Savings from Preventing Lifetime Smoking and Obesity in Young Adults: A Scoping Study

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Introduction

The Health Promotion Forum originally asked us to develop a full cost-benefit analysis (CBA) of measures to prevent smoking and obesity in young adults in New Zealand, as two examples of public health programmes. We lacked the funding or resources to do this.

This report is to pave the way for such a cost-benefit analysis. We argue that health promotion has for too long been stymied by a perception that they lack the data and indeed the funds to do a perfect cost benefit analysis.

This is a scoping study which seeks to illustrate that building a case for health promotion need not be excessively costly, nor does it need to wait for the perfect data. We illustrate the ideas using obesity and smoking as exemplars. We would however caution the use of the results.

Smoking prevention and obesity prevention need to serve as two standalone priorities in themselves, but at the same time as examples of methodology for CBA of preventive public health programmes in general. It will also be necessary to explain why CBA is even appropriate and to take account of the argument that smokers and obese people are "cheaper" because they die younger.

The public health literature advocates prevention programmes as a central plank of New Zealand's overall health strategy. Among its top priorities, the literature identifies the need to address obesity and smoking (Theo Vos et al., 2010). These two risk factors contribute greatly to the non-communicable disease crisis because they are prevalent and closely correlated with chronic diseases.

The New Zealand Government, however, has de-emphasised prevention in national health policy. The position as summed up in the report of the Ministerial Review Group (MRG) (Ministerial Review Group, 2009) . The MRG seems at best sceptical of prevention as a major strand of the health care system. It states

> *"Opinion is divided, however, on the much narrower question of the extent to which further spending in this area [prevention] at the expense of more immediate health needs might help reduce future health costs or improve the country's economic performance, thus making future health spending more affordable.*
>
> *On the question of cost, it is not clear that living longer and generally healthier lives will necessarily reduce our demand on health and disability services over our lifetime. Half of all health spending goes on the last year of life and the older we are the more likely we are to suffer from multiple conditions." (Ministerial Review Group, 2009) page 50)*

This suggests that prevention requires a more rigorous analysis to demonstrate that they would save the Government money or be self-funding. Rightly or wrongly, this resistance has effectively

thrown down a gauntlet to the public health sector to frame their case in cost-benefit terms and this report is the step to picking up that gauntlet[2].

The Case for Cost Benefit Analysis

Cost-benefit analysis is a common technique in welfare economics and elsewhere for assessing whether a proposal's beneficial outcomes outweigh the monetary and other costs of investing in them. Costs and benefits expected with some probability either immediately or in the future are translated into the common denominator of "present value dollars".

The headline result is often expressed as a Benefit-to-Cost Ratio (BCR). A BCR of 1 indicates that a dollar invested returns a dollar and is therefore a breakeven investment. All other things being equal, proposals with a BCR above 1 (allowing for some margin of uncertainty) ought to be undertaken.

Many public health professionals recoil from the thought of framing prevention services in terms of monetary costs and benefit. Surely, the strong humanitarian ground for preventive public health programmes ought to win the day?

Another source of reluctance on the part of public health professionals is their reluctance to embark on such projects unless the perfect data and the perfect methodology is available and there is sufficient time and resources to produce the most rigorous answer.

Meanwhile, the health dollar (and indeed public spending across the board) is being diverted to areas where either there are more resources to generate cost benefit analyse because of the private benefit from doing so (such as pharmaceuticals) or the political will carries the day .

The cases for Roads of National Significance (RoNS) is a case in point. These projects will attract more than $7billion in funding. Many of these projects have very low BCR. For example, the Waterview Connection which will cost in excesses of $2.2b and which was accepted on the basis of having a positive BCR has some extremely questionable methodologies applied (R. Vaithianathan, 2009). In particular, 95% of the benefits from that project is savings in time travel of around 5 minutes. Given that it is estimated that one third of traffic during peak-period are school children the bottom line is that New Zealand is committing $2b to make the trip to school faster. If that $2b was invested in the bank account with a 5% yield, it would generate $125 per child per year for ever.

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[2] We have critiqued the MRG report elsewhere Vaithianathan, R. 2010. "Building on Myths: An Economist's Response to the Ministerial Review Group Report on the Health System." *N Z Med J*, 123(1314), 79-83.

This raises the question whether CBA is used as an ex-post rationalisation rather than evidence that is scrutinised and then followed wherever it leads. There is a high risk that CBAs can be intentionally hijacked by interest groups as well as simply innocently misapplied and misunderstood. This is reason to be explicit, scrupulous and transparent. However, even transparency is of limited use when one needs expertise to interpret the evidence.

"Cost-benefit analysis" gets invoked a lot. But not all CBAs are equally sound. It may be that the unfavourable studies alluded to by the MRG Report fell into a similar trap as the alleged public health case against preventing smoking which Crampton (Eric Crampton, 2010)) and others invoke.

Crampton uses cost-benefit analysis to argue that since smokers pay more cigarette tax in their lifetime than they cost the health system – given their shortened life span—smoking has a positive effect on the health economy. Moreover, since individuals choose to smoke, their own private pleasure from doing so outweighs the costs. By this reasoning, smoking is not a net cost to society: rather, it is an excellent and efficient source of revenue.

However, this leads to the argument that we ought to encourage smoking as a mechanism for revenue raising and subsidise the advertising of tobacco. Indeed, the ideal would be a highly taxable, irresistibly addictive substance that creates both happiness (in the narrow sense of satisfying an induced and activity-limiting craving) and tax revenue; does not reduce ability to earn during working life; and curtails retirement early and tidily by rapid, low-cost death.

Many population health experts are however reluctant to embark on cost-benefit analysis until the perfect methodology and the complete data set is available. This is unhelpful. Embarking on such a project – however flawed – provides the opportunity to understand exactly *what* evidence is missing and how methodologies might be improved.

Perfect data will never arrive. The data we use in our own analysis is far less than perfect and the methodology quite incomplete. But the analysis is acceptable and useful as long as the methodologies explicitly acknowledge their assumptions and limitations articulated (which is more than can be said for the case for Waterview). We show the next steps that future researchers should take to improving these deficiencies. We endeavour to do this in the rest of this report.

Obesity and Smoking

Obesity: Definition, Prevalence, Trends and Morbidities

The World Health Organization (WHO) defines an obese person as a person with a BMI that is greater than or equal to 30 (World Health Organization). It is common in New Zealand to define obese Maori and Pacific people as those with a BMI that is greater than or equal to 32.

As in most parts of the world, obesity rates in New Zealand are increasing. Prevalence of obesity rose from 9 percent of males and 11 percent of females in 1977, to 20 percent of males and 22

percent of females being obese in 2003(Ministry of Health, 2003). The 2006/07 survey found that 26.5 percent of adults were obese (Ministry of Health, 2007) see Table 1.

Age	Prevalence of obesity (%)
Children:	
2 – 4	8.3
5 – 9	8.2
10 – 14	8.5
All children	8.3
Adults:	
15 – 24	14.2
25 – 34	24.4
35 – 44	28.4
45 – 54	30.5
55 – 64	35.9
65 – 74	32.8
75+	20.8
All Adults	26.5

Table 1. Unadjusted prevalence of obesity from the 2006/07 New Zealand Health Survey (Ministry of Health, 2007)

The 2006/07 New Zealand Health Survey found that 1 in 5 children aged 2 to 14 were overweight (20.9%) and 1 in 12 were obese (8.3%). The prevalence of obesity was highest amongst Pacific Island children (28.6%) and adolescents (34.6%) and compared with European children (5.5%) and adolescents (8.8%). There is also some evidence of a poverty gradient effect in the sense that children and adolescents from more deprived areas are more likely to be obese than those from less deprived areas (J. Utter et al., 2010, J. Utter et al., 2007). The 2006/07 New Zealand Health Survey found that some 1 in 3 adults in New Zealand were overweight (36.3%) and 1 in 4 adults were obese (26.5%).

Since obesity in childhood is correlated with obesity in adulthood, the growing levels of obesity amongst children and adolescents suggest a positive long term trend in adult obesity unless prevention programmes are in place to tackle childhood obesity. Bouchard (C. Bouchard, 1997) found that a third of children who were obese during preschool become obese adults and about half of obese grade school children – equivalent to New Zealand primary school children – become obese adults.

Obesity is associated with a range of diseases in the sense that people with higher BMI have higher prevalence rates. Turley, Tobias and Paul (M. Turley et al., 2006) analyse the 2002/03 NZ Health Survey and find that the relative prevalence for a range of diseases. Their summary table is reproduced in Table 2.

	Illness	Unexposed (%)	BMI Class II (25.0 – 29.9)	BMI Class III (30.0-34.9)	BMI Class IV (≥35.0)
Males	Cardiovascular disease	7.1	1.1(0.8-1.5)	1.6(1.0-2.1)	1.3(0.6-2.0)
	Diabetes	1.8	1.5(0.7-2.3)	3.3(1.5-5.0)	7.1(3.3-10.9)
	Osteoarthritis	2.7	1.9(1.0-2.8)	2.7(1.4-4.0)	3.7(1.0-6.5)
	Asthma	10.7	1.0(0.6-1.5)	1.8(1.1-2.6)	1.7(0.6-2.9)
	Sleep disorders	13.0	0.8(0.6-1.1)	1.2(0.9-1.6)	2.0(1.2-2.8)
	Depression	4.1	1.1(0.5-1.7)	1.4(0.6-2.2)	1.8(0.4-3.1)
	High blood pressure	11.2	1.5(1.1-1.9)	2.8(2.0-3.5)	3.3(2.3-4.3)
	High blood cholesterol	15.5	1.4(1.1-1.7)	1.4(1.1-1.8)	1.5(1.0-2.1)
	No chronic disease	64.7	1.0(0.9-1.1)	0.8(0.7-0.9)	0.7(0.5-0.8)
	1 chronic disease	26.2	1.1(0.9-1.3)	1.2(1.0-1.5)	1.2(0.8-1.5)
	2 chronic Diseases	6.9	0.9(0.6-1.2)	1.8(1.3-2.3)	2.7(1.4-3.9)
	3+ chronic diseases	0.7	1.5(0.3-2.7)	2.6(0.6-4.6)	4.6(0.8-8.4)
Females	Cardiovascular disease	6.8	1.0(0.7-1.2)	1.4(1.0-1.9)	1.9(1.2-2.5)
	Diabetes	1.8	0.9(0.4-1.4)	1.6(0.7-2.6)	3.6(1.7-5.4)
	Osteoarthritis	4.2	1.6(1.1-2.0)	1.5(1.0-2.0)	1.5(0.9-2.2)
	Asthma	9.7	1.3(0.9-1.7)	1.3(0.9-1.8)	1.5(0.9-2.1)
	Sleep disorders	18.5	1.1(0.9-1.3)	1.3(1.0-1.5)	1.4(1.1-1.7)
	Depression	4.9	1.1(0.7-1.5)	0.9(0.4-1.3)	1.4(0.8-2.0)
	High blood pressure	15.3	1.5(1.2-1.7)	1.8(1.4-2.2)	2.9(2.3-3.5)
	High blood cholesterol	12.5	1.2(1.0-1.5)	1.4(1.0-1,7)	1.7(1.3-2.2)
	No chronic disease	60.6	0.9(0.9-1.)	0.9(0.8.0.9)	0.7(0.7-0.8)
	1 chronic disease	26.9	1.1(1.0-1.3)	1.2(1.0-1.3)	1.3(1.0-1.5)
	2 chronic Diseases	10.1	1.1(0.8-1.4)	1.4(1.0-1.8)	1.6(1.1-2.0)
	3+ chronic diseases	1.1	1.2(0.6-1.8)	1.2(0.4-1.9)	2.1(0.9-3.3)

(Note: Age ≥25 years for all health conditions, except asthma where age range is 25-44 years)

Table 2: BMI and Prevalence Rate ratios from Turley, Tobias and Paul (2006)

Using an obesity prevalence estimate of 17% of the New Zealand adult population in 1997, Wilson and Wilson (BD Wilson et al., 2001) estimate that this leads to 4.7% of the population of life years lost in New Zealand.

The CMDHB system dynamic model for diabetes projected that if the prevalence of obesity remained at the 2007 level for 20 years, the number of people with diabetes would increase by 31 percent (WC Chan et al., 2010).

Smoking: Definition, Prevalence, Trends

The World Health Organisation defines a smoker as someone who has smoked more than a 100 cigarettes in their lifetime and currently smokes at least once a month (Ministry of Health, 2009) . Smoking refers to cigarettes, roll-your-own tobacco (RYO), cigars and pipes.

Measuring tobacco smoking generally relies on self-report, which can be subject to under-reporting (Murray Laugesen et al., 2009) .

The 2006 Census reported that 654,000 people were daily smokers in New Zealand, being 20.7 percent of adults (15 years and older) (M; Laugesen et al., 2010). The rate is double for Maori, with two in five Maori adults smoking, and 20 percent of all cigarettes are smoked by Maori people. According to the New Zealand Tobacco Use Survey, conducted in 2008 on a sample of 5132 respondents aged 15 – 64 years of age, 23.1 percent of people were smokers (Ministry of Health, 2009).

In 2008, 20.8 percent of adolescents aged 15 – 19 years of age were smokers (Ministry of Health, 2009) and it is estimated that every year around 16,000 youths enter their 20s as a smoker. The average age that young people (15 – 19 year olds) start smoking is 13.3. Average age that young people become addicted to smoking is 14.6 years (K Evison, 2009). In 2008, 50.5 percent of 15 – 19 years had never tried smoking, which is significant more than in 2006 where 39 percent of 15 – 19 year olds had never tried smoking (Ministry of Health, 2009).

A 2008 survey of school children found that 7 percent of year 10 (approximately 14 – 15 year olds) students were daily smokers, 3 percent weekly smokers, and 3 percent monthly smokers (J. Paynter et al., 2009). A majority (61 percent) had never smoked, an increase from 57 percent in 2007.

The smoking rate of people aged 15 years and over is 21 percent (Ministry of Health, 2009). There has been a downward trend in smoking over the last 25 years (Ministry of Health, 2009). The decrease in year 10 smokers over the period of 2006 – 2008 was 15 percent. This is a smaller decrease than over the period 2003 – 2005, which had a decrease in year 10 smokers of 25 percent.

Smoking prevalence has decreased from 40 percent in 1976 to 23.5 percent in 2006 (R. Barnett et al., 2009). This is a bigger fall than what has been seen in most other developed countries.

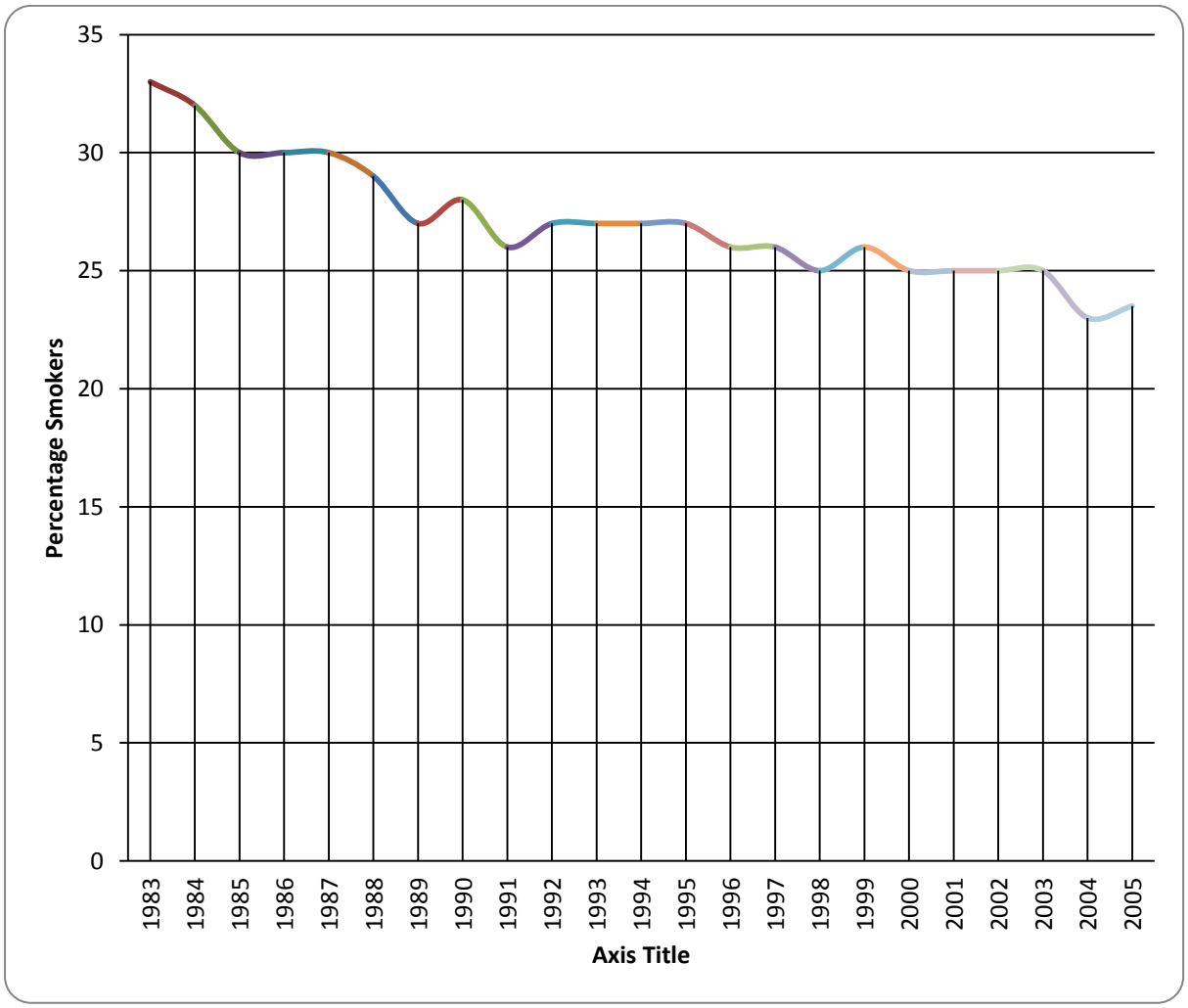

Figure 1: Smoking rates. Ministry of Health. (2006)

Note:

1. From July 1989 to March 1996, data are selected from people aged 16 years and above. Adjustments are made by assuming that the smoking rate of 15 years old age group is equivalent to the smoking rate of 16 years old age group.
2. In 2004, data are collected from people aged 18 and above. Smoking rate for each of the age groups for 14, 15, 16 and 17 years is assumed to be equivalent to the smoking rate of 18 years old age group.
3. Until 1999, a smoking percentage of each year is an average of quarterly measured smoking rates. From 2000, an annual smoking rate is derived from an annual data collection

Cavana and Tobias (R. Y. Cavana and M. Tobias, 2008) construct a 'business as usual' scenario that predicts what the prevalence of smoking will be in New Zealand based on recent trends. They assume that smoking will decrease by 6.4 percent over 30 years (a 0.2 percent decrease per year). See

	Smoking Prevalence		Tobacco Consumption			
	Rate (per 100)	Count (000 people/year)	Per capita (cigarette/year)	Total (tonnes/year)	Rate (per 100,000)	Count (people/year)
2001	22.7	744	996	3,259	110	4,244
2011	21.4	747	939	3,276	118	4,799
2021	19.4	689	840	3,061	112	4,719
2031	16.3	616	715	2,702	102	4,459

Table 3: Major Performance Measures for Scenario 1: Business as Usual. From (R. Y. Cavana and M. Tobias, 2008)

Between 2002 and 2006, somewhere from 4,500 to 5000 people are estimated to have died from cigarette smoking each year ((Murray Laugesen, Michael Epton, Chris Frampton, Marewa Glover and Rod Lea, 2009)), with about 1,500 of these deaths occurring in middle age (Ministry of Health, 2009). Since 1950, the premature death of over 160,000 New Zealanders has been attributed to cigarette smoking.

Methodology

The approach that we take is a stripped down version of a Markov-decision tree model used in the Australia ACE studies (M. Forster et al., 2011, Theo Vos, Rob Carter, Jan Barendregt, Cathrine Mihalopoulos, Lennert Veerman, Anne Magnus, Linda Cobiac, Melanie Bertram and Angela Wallace, 2010). *Note that our approach is purely illustrative and further work is necessary to make it more robust.* However, the purpose is to show how using a readily accessible dataset like the National Minimum Dataset which is hospital event based data, one can quickly make a broad economic case for prevention.

Sources

In this study we use primary data from National Minimum Dataset (Hospital Events) (hereafter NMDS), between July 2005 and June 2009 for individuals aged below 65. NMDS is a national collection of information on public and private hospital discharges for inpatients and day patients in New Zealand (Ministry of Health, 2009). From this data, we can identify each patient's age, diagnosis on admission (Principal diagnosis) and a cost weighting for the government's funding (WIES). In these three data sets, each patient is uniquely coded with an encrypted identification.

Aim

Ideally we would like to estimate the additional costs of hospital care for individuals who are smokers or ever smoked against those who are non-smokers. Unfortunately we are unable to establish whether individuals are smokers/ obese as the NMDS data does not register this[3].

Therefore, we undertake the following. We consider key diseases that have been associated with smoking and obesity

Disease	ICD-10 code used in NMDS	Identification of ICD-10 code according to ICD-10 rules
COPD	Codes with J44	Other chronic obstructive pulmonary diseases
Cardio vascular disease (CVD)	Codes starting with I	Diseases of the circulatory system
Asthma	Codes starting with J45	Asthma
	Codes starting with J46	Status asthma
Diabetics	Codes starting with either E11, E12, E13, E14 or E15	Diabetes mellitus; excluding insulin dependent (E10)
Breast cancer	Codes starting with C50	Malignant neoplasm of breast
Lung cancer	Codes starting with C34	Malignant neoplasm of bronchus and lung
Melanoma	Codes starting with C43	Malignant melanoma of skin
Prostate cancer	Codes starting with C61	Malignant neoplasm of prostate
Colorectal cancer	Codes starting with C18	Malignant neoplasm of colon
	Codes starting with C19	Malignant neoplasm of recto sigmoid junction
	Codes starting with C20	Malignant neoplasm of rectum
	Codes starting with C26	Malignant neoplasm of other and ill-defined digestive organs
Others	Codes not satisfying any of the above codes	Diseases different from any of the above diseases.

Table 4: Disease Classifications (World Health Organisation, 2010)

[3] Smoking status is observed and collected by the hospital, but is not part of the NMDS. A requirement to enter smoking status as a required field in the NMDS would be extremely helpful in establishing the effect of smoking on hospitalization costs.

Calculating hospitalisation costs

We calculate average annual hospitalisation costs for a person who was admitted in that year for a particular disease. The average cost of hospitalisation for the "other" category is therefore for people who were hospitalised – but not for any of the nine key diseases.

Recall that the objective of this exercise is to calculate the present value of hospitalisation costs that the public health system would save if it were to prevent a person smoking or becoming obese. To calculate this we start with the premise that smoking and obesity each heighten risks of being hospitalised for each of these diseases. For each of the key nine diseases we apply an *incremental rate* of the disease attributable to smoking and likewise an incremental risk attributable to obesity.

Incremental rates of risk for each of the disease by smoking and obesity for each of the eight diseases are shown in Table 6 and Table 7. *Incremental rate of risk by smoking* for a disease is the additional rate of risk for one of the eight diseases due to smoking. Similarly, *Incremental rate of risk by* obesity for a disease is the increase of risk rate for a disease caused by obesity. Note that these rates are simply illustrative of our method – and at this stage they have not been subject to extensive cross-checking.

Note that we have not considered how obesity and smoking may interact as risk factors. The effect could be multiplicative – bigger than simply summing the two independent effects – but it could also be less than summing them.

Incremental risk for each factor

Assuming that smoking and obesity are uncorrelated, we obtain aggregate values for *Incremental risk of a disease by smoking* and for *Incremental risk of a disease by obesity*. Since the rates are derived from separate studies, there are a number of inconsistencies between the rates. For instance, different research populations are used in each of the studies. In some, the rates are explicitly given, but in others, calculation is required in order to find the rates we want. In the calculation, it is assumed that the gender proportion in the total population is 50:50. Only current smokers and non-smokers are accounted for; past smokers and second hand smoking is not considered. An incremental risk of 22% for asthma means that a person who smokes is 22% more likely to be hospitalised for asthma than if he or she did not smoke.

Calculating incremental costs of hospitalisations

To calculate the additional costs of smoking and obesity respectively, we take the incremental risk of each disease and multiply it with the average hospitalisation cost for that disease multiplied by the probability of being hospitalised.

The probability of being hospitalised for the disease is the number of people in the age group who were hospitalised for the disease divided by the census population in that age group. The census population is taken from 2006 New Zealand census of population and dwelling. This yields the incremental hospitalisation risk from each disease for each age group that is posed by smoking or obesity.

Therefore if a smoker is 22% more likely to have asthmatic symptoms, then he or she is 22% more likely to be admitted to hospital. We assume that this increased risk is equally applicable to all age groups. For example, in our sample 64 people aged between 20 and 21 were admitted to hospital with a principle diagnosis of asthma. According to the 2006 census, there are 54,195 people in that age group. This means that the average admission rate for that age group is 64/54,195. Let us assume that smoking rates in this age group are presently 0. Then all 54,195 people became smokers we would expect a 22% increase in admission rates in this age group. The additional number of hospital admissions can be therefore calculated.

Note that we are assuming that the current hospitalisation rates are for non-smokers. The reason is that we do not have enough data to know what percentage of each population are already smoking. For example, if we knew that 50% of 20-21 year olds were smokers. Then we know that the current hospitalisation rate is already 11% higher due to smoking and the reduction in hospitalisation rate from eradicating smoking will be *less* than is estimated by us.

Present value

We then calculate the present value of preventing the lifetime costs associated with the extra nine diseases. Present value is a technique for comparing costs and/or benefits that occur in different time periods by reducing them through a "discount rate" to a common present denominator. To calculate the present value we take the perspective of preventing a 20 year old from smoking over his or her life time / or being free of obesity over his or her lifetime. We assume that below 20 his or her chances of each of the key nine diseases are the same as if he did not smoke or was not obese. We assume that from age 20 to 64 he or she then has higher chances of hospitalisation of each of the key diseases (as per).

Allowing for shorter life-spans of smokers and obese people: cut-off at age 65

This point addresses one of the main reasons alluded to or given by the MRG Report, Crampton and others to be sceptical about favourable benefit-to-cost ratios of intervening to prevent smoking or obesity. The reason was that smokers and obese people die younger and there are therefore makes these groups cheaper on average over a lifetime than non-smokers and non-obese people. The case is that this is all the more true in the case of smokers, because they pay high tobacco taxes.

We take 65 as the terminating year. If we were to extend the period beyond, we would have to adjust for the shorter life spans associated with each of smoking and obesity. US data suggests that after age 51 the higher mortality rate reduces the personal health costs of smokers compared to non-smokers (Frank A. Sloan et al., 2004). Therefore comparing only costs over the 20-65 years maintains a conservative assumption that from 65 to end of life, the shorter life spans from smoking and obesity might offset the fact that while alive hospitalisation costs are higher – meaning that the average costs of smoking and obesity from age 65 to the end of life might be the same as or even less than the cheaper but longer life of non-smokers or non-obese individuals.

Disease Correlations Calculated For Obesity

We calculate the following incremental risks from obesity.

Disease	Increased rate of risk by obesity (%)
CVD	19.5
Asthma	50.0
Diabetics	58.0
Breast Cancer	8.0
Lung Cancer	0.0
Melanoma	5.0
Prostate Cancer	0.0
Colorectal Cancer	11.5
COPD	50.0

Table 5: Incremental rates of risk by obesity used to illustrate method

We calculate the following incremental risks from smoking.

Disease	Increased rate of risk by smoking (%)
CVD	22.0
Asthma	66.0
Diabetics	42.0
Breast Cancer	18.0
Lung Cancer	80.0
Melanoma	0.0
Prostate Cancer	30.0
Colorectal Cancer	17.0
COPD	66.0

Table 6: Incremental rates of risk by smoking used to illustrate method

Disease correlations for smoking and obesity

We note again that we have assumed that smoking and obesity are uncorrelated, and that we have not considered how obesity and smoking may interact as risk factors. The effect could be multiplicative – bigger than simply summing the two independent effects – but it could also be less than summing them.

Disease	Increased rate of risk by smoking or obesity (3dp)
CVD	0.415
Asthma	1.160
Diabetics	1.000
Breast Cancer	0.260
Lung Cancer	0.800
Melanoma	0.050
Prostate Cancer	0.300
Colorectal Cancer	0.285
COPD	1.160

Table 7: Incremental rates of risk by smoking or obesity used to illustrate method

Results

The results for each risk factor (obesity and smoking) again are parallel and to be read the same way.

	Lifetime Savings per person
Smoking	$ 310,064
Obesity	$13,361

Table 8: Public Hospital Costs Savings for a 20 year old who is prevented from becoming obese (NPV based on 3%)

Table 8 summarises the calculations for obesity and obesity. What that table says is that if we have an intervention that can prevent a 20-year-old from taking up smoking over his or her lifetime, then we ought to be willing to invest $310,064 per 20 year old. Similarly, we would break even if we invested $13,361 in preventing a 20 year old individual from entering obesity for sure.

To put this in perspective, according to the 2006 Census there were 54,196 20-year-olds. Prevalence of obesity in this group is around 25%. Therefore, halving the obesity in this cohort in the next 45 years is worth an investment of $155 million for that cohort alone.

Similarly, using the estimate that around 16,000 youth enter their 20s as smokers, the value of ensuring that they all quit and that no one else in their cohort starts is worth an investment of $11b based on reduction in hospital costs.

Conclusion

How will future researchers "plug" our results on hospital savings, along with all the other costs and benefits, into a full CBA? This is not self-evident because in principle and in practice CBAs, or what pass for CBAs, vary in significant ways that can fundamentally alter the headline figure: the Benefit-to-Cost Ratio.

Moreover, given that we are picking up the Government's gauntlet, it would make sense in the first instance to meet that challenge on its own terms. But those are unspecified and there is more than one candidate framework for what Government would/should accept.

Along with factors such as the choice of discount rate, one important point of difference among CBA frameworks is in what the analysis counts conceptually as a cost and, more influentially, what it counts as a benefit matters hugely. Costs (once established) remain a relatively constant denominator in the Benefit-to-Cost Ratio formula. It is what counts as a valid benefit for societal or fiscal purposes that more usually swings the balance of the ratio. We consider the candidates for such benefits next.

Candidates for Categories of Benefit

Most methodologies of cost-benefit analysis for health interventions range across the following benefits:

1: Direct benefits – that is, direct improvement to lived experience of individuals who would otherwise have gone on to suffer the diseases that obesity and smoking put them more at risk of.. We have not even tried to count this, but it can be done by using a very standard measure called Quality-Adjusted Life Years or QALYs.

Either 2(a): Employment benefits – the avoided decrease in employment due that those diseases would have caused. Employment benefit equates to output benefit or, since output is all paid for to the seller, income benefit – essentially the benefit to gross domestic product (GDP). We have not even tried to count this, but it can be done.

Or **2(b): Tax benefits** - the portion of the increase from 2(a) which flows to the public purse as extra income tax. We have not even tried to count this, but it can be done.

3: Public healthcare savings, including, but not limited to, hospitalisations – avoided expenses on public health expenditure that would have come from diseases that obesity or smoking puts people more at risk of. We have counted the hospitalisation part, though the diseases need refining. We will also suggest other public healthcare savings below such as subsidised GP visits and lab tests.

4: Welfare savings – savings in unemployment, sickness or invalid benefit to people who were receiving them but may now exit the welfare system. We have not even tried to count this, but it can be done. However, even though this has a place in a fiscal cost-benefit analysis (which is really just a

business case for the taxpayer, which if positive is called a dominant case), we explain that welfare economics would not count this kind of "transfer" payment one way or the other.

Candidates for Cost-Benefit Frameworks According to Benefits They Count

The table below sets out two main frameworks of CBA. We can then locate various specific CBAs relative to these. Note that all of these would incorporate a hospital savings component such as we have derived. Note also the other healthcare costs that should be included as in out proposed Next steps.

The narrowest case of a purely fiscal CBA is really not a CBA in welfare economics terms at all, but a bottom-line business case for the taxpayer. This counts only tax take, welfare spending and public healthcare spending.

At the other extreme, a comprehensive societal CBA includes private as well as public costs and benefits (??). It would thus: count the whole employment effect, rather than only the amount of it that flows into tax revenue; count as much of the direct benefit as is not already implicitly counted by the employment effect; count healthcare; but disregards welfare payments, since these are in pure economic terms welfare-neutral "transfers" from one person to another.

Table 9 : Potential Cost-Benefit Frameworks

	A pure fiscal view. This would be a business case for the taxpayer, not a true cost-benefit analysis	What pure welfare economics approach would count
1 Increased quality of life of people prevented from lifetime smoking or obesity	No, because it does not go to the taxpayer	Yes, but beware possible double-counting to extent overlaps with the Employment effect
Either 2a Increased employment/output/income	No, because it does not go to the taxpayer	Yes
Or 2b: Increased income tax	Yes	No because covered by employment/output/income effect (this is always an Either/Or)

3 Saved public healthcare expenses	Yes, since taxpayers also pay public healthcare (meaning "public health" in the sense of publicly funded personal health tests and treatments and other personal health interventions)	Yes
4 Saved transfers (welfare benefits)	Yes	No (transfers are neutral in pure welfare economics)

Table 9 : Potential Cost-Benefit Frameworks

Which framework is most appropriate?

The gauntlet which this report picked up in Part I was the New Zealand Government's implicit challenge to present a case for preventive public health based on cost-benefit analysis. Since the Government's own challenge was the spur to this report, whatever framework the Government indicated becomes the key one for proponents of preventive health to use in the first instance – albeit perhaps accompanied by others, which in the end are also likely to yield higher BCRs. This would meet the Government's objection on its own terms. However, exactly what framework the Government has in mind is less clear, due to inconsistencies noted in Part I.

On the one hand, although the MRG Report's allusion to negative results from CBA assessments of preventive public health programmes was passing and unclear, it likely gestured towards some kind of fiscal CBA. It indicated going slightly beyond a pure business case for the taxpayer by counting the whole employment benefit.

On the other hand, the CBA that the Government accepted for the Waterview Connection arguably sets the appropriate standard, on the basis of equal treatment. This of course needs to be corrected for outright methodological errors.

Of course it would be unconscionable to use the *actual failings* of other reports which Government has accepted (even trumpeted) to justify repeating them in public health proposals. Our point is to advocate basic consistency and transparency. Again, we warn that CBAs should not be hijacked, or used as window-dressing or policy pseudoscience should be taken purely on their merits and with acknowledgement of their limitations. While it is reasonable and inevitable, the political component of decision-making needs to be explicitly distinguished and recognised for what it is.

Alternatively, the cost-utility approach which PHARMAC de facto applies could be the most fitting measure. This is not strictly a cost-benefit analysis, but is related. It is outside the scope of this report. We note simply that it asks how many dollars to costs to buy an extra equivalent to a year of full health – for instance two years at half of full health. This can be turned into a rough benchmarking of which clinically efficacious interventions will be deemed cost-effective and worth Government subsidy.

It may or may not be advisable simply to ask the Government to specify the type of CBA it would accept.

Against all the above choices, a pure and conservative welfare economics approach would mandate a wider societal CBA. Being the proper measure, this should in an ideal world be the most convincing if fully explained. A comparative table could still show what other frameworks would have produced.

A health economist may well argue that we should not, by meeting the Government on its own ground as it were, encourage Government to view health purely from a business-case perspective. They might instead argue, for instance, that it would be possible and proper to include that approach not as a "cost-benefit analysis" but as a "fiscal implications" appendix.

Whatever framework is adopted should be adopted explicitly, transparently and for clearly articulated reasons, and with full acknowledgement of limitations and assumptions. It should also be accompanied by supporting humanitarian and medical arguments.

Ideally, the acknowledgement that policy decisions are inevitably in part political should also be made. Unlike pharmaceutical and medical devices, where the patent holder has a strong incentive to develop the economic case for investing in their chosen treatment – prevention services have no patent holder who can expropriate the returns from such establishing such a case. Indeed, one could argue that most commercial interests are in exactly the opposite direction. Proponents of preventive measures need at least to bear this in mind.

The objective of this paper was to pave the way for policy-makers to undertake or commission a more fully informed New Zealand cost-benefit analysis of preventive public health, in response to the Government's implicit challenge to do so. To that end we have calculated one substantial benefit from young-adult programmes to prevent lifetime smoking and/or obesity: potential hospital savings up to age 65. The methodology of incremental risk that we used could be applied to calculating other benefits. We have also provided the conceptual framework for the whole analysis by elaborating the types of CBA that might be used, their justifications and their varying implications. In the last section below we recommend specific next steps.

Caveats and Further Research

In a report whose objective was to pave the way for a full study, "conclusions" will necessarily be interim. Broadly, this report has concluded that a cost-benefit analysis, while far from the only justification for preventive public health measures, is necessitated by the current New Zealand government's insistence on such analysis and its implicit assertion that none of a satisfactory nature exists.

More specifically, using smoking prevention and obesity prevention as strong and independent cases in themselves but also examples for public health more generally, we have derived provisional results for one core element of all cost-benefit frameworks that would be run on such proposals.

General caveats about cost-benefit methodology – its inconsistent application, and its varied and often unacknowledged frameworks with their significant impacts on the headline benefit-to-cost ratio that will result – are explained in Parts I and V and we refer the reader to them. There, too, is advice as to how to counter distorted arguments or genuine objections and expose and avoid common errors, especially as to the effect of early mortality in smokers and obese people, and revenue effects of taxing tobacco. We conclude there that it is possible to address the Government's implicit challenge on its own terms and to counter the likely skewed arguments of interested parties yet retain legitimacy and transparency by stating all terms for what they are.

Developing sound business cases for Actual Interventions; and the costs side

Once robust savings to personal health expenditure from reduction in obesity or prevention of smoking are established, there is still the question of what works to prevent lifetime take-up of smoking. If such interventions could be identified and costed, then the break-even effectiveness where the Benefit-to-Cost Ratio would equal 1 could be established, partly by using the savings identified in this paper.

There are a number of crucial assumptions underlying our calculation of hospital savings; and valuable extensions that ought to be explored to flesh out the full public healthcare savings benefits that would flow from preventing obesity or smoking. We would recommend the following next steps:

Linking GP, pharmaceutical and laboratory data

It is possible to link the pharmaceutical, lab and GP data using the encrypted patient ID to get a broader range of health care expenditure.[4] This would provide more fully scoped costs to the health care system.

Ensuring that the relative risks of each disease are robust

We do not believe that the risk rates are correct or the choice of the key diseases exhaustive. While the final list of diseases to be included did get some input from epidemiologists and public health specialists, we believe that a more comprehensive literature review would help identify the best key disease groups and relative risk rates to apply to the model. Note that once these risk rates are established, re-calculating the lifetime cost savings would be a trivial matter.

Add?? Researchers would do well to keep the cases for smoking prevention and obesity prevention separate and independent, so neither hangs on the other. An obvious difference is that smoking is easily identifiable and depends on a single, taxable product. It is already both successfully marginalised and reduced from what it was 30 years ago, and heavily taxed, thus earning the Government substantial revenue. Obesity does not share these features. Talk of taxes on particularly

[4] Earlier versions of this paper did do that – although we did not have sufficient time to undertake a full cost attribution and therefore left this component out of the present paper.

fattening foods is at an early stage and is complicated by the fact that, whereas every cigarette does harm, not every calorie does. A tax on obesity itself is currently politically unacceptable within New Zealand, though it is noteworthy that immigration criteria factor it in.

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