Restricting Numbers and Density of Tobacco Retail Outlets

modelling its potential impact on health and costs

SUMMARY

Countries are increasingly considering how to reduce or even end tobacco consumption, and New Zealand has a tobacco "endgame" goal (Smokefree Aotearoa 2025). There is a growing interest in restrictions on tobacco retail outlet locations and density with the aim of reducing smoking prevalence further. We evaluated four such interventions and estimated its impact on health and health system costs.

We evaluated restrictions on numbers and density of tobacco retail outlets

We modelled four interventions:

1. Reduce the total number of tobacco retail outlets by 95%
2. Permit sales at half the liquor stores (and nowhere else)
3. Eliminate sales from outlets within 1 km of schools
4. Eliminate sales from outlets within 2 km of schools

Each intervention was compared to current practice ("business-as-usual")
The target population was the entire 2011 NZ population.

We modelled the impact of these interventions on health, health inequalities, and health system costs

Across 16 tobacco-related diseases, the model estimated how much health benefit was gained (in quality-adjusted life-years or QALYs) from these restrictive interventions, and how much it cost or saved the health system. We also investigated the impact of tax rises on health inequalities by age, sex, and ethnicity.

What is the impact of restricting tobacco retail outlet locations and density?

Over the lifetime of the population, Intervention 2 produced the most QALYs gained (105,060 QALYs), followed by Intervention 4 (67,030 QALYs), Intervention 1 (29,700 QALYs) and lastly Intervention 3 (24,790 QALYs). Cost savings were NZ$ 369 to NZ$ 1536 million, depending on the intervention, over the remainder of the 2011 population's lifetime. QALY gains per person were 3.2 times higher for Māori than for non-Māori for the most effective intervention (Intervention 2). The impact on health inequalities (measured by differences in mortality rates) between Māori and non-Māori were relatively small, projected to decline 0.76% by 2031 with Intervention 2.

Our bottom line

In this evaluation, reductions in tobacco outlet availability make relatively modest yet important impacts on reducing tobacco-related diseases and reductions in health inequalities into the future. However, they should be considered alongside alternative tobacco control strategies such as tobacco taxes (see another BODE[3] evaluation summary).

Blakely T, Cobiac LJ, Cleghorn CL, Pearson AL, van der Deen FS, Kvizhinadze G, Nghiem N, McLeod M, Wilson N. Health, health inequality and cost impacts of annual increases in tobacco tax: Multistate lifetable modeling in New Zealand. *PLoS Med* 2015;12(7): e1001856.

Restricting Numbers and Density of Tobacco Retail Outlets

Easy access to tobacco retailers is thought to influence both smoking initiation and limit successful quitting. A few studies now suggest that limiting the density and distribution of tobacco retail outlets may reduce smoking prevalence further. We modelled four legally mandated tobacco outlet reduction interventions, selected based on their estimated impact on smoking prevalence and likely feasibility:

1. Reduce the total number of tobacco retail outlets by 95%
2. Permit sales at half the liquor stores (and nowhere else)
3. Eliminate sales from outlets within 1 km of schools
4. Eliminate sales from outlets within 2 km of schools

Interventions were modelled so as to be implemented incrementally and reaching full impact after a 10-year period. Each intervention was compared to business-as-usual.

Model

We used a combination of geographical, economic, and epidemiological approaches to answer our research question. We began with the entire 2011 NZ population of 4.4 million people, and used a multi-state life-table model to follow this population through to death or a maximum of 110 years. The model included 16 tobacco-related diseases: coronary heart disease, chronic obstructive pulmonary disease (COPD), lower respiratory tract infection, and multiple cancers (lung, oesophageal, stomach, liver, head and neck, pancreas, cervical, bladder, kidney, endometrial, melanoma, and thyroic cancer). Basically the model captured how tobacco outlet reduction interventions increased the cost of obtaining tobacco (via time and travel costs) and subsequently how it reduced the prevalence of smoking (similar to how tax-mediated price increases reduce smoking). From the reduced smoking prevalence we estimated the risk of developing these tobacco-related diseases. The model estimated the size and timing of:

> QALY or Quality-Adjusted Life-Year:
>
> The remaining life expectancy, adjusted for quality of life. Think of one QALY as one year of life in perfect health.

- Health gain in quality-adjusted life-years or QALYs
- Health system costs in NZ$ (including those associated with living longer lives as a result of the intervention)
- Impact on health inequalities (as measured by mortality differences between Māori and non- Māori)

Assumptions in the Model

Our model contains multiple assumptions. Some of these assumptions apply across all BODE[3] evaluations, and are described in a range of protocols at the BODE[3] website here. Some assumptions are specific to this topic: please refer to the journal article for more information. Some of our key assumptions include the following:

- We assumed that the cost of travel time and direct transport costs acted in a similar way to how tobacco price increases (via tobacco taxes) work. In other words, these costs were treated as per a direct increase in the price of tobacco.
- We used a health system perspective and so did not include costs and consequences beyond the health system (such as benefits to workplace productivity from preventing disease in working age adults).
- We included costs both related and unrelated to the tobacco diseases (meaning if tobacco control helped individuals live longer, we included the health system costs of their "living longer").
- We allowed for expected or background disease and limited the maximum amount of QALYs that could be gained with increasing age.
- We applied a 0% discount rate to costs and QALYs gained in our main model, but used a 3% discount rate in scenario analyses (see below).
- The cost of the tobacco outlet reduction interventions were considered to be the previously estimated costs of a new law in New Zealand to mandate tobacco retail restrictions (NZ$ 3.5 million).
- The effect of the reduced tobacco availability on rates of quitting smoking was only applied for the 10 years of the phased intervention.
- We also assumed Māori were more sensitive to the higher travel-related costs of obtaining tobacco than non-Māori, based on NZ and some international evidence.

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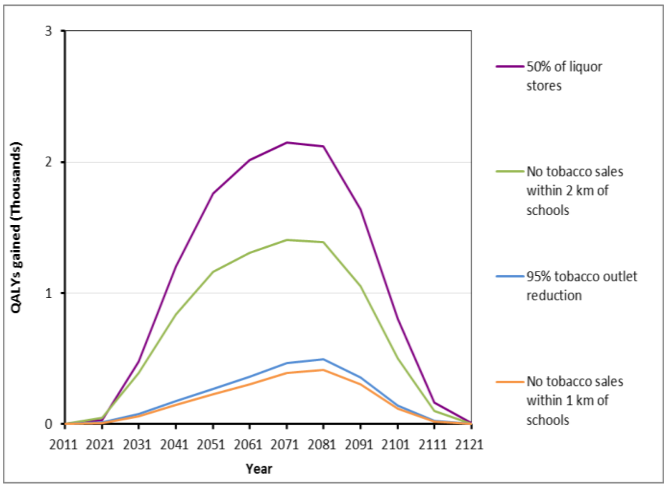
QALYs, Cost Savings & Health Inequality Impacts

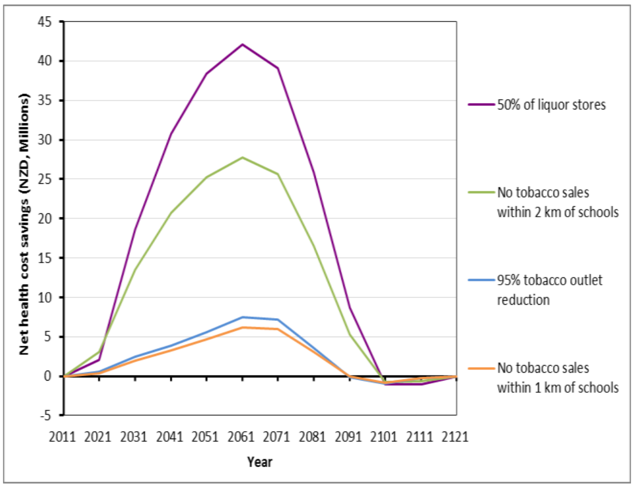
QALYs	Intervention 2 (limiting sales to just half of liquor stores) gained the most QALYs (105,060 QALYs), followed by Intervention 4 (67,030 QALYs), Intervention 1 (29,700 QALYs) and lastly Intervention 3 (24,790 QALYs). By 2031, tobacco smoking prevalence was estimated to be 8.1 for a business-as-usual scenario, 7.3% for Intervention 2, 7.6% for Intervention 4, 7.8% for Intervention 1, and 7.9% for Intervention 3.
Cost Savings	Cost savings were NZ$ 369 to NZ$ 1536 million, depending on the intervention, over the remainder of the 2011 population's lifetime.
Health inequalities	For the most effective intervention (Intervention 2), health inequalities (measured by differences in mortality rates) between Māori and non- Māori were projected to decline by 0.76% (ranging from 0.46% to 1.21%) in 2031. Māori women aged 45 to 64 years had the greatest estimated reduction in health inequalities.

Distribution of health gains and cost savings over time

The graph below illustrates how the health gains, while beginning immediately, do not peak for six to seven decades into the future. This is because of the time lags associated with tobacco-related diseases developing and because the outlet reduction intervention is particularly likely to impact on young people (who are the most price sensitive). The second graph also illustrates this long time lag before the health cost savings peak.

The following graphs show the size and timing of QALY gains (left) and cost savings (right) for each of the four tobacco outlet reduction interventions.





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QALYs and Cost Savings in Different Populations

Age	QALY gains over their remaining life-time were largest for the younger age groups.
Sex	QALY gains were higher for women than for men.
Ethnicity	QALY gains per person were 3.2 times higher for Māori than for non- Māori, because of more Māori living rurally and semi-urban generating higher travel costs, higher background smoking prevalence and Māori probably being more sensitive to price increases in general.

Equity Analysis

Māori have higher background disease and death rates compared to non-Māori. Māori can therefore be automatically “disadvantaged” in economic evaluations because Māori have a more limited envelope of QALYs that can be gained from health interventions. We therefore conducted an ‘equity analysis’ to adjust for this, applying non-Māori rates of background disease and death to Māori instead of using Māori rates. In this scenario, QALY gains for Māori improved even further, becoming 5.8 times higher for Māori compared to non-Māori.

Uncertainty in our Results

There is unavoidable uncertainty present in the values we put into our models, and thus uncertainty in estimates of QALYs and cost savings. A particularly important driver of uncertainty is the price elasticities (“sensitiveness” to price) used in the calculations (these vary by age-group and probably by ethnic group – see the Table below in “Changing Some Assumptions”).

Changing Some Assumptions

The results of the evaluation are sensitive to different assumptions. For example:

What if we assumed Māori were as sensitive to tobacco price changes as non-Māori (not more so as per our baseline modelling)?	QALYs gained for Māori would decrease by 16%.
What if we discounted QALYs and costs at 3% (instead of 0%)?	QALYs gained would decrease. For example from 105,160 QALYs to 23,700 QALYs for the most effective intervention (Intervention 2: limiting sales to just half of liquor stores) and from 24,790 QALYs to 5,750 QALYs for the least effective intervention (Intervention 3: eliminating sales from outlets within 1 km of schools). Cost savings decreased from an initial range of NZ$ 369 - NZ$ 1536, to NZ$ 116 – NZ$ 472 million.

Our Bottom Line

1. This is the first study to model tobacco retail outlet reductions through to health gain and health costs, by combining geographic, economic, and epidemiological methods.
2. In this evaluation, reductions in tobacco outlet availability make relatively modest but still important impacts on reducing tobacco-related diseases and reductions in health inequalities into the future. However, they should be considered alongside other tobacco control strategies such as increased tobacco taxes.

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