New Zealand Injury Prevention Strategy

Rautaki Ārai Whara o Aotearoa

Five-year Evaluation
New Zealand estimates of the total social and economic cost of "all injuries" and the six priority areas respectively, at June 2008 prices

New Zealand Government

Authors

Des O'Dea
Health Economist
University of Otago
Wellington
Contact details: desodea@paradise.net.nz

and

Dr John Wren
Senior Research Programme Manager
ACC
Shamrock House
Wellington
Contact details: john.wren@acc.co.nz

Citation

O'Dea, D. and Wren, J. (2010). New Zealand Estimates of the Total Social and Economic Cost of "All Injuries" and the Six Priority Areas Respectively, at June 2008 Prices: Technical Report Prepared for NZIPS Evaluation. Accident Compensation Corporation, Wellington, New Zealand. February 2010.

Acknowledgements

External Peer Reviewers

- Lynne Pezzullo, Access Economics, Canberra (Head Office), Level 1, 9 Sydney Ave, Barton ACT 2600, Australia.
- Dr Martin Tobias and Dr Tony Blakely, Health and Disability Intelligence, Health and Disability Systems Strategy, Ministry of Health, Wellington, New Zealand.
- Dr Jagadish Guria, New Zealand Institute of Economic Research, Thorndon, Wellington, New Zealand.

Other Services

- Analytical Services, Information Directorate, Ministry of Health for the supply of mortality and morbidity data on the incidence of injury events.
- Lorna Bunt, Manager Business Intelligence, Injury Prevention, ACC for the supply of ACC claims cost data.
- Pauline Gulliver, Injury Prevention Research Unit, University of Otago for the supply of injury statistics.

Table of contents

Tables

Summary

Background

1. Injuries are a significant burden on New Zealand society, and a cause of pain and suffering for many.

    - There were 1,681 injury deaths in 2006

    - In 2008 there were 9,865 first admissions to hospital for "serious non-fatal" injuries, and of the order of 60,000 first admissions for "non-serious" injuries. Many more injuries did not require hospital in-patient or day-patient treatment but did require care from other health-care providers.

    - The Accident Compensation Corporation (ACC) spent of the order of $2.5 billion in 2008.

    - That sum was spent on treatment and rehabilitation, on Income Maintenance (injured persons unable to return to their pre-injury employment are entitled to 80 percent of their previous employment income), and on other benefits and support.

2. ACC spending is not in fact the largest part of the burden of injury. As will be evident from the numbers in this report, the largest component is the human cost. That is, the years of life lost (YLL) because of premature mortality from injury and the effects of injury-caused disability on quality of life. Disability Adjusted Life Years (DALYs) are the measure used in this report to combine these two consequences.

3. This report has been commissioned under the ambit of the *New Zealand Injury Prevention Strategy* (NZIPS), the Strategy. That strategy has defined six priority areas for injury prevention work.

    - Four of these priority areas are for accidental injuries. Namely, falls, drowning and near drowning, motor vehicle traffic crashes (MVTC), and workplace or work-related injury.

    - Two are for "intentional" injury. They are assault, suicide and deliberate self-harm.

4. Two objectives of this report are:

    - to provide estimates of the total current burden of injury

    - to also do this for the six priority areas.

5. Information on the cost of each priority area is potentially useful for identifying possible imbalances in the current allocation of preventive expenditure. That is, of course, only a first step. Interventions that are cost effective need to be identified as well.

Key Results

6. Table 1 below summarises the material in this report. The numbers are the base-case estimates for the cost of injury in New Zealand in 2008. Dollar costs are measured in New Zealand dollars of 2008. Goods and Services Tax (GST) is excluded. The discount rate used for the base case is 3% per annum, in "real" terms.

TABLE 1: SUMMARY TABLE OF INJURY COSTS BY COST CATEGORY AND PRIORITY AREA. BASE-CASE ESTIMATE USING OFFICIAL TRANSPORT SECTOR VPF, 3% DISCOUNT RATE, NEW ZEALAND $ JUNE 2008 PRICES.

Priority Area / Cost Category	Treatment and Rehabilitation	Lost Economic Contribution	Human Costs	Total Social and Economic Cost	% of Total Social and Economic Cost – All Injuries
Assault	$2.5	$49.5	$327.5	$379.6	3.9%
Falls	$535.7	$270.8	$928.7	$1,735.2	17.9%
Drowning	$0.8	$48.2	$246.4	$295.5	3.1%
Motor Vehicle	$253.5	$464.5	$1,477.0	$2,195.0	22.7%
Suicide/Self-harm	$1.6	$380.1	$1,787.4	$2,169.1	22.4%
Workplace	$349.5	$640.3	$357.8	$1,347.5	13.9%
Subtotal – Six Priority Areas, $ millions, (Excl. GST)	$1,143.6	$1,853.5	$5,124.8	$8,121.8	83.9%
Estimated "Non-priority" Cost, $ millions (Excl. GST)	$251.7	$216.6	$1,087.1	$1,555.4	16.1%
All Injuries, $ millions (Excl. GST)	$1,395.2	$2,070.1	$6,211.9	$9,677.2	100.0%

7. Referring to Table 1, treatment and rehabilitation costs of $1.4 billion, excluding GST, represent the economic costs for the purchase by ACC of these services.

8. The lost economic contribution cost of $2.07 billion has two components, approximately equal in size. The first is the lost production from those still suffering consequences of their injury and not yet able to return to paid employment. This is estimated as 125% of Income Maintenance payments by ACC (which are paid at 80% of employment income before suffering injury). The second component is more hypothetical, being the lost future economic contribution of those who die prematurely because of their injury.

9. The final component, the human cost of $6.2 billion, is derived by calculating, as a first step, the DALYs incurred from premature mortality and from disability associated with injury. The second step is to place a dollar value on each DALY. The value used here is $150,000 per DALY. Justification for this is given in the detail of the report. In brief, the value of a life year is linked to the official Transport Sector Value of Statistical Life (VoSL) – or Value of a Preventable Fatality (VPF) - which was derived from "willingness to pay" (WtP) surveys in the late 1980s. The original estimate has been adjusted upwards for subsequent increases in average ordinary-time earnings. The VoSL at June 2008 prices was $3.352 million.

Rank Orders For the Priority Areas

10. The "rank order" of the different priority areas in terms of total cost is shown by comparing the percentages in the summary table. First comes MVTC, followed by suicide, followed by falls, and then workplace injuries.

11. The human cost component is influential in determining this rank order. It will be observed that workplace injuries, and also falls injuries, rank highly or relatively highly for the first two components, but less so for human costs, particularly for workplace injuries. This is because actual fatalities from workplace injuries are relatively low, at 88, compared with (in 2006) more than 500 from suicide, and nearly 400 each for falls and motor vehicle injuries. (The precise numbers are given in the report).

12. The relatively low ranking of falls in the final column has a different cause. Although fatalities are relatively high in number, these occur much more among the aged than do fatalities from other causes of injury. This means that a relatively much smaller number of life years are lost because of falls-caused fatalities, than is the case for other causes of injury. Hence a lowering of the human cost. A measure of human cost based on the value of a life rather than the value of a life year, or DALY, would see a considerably higher total cost for falls.

Sensitivity Analyses

13. The results above have been subjected to sensitivity analyses, as described in detail in the body of the report. The dollar value of a DALY has been varied, either increased in line with the higher value estimated for a VoSL in research carried out by the Ministry of Transport (MOT) and reported in 1998; or decreased in line with the lower value estimated by BERL (2007) for fire-caused fatalities. Naturally the total cost changed as a result of these variations. The percentages of total cost for the different priority areas did vary, but by relatively small amounts, and rank orderings were unchanged, except that for the highest value of a life year, suicide costs moved into first rank, ahead of MVTC.

14. The results were also tested for changes in the discount rate. Total cost was little affected by these variations, because in the methodology employed here the discount rate and the cost assigned to a DALY moved inversely.

15. The rank orderings of the priority area were affected, however. Notably, higher discount rates, at 8% and 10%, moved falls into the highest ranking category. As already noted, this is explained by deaths from falls being most prevalent among the elderly. Lost life years are therefore much more nearer-term than for other categories, and are therefore less affected by increases in the discount rate.

16. The rank orderings do show, therefore, some response to changes in the parameters. In general, however, they are not especially responsive.

Estimates of the Burden and Cost of Injury in New Zealand, 2008

Introduction to Methodological Approach

A: Objective

To prepare updated estimates of the cost of injury in New Zealand, with the expectation that the estimates could be used to inform future economic cost-benefit analyses, and to provide guidance on how the cost of injuries compares to government expenditure on injury prevention.

B: Framework

The estimates are required for consequential costs of injury only. That is, not including preventive costs.

B.1 Cost Categories

Estimates are required for the following three cost categories:

- treatment and rehabilitation costs
- output and productivity costs
- human costs.

These cost categories are based upon the those set out in the 2004 Department of Labour report on methods for estimating cost of injuries in New Zealand by government agencies (Department of Labour, 2004).

Treatment and rehabilitation costs refer to all the (out-of-pocket) monetary payments made in relation to diagnosis, treatment and rehabilitation of injuries sustained by the population (of interest). Associated costs include transport, home modifications and ongoing assistance with impairment. Services are both publicly funded and privately paid for by individuals.

Output and productivity costs result from an individual not being able to work as a consequence of an injury. Loss of income (earnings to individuals and their friends and family, and loss of profit to employers) is the primary flow-on economic cost that can be measured. (This includes the productivity of those who work voluntarily or who are too young or old to earn taxable income.)

Human costs from an injury or a premature death include psychosocial effects of injury, psychological distress, impaired physical or mental health, pain and suffering. The "costs" are often non-figurative and difficult to measure.

The BERL report of 2002, for government agencies on methods for estimating the cost of injuries, discusses these costs in considerable detail (Goodchild, Sanderson, & Nana, 2002).

B.2 Perspective

The estimates in this report are from the perspective of society as a whole, rather than for individuals and family, or employers, or government.

B.3 Six Priority Areas

The estimates are required for each of the following six areas, as well as total injuries, including "non-priority" injury areas:

1. motor vehicle injuries
2. workplace injuries
3. drowning and near drowning
4. falls
5. suicide and deliberate self-harm
6. assault

In 2004 these six priority areas were claimed to account for 80% of injury deaths and serious injuries in New Zealand (Department of Labour, 2004. (p. 2)). Table 3 later in this report shows that 9.2% of injury fatalities and 15% of "serious non-fatal" initial hospital admissions were in "non-priority" areas. On the basis of the latter number it is assumed in this report that 15% of ACC expenditure was on the "non-priority" area of injuries.

B.4 The Definition of "Injury"

The Injury Prevention Research Unit (IPRU) at the University of Otago quotes, in their report (Gulliver et al, 2008) on the NZIPS web site (www.nzips.govt.nz) the following theoretical definition

> *"Injury is tissue damage resulting from either the acute transfer to individuals of one of the five forms of physical energy (kinetic or mechanical, thermal, chemical, electrical, or radiation) or from the sudden interruption of normal energy patterns to maintain life processes".*

The IPRU notes that this does not include "psychological injury", and also that there is no widely accepted theoretical definition of what is to be considered "psychological injury".

On this basis, spending by ACC on "sensitive" (e.g. sexual abuse) cases is excluded from the analyses in this report.

For "physical" injuries the IPRU uses the following definitions in the tabulations it supplies. It is to be noted that "occupational" diseases are not included.

> *"Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01–Y36, where external cause codes are coded using the ICD-10-AM classification"*.
>
> *"Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00–T78 and a first external cause code in the range V01–Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification"* (Gulliver et al, 2008).

The same source provides precise definitions in terms of the ICD-10-AM classification for each of the six priority injuries listed above. It should be noted that workplace and work related injury tabulations require information on the place or circumstances of injuries, as well as "cause" of injury or death, whereas the tabulations for the other priority areas are based on "cause" only. The workplace and work related category thus cuts across other categories, and has priority over the other categories.

It should also be noted that the following ICD-10 categories are not included in the IPRU tabulations. (Numbers in brackets are deaths in 2006.)

- Y40–Y84 Complications of medical and surgical care (3)
- Y60–Y69 Misadventures to patients during surgical and medical care (3)
- Y85–Y89 Sequelae of external causes of morbidity and mortality (53)

In line with this, ACC spending on treatment injuries is excluded from the analyses given in this report.

In summary, the term "injury" as used in this report excludes:

- "psychological" injury, for example, sexual-abuse cases
- "treatment" and "sequelae" injuries (ICD-10 codes Y40–Y89)
- "occupational disease" cases.

C: Prevalence or Incidence Framework

There are two different standard approaches to constructing cost of illness or burden of injury estimates. They are:

Prevalence studies. These estimate costs occurring in the current period which are caused by injuries in either the current or previous period.

Incidence studies. These estimate costs resulting from injuries in the current period, including both current and future costs, but not costs resulting from injuries in previous periods. This approach, because it measures costs in future periods, requires choosing a discount rate to give "present values" of those future costs. Our "benchmark" discount rate here is the international standard rate for health economics of 3% per annum, in real terms.

The prevalence approach tends to be used for analyses of long-term chronic conditions, while the incidence approach is more convenient for events that have a well-defined start point, such as injuries.

This paper is an incidence study.

D: Data Sources

The important data sources are:

- ACC's own accounting and statistical information
  - data on expenditures, built up from ACC claims data. This is the basis for the estimates of treatment and rehabilitation costs. It also contributes to estimates of "lost output".
  - extensive statistical data on claims and their causes, and on health-care and rehabilitation services provided.
- the Ministry of Health's regular compilation of statistics on deaths and on hospital discharges, by cause of death or hospital admission. These provide the information allowing calculation of YLL as a result of injury-caused premature deaths. Note that the hospital-discharges data in their published form give the number of discharges, not the number of persons injured and requiring hospital treatment. An injured person may need more than one course of hospital treatment.
- compilations by the IPRU of the number of injury-caused fatalities and of the number of persons requiring hospital admission on one or more occasions (so persons requiring two or more hospital admissions are counted only once). The latter are divided into "serious non-fatal" and "other". These compilations are supplied regularly to ACC, and posted as Chartbooks on the website www.nzips.govt.nz. The site also provides documentation of compilation methods (Gulliver et al, 2008).

- the estimated VoSL, computed originally in 1991 as having a value of $2 million (Miller & Guria, 1991), and updated subsequently in line with increases in average ordinary-time earnings. Its value in June 2008 dollars was $3.352 million.

E: Brief Contextual Information

From information provided by IPRU:[1]

- injury-caused fatalities in 2006 numbered 1,681
- injuries requiring hospital admission in 2006, and classified as serious non-fatal, numbered 9,318, increasing to 9,454 in 2007 and 9,865 in 2008
- injuries requiring hospital admission in 2006, but not classified as serious non-fatal, numbered 60,996, increasing to 61,464 in 2007.

ACC total expenditures on treatment and rehabilitation, income compensation (80% of income prior to injury for long-term injured persons unable to return to work), and other benefits and allowances are given in the following table. Expenditures on injury prevention are not included. The expenditures exclude GST.

Spending by ACC on sensitive cases (e.g., sexual-abuse claims) and on treatment Injury claims has recently been running in total at more than $100 million. These expenditures have been excluded from the analyses that follow in this report.[2] On this basis total expenditure in 2008 amounted to almost $2.5 billion.

TABLE 2: ANNUAL ACC EXPENDITURE 2005–2008, $MILLION, (EXCL. GST)

Year	Total Expenditure	Sensitive Cases and Treatment Injuries	Total excluding Sensitive and Treatment Injury Cases
2005	$1,678.00	$87.00	$1,591.00
2006	$2,009.60	$101.30	$1,908.40
2007	$2,236.30	$102.20	$2,134.20
2008	$2,589.50	$110.0(est)	$2,479.50

(Source: ACC. Note that "preventive" expenditures are not included.)

These amounts are those incurred by ACC. They exclude therefore injured persons out-of-pocket costs (mainly a proportion of GP consultation fees, and, very recently, patients' contribution to physiotherapy costs); and initial time off work, paid for by employers.

"Order of magnitude" costs for these can be derived as follows (using ACC tabulations of number of claims for various services, and visits per claim).

1. The IPRU numbers given here are based on information available at the end of 2009. Much of the detail on deaths LLY and DALYs incurred calculated for this report is based on an earlier mortality data set for 2006. In this earlier data set, fatalities total 1,654. The detailed estimates are scaled upwards 1.6 %, corresponding to the total of 1,681 in the IPRU numbers. Similar adjustments are made as required to fatality sub-categories.
2. However, ACC spending on occupational disease (including Occupational Over-use Syndrome OOS) is included.

- GP visits (including accident and medical clinics, and to GPs receiving Rural Bonus) covered by ACC, increased in total from 2.15 million in 2005, to 2.2 million in 2006 and 2.4 million in 2007. Assume 2.5 million in 2008. Assume also that the out-of-pocket contribution per visit is $20, after deducting ACC's contribution. Estimated total cost in 2008 is $50 million.

- Work-related GP visits (including accident and medical clinics and Rural Bonus payments to GPs) covered by ACC were running around 370,000 per year in the 2005–2007 period. There were approximately two such visits per claim. Assume the same number of visits for 2008. Assume also that time off work will approximately average 0.5 days per visit (including time off for services other than GP services), and that lost production is $200 per day off, or $25 per hour. Estimated total cost is $37 million.

These estimates give an order-of-magnitude total of $87 million per annum borne by injured persons or their employers, rather than by ACC. Because of its approximate nature, however, this amount is not included in the estimated total cost given in this report. The introduction of part-charges for physiotherapy services will increase these non-ACC costs.

F: A first comparison of the six priority areas.

Table 3 on the next page shows injury fatality and severe non-fatal injury estimates, supplied by IPRU for the latest available years (the year 2006 for fatalities, and 2008 for serious non-fatal injuries), and the percentage breakdown by priority area. Severe injury is defined as injuries having an estimated "6% Threat to Life" at time of hospital admission.

TABLE 3: FATALITIES AND SERIOUS NON-FATAL INJURIES REQUIRING HOSPITAL ADMISSION, BY PRIORITY AREA

	Numbers		Percentage (%)	
	Fatalities	Serious Non-fatal	Fatalities	Serious Non-fatal
Priority Area	2006	2008	2006	2008
Motor vehicle	391	1,813	23%	18%
Work	88	498	5%	5%
Drowning/near drowning	77	12	5%	0%
Falls	383	4,806	23%	49%
Suicide/intentional self-harm	524	247	31%	3%
Assault	64	1012	4%	10%
Residual	154	1475	9%	15%
Total	1681	9863	100%	100%

(Source: IPRU tabulations for this report.[3])

In terms of fatalities, suicide is the most significant contributor, followed by motor vehicle accidents, falls, and work-related. In terms of serious non-fatal injuries, falls are by far the largest contributor, followed by motor vehicle accidents, and assault.

The changes in ordering are quite dramatic. It appears that the "outcome" measure – in this table either fatalities, or serious non-fatal injuries – needs some discussion as to which measure is most useful for determining resource allocation. This point is returned to later in more detail.

The residual item represents the non-priority injury causes, for instance, non-road transport accidents, burns, poisoning, collision with animate or inanimate objects, other than in a work situation. (Note that the IPRU numbers do not include treatment injuries. These have ICD-10 codes Y40–Y84).

As an initial approximation, based on Table 3, non-priority injury causes could be expected to account for about 15% of ACC expenditure outlays (after removing expenditure on sexual abuse cases and treatment injuries).

G: The Choice of Metric for the Human Cost of Injuries – Lives Lost, or Life Years Lost?

The purpose of injury prevention and treatment is to save lives, which also means saving life years. For the latter, this can be further refined to take account of the quality of those life years, and can be measured in Quality-adjusted life-years (QALYs) or DALYs.

The more specific purpose of this report is to measure the "burden of injury", as specified in Section B.1 earlier. There is no problem in how we measure the treatment and rehabilitation and output and productivity costs – they are simply measured in dollars (exclusive of GST). For the human costs component the problem is more difficult. They can be measured either in lives saved, or in life years saved (or more or less equivalently, in terms of DALYs averted), and then appropriate dollar values – for the Value of a Preventable Fatality (VPF)[4] or the Value of a Statistical Life Year (VoSLY) gained – can be applied. The question here is which is the most appropriate for our purpose.

Whatever approach is used, it is worth mentioning in advance that these human costs, once put in dollar terms, are generally much larger in magnitude than the sum in dollars of treatment and rehabilitation and output and productivity costs.

One of the main purposes for constructing burden of injury estimates is to provide useful data for carrying out economic evaluations of whether proposed interventions to reduce injury should be funded. Either of the two measures of health gain – lives saved, or life years saved (or QALYs gained or DALYs averted) – can be used in such economic evaluations. By far the commonest practice in Health Sector economic analyses, however, is to use QALYs gained (or life years gained, or DALYs averted) as the appropriate measure

3. Much of the information used in this report, particularly the age-distribution of deaths, is derived from mortality statistics for 2006. The overall total and some of the priority area totals are generally in good agreement with the IPRU numbers (which use more detailed criteria), but there are more substantial differences for drowning and MVTC. The 2006 numbers used in this report have been scaled to agree with the IPRU fatality totals. Also information on workplace injuries is not directly available from the standard mortality statistics. For calculation purposes, workplace injuries have been assumed to occur only in the age range 20–64, and that within that age range they have been assumed to have the same age distribution as MVTC injuries.

4. This report is using this label instead of the VoSL in earlier terminology.

of health gain. In particular, in New Zealand PHARMAC carries out its analyses for new drugs proposed for subsidy in terms of QALYs gained.

The general argument for this approach is that saving a life with many expected life years remaining should be given preference over saving a life with only a few life years remaining. There is evidence in the literature that people in general (including elderly people) do prefer saving a younger person's life over saving an older person's life (Busschbach, Hessing & de Charro, 1993).

Some relevant evidence is given in Table 4 below for injury fatalities in New Zealand. Average age at death is given for the selected injury categories, and also average YLL in terms of years of life otherwise to be expected at the time of death. For these latter calculations, "model" life tables are used. This helps ensure consistency over time, as using the latest New Zealand Life Tables would involve changes in the benchmark every five years. The model life tables used are West Model Level 25 (applied to males) and Level 26 (females), (copies available on request.). In these tables, life expectancy at birth is 80 years for males, and 82.5 years for females. (It is of interest that the latest 2005–2007 New Zealand Non-Maori Life Table expectancies – at 79.0 and 83.0 years respectively – are now quite close to the model life tables).

There are some interesting contrasts in the table between the injury priority areas. For example, the average age at death from falls is high, and average YLL relatively low. In contrast, MVTC, drowning, suicide and assaults, have considerably lower average ages at death, and significantly higher averages for YLL. The largest contribution to Total Years of Life Lost is made by suicide/intentional self-harm), followed by MVTC.

TABLE 4: NUMBER OF INJURY-RELATED DEATHS, AVERAGE AGE AT DEATH, AVERAGE TOTAL YLL, 2006

Injury Deaths in 2006 Average Age at Death,and Average and Total YLL				
Injury Category	**Total Deaths**	**Average Age at Death**	**Average YLL**	**Total YLL (Discount Rate 0%)**
Assaults				
Male	41	33.4	47.4	1,945
Female	23	31.1	52.8	1,215
Falls				
Male	167	75.5	12.7	2,123
Female	216	84.8	8.0	1,722
Drowning and submersion				
Male	61	42.4	39	2,390
Female	16	47.2	38.7	607
Motor vehicle traffic crashes				
Male	275	40.1	41.8	11,514
Female	116	45.4	39.5	4,564
Suicide/intentional self-harm				
Male	387	40.2	41.1	15,891
Female	137	41.2	43	5,917
Work-related				
Male	66	38	42.7	2,802
Female	22	44.6	39.3	882
Total of six priority areas				
Male	997			36,665
Female	530			14,907
Other				
Male	103	41.6	40.5	4,184
Female	51	48.4	38.1	1,925
All injuries				
Male	1,100	45.4	37.1	40,849
Female	581	58.7	29	16,831
			Grand total YLL to all injuries	**57,680**

The proposition in this report is that these differences in YLL should be taken into account in calculating the human costs of injury.

It should be added that not all would agree with this approach. Recent estimates by the New Zealand Institute of Economic Research (NZIER) (New Zealand Institute of Economic

Research, 2008) for example, calculate human cost predominantly in terms of Lives Lost, attributing to each life lost a dollar value of the order of NZ$3 million.

The NZIER approach can be argued for if it is assumed the objective is to prevent loss of life, without taking account of the differences in remaining life expectancy for different causes of injury.

For this paper, though, it is assumed that the best measure of the human cost burden of injury should be based on YLL, or closely related measures such as QALYs lost. In 2006 an overall total of 57,680 years of life were lost, including suicides and assaults, as well as non-intentional accidental deaths.

H: Estimates of Cost Components

Much of the information on ACC expenditure given in this section is from tabulations compiled by ACC from claims data. Table 5 gives the main expenditure categories for 2008, by priority area and in total. Note that 30.8% of total ACC expenditure in 2008, or $764.7 million, is not allocated in the ACC accounting system to one or other of the six priority areas. It is assumed here that only half of this is for non-priority injury areas. The remaining half has been allocated pro rata over the six priority areas. The residual proportions in the serious non-fatal injury data supplied by IPRU (Table 3 above) are taken to justify this procedure.

H.1: Treatment and Rehabilitation Costs

Treatment and rehabilitation costs are those in the final two columns of Table 5 on the next page: medical and hospital costs and vocational rehab and support allowance.

Independence allowance, lump sums and death benefits are “transfer payments”. A transfer payment is a transfer between two parties that does not require in return the delivery of a specified service or commodity. Examples are the payment of welfare benefits and taxes. A transfer payment is not an economic cost, in the sense of requiring the use of any economic resources.[5] Such payments should not therefore be counted as part of the overall burden of injury, and are not in this report.

The weekly compensation item represents compensation for income lost because of injury. It is paid at 80% of income earned in employment prior to injury. 125% of this can therefore be taken as representing the lost economic contribution of those not at work because of injury. Note, however, that this does not include the lost contribution of those dying as a result of their injury. That is covered in Table 6 on the next page.

5. A transfer payment needs, however, to be funded by taxes or levies, and these do incur so-called “deadweight” losses, from the distortions to market choices caused by the levies or taxes. No attempt is made, however, to estimate such distortionary or deadweight costs in this report.

TABLE 5: EXPENDITURES BY ACC 2008, $ MILLION, PRINCIPAL EXPENDITURE BY COST CATEGORIES BY SIX PRIORITY AREAS

Injury Priority Area/ACC Cost Category	Weekly Compensation	Independence Allowance, Lump Sums, Death Benefits, etc.	Vocational Rehab and Support Allowance	Medical and Hospital	All
Assault	$1.78	$0.51	$0.98	$1.50	$4.77
Falls	$193.29	$24.34	$149.34	$386.36	$753.34
Drowning	$0.23	$1.34	$0.53	$0.30	$2.41
Motor Vehicle Traffic Crashes	$165.13	$63.18	$177.52	$75.94	$481.78
Suicide/ Intentional Self-harm	$0.41	$3.44	$0.61	$0.97	$5.43
Workplace	$456.75	$49.03	$132.90	$216.60	$855.28
Sum of Six Priority Areas	$817.61	$141.85	$461.89	$681.67	$2,103.01
Other	$111.33	$19.30	$66.09	$185.58	$382.30
All Injuries	$928.93	$161.15	$527.98	$867.25	$2,485.31

(Source: ACC)

1) Sensitive and treatment injury cases excluded

2) Other represents half of the originally unallocated expenditures

3) The remaining half is allocated pro rata over the six priority categories

It was noted earlier in Section B that the estimates in this report are compiled on an incidence rather than prevalence basis. Here, however, the weekly compensation amounts are more suited to a prevalence-type analysis than to an incidence-type analysis. This is because a proportion of the compensation payments relate to injuries in previous years, sometimes many years earlier. For a growing population, and increasing numbers of injuries, an incidence approach would be expected to result in higher costs than derived here. A recent NZIER report (NZIER, 2008 (p.6)) refers to the ratio of lifetime cost to first year's cost as being 1.17 for ACC weekly compensation. If applied to weekly compensation across all injury categories this would add a substantial amount, perhaps of the order of $150 million or more per year, to subsequent estimates in this report. However the ratio of 1.17 is specified in the NZIER report as being for motor vehicle injuries, and the corresponding ratio for other injury categories, such as falls, could be expected to be lower. Also the NZIER report does not seem to have applied a discount rate to future payments.

H.2 Output and Productivity Costs

There is a lost economic contribution to society by those prematurely dead because of externally caused mortality. Estimates of this are given in Table 6, for a range of discount rates. The estimates are based on average income[6] from employment, by gender and

6. The average income is an average of employment plus self-employment income across all persons in the relevant age-gender category, not just those actually in employment.

age group, in June 2008, from the Household Labour Force Survey of that quarter. The 3% discount rate is used for the base-case estimates. Numbers for other discount rates are for later use in sensitivity analyses. The lost contribution for the 3% discount rate is estimated to total $909 million in 2008 dollars.

TABLE 6: ESTIMATED LOST INCOME. $ MILLION, DUE PREMATURE (2006) EXTERNALLY CAUSED MORTALITY, BY SIX PRIORITY AREAS, AT VARIOUS DISCOUNT RATES

Injury Priority Area/Lost Income ($ Millions)	3.0%	3.5%	5.0%	8.0%	10.0%
Assault	47.3	43.7	35.2	24.8	20.6
Falls	29.2	27.6	23.7	18.6	16.4
Drowning	47.9	44.6	36.8	27.1	23.1
Motor Vehicle Traffic Crashes	258.1	239.0	194.0	138.3	115.5
Suicide/Intentional Self-harm	379.6	354.4	293.7	216.0	183.1
Workplace	69.3	65.1	54.8	41.2	35.3
Sum of Six Priority Areas	831.4	774.4	638.2	466.0	394.0
Other	77.4	70.9	56.0	39.0	32.4
All Injuries	908.9	845.2	694.1	505.1	426.4

There is some controversy about such estimates. The first controversial point is whether counting such costs is in fact "double-counting". This is because estimates of the value of lost life years, and of DALYs, given in the following section, are based on the value people on average are willing to pay to prevent a fatality. It is uncertain whether respondents to such questions take into account lost future income, or whether their responses are based solely on intangible attributes of life. Double-counting arises if the former is true. Here, the latter is assumed, in which case there is no double-counting problem. There is a reasonably sized literature debating this matter. For a brief summary see (Drummond, Sculpher, Torrance, O'Brien & Stoddary, 2005 (p.86)).

Another controversial point is whether the lost contribution should be restricted to paid income only, or whether a broader view should be taken of contribution to society. There is also the question of whether contribution should be calculated in terms of net contribution that is output less consumption.

H.3. Human Costs

These costs are the YLL as a result of premature mortality due to injury, plus the reduction in quality of life lost as a result of injury-caused disability, or Years Lived with Disability (YLD). The two sum to DALYs.

YLL are calculated in the manner shown earlier in Table 4, based on actual New Zealand injury mortality in 2006, and using life expectancies from the West Model Life Tables Level 25 and 26. Appropriate discount rates are applied to future YLL.

For the next step it is necessary to establish the ratio of DALYs to the YLL estimates. This is because we lack the detailed information on the disability consequences of injury required for direct calculation of the YLD component. The procedure followed is to use the ratios from the most recent Australian Burden of Disease and Injury study (Begg, Vos, Barker, Stevenson, Stanley et al., 2007). Excel spreadsheets are available on the AIHW website, www.aihw.gov.au.

The Australian ratios are presented in Table 7 below. The assumptions here are that New Zealand injury and disability experience corresponds closely to that of Australia, a reasonable assumption, and that weights and ratios calculated for Australia in 2003 are still reasonably accurate for 2010.

TABLE 7: RATIOS OF DALYS TO LIFE YEARS LOST, FOR INJURY PRIORITY AREA

	Assaults	Falls	Drowning and submersion	Motor Vehicle Traffic Crashes	Suicide / Intentional Self-harm	Work-related	All Injuries
Male	1.405	2.004	1.015	1.163	1.007	1.163	1.287
Female	1.361	2.270	1.003	1.178	1.023	1.178	1.387

(Source: AIHW website. As used in Australian Burden of Disease and Injury Study. Ratios are for 3% discount rate.)

Using these ratios, Table 8 gives estimates of the DALY burden, by discount rate, for the injury categories. In default of better information, the Australian ratios are applied for all discount rates, though strictly they apply to the 3% case only. Unfortunately values of the ratios for other discount rates are unavailable. Given that disability precedes mortality, it would be expected that the true ratios would increase for higher discount rates. That is, there will be a downwards bias in the estimates for higher discount rates.

Table 9 then calculates the dollar cost of these DALY tables. These dollar values vary with the discount rate. Their derivation is given in a subsequent section of this report.

TABLE 8: ESTIMATED NUMBER OF DALYS BY INJURY PRIORITY AREA AND DISCOUNT RATE

Injury Priority Area / Estimated Number of DALYs	Discount Rate % pa					
	0.0%	3.0%	3.5%	5.0%	8.0%	10.0%
Assault	4,386	2,184	1,990	1,552	1,052	859
Falls	8,163	6,191	5,969	5,408	4,595	4,194
Drowning	3,035	1,643	1,514	1,215	856	711
Motor Vehicle Traffic Crashes	18,768	9,846	9,031	7,170	4,988	4,124
Suicide/Intentional Self-harm	22,055	11,916	10,950	8,715	6,047	4,980
Workplace	4,298	2,385	2,196	1,753	1,215	997
Sum of Six Priority Areas	60,705	34,165	31,650	25,813	18,753	15,865
Other	15,213	7,247	6,546	4,966	3,167	2,480
All Injuries	75,918	41,412	38,196	30,779	21,920	18,345

TABLE 9: ESTIMATED TOTAL COST OF DALYS, $ MILLION, BY DISCOUNT RATE AND INJURY CATEGORY

Injury Priority Area/ Estimated Total Cost $ Million	Discount Rate % pa.					
	0.0%	3.0%	3.5%	5.0%	8.0%	10.0%
Assault	$368	$328	$312	$303	$296	$294
Falls	$684	$929	$937	$1,057	$1,292	$1,438
Drowning	$254	$246	$238	$237	$241	$244
Motor Vehicle Traffic Crashes	$1,573	$1,477	$1,418	$1,401	$1,402	$1,414
Suicide/ Intentional Self-harm	$1,848	$1,787	$1,719	$1,703	$1,700	$1,707
Workplace	$360	$358	$345	$343	$341	$342
Sum of Six Priority Areas	$5,087	$5,125	$4,969	$5,044	$5,272	$5,439
Other	$1,275	$1,087	$1,028	$970	$890	$850
All Injuries	$6,362	$6,212	$5,997	$6,014	$6,162	$6,289

H.4. Summary Total Social and Economic Cost for June 2008, Base-case Estimate

Table 10 brings together the estimates from earlier tables, for the base case of a 3% discount rate.

Overall, the table gives in dollar terms a total of $9.7 billion. Of this, human costs, for 41,412 DALYs, amount to $6.2 billion, or 64% of the total. The remaining $3.5 billion are the economic costs of treatment and rehabilitation, and lost output and productivity.

TABLE 10: ECONOMIC AND SOCIAL COST AND BURDEN OF INJURY, 2008 BASE-CASE, DISCOUNT RATE 3%, JUNE 2008 PRICES ($ MILLION)

Injury Priority Area	Lost Economic Contribution, Total Cost $ Million (Excl. GST), June 2008 Prices						
	Treatment	Rehabilitation	Weekly Compensation	Lost income to Premature Mortality	Human DALYs (Number)	Human Cost at $150,000 each DALY	Total Social and Economic Cost
Assault	$1.5	$1.0	$2.2	$47.3	2,184	$327.5	$379.6
Falls	$386.4	$149.3	$241.6	$29.2	6,191	$928.7	$1,735.2
Drowning	$0.3	$0.5	$0.3	$47.9	1,643	$246.4	$295.5
Motor Vehicle Traffic Crashes	$75.9	$177.5	$206.4	$258.1	9,846	$1,477.0	$2,195.0
Suicide/ Intentional Self-harm	$1.0	$0.6	$0.5	$379.6	11,916	$1,787.4	$2,169.1
Workplace	$216.6	$132.9	$570.9	$69.3	2,385	$357.8	$1,347.5
Sum of Six Priority Areas	$681.7	$461.8	$1,021.9	$831.4	34,165	$5,124.8	$8,121.9
Estimated "Non-priority" Injuries	$185.6	$66.1	$139.2	$77.4	7,247	$1,087.1	$1,555.4
All Injuries	$867.3	$527.9	$1,161.1	$908.8	41,412	$6,211.9	$9,677.3

Weekly Compensation is scaled up 25% from actual spending, to allow for being 80% of actual income.

It is helpful to condense the above table, as in Table 11 below. The final column shows the percentage contribution of the different priority areas. This gives some indication of how resources might be allocated for the prevention of accidents and injuries (depending on there being effective interventions available). The four largest contributors to the overall total are motor vehicle, suicide/intentional self-harm, workplace, and falls, in that order.

As always there are uncertainties about these estimates. Assumptions are required, in particular, for the estimates of workplace components of cost, and for estimating the overall size of non-priority injuries and accidents. Some analysts would not include the lost economic contribution due to premature mortality item, or would have rather different estimates.

Given the importance of the contribution of human costs to the total, it is of particular interest to investigate the impact on the estimates of variability in this component. This is done in Section J of this report, but prior to that we need to discuss issues around the choice of a discount rate, and the dollar valuation of a life year or DALY. The value used so far – $150,000 – needs justification. This is done in the next section.

TABLE 11: CONDENSED TABLE OF INJURY COSTS, BY COST CATEGORY AND PRIORITY AREA. BASE-CASE ESTIMATE USING OFFICIAL TRANSPORT SECTOR VPF, 3% DISCOUNT RATE, $ MILLIONS, JUNE 2008 PRICES

Priority Area / Cost Category	Treatment and Rehabilitation	Lost Economic Contribution	Human Costs	Total Social and Economic Cost	% of Total Social and Economic Cost – All Injuries
Assault	$2.5	$49.5	$327.5	$379.6	4%
Falls	$535.7	$270.8	$928.7	$1,735.2	18%
Drowning	$0.8	$48.2	$246.4	$295.5	3%
Motor Vehicle	$253.5	$464.5	$1,477.0	$2,195.0	23%
Suicide/Self-harm	$1.6	$380.1	$1,787.4	$2,169.1	22%
Workplace	$349.5	$640.3	$357.8	$1,347.5	14%
Subtotal – Six Priority Areas, $ Millions, (Excl. GST)	$1,144	$1,853	$5,125	$8,122	84%
Estimated "Non-priority" Cost, $ Millions (Excl. GST)	$252	$217	$1,087	$1,555	16%
All Injuries, $ Millions (Excl. GST)	$1,395	$2,070	$6,212	$9,677	100%

I. Discount Rates, and Valuation of Life Years and DALYs

I.1 Choosing a Discount Rate

Economic evaluations, assessing the worth of future benefits against present costs, the need to discount future outcomes back to the present to allow computation of a Net Present Value (NPV) – all this requires the choice of a discount rate.

The choice is often controversial, perhaps especially so for the health sector. The literature on the matter is voluminous and will not be reviewed here. There is a useful discussion in Treasury's 2005 Cost Benefit Analysis Primer. Also, earlier in 2005, there was a discussion in the New Zealand Medical Journal about the appropriate discount rate for Health Sector interventions in New Zealand (Metcalfe, Brougham, Moodie, & Grocott, 2005; Milne, 2005).

Relevant to the choice are the following comments and recommendations (all rates are "real"; that is they are applied to cost and benefit streams which have had inflation removed).

- Treasury (2005, p 27) comments "There is no single rate of return that is appropriate for every project. The Treasury uses a 10% real discount rate whenever there is no other agreed sector discount rate for costing policy proposals. Where there is an agreed sector rate, it may be used instead."

- Gold et al. (1996) recommend a 3% rate for the United States Health Sector. They recognise this may not be applicable in other jurisdictions, but recommend that results for a 3% discount rate should be provided as part of any cost-effectiveness analysis, thus allowing easier comparison of analyses in different countries.

- Burden of disease analyses in Australia and New Zealand around the year 2000 used a 3% discount rate.

- Countries such as Australia and the UK appear to currently use rates of around 5% or 6% per annum for health sector cost-effectiveness or cost-utility analyses.

- PHARMAC in the 2005 NZMJ article referred to above favoured an 8% rate. However, in their subsequent update of their *Prescription for Pharmacoeconomic Analysis* (May 2007) they recommended the use of discount rates in cost utility analyses (CUA) of 3.5%, and to include in sensitivity analyses discount rates of 0%, 5%, and 10%.

It is on the basis of this last recommendation that New Zealand Health Sector analyses tend now to use a 3.5% discount rate.

Earlier in this report, a 3% rate was used, principally for comparison with broader burden of disease analyses. In a subsequent section we test the sensitivity of the results to a range of discount rates. As will be seen the results, with one interesting exception, are not in fact particularly sensitive to the choice of discount rate.

I.2 Valuing Life Years and DALYs

As earlier discussed the use of DALYs is favoured here as the outcome measure for measuring the burden of injury, taking account of both years of life lost to premature mortality and of lost quality of life because of disability.

It is not always necessary to put a dollar value on a DALY or a life year. In fact, doing so can obscure the meaning of what is happening, and also can generate huge "gee whizz" dollar numbers. However, to combine DALYs with economic costs such as those of health care and rehabilitation it is necessary to express all outcomes in dollar terms.

The question is how to work out the dollar value of a DALY. There is fact a considerable current research literature on this topic (Abelson, 2003; Mason, Jones-Lee, & Donaldson, 2009).

Generally, the most used approach (though not by all) has been around for a couple of decades. The first step is to obtain a dollar value for a preventable fatality (VPF or,

formerly, VoSL). This value is then "annualised", by assuming that the sum of discounted future life years must sum to the present VPF.

It can be seen that the higher the discount rate the higher the value of the statistical life year or DALY must also be, to give the correct present sum.

For our purposes here we suppose that persons responding to surveys of what they would be willing to pay to reduce the risk of, say, a road fatality are thinking in terms of a person of around forty years of age, whose normal life expectancy would be about another forty years (see Table 4). The equation we are solving is:

$$V \times \{ 1/(1+d) + 1/(1+d)^2 + \ldots + 1/(1+d)^{40} \} = VPF$$

Where V represents the value of a preventable life-year lost, and d is the discount rate.

We have a range of estimates for the VPF in New Zealand. Namely:

- the original Ministry of Transport VoSL (Guria & Miller) in 1991 of $2 million
- an estimate (BERL 2007) that the value of a life lost to fire is 0.66 times the MOT value
- a revised Land Transport Safety Authority estimate of $4 million in 1998, updating the 1991 estimate. (However, unlike the earlier estimate, this has not been adopted for policy purposes.) This is approximately 70% higher in real terms than the earlier estimate.

Adjusting for wage inflation, these three estimates have been updated to 2008 dollars. The respective values in 2008 dollars are $3.35 million, $2.2 million, and $5.7 million. Table 12 gives for each of these VPF values the corresponding values for life years or DALYs, obtained from the formula given above.

TABLE 12: JUNE 2008 VALUE OF A LIFE YEAR FOR DIFFERENT NEW ZEALAND VALUES OF PREVENTABLE FATALITY, AND A RANGE OF DISCOUNT RATES

Discount Rate	Transport 1991 Based	Transport 1998 Based	Fire BERL 2007
VPF	$3,352,448	$5,676,732	$2,212,616
0.0%	$83,811	$141,918	$55,315
3.0%	$145,035	$245,589	$95,723
3.5%	$156,986	$265,826	$103,611
5.0%	$195,375	$330,830	$128,947
6.0%	$222,809	$377,284	$147,054
7.0%	$251,464	$425,807	$165,966
8.0%	$281,137	$476,052	$185,550
10.0%	$342,819	$580,499	$226,261

I.3 Discussion of the Assumptions

The assumptions used above to calculate the value of a statistical life year or, equivalently, a DALY, can be questioned on several grounds.

The first of these is the assumption that a VPF based on WtP surveys should be taken as referring to a forty-year old, with a remaining life expectancy of forty years.

The results, however, are not very sensitive to this particular assumption. Suppose instead we assume the VPF applies to a thirty-year old with a remaining life expectancy of fifty years. For a VPF in 2008 dollars of $3.35 million, and a discount rate of 3%, the result is a value of $130,295 for a life year or DALY. This compares with the value of $145,305 in Table 12 for the case of a forty-year old with a forty-year life expectancy.

Going further, if the VPF is assumed to apply to a new-born baby with a life expectancy of eighty years, the corresponding DALY value is $111,005.

The DALY value does then reduce as the assumed remaining life expectancy increases, but not dramatically. It would be desirable of course, in future WtP surveys, to try to establish more precisely whether respondents were visualising their own situation, or that of family members, or that of some hypothetical "typical" person.

A more fundamental question concerns the assumption that a life year has a constant value across the lifespan. If this were so, one would expect the VPF to decrease steadily with age, assuming respondents are thinking in terms of their own personal situation. As pointed out by one of the reviewers, this is certainly not the case for New Zealand. The data do not show a significant decline with the age of respondent, although they do show a slightly lower average value for those above sixty years of age.

Aldy & Viscusi (2008) also comment on this point for United States data. (With, incidentally, VoSLY of the order of US$300,000 for 1993–2000 data and a 3% discount rate.) Factors they mention include the general increase in resources available with increasing age (up to retirement age), and the lack of perfect capital markets to enable lower-paid younger persons to invest more in mortality prevention. To quote their research:

> *"Explicit construction of age-specific VSLY levels from our age-VSL profiles shows that the value of a statistical life-year varies with age. The conventional assumption of a constant VSLY is not borne out. This result in turn stems from the failure of VSL to decline monotonically with age, which is a common assumption that lacks a firm empirical basis. Both VSL and VSLY vary with age, but the relationship is not a simple one"* (Aldy & Viscusi, 2008).

A possible counter-argument to these empirical results is a non-empirical one. This is that governments, when having to make investment decisions for the community as a whole, are also commonly trying to distribute the benefits equitably, and that this equitable distribution is best done on the basis of valuing life years equally.

Research is continuing on these matters. See, for instance, Abelson (2003) and Mason et al. (2009). A worthwhile piece of empirical research for New Zealand, which could quite easily be carried out, would be to take the VoSLY age profile given in the paper by Aldy & Viscusi, a so-called "inverted-U profile", and apply it to estimate New Zealand DALY values, varying with year of age. These could then be inserted in the calculation spreadsheets used for this report, and the sensitivity of the conclusions to this change tested. One expected consequence would be that the human cost of falls would increase relative to those of other injury priority categories.

J: Sensitivity Analyses

Sensitivity analyses are used here to check the sensitivity to changes in parameter estimates, whether in terms of the overall cost total, or in terms of the relative importance of the specified priority areas.

J.1 Sensitivity to Changes in the Value of a Preventable Fatality

When life year values are derived from life values in the way described in the previous section, the value of the former will be directly proportional to the value of the latter. The two alternative estimates to the standard Ministry of Transport estimate, created in 1991, can be used simply by scaling proportionately the human cost component.

Inserting the values of $95,723 from Table 12 based on the BERL Fire estimate, and that of $245,589 from the 1998 Transport estimate gives the following results shown in Table 13, for a discount rate of 3% per annum.

Note for the standard estimate we have so far used a value of $150,000, in place of the more precise $145,305. The difference is small.

Not surprisingly there are significant changes in total cost, reducing 23.2% for the lower value, and increasing 40.9% for the higher value, giving a range from $7.4 billion to $13.6 billion, about the base-case $9.7 billion.

The percentage allocation over the different priority areas does change, with workplace injuries' share seeming the most sensitive to the changes. In general, the rank order of the six priority areas is pretty much unchanged, with the exception that for the highest value of a life year, suicides rank ahead of MVTC. This reflects the importance of lost life years in the total of costs for suicide.

TABLE 13: SENSITIVITY ANALYSES AROUND 2008 BASE-CASE: CHANGING VALUE OF LIFE YEARS

	Base Case, MOT 1991: $150,000	BERL 2007: $95,723	MOT 1998: $245,589
Priority Area	**% of All Injuries**		
Assault	3.9	3.5	4.3
Falls	17.9	18.8	17.1
Drowning	3.1	2.8	3.3
Motor Vehicle	22.7	22.4	23
Suicide/Self-harm	22.4	20.5	24.3
Workplace	13.9	16.4	11.6
Subtotal Six Priority Areas, % All Injuries	83.9	84.4	83.6
% Estimated "Non-priority" Injuries	16.1	15.6	16.5
All Injuries, $ millions (Excl. GST)	$9,677	$7,429	$13,636
Percent (%) change from Base Case		−23.0%	40.90%

J.2 Sensitivity to Changes in the Discount Rate

This involves a double variation, with not only the discount rate being changed, but also the dollar value of a life year as shown in Table 12. We would expect the present value of future life years to diminish as the discount rate increases, but with some offset from the increasing life-year dollar values.

The next table gives the results for a selected range of discount rates. The total cost numbers are in fact very insensitive to changes in the discount rate. The rank orders of the six priority areas do show, however, some sensitivity. For the higher 8% and 10% discount rate cases, falls move from ranking third behind motor vehicles and suicide to first place.

This shifting in rank is explainable by the fact that most falls fatalities occur in the older age groups. Therefore the remaining average YLL are considerably smaller than for other categories. A higher discount rate has less impact on these nearer-term lost life years than it does on the longer-term lost life years for other categories.

TABLE 14: INJURY COSTS IN JUNE 2008. SENSITIVITY OF RESULTS TO CHANGES IN DISCOUNT RATE

Percent (%) Composition by Priority Area	Sensitivity: Changing Discount Rate				
	3.0%	3.5%	5.0%	8.0%	10.0%
Total Cost $ Million, June 2008 Prices	$9,677.2	$9,397.9	$9,264.1	$9,224.0	$9,271.50
Assault	3.9%	3.8%	3.7%	3.5%	3.4%
Falls	17.9%	18.5%	20.1%	22.6%	24.1%
Drowning	3.1%	3.0%	3.0%	2.9%	2.9%
Motor Vehicle	22.7%	22.5%	22.2%	21.7%	21.5%
Suicide/Self-harm	22.4%	22.1%	21.6%	20.8%	20.4%
Workplace	13.9%	14.2%	14.2%	14.1%	14.0%
Subtotal – Six Priority Areas, % All Injuries	83.9%	84.1%	84.8%	85.6%	86.3%
% Estimated "Non-priority" Injuries	16.1%	15.8%	15.3%	14.3%	13.7%
All	100.0%	99.9%	100.1%	99.9%	100.0%

K: Summary

Table 15 below summarises the material in this report. The numbers are the base-case estimates for the cost of injury in New Zealand in 2008. Dollar costs are measured in New Zealand dollars, June 2008 prices. GST is excluded. The discount rate used for the base-case is 3% per annum, in real terms.

TABLE 15: SUMMARY TABLE OF PERCENT (%) INJURY COST BY COST CATEGORY AND PRIORITY AREA, BASE-CASE 2008, 3% DISCOUNT RATE

Priority Area / Cost Category	Treatment and Rehabilitation	Lost Economic Contribution	Human Costs	Total Social and Economic Cost
Assault	0.2%	2.4%	5.3%	3.9%
Falls	38.4%	13.1%	15.0%	17.9%
Drowning	0.1%	2.3%	4.0%	3.1%
Motor Vehicle	18.2%	22.4%	23.8%	22.7%
Suicide/Self-harm	0.1%	18.4%	28.8%	22.4%
Workplace	25.0%	30.9%	5.8%	13.9%
Subtotal – Six Priority areas, $ Millions, (Excl. GST)	82.0%	89.5%	82.7%	83.9%
Estimated "Non-priority" Injuries	18.0%	10.5%	17.5%	16.1%
All Injuries	100.0%	100.0%	100.2%	100.0%
Total Cost ($ Million)	$1,395.20	$2,070.10	$6,211.90	$9,677.20

Treatment and rehabilitation costs of $1.4 billion, excluding GST, represent the economic costs for the purchase by ACC of these services. Note that ACC outlays on death benefits and independence allowances, etc. are not included in the totals. This is because, as discussed earlier, they are transfer payments rather than payment for a service.

The lost economic contribution cost of $2.07 billion has two components. The first is the lost production from those still suffering consequences of their injury and not yet able to return to paid employment. This is estimated as 125% of Income Maintenance payments by ACC (which are paid at 80% of previous employment income before suffering injury). The second component is more hypothetical, being the lost future contribution of those who die prematurely because of their injury. Population averages of income from employment by age and gender groupings are used in its derivation.

The final component – the human cost of $6.2 billion – is derived by calculating, first, the DALYs incurred from premature mortality and from disability associated with injury, and then placing a value of NZ$150,000 on each DALY. Justification for this is given in the detail of the report.

K.1 Rank Orderings of Priority Areas

The rank order of the different priority areas in terms of total cost is motor vehicle, followed by suicide, followed by falls, and then workplace injuries.

The human cost component is influential in determining this rank order. It will be observed that workplace injuries, and also falls injuries, rank highly or relatively highly for the first two components, but less so for human costs, particularly for workplace injuries. This is because fatalities from workplace injuries are relatively low, at 88, compared with (in 2006) more than 500 from suicide, and nearly 400 each for falls and motor vehicle injuries. The serious non-fatal injury contribution also appears relatively low for workforce injuries. That is non-serious injuries contribute relatively much more to the burden of workforce injury than for other injury priority areas.

The relatively low ranking, also, of falls in the final column has a different cause. Although fatalities are relatively high in number, these occur much more among the aged than do fatalities from other causes of injury. This means that a relatively much smaller number of life years are lost because of falls-caused fatalities, than is the case for other causes of injury. Hence a relatively low human cost.

K.2 Dependence of Estimates of Human Cost on the Outcome Measure

It should be mentioned again at this point that the human cost estimates are based on estimates of life years lost, and DALYs incurred. An alternative would be to base such estimates on the value of lives lost, not taking into account the age at death from injury. This alternative approach would unquestionably affect the rank order of the priority areas. Falls would be higher up the list, around the same place as motor vehicle injuries, while workplace injuries would be relatively low in the ranking.

K.3 Sensitivity Analyses

The results above have been subjected to sensitivity analyses, as described in detail in the body of the report. The dollar value of a DALY has been varied, and either increased in line with the higher value estimated for a statistical life in research carried out by the MOT and reported in 1998; or decreased in line with the lower value estimated by BERL for fire-caused fatalities in 2007. Naturally the total cost changed as a result of these variations. The percentages of total cost for the different priority areas did vary, but by relatively small amounts, and rank orderings were unchanged, except that for the highest value of a life year suicide costs moved into first rank, ahead of motor vehicle crashes.

The results were also tested for changes in the discount rate. Total cost was little affected by these variations, because in the methodology employed here the discount rate and the cost assigned to a DALY move inversely.

The rank orderings of the priority area were affected, however. Notably, falls became the highest ranking category for higher discount rates at 8% and 10%. This is explainable by, as already noted, deaths from falls being most prevalent among the elderly. Lost life years are therefore much more nearer-term than for other categories, and are therefore less affected by increases in the discount rate.

L: Recommendations Further Work

The estimates in this report are believed to give a reasonably accurate estimate of the total cost of injury to New Zealand in 2008, and of its allocation across injury categories. However, as noted in the report, there are some omissions from the total, and also areas where additional work could improve the quality of the estimates.

Improvements would be possible in the following areas:

a. The proportion of unallocated ACC expenditure over the injury priority categories could be further investigated, to establish how much is genuinely unallocated, and how much is caused by the non-priority category of injuries.

b. The YLL analysis of mortality data could be carried out for years other than 2006, to check on the stability of the estimates over time.

c. A precise distribution of workplace mortality by age should be used rather than simply assuming the same distribution as for motor vehicle crashes over the age range 20–64.

d. Private costs, that is out-of-pocket costs borne by injured persons, and costs to employers of initial absence of injured persons from work, should be estimated and added to the total of ACC costs. Order-of-magnitude estimates in Section E of this report estimate the amounts involved at $50 and $37 million respectively, but more accurate estimates should be possible.

e. For some classes of ACC expenditure there is a long "tail" – that is outlays for injuries that occurred in earlier years, sometimes many years earlier. Because of this, and with population and numbers of injuries increasing, lifetime costs will exceed annual cross-sectional costs. The main component affected is Workers Compensation. The extra lifetime costs need to be estimated. Their magnitude could possibly be of the order of $100 to $200 million annually.

f. For the step from estimating the number of life years lost from premature injury-caused mortality, to calculating the number of DALYs, it was necessary to use DALY/YLL ratios from a 2003 Australian Burden of Disease report. The ratios were based on data discounted at 3% per annum. Clearly it is undesirable to rely on an overseas source for these ratios, and one reviewer suggested we should carry out our own DALY calculations, for a range of discount rates. This, however, would be a task exceeding presently available resources. Given that the Ministry of Health will probably soon be carrying out an updated burden of disease report for New Zealand, and that WHO is also in the process of updating its burden of disease work, including a review of the disability weights, it seems best to await the outcome of these developments.

g. A key assumption in this report is that a YLL, or a DALY caused, should have the same value right across the age range. This is a questionable assumption. As pointed out in the NZIER review, the assumption is contradicted by empirical evidence from WtP surveys. Survey material points to a rather higher than average value per year of life at older ages and a lower value than average at younger ages. The matter is receiving quite a bit of attention in the research literature, and this might lead to a clearer view on these matters in future. It might well also be worthwhile carrying out updated WtP studies in this country, and if possible getting a better handle on what precisely determines what people are willing to pay to reduce mortality and injury. In the meantime, one check that could be carried out fairly readily would be to apply age profiles of the VoSLY from overseas research to the calculations underlying this report. This would test the sensitivity of the results to such a change.

References

Abelson, Peter. June 2003. The Value of Life and Health for Public Policy. *The Economic Record,* vol. 79, special issue, June 2003, S2 – S13.

Access Economics (2008). The Health of Nations: The Value of a Statistical Life. Report for Office of the Australian Safety and Compensation Council.

Aldy, J.E., & Viscusi, W.K. (2008). Adjusting the Value of a Statistical Life for Age and Cohort Effects. *The Review of Economics and Statistics*, 90(3); 573–581.

Begg, S., Vos, T.,Barker, B., Stevenson, C., Stanley, L., & Lopez, A.D. (2007). The burden of disease and injury in Australia 2003. Australian Institute of Health and Welfare: Canberra.

Busschbach, J.J.V., Hessing, D.J., and de Charro, F. Th. (1993). The Utility of Health at Different Stages in Life: A Quantitative Approach. *Social Science & Medicine*. vol. 37, no. 2, 153–158.

Department of Labour (2004). Measuring the Costs of Injury in New Zealand. Wellington: Department of Labour.

Drummond, M.F., Sculpher, M. , Torrance, G.W., O'Brien, B. & Stoddart, G (2005). *Methods for the economic evaluation of health care programmes*. 3rd edition. Oxford University Press, Oxford.

Gold, M.R., Siegel, J.E., Russell, L.B., and Weinstein, M.C. (1996). *Cost-Effectiveness in Health and Medicine*. Oxford University Press, New York.

Goodchild, M., Sanderson, K., & Nana, G. (2002). Measuring the total cost of injury in New Zealand: A review of alternative cost methodologies. Wellington: BERL.

Gulliver, P., Cryer, C & Davie, G. (2008). The New Zealand Injury Prevention Strategy Serious Injury Outcome Indicators: Technical Report. Wellington: Injury Prevention Research Unit, University of Otago (NZIPS). Retrieved from www.nzips.govt.nz/resources/publications/php

Guria, J., Jones, W., Jones-Lee, M. W., Keall, M., Leung, J. and Loomes, G. (2003). The New Zealand Values of Statistical Life and of Prevention of Injuries. Wellington, Land Transport Safety Authority.

Mason, H., Jones-Lee, M., and Donaldson, C., (2009). Modelling the Monetary Value of a QALY: A New Approach Based on UK Data. *Health Economics*, 18: 933–950.

Metcalfe, S., Brougham, M., Moodie, P. & Grocott, R. (2005). PHARMAC responds to Richard Milne on discounting health benefits and costs. New Zealand Medical Journal. Retrieved from www.nzma.org.nz/journal/118-1219/1600/.

Miller, T.R., and Guria, J. (1991). The Value of Statistical Life in New Zealand: Market Research on Road Safety. Wellington, Ministry of Transport.

Milne, R. (2005). Valuing prevention: discounting health benefits and costs in New Zealand. *New Zealand Medical Journal*. Retrieved from www.nzma.org.nz/journal/118-1214/1443/.

New Zealand Injury Prevention Strategy (2008). A Chartbook of the New Zealand Injury Prevention Strategy Serious Injury Outcome Indicators: 1994-2007. www.nzips.govt.nz

New Zealand Treasury (2005). Cost Benefit Analysis Primer. Wellington: New Zealand Treasury.

O'Dea, Des (2002). Measuring the Social Cost of Serious Injury. A report to the Expert Advisory Panel, New Zealand Injury Prevention Strategy. Wellington.

PriceWaterhouseCoopers (2009, draft). Review of the Economic and Social Costs of Drowning and Water Related Injuries Compared to Prevention. A draft Report to ACC.

New Zealand Government

Published in February 2010 by the Accident Compensation Corporation (ACC)
This document is available on the New Zealand Injury Prevention Strategy website www.nzips.govt.nz
NZIPS Secretariat ACC PO Box 242 Wellington New Zealand Email: nzips@acc.co.nz

ACC5424 • ISBN: 978-0-478-31473-1