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Fire-fighters' Cancer Risk

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Fire-fighters' Cancer Risk

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Abstract

Research indicates that fire-fighters may suffer a relatively higher risk of contracting a range of cancers. Based on this research, we explore the expected lifetime cost and annual population costs for these cancers. The annual expected costs are compared to wages in a number of jurisdictions, for a range of benefit designs and entitlement periods.

Population cancer incidence increases significantly with age, particular for ages 55 and above. Research also indicates that fire-fighters' relative risk may also increase with length of service (or exposure) and hence the expected cost of claims would be largely concentrated in the years post retirement. This latency impact, coupled with changing retirement ages and an aging population, causes a mismatch between the timing of exposure and the timing of expected benefit payments.

Given these features of the experience, we explore different funding and insurance options, using an assessment framework.

Keywords: Lisa Simpson, Kathryn Cannon, Fire-fighter, Cancer, workers' compensation, presumptive legislation, prescribed disease, occupational exposure

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Introduction

From 4th July 2011, Comcare became the first workers compensation scheme in Australia to include presumptive legislation in respect of certain cancers contracted by fire-fighters[i]. The legislation provides a rebuttable presumption that these cancers are work related and hence compensable under the Comcare Scheme, provided that the fire-fighter has been employed for a certain period of time before diagnosis, with the length of period varying with the type of cancer. In other words, the legislation removes the requirement for the fire-fighter to prove that their illness is work-related.

Table 1 List of cancers and qualifying period

Disease	Qualifying period
Brain cancer	5 years
Bladder cancer	15 years
Kidney cancer	15 years
Non-Hodgkin's lymphoma	15 years
Leukaemia	5 years
Breast cancer	10 years
Testicular cancer	10 years
Multiple myeloma	15 years
Primary site prostate cancer	15 years
Primary site ureter cancer	15 years
Primary site colorectal	15 years
Primary site oesophageal cancer	25 years

Comcare introduced this legislation after considering the impact of similar legislation in North America.

Tasmania joined Comcare by passing legislation on 27th September 2013, which also enacted presumptive legislation for fire-fighters, including volunteers. The same list of 12 cancers and qualifying periods have been adopted in the Tasmanian legislation as for Comcare, as listed above. In the Tasmanian legislation, coverage is provided for up to 10 years after ceasing work as a fire-fighter. For volunteers, there is a requirement to have attended at least 260 exposure events over a 5-10 year period, depending on the type of cancer.

Presumptive legislation exists in many workers compensation scheme in Australia for prescribed lists of occupational diseases. The effect of this legislation is to remove the onus of proof from the injured worker to prove that their injury is work related,

provided that they work in the occupation described for each disease. The diseases included in such legislation are ones where there is a body of evidence to show that there is a causal link between the exposures in the work place for certain occupations and the particular disease.

A list of common prescribed diseases is included in Appendix A, drawn from various workers compensation legislation in Australia. An example of such a disease is brucellosis, which has a strong link to the occupation of working in an abattoir. Many of the diseases are relatively rare in terms of incidence, with the exception of asbestosis and mesothelioma.

The benefit of having such presumptive legislation for diseases is to reduce the level of disputation regarding workers compensation claims. This is beneficial especially where the effects of the disease are very aggressive, reducing the stress for the injured worker in having to prove their illness is work related. The list of diseases is relatively similar between the different jurisdictions in Australia, and is generally accepted by each scheme to be based on sound medical evidence. Therefore, the legislation effectively reduces the administrative burden for the schemes relating to such claims, with very little perceived risk to the scheme of paying claims which are not truly work related.

Unlike the current list of prescribed occupational diseases, cancer risk for fire-fighters is not generally agreed and accepted for coverage by the workers compensation schemes in Australia to be work related. The evidence is not conclusive, as we will discuss in following sections. The result is that fire-fighters who suffer cancer (outside of the Tasmanian and Comcare schemes) need to be able to demonstrate that their illness is work related, with the requirements varying by state for this process.

In our view, the decision about whether or not to include cancer in the presumptive legislation for workers compensation is more of a social policy issue rather than one which can be decided purely based on medical evidence, given that the medical evidence is not conclusive. In this paper, we do not address whether or not workers compensation should be automatically available for fire-fighters with cancer, but rather explore all of the options and funding approaches which could be used to provide this coverage.

Firstly, we explore the different insurance options available to fire-fighters to source benefits in the event of a diagnosis of cancer.

Insurance options

There are a range of insurance options which could be considered to meet the needs of fire-fighters contracting cancer, including:

- Individual income protection policies sold through life insurers, which provide replacement income for periods where the fire-fighter is unable to work. These products traditionally do not include payment for medical treatment costs, and hence would not provide a complete solution by themselves. Private health insurance would be required to cover treatment benefits. Alternatively, Medicare and PBS would provide rebates against some of the cost of treatment. However, it is possible that the injured worker would still need to fund a high amount of treatment costs themselves if they did not have private health. Furthermore, the policy design for income protection might limit the benefit period depending on the option chosen, and this may not correspond to the period during which the fire-fighter is unable to work. [ii]

- Individual trauma insurance sold through life insurers, which provide lump sum benefits upon diagnosis of a range of different illnesses. The lump sum may or may not cover the lost income and treatment costs, depending on the nature of the illness, and time away from work. There is no linkage between the benefits received and the loss of income and treatment costs incurred. Furthermore, there is a certain severity of illness required to satisfy eligibility for benefits, which may not be met in all circumstances for the list of cancers shown in table 1.

- Individual total and permanent disability, sold through life insurers. This insurance provides a lump sum if the injured worker is not able to return to their pre-injury occupation, or any occupation, depending on the nature of the policy. It would not be expected to provide benefits under all circumstances envisaged when a fire fighter contracts one of the cancers in the list in table 1, as some instances only result in temporary disability, or partial disability.

- Specialist group death and disability schemes for fire-fighter and emergency services workers provided and funded through industry related superannuation schemes. An example of such a scheme is the NSW Fire Brigades Fire-fighting Staff Death and Disability Superannuation Fund. This fund provides a lump sum or life time pension for those who die or suffer total and permanent incapacity which arises from a work related cause. Again, this would not cover treatment costs, and may not provide benefits for all cancers in table 1.[iii]

- Workers' compensation. Most schemes in Australia provide income replacement and reasonable treatment costs, where the illness can be

shown to be work related. Therefore, even without presumptive legislation, it is possible to claim workers compensation benefits for cancer linked to occupational exposures. However, as discussed earlier, not all schemes would accept a cancer as being occupationally related, and hence coverage would not be guaranteed. We provide illustrative examples of the experience in different schemes later in this paper.

In summary, there is currently no standard national insurance solution for income and treatment benefits for fire-fighters contracting cancers listed in table 1. In states without presumptive legislation, additional life insurance cover may be necessary to cover lost income or a lump sum benefit, but these policies may also not respond in every circumstance.

We now examine the current sources of funding and the associated costs of fire-fighting services, before exploring the possible annual costs of cancer benefits, and comparing these to other employee related fire-fighting expenses.

Current funding

In addition to government contributions, funding for the cost of fire services has traditionally been through the collection of a fire services levy, which is often collected by general insurers issuing property policies and through property rates.

Reviewing the annual reports of the fire services in each state and territory revealed that the total funding provided through insurance levies, land taxes, local, state and commonwealth contributions was approximately $2.5Bn in the 2011/12 financial year. The employee related expenses of the fire services were $1.7Bn, or two thirds of the funding provided.[iv]

Table 2 Current costs and funding for fire services

	Employee costs $m	Contributions $m
Victoria	446.3	809.2
NSW	528.5	602.2
Qld	345.7	504.8
SA	113.6	170.0
WA	158.4	247.2
Tas	43.7	61.4
NT	24.5	32.7
ACT	76.4	87.7
Total	1,737.0	2,515.3

The costs of fire fighting services currently include wages, superannuation, associated death and disability scheme costs and workers compensation premiums for the employed fire-fighters, on top of the cost of physical assets required to perform the services.

By comparison, the 2011 census data includes a break-down of the total persons by sex and weekly income by $500 bands for those employed as fire and emergency services workers. Using this break-down, we estimated that total reported income was approximately $977m in the 2011 year. We have broadly reconciled the difference in reported income from the census data to the total employee related costs above, by taking into account superannuation, payroll, workers compensation premiums, employee costs for non-active duty personnel and long service leave.

In Victoria, the funding has changed from a levy on insurance to a land tax based levy from 1 July 2013. This change was implemented in order to spread the cost of the fire service over all land owners, rather than just those who choose to insure their properties. The rate depends on whether the property is located in a rural or metropolitan area, and on the nature of the property sector. There is a base charge and a variable component, which depends on the value of the property as shown in the following table:

Table 3 Variable rates (cents per $1,000 of capital improved value)

Property Sector	MFB	CFA
Residential	6.9	11.5
Commercial	60.7	109.2
Industrial	95.0	170.9
Primary production	17.3	31.2
Public benefit	6.9	11.5
Vacant (excluding vacant residential land)	6.9	11.5

The contribution of an average household in a CFA (rural) area is estimated to be $142 in 2013-14 and $143 in an MFB (metropolitan) area. In addition, the State

Government contributes 12.5% per cent of the MFB budget and 22.5% per cent of the CFA budget to fund the state's fire services.

Similarly, Western Australia has included the emergency services levy in their council rates since 2003 and also removed the levy from the insurance premium. The levy funds most of the fire-fighting costs.

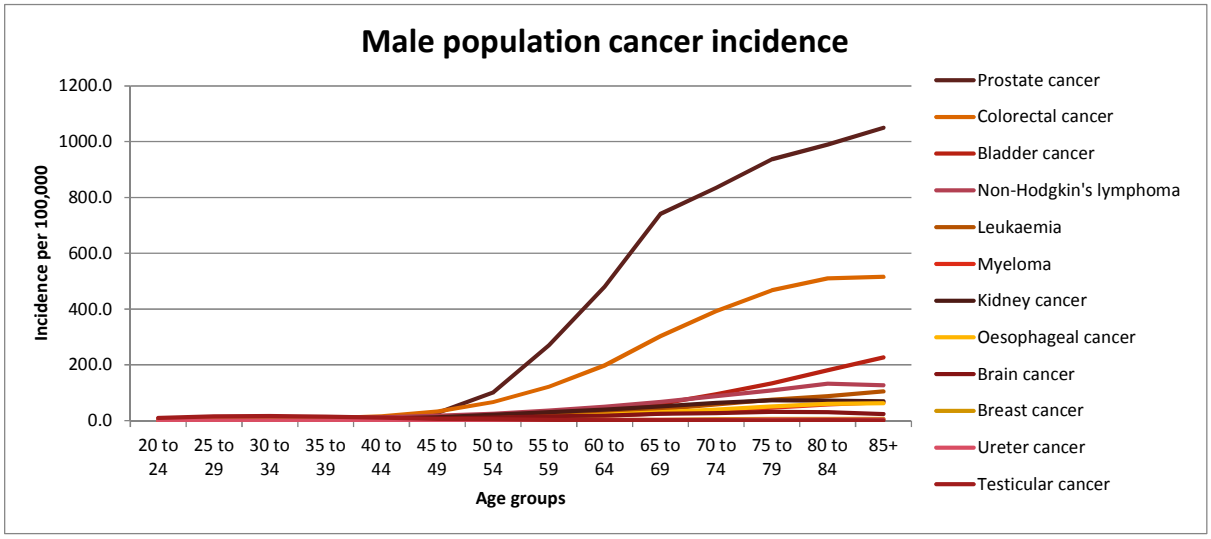
In summary, the funding of fire-fighting services is through taxation and levies on property owners.

Next we estimate the annual cost of providing benefits to fire-fighters contracting cancer, which is calculated using age specific incidence rate, multiplied by the average benefit size estimated for each type of cancer, using two different example workers' compensation benefit regimes.

Population cancer incidence rates

The following graph shows estimated age-specific population incidence rates for the twelve cancers in table 1, based on the Australian Cancer Incidence and Mortality workbooks by the AIHW, based on the 2001 Australian population.

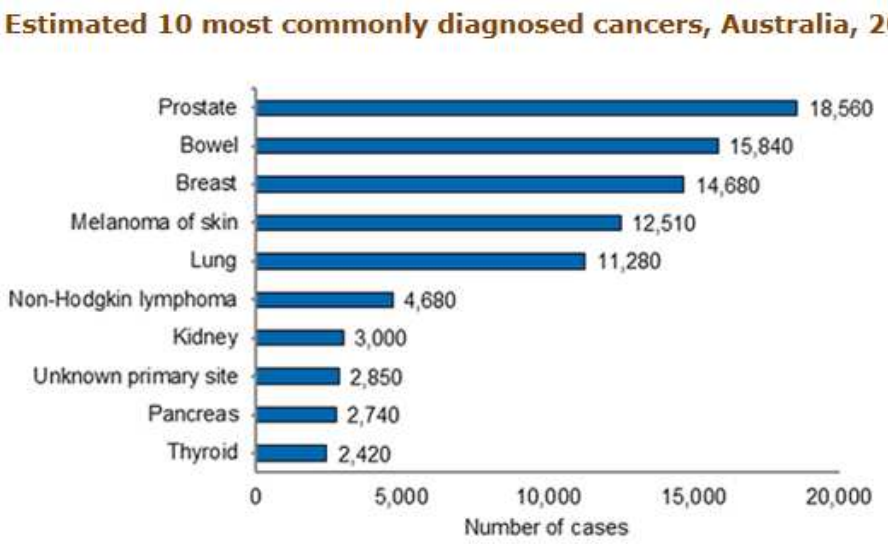
Figure 4 Population age specific cancer incidence rates AIHW



The chart shows that incidence rates increase markedly with age, particularly from age 55 onwards. The chart also shows that prostate cancer has a very high relative incidence rate, which increases from age 50 onwards. Colorectal cancer similarly exhibits notably higher incidence, also increasing from age 50 onwards. Based on population incidence rates, we would expect significantly higher numbers of claims from older fire-fighters. Furthermore, it is important to consider the length of time for which benefits would continue to be paid post retirement for new cancer diagnoses for fire-fighters. Given that cancer incidence increases with age in the general population, it becomes difficult to distinguish between cancer which is related to occupational exposure and cancer which is more related to old age, the older the retired fire-fighter becomes.

According to the AIHW, the following cancers are estimated to be the most commonly diagnosed in Australia in 2012:

Figure 5 Common cancers in Australia



The list of the 10 most commonly diagnosed cancers includes 5 of the cancers covered under the Comcare and Tasmanian presumptive legislation, namely prostate, bowel (or colorectal), breast, non-Hodgkin lymphoma and kidney cancer. In fact, these five cancers are in the top 7 most commonly diagnosed cancer list in Australia. In other words, there is a high likelihood of contracting one of these cancers in the general population to start with, let alone the impact of increased incidence due to occupational exposures for fire-fighters.

According to the AIHW, the risk of being diagnosed with cancer before the age of 75 is approximately 1in 3 for males and 1 in 4 for females. Similarly, the risk of being diagnosed before the age of 85 is 1 in 2 for males and 1 in 3 for females. In summary, given the increasing incidence of cancer by age, and the fact that the covered cancers for fire-fighters are amongst the most common cancers in the population, there is a very high chance that fire-fighters will lodge a claim for occupationally related cancer. For example, under the Tasmanian legislation, which provides coverage for 10 years post retirement, the chance might be up to 1 in 3 for males. For the Comcare scheme, which appears to provide coverage for all retired fire-fighters, the chance might be 1 in 2 for males.

Relative fire-fighter incidence rates

There have been numerous studies carried out across a range of different jurisdictions on the links between cancer and occupational exposure to carcinogens from fighting fires.

One of the first Australian studies examined the cancer incidence of Queensland fire-fighters employed between July 1995 and December 2006. This study found that there was no statistically significant evidence of higher than expected levels.[v] However, there were a number of reported limitations to the study, including:

- The small size of the group of active fire fighters and the limited statistical power resulting from this, especially for female fire fighters and for uncommon tumours, such as benign brain tumours.
- The fact that cancer rates could not be examined prior to 1995.
- The cohort has had a short period of follow up, with almost half of the fire fighters included in the study having started work after 1995.
- Cancers which were diagnosed outside Queensland could not be identified.
- The results could not be adjusted for differences in factors known to affect cancer rates, such as cigarette smoking and sun exposure.
- The re-analyses based on breakdown by more than 12 months (when training is completed) and by categorising fire fighters as full or part time, did not permit more sophisticated assessment of the impact of different exposures.

Subsequently, there is now a significant study being undertaken by Monash university, the "Australian Fire-fighters' Health Study." The aims of this study are to:

- Investigate differences in the overall death rate and rates for specific causes of death in Australian firefighters compared to those of the general population. The outcomes of primary interest are deaths from cancer, cardiovascular disease, non-malignant respiratory diseases and traumatic injury.

- Examine differences in the overall cancer rate and rates of specific cancer types in Australian firefighters compared to those of the general population. The cancers of primary interest are brain and central nervous system malignancies, melanoma, testicular cancer, prostate cancer, bladder cancer, non-Hodgkin lymphoma, multiple myeloma, and for women, cervical cancer, thyroid cancer and breast cancer.

- Compare the cancer incidence and death rates for subgroups within the cohort; e.g. by agency, type of firefighter, duration of active firefighting, types of incidents attended and other exposure types.

- Assess the feasibility of investigating other health outcomes for which employed and volunteer firefighters may be at increased risk.

- Identify exposures which may be associated with increased risk of cancer and/or mortality among firefighters.

The findings of this study are not due to be published until mid to late 2014. The outcomes will be important in assessing not only the relative cancer rates for fire-fighters, but also the overall death rates. One hypothesis is that fire-fighters are healthier on average than the general population, which may reduce their incidence for diseases such as cancer. In other words, fire-fighters may not appear to have elevated incident rates for cancers because their relative good health offsets the impacts of their occupational exposures. This has been raised as a potential confounder in other studies of relative cancer incidence.

One often quoted study is that of LeMasters, G, et al, "Cancer Risk Among Firefighters; A Review and Meta-Analysis of 32 studies"[vi]. This meta-analysis reviewed 28 separate studies, covering the US, Canada, Australia, Sweden, Germany, France, Denmark and Britain, published from 1975 to 2001. These studies investigated

relative mortality and incidence rates of various cancers for fire-fighters compared to different control populations.

The following table shows the relative incidence summary risk estimate from the LeMasters study for the cancers listed in table 1:

Table 6 Relative risk for fire-fighters for selected cancers

Disease	Multiple
Brain cancer	1.32
Bladder cancer	1.20
Kidney cancer	1.07
Non-Hodgkin's lymphoma	1.51
Leukaemia	1.14
Breast cancer	1.00
Testicular cancer	2.02
Myeloma	1.53
Prostate cancer	1.28
Ureter cancer	1.07
Colorectal cancer	1.21
Oesophageal cancer	1.16

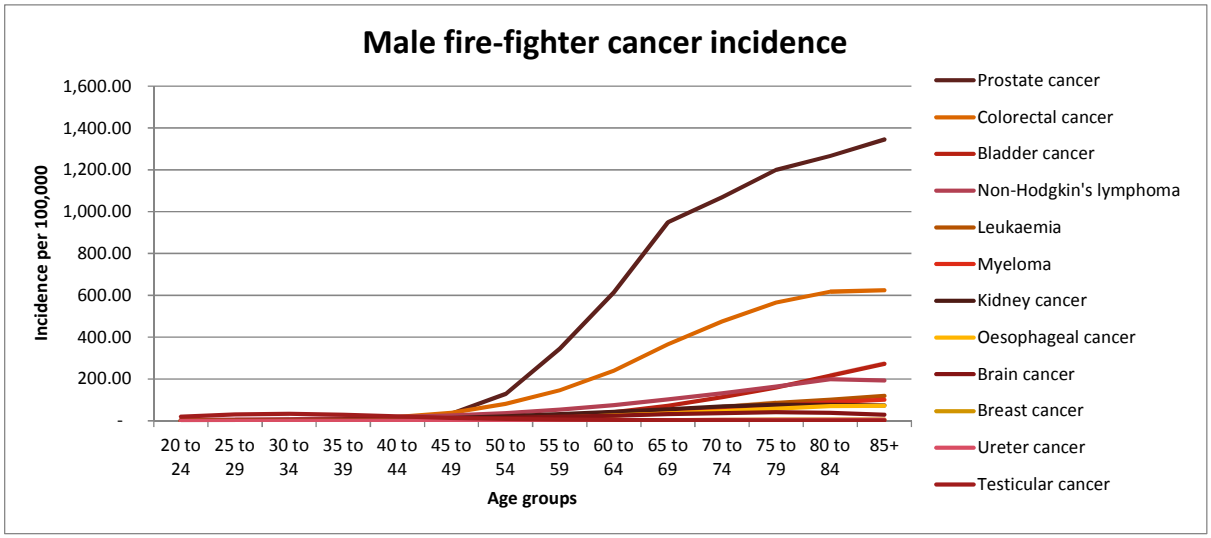
The paper also discussed key findings from the studies reviewed. One study showed increasing relative incidence with time in employment for myeloma. After 10 years of service, the relative risk was 1.5 times standard mortality, increasing to 2.31 after 20 years. In other words, the longer one is employed, the longer the exposure to carcinogens and the higher the relative incidence. Another study showed similar increasing relative incidence with time in employment for testicular cancer. The relative incidence increased to 1.39 times standard with 10 years' employment and 4.03 for 11-20 years' employment. These findings support the use of a "waiting period," for eligibility for workers compensation benefits. For the purpose of our analysis, we have assumed the same relative experience across all age bands for each cancer considered. This may act to understate the relative experience at older ages.

The relative risk measures were derived from analysis of relative incidence and relative mortality across a range of different studies. We have assumed that they can be equally applied to mortality and incidence rates, using Australian standard rates as a starting point. It is possible that relativities would be different in an Australian context from those considered in the LeMasters study. For these reasons, there is significant uncertainty in the relative incidence and mortality assumptions used in our analysis.

There are further considerations for volunteer fire-fighters and those working in regional areas rather than metropolitan areas. Fires in metropolitan areas are more likely to involve exposures to a wide range of carcinogens than bushfires. Volunteer fire-fighters may attend fewer fire events, reducing their relative risk compared to full time employed fire-fighters. The hypothesised "healthy worker effect" may be less for volunteer fire-fighters, which would act to increase their cancer incidence rates relative to employed fire-fighters, even before considering exposure to carcinogens.

Throughout the remainder of this report, the results incorporate the increased incidence rates from the LeMasters study. However, as discussed above, the medical evidence is not conclusive. Applying the relativities above to the base Australian population incidence rates produces the following age-specific incidence rates for male fire-fighters:[vii]

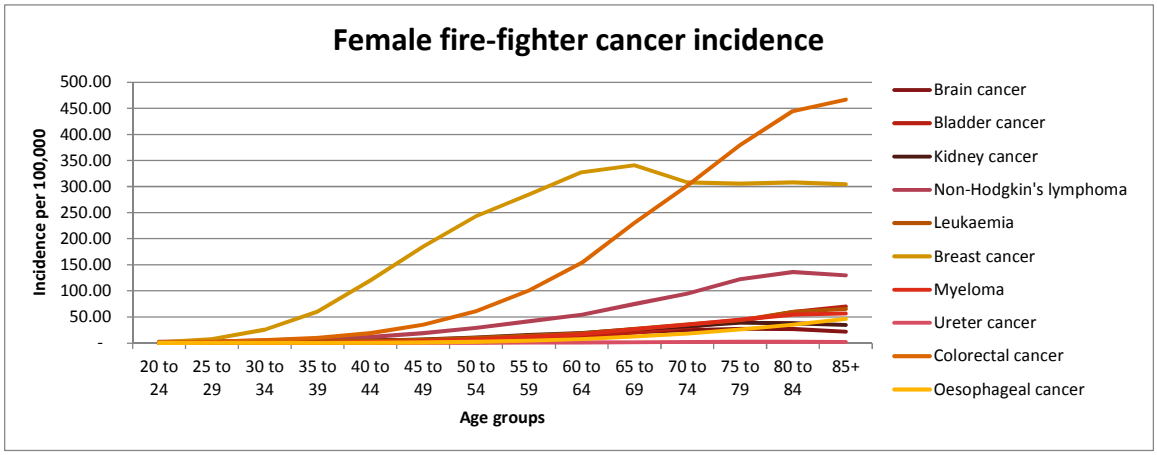
Figure 7 Estimated male age specific fire-fighters cancer incidence rates



Prostate cancer and colorectal cancer continue to be the most dominant type of cancers after adjusting for the relative risk for fire-fighters from the LeMasters study, with incidence rates increasing at faster rates beyond age 55. The experience shows the importance of the decision as to whether or not to incorporate an age limit for bringing a workers' compensation claim for retired fire-fighters. If an age limit is adopted, or a limit based on the number of years after leaving employment as a fire-fighter, this has a significant impact on the total cost of claims. In our view, the question of whether or not to impose such a limit is a social policy question.

The following graph shows the estimated incidence rates for female fire-fighters, adjusting for the relative risk from the LeMasters study for the cancers of interest.

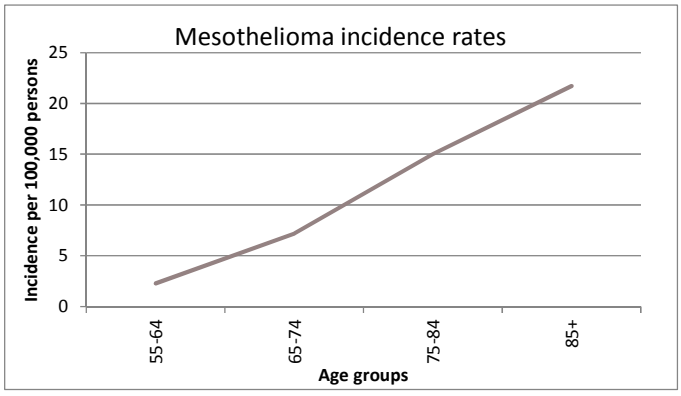
Figure 8 Estimated female age specific fire-fighters cancer incidence rates



The two most common cancers for female fire-fighters are breast and colorectal cancer, which are both in the top three most common cancers in the Australian population. Incidence rates for breast cancer show a marked increase from age 35 onwards, but tend to flatten out at the point of retirement. Conversely, incidence rates for colorectal cancer increase from age 55 onwards, and for other cancers from age 65 onwards.

The fact that population incidence rates for all cancers except breast cancer increase markedly with age means that there is also expected to be a long delay between periods of any occupational exposure and manifestation of the cancer and hence benefit payment. In this way, the issues associated with funding of benefits for fire-fighters for cancer are similar to the issues for funding benefits for asbestos related diseases. As an example, the following graph shows the age specific estimated incidence rates for mesothelioma in the US in 2008-09, reported by the National Cancer Institute, SEER cancer incidence rates, which show the same marked upwards trend from age 55 onwards.

Figure 9 Mesothelioma incidence rates



Similarly, medical indemnity insurance also often suffers a long lag between the time of "incident" or exposure and the payment of benefits. We examine the different approaches used to fund asbestos related disease and medical indemnity schemes in later sections, and discuss their suitability to fund benefits for cancer for fire-fighters.

Average time lost and treatment costs

Treatment costs have been estimated with reference to the Australian Institute of Health and Welfare publication, "Health System expenditures on cancer and other neoplasms in Australia 2000-2001." [viii] Allowance has been made for inflation to today's dollars using CPI. However, it is possible that the costs of medical treatment have increased at a rate faster than inflation, and that advances in treatment options, particularly new chemotherapy drugs, could result in far higher treatment costs. This adds uncertainty to the costing results presented in this report.

Table 10 Estimated treatment costs for selected cancers

Medical cost per cancer		2013/14	
Disease	2000/01	Inflated (a)	Inflated / discounted (b)
Brain cancer	40,732	60,862	58,563
Bladder cancer	22,915	34,240	32,947
Kidney cancer	15,892	23,746	22,849
Non-Hodgkin's lymphoma	27,620	41,270	39,711
Leukaemia	51,196	76,498	73,608
Breast cancer	11,897	17,777	17,105
Testicular cancer	5,805	8,674	8,346
Myeloma	37,068	55,387	53,295
Prostate cancer	17,942	26,809	25,797
Ureter cancer (c)	15,892	23,746	22,849
Colorectal cancer	18,246	27,263	26,234
Oesophageal cancer	30,808	46,034	44,295

For income and other benefits, we have considered two different schemes:

- WorkCover WA. As an illustration, we have allowed for 2 years of weekly compensation for non-fatal claims, and 1.5 years of weekly compensation and a death lump sum for fatal claims. In WA, the amount of lump sum compensation paid is dependent on the amount of weekly compensation

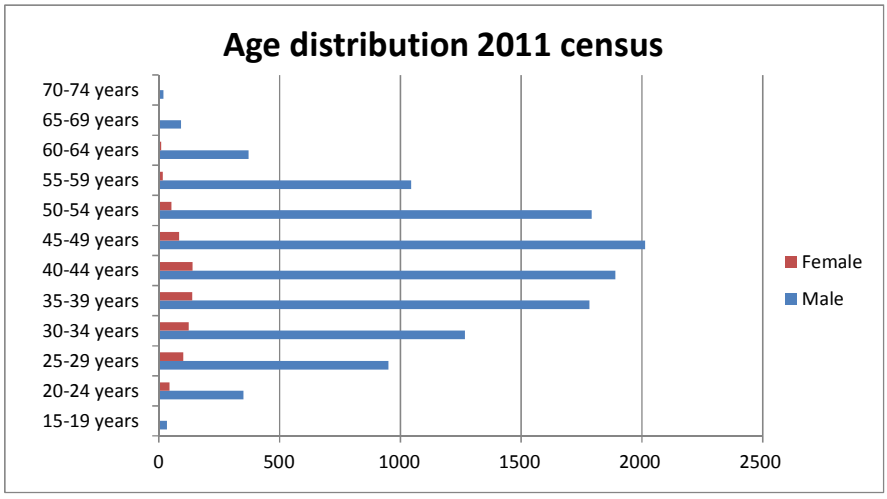
paid. For death benefits we have assumed 100% dependency and no children's benefits.

- An alternative jurisdiction. Other jurisdictions provide for a lump sum payment for non-fatal claims depending on the severity of the injury, and may provide further lump sums for very severe and fatal claims. These lumps sums are not reduced for weekly compensation paid. For example, WorkCover Queensland pays an "additional" lump sum benefit for those with more than 30% WRI. Such lump sum compensation is independent of the amount paid for weekly compensation, and hence the total statutory benefits paid are likely to be higher than under the WA scheme for very severe injuries.

Annual cost estimates

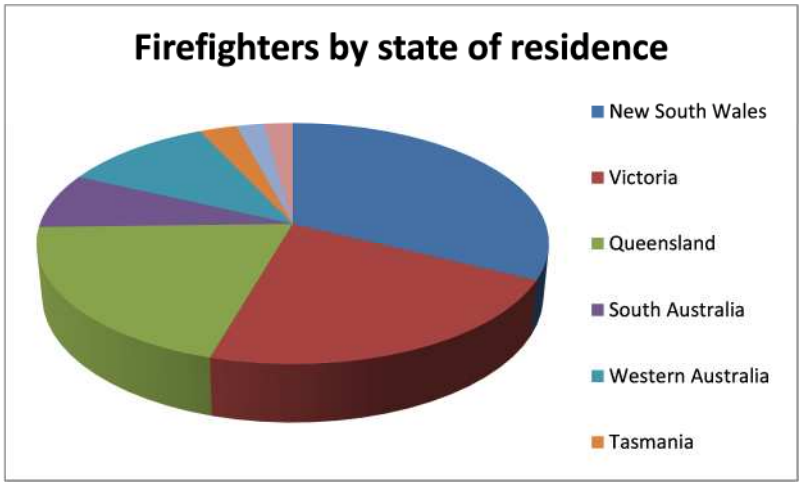
The following chart shows the age distribution of persons who described their employment as Fire-fighters and Emergency Services in the 2011 census, as published by the Australian Bureau of Statistics. The graph illustrates the fact that the industry is male dominated. The average age is 43 years.

Figure 11 Australian fire and emergency services workers by age and sex



The following graph shows the residence of those who stated their employment as Fire-fighters and Emergency services in the 2011 census. Broadly speaking, the distribution is in line with the size of the population in each state.

Figure 12 Australian fire and emergency services workers by state



The census data also record the place of work for most of these persons, and further divide these into metropolitan and rural areas. From the 2011 census, roughly two thirds of Fire-fighter and Emergency Services workers are employed in a metropolitan area, and the remaining one third in rural areas. Note that the industry would also include emergency services workers in addition to fire-fighters, and hence the census data will likely overstate the true number of fire-fighters.

The following table compares the numbers of fire-fighters from the annual reports of each fire service with the numbers in the census data.

Table 13 Census population compared to annual report.

State	Census	Annual report
New South Wales	3,985	3,516
Victoria	2,728	2,381
South Australia	921	978
Western Australia	1,358	1,123
Tasmania	342	447

The figures are broadly comparable for those states where we were able to determine numbers of employees from annual reports. We have relied on the numbers from the census data, given that they are available in age groups, which is important to the analysis given the increasing incidence at higher ages.

Using these figures, and applying the relative incidence rates and average benefit sizes estimated in earlier sections, we derive the following estimated annual costs for cancer for employed fire-fighters, across Australia as a whole.

Table 14 Annual costs for employed fire-fighters – using WA benefits

	Males non-fatal		Females non-fatal		Males fatal		Females fatal		Total	
Disease	No of claims	Total cost ($M)	No of claims	Total cost ($M)	No of claims	Total cost ($M)	No of claims	Total cost ($M)	No of claims	Total cost ($M)
Brain cancer	0.26	0.056	0.01	0.002	0.89	0.312	0.02	0.008	1.18	0.378
Bladder cancer	0.68	0.134	0.01	0.001	0.18	0.059	0.00	0.001	0.87	0.195
Kidney cancer	1.10	0.209	0.02	0.003	0.37	0.116	0.00	0.001	1.49	0.330
Non-Hodgkin's lymphoma	2.00	0.414	0.06	0.010	0.69	0.228	0.01	0.005	2.76	0.656
Leukaemia	0.71	0.169	0.02	0.004	0.40	0.147	0.01	0.004	1.14	0.324
Breast cancer	0.06	0.010	0.55	0.081	0.01	0.004	0.10	0.030	0.72	0.126
Testicular cancer	1.80	0.310	-	0.000	0.06	0.019	-	0.000	1.87	0.330
Myeloma	0.43	0.094	0.01	0.002	0.26	0.090	0.00	0.002	0.70	0.188
Prostate cancer	9.53	1.804	-	0.000	0.59	0.187	-	0.000	10.12	1.991
Ureter cancer	0.06	0.012	0.00	0.000	0.02	0.007	0.00	0.000	0.09	0.019
Colorectal cancer	4.05	0.777	0.10	0.015	1.56	0.496	0.03	0.011	5.74	1.299
Oesophageal cancer	0.08	0.016	0.00	0.000	0.49	0.165	0.00	0.001	0.57	0.182
Total	**20.74**	**4.007**	**0.78**	**0.118**	**5.54**	**1.830**	**0.19**	**0.062**	**27.25**	**6.018**

Comparing this total cost to the total census data reported wages of $977m results in a rate of 0.6%.

In addition to the analysis for the current population of fire-fighters, it is necessary to consider those who are retired and who would meet the years of service entitlement period in order to estimate the cost of a full year of diagnoses.

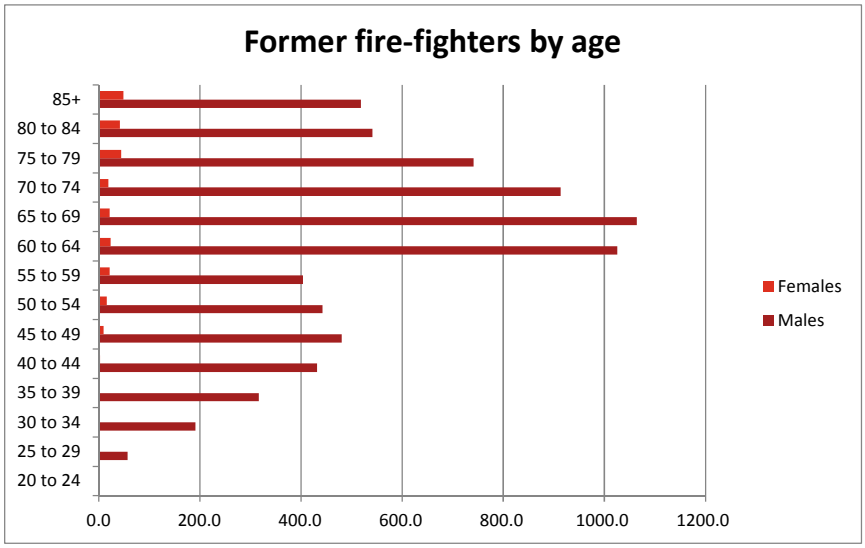
In order to estimate the numbers of former fire-fighters, we used the following assumptions:

- That the fire-fighter population has been growing at 1.4% p.a. over time, which is in line with Australian population growth from 1981 to 2012.

- That 2.5% of employed fire-fighters leave the service each year with more than 5 year's of active duty. This is based on experience in the WA fire-fighter population. Similarly, we have assumed a distribution of years of active service for retired fire-fighters from the WA experience.

We have applied Australian mortality to estimate the numbers of former fire-fighters who are still alive. The following chart shows the age distribution arising from this analysis.

Figure 15 Former fire-fighters age distribution



The jump in the number of former fire-fighters in the age 60-64 group is due to the retirement effect. Total projected living numbers of former fire-fighters was 7,608, or about 60% of the current population numbers.

The following table shows the annual estimated cost of new diagnoses for the current and former fire-fighters using WA illustrative benefits, and assuming a retirement age of 65.

Table 16 Annual costs employed fire-fighters – WA benefits and age 65 retire

Scenario	Number of claims	Cost estimate ($M)	Number of firefighters	Cost estimate per firefighter $	Wages ($M)	Cost as % of wageroll
Former firefighter						
Left in last 10 years	24.7	3.2	2,768	1,168		0.3%
Left more than 10 years ago	64.2	10.8	4,841	2,224		1.1%
Total former firefighters	**88.9**	**14.0**	**7,609**	**1,840**		**1.4%**
Current national career fire	**27.3**	**6.0**	**12,325**	**488**	**977**	**0.6%**
Total	**116.1**	**20.0**	**19,934**	**2,328**	**977**	**2.0%**

If the retirement age is increased to age 75, higher weekly compensation amounts are projected for former fire-fighters, assuming that they are employed in alternative employment at the time of their diagnosis. The results are shown in the following table.

Table 17 Annual costs for employed fire-fighters – using WA benefits and age 75 retire

Scenario	Number of claims	Cost estimate ($M)	Number of firefighters	Cost estimate per firefighter $	Wages ($M)	Cost as % of wageroll
Former firefighter						
Left in last 10 years	**24.7**	**4.7**	2,768	1,703		0.5%
Left more than 10 years ago	**64.2**	**12.3**	4,841	2,532		1.3%
Total former firefighters	**88.9**	**17.0**	**7,609**	**2,230**		1.7%
Current national career fire	**27.3**	**6.0**	12,325	488	**977.1**	0.6%
Total	**116.1**	**23.0**	19,934	2718	**977.1**	2.4%

Using the alternative scheme benefit design, results in the following estimated annual costs:

Table 18 Annual costs for employed fire-fighters – alternative benefits and age 65 retire

Scenario	Number of claims	Cost estimate ($M)	Number of firefighters	Cost estimate per firefighter $	Wages ($M)	Cost as % of wageroll
Former firefighter						
Left in last 10 years	24.7	8.1	2,768	2,929		0.8%
Left more than 10 years ago	64.2	31.5	4,841	6,497		3.2%
Total former firefighters	**88.9**	**39.6**	**7,609**	**5,199**		**4.0%**
Current national career fire	**27.3**	**11.6**	**12,325**	**938**	**977.1**	**1.2%**
Total	**116.1**	**51.1**	**19,934**	**2,564**	**977.1**	**5.2%**

These costs are significantly higher due to the additional lump sum benefit and the higher death lump sum benefit which is not reduced for weekly compensation paid.

It can be seen that there is a wide range of potential costs, depending on the amount of lump sum compensation paid, and also the entitlement period for bringing a claim after leaving employment as a fire-fighter. The following table shows the results of extending anticipated retirement age to 75 for the alternative benefit scheme.

Table 19 Annual costs for employed fire-fighters – alternative benefits and age 75 retire

Scenario	Number of claims	Cost estimate ($M)	Number of firefighters	Cost estimate per firefighter $	Wages ($M)	Cost as % of wageroll
Former firefighter						
Left in last 10 years	24.7	9.9	2,768	3,593		1.0%
Left more than 10 years ago	64.2	33.4	4,841	6,899		3.4%
Total former firefighters	**88.9**	**43.3**	**7,609**	**5,696**		**4.4%**
Current national career fire	**27.3**	**11.6**	**12,325**	**938**	**977.1**	**1.2%**
Total	**116.1**	**54.9**	**19,934**	**2,754**	**977.1**	**5.6%**

The annual cost estimate for this scenario represents about 5.6% of the census estimated total wages, or about 2.2% of the total annual contributions paid through taxes and levies.

As a sense check on these projections, we now examine the emerging claims experience in workers compensation jurisdictions to date.

Current claims experience

Comcare

SRCOLA II and the Fire-fighters Bill received Royal Assent in January 2012. Since that time and up to 26 July 2013, Comcare has received 9 claims. Of the 9 claims received, four of these have been accepted, four denied and one claim has not yet been determined.

Of the four accepted claims, the total incurred cost to date is $250,000 over an 18 month report period. The four claims were denied as they had either been diagnosed before the date of the new legislation taking effect, or because the fire-fighter had not worked the required period to be included for coverage for the cancer stated.

WorkCover Qld

Workcover Queensland have received 8 claims for cancer from fire-fighters, which have mostly been diagnosed in the last few years, and lodged relatively recently. The lodgements are likely to have been influenced by the presumptive legislation in the Comcare scheme and coverage in the press of cancer incidence relating to the Fiskville training facility.

Of the 8 claims, 3 have been initially accepted and 5 have been initially denied, although further medical evidence is being sought for some of the denied claims. Of the 8 claims, six would have met the eligibility requirements under the Comcare presumptive legislation in terms of the type of cancer and years of employment required.

Other schemes

Alberta and Manitoba are two provinces in Canada which have similar legislation providing cover for cancer for fire-fighters. The total cost of workers compensation claims in Alberta, including the cost of cancer benefits, has varied between 1.18% and 1.32% for the four years to 2012, with no particular trend. This information was presented to various parliamentary enquiries in Australia who were considering introducing legislation to change workers compensation benefits. [ix]

The relative stability of recent claims costs in Alberta was used to illustrate the fact that there had not been a significant upwards trend following the introduction of presumptive legislation. However, it is to be noted that the legislation was introduce in Alberta in 2003, with further cancers added at later stages. Therefore, it would be more instructive to examine the impact on claims costs in the mid- 2000s. It is also not clear whether this jurisdiction provides benefits for retired fire-fighters, although the legislation seems to provide provision for the board to determine to pay such benefits.

Life time annual costs comparison

Overall, the experience to date in Australian workers compensation schemes has been modest, and compares reasonably well with our estimates for employed fire-fighters, albeit based on limited claims experience. This would imply that the cost for funding such claims would represent only a small additional amount compared to current employee costs by state.

However, there are certain key features of benefit design which could act to significantly change the annual cost of benefits. The most important of these is the age at which entitlement ceases. Benefit entitlement can cease at the time of resignation or retirement, for a period after resignation or retirement, or be provided for lifetime. The longer the entitlement period, the longer the average delay between any occupational exposure and benefit payment, and the higher the annual cost. This is an important consideration when deciding which funding approach should be used.

We have prepared analysis of the expected lifetime cost for a fire-fighter entering employment at age 18. The following table compares the average annual cost on the three different entitlement periods and the two different jurisdictions examined:

Table 20 Annual costs with different entitlement periods for different schemes

Retirement Age	Entitlement Age	WA Male Lifetime % wages	WA Female Lifetime % wages	Other Male Lifetime % wages	Other Female Lifetime % wages
55	100	0.8%	0.6%	3.9%	2.3%
65	100	1.0%	0.8%	4.3%	2.5%
75	100	1.2%	1.1%	4.9%	2.8%
55	65	0.3%	0.3%	0.9%	0.9%
65	75	0.7%	0.7%	2.2%	1.6%
75	85	1.2%	1.0%	4.1%	2.4%

The assumptions underlying this projected lifetime cost include:

1) Fire-fighter enters service at age 18, and move through promotions with increases in salary through the different employment classes, reaching the level of station officer at age 44. Salaries were sourced from Enterprise Bargaining Agreements for Western Australian fire-fighter information, and compared to census data for reasonableness. The following table shows the average incomes in 5 year age bands for Fire and Emergency Services workers from the 2011 census:

Table 21 Census average income for Fire and Emergency Services workers 2011[x]

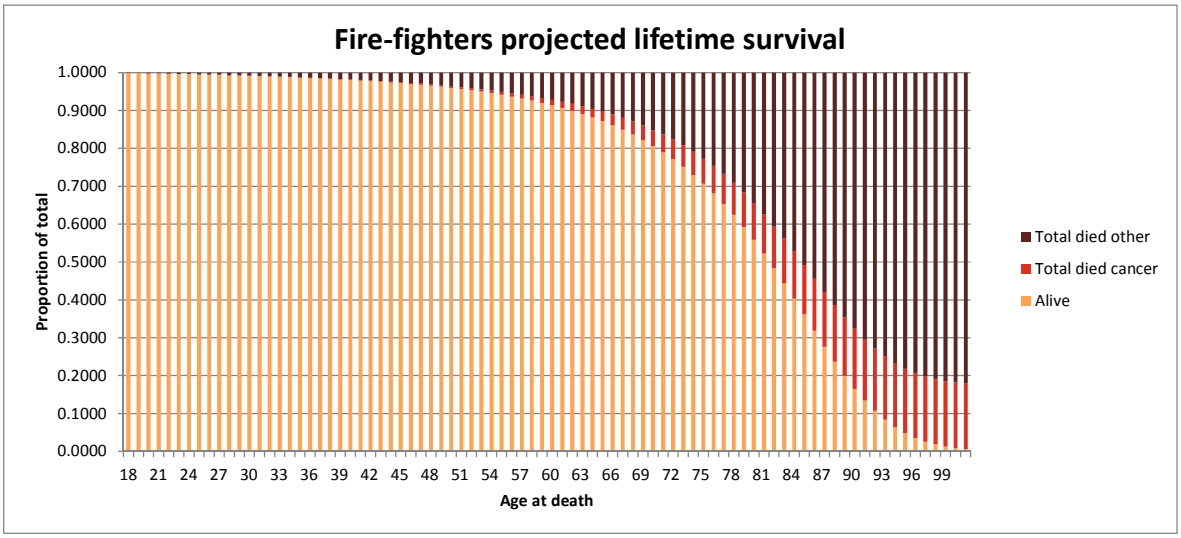
Age	Male	Female
15-19 years	26,325	31,200
20-24 years	49,811	39,231
25-29 years	68,634	61,975
30-34 years	75,207	65,243
35-39 years	81,028	61,954
40-44 years	81,829	66,339
45-49 years	86,026	71,460
50-54 years	86,936	61,442
55-59 years	84,881	80,539
60-64 years	79,401	15,229
65-69 years	55,276	
70-74 years	60,632	

2) Total mortality for fire-fighters at each age is the same as population mortality. In other words, the impact of the fire-fighter population being healthier on average than the general population is assumed to be offset by their

relatively higher cancer incidence. Australian Life tables 2009-2011 are used for mortality projections.

The following chart shows the projected survival experience for males, indicating that approximately 20% of male fire-fighters would be projected to die from one of the cancers listed in table 1, over their entire lifetime:

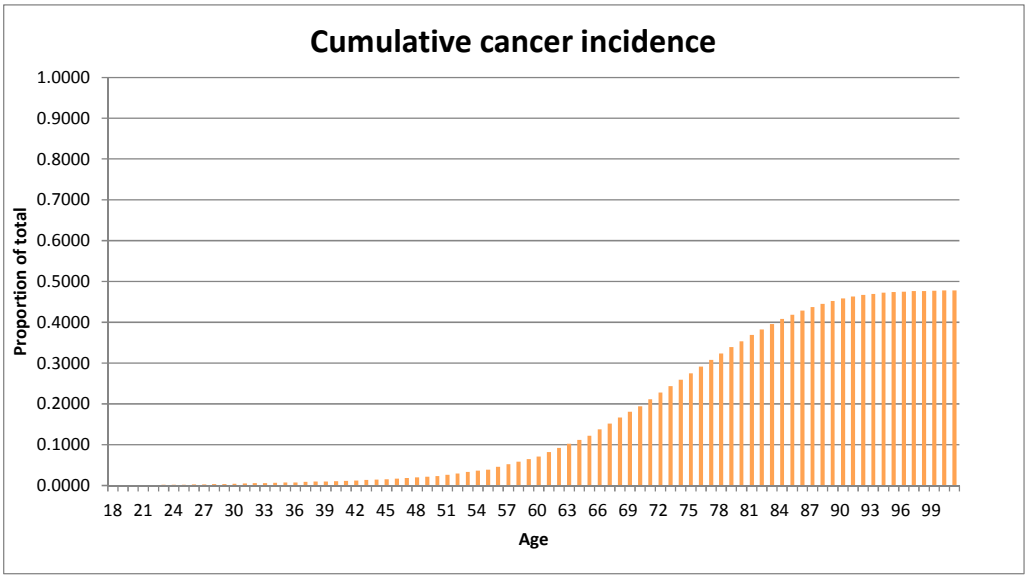
Figure 22 Projected survival for male career fire-fighter



The following chart shows the cumulative male cancer diagnoses, regardless of whether these lead to the death of the fire-fighter, or whether they survived. It shows that approximately 50% of fire-fighters will have a cancer diagnosis for one of the cancers listed in table 1. Note that the AIHW estimates that 50% of men in Australia will have a cancer diagnosis prior to age 85, but this is in respect of all cancers, rather than the subset in table 1. Nonetheless, the projection seems reasonable compared to this comparative statistic:

The projection for female fire-fighters is less dramatic, with 25% of the population ultimately projected to have a cancer diagnosis.

Figure 23 Projected cancer diagnoses for male career fire-fighter



3) For the WA projections, weekly compensation is assumed to be paid for 2 years for non-fatal claims and 1.5 years for fatal claims. An additional death lump sum benefit was projected for fatal claims, as per WorkCover WA's current entitlements but for simplicity assuming 100% dependency and no children's pension. Such lump sums are net of other weekly compensation paid. Weekly compensation is only payable up to the date of retirement shown in the table. Fire-fighters in WA retire from active service on average at age 55. Many continue in a volunteer capacity beyond this time. We have not projected benefits for volunteers in this analysis.

4) For the alternative scheme projections, we have increased the lump sum payments, particularly for fatal claims to reflect higher benefits available in other schemes. For these projections, the lump sum benefits do not depend on the amount of weekly compensation payable.

5) We have ignored the impact of resignations in this analysis, and hence the estimates are higher than would be expected if these were taken into account. In other words, fewer fire fighters would be anticipated to reach the years of service required for eligibility for coverage for cancer.

6) We have projected treatment benefits and lump sums, including fatality lump sums to be payable up to the entitlement age as shown in the table. We have not made any adjustment for the propensity to claim. It is possible that not all fire-fighters would bring a claim for compensation in respect of cancer,

especially once they have retired. This may arise due to lack of knowledge about entitlement to benefits, and would act to reduce the cost estimates shown in the table, especially for scenarios with long entitlement periods.

7) Inflation has been applied to future benefits at 4% p.a. for wages, and 3% p.a. for CPI and benefits have been discounted at 5%.

The industry rate for fire-fighters published in WorkCover WA's gazette is 4.54%of wages. Therefore, the estimated range of increases is between 7% and 28% of this rate, depending on the entitlement period and retirement age combination.

By comparison, gazetted industry rates for other schemes are as follows:

Table 24 Gazette industry rates.

Scheme	Gazette rate
WA WorkCover	4.54%
NSW WorkCover	4.348%
WorkSafe Victoria	3.161%
WorkCover Qld	1.795%
SA WorkCover	4.40%

The estimated range of increases for the alternative scheme would translate to a much higher proportionate increase for other states.

Funding options

The current employment costs of the fire services include workers compensation premiums, contributions to superannuation and any associated insurance, such as premiums for the death and disability scheme associated with the NSW Fire service. Therefore, the cost of any work related injuries or deaths are being effectively funded through rate payers and taxation receipts contributed by government, passed through to the workers compensation schemes in each state for payment of benefits.

As discussed earlier, fire-fighter cancer risk could be funded through current workers compensation arrangements, or presumptive legislation for workers compensation, or a range of life insurance options. The cost of individual life insurance policies would be funded by individual fire-fighters. The cost of group life insurance policies in a specialist death and disability scheme can be funded through both employers

(through taxation and rates) and individual fire fighters contributing part of their salary.

Regardless of the insurance solution and who is funding the cost of the solution, the following criteria are important when assessing different options:

1) Stability of funding rate from year to year.
   This is important to enable rate payers, insurance premium payers and governments to budget for expenses each year. Avoiding sudden large increases or decreases is desirable.

2) Responsiveness of funding rate to trends in experience.
   Where there are experience trends over time, the funding rate should respond appropriately to these trends. Ideally, and changes in funding rate should be managed in a smooth environment.

3) Matching of exposure period to payment period.
   Intergenerational equity is desirable in any funding system, so that those who benefit from the fire fighting service are paying an appropriate contribution to any corresponding exposures to carcinogens.

4) Ease of calculation and parsimony.
   All else being equal, a funding system which relies on fewer assumptions and less projected experience is preferable, and may be easier to explain to stakeholders.

For workers compensation, each state has different rules as to the funding for work related diseases which relate to long periods of exposure, such as cancers. The date of injury is the key determinant of the funding approach. For many schemes, the date of injury is set to be the date that the injured person was last employed in the industry which gave rise to the exposure causing the work related disease. Such an approach can be considered broadly to be an "incurred claims" approach. However, if the person is still employed in the industry which gives rise to the exposure, the date of injury becomes the date of diagnosis of the disease. In this case, the approach is closer to a claims made insurance basis.

An alternative is to define the date of injury purely based on the date of diagnosis, which would be considered a "claims made" approach. Such an approach is currently adopted by WorkCover Queensland in respect of asbestos related diseases. The out-workings of this approach are that the liabilities for disease claims only need to be estimated for claims which have been diagnosed, including those

which are not yet reported to the insurer. We refer to these as "diagnosed, but not reported claims," or DBNR.

Life insurance policies adopt a claims made approach, where the policy benefits are paid for new diagnoses.

Comparing these two alternatives, it is evident that an incurred claims approach is more complex, for the following reasons:

1) It is necessary to estimate the future diagnoses which will occur due to past exposure periods. This requires projection of cancer incidence rates for the current population of employed fire-fighters over their remaining lifetimes. The longer the time-frame for projection, the less certain the resulting estimate. Further, small changes in assumptions can result in large increases in funding costs.

2) There is also the complication question of how to allow for the qualification period. For fire-fighters who have not yet completed the required years of service for eligibility for a particular cancer, there is a question as to whether or not to recognise past exposures. If they are included, then it is necessary to project future rates of discontinuance of employment as a fire-fighter in order to allow for the probability of completing the required years of service. If past exposures are not included until the fire-fighter has completed the required years of service, the result is a large increase in funding required at that time.

3) An incurred claims approach requires a decision about the level of retrospective application for prior exposure periods, and may result in an unfunded liability at the time of introduction.

A third alternative would be to consider a lifetime costing approach based on the current population of employed fire-fighters, similar to our earlier calculations in this report. Such a method would include:

- Projecting future rates of discontinuance of employment
- Projecting future cancer incidence rates and survival rates
- Projecting the cost of future diagnoses
- Projecting future employment costs
- Dividing the total estimated cost of future diagnoses by the future employment costs to derive a lifetime cost rate.

The lifetime cost rate would then be used as a funding mechanism, with the annual premiums being allocated to a fund for future benefit payments.

A funding rate can be calculated to cover the cost of cancer claims, taking into account the age distribution of current and former fire-fighters.

Lifetime costing approaches are gaining more popularity in different jurisdictions. Other examples include:

- Proposed funding arrangements for the National Disability Insurance Scheme. Although this scheme is proposed to be funded each year for the annual cost of services only, projections of the life time cost of care packages are also carried out to enable an understanding of how costs will evolve and to form the basis of monitoring.[xi]

- The medical indemnity Run-Off Cover Scheme. This scheme provides medical indemnity cover in respect of practitioners who have ceased employment, due to reasons such as death, disability, retirement, or maternity leave. Liabilities for this scheme are calculated using lifetime projection models, based on the current population of doctors and their projected future entitlement to coverage under the scheme. [xii]

- The benefits system in New Zealand. Life time costing approaches are being used to assist designing interventions to reduce the long term social, economic and fiscal costs of welfare dependency. [xiii]

The difficulty with a lifetime costing approach is that it is more complex than other funding methods, such as the claims made approach. The additional complexity would seem only to be warranted where it would be likely that the costs may increase due to aging of the fire fighter population over time. Assuming that the fire-fighting population is aging at the same rate as the Australian population (increased cancer incidence not withstanding) then a lifetime costing approach may be justified.

Lifetime costing approaches can be beneficial in terms of designing social systems, as they provide a more fulsome picture of how costs will be expected to trend over time. This approach can help inform benefit design in order to maintain affordability in the longer term.

In the following sections we explore the different funding approaches in light of the assessment criteria.

Funding options assessment

The following table shows an assessment of the different funding options against the criteria outlined above:

Table 25 Assessment of different funding options

Alternative	Stability	Responsiveness	Matching exposure	Ease of calculation
Claims made	Low	High	Low	High
Claims incurred	Medium	Medium	Medium	Medium
Lifetime costing	High	Low	High	Low

It should be noted that the assessment in somewhat subjective. For example, we have assumed that the stability of estimated costs would depend on the horizon for analysis: if a claims made approach is used then the horizon is the costs which will emerge from diagnoses in the next 12 months, and these estimates can change a lot from year to year. Alternatively, if a lifetime costing approach is used, it would be expected that the total estimate would only react slowly to emerging experience trends, and hence the estimated annual cost would be more stable. However, this also depends on the approach adopted by the actuary carrying out the analysis.

The benefit design also impacts the assessment of different funding options. The longer the entitlement period, the more years are required to be projected for a lifetime costing option, increasing the complexity of this approach.

Discussion

There is evidence in the research that the relative cancer risk for fire-fighters may increase with length of service and, therefore, also with age. Population incidence also increases with age. Therefore, based on the results of the LeMasters study, there may be an exponential increase in relative risk at advanced ages for fire-fighters. If the benefit design is intended to cover treatment costs for the lifetime of fire-fighters, regardless of their age at diagnosis, then the majority of the benefits would be paid after the fire-fighter ceased work.

In other words, there would be expected to be a major timing difference between the period of funding and the period of incidence for such risks. If the age distribution of current and former fire-fighters remains relatively stable over time, then this timing difference should not cause a problem for premium or levy calculations.

However, if the population were to age over time, an increased burden would fall on current premium or levy payers compared to generations who benefitted from the fire-fighters' services.

In summary, these aspects of the experience require careful consideration of the funding approach for coverage of such cancers.

Appendix A Prescribed Occupational diseases

	Description of Disease	Description of process or Occupation	Rarity
822	Anthrax	Wool combing; wool sorting; handling of or coming into contact with hides, skins, wool, hair, bristles or carcasses, work in connection with animals infected with anthrax, loading and unloading or transport of merchandise.	Rare
302	Arsenic poisoning or its sequelae	Any manufacturing or other process involving the use of or contact with arsenic or its preparations or compounds.	Rare
783	Asbestosis (with or without mesothelioma)	Any mining, manufacturing or other process which involves the use of or contact with asbestos.	Rare
599	Avascular Necrosis or its sequelae	Any occupation involving working underground or underwater where the worker is subjected to greater than normal atmospheric pressure and subsequent decompression.	Rare
823	Brucellosis(Undulant Fever)	Work in connection with animals or carcasses infected with the brucella organism.	
302	Carbon bisulphide poisoning	Any manufacturing or other process involving working in contact with or the inhalation of carbon bisulphide gas.	Rare
302	Carbon monoxide poisoning	Any manufacturing or other process involving working in contact with or the inhalation of carbon monoxide gas.	Rare
759	Chrome ulceration or its sequelae	Any manufacturing or other process involving the use of or contact with chromic acid or bichromate of ammonium potassium or sodium or their preparations.	Rare
302	Copper poisoning or its sequelae	Any manufacturing or other process involving the use of or contact with copper or its preparation or compounds.	Rare
741	Dermatitis venenata	Any occupation involving the use of or contact with vegetable or mineral matter.	
302	Lead poisoning or its sequelae	Any manufacturing or other process involving the use of or contact with lead or its preparation or compounds.	Rare
825	Leptospirosis, as caused by any of the serotypes of the	Any work done at abattoirs, slaughterhouses and knackeries involving contact directly or indirectly with animals or tissues of animals.	

	Description of Disease	Description of process or Occupation	Rarity
	micro-organism Leptospira, in any of its clinical manifestations		
302	Mercury poisoning or its sequelae	Any manufacturing or other process involving the use of or contact with mercury or its preparations or compounds.	Rare
Inj 189 (burns) Inj 302 (other)	Pathological manifestations due to radium and other radioactive substances or X-rays	Any process involving exposure to the action of radium, radioactive substances or X-rays.	Rare
302	Phosphorus poisoning or its sequelae	Any manufacturing or other process involving the use of or contact with phosphorus or its preparation or compounds.	Rare
302	Poisoning by benzol, its homologues or its nitro and amido derivatives and the sequelae of these poisonings	Any process or occupation involving the production, liberation of or exposure to benzol its homologues or its nitro and amido derivates.	Rare
302	Poisoning by the halogen derivatives of hydrocarbons of the aliphatic series	Any process or occupation involving the production liberation or utilisation of halogen derivatives of hydrocarbons of the aliphatic series	Rare
841	Primary epitheliomatous cancer of the skin	Any process or occupation involving the handling of or use of tar, pitch, bitumen, mineral oil, paraffin, or the compounds, products or residues of those substances.	
824	Q fever, as caused by miro-organism Coxiella burneti (also known as Rickettsia burneti) in any of its clinical manifestations	Any work done at abattoirs, slaughterhouses and knackeries involving contact directly or indirectly with animals or tissues of animals.	
839	Septic poisoning or its sequelae	Any work involving the handling of meat or the manufacture of meat products or animal products in connection with the trade of a butcher or slaughterman.	
784	Silicosis with or without pulmonary	Any manufacturing or other processes involving exposure to the inhalation of silica dust.	Rare

	Description of Disease	Description of process or Occupation	Rarity
	tuberculosis		
526	Subcutaneous cellulitis or acute bursitis over the elbow (beat elbow)	Mining.	
526	Subcutaneous cellulitis or acute bursitis arising at or about the knee (beat knee)	Mining	
526	Tenosynovitis (inflammation of the tendon sheaths of the hand, wrists, forearm or elbow)	Any process or occupation connected with the preparation preserving, canning or bottling of jams, sauces, fruits, pickles or other similar foods for human consumption.	
302	Zinc poisoning or its sequelae	Any manufacturing or other process involving the use of or contact with zinc or its preparations or compounds.	Rare

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