Smoking targets
A microsimulation analysis

Final Report to the Ministry of Health

October 2012
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Date: October 2012
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**Key points**

We have used a microsimulation model of the New Zealand population to explore the potential impact of policy interventions on smoking prevalence.

**Baseline**

- We estimate current smoking prevalence¹ is 20.8% (Māori 44.2%, Pacific 30.1%, European 17.1%).
- Using current trends, we predict smoking prevalence to drop to 16.6% by 2025 (Māori 35.2%, Pacific 23.7% and European 13.4%)².
- The baseline is estimated from 2006, 2007 and 2009 trends. If policies implemented after this period, such as the taxation excise increases, have been effective in reducing smoking prevalence, the baseline will overestimate actual prevalence.

**Smoke-free by 2025**

The Government has set a goal of a smoke-free New Zealand by 2025, which we interpret as a total smoking prevalence of 3% or less. We find that such a goal:

- is unattainable by stopping initiation alone
- requires very significant increases in cessation rates (25% per annum increases, or a 2025 rate that is 15 times higher than today)
- as a mid-way point requires a 2018 total population–wide prevalence rate of between 9.9% and 12.8%, which is broadly concordant with Australia’s 10% by 2018 target
- requires reductions in Māori prevalence from 44% today to around 25% in 2018 and at most 8% in 2025, and reductions in Pacific prevalence from 30% today to around 15% in 2018 and at most 4% in 2025. The relative magnitudes of these reductions are much greater than for the European/other population. This is broadly consistent with Australia’s 2018 target of halving indigenous population (aboriginal people and Torres Strait Islanders) prevalence within the overall population–wide target of 10% by 2018.

**Taxation**

The broad conclusion from over 25 years of research is that smoking demand is influenced by price (Tauras 2004). In 2010, the New Zealand government imposed three compounding increases of 10% p.a. (plus inflation adjustments) in the excise on smoking products over the 2010-2012 period. We investigate the impact of continuing this policy with annual 10% increases out to 2025. We find that:

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¹ Current smoking prevalence is defined as the proportion of surveyed adults aged 15-64 who respond that they have smoked at least 100 cigarettes in their lifetime and currently smoke at least one cigarette per month. Our estimates are based on the 2006, 2008 and 2009 Tobacco Use Surveys.

² These projected rates are consistent with historical prevalence reductions to 2009, however they do not incorporate policy initiatives such as taxation excises that have occurred in the years from 2010 onwards. The baseline should therefore be considered as a “historical to 2009 status-quo” rather than an actual forecast.
under conservative assumptions about consumers response to price increases, 2025 smoking prevalence drops from 16.6% to 14.5%
under more optimistic assumptions, 2025 prevalence drops from 16.6% to 12.4%
Māori (27-31%) and Pacific (16-20%) 2025 prevalence remains high
analysis of the response to the 2010 and 2011 taxation increases will provide insight into which of the conservative or optimistic scenarios are more likely for New Zealand.

ABC

The ABC approach of the New Zealand Smoking Cessation Guidelines is the Ministry of Health’s approach to providing consistent cessation assistance at every level of the health system. We find that:

- the ABC approach has the potential to make a significant improvement to smoking prevalence. If it can deliver a 50% increase in quit attempts (without any improvement in quit success rates), it can improve 2025 smoking prevalence from 16.6% to 14.1%
- if it can also significantly improve the use of smoking cessation services and treatments to support quit attempts, as is likely, it can reduce 2025 prevalence further to 13.7%
- increasing quit attempts provides a significant reduction in total prevalence. By contrast, increasing use of services provides a smaller gain. This is because the increase in services only applies to a proportion of smokers who attempt to quit.

Marketing

Marketing is widely used to influence behaviour. We analyse the impact on the number of quit attempts and the use of cessation services of continuing TV marketing at 2009 levels. We find that:

- the sum of evidence supports our findings that marketing makes a significant contribution to reducing smoking
- TV marketing makes a significant contribution of 0.9% to the reduction in smoking prevalence from 20.8% today to 16.6% in 2025. While this is a substantial improvement on today’s 21% prevalence, it is still well short of the smoke-free target
- marketing can be linked together with other interventions such as ABC or taxation increases, to help change behaviour. There is research literature to support the existence of sizeable synergies from combining these interventions, but little definitive quantitative evidence. This is an opportunity for further research.

Note that we have only considered the impact of marketing on Quit-line attempts. We have not considered the role marketing plays in providing on-going public information and education. These campaigns also play a wider background role in influencing the overall decline in smoking prevalence (including in the baseline projection).

Achieving a smoke-free New Zealand by 2025

We would like to know if the interventions we have analysed are effective enough to meet the Government’s goal of a smoke-free New Zealand by 2025. However it is
uncertain if the interventions help or hinder each other when combined together. If we assume that they can be simply added, we find that:

- the interventions can achieve a 2025 smoking prevalence of 8.5%
- it remains very difficult to achieve a smoke-free New Zealand by 2025, primarily because the ‘stock’ of smokers is simply too large for gradual changes to achieve the necessary reductions.

Thus a key requirement for getting as close as possible to smoke-free by 2025 is significant action in the short term. That means:

- large taxation increase in the short term to significantly reduce initiation and cessation
- increased coverage of ABC to significantly increase in cessation attempts and uses of services/treatments

Some indicative test simulations suggest that a one-off taxation excise increase of 60% would result in a halving of initiation rates. Combined with ABC coverage that delivers double the quit attempts in the short term, plus on-going excise increases of 30% per annum, ABC coverage and marketing that leads to ~7% per annum increases in cessation, smoking prevalence can be reduced to around 5% by 2025.

**Health care costs and benefits**

Reducing the prevalence of smoking creates both health care savings (from a healthier population) and costs (from a longer-living population). The different policy interventions analysed here cause smoking prevalence to reduce at different rates along different paths and by different means. This influences the costs and benefits. We have considered only the direct health care costs, and not the wider costs such as healthy life years lost to smoking. We find that:

- stopping someone from starting to smoke delivers significantly larger health care cost savings than from helping someone quit
- when policies deliver initiation improvements, the gains from a healthier population are large enough to outweigh the costs of a longer-living population (because of the relatively larger differential between smoker and non-smoker health care costs). In this case, reductions in smoking prevalence generate definitive health care cost savings
- when policies deliver only cessation improvements, the costs of a longer living population can outweigh the gains from a healthier population (because the cost-differential between smokers and ex-smokers is relatively small). However
- the net additional end of life health care costs are small relative to the gains in health and longevity. Achieving smoke-free by 2025 would save 370,000 life years by 2060 and result in a population 13,000 higher. Even in the worst case scenarios, this equates to a cost of just $70 for a life year saved, which makes smoking cessation a cost effective way to improve health. PHARMAC don’t quote a dollar per life year due to their fixed budget model but typically have funded drugs up to $25,000 per life year saved (Rosevear 2006).
- if we consider distance-to-death health care costs (rather than distance to birth or age – see MOH 2004), the extra health care costs of longevity reduce significantly and no longer outweigh the gains from a healthier population
other benefits not considered here such as increased productivity and value of life typically add an order of magnitude to the benefits (see Miller et al 2010).

**International comparisons of health care costs**

We analysed a wide-range of international literature to compare our health care costs results. We find that:

- short term or static models invariably suggest large gains from reducing smoking or attribute a large health care cost burden to smoking. This is because they don’t consider the life cycle health care costs of increased population longevity in the absence of smoking
- reducing smoking prevalence will increase the longevity of the population. This means that a life cycle approach that considers increased population longevity is required to accurately understand the health care impacts of reducing smoking prevalence
- the life cycle analysis literature is inconclusive on the net health care costs of reducing smoking prevalence
- even in studies that find a net cost from reducing smoking prevalence, the subsequent positive health outcomes are large enough to ensure reductions in smoking prevalence remain a cost-effective relative to other health interventions
- specific population and intervention characteristics such as population demographics, initial smoking prevalence and rate and type of interventions, impact the balance between net health care costs and net benefits.
- studies that look beyond health care costs and include wider costs of disability, death and productivity loss find clear economic benefits from reducing smoking prevalence (e.g. Collins and Lapsely 2008).
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1. Introduction

Smoking is the largest preventable cause of premature mortality in the developed world. The Ministry of Health (MOH) seeks to significantly reduce the prevalence of smoking within New Zealand. In this report, we estimate the impact of various policy interventions on smoking prevalence over the next 15 years.

2. Methodology: Microsimulation

2.1 Microsimulation

Microsimulation modelling is an advanced computational methodology that allows us to model the life paths of the population. Life events such as birth, smoking initiation and cessation are explicitly modelled at the individual (decision-making) level.

We use a specifically designed microsimulation model of the New Zealand population called POCS. POCS is highly disaggregated and can look at specific socio-demographic sub-populations across gender, ethnicity and income. This is particularly relevant for smoking, which is more prevalent amongst Māori and Pacific populations than European and Asian populations.

POCS is based on the Statistics Canada Population Health Model (POHEM), and we have used the Statistics Canada MODGEN software to implement the model.\(^1\)

2.2 Smoking

2.2.1 Smoking status and prevalence

POCS considers three smoking statuses:

- Smoker. We use the ‘current smoker’ definition for this work. The Tobacco Use Survey (TUS) and the World Health Organisation define a current smoker as someone who has smoked more than 100 cigarettes in their lifetime and at the time of the survey was smoking at least once a month (WHO 1998).
- Ex-smoker. An ex-smoker is a person who was once a smoker as defined above, but who has successfully quit. Successfully quitting is defined as a smoker who has abstained for at least 6 months.\(^2\)
- Non-smoker. A person who is neither a smoker nor an ex-smoker.

Smoking prevalence rates are calculated for the population aged 15-64 years as per the TUS.

2.2.2 Initiation

POCS considers initiation by age, gender and ethnicity. Initiation rates are derived from the 2009 TUS and calibrated to ensure prevalence curves match the 2009 TUS.

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\(^1\) Full documentation of MODGEN is available at [http://www.statcan.gc.ca/microsimulation/modgen/doc-eng.htm](http://www.statcan.gc.ca/microsimulation/modgen/doc-eng.htm)

\(^2\) The aggregations mean that heterogeneous smokers are lumped together (for example, a pack a day smoker and a once a month smoker, however over 90% of current smokers are daily smokers (TUS 2009)
2.2.3 Cessation

POCS considers a behavioural tree cessation process as per McRobbie (2010):

- Smokers attempt to quit. About 44% of smokers attempt to quit each year. POCS considers attempts to quit by age, gender and ethnicity based on the 2008 TUS quitting analysis.
- The quit attempt can either use cessation treatments or be ‘cold turkey’. 25% of quitters use cessation treatments, while 75% go ‘cold turkey’ (McRobbie 2010).
- The quit attempt has a success ratio of 9% on average if treatments are employed; 5% if no services are used\(^3\). These success rates are calibrated across age, gender and ethnicity to ensure prevalence curves match the 2009 TUS.

**Figure 1 The process of quitting**

![Diagram of the smoking cessation process]

Source: NZIER, McRobbie 2010

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\(^3\) This is at the more optimistic end of the ‘cold turkey’ quit rates which Hughes et al (1999) list as 3-5%.
3. Baseline projections

3.1 Calibration

We project smoking prevalence for the next 15 years. The model is calibrated to the Statistics New Zealand medium term population projections (Statistics New Zealand 2010) and therefore includes expected New Zealand demographic change. Initiation and cessation rates are age, gender and ethnicity dependent and based on the 2008 and 2009 TUS. Data is available and robust for prevalence metrics. Cessation data is available but with large confidence intervals; initiation data is very limited.

We calibrate the model to the 2009 TUS prevalence rates by adjusting the parameters we are least certain about: most notably initiation rates. The order of calibration is as follows:

- TUS 2009 population prevalence 21.0%
- TUS 2009 age-group by sex prevalence
- TUS 2009 prevalence by ethnicity

Tobias et al (2010) published a New Zealand smoking prevalence projection based on a systems dynamics model calibrated to the 2006 TUS. We checked that our initiation and cessation rates broadly matched the Tobias et al model.

In addition, we use the trends established in Tobias et al (2010) in initiation and cessation rates for projecting forward:

- a decline in initiation rates of 2% per year across the population
- an increase in the cessation of 1% per year across the population.

These rates provide a projection that is consistent with historical prevalence reductions to 2009, however they do not incorporate policy initiatives such as taxation excises that have occurred in the years from 2010 onwards. At the time of writing, the latest level of prevalence data is the 2009 TUS. The baseline should therefore be considered as a “historical to 2009 status-quo” rather than an actual forecast.

3.2 Current coverage of cessation programs

While we do not yet know the impact of policies of the last two years, we liaised with MOH to investigate the reach of current cessation programs across ethnicities. This helps us project prevalence by ethnicity.

Targeted cessation programs include:

- Aukati Kai Paipa (AKP) by Māori, for Māori service: 5,256-6,570 service users per annum nationally
- Whanau Ora integrated contracts by Māori, for Māori service: 1,848-2,310 service users per annum nationally

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4 This list captures the major separately funded cessation services. There are also a number of hospital based cessation services in the 12 DHBs that were not able to be included in the analysis.
- Pregnancy specific services: 1,800-2,250 service users per annum nationally
- Pacific specific services: 1,644-2,055 service users per annum nationally
- Quit group programs: expected to reach 100,000 service users per annum. 23,000 should be Māori, and 5,100-6,300 should be Pacific.

Our analysis of these programs suggests that the reach of cessation programs targeted at Māori is similar to the reach achieved for the wider population (16%). However Pacific coverage lags at 10% versus 16%. We incorporate this coverage within the baseline projections.

**Table 1 Current reach of targeted programs**

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Program</th>
<th>Average reach</th>
<th>Current smokers</th>
<th>Reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Māori</td>
<td>Aukati Kai Paipa</td>
<td>5,913</td>
<td>197,300</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Whanau Ora</td>
<td>2,079</td>
<td>197,300</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Quit</td>
<td>23,000</td>
<td>197,300</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>Total Māori</td>
<td>30,992</td>
<td>197,300</td>
<td>16%</td>
</tr>
<tr>
<td>Pacific</td>
<td>Pacific services</td>
<td>1,850</td>
<td>77,390</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Quit</td>
<td>5,700</td>
<td>77,390</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>Total Pacific</td>
<td>7,550</td>
<td>77,390</td>
<td>10%</td>
</tr>
<tr>
<td>All other</td>
<td>Quit</td>
<td>71,300</td>
<td>441,960</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>Total All other</td>
<td>71,300</td>
<td>441,960</td>
<td>16%</td>
</tr>
</tbody>
</table>

Source: MOH, NZIER
3.3 Projections

Smoking prevalence is expected to drop from 21.0% in 2009 to 16.6% in 2025. Smoking prevalence amongst Māori is expected to drop from 45.1% to 35.2%. Smoking prevalence amongst Pacific is expected to drop from 30.3% to 23.7%.

Figure 2 Smoking prevalence projections by ethnicity

Table 2 Baseline projections

<table>
<thead>
<tr>
<th></th>
<th>European</th>
<th>Māori</th>
<th>Pacific</th>
<th>Asian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Baseline</td>
<td>17.1%</td>
<td>44.2%</td>
<td>30.1%</td>
<td>10.8%</td>
</tr>
<tr>
<td>2018</td>
<td>Baseline</td>
<td>15.4%</td>
<td>39.4%</td>
<td>26.7%</td>
<td>9.6%</td>
</tr>
<tr>
<td>2025</td>
<td>Baseline</td>
<td>13.4%</td>
<td>35.2%</td>
<td>23.7%</td>
<td>8.3%</td>
</tr>
</tbody>
</table>

Source: NZIER

In the following sections, we analyse how a range of policy interventions impact on these baseline projections.
4. Smoke-free by 2025

4.1 Background

The Government seeks a smoke-free New Zealand by 2025, but has not set intermediate targets towards the goal or specific targets for sub-populations or to be achieved particular policies.

In comparison, Australia has not set a smoke-free goal similar to New Zealand’s. However, the states of Australia and its federal Government have agreed an Australia-wide smoking prevalence target of 10% by 2018, including a separate target of halving the much higher smoking prevalence among its indigenous populations (aboriginal people and Torres Strait Islanders).

Broadly equivalent intermediate targets for New Zealand would be to halve Māori and Pacific prevalence rates and achieve an overall prevalence of 10% by 2018.

4.2 Scenario design

We define ‘smoke-free’ as a prevalence of 3% or less. We estimate the initiation and cessation improvements required to achieve 3% prevalence by 2025. Specifically, we compute the following scenarios:

- cessation improvements required, holding initiation improvement at 2% p.a. We investigate both a percentage increase in cessation and a linear increase in cessation
- initiation improvements required, holding cessation improvement at 1% p.a.

In doing so, we also confirm if the shorter-term goals of halving Maori and Pacific prevalence and achieving 10% overall prevalence by 2018 concord with the broader goal of a smoke-free New Zealand by 2025.

4.3 Results

4.3.1 Cessation

- A 25% p.a. improvement in the number of people successfully stopping smoking is required to reduce smoking prevalence to 3% by 2025.
- To put this in context, the current improvement rate, given the wide range of policy interventions and other causes of changes in social preferences, is around 1% p.a.
- Using a linear rate, a cessation rate that increases to 15 times higher than today by 2025 is required to reduce smoking prevalence to 3% by 2025.
4.3.2 Initiation

- Initiation improvements on their own are insufficient to reduce smoking prevalence to 3% by 2025.
- If initiation stopped completely from 2011, but cessation rates only improved at the baseline 1% p.a., smoking prevalence would still be around 9.9% in 2025.

4.3.3 Concordance with other targets

- Meeting 3% by 2025 requires a 2018 prevalence rate of between 9.9% and 12.8%, within striking distance of a 10% target.
- Meeting 3% by 2025 requires Māori prevalence to have dropped to between 23.0% and 29.2% by 2018, just over half of the 2010 prevalence (44.2%).
- Meeting 3% by 2025 requires Pacific prevalence to have dropped to between 13.2% and 17.5% by 2018, half of the 2010 prevalence (30.1%).
- This confirms that a set of intermediate 2018 targets similar to Australia’s would be broadly concordant with New Zealand’s smoke-free 2025 goal.
**Table 3 Target scenarios**
Current smoker prevalence

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario</th>
<th>European</th>
<th>Māori</th>
<th>Pacific</th>
<th>Asian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Baseline</td>
<td>17.1%</td>
<td>44.2%</td>
<td>30.1%</td>
<td>10.8%</td>
<td>20.8%</td>
</tr>
<tr>
<td>2018</td>
<td>Baseline</td>
<td>15.4%</td>
<td>39.4%</td>
<td>26.7%</td>
<td>9.6%</td>
<td>18.7%</td>
</tr>
<tr>
<td></td>
<td>No Initiation</td>
<td>12.6%</td>
<td>31.0%</td>
<td>19.1%</td>
<td>7.6%</td>
<td>14.9%</td>
</tr>
<tr>
<td></td>
<td>3% 2025 – linear</td>
<td>7.6%</td>
<td>23.0%</td>
<td>13.2%</td>
<td>5.0%</td>
<td>9.8%</td>
</tr>
<tr>
<td></td>
<td>3% 2025 – %</td>
<td>10.3%</td>
<td>29.2%</td>
<td>17.5%</td>
<td>6.3%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2025</td>
<td>Baseline</td>
<td>13.4%</td>
<td>35.2%</td>
<td>23.7%</td>
<td>8.3%</td>
<td>16.6%</td>
</tr>
<tr>
<td></td>
<td>No Initiation</td>
<td>8.6%</td>
<td>20.2%</td>
<td>11.4%</td>
<td>5.0%</td>
<td>9.9%</td>
</tr>
<tr>
<td></td>
<td>3% 2025 - linear</td>
<td>1.6%</td>
<td>8.0%</td>
<td>3.8%</td>
<td>3.1%</td>
<td>3.0%</td>
</tr>
<tr>
<td></td>
<td>3% 2025 - %</td>
<td>1.6%</td>
<td>8.0%</td>
<td>3.8%</td>
<td>3.1%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

Source: NZIER

### 4.4 Discussion

A smoke-free New Zealand by 2025 is unattainable through initiation measures alone because the current number of smokers in 2011 is simply too high. Even with no new initiation, too many smokers would not successfully quit by 2025.

To meet the target through cessation (i.e. increasing the number of successful quit attempts supported by smoking cessation services and treatments), rates would need to increase dramatically. Such dramatic increases can follow a number of paths as highlighted by the linear and percentage cessation improvements. Our results are broadly consistent with the Garner et al (2009) analysis of smoking prevalence in Australia. They found that a doubling of cessation rates was required to achieve a moderate 2020 improvement from 14% to 10%.

The target to halve Pacific and Māori prevalence rates and achieve 10% overall prevalence by 2018 are broadly consistent with achieving a smoke-free New Zealand by 2025.
5. Taxation

5.1 Background

The broad conclusion from over 25 years of research is that smoking demand is influenced by price, among other things (Tauras 2004). In 2010, the New Zealand government imposed a 10% p.a. increase in the excise on smoking products for the 2010-2012 period. The 2010 and 2011 increases have been implemented, with another set for Jan 1st 2012.

The impact of price on smoking demand is known as the price elasticity. The price elasticity is the percent change in smoking demand for a 1 percent change in price.

The transmission mechanism of price to smoking demand can be through various paths, each with its own price elasticity:

- Initiation. Initiation rates are influenced by price. Initiation predominantly occurs in 15-24 year olds who are typically budget constrained. The price elasticity of initiation is the percent change in initiation to a 1 percent change in price.

- Attempts to quit. As prices rise, the incentive to attempt to quit increases for many smokers. The price elasticity of attempts to quit is the percent change in attempts to a 1 percent change in price.

- Intensity/volume. As prices rise, the incentive to reduce the volume or intensity of smoking increases for many people. The price elasticity of intensity is the percent change in quantity of cigarettes consumed to a 1 percent change in price.

- Prevalence. At the macro level, total smoking prevalence is influenced by price through the impact on initiation and cessation as described above. The price elasticity of prevalence is the percent change in total prevalence to a 1 percent change in price. This is sometimes calculated in econometric studies that do not have individual or more detailed cessation data.

Because our modelling is ‘bottom up’, we focus on the initiation and attempts to quit transmission paths. We explicitly model how individuals’ initiation and cessation behaviours change in response to increased taxation, across the heterogeneous population, and calculate how total prevalence changes as a result. We do not consider intensity in this analysis.
5.2 Estimates of price elasticities

5.2.1 International evidence

There is a range of international evidence on the price elasticity of smoking. We focus on the meta studies that summarise estimates across a range of studies and methodologies.


*Three of the four longitudinal studies using more than two waves of data reported an elastic response to price implying a 10% increase in price is associated with between a 6.5 and 9% decrease in smoking initiation. A single longitudinal study which included controls for state level anti-smoking sentiment found a lower response to price, suggesting a reduction of 1% in smoking initiation for a 10% price increase.*

Ross and Chaloupka (2003) found a price elasticity of participation amongst High School students of \(-0.35\)^5.

Gallet and List (2003) identify a price elasticity of demand of \(-0.47\) from the studies published in top-ranking journals. This is not split into intensity and cessation. However, typically studies show a roughly 50-50 split between intensity response and cessation response (Hu et al 1995).

Tauras (2004) found a price elasticity of cessation of 0.35. Levy et al (2005) reported a price elasticity of cessation of 0.5.

5.2.2 New Zealand evidence

New Zealand evidence is slim. Wilson and Thomson (2005) note an overall price elasticity of \(-0.5 \text{ to } -0.8\) for analysis of the period 1988-98, but data on the price elasticity of initiation is limited. MOH is currently reviewing the impact of the current 2010 and 2011 excise increases, which should provide excellent information for an update of this report.

5.2.3 Are elasticities constant?

Calculating a single price elasticity is typically data-intensive, and a useful step in approximating behaviour. However, it is unlikely that the price elasticities are constant across different sub-populations, or that price elasticities remain constant over time as the price of cigarettes increases.

An increasing price elasticity is possible if we consider the behavioural response of individuals to particularly high prices or ‘psychological barriers’. The concept of psychological barriers is that consumption dramatically falls if the price crosses the certain price level - the psychological barrier. Psychological pricing is observed

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^5 Note the signs on the elasticities. A price rise reduces initiation, so the elasticity sign is negative. A price rise increases cessation, so the sign is positive.
every day in supermarkets where products are often priced just below the round number e.g. $3.99 instead than $4.00, on the basis that demand at $3.99 will be significantly higher than at $4.00. For smoking, it is plausible that such barriers may exist at the price-per-pack ($20 or $30 per pack) or price-per-stick (e.g. $1 or $2 per cigarette) level.

A decreasing price elasticity is possible if we consider addiction and entrenched smokers:

- Addiction. The addictive nature of smoking means that most people who smoke want to quit, yet struggle to do so. If the addiction effect is strong enough, smokers will continue to smoke regardless of the price. In the economic literature, myopic addiction models which account for the irrationality of addiction estimated lower elasticities than rational addiction models (Gallet and List 2003).

- Entrenched smokers. There is also the real possibility that some of the smoking population are entrenched smokers: they wish to smoke regardless of the cost and health implications. There is also evidence that there is diminishing marginal returns to health warnings and education.

These suggest a decreasing pricing elasticity, where at some point a change in the price has minimal impact on the demand for smoking.

5.3 Scenario design

We look at the impact of continuing the annual 10% increase in smoking excise.

- We use a simple model and an inflation forecast to predict the impact of excise increases on real cigarette prices (around 6.7% p.a.).

- We then use price elasticity estimates from the literature to convert price increases to changes in smoking initiation and cessation behaviour.

- Because of the uncertainty in elasticity estimates and long-term projections, we calculate both conservative and optimistic scenarios.

5.3.1 Conservative scenario

- For the price elasticity of initiation, we use Ross and Chaloupka (2003) estimates of -0.35. A 10% increase in price will lead to a 3.5% decrease in initiation rates. This is at the lower end of the -0.1 to -0.9 range reported in Godfrey et al (2009).

- We use Tauras (2004) estimates for the price elasticity of cessation of 0.35 because they are derived from a methodology that specifically mimics and investigates smoking behaviour. In particular, Tauras investigates the impact of price on cessation behaviour. Thus the interpretation of Tauras’ work is that a 10% increase in price will lead to a 3.5% increase in cessation attempts.

- We assume that the elasticities remain constant.

- When we apply the elasticities to the expected price rises of 6.7% p.a., we estimate improvements in both cessation and initiation rates of 2.3%.

---

6 The model calculates the ‘pass-through’ rate of taxation excise to price and is consistent with that used by the Treasury and Ministry of Health in excise calculations.
5.3.2 Optimistic scenario

- For the price elasticity of initiation, we use an elasticity of -0.9 based on the upper estimate of Godfrey et al (2009).
- We assume a price elasticity of 0.35 for cessation as per the conservative scenario.
- We assume that the elasticities increase over time, doubling in size by 2025\(^7\), on the assumption that with prevalence rates still above 10% increasing elasticities are plausible.

5.4 Results

5.4.1 Overall

- Under the conservative scenario, total 2025 prevalence rates drop from 16.6% to 14.5%.
- Under the optimistic scenario, total 2025 prevalence rates drop from 16.6% to 12.4%.

5.4.2 Ethnicity

- Under the conservative scenario, Māori 2025 prevalence rates drop from 35.2% to 31.3%.
- Under the optimistic scenario, Māori 2025 prevalence rates drop from 35.2% to 26.9%.
- Under the conservative scenario, Pacific 2025 prevalence rates drop from 23.7% to 19.8%.

\(^7\) We find little evidence available for how elasticites increase with price for smoking. We defer to a confidential NZIER analysis on fuel prices which estimated that the price elasticity increased by 50-100% as the price doubled. In this example, the price of cigarettes increases almost threefold.
- Under the optimistic scenario, Pacific 2025 prevalence rates drop from 23.2% to 16.3%.

**Table 4 Taxation scenarios**

Current smoker prevalence

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario</th>
<th>European</th>
<th>Māori</th>
<th>Pacific</th>
<th>Asian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Baseline</td>
<td>17.1%</td>
<td>44.2%</td>
<td>30.1%</td>
<td>10.8%</td>
<td>20.8%</td>
</tr>
<tr>
<td>2018</td>
<td>Baseline</td>
<td>15.4%</td>
<td>39.4%</td>
<td>26.7%</td>
<td>9.6%</td>
<td>18.7%</td>
</tr>
<tr>
<td></td>
<td>Conservative</td>
<td>14.8%</td>
<td>38.3%</td>
<td>25.3%</td>
<td>9.2%</td>
<td>18.0%</td>
</tr>
<tr>
<td></td>
<td>Optimistic</td>
<td>14.4%</td>
<td>37.1%</td>
<td>24.2%</td>
<td>8.9%</td>
<td>17.4%</td>
</tr>
<tr>
<td>2025</td>
<td>Baseline</td>
<td>13.4%</td>
<td>35.2%</td>
<td>23.7%</td>
<td>8.3%</td>
<td>16.6%</td>
</tr>
<tr>
<td></td>
<td>Conservative</td>
<td>11.6%</td>
<td>31.3%</td>
<td>19.8%</td>
<td>7.1%</td>
<td>14.5%</td>
</tr>
<tr>
<td></td>
<td>Optimistic</td>
<td>10.1%</td>
<td>26.9%</td>
<td>16.3%</td>
<td>6.1%</td>
<td>12.4%</td>
</tr>
</tbody>
</table>

Source: NZIER

### 5.5 Discussion

#### 5.5.1 Prevalence is slow to reduce

Even with conservative estimates of price elasticities, the impact of the 10% excise increase on the initiation (2.3% decrease) and quitting rates (2.3% increase) is significant. However, these improvements in initiation and cessation rates take time to filter through to sizeable gains in prevalence. This is because the 'stock' of smokers is large relative to the net quit flow of smokers:

- there are currently around 600,000 current smokers in New Zealand
- each year, about 19,000 start smoking, and 21,000 quit smoking for a net quit flow of around 2,000 (or around 0.3% of current smokers)
- thus increasing quitting and reducing initiation takes time to impact on the 600,000 'stock' of smokers.

By 2025 however, under the optimistic scenario:

- there are only 390,000 smokers
- 6,000 start smoking and 24,000 quit smoking, for a net quit flow of 18,000 (or 5%)
- reductions to smoking prevalence occur at a rapid pace.

The MOH planned analysis of the response to the 2010 and 2011 taxation increases will provide valuable New Zealand-specific data, and help identify which of the conservative or optimistic scenarios are more likely.

#### 5.5.2 Ethnicity issues remain

2025 smoking prevalence in Māori and Pacific groups, even under the optimistic scenario, remain high. Some argue (Regidor et al 2007, Martire et al 2010 for example) that as incomes and education continue to increase in developed countries such as New Zealand, smoking becomes a phenomenon associated with the poor
and less-educated, whose price elasticity of demand is typically low. Tobacco excise increases then become significantly regressive and less effective.

By contrast, other literature suggests that price sensitivity is greatest amongst lower income groups and that price increases are a particularly effective intervention relative to public marketing and awareness campaigns (Townsend et al 1994).

The key message is that taxation policy needs to be regularly re-evaluated and refined to help maximise effectiveness. We suggest the analysis of the 2010 and 2011 taxation increases should disaggregate elasticities across ethnic and income lines so that these issues can be investigated explicitly. This data could be used in the POCS simulation model to evaluate policy across socio-economic groups.
6. ABC

6.1 Background

The New Zealand Smoking Cessation guidelines provide evidence based advice for healthcare professionals to provide help and advice to people who smoke. The guidelines present the ‘ABC approach’ to smoking cessation. ABC is a simple memory aid for health care workers to understand the key steps to helping people who smoke. These steps are as follows:

A. Ask all people about their smoking status and document this.

B. Provide Brief advice to stop smoking to all people who smoke, regardless of their desire or motivation to quit.

C. Make an offer of, and refer to or provide, evidence based Cessation treatment.

ABC essentially seeks to ensure smokers receive consistent advice and assistance for smoking cessation upon every dealing with the health care system. It does not replace specialist smoking cessation treatment. Smoking cessation specialists, such as Quitline staff, Aukati Kai Paipa kaimahi, and health care workers who have been trained as smoking cessation treatment providers, are a key component of the ABC approach.

In basic terms, the ABC program aims to increase both the number of quit attempts and the number of quit attempts that use a cessation support treatment (such as nicotine replacement therapy (NRT) in the form of nicotine replacement gums, patches and lozenges) and/or is supported by a cessation service. The effectiveness of quit attempts that use cessation services and treatments are considerably improved: the effectiveness of quit attempts supported by NRT is almost twice that on average of those who attempt to quit ‘cold turkey’.

6.2 Scenario design

The scenarios we consider are:

- 50% increase in the number of smokers who attempt to quit
- 50% increase in the number of smokers who attempt to quit and the number of smokers who use services when attempting to quit.

In both scenarios, we use a 3 year transition to achieve the 50% improvements.

6.3 Results

6.3.1 Overall

- A 50% increase in the rate of attempting to quit over 3 years reduces 2025 smoking prevalence from 16.6% to 14.1%.
- A 50% increase in the rate of attempting to quit over 3 years and a 50% increase in the share of people attempting to quit who use services reduces 2025 smoking prevalence from 16.6% to 13.7%.
**Figure 5 Impact of ABC example scenarios**

Current smoker prevalence

![Graph showing Impact of ABC example scenarios](image)

**Source:** NZIER

### 6.3.2 Ethnicity

- A 50% increase in the rate of attempting to quit over 3 years reduces 2025 smoking Māori prevalence from 44.2% to 31.1%.
- A 50% increase in the rate of attempting to quit over 3 years and a 50% increase in the share of people attempting to quit who use services reduces 2025 smoking prevalence from 44.2% to 30.2%.

### Table 5 ABC example scenarios

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario</th>
<th>European</th>
<th>Māori</th>
<th>Pacific</th>
<th>Asian</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>2010</td>
<td>Baseline</td>
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<td>44.2%</td>
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<td>9.6%</td>
<td>18.7%</td>
</tr>
<tr>
<td></td>
<td>50% attempts</td>
<td>14.1%</td>
<td>37.1%</td>
<td>24.1%</td>
<td>8.7%</td>
<td>17.2%</td>
</tr>
<tr>
<td></td>
<td>50% attempts and services</td>
<td>13.8%</td>
<td>36.5%</td>
<td>23.7%</td>
<td>8.5%</td>
<td>16.9%</td>
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<td>30.2%</td>
<td>19.1%</td>
<td>6.8%</td>
<td>13.7%</td>
</tr>
</tbody>
</table>

**Source:** NZIER
6.4 Discussion

- The ABC guidelines have the potential to make a significant reduction to smoking prevalence. If it can deliver a 50% increase in quit attempts, it can reduce 2025 smoking prevalence by 15% from 16.6% to 14.1%. If it can also significantly improve the success rate of quit attempts by prompting greater use of treatments and other support provided through cessation services, as is likely, it can reduce 2025 prevalence further to 13.7%.

- Increasing quit attempts provides a significant reduction in total prevalence. By contrast, increasing use of services provides a smaller gain. This is because the increase in services only applies to a proportion of smokers who attempt to quit.


- Levy (2010) estimated a 30% reduction in prevalence from a 100% increase in quit attempts (on par with our results of 15% reduction in prevalence from a 50% increase in quit attempts). Levy’s estimate of a 15% reduction in prevalence from a 100% increase in use of treatments is much higher than our results of a 3% reduction in prevalence. This is most probably due to the relatively low proportion of attempts to quit that use services within New Zealand. This also suggests there is a large potential improvement for policy that focuses on increasing the use of services in cessation.
7. TV Marketing

7.1 Background

Marketing campaigns to promote cessation are a common tool used to help reduce smoking prevalence. There are a variety of transmission paths:

- advertising the health implications to young people (reducing initiation)
- advertising the health and socio-economic implications to smokers (increasing cessation)
- advertising the health and socio-economic implications to target groups of smokers (increasing cessation amongst high-prevalence sub-populations).

In New Zealand, Wilson (2004) analysed four TV campaigns to promote calls to the Quitline. He estimated that between 41% and 65% of Quitline volumes were derived from TV advertising. More generally, the international literature (see the meta-study by Gallet and List 2004) suggests a small but significant elasticity of smoking to advertising – that is, advertising is effective at reducing smoking prevalence.

7.2 Scenario design

We investigate the contribution of TV marketing campaigns to the reduction in smoking prevalence through quit attempts to the Quitline. We use the following data:

- in 2010, there were approximately 40,000 quit attempts through the QUIT line (QUIT Group 2011)
- Wilson (2004) suggests that between 41% and 65% of Quitline attempts are derived from TV advertising. We use the midpoint of Wilson’s 53%
- this suggests that around 21,000 (40,000 x 53%) quit attempts per year are a direct result of TV advertising.

We compute a baseline without these quit attempts to derive the contribution that current (i.e. the historic level in 2009/10) advertising makes to the baseline prevalence reductions.

7.3 Results

7.3.1 Overall

Without the contribution of current TV marketing campaigns (i.e. maintaining marketing at the baseline 2009/10 level), the smoking prevalence in 2025 would be 0.9% higher at 17.5% versus 16.6% in the baseline.
7.3.2 Ethnicity

- Without current TV marketing, the 2025 smoking prevalence for Māori would increase from 35.2% to 36.8%
- Without current TV marketing, the 2025 smoking prevalence for Pacific would increase from 23.7% to 24.6%

Table 6 TV marketing
Current smoker prevalence

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline</th>
<th>European</th>
<th>Māori</th>
<th>Pacific</th>
<th>Asian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>44.2%</td>
<td>30.1%</td>
<td>10.8%</td>
<td>20.8%</td>
</tr>
<tr>
<td>2018</td>
<td></td>
<td>15.4%</td>
<td>39.4%</td>
<td>26.7%</td>
<td>9.6%</td>
<td>18.7%</td>
</tr>
<tr>
<td></td>
<td>Without TV marketing</td>
<td>15.9%</td>
<td>40.5%</td>
<td>27.4%</td>
<td>10.0%</td>
<td>19.3%</td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td>13.4%</td>
<td>35.2%</td>
<td>23.7%</td>
<td>8.3%</td>
<td>16.6%</td>
</tr>
<tr>
<td></td>
<td>Without TV marketing</td>
<td>14.3%</td>
<td>36.8%</td>
<td>24.6%</td>
<td>8.9%</td>
<td>17.5%</td>
</tr>
</tbody>
</table>

Source: NZIER

7.4 Discussion

The results indicate that TV marketing makes a significant contribution to the reduction in smoking prevalence by 0.9% from 17.5% to 16.6%.

By comparison, Hurley et al (2009) investigate the benefits of media spending that generates 350 TARPs per month over 3 years. They find that the spending generates a prevalence improvement of 0.6%. Similarly, the reduction in our
results from 17.5% to 16.6% is 5.1% in proportional terms. Levy et al (2010) cite a 4.7% reduction in prevalence from mass media campaigns.

A Cochrane review (2009) assessed eleven marketing campaigns. Three of the seven large scale programs reported statistically significant consumption reductions; one showed significant reduction in prevalence; and one showed positive results up to 8 years after the campaign. The results were variable largely due to the heterogeneous campaign interventions.

The sum of evidence supports our findings that marketing makes a significant contribution to reducing smoking. In addition, marketing can be linked together with other interventions such as ABC or taxation increases, to help further change behaviour. However, there is little quantitative evidence of the synergies that combining interventions brings. This is an opportunity for further research.

8. Achieving a smoke-free New Zealand by 2025

In section 4, we highlighted the goal to make New Zealand smoke-free by 2025. In sections 5 through 7 we analysed taxation, ABC and marketing interventions and found that none of the scenarios on their own are able to reduce smoking prevalence to what we would deem smoke-free (3% or less).

The obvious next question is if, combined, the interventions can achieve the target. Fundamental to this is if the interventions help or hinder each other when combined together. In the scenarios we analysed, ABC and marketing impacted on cessation, while taxation impacted on both initiation and cessation. It seems reasonable to assume then that ABC and marketing should only enhance further taxation impacts on initiation. On cessation, the interventions may not be cumulative but overlap each other (a taxation increase could induce a quit attempt, just as increased ABC coverage could induce a quit attempt, but both taxation and increased ABC coverage might only induce that same one quit attempt rather than two quit attempts). In Table 7 and Figure 7 we highlight the impact if the interventions can be simply added. Even if we assume the effectiveness of the interventions is cumulative and can be simply added together, 2025 smoking prevalence is still 8.5%.

<table>
<thead>
<tr>
<th>Table 7 Combining the interventions</th>
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</thead>
<tbody>
<tr>
<td>Baseline 2025 projection</td>
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<tr>
<td>Optimistic taxation improvement</td>
</tr>
<tr>
<td>ABC improvement</td>
</tr>
<tr>
<td>Marketing improvement (1)</td>
</tr>
<tr>
<td>Possible revised 2025 projection (2)</td>
</tr>
</tbody>
</table>

Notes: (1) If current marketing effort was doubled (2) If impacts of interventions are cumulative.

Source: NZIER
The simulations show that it is very difficult to achieve a smoke-free New Zealand by 2025, primarily because the 'stock' of smokers is simply too large for gradual changes like annual excise increases to achieve the necessary reductions. Thus a key requirement for getting as close as possible to smoke-free by 2025 is significant action in the short term. That means:

- Large taxation increase in the short term to significantly reduce initiation and cessation
- Increased coverage of ABC to significantly increase in cessation

Some test simulations we run suggest that a one-off taxation excise increase of 60% would result in a halving of initiation rates. Combined with ABC coverage that delivers double the quit attempts in the short term, plus on-going excise increases of 30% per annum, ABC coverage and marketing that leads to ~7% per annum increases in cessation, smoking prevalence can be reduced to around 5% by 2025.

These types of simulations are speculative due to the lack of information about how interventions can combine together, and how larger scale price shocks impact on initiation and cessation, however they broadly highlight the magnitude of the effort required to make New Zealand smoke-free by 2025.
9. Health care costs and benefits

9.1 Background

We investigate potential health care savings from reducing smoking prevalence. Smokers tend to have higher health care costs but comparatively shorter lives. The benefit of reducing smoking is an increase in mortality, however it is uncertain if reductions to smoking prevalence lead to lower long term health expenditure.

Health care costs (i.e. the costs of treating people in the health system) are an important component of the costs of smoking/benefits of reducing smoking prevalence. However, there are many other social and economic costs, including the value of the healthy life years lost to smoking. These wider costs are not included in the assessment of health care costs in this section.

9.2 Health care costs in the model

9.2.1 Approach

We use data analysed by MOH (see Appendix A for full description) that differentiates health care costs between smokers, ex-smokers and non-smokers. Health care cost data are stratified across age, gender, ethnicity and risky drinking, allowing us to ‘block-match’ to infer cost differentials. We do not attempt to calculate the costs of each smoking-related disease from the ‘bottom up’, but attribute to smoking the health care cost differential between smoker versus non-smoker populations that are otherwise alike e.g. a smoking risky drinking 45 year old Māori male and a non-smoking risky drinking 45 Māori male. We include risky drinking in the block matching as it is highly correlated with smoking, and also leads to costly health expenditure.
On average, the health care cost differential between smokers and non-smokers reaches $700 by the 80 year old mark. By comparison, Hayashida et al (2010) identify a cost differential between 64-81 year old smokers and non-smokers of around $1,250 (US$1,000). Rasmussen et al (2004) showed cost differentials between 65 year old and above smokers and non-smokers for Denmark of around $1,100 to $2,200 (DKK$5,000 to DKK$10,000). Barendregt et al (1997) suggest smokers annual health care costs are 33% higher than non-smokers for 65-74 year old age group, compared with 31% for our data.

The differential between smokers and ex-smokers is much smaller however, reaching just $130 for elderly ex-smokers. This is most likely due to aggregating all ex-smokers into one category.

9.2.2 Limitations

There are limitations with our approach to health care costs and benefits within the model.

- We are unable to disaggregate ex-smokers. A smoker who quits at 25 is much less likely to have smoking related health issues at 65 than a smoker who quits at 64. Our data averages the costs across all ex-smokers. This is a simplification but it is uncertain if this biases the results one way or the other.

- No ‘bottom-up’ calculation of health care costs. We have used an econometric technique to infer the cost differential between smokers, non-smokers and ex-smokers. We believe this provides a good approximation of the health care cost differentials, however it is not a step-by-step appraisal of each disease that smoking causes, and the increased costs of treating these diseases. Our comparison with international ‘bottom-up’ analysis suggests our differentials are conservative. The difference between smokers and non-smokers that we have calculated is smaller than that reported in the international literature.
• Health care costs by age. We have used health care costs by age as per Figure 8. More recent research (MOH 2004) is suggesting that health care costs are a function of years to death rather than years from birth (age). The result of this is that we overestimate the costs of longevity. As MOH (2004) notes:

  *In summary, as health status improves, so the age–cost curve flattens and the impact of ageing on health expenditure lessens.*

• We have focused purely on health care costs. There are also other costs and benefits associated with reducing smoking prevalence that we do not consider:
  - Labour productivity
  - Human capital
  - Value of life
  - Revenue from excises on tobacco

  The literature suggests that these will typically increase the benefits of tobacco control programs by an order of magnitude (see Miller et al 2010).

The direction of all three later limitations is to underestimate the benefits of reducing smoking prevalence.

### 9.3 Health benefits in the model

One of the benefits of reducing smoking is an increase in mortality. Non-smokers typically live longer than smokers. The metric we use to capture this benefit is years of life saved. We look at the population with and without the smoking intervention, and sum up the extra years of life saved across the population. We do not adjust the years of life saved for morbidity, which means these figures are not strictly comparable with a Quality of Adjusted Life Years (QALY) measure, however they nonetheless provide an important measure of improvement in population health due to reductions in smoking.

### 9.4 Results of health care costs and benefits

Using the health care cost differentials between smokers, ex-smokers and non-smokers, we can calculate the health care cost savings due to each of the policy interventions analysed earlier. We use a discount rate of 3.5% as per the UK (NICE 2008), and calculate the net present value of the savings that accrue between 2011 and 2025. As the costs and benefits from quitting smoking accrue later on in life, we also calculate the net present value of the savings that accrue between 2011 and 2060.

#### 9.4.1 Smoke-free by 2025

We find that:

• there are initially positive gains in health care costs from reducing smoking prevalence to 3% by 2025, in net present value terms of around $30 million. Fewer smokers will result in a healthier population and save health care costs (see Figure 9)

• the healthier population live longer. Over time, this imposes additional costs. By 2035, these costs begin to outweigh the benefits due to the healthier population
by 2060, health care costs are around $20 million higher than they would have been if smoking had not been reduced to 3% by 2025. The net present value of the costs between 2011 and 2060 are between $20 and $26 million.

the increased health care costs are a function of a population with increased longevity. We estimate that by 2060 the population is 13,000 people higher than it would have been if smoking had not been reduced to 3% by 2025, and that an estimated 370,000 life years have been saved.

this equates to a cost of just $70 for a life year. This is low relative to most studies. In the UK, interventions that cost between $40,000 and $60,000 per life year are typically regarded cost effective (NICE 2010). Locally, PHARMAC don’t quote a dollar per QALY figure due to their fixed budget model but typically have funded drugs up to $25,000 per QALY (Rosevear 2006).

There are two further points that need be considered when interpreting these results:

this scenario uses dramatically increased cessation rates to reduce smoking prevalence. The savings that accrue are from smokers becoming ex-smokers. This saving is much smaller than from smokers never starting (that is, when compared to the saving between smokers and non-smokers: see Figure 8). The net present costs can be reduced to zero with initiation improvements of 1% per annum over and above baseline.

the costs imposed by additional longevity depend on assumptions about the correlation of health care cost with age or with distance-to-death. We use health care costs by age. If we had instead used distance-to-death, these costs would dramatically reduce and a smoke-free New Zealand would be a clear health care cost saving.

9.4.2 Taxation

We find that:

taxation policies generate positive gains in health care costs from a reduction in smoking prevalence, in net present terms by between $6 million and $14 million for the period 2011 to 2025.

by contrast to the 3% by 2025 analysis, health care savings continue to grow out to 2060 (see Figure 9). This is because of two reasons:

1) Taxation impacts on initiation - which means larger savings (saving of smoker minus non-smoker costs compared with smoker versus ex-smoker costs)

2) The taxation policy interventions are not a one-off shock but annual shocks that move more and more people out of smoking

for net present savings of $61 million, taxation policies would also save 3,100 lives and over 56,000 years of life by 2060.

9.4.3 ABC

We find that:

the ABC program saves $6 million in health care costs in net present terms between 2011 and 2025 by reducing smoking prevalence and increasing the health of the population.
• however, as per the smoke-free by 2025 cessation analysis, over the very long term, the increased longevity of the population causes health care costs to rise and outweigh the initial gains. The net present value of the health care costs between 2011 and 2060 is an increase of $3.4 million (see Figure 9)
• for a net present cost of $3.4 million, the ABC could save 4,300 lives and 94,000 years of life by 2060, at a cost of just $36 per life year saved.

9.4.4 Marketing

We find that:
• the marketing program saves $2 million in health care costs in net present terms between 2011 and 2025 by reducing smoking prevalence and increasing the health of the population
• however, as per the smoke-free by 2025 analysis, over the very long term, the increased longevity of the population causes health care costs to rise. The net present value of the health care costs between 2011 and 2060 is close to zero (see Figure 9)
• for a net present cost of close to zero to health care costs, the marketing program would save almost 1,700 lives and 34,000 life years by 2060.

Figure 9 Health care cost savings over time

9.4.5 Summary of health care costs

Reducing the prevalence of smoking creates both health care savings (from a healthier population) and costs (from a longer-living population). The different policy interventions analysed here cause smoking prevalence to reduce at different rates along different paths and by different means. This influences the health care costs and benefits from reducing the prevalence of smoking. We find that:
• stopping someone from starting to smoke delivers significantly larger health care cost savings than from helping someone quit
when policies deliver initiation improvements, the gains from a healthier population are large enough to outweigh the health care costs of a longer-living population (because of the relatively larger differential between smoker and non-smoker health care costs). In this case, reductions in smoking prevalence generate definitive health care cost savings.

when policies deliver only cessation improvements, the health care costs of a longer living population can outweigh the gains from a healthier population (because the cost-differential between smokers and ex-smokers is relatively small). However,

the health care costs are small relative to the gains in health and longevity. All health care interventions aim to improve health outcomes, and cessation interventions remain a cost effective way to achieve this.

if we consider distance-to-death health care costs (rather than distance to birth or age – see MOH 2004), the costs of longevity reduce significantly and no longer outweigh the gains from a healthier population.

other benefits not considered here such as increased productivity and value of life typically add an order of magnitude to the benefits (see Miller et al 2010).

### Table 8 Summary of health care cost savings

<table>
<thead>
<tr>
<th>Intervention</th>
<th>2011-2025</th>
<th>2011-2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>3% by 2025 - cessation</td>
<td>$27.6 to $34.2</td>
<td>-$20.6 to -$26.1</td>
</tr>
<tr>
<td>Taxation - conservative</td>
<td>$5.7</td>
<td>$60.6</td>
</tr>
<tr>
<td>Taxation - optimistic</td>
<td>$14.4</td>
<td>$151.1</td>
</tr>
<tr>
<td>ABC 50% increase in attempts and treatment use</td>
<td>$6.0</td>
<td>-$3.4</td>
</tr>
<tr>
<td>Marketing</td>
<td>$2.0</td>
<td>$0.1</td>
</tr>
</tbody>
</table>

Notes:  
(1) 3.5% discount rate
Source: NZIER

### 9.5 International comparison

#### 9.5.1 Short term or static models

Short term or static models invariably suggest large gains from reducing smoking or attribute a large cost burden to smoking. This is because they don’t consider the life cycle costs of increased population longevity in the absence of smoking.

Magnus et al (2011) cite health care cost savings of around $600 million from reducing smoking prevalence from 23% to 15% between 2005 and 2008. They use a bottom-up approach of assigning the portion of health care costs associated with diseases (as calculated by an Australian Burden of Disease study) related to smoking using population-attributable risk fractions.

Using their numbers, we estimate that the prevalence reduction reduces the number of current smokers by around 800,000, with a cost saving of $750 for each less...
smoker. This is greater than our estimate of the cost differentials between smokers and non-smokers which peaks at $700 for 80 year olds plus (see Figure 8) but averages significantly less than that across all ages. It is also significantly greater than the differential we use for smokers to ex-smokers which peaks at $130. Sloan et al (2004) cite medical expenditure estimates of between $35.3 billion to $143.7 billion with a median of $72.8 billion, for a smoking population of around 50 million. This equates to around $650 to $2,700 per smoker.

There are many more types of these analyses however they present only a limited picture of the costs and benefits of smoking and therefore are of minimal use for comparison.

9.5.2 Life cycle models

The international evidence from research that considers a life cycle approach (considers population longevity as well as population health) is inconclusive.

The Hayashida et al (2010) Japanese study concluded that non-smokers lifetime health expenditure were higher than smokers by a minimal amount. They use a longitudinal cohort dataset that tracks smoking status and health care costs over time to parameterise the health care costs.

A commonly cited paper by Barendregt et al (1997) found lifetime health care costs in Holland to be higher for non-smokers than smokers, however they did conclude that anti-smoking policies yield a high return in terms of health expenditure.

Both studies use cost differentials between smokers and non-smokers that are marginally greater than what we used in this study (although there is no data for their differential between smokers and ex-smokers). This would, with everything else equal, lead to increased cost savings from smoking reductions, however their results indicate increased costs.

Miller et al (2010) also suggest that gains from tobacco control programs, over 90 years from 1990 to 2079, disappear to zero if the impact of increased population longevity is included.

By contrast, Rasmussen et al (2004) found that in Denmark smoking imposes direct costs to society even after accounting for life expectancy considerations. Sloan et al (2004) estimate that over a life time, smokers add $2,100 in present value to health care costs after accounting for impacts on longevity. Both examples use a ‘typical person’ approach rather than a prevalence across the population analysis.

Despite the literature being inconclusive on the net health care costs or benefits of reducing smoking prevalence, there are clear messages:

- reducing smoking prevalence will increase the longevity of the population. This means that a life cycle approach that considers increased population longevity is required to accurately understand the health care impacts of reducing smoking prevalence
- studies that find a net cost from reducing smoking prevalence indicate that the subsequent positive health outcomes are large enough to ensure smoking prevalence remains a cost-effective health intervention
• specific population and intervention characteristics impact the net cost outcomes:
  – Smoking prevalence rates
  – Population demographics
  – Health care cost differentials between smokers, non-smokers and ex-smokers
  – If the interventions target cessation or initiation.

• studies that look beyond health care costs and include wider costs of disability, death and productivity loss find clear economic benefits from reducing smoking prevalence (e.g. Collins and Lapsely 2008).
Appendix A Health care cost analysis

The Ministry of Health provided the following information about the health care cost data provided:

The 2007/08 New Zealand Health Tracker denominator table was linked deterministically to the 2006/07 New Zealand Health Survey by date of birth, gender and Statistics NZ 2006 Meshblock of domicile. The linkage of these two data sources provided a comprehensive source for analysis that included annual health system expenditure and recent self-reported smoking status.

We linked 8,604 individuals 15 years of age or older (74% match rate). A further 468 were excluded as they did not survive the 2007/08 financial year and hence would not have full event price follow-up. The remaining 8,542 individuals were linked to their individual health service utilisation frequencies and event prices by NHI.

Health services included in this linkage were:

- Public hospital discharge
- Community pharmaceutical dispensing
- Community laboratory testing
- MOH and DHB disability support services funding
- Outpatient attendances
- Emergency department visits
- Primary care consultations
- Secondary mental health services

In 2007/08 these services amounted to approximately $7.7 Billion of Vote Health appropriations.

To determine average annual public expenditure for services in 2007/08 we fitted a regression model (distribution=Normal link=Identity) in SAS using PROC GENMOD. The dependent variable was the Box-Cox transformed (lambda=-.25) total expenditure for each individual to deal with heteroskedacity.

The model fitted included only main effects as parts of the response space suffered from particularly low counts and the model was unstable when interactions were fitted. The dependent variables were 10 year age-group, gender, ethnic group (Māori, Pacific and Other), risky drinking (AUDIT score of 8+), NZDeprivation 2006 Quinitile of area of domicile and smoking status (Current Daily Smoker, Ex-smoker (more than five years), Ex-smoker (up to five years) and Never Smoked).
Appendix B References


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