burden of Disease (GBD) study, and is through the GBD Compare tool.[56] This tool presents:

- DALYs lost due to mesothelioma associated with occupational and non-occupational exposure, and
- DALYs lost due to lung, larynx and ovarian cancer associated with occupational exposure.

We have estimated DALYs lost due to lung, larynx and ovarian cancer associated with non-occupational exposure by assuming the ratio of occupational to non-occupational DALYs lost is the same for these diseases as for mesothelioma. Data indicating the prevalence, YLDs or DALYs lost due to asbestosis is not available.[57]

Table 5.3 shows the DALYs lost by ARD and patient category in 2015. Most DALYs are lost due to lung cancer and mesothelioma and around 90 per cent of DALYs lost are associated with occupational (rather than non-occupational) exposure.

5.3 DALYs lost due to asbestos-related disease (2015)

Patient category	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	Number	Number	Number	Number	Number	
Occupational exposure						
Male	9 712	N/A	36 026	568	0	46 306
Female	1 502	N/A	3 961	4	195	5 663
Both	11 214	N/A	39 988	571	195	51 968
Non-occupational exposure						
Male	1 322	N/A	2 338	21	0	3 681
Female	923	N/A	1 427	1	77	2 428
Both	2 246	N/A	3 765	22	77	6 109
All sources of exposure						
Male	11 034	N/A	38 364	588	0	49 987
Female	2 426	N/A	5 388	5	272	8 091
Both	13 460	N/A	43 752	593	272	58 077

[a] Includes tracheal, bronchus, and lung cancer.

Source: CIE.

56 Available at https://vizhub.healthdata.org/gbd-compare/

57 The *Lung Disease in Australia Report* (2014, available from: http://lungfoundation.com.au/about-us/advocacy/lung-disease-in-australia-report/) contains data on YLD due to pneumoconiosis (mainly asbestos and silicosis) for 2010. This data indicates that there were 791 YLD among males and 1038 among females. However, while the source is stated as the GBD 2010 study, this study does not appear to have data for asbestosis prevalence of YLDs. Therefore, we are unable to verify the source of the data and evaluate the robustness of the assumptions used to estimate prevalence. This data does not appear to be consistent with AIHW separations data, which indicates that there were 128 separations for males and 6 for females associated with asbestosis (ICD-10-AM code J61) in 2014/15.

DALYs quantify lost quality of life in terms of the loss of disability-adjusted years of life. However, lost quality of life can also be represented in monetary terms by applying a valuation to lost DALYs. Box 5.4 explains the methodology and assumptions used to estimate the monetary value of lost quality or years of life, and applies this methodology to asbestos-related disease for 2015.

5.4 Estimating the value of lost quality or years of life

In principle, the cost of lost quality of life and death can be estimated by multiplying the number of DALYs by the value of a statistical life year (VSLY). Measuring the economic cost of lost quality of life due to ARDs involves establishing a monetary value for lives saved. The VSLY is a notional value an individual places on each additional year of life.

There are various VSLY estimates that are used in policy analysis in Australia. The Commonwealth Office of Best Practice Regulation (OBPR) advises that a VSLY of $182 000 (in 2014 dollars) should be used in regulatory impact analysis.[58] In current prices for 2016 this equates to $186 640.[59]

These recommendations are based on a review by Abelson (2008) of research into Value of a Statistical Life (VSL) and VSLY (including studies that attempt to establish the community's attitude towards safety risk through observing their economic behaviour) and international guidelines for life and health values.[60] Abelson's recommendations were based on a middle-aged individual, where premature death deprives them of 40 life years. However, the DALYs lost due to ARD are expected to be in the later years of life.

It is generally assumed that VSLY measures include the impact on family and friends, as people would take this into account in their behaviour. However, it is not clear to what extent the VSLY takes into account the impact on families in the case of elderly people.

The value of lost DALYs can be represented by the following general equation:

$$Value\ of\ lost\ DALYs_d = \sum_{s}\left(\sum_{a=0}^{100}[DALY_{asd} \times VSLY_{as}]\right)$$

where

- *d* refers to the set of ARDs

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58 This value is estimated on the basis that the VSL is the present value of 40 life years. The VSLY is, therefore, taken to be the constant annual sum which has a discounted value equal to the estimated VSL. That is, the present value of $182 000 paid each year for 40 years is approximately equal to the present value of $4.2 million.

59 ABS, *Consumer Price Index, Australia,* All Groups CPI, Australia, Cat. No. 6401.0.

60 Abelson, P. 2008, *Establishing a Monetary Value for Lives Saved: Issues and Controversies*, Working papers in cost-benefit analysis, WP 2008-02, Office of Best Practice Regulation, Department of Finance and Deregulation.

- $DALYs$ is the number of lost disability-adjusted life years
- a refers to an age cohort (e.g. seventy-year-olds)
- s refers to sex, and
- $VSLY_{as}$ refers to the Value of a Statistical life for a given sex and age cohort.

We use a constant VSLY across age and sex cohorts. Therefore, the Value of lost DALYs for a particular ARD is calculated according to the following simpler equation:

$$Value\ of\ lost\ DALYs_d = DALY_d \times VSLY$$

There is long-standing debate as to whether policy evaluation should value 'lives saved' or 'life-years saved'.[61] By valuing life according to the value of a life year (VSLY), we will place a higher value on the life of younger people than elderly people, who have fewer remaining years of life. Using the VSLY rather than VSL implicitly assumes that VSL declines with age (as life expectancy falls with age).

However, theory and evidence suggest that the value of a statistical life varies with age and other characteristics. While the relationship between age and VSL has not been conclusively measured, there is a significant weight of evidence suggesting it does fall with age.[62] For example, in a review of literature available on age variation in VSL levels, Aldy & Viscusi (2007)[63] find evidence that VSL exhibits an 'inverted-u' relationship. They find that VSLY shows a similar pattern and is not time-invariant. Given the lack of conclusive evidence in this area, we assume a constant. As described above, we assumed that $VSLY$ = \$186 640, which is a constant level with respect to age. This approach is consistent with OBPR guidance, which does not propose an age-variant VSLY.

This estimate may overestimate the VSLY for older people given factors such as lower expectations of future earnings as years of life remaining decreases. This shortcoming is partly offset by the lower age profile of people acquiring ARD in a non-occupational setting.

The loss of DALYs can be represented in monetary terms by multiplying the values in table 5.3 by the assumed VSLY (\$186 640). Table 5.5 summarises the value of lost quality of life due to asbestos-related disease based on a constant VSLY with respect to age.

61 Hammit, J., 2008, 'Valuing "lives saved" vs. "life-years saved", *Risk in Perspective*, 16(1), Harvard Center for Risk Analysis, March, 2008, p.36, available at: http://www.lse.ac.uk/LSEHealthAndSocialCare/pdf/eurohealth/VOL14No1/Harvard.pdf

62 Access Economics, 2008, *The health of nations: The value of a statistical life*, pp.75-79, available at: https://www.safeworkaustralia.gov.au/system/files/documents/1702/thehealthofnations_value_statisticallife_2008_pdf.pdf

63 Aldi, J. & Viscusi, WK., 2007, 'Age Differences in the Value of Statistical Life, Discussion paper, April 2007, p. 18, available at: http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-07-05.pdf

5.5 Value of lost quality of life due to asbestos-related disease (2015)

Patient category	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer	All diseases
	$million	$million	$million	$million	$million	$million
Occupational exposure						
Male	1 813	N/A	6 724	106	0	8 642
Female	280	N/A	739	1	36	1 057
Both	2 093	N/A	7 463	107	36	9 699
Non-occupational exposure						
Male	247	N/A	436	4	0	687
Female	172	N/A	266	0	14	453
Both	419	N/A	703	4	14	1 140
All sources of exposure						
Male	2 059	N/A	7 160	110	0	9 330
Female	453	N/A	1 006	1	51	1 510
Both	2 512	N/A	8 166	111	51	10 840

[a] Includes tracheal, bronchus, and lung cancer.

Note: The value of lost quality-of-life due to asbestosis has not been estimated because data on DALYs lost is not available.

Source: CIE.

The GBD study methodology does not discount losses of years of life in the future (for deaths in the current year) or YLDs.[64] This approach is consistent with the approach taken by AIHW in estimating DALYs.

There is considerable variation in the literature estimating VSL and VSLY parameters. For example, Access Economics (2008)[65] reports that Australian VSL studies for health evaluations estimated VSL values between $1.2–$2.9million (in 2006A$). The VSL estimates used in international studies are generally higher, with Access Economics (2008) reporting a range of $0.1–117.0 million. For example, the US Department of Transport uses a value of a statistical life of US$9.6 million.[66]

If we assume lower and upper bounds of VSLY of $93 320 (50 per cent lower) and $279 960 (50 per cent higher), the value of lost quality of life associated with ARDs would be between $5.5–16.5 billion, with a central estimate of $10 966 billion.

The value of DALYs cannot be combined or summed together with the productivity impacts estimated in this report, where discounting is used to value changes in the productive capacity of individuals with ARD.

64 Australian Institute of Health and Welfare 2016. Australian Burden of Disease 2011: methods and supplementary material. Australian Burden of Disease Study series no. 5. Cat. no. BOD 6. Canberra: AIHW, p.5, available at: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129558665

The financial costs identified in table 5.2 point to large costs associated with quality of life losses due to ARD (close to $11 billion). One concern with the inclusion of both quality-of-life losses and productivity losses in economic burden estimates is the potential for double-counting. This is because VSL measures used to estimate the monetary value of lost quality-of-life are based on studies of willingness to pay to preserve life/health. Preference-based measures of VSL may partially capture the willingness to avoid individual productivity losses from death.

While the issue of potential double counting remains somewhat controversial, the recently published Recommendations by the Second Panel on Cost-Effectiveness in Health and Medicine (2016)[67] departed from the Recommendations of the First Panel in "observing that effects on productivity are unlikely to have been captured by most preference-based measures"[68]. Therefore, the Second Panel recommends that productivity consequences be included in cost-effectiveness analysis in addition to preference-based measures of quality-of-life losses.

While we agree that it is appropriate to include estimates of both productivity losses and the monetary value of lost quality-of-life, the sum of both effects should be cautiously interpreted, as they may well overstate the total quality-of-life and productivity losses associated with ARD.

Consideration of the burden of mental ill-health caused by asbestos-related diseases

It is noted that studies on ARD focus primarily on *physical* health. However, any serious illness can affect the mental health of the patient, family and caregivers. Serious illness such as asbestos-related cancers can have a number of impacts that may lead to mental illness such as:

- reduction in the ability to be independent
- reduced mobility and enjoyment of physical activities
- difficulties with family and other relationships caused by financial and emotional burden of disease, and

65 Access Economics, 2008, *The health of nations: The value of a statistical life*, p.63, available at: https://www.safeworkaustralia.gov.au/system/files/documents/1702/thehealthofnations_value_statisticallife_2008_pdf.pdf

66 US Department of Transportation, 2016, *Revised departmental guidance 2016: Treatment of the value of preventing fatalities and injuries in preparing economic analyses*, available at: https://cms.dot.gov/sites/dot.gov/files/docs/2016%20Revised%20Value%20of%20a%20Statistical%20Life%20Guidance.pdf

67 Sanders, G., Neumann, P., Basu, A., Brock, D., Feeny, D., Krahn, M., Kintz, K., Meltzer, D., Owen, D., Prosser, L., Salomon, J., Sculpher, M., Trikalinos, T., Russell, L., Siegel, J. and Ganiats, T., 2016, 'Recommendations for conduct, methodological practices, and reporting of cost-effectiveness analyses: Second panel on cost-effectiveness analysis in health and medicine', *Journal of the American Medical Association*, 316(10), p.1093, available at: http://eprints.whiterose.ac.uk/105455/1/jsc160017_1.pdf

68 Sanders, G., et. al., 2016, p.1097.

- feelings of sadness and devastation that may be associated with the process of diagnosis, treatment and suffering with disease.[69]

These costs cannot be reliably estimated due to lack of data relating to the prevalence of mental diseases among ARD patients and therefore we have not included this in the costings. Notwithstanding this limitation, mental ill health associated with the burden of ARDs does pose a social and economic impact on the community.

At a broad level, there is considerable data on the burden of mental disease.

The National Survey of Mental Health and Wellbeing (NSMHW) provide data on the prevalence and impact of mental illness. It shows that anxiety disorders are the most common mental illness, affecting 14 per cent of the population in 2007, followed by affective disorders such as depression (6 per cent).[70]

Some sufferers of mental illness seek treatment, which is measured in terms of consultation with a GP, psychiatrist, psychologist, nurses, occupational therapists and social workers.

The NSMHW provides data on mental health-related services provided annually, beds available for specialised mental health care, recurrent expenditure on specialised mental health services, and expenditure on treatments subsidised by the MBS, PBS and RPBS.

Data is also available on deaths due to mental illness. In 2013, mental disorders were responsible for 597 deaths, excluding suicide and dementia.[71] However, the mental health impacts of asbestos and ARDs are more commonly undiagnosed anxiety and depression for sufferers, their friends and family.

There may also be economic costs associated with impacts on people other than patients that have ARDs. Mental ill health may be associated with having asbestos in the community, and this ill health would be experienced by people at the greatest risk of contracting ARDs. Further, mental health issues may exist for those already exposed but not having yet contracted ARD.

The discovery of asbestos in homes and community environments can lead to considerable anxiety, distress, and mental ill health. One example is the discovery of loose-fill asbestos in NSW and ACT homes. Loose-fill asbestos was installed in the 1960s and 1970s in homes as ceiling insulation. Hazardous asbestos fibres were later known to migrate from the ceiling into living spaces and pose a risk to human health. The discovery of loose-fill in asbestos in homes has a direct mental health impact on residents, and others may also experience anxiety about the potential discovery of asbestos in their homes.

A survey of residents of homes with loose-fill asbestos insulation was conducted as part of the ACT Asbestos Health Study. Some findings of this study illustrate the impact that asbestos and ARD has on mental health.

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69 See https://www.mesotheliomagroup.com/resources/mental-health/

70 AIHW 2015, Mental Health Services: in brief 2015, Catalogue No. HSE 169, Canberra: AIHW.

71 AIHW analysis of the National Morbidity Database.

- one third of survey respondents "had seen a health professional" for mental or physical health issues related to living in a house with loose-fill asbestos[72]
- one quarter of respondents reported high levels of psychological distress associated with asbestos in their homes,[73] and
- no residents reported being diagnosed with mesothelioma, which illustrates that ARD can have mental health impacts beyond just those who contract ARDs.

Impacts on carers

We have not robustly estimated the impacts of ARD on carers of patients. There is no data available on the number of carers and their time spent caring for people with ARDs.

One indication of these costs is the amount of Carer Allowance that would be paid if all ARD patients had a carer.[74] The Allowance is $124.70 per fortnight ($3 242.20 per year, and there is no income or assets test to receive the allowance. If all 10 444 people with an asbestos-related disease in 2015 (see table 2.1) had a carer who received the Allowance, the total payment would be $33.9 million per year.

This is unlikely to be a robust estimate for a number of reasons:

- the Carer Allowance may imperfectly compensate carers for their time spent providing care. The Aged Care Award 2010[75] indicates the minimum rate of pay for an Aged Care employee is $738.80 per week for 38 hours of work, which equates to $19.44 per hour. The amount of the Carer Allowance would be sufficient to cover slightly over 6 hours of work per fortnight for such a worker. Carers for people with ARDs are likely to provide significantly more care than 6 hours per fortnight.
- The amount of sufferers who have a carer may be overestimated, with the assumption that all sufferers require a carer being an upper bound to the number of carers.

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72 See https://www.gizmodo.com.au/2017/02/one-third-of-australians-with-asbestos-in-their-home-now-have-health-issues/

73 See http://www.canberratimes.com.au/act-news/mr-fluffy-loosefill-asbestos-has-major-impact-on-mental-health-new-report-shows-20170125-gtyu6x.html

74 See https://www.humanservices.gov.au/individuals/services/centrelink/carer-allowance

75 Available at: http://awardviewer.fwo.gov.au/award/show/MA000018#P282_26278

6 Compensation for ARD claims

Sufferers of ARDs often have a right to obtain monetary compensation for their loss due to the disease.

Rights to compensation do not fully compensate for actual losses due to statutory limits on payments, and difficultly in providing evidence of exposures that occurred many years ago. There are also fewer settlements than instances of ARD.

Nonetheless, the amounts of compensation payments are a useful cross-check of estimated costs associated with ARD.

There are two main types of compensation. Firstly, statutory entitlements fulfilled by bodies such as icare Dust Diseases Care (in NSW) which provide a no-fault workers compensation scheme following occupational exposure in NSW to scheduled dusts under the legislation. Secondly, common law damages, which are subject to burden of proof requirements.

Data provided by icare showing mesothelioma claimants receiving the highest average compensation payment at $31 960, followed by lung cancer ($19 517) and asbestosis claimants ($12 418), although there is a wide range of payments. Statutory entitlements paid by icare cannot readily be compared to the estimated average costs of ARD, because payments will reflect individual claimant needs and are highly variable.

Common law claims from companies such as James Hardie can be much larger. The average compensation payments by James Hardie were $295 000 for mesothelioma, $100 000 for asbestosis and $115 000 for lung cancer in 2015-16. Additionally, a number of claims paid by James Hardie have been in the multi-millions. However, James Hardie is only one defendant and many claims are settled and confidential.

The compensation environment for asbestos-related disease

Sufferers of ARD may have a legal right to claim compensation for medical expenses, pain and suffering, lost ability to care for dependents, and other types of loss. The general rule for compensation claims is that damages should put the injured party (with an asbestos-related disease) in the same position, as they would be in without having suffered the injury.[76]

76 Luntz, H, 2006, *Assessment of Damages for personal injury and death: General principles*, Sydney, 2006.

There are two main sources of compensation:

- statutory entitlements fulfilled by bodies such as icare Dust Diseases Care (in NSW), formerly known as the Dust Diseases Board (DDB) or Dust Diseases Authority, and
- companies and individuals, such as a former employer, against whom sufferers of ARDs may make claims for common law damages.[77]

Applications to icare are in addition to common law claims, and claimants may receive both common law damages and icare payments.

For many reasons, compensation settlements are only a lower bound measure of the costs of asbestos-related disease. For instance:

- there may be evidentiary issues, and establishing an instance of exposure may be difficult given the lag time between exposure and contraction of disease can weaken memory recall
- compensation payments may be subject to statutory limitations. For example, Civil Liability Act s15B 2002 (NSW) specifies the requirements around a claim for damages for loss of capacity to provide domestic services
- it is hard to measure pain and suffering and wages in the future are uncertain, and
- it is also difficult to make assessments where there are comorbidities such as diabetes, which reduce life expectancy.

The administration of the workers compensation system is counted as a direct cost of disease in Tompa et. al. (2015).[78] However, it is not counted in this study because of the likelihood that resources currently used for asbestos-related compensation would likely be transferred to other areas of administrative/legal 'production' in the absence of asbestos exposure.

Where claims for common law damages are successful, damages in the form of lump sum payment compensate victims for pain and suffering, loss of expectation of life, medical and other expenses (if not covered by other compensation schemes), the commercial cost of care provided by family or friends, loss of earnings and superannuation and in some cases, the commercial cost of replacing services provided to others (young children or a sick or elderly child, spouse or parent) by the victim.

Compensation payments from icare Dust Diseases Care (NSW)

icare Dust Diseases Care (NSW) formerly known as the Dust Diseases Board (DDB) or the Dust Diseases Authority (DDA)) provides financial compensation to people with a

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77 http://www.segelovtaylor.com.au/asbestos-diseases/mesothelioma/

78 Tompa, E. et al. 2015, 'The economic burden of lung cancer and mesothelioma in Canada due to occupational asbestos exposure', *At Work*, Issue 85, Summer 2016: Institute for Work and Health, Toronto, see http://www.iwh.on.ca/at-work/85/new-cases-of-mesothelioma-and-asbestos-related-lung-cancer-in-one-year-cost-19b

NSW work-related dust disease (such as mesothelioma) following exposure whilst employed as a worker in NSW.[79]

The statutory definition of a work-related dust disease includes mesothelioma, asbestosis and asbestos-related lung cancer, and a range of other pathological conditions.[80]

For the purpose of this report a claim represents the cost associated with a predetermined annualised entitlement paid in the form of fortnightly payments, or payment for a service provided to the worker. Once accepted into the scheme all reasonable and necessary medical and treatment costs associated with the disease are paid, in addition to fortnightly payments. Medical compensation costs relate to the worker only. Upon the worker's death, surviving dependants, typically spouses but may be dependent children, receive a lump sum and fortnightly payments.

Individuals with mesothelioma and asbestos-related lung cancer are typically classified as having 100 per cent disability due to the malignant nature of these diseases. The disability level for lung cancer may be reduced post-diagnosis depending on the success of treatment. Individuals diagnosed with asbestosis may vary in their disability level over time (up to 100 per cent), and this has an impact on entitlements.

Determination of entitlement can be complex, particularly for those who have worked and been exposed in multiple states.[81] Compensation from icare does not cover sufferers of ARDs caused by non-occupational exposure.

Table 6.1 provides a description of each category of compensation paid by icare.

6.1 Categories of compensation from icare

Compensation categories	Description
Worker	
Compensation payments	Includes payments made to workers in the form of fortnightly benefits and for the workers' funeral.[a]
Medical expenses	Includes costs related to: ▪ Hospitalisation of workers for the treatment of their Dust Disease ▪ Home nursing services (including in-home respite) within a client's home ▪ Nonmedical professional services such as occupational therapy assessment, physiotherapy treatment, gym programs, psychological counselling and dieticians ▪ Ambulance transport costs to or from hospital ▪ Therapies or treatment such as vitamins, dieticians, counselling, workplace rehabilitation ▪ Specialists for e.g. oncologists, cardiothoracic surgeons

79 Compensation also depends on the level of disability as a result of their disease.

80 *Workers' Compensation (Dust Diseases) Act 1942* (NSW), Schedule 1, available at: https://legislation.nsw.gov.au/#/view/act/1942/14/sch1

81 Gunningham, N., 2012, 'Asbestos-related diseases and workers' compensation', *Sydney Law Review*, 34(2) (June 2012), available at: http://www.austlii.edu.au/au/journals/SydLawRw/2012/13.pdf

Compensation categories	Description
	▪ Pharmaceutical prescriptions ▪ Home and portable oxygen ▪ Approved nursing home or hostel charges ▪ Pathology services for diagnosis and ongoing monitoring of disease ▪ Diagnostic imaging for radiology and CT Scans
Non-medical expenses	Includes costs related to: ▪ Domestic assistance services within the clients home including house cleaning, transporting to doctors' appointments, lawn mowing, meals on wheels etc. ▪ Minor home modifications including minor bathroom renovations, installation of grab rail or hand rails etc. ▪ Equipment of mobility aids
Dependant	
Compensation payments	Includes payments made to dependants in the form of fortnightly benefits and when DDC makes an Award of a fortnightly benefit they will also make an Award for a lump sum

[a] From November 2017 onwards a one-off payment of $9,000 is paid for a worker's funeral.

Source: icare data request information.

The number of claimants for 2015-16 for each disease category represents:

- the number of new cases certified and awarded by icare,
- existing cases diagnosed and awarded in previous years,
- and new and existing dependants whose financial support stems from the former worker.

The icare 2015-16 Annual Report[82] indicates that in total 1 128 workers and 2 999 dependants of a deceased worker received financial support and includes the three diseases described here.

Of all of the new cases certified with a compensable dust disease by the icare Dust Diseases Care Medical Assessment Panel (a panel of three respiratory physicians) in the 2015-16 financial year:

- 139 cases were mesothelioma (48 per cent of new cases)
- 45 cases (16 per cent) were asbestosis, and
- 20 case (7 per cent) were asbestos-related lung cancer.

Compensation claims data from icare for 2015-16 shows that most compensable claims (payable to the worker, or upon the workers' death, their surviving dependant) in NSW of the three diseases presented here were paid in relation to mesothelioma, and there were approximately twice the number of claims as claimants across all disease types (table 6.2). The low number of claims per claimant reflects that most claimants are dependants.

82 icare, 2016, *Annual Report 2015-16*, available at: https://www.icare.nsw.gov.au/-/media/863ac141af874b8faf00de42d81eaf22.ashx

6.2 Compensation claims paid by icare in 2015-16

	Mesothelioma	Asbestosis	Lung cancer
Number of claimants	2 291	702	374
Number of claims where compensation was paid	4 931	1 620	706

Source: icare, CIE.

Compensation payments for financial support and funeral expenses

The following data (tables 6.3-6.6) details the total value of compensation payments for mesothelioma, asbestosis and lung cancer, as well as the subcategories of compensation payments and medical and treatment expenses.

icare provides financial support for losses such as wages for those injured workers still working (represents a small subset due to the long latency of dust diseases), payments representing income replacement for those who have left the workforce and pays the workers' funeral expenses. Dependants are the largest cohort receiving financial support via the scheme, and account for the vast majority of payments (table 6.3).

6.3 Number and total amount paid in compensation payments in 2015-16

Compensation category	Mesothelioma	Asbestosis	Lung cancer
	$000's (Number of Claims)	$000's (Number of Claims)	$000's (Number of Claims)
Worker	$6 936 (425)	$2 747 (298)	$1 623 (92)
Dependant	$24 816 (1931)	$4 142 (442)	$3 587 (281)
Lump Sum Awards to Dependants	$18 609 (106)	$3 230 (33)	$1 460 (10)
Funeral	$1 187 (155)	$350 (47)	$82 (13)

Source: icare, CIE.

Medical and nonmedical payments for health care services

Medical and nonmedical compensation payments are paid to the worker only (Table 6.4). Medical compensation payments relate to medical and treatment related expenses, while nonmedical expenses relate to domestic assistance such as home modifications. Within the medical expenses category, the largest expenditure items relate to hospital costs and the cost of health benefit claims paid by health insurance companies, including Medicare. These costs exclude the cost to government of providing medical care (outside of Medicare).

The following examples demonstrate the high degree of variation in the composition of medical compensation across the disease types:

- mesothelioma expenses are dominated by hospital expenses and repayment of private health insurance claims and Medicare
- asbestosis expenses are dominated by domestic assistance and other medical costs (mainly travel by taxi for claimants), and
- lung cancer expenses are mostly for repayment of private health insurance claims and Medicare, domestic assistance and other medical costs.

6.4 Number and total amount paid in medical and related treatments in 2015-16

Compensation category	Mesothelioma	Asbestosis	Lung cancer
	$000's (Number of claims)	$000's (Number of claims)	$000's (Number of claims)
Medical Expenses			
Hospital Expenses	$1 921 (173)	$29 (5)	$0 (0)
Past HIC benefits reimbursement	$1 487 (149)	$23 (10)	$68 (4)
Other therapies/treatments	$933 (859)	$81 (292)	$60 (133)
Pharmaceutical	$524 (267)	$10 (36)	$4 (19)
Home Nursing	$252 (187)	$63 (80)	$11 (21)
Nursing Home and Hostel Charges	$58 (19)	$58 (7)	$8 (6)
Pathology	$49 (74)	$2 (4)	$0 (0)
Non-Medical Professional	$32 (70)	$11 (20)	$4 (8)
Diagnostic imaging	$24 (77)	$17 (50)	$3 (17)
Oxygen	$16 (44)	$62 (50)	$13 (11)
Ambulance Expenses	$16 (22)	$1 (2)	$1 (1)
Non-Medical Expenses			
Domestic Assistance	$233 (213)	$173 (163)	$67 (65)
Equipment	$105 (130)	$53 (74)	$17 (23)
Home Modification	$46 (30)	$16 (7)	$1 (2)

Source: icare, CIE.

Average compensation paid by icare

On average, past workers with mesothelioma received the highest average compensation entitlements at $31, 960 in 2015/16, followed by lung cancer ($19, 517) and asbestosis

($12, 418) (table 6.5). However, there is a very wide variation in the amounts received across claimants, irrespective of disease. icare provides financial and health care support to workers with a dust disease throughout their life. The total amount an individual receives depends upon their disease and disability, and their duration on the scheme.

Lump sum payments were made to a total of 149 dependants following the death of the worker, across disease groups, and the average lump sum awarded ranged from around $98,000 to $175,000 (table 6.6).

The usefulness of average claim costs as a measure of burden of disease for this dataset is limited because it masks a high degree of variation in the individual claim patterns of claimants i.e. in payouts across claims, payment items and across the disease types.

6.5 Average compensation per worker from icare for 2015-16

Compensation categories	Mesothelioma	Asbestosis	Lung cancer
	$/claimant	$/claimant	$/claimant
Compensation payments	17 558	10 209	16 904
Medical and nonmedical compensation [a]	14 402	2 209	2 613
Total (Average)	**31 960**	**12 418**	**19 517**

[a] Medical compensation includes all subcategories of medical compensation in table 6.1.

Note: The total (average payment across all categories per claimant) will not be equal to the sum of each component, since only a proportion of all claimants receive each category of compensation. Compensation payments are paid fortnightly.

Data source: icare data request, CIE.

6.6 Average compensation per dependant from icare for 2015-16

Compensation categories	Mesothelioma	Asbestosis	Lung cancer
	$/claimant	$/claimant	$/claimant
Compensation payments	13 089	9 566	12 902
Lump Sum Payment [a]	175 557	97 879	146 000
Funeral [a]	8 604	7 279	6 256

[a] These represents one-off payments.

Note: Compensation payments are paid fortnightly.

Data source: icare data request, CIE.

Comparison to medical costs estimates

Mesothelioma, asbestosis and lung cancer claimants received an average of $14, 902, $2, 209 and $2, 613 in 2015/16 respectively in medical compensation. These amounts are very low in comparison to the medical expenses estimated in this report (refer chapter 3), where mesothelioma and lung cancer patients require health services valued at $39, 300 and $13, 600 respectively. Mesothelioma is characterised by poor survival from diagnosis and requires intensive medical and palliative support, particularly at end-of-life as reflected in table 6.4. The low number of claims and low health care costs overall for asbestosis, mainly reflect domestic assistance as a result of symptoms such as breathlessness which impact on the ability to perform daily tasks. The number of claims and overall costs for lung cancer are also low and reflect that many of our workers with lung cancer are deemed ineligible for treatment because they are too elderly.

icare Dust Diseases Care introduced a compassionate access scheme to Keytruda in October 2015 for workers receiving compensation for mesothelioma. To date, more than 100 workers have received treatment with a total spend on pharmaceuticals exceeding $3.3 million.

Summary

In 2015/16 icare provided a total of $91 million in benefits of which $82 million were for compensation benefits and $9.5 million were for healthcare and funeral benefits for over 4 400 people. Compensation costs described in this report relate only to the three asbestos-related diseases analysed.

ARDs not covered in this analysis e.g. ARPD which accounts for approximately 26 per cent of cases. Costs associated with monitoring the health of those individuals who have been classified with pleural plaques which are not thought to be disabling are not considered in this analysis.

Compensation payments under common law

Sufferers of ARDs may have claims under common law against former employers or manufacturers of asbestos-containing products. One example of such a company is James Hardie. James Hardie has ongoing liabilities for compensation to certain victims of ARDs in Australia. Common law damages are paid to claimants as a lump sum.

Each year, KPMG Actuaries provide reports of the valuation of asbestos-related disease liabilities of former James Hardie entities. The most recent report available contains data as at 31 March 2016, which relates to claims for the 2015-16 financial year.

Table 6.7 presents the average value of asbestos-related disease liabilities of former James Hardie entities in 2015-16. It shows that mesothelioma claims have the highest value, above those of lung cancer. This may be because lung cancer is less easily attributable to asbestos exposure (and may be due to smoking), and thus expected compensation liabilities are lower in recognition of the greater evidentiary burden that claimants must meet.

This only includes claims for diseases considered in this report as asbestos-related disease (mesothelioma, asbestosis, lung cancer, larynx cancer and ovarian cancer). However, there have been no claims for ovarian cancer or larynx cancer. Asbestos-related pleural disease and other diseases have been excluded.

We have also excluded Workers Compensation claims and Wharf worker claims, for which insurance arrangements mean the financial liability for James Hardie entities is not significant.

6.7 Compensation claims from James Hardie (2015-16)

	FY16 Actual
	$
Average claim value	
Mesothelioma	294 048
Asbestosis	99 691
Lung cancer	115 507
Mesothelioma Large Claims (settled)	
Number	3
Average claim size	3 170 000
Large claim expenditure	9 510 000

Source: KPMG, 2016, Valuation of asbestos-related disease liabilities of former James Hardie entities ("the liable entities") to be met by the AICF Trust, prepared for Asbestos Injuries Compensation Fund Limited ("AICFL"), May, 2016, available at: http://www.ir.jameshardie.com.au/public/download.jsp?id=5839&showOrig=t

There are a number of key limitations with using James Hardie compensation data to indicate common law damages from other defendants, including:

- James Hardie is only one defendant, and other defendant's damages may be higher or lower than those paid by James Hardie, and
- most victims settle on a confidential basis, and thus observed compensation amounts may differ from compensation amounts including settlements.

Additionally, common law damages don't include medical and other expenses, suggesting that total losses suffered by sufferers of ARD would exceed the claim amounts paid by James Hardie.

However, common law damages cover a greater scope of damages and are a more complete measure of losses suffered by those with asbestos-related disease. Common law damages sometimes include exemplary damages where the defendant was recklessly indifferent to harm caused by asbestos.[83]

Differences in entitlements between states

Reasonable compensation for ARDs is generally available in all states and territories.[84] However, there are differences in the compensation available between states, and some examples of differences are summarised below.

83 See http://curwoods.com.au/casenotes/new-benchmark-general-damages-exemplary-damages-mesothelioma-claim-caused-asbestos-exposure-latz-v-amaca-pl-formerly-james-hardie-co-pl-2017-sadc-56/

84 Turner Freeman, 2015, *Asbestos disease compensation Western Australia 2015*, p.26, available at: http://www.turnerfreeman.com.au/wa/wp-content/uploads/2014/08/KAC-WA-Brochure-Final-2014-partner-version-final.pdf

- In NSW, South Australia and Victoria claims are allowed to begin on a provisional damage basis, whereby a claim is made for a current ARD, and a different claim can be made in the future if the claimant develops another ARD.
- *Sullivan v Gordon* damages refer to damages for services provided to a third party, such as caring services provided by family for a mesothelioma sufferer. While the High Court decision of *CSR Limited v Eddy* abolished these damages, NSW, South Australia, Victoria, ACT and Queensland have enacted legislation to make these damages available.
- NSW is the only state which has a dedicated ARD compensation body (icare Dust Diseases Care). Other states and territories have workers' compensation bodies which are responsible for statutory claims for compensation in those jurisdictions. This may suggest that NSW has a better compensation system than other states, potentially resulting in more claimants and higher payments.

Overall, the differences between states in terms of compensation allowable are small. Therefore, the average claim amounts presented in this chapter are likely to be reasonable indicators of claim amounts in other states.

7 Conclusion and implications for future research

ARDs impose substantial costs on sufferers, their families, and the wider community and economy.

The population of ARD sufferers is not in any way limited to the current pool of patients, due to the long latency period of disease, and the increase in incidence associated with non-occupational exposure.

Moreover, disease does not have to be present in order to generate concern and anxiety associated with asbestos in the community.

This study has estimated only the health system and productivity costs associated with the physical aspects of ARD.

Further primary research is required to extend the understanding of costs to mental health and other implications of living with ARD in the Australian community.

Extending measurement of costs to other aspects of asbestos-related disease

In this report, we have estimated the monetary value of health system costs and lost productivity due to ARD. This is only part of the financial footprint associated with the current level and distribution of asbestos in the Australian community today.

While it is acknowledged that the very nature of having asbestos in the community can cause stress, the areas of unquantified costs that are most material to understanding the economic burden of asbestos and ARD include:

- the costs of mental ill health associated with ARD
- the costs to industry of managing asbestos in buildings
- potential house price impacts associated with asbestos removal, and
- the governance, monitoring and reporting costs of implementing asbestos policy.

To understand the full cost of ARD in Australia, future costing work is required with primary data collection on the mental health impacts of living with ARD, and industry surveys to understand costs to business.

A comparative analysis of governance and reporting costs under alternative policy models would also be valuable, possibly across Australia and internationally.

Understanding future costs

Even for those items measured as part of this study, it is possible, and indeed likely, that the future costs of ARD per person may be higher than the costs measured here. This would certainly be the case if clinical evidence on the link between asbestos exposure and other diseases became more conclusive.

At the very least, there is some evidence to suggest that the cohort of sufferers of ARDs are getting younger, and being more strongly represented by women, as the third wave of exposures progresses.

Changes in the demographic profile of Australians with ARD, particularly with respect to age, will result in greater productivity losses per person, as sufferers will lose more years of potential work due to disabling and fatal diseases such as mesothelioma.

It also suggests that healthcare costs will be higher since patients will live, and require treatment, for longer.

Enabling evidence based asbestos policy development

Future asbestos policy development should be informed by an understanding of the costs of asbestos exposure and ARD.

In this sense, this report contributes to the evidence-base for asbestos policy development in confirming that there are large costs associated with ARD in Australia in 2015.

Policies that are able to reduce asbestos exposure and the incidence of ARDs would reduce the health system and productivity costs measured in this report, and a reduction in ARD prevalence would free up health system resources for other priorities.

Hence, the findings in this report will help future policy development by enabling policy makers to consider the net benefits for society of alternative policy choices.

A Comparison of the populations and costs associated with lung cancer and mesothelioma

This appendix summarises the data available about the relationship between lung cancer and mesothelioma. It also discusses the methodology used to fill gaps in the data available with respect to prevalence and deaths.

Data available about prevalence and deaths

Detailed data about the population of sufferers and deaths due to ARD is available, and is disaggregated by age and sex. These data have been obtained from the Global Burden of Disease study, through the GBD Compare online tool.[85]

Table A.1 shows what data is available and where estimates have been made based on other assumptions or sources. The table illustrates the following gaps in the data for which we have estimated deaths/prevalence:

- data is not available for deaths associated with lung, larynx and ovarian cancer due to non-occupational asbestos exposure,
- data is not available for prevalence associated with lung, larynx and ovarian cancer due to asbestos exposure, and
- data is not available indicating the prevalence associated with occupational and non-occupational exposure.

A.1 Data available about population with asbestos-related diseases

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer
Deaths	Yes	Yes	Yes	Yes	Yes
▪ Asbestos-related and non-asbestos related	Yes	Yes	Estimated	Estimated	Estimated
▪ Occupational exposure	Yes	Yes	Yes	Yes	Yes
▪ Non-occupational exposure	Yes	Yes [b]	Estimated	Estimated	Estimated
Prevalence	Yes	N/A	Yes	Yes	Yes
▪ Asbestos-related and non-asbestos related	Yes	N/A	Estimated	Estimated	Estimated
▪ Occupational exposure	Estimated	N/A	Estimated	Estimated	Estimated

85 Institute for Health Metrics and Evaluation (IHME). GBD Compare Data Visualization. Seattle, WA: IHME, University of Washington, 2016. Available from http://vizhub.healthdata.org/gbd-compare.

	Mesothelioma	Asbestosis	Lung cancer [a]	Larynx cancer	Ovarian cancer
▪ Non-occupational exposure	Estimated	N/A	Estimated	Estimated	Estimated

[a] Includes tracheal, bronchus, and lung cancer.

[b] It is assumed that the number of deaths and cases of asbestosis associated with non-occupational exposure are zero. This is because asbestosis is caused by heavy exposure to asbestos, usually in workplace environments.[86]

Note: 'Yes' indicates that this data is available. 'Estimated' indicates that this data has been estimated based on the other data that is available. N/A indicates that the data is not available and has not been estimated.

Source: Global Burden of Disease project ('GBD Compare' tool, available at https://vizhub.healthdata.org/gbd-compare/), CIE.

Methodology to estimate lung, larynx and ovarian cancer deaths and prevalence

Estimating the proportion of deaths attributable to non-occupational asbestos exposure

The number of total asbestos-related deaths is the sum of deaths associated with occupational and non-occupational exposure.

While the number of deaths associated with lung, larynx and ovarian cancer caused by occupational asbestos exposure is known, data is not available indicating deaths associated with these diseases where caused by non-occupational exposure.

We estimate the number of deaths associated with these diseases where caused by non-occupational exposure to asbestos. We assume that the ratio of deaths due to mesothelioma caused by occupational and non-occupational exposure is equal to the ratio of deaths caused by occupational and non-occupational exposure for these other diseases. This can be represented by the following equation:

$$\frac{deaths_{as,occ,meso}}{deaths_{as,non-occ,meso}} = \frac{deaths_{as,occ,d}}{deaths_{as,non-occ,d}}$$

where

- *deaths* indicates the number of deaths
- *a* refers to an age cohort (e.g. seventy-year-olds)
- *s* refers to sex

86 See https://www.berniebanton.com.au/mesothelioma-asbestos-disease-support/types-of-asbestos-diseases/asbestosis/ Asbestosis may potentially be caused by heavy exposure in non-occupational settings. For example, studies conducted in China of farmers in a rural province show higher incidence of asbestosis among farmers exposed to asbestos-polluted soil. (Goldberg, M. & Luce, D., 2012, 'The health impact of nonoccupational exposure to asbestos: what do we know?', *Eur J Cancer Prev*. 2009 Nov; 18(6): 489–503, available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3499908/). These results may not be applicable to the Australian context, where we believe high levels of exposure outside of occupational contexts is unlikely.

- *occ* and *non-occ* denote deaths due to diseases associated with occupational and non-occupational exposure respectively
- *meso* denotes deaths due to mesothelioma, and
- *d* denotes each ARD including lung cancer, larynx cancer and ovarian cancer.

Making this assumption assumes that the ratio of deaths associated with occupational and non-occupational exposure is equal among mesothelioma, lung cancer, larynx cancer and ovarian cancer.

Simply rearranging this equation gives the following expression for the number of deaths (by age and sex) due to lung, larynx or ovarian cancer associated with non-occupational exposure.

$$deaths_{as,non-occ,d} = \frac{deaths_{as,non-occ,meso}}{deaths_{as,occ,meso}} \times deaths_{as,occ,d}$$

The share of deaths from ARD associated with non-occupational exposure may be underestimated. This is because identifying and attributing disease to sources of non-occupational exposure is difficult in comparison to identifying sources of occupational exposure.

Estimating the proportion of prevalence attributable to asbestos exposure

Data for the number of prevalent cases of lung, larynx and ovarian cancer caused by asbestos-exposure is not available. The numbers of prevalent cases of asbestos-related cancers have been estimated by combining the following data:

- Prevalence of lung, larynx and ovarian cancer regardless of asbestos exposure
- Deaths due to with lung, larynx and ovarian cancer associated with asbestos exposure

We have assumed that the ratio of asbestos-related deaths to total deaths by each disease is equal to the ratio of asbestos-related prevalent cases to total prevalent cases by disease. This can be represented by the following equation

$$\frac{deaths_{d,A}}{deaths_{d}} = \frac{prevalence_{d,A}}{prevalence_{d}}$$

where

- *deaths* and *prevalence* indicate the number of deaths and prevalent cases respectively
- *d* denotes each ARD including lung cancer, larynx cancer and ovarian cancer
- *A* denotes that *deaths* or *prevalence* relates to diseases caused by asbestos exposure only.

Making this assumption implicitly assumes that the likelihood of death in a given year for a sufferer of lung cancer is the same regardless of whether the disease was caused by asbestos-exposure or not.

Simply rearranging this equation gives the following expression for the number of prevalent cases of asbestos-related lung cancer:

$$prevalence_{asdA} = \frac{deaths_{asdA}}{deaths_{asd}} \times prevalence_{asd}$$

Table A.2 illustrates the results of this calculation for lung cancer. It shows deaths due to lung cancer, deaths due to lung cancer associated with asbestos-exposure, prevalence due to lung cancer, and prevalence of lung cancer associated with asbestos-exposure, which has been estimated according to the equation above.

A.2 Estimated asbestos-related prevalence for lung cancer.

Age and sex	Deaths	Asbestos-related deaths	Prevalence	Estimated asbestos-related prevalence
	Number	Number	Number	Number
Male				
0-6 days	0	0	0	0
7-27 days	0	0	0	0
28-364 days	0	0	0	0
1-4 years	0	0	0	0
5-9 years	0	0	0	0
10-14 years	0	0	0	0
15-19 years	0	0	1	0
20-24 years	1	0	2	0
25-29 years	1	0	7	0
30-34 years	3	0	20	0
35-39 years	11	0	56	2
40-44 years	32	1	103	4
45-49 years	97	6	333	19
50-54 years	198	19	575	56
55-59 years	349	58	1 034	173
60-64 years	701	184	1 963	516
65-69 years	815	310	2 335	889
70-74 years	902	460	2 378	1 214
75-79 years	837	563	1 914	1 286
80+ years	1 722	1 244	3 717	2 685
Total	**5 670**	**2 847**	**14 438**	**6 845**
Female				
0-6 days	0	0	0	0
7-27 days	0	0	0	0
28-364 days	0	0	0	0
1-4 years	0	0	0	0
5-9 years	0	0	0	0
10-14 years	0	0	0	0
15-19 years	0	0	2	0
20-24 years	0	0	3	0
25-29 years	1	0	11	0
30-34 years	3	0	27	1

Age and sex	Deaths	Asbestos-related deaths	Prevalence	Estimated asbestos-related prevalence
	Number	Number	Number	Number
35-39 years	12	0	80	2
40-44 years	31	1	141	4
45-49 years	83	3	375	12
50-54 years	153	6	633	26
55-59 years	239	13	1 004	53
60-64 years	429	30	1 578	110
65-69 years	456	40	1 745	154
70-74 years	491	58	1 748	207
75-79 years	450	64	1 348	190
80+ years	1 027	183	2 845	507
Total	**3 376**	**397**	**11 541**	**1 265**
Both sexes				
Total	**9 046**	**3 244**	**25 979**	**8 111**

Source: GBD 2015, CIE.

The total number of asbestos-related prevalent cases of lung cancer is 8 111. Given that there are 1 562 prevalent cases of mesothelioma[87], this implies a ratio of 5.2 prevalent cases of lung cancer for each of mesothelioma. This is markedly different from the ratio of asbestos-related lung cancer deaths to mesothelioma deaths, which is 4.2 asbestos-related lung cancer deaths per mesothelioma death.

Another approach would be to assume that the ratio of asbestos-related lung cancer deaths to mesothelioma deaths is the same as the ratio of asbestos-related lung cancer prevalence to mesothelioma prevalence. That is, assume that the ratio of asbestos-related lung cancer prevalence to mesothelioma prevalence is 4.2. This assumption can be represented by the following equation:

$$\frac{deaths_{asdA}}{deaths_{asmA}} = \frac{prevalence_{asdA}}{prevalence_{asmA}}$$

This equation can likewise be rearranged to solve for $prevalence_{asdA}$, the number of asbestos-related deaths by ARD, age and sex.

However, this approach is considered less plausible. Mesothelioma and lung cancer have different impacts on the body and different survival rates. It is not expected that the survival rate of mesothelioma would necessarily be the same as lung cancer, larynx cancer and ovarian cancer caused by asbestos-exposure.

87 Note that all cases of mesothelioma are assumed to be asbestos-related.

Estimating the split between prevalent cases associated with occupational and non-occupational exposure

Data is not available indicating the amount of prevalent cases of ARDs associated with occupational and non-occupational exposure.

Having calculated the split between deaths attributable to occupational and non-occupational exposure, we apply this ratio of deaths from occupational and non-occupational exposure to prevalent cases. We assume that that ratio of deaths from mesothelioma due to occupational and non-occupational exposure is equal to the ratio of prevalent cases from each ARD due to occupational and non-occupational exposure.

This can be represented by the following equation:

$$\frac{deaths_{as,occ,meso}}{deaths_{as,non-occ,meso}} = \frac{prevalence_{as,occ,d}}{prevalence_{as,non-occ,d}}$$

where

- *deaths* and *prevalence* indicate the number of deaths and prevalent cases respectively
- *a* refers to an age cohort (e.g. seventy-year-olds)
- *s* refers to sex
- *occ* and *non-occ* denote deaths due to diseases associated with occupational and non-occupational exposure respectively
- *meso* denotes deaths due to mesothelioma, and
- *d* denotes each ARD including mesothelioma, lung cancer, larynx cancer and ovarian cancer.

Making this assumption implies that the survival rate of ARDs is equal regardless of whether the exposure source was occupational or non-occupational.

Simply rearranging this equation gives the following expression for the number of deaths (by age and sex) due to lung, larynx or ovarian cancer associated with non-occupational exposure.

$$prevalence_{as,non-occ,d} = \frac{deaths_{as,non-occ,meso}}{deaths_{as,occ,meso}} \times prevalence_{as,occ,d}$$

The number of cases of ARD associated with non-occupational exposure may be underestimated. This is because identifying and attributing disease to sources of non-occupational exposure is difficult in comparison to identifying sources of occupational exposure.

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