NZAE Paper 2011 Conference. Des O'Dea and John Wren

Cost of Illness Studies. Why do the results vary so much?

Abstract

Cost of Illness Studies are an example of the application of economics in the Health sector. The procedure is that a specific disease, or a risk factor (e.g. smoking or obesity), or a wider group of diseases or injuries, is specified. The 'costs' of the disease are then calculated, typically under three broad headings, often labelled as –

- "Direct" costs – treatment costs, rehabilitation, and prevention.
- "Intangible costs" – deaths, years of life lost to premature mortality, and lost quality of life. It is quite common to associate a dollar value with each life lost, or each Year of Life Lost, or Quality-adjusted Life-year (QALY) lost.
- "Indirect costs" (sometimes called "productivity costs") – the 'lost contribution' to the economy and to society following from either premature mortality, or from illness or disability.

Often the costs under these three headings are combined into one total, given in dollar terms. Such totals are sometimes used for "shroud-waving" purposes. A more legitimate use is to identify areas where costs of illness are particularly high, and therefore might give large returns to appropriate interventions if such can be found.

The problem is that sometimes estimates by different agencies or researchers for a given disease or injury aggregate differ substantially – in the case recently of All Injuries estimates by several magnitudes.

I tabulate and discuss in this paper the differences in philosophy and estimation methods which account for these differences; and make recommendations as to what should in my opinion be standard practice. The more important of these are that, for "intangible costs", the measure should be QALYs lost, rather than lives lost; and that "lost productivity" should be measured in terms of actual economic costs, not including unpaid 'social contribution'. And regarding "lost productivity", more attention needs to be given the argument (by Koopmanschap and others, Journal of Health Economics, 1995) that economies adjust relatively quickly to reduce production losses.

Contact addresses: Des O'Dea, Department of Public Health, University of Otago, PO Box 7343, Wellington South 6242. New Zealand. Des.odea@otago.ac.nz and desodea@paradise.net.nz

John Wren. Principal Research Advisor, ACC Research. PO Box 242, Wellington 6011 New Zealand.

John.wren@acc.co.nz

I: Definitions

Cost of Illness (CoI) studies, and their near relative, Burden of Disease (BoD) studies, set out to measure "costs", in some sense, of illness and injury. They can relate to a specific disease or injury type, or to broad groupings of such, or to the costs attached to specified 'risk factors' such as smoking, obesity, etc.

- Burden of Disease studies characteristically measure the 'burden' in terms of lost years of life due to premature mortality, and lost years of 'quality life' due to disability or morbidity. The summary measure of 'cost' is the total of Disability-adjusted Life Years (DALYs), where –
  DALYs = YLL+ YLD YLL Years of Life Lost. YLD Years lost to Disability
  Good examples of BoD studies are those carried out by the Ministry of Health a decade ago and currently being updated. (Ministry of Health, 1999, 2001.)

- Cost of Illness studies in general include some metric of 'health loss'. Most commonly the measure is in terms of DALYs, but there are other possibilities, in particular total Lives Lost. In addition CoI studies seek to measure the resource costs of the illness, measured in dollars. These include health-care costs, and often also the "lost (economic or social) contribution" from premature death, or health impairment. Quite often a dollar value is also assigned to the 'health loss' measure, DALYs or Lives Lost, allowing a total 'cost' in dollar terms to be calculated.

Typically Cost of Illness estimates are set out under three main headings:-

- "Direct" costs – treatment costs, rehabilitation, and prevention.
- "Intangible costs" – deaths, years of life lost to premature mortality, and lost quality of life. It is quite common to associate a dollar value with each life lost, or each Year of Life Lost, or Quality-adjusted Life-year (QALY) or Disability-adjusted Life-year (DALY) lost.
- "Indirect costs" (sometimes called "productivity costs") – the 'lost contribution' to the economy and to society following from either premature mortality, or from illness or disability.

What use are such studies? Sometimes they are mis-used. But Burden of Disease studies can be used to estimate the 'average burden' for sub-populations, thus identifying inequalities and the need to seek interventions addressing these inequalities. Cost of Illness studies provide useful information for subsequent use in cost-effectiveness analyses of specified interventions. To quote Segel's 2006 'Primer' (which it isn't) "When performed with a clear explanation, cost-of-illness studies represent an important analytic tool in public health policy." (Page 4.)

Note that the results of cost-effectiveness analyses are customarily expressed as ratios such as "Cost per QALY gained", or "Cost per DALY averted"; and so do not require a $ value to be assigned to the unit of 'health gain'.

Note also that Cost of Illness studies fall into two main categories.

- 'Prevalence' studies, summing the cost in a given year of all cases arising in previous years as well as the current year.
- 'Incidence' studies, summing the cost in the current year and future years of cases arising in the current year.

Both types have their uses. Prevalence studies avoid the need in Incidence studies of deciding on a discount rate for future outcomes. Incidence studies provide more useful information on disease 'pathways' for use in cost-effectiveness analyses.

Segel (2006) notes a USA cost of epilepsy study showing "that prevalence- and incidence-based studies tend to have similar cost estimates, with prevalence-based studies often having slightly higher estimates." (Pages 12-13.)

II: Examples

There have been a number of 'Cost of Illness' studies carried out in New Zealand, dating from as far back as Easton. Jaine (2009) gives a recent compilation. Holt in a recent Treasury paper gives an overall view of 'Cost of Illness' ion New Zealand , though in fact restricted to just lost labour force contributions and hospital in-patient costs, not all health-care costs. Of particular interest is the high estimate she gives for the cost of "presenteeism", namely the reduced contribution of those who are unwell but still turn up for work.

Two examples of NZ work by O'Dea are represented by the following tables for Skin Cancer, and for the Cost of Injury, Total and by six priority areas. Both are best regarded as prevalence studies.

Costs of Skin Cancer and Related Conditions to New Zealand 2006.
NZ$ in 2007/08 prices.

	Melanoma	**Non-melanoma (incl. related neoplasms)**	**Total**
Lost life-years	3,811	930	4,741
Health-care Costs (NZ $mn; excl GST)	$5.7 mn	$51.4 mn	$57.1 mn
'Lost Production' (NZ $mn)	$59.3 mn	$ 6.7 mn	$66.0 mn

Note that Health-care Costs include $11.6 million for 'related neoplasms'.

Source: O'Dea, 2009.

Note that in the summary table below for Injuries, the VPF (Value of a Preventable Fatality, or Value of a Statistical Life) has a value of $3.352 million in June 2008 prices. A value of $150,000 is given each DALY, based on a 3 percent discount rate. This value is used to calculate the numbers in the Human Costs column.

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.
Cost Category

Priority Area	Treatment & Rehabilitation	Lost Economic Contribution	Human Costs	Total Social & Economic Cost	% of Total Social & 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%

Source: O'Dea and Wren, 2010.

III: The Problem

Now the problem. Focusing on Cost of Injury estimates, comparatively recent estimates by the NZ Institute of Economic Research (NZIER) exceeded those given above from O'Dea and Wren by a substantial multiple. Likewise a recent paper by Keall et al. (2011) estimated that "unintentional home injuries in New Zealand impose an annual social cost of about $NZ 13 billion … which is about 3.5 times the annual social cost of road injury." Again clearly out of line with the estimates tabled above.

The differences appear to be due to the following factors –

- The inclusion in the NZIER and Keall et al work of 'willingness-to-pay' estimates for not just the 'value of a statistical life', but also for 'serious accidents' and 'minor accidents'.
- The use by the same parties as their 'metric' of 'health gain/loss' of the average Value of a Statistical Life for fatalities. That is the use of a value of $3.352 million as the cost of any fatality, regardless of the number of life-years lost as a result of the fatality.

A further issue is, if one does use as the 'metric' QALYs or DALYs, and wishes to put a dollar value on such, how should that value be calculated? The standard approach, as in O'Dea and Wren, Easton, and others has been to assume that a DALY has the same value across the age-range, and can be calculated by summing discounted values across a reasonable part of the life-span to a total equal to the Value of a Statistical Life – hence the $150,000 approximate cited above for a discount rate of 3.5 percent per annum, and numbers similarly derived in a number of papers. (Abelson. Mason et al and others.) It is becoming increasingly apparent in the recent literature, however, that this is too simplistic an approach (see Aldy and Viscusi, 2008). (And indeed Dr Guria has always argued that his work in New Zealand in the early 1990s on the willingness-to-pay to avert a road fatality showed no such simple relationship with age as would be expected from giving all life-years the same value, regardless of age.)

I focus here on the question of the appropriate 'metric', drawing the numbers below from O'Dea and Wren (2010) and presentation of the material in that report.

The first table gives NZ injury-caused fatalities by 'priority area' for 2006. Suicides make the largest contribution, followed by Motor Vehicle crashes, and Falls. IPRU stands for the Injury Prevention Research Unit which provides these data for the NZ Injury Prevention Strategy 'chart-books'.

If the average age at death, and distribution by age, was approximately the same for all causes, then the ranking by priority area would be unaffected by whether one used Lives Lost, or Life-years Lost, as the measure of 'Health Loss'. However, it is not the case that average age and distribution are approximately the same. The next table shows average age at death for all Injuries and for Falls.

Fatalities in 2006 (IPRU), by Priority Area

• Motor Vehicle	391	23%
• Work	88	5%
• Drowning	77	5%
• Falls	383	23%
• Suicide	524	31%
• Assault	64	4%
• Residual	154	9%
• Total	1,681	100%

Injury deaths, average age at death, and Years of Life Lost (Mortality data)

	Total deaths	Av Age at death	Av YLL	Total YLL
<u>All Injuries</u>				
Male	1,100	45.4	37.1	40,849
Female	581	58.7	29	16,831
<u>Falls</u>				
Male	167	75.5	12.7	2,123
Female	216	84.8	8.0	1,722

Clearly fatalities caused by Falls occur at much higher ages than those from other causes. In fact (though not shown here), average age at death for Falls is actually higher than for deaths from 'all causes', both disease and injuries. Average years of life lost per Fall fatality are much less than for other injury causes of death.

It seems clear to me that in measuring in dollar terms the 'human cost' of injuries the number of years of life should (must?) be taken into account. Certainly in cost-effectiveness analyses the almost universal practice of health economists is to use outcome measures based on life-years, such as QALYs or DALYs.

IV: Other Issues.

Some other issues that tend to recur with Cost of Illness studies are discussed, cursorily, here.

- Estimates of the 'lost contribution' or 'lost productivity', as a result of morbidity or premature mortality should be regarded with some suspicion, perhaps being best thought of as an optional 'add-on'. The usual approach to e4stimating this component is a 'human capital' approach – estimating what the income contribution of a sick or dead person would otherwise have been. As pointed out by Koopmanschap et al (1995) some time ago, however, unless the economy is working at full capacity, the lost contribution might well soon be made up for by a substitute. There will be some initial disruption costs plus training costs - labelled as "friction costs", but these will be, the authors claim, considerably lower than estimates based on the traditional human capital approach.
- Such 'human capital' estimates also often seek to go beyond calculating losses of income to including calculations also of the lost 'contribution to society' incurred by persons not in the paid labour force, perhaps using the value of leisure relative to being in paid work, or the wages it would be necessary to pay a substitute for the person concerned. The desire to do this is understandable, but it is considerably simpler to restrict 'contribution' estimates to only those that are normally counted as part of GDP.
- In 'human capital' estimates it is desirable to allow for some increase over time in real wages – a standard value perhaps being 1 percent per annum. In fact, such adjustments should also apply to estimates of the value of future life-years, or lives.
- A factor which should be taken into account in calculating QALYs and DALYs is that physical quality of life does tend to diminish with age, and disability increase. See for instance Figure 2 in Devlin et al (2000).

V: Summing up.

It should be apparent from this paper that there are a number of concerning methodological issues concerned with 'Cost of Illness ' estimates, and that it would be desirable for practitioners to be better aware of these, and also to make more effort to reconcile some of the differences.

One simple step would be for authors to include in their papers both justification and specific numbers for the 'health outcome' measures being used. For example number of deaths, and number of estimated life-years lost. Often, e.g. for cost-effectiveness analyses, these alone should be a sufficient measure of outcome, but there are often pressures to put a $ value on these outcomes, which can be justified when seeking to prioritise between disease or injury groupings.

There are more significant issues, of course, in particular getting the appropriate balance between 'willingness-to-pay' valuation methods and the more standard 'resource costs' approach. And also around the valuation of life years - is the Value of a Statistical Life any guide at all to valuing a life year. Should such life-year values be allowed to vary with age, and if so in what fashion? Some experimentation with the kind of analysis in Aldy and Viscusi would be an interesting area for research.

References

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

Devlin, N. Hansen, P. Herbison, P. 2000. *Variations in self-reported health status: results from a New Zealand survey.* NZMJ Vol 113 No 1123 517-520

Easton B (April 1997). *The Social Costs of Tobacco Use and Alcohol Misuse.* Public Health Monograph Series No. 2. Department of Public Health, Wellington School of Medicine, University of Otago.

Holt, Heather. 2010. *The Cost of Ill Health.* New Zealand Treasury Working Paper 10/04. November 2010.

Jaine R. 2009. *Report on New Zealand Cost-of-Illness Studies on Long-Term Conditions.* Ministry of Health publication July 2009.

Keall, M.D. Guria, J. Howden-Chapman, P. Baker M.G. 2011. *Estimation of the social costs of home injury: A comparison with estimates for road injury.* Accident Analysis and Prevention 43 (2011) pp 998-1002.

Koopmanschap, M.A. Rutten F.F.H. van Ineveld B.M. and van Roijen L. 1995. *The friction cost method for measuring indirect costs of disease.* Journal of Health Economics 14 (1995) 171-189.

Ministry of Health. 1999. *Our Health, Our Future: the Health of New Zealanders 1999.*

Ministry of Health. 2001. *The Burden of Disease and Injury in New Zealand.* Public Health Intelligence Occasional Bulletin No. 1.

O'Dea, D. 2009. *The Costs of Skin Cancer to New Zealand.* Report to the Cancer Society of New Zealand. October 2009.

O'Dea, D. and Wren, J. 2010. *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.* Technical report prepared for New Zealand Injury Prevention Strategy Evaluation. ACC. February 2010.

Segel J. E. January 2006. *Cost-of-Illness Studies – A Primer.* RTI International. RTI-UNC Center of Excellence in Health Promotion Economics.