Department of Health & Social Care

Stopping the start: our new plan to create a smokefree generation

Annex 1 – Modelling assumptions

CP 949-II

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Modelling assumptions

To understand the impact of legislating for a smokefree generation, modelling has been used to forecast changes in smoking prevalence over time. This modelling is preliminary and will continue to be further refined ahead of publication of a full impact assessment.

Approach

The model forecasts changes in smoking prevalence over time. It focuses on the 14 to 30 age group, given the aim is to further reduce the number of young people taking up smoking, which is referred to as the 'instigation rate'. To assess the longer-term impacts on disease incidence, mortality and costs, the lifetime effects of changes in the instigation rate are modelled, taking into account subsequent smoking behaviours (quitting and relapse).

Baseline

The baseline assumption around how prevalence in the 14 to 30 age group will continue to fall irrespective of any new policy is based on current numbers of smokers (taken from ONS-mid population estimates, ONS adult smoking habits, NHS Digital and UCL data) and probabilities for smoking instigation and quit rates from the University of Sheffield's Alcohol and Tobacco model. The baseline is similar to other published estimates, including Cancer Research UK and University of Sheffield's projections from 2021. In the ten years from 2011-2021, smoking rates declined in all ages with the largest reduction among 18 to 24 years: 25.7% of this group smoked in 2011 compared with 11.6% in 2022.

The baseline shows a flattening of future smoking prevalence in the longer-term, after a decrease in prevalence in the short to medium-term. This is a result of the model assuming constant instigation and quit rates in the baseline. This is a neutral assumption in the absence of other information.

Scenarios

The model applies a number of scenarios to the assumed impact of the policy on the instigation rate across the 14 to 30 age group. Four different modelled impacts are shown, ranging from pessimistic (<10% reduction in the instigation rate) to optimistic (90% reduction in the instigation rate).

In all scenarios, the model assumes smoking instigation rates reduce year-on-year to reflect ongoing increases in the age of sale.

Reflecting the policy intent, the model assumes change to the age of sale would be introduced gradually, one year at a time. Changes to instigation rates at or below the current age of sale are modelled from the first year, and changes to instigation rates at ages that subsequently become under the legal age of sale are introduced as that happens.

Scenario	Explanation
Scenario 1	Reflects a report published by the Institute of Medicine (IoM) in the US in 2015 that projected raising the age of sale by one year to 19 would reduce rates by 10% for most age groups below the threshold, and 5% for some.
Scenario 2	Assumes a 30% reduction in instigation rates per year for those below the age of sale. Reflects a projection from UCL that raising the age of sale to 21 would reduce prevalence among 18 to 20 year olds by 30% and reduce instigation rates by the same amount.
Scenario 3	Assumes a 60% reduction in instigation rates per year for those below the age of sale. Reflects mid-point of Scenario 2 and 4.
Scenario 4	Assumes a 90% reduction in instigation rates per year for those below the age of sale. Reflects the assumptions used by the New Zealand government for its implementation of a smokefree generation, which assumed a 100% reduction in instigation rates. A 90% year on year reduction has been modelled here rather than assuming immediate universal cessation of smoking instigation.

Results

Table 1: Smoking prevalence ages 14-30

	2023	2030	2040	2050
Baseline	13.0%	9.0%	8.1%	8.1%
Scenario 1: <10% reduction in instigation rate	13.0%	8.4%	5.1%	3.1%
Scenario 2: 30% reduction in instigation rate	13.0%	7.3%	1.3%	0.0%
Scenario 3: 60% reduction in instigation rate	13.0%	6.4%	0.6%	0.0%
Scenario 4: 90% reduction in instigation rate	13.0%	6.1%	0.4%	0.0%

Table 2: Cumulative smoking-related deaths avoided

	2050	2075	2100
Scenario 1: <10% reduction in instigation rate	128	11,466	70,205
Scenario 2: 30% reduction in instigation rate	359	23,925	118,447
Scenario 3: 60% reduction in instigation rate	539	27,399	126,829
Scenario 4: 90% reduction in instigation rate	634	28,688	129,593

Table 3: Cumulative cases of selected smoking-related disease avoided by 2075

Lung cancer, stroke, coronary heart disease (CHD) and chronic obstructive pulmonary disease (COPD) account for nearly 60% of the DALY burden (a measure of both the mortality and morbidity impacts) caused by smoking in England.

	Lung cancer	Stroke	CHD	COPD
Scenario 1: <10% reduction in instigation rate	2,331	1,507	15,445	28,415
Scenario 2: 30% reduction in instigation rate	5,082	2,958	31,978	57,854
Scenario 3: 60% reduction in instigation rate	5,979	3,293	36,294	65,142
Scenario 4: 90% reduction in instigation rate	6,328	3,409	37,828	67,757

Table 4: Cumulative social value gained (Total savings, £bn, against baseline in 2075, undiscounted)

	Healthcare Costs	Productivity Gains	Social Care Costs	Costs of smoking-related Fires	Quality-Adjusted Life Year gains*	Totals
Scenario 1: <10% reduction in instigation rate	£7	£49	£4	£2	£5	£67
Scenario 2: 30% reduction in instigation rate	£10	£79	£6	£3	£12	£111
Scenario 3: 60% reduction in instigation rate	£11	£83	£7	£3	£14	£119
Scenario 4: 90% reduction in instigation rate	£11	£85	£7	£3	£15	£121

**The monetised value of Quality-Adjusted Life Year (QALY) gains presented here are from mortality only meaning changes to quality of life have not been considered*

Methodology and limitations

The model is based on a Markov approach, commonly used in academia to analyse dynamic processes like smoking behaviour. The population is segmented into discrete states (smoker, former smoker, non-smoker) and transition probabilities based on empirical data are used to reflect how individuals move between these states over time. This approach allows for the analysis of complex interventions.

While a Markov model is a widely used approach for considering smoking behaviour, there are some limitations.

The model does not assume any changes to quit or relapse rates as a result of the policy change. It only looks at smoking status, meaning it considers smokers, former smokers and non-smokers, but does not reflect whether some smokers would smoke less. The model looks only at current smoking states and not how long someone has smoked; it also doesn't capture the reduction in risk over time of quitting smoking.

It is recognised that the legislating for a smokefree generation might plausibly lead to an increase in quit rates, a reduction in amount smoked and a reduction in relapse among existing smokers as a result of wider societal change, but as a conservative assumption, the model assumes no change to these variables.

While the modelling results consider early mortality and four major health conditions associated with smoking, it is well evidenced that there are a number of other smoking-related impacts that would be reduced by legislating for a smokefree generation. This includes two areas where outcomes are particularly poor for younger people:

- Smoking during pregnancy, which is a major cause of stillbirths, small-for-dates babies and impairment of childhood lung development – noting prevalence of smoking in pregnancy is high for the under 18 age range, at 31.8%, and the 18-19 age range at 31.2%.

- Passive smoking, which can cause all the harms of smoking, although at lower levels, with children exposed to parental and household smoking more likely to become regular smokers – in 2021, 52% of pupils reported being exposed to secondhand smoke in a home or in a car.

There are further limitations to the approach summarised below:

- Societal costs are applied to those currently smoking, without taking into account that some of the costs to society will accrue later in life. In addition, productivity costs are based on ASH estimates. While these are the best estimates currently available, they may include wider determinants of productivity loss correlated with, but not caused by, smoking.

- Quality of life impacts, including the impact of disease on the individual, are not captured by the modelling.

- The model does not include those who smoke under the age of 14 or over the age of 90.

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