# Making Conversations Count

## The health and economic benefits of improving smoking cessation support in UK general practice

October 2020

Together we will beat cancer

CANCER RESEARCH UK

# Reference

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EC, MX, LR, JG and LW designed and performed the study. TC, SB, and JV advised on study design. All authors contributed to writing of the report.

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# Cancer Research UK

Cancer Research UK is the world's largest independent cancer charity dedicated to saving lives through research. We support research into all aspects of cancer through the work of over 4,000 scientists, doctors and nurses. In 2017/2018, we spent £423 million on research institutes, hospitals and universities across the UK. We receive no funding from Government for our research.

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# List of acronyms

| | |
|---|---|
| AML | acute myeloid leukaemia |
| CHD | coronary heart disease |
| CML | chronic myelogenous leukaemia |
| COPD | chronic obstructive pulmonary disease |
| CRUK | Cancer Research UK |
| GP | general practitioner |
| HL | HealthLumen |
| NCSCT | National Centre for Smoking Cessation and Training |
| NICE | National Institute of Health and Care Excellence |
| NHS | National Health Service |
| NRT | nicotine replacement therapy |
| ONS | Office for National Statistics |
| SSS | stop smoking service |
| VBA | Very Brief Advice |

# Foreword

Tobacco smoking causes devastating harm to individuals, families, communities and national economies. Despite numerous successes in tobacco control, smoking remains the UK's biggest cause of preventable disease and death, placing a massive but avoidable burden on our health and social care system and society as a whole. Quitting is the best action that people addicted to tobacco can take to improve their health – however, to achieve this, they need access to systematic and effective support from their General Practitioners (GPs) and stop smoking services (SSS) in the community.

Much more can be done to help people who currently smoke to quit. As the majority of people who smoke have contact with their GP at least once in a given year, these consultations provide a crucial opportunity for doctors to talk to their patients about smoking, and to support them in quitting. However, we know that these discussions are not routinely happening across the UK and the variation in availability of SSS in England, in part due to local government budget cuts, means there are fewer SSS for GPs to refer patients to in these areas.

This report explains the overwhelming benefits that improved GP delivery of stop smoking support, and by extension, improved quit rates, can have on the health and economy of the UK in the next 20 years, while also addressing health inequalities. Not only will implementation of interventions in general practice prevent many cases of serious health conditions, including cancer and heart disease, but it will also reduce hundreds of thousands of GP visits and tens of thousands of premature deaths, saving the health service billions of pounds of smoking-related treatment costs. Such reductions could be used to improve the health service's capacity to respond rapidly to other emerging health priorities, including the potential for future epidemics like COVID-19.

However, routine support by GPs alone cannot bring us to a smokefree UK (≤5% smoking prevalence in adults). Smoking cessation interventions should be extended across the health service, being delivered by a variety of health professionals, and SSS need to be universally available and sufficiently promoted to ensure optimal and equitable use across the full breadth of society.

If we successfully achieve universal and systematic treatment of tobacco addiction in primary care, as set out in this report, we can make quicker progress towards a smokefree future, a reduction in health inequalities, a healthier society, free up resources to address other areas of health and well-being.

**Dr Richard Roope**

Clinical Champion for Cancer
Royal College of General Physicians &
Cancer Research UK

# Executive Summary

## Background

Smoking remains the biggest cause of preventable cancer and death in the UK, accounting for 125,000 all-cause deaths and 54,300 cases of cancer per year[1,2,3]. Beyond this human cost, there is considerable cost to the health service and its workforce. In England alone it is estimated that treatment of smoking-related illness costs the NHS approximately £2.4 billion per year[4].

Cancer Research UK's goal is for a smokefree UK (5% or fewer of the adult population smoking) by 2030, and national governments have made similar commitments. Reducing smoking prevalence to such levels will require reducing smoking uptake, and increasing both the number and success rate of quit attempts.

Alongside national and local governments, the health service plays an important role in supporting people who smoke to quit. Consultations with primary care practitioners, including GPs, provide an ideal opportunity to deliver smoking cessation support to a large number of people. In England and Wales, guidance from the National Institute for Health and Care Excellence (NICE)[5] recommends that primary care practitioners deliver Very Brief Advice (VBA) on smoking to patients. VBA on smoking can be delivered in 30 seconds, using an "AAA" framework where practitioners:

- **Ask** their patient about smoking to establish their smoking status, and record;
- **Advise** their patients on how they can stop smoking; and
- **Act** by offering support to quit by referring them to a stop smoking service (SSS) or prescribing pharmacotherapy with brief advice.

Despite these recommendations, VBA on smoking is not widely delivered, with only 53% of GPs and practice nurses reporting that they frequently complete all steps of VBA with people who smoke[6]. Moreover, the ability to refer patients to SSS depends on the availability of such services, yet in 2019 only 59% of local authorities in England commissioned a service available to all local people who smoke[7].

While VBA for smoking cessation has been recommended by NICE, alternative models for delivering smoking cessation interventions exist. The University of Ottawa Heart Institute has developed the 'Ottawa Model for Smoking Cessation'. This is model is also based on the "AAA" framework, but provides a structured end-to-end programme, from staff training through to implementation and evaluation. One version of this model, intended for use in the hospital setting, is already being rolled out across secondary care in England[8]. Another version of the model, intended for primary care, could also be adopted.

This study aimed to quantify the health and economic benefits of GPs routinely delivering stop smoking support to patients during consultations in the UK. Using a microsimulation model over the period 2019 to 2039, a current practice 'baseline' scenario was compared to three opt-out smoking cessation intervention scenarios:

- VBA on smoking, followed by prescribing pharmacotherapy with brief advice;
- VBA on smoking, followed by referral to a SSS;
- the Ottawa Model for Smoking Cessation.

# Key Findings


### Smoking will continue to be a major burden on the UK if appropriate action is not taken

Following current trends (i.e. in the 'baseline' scenario), smoking prevalence would reach 5.8% by 2039. This means that significant action needs to be taken to meet government targets of a smokefree England and Scotland by 2030 and 2034 respectively.

If current trends continue, around three million cases of disease, and over half a million premature deaths, are predicted to be attributable to smoking between 2019 and 2039. Around one million cases of cancer, including over 600,000 cases of lung cancer, would also occur due to smoking during this period.

Over this 20-year period, smoking was predicted to cause:

- £60.9 billion in costs to the UK health service, including:
  - £8.3 billion primary care costs, the equivalent of the cost of over 275 million GP appointments
  - 3.7 million hospitalisations
- £106.7 million in costs to wider society through morbidity and mortality

### Smoking cessation interventions delivered by GPs can substantially improve health and economic outcomes

All three scenarios of delivering smoking cessation interventions in general practice resulted in more rapid declines in smoking prevalence over the 20-year period. By 2030, smoking prevalence in all three intervention scenarios was predicted to be two percentage points lower than in the baseline scenario. This corresponds to an additional reduction in around one million smokers—

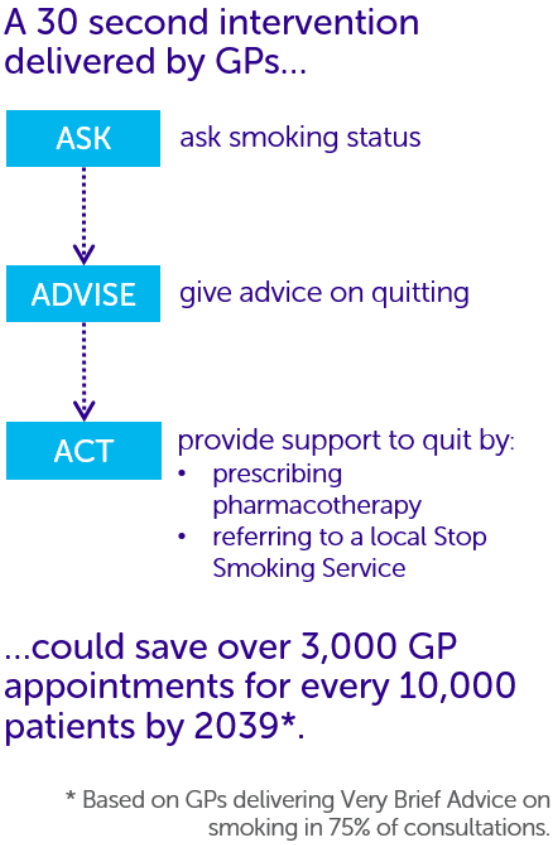
approximately the population of Birmingham, and one seventh of the number of people who currently smoke in the UK.

By 2039, all three intervention scenarios resulted in:

- Over 430,000 fewer cases of smoking-related disease, including:
  - 200,000 fewer cases of cancer
  - 120,000 fewer cases of lung cancer
- Over 88,000 fewer premature deaths

For each of the interventions, economic savings (2019–2039) included:

- Over £9.4 billion in costs to the UK health service, including:
  - Over £650 million primary care costs, which could fund over 20 million GP appointments
  - Around 700,000 hospitalisations
- Over £15 billion in costs to wider society through morbidity/mortality




# Policy Recommendations

Primary care professionals across the UK should systematically deliver smoking cessation interventions to patients who smoke. In line with NICE guidance for England and Wales, this means they should:

- Undertake training in delivering VBA on smoking.
- Routinely deliver VBA on smoking in consultations with patients who smoke.
- Offer evidence-based interventions to patients to support them to stop smoking, including systematically prescribing pharmacotherapy for smoking cessation with brief advice and, where available, referring them to a local SSS for ongoing support.

To support this, it is important that smoking cessation pharmacotherapy and services are available for professionals to prescribe and refer to respectively.

Therefore:

Primary care commissioners should repeal any restrictions placed on prescribing smoking cessation pharmacotherapy, and

Local authorities in England should offer a stop smoking service to all those who smoke in their area, and promote this service to local primary care professionals.

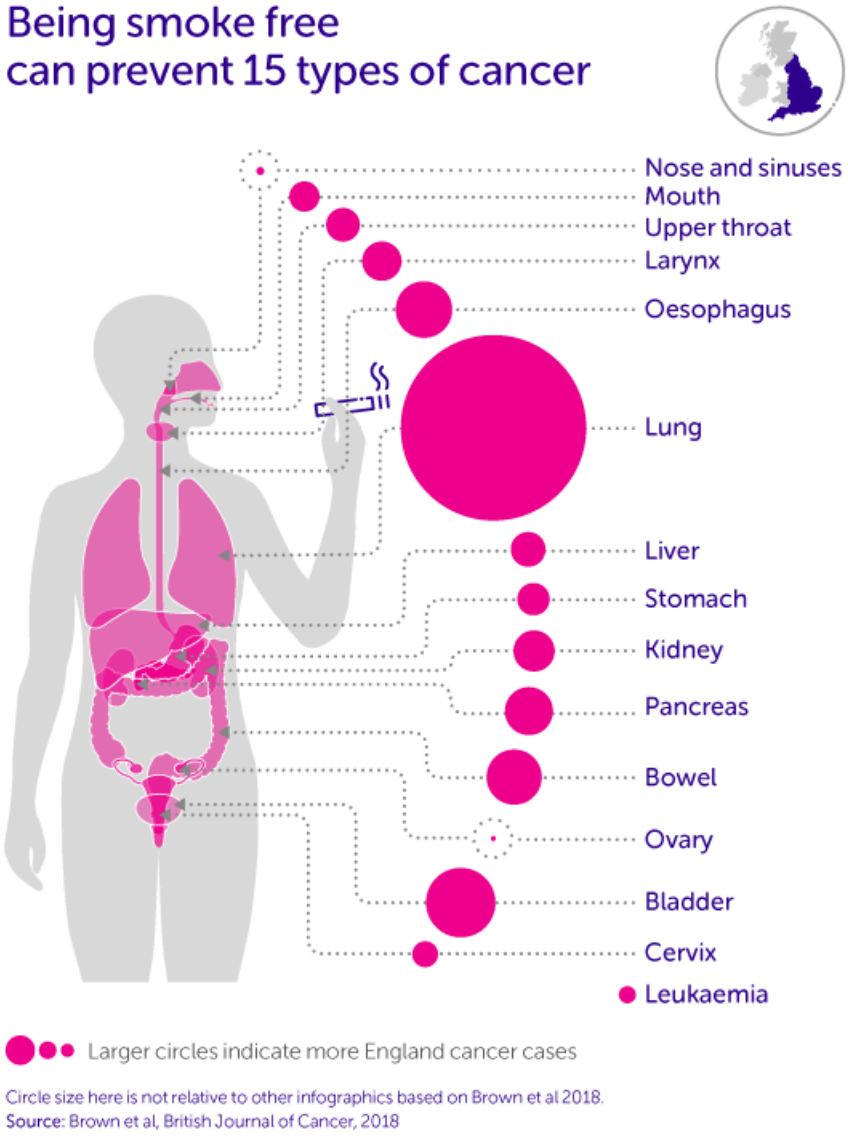
In addition:

National health bodies should introduce effective commissioning levers to make the delivery of smoking cessation interventions widespread and systematic throughout primary care.

# Contents

# 1 Introduction

Smoking is the biggest cause of preventable illness and avoidable death in the UK, accounting for 125,000 all-cause deaths per year[3]. It is the single biggest preventable cause of cancer in the UK, causing at least 15 different types, and in 2015 smoking cased 54,300 cancer cases[1]. The cancer types caused by smoking include lung cancer, which has one of the lowest survival rates of all cancers[9], and of which over seven in ten cases are a result of smoking[1]. It is estimated that the treatment of smoking-related illnesses in England alone costs the NHS approximately £2.4 billion a year[4], and in 2017–18 almost half a million hospital admissions in England could be attributed to smoking[10]. The burden of preventable illness on the health service has meant the system and its workforce is struggling to keep up with the increasing demand of a growing and ageing population. In addition to healthcare, it is estimated that smoking in England costs society a further £10.1 billion in social care, productivity loss, and house fires annually[4].



Smoking is also a major contributor to health inequalities across the UK, with smoking prevalence around two and a half times higher amongst those on the lowest incomes, compared to those with the highest incomes[11] and smoking accounting for approximately half of the difference in life expectancy between these two groups in England[12]. Smoking prevalence also varies vastly by location. For example, smoking prevalence across local authorities in England varies over four-fold from around 6% to 26%[13].

Decades of increased tobacco control initiatives have played an important part in bringing adult smoking prevalence in the UK down from over 40% in the 1970's, to a record low of 14.1% (13.9% for England, 15.4% for Scotland, 15.5% for Wales, and 15.6% for Northern Ireland) in 2019[14]. Despite these reductions, more effort is needed to achieve the UK and devolved governments' ambitions for a smokefree UK, which is widely accepted as adult smoking prevalence below 5%. Building upon the ambitions for a "smokefree" generation in England by 2030[15], and for a "tobacco-free" generation in Scotland by 2034[16], Cancer Research UK's ambition is for a smokefree UK by 2030. Reducing smoking prevalence requires action across three key areas: (i) reducing smoking uptake, (ii) increasing quit attempts, and (iii) increasing the success of quit attempts[17] – and must target those groups with the highest smoking rates.

National and local governments and the health service play an important role in reducing smoking prevalence by supporting people to quit smoking. Regarded as a global leader in tobacco control, one of the key measures taken in the UK is to provide free stop smoking services (SSS) to support people who smoke to quit. Quit attempts using a SSS, through a combination of pharmacotherapy and specialist behavioural support, are around three times more likely to be successful than unaided attempts[18]. Such interventions are also cost effective[5,19,20]. In Scotland, Wales, and Northern Ireland, the national health services are responsible for national planning and delivery of SSS. In England, this responsibility was transferred to local authorities through the *Health and Social Care Act 2012*.

In the secondary care setting, there is a growing appetite for implementing best practice initiatives that routinely identify and treat people who smoke in hospitals to support patients to quit. In the NHS Long Term Plan[8], NHS England committed to implementing NHS-funded tobacco dependency treatment services to all patients admitted to hospital by 2023/24 based on proven models implemented in Ottawa, Canada[21] (the Ottawa Model for Smoking Cessation) and Greater Manchester[22]. Similar offers are advised for health boards across Scotland[23], and are under consideration in Wales and Northern Ireland. Although these initiatives are effective, they nevertheless only provide support to a relatively small number of patients admitted to acute care, who are typically sicker, older or living with multiple morbidities.

Delivering smoking cessation support in primary care has the potential to reach a larger number of people who smoke. Primary care interventions can also be simple and quick to implement[24]. Recent guidance from the National Institute for Health and Care Excellence (NICE)[5] recommends that primary care professionals in England and Wales deliver 'Very Brief Advice' (VBA) on smoking, whereby they:

i) **ask** their patient about smoking to establish their smoking status, and record this information;
ii) **advise** their patients on how they can stop smoking; and
iii) **act** by offering help to support them quit, by referring them to a stop smoking service or prescribing pharmacotherapy with brief advice.

VBA can be delivered in as little as 30 seconds and can be a useful tool for health professionals with limited consultation time. In Scotland and Northern Ireland, although guidance does not recommend VBA on smoking specifically, brief interventions including behavioural support and pharmacotherapy are generally endorsed[23].

Despite these recommendations, primary care is not doing enough to support people to quit smoking. In a survey conducted in 2017, only 53% of GPs and practice nurses reported frequently completing all three steps of VBA for smoking cessation[6]. Unsurprisingly, the survey found that frequent completion of VBA for smoking cessation was associated with GP and practice nurse knowledge of local SSS. This demonstrates the importance of these services not only being available locally but also sufficiently promoted so that healthcare professionals are aware of them and can refer smokers accordingly.

Whereas VBA on smoking may be implemented in current UK health systems, alternative approaches for smoking cessation support in primary care have been trialled with success in other countries. The Ottawa Model for Smoking Cessation is a structured, multicomponent smoking cessation intervention that has been trialled in primary care practices in Ontario, Canada[21]. Like VBA, the Ottawa Model is based on the three A's model of Ask, Advise and Act. It also incorporates clinical staff training, outreach facilitation visits, standardised staff and patient tools, real time prompts and electronic medical record tools, and follow-up support and counselling. Practices are given structured feedback reports based on both pre- and post-intervention assessments[21]. A variant of the model, applicable to the hospital setting, is already being rolled out across secondary care in England, with NHS England requiring all hospitals to deliver tobacco dependency treatment services for in-patients by 2023/24[8].

While primary care interventions to promote smoking cessation are recommended in clinical guidance[5], and have been proven to be effective internationally, the benefit of implementing such interventions across the UK health service has never been quantified. This study aimed to determine to what extent increasing delivery of smoking cessation interventions by GPs would affect smoking rates and smoking-related health and economic outcomes across the UK. It predicts that such interventions would lead to large decreases in smoking rates over the next 20 years in the UK, avoiding onset of disease and several hundred thousand episodes of care, tens of thousands of premature deaths, and saving billions of pounds worth of healthcare and wider economic costs.

# 2 Research aims and objectives

This study aimed to quantify the impact of GPs delivering smoking cessation support to patients who smoke on health and economic outcomes in the UK. The study used a microsimulation model to quantify the impact of three different primary care smoking cessation interventions on smoking prevalence, disease incidence, premature mortality, GP appointments, hospitalisations, and associated cost savings to the health service and wider UK society.

The four scenarios modelled in the study were:

1. Current general practice ("baseline")
2. Majority (75%*) of people who smoke visiting their GP receive VBA on smoking including a referral to SSS ("VBA with referral")
3. Majority (75%*) of people who smoke visiting their GP receive VBA on smoking including a prescription of smoking cessation pharmacotherapy with brief advice ("VBA with prescription")
4. Majority (75%*) of people who smoke visiting their GP receive the Ottawa Model for smoking cessation in primary care ("Ottawa")

These scenarios are described in detail in Section 3.2: Scenarios.

* Note that these scenarios are in addition to current practice. Current practice includes some implementation of VBA in general practice, therefore these intervention scenarios should be interpreted as 75% delivery of the intervention *for those who would have not quit smoking under current practice*.

# 3 Methods

## 3.1 HealthLumen Microsimulation model

This study used the HealthLumen (HL) Microsimulation model[25-27]. This approach models the impact of interventions upon non-communicable diseases and the related economic effects, in a virtual population of 100 million individuals. This is a single integrated mathematical model used to generate a range of outputs. Each individual modelled has a specified age (in this simulation, people who smoke are aged 20 years or older), sex, and smoking status (i.e. smoker, ex-smoker, never smoker) based on known population statistics across the UK. The HL Microsimulation model is made up of multiple modules (Figure 1).

The first module projects smoking prevalence trends forward to 2039. In brief, this is performed by fitting a non-linear multivariate categorical regression model to create age- and sex-stratified smoking status trends from the Annual Population Survey data (years 2010 to 2017[28]), which are extrapolated forward to provide annual estimates of non-smoker and smoker prevalence from 2019 to 2039. These probabilities are constrained to a total value of 1.

Individuals in the model may belong to one of the three possible smoking categories (never smoked, ex-smoker, smoker) with their respective probabilities $p_0, p_1, p_2$. These states are updated on receipt of the information (from the previous year) that the person is either a smoker or a non-smoker. They will be a never-smoker or an ex-smoker depending on their original state (an ex-smoker can never become a never-smoker).

The complete set of longitudinal smoking trajectories and the probabilities of their happening is generated for the simulation years by allowing all possible transitions between smoking categories:

$$\textit{never smoker} \rightarrow \textit{never smoker, smoker}$$
$$\textit{ex-smoker} \rightarrow \textit{ex-smoker, smoker}$$
$$\textit{smoker} \rightarrow \textit{ex-smoker, smoker}$$

When the probability of being a smoker is $p$ the allowed transitions are summarised in the state update equation:

$$\begin{bmatrix} p_0' \\ p_1' \\ p_2' \end{bmatrix} = \begin{bmatrix} 1-p & 0 & 0 \\ 0 & 1-p & 1-p \\ p & p & p \end{bmatrix} \begin{bmatrix} p_0 \\ p_1 \\ p_2 \end{bmatrix}$$

In the initial year of the simulation, a person may be in one of the three smoking categories. This is determined by the static trend with three smoking categories. After $N$ updates there will be $3 \times 2^N$ possible trajectories. These trajectories will each have a calculated probability of occurring; the sum of these probabilities is 1.

In each year the probability of being a smoker or a non-smoker will depend on the forecast smoking scenario which provides exactly that information. In the baseline scenario this is the dynamic trend. Note that these states are two-dimensional and cross-sectional (non-smoking, smoking), and they are turned into three dimensional states (never smoker, ex-smoker, smoker) as described above. The time evolution of

the three-dimensional states are the smoking trajectories necessary for the computation of disease and death probabilities.

The second module uses these smoking prevalence trends within a Monte Carlo microsimulation of a virtual population, generated with demographic characteristics matching those of the observed data (from the Office of National Statistics (ONS)) for the UK[29]. The health trajectory of each individual from the population is simulated over time allowing them to develop, survive or die from a set of non-communicable diseases related to smoking. Intervention scenarios, described below, were introduced allowing individuals to transition between risk states (i.e. from smoking to having quit). The model began in 2019 and was run for 20 years, with annual outputs available.

A more detailed description of the model can be found in Appendix 1.

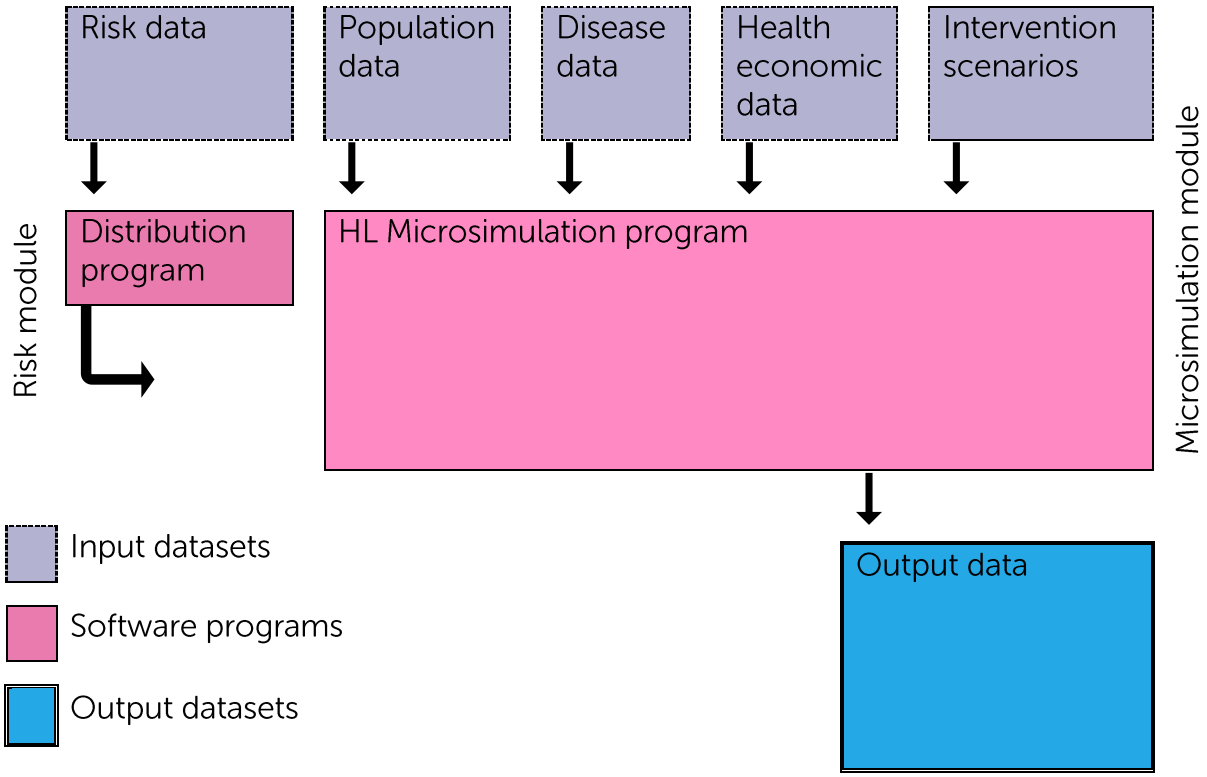



Figure 1: The HL Microsimulation model, comprising 2 main modules: the risk module (purple) and the microsimulation module (pink).

## 3.2 Scenarios

The four smoking cessation scenarios modelled are shown in Figure 2.

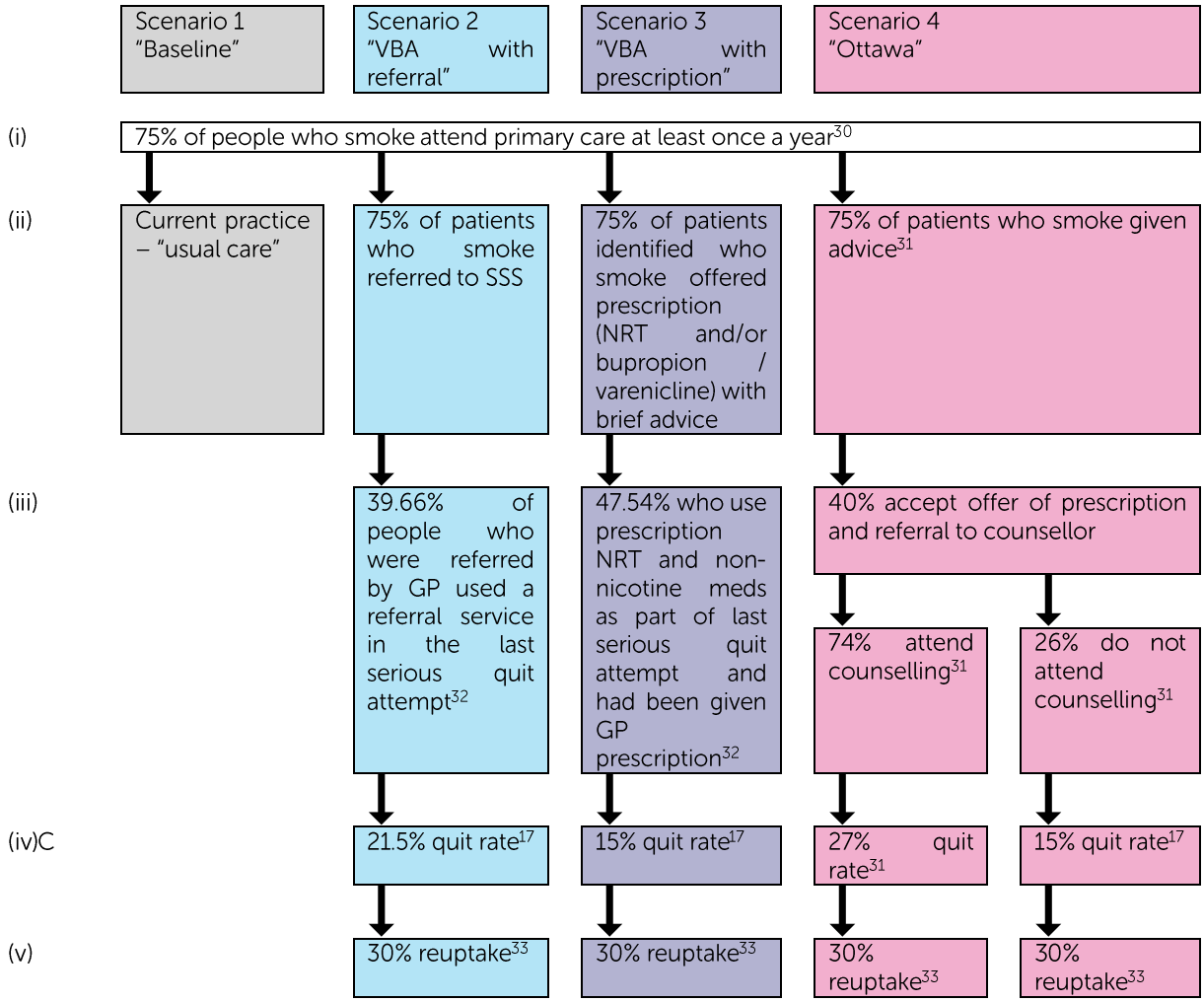



Figure 2: Flow diagram of scenarios modelled.

Scenario 1 followed current smoking trends, as projected from the Annual Population Survey data (years 2010 to 2017[28]), using a multinomial regression model. This could be considered a continuation of current clinical practice on smoking cessation with continued population-level policy change, including some implementation of stop smoking support by GPs.

Scenarios 2 to 4 introduced routine smoking cessation support during an individual's visits to their GP. Smoking cessation was modelled in multiple steps. In step (i) 75% of people who smoke were assumed to visit their GP at least once a year, based on observations from Information Services Division (ISD) Scotland[30]. No differentiation was made by age and sex.

In step (ii), the intervention—one of: VBA on smoking including referral to a SSS ("VBA with referral"), VBA on smoking including prescription of pharmacotherapy with brief

advice ("VBA with prescription"), or advice as part of the Ottawa Model ("Ottawa")—is delivered by the GP. This is delivered to 75% of people who smoke attending general practice beyond the assumed baseline practice—a hypothetical but achievable increase on current practice that captures the majority of those who smoke attending their GP receiving a smoking cessation intervention. For prescription of pharmacotherapy, the model assumed no single smoking cessation medication in particular—this may encapsulate single- or dual-form nicotine replacement therapy (NRT), and/or non-NRT pharmacotherapy (e.g. bupropion or varenicline). Delivery of VBA on smoking with referral assumes that specialist behavioural support is offered universally across the UK, and all intervention scenarios assume that GPs are able to prescribe appropriate pharmacotherapies and that they are being used by people who smoke for the prescribed time.

Step (iii) represented intervention uptake by the patient, and is based on evidence from the Smoking Toolkit Study (uptake of VBA with referral and VBA with prescription offers, assuming that all these people also received VBA on smoking prior to their referral or prescription)[32] and Ottawa Model trials (uptake of prescription and counselling)[31].

Steps (iv) and (v) represented quit[17] and reuptake[33] rates, respectively, based on empirical data from the relevant literature. To summarise quit rates for a range of potential pharmacotherapy and behavioural support, midpoints were taken from quit rates presented in a review by West (2017)[17]. The effects of pharmacotherapy and behavioural support on quit rate were assumed to be additive.

In all three intervention scenarios it is assumed that individuals can only receive the intervention once per year, and that there is no diminishing of an intervention's effectiveness over time.

More detailed information regarding the scenarios, assumptions and input data can be found in Appendix 2.

### Attributable scenario

Smoking-attributable disease, mortality, GP appointments, hospitalisations, and costs were calculated by performing a simulation where smoking prevalence is 0% and subtracting these outcomes from those for the baseline scenario.

## 3.3 Smoking-related diseases

Nineteen smoking-related non-communicable diseases were selected for inclusion in the single integrated microsimulation model; these were: chronic heart disease (CHD), chronic obstructive pulmonary disease (COPD), type 2 diabetes, depression, stroke, and 14 cancers: acute myeloid leukaemia (AML), bladder cancer, cervical cancer, chronic myelogenous leukaemia (CML), colorectal cancer, gastric cancer, kidney cancer, liver cancer, lung cancer, laryngeal cancer, lip, oral cavity and pharynx cancer, oesophageal cancer, ovarian cancer, and pancreatic cancer.

## 3.4 Data input

For each disease, publicly available datasets were used to source data on incidence[30,34-39], prevalence[40-43], mortality[34-36,38,40,44], survival[45,46], relative risk[47-60], utility[61-64], hospitalisation rate, and health care costs[65-74]. Primary care costs were available for only six of the nineteen modelled diseases[i], and are therefore underestimated in the analysis. Where data were unavailable for incidence and survival, data manipulations were made based on other available data. A detailed break-down of data sources by disease, as well as detail on data manipulations, can be found in the Appendix 4.

Population data, including age and sex distributions, total fertility rate and mortality rate were obtained from 2016-based National Population Projections from ONS[29].

## 3.5 Health economics

Health care costs[65-74] were sourced from the literature, both for total health services costs as well as primary care costs specifically. Details of the costs and sources used are provided in Appendix 3. A cost per disease case was calculated and input into the model. GP appointments avoided were estimated by dividing primary care savings by the average cost of a GP appointment, assumed to be £30 based on reports from NHS England[75]. Savings per 10,000 patients were estimated by dividing this number by the total number of patients registered in UK general practice (see Appendix 1 for detail on patient number).

Wider societal costs were calculated using a method which takes a human capital approach that measures productivity loss resulting from premature morbidity and mortality[76]. The mortality cost is obtained by summing the gross annual income from age of death to 65 years old (end of working age in the UK). Lost earnings due to premature mortality by age and sex are based on data obtained from the ONS (2016)[77,78]. Productivity loss attributable to premature morbidity refers to the loss of potential earnings incurred when an individual develops a disease which impacts their productivity. These data are based on data from the Annual Survey of Hours and Earnings (ASHE)[78] and the Labour Force Survey (LFS)[77], which is available from the UK Data Service.

The aim of this project was to project the future epidemiological and financial benefits rather than the upfront investment required. Therefore, discounting was not applied since a cost-benefit analysis was not carried out.

[i] Data were available for CHD, COPD, type 2 diabetes, Lung Cancer, Colorectal cancer and stroke

## 3.6 Output data

For each scenario, the following outputs were generated:

- smoking prevalence by age and sex
- disease incidence
- premature mortality cases
- health care costs, by disease
- wider societal costs (from morbidity and mortality)
- primary care costs
- GP appointments
- hospitalisations

For each intervention scenario, cases and costs avoided were calculated by subtracting intervention scenario outcomes from the baseline outcomes. All outputs were rescaled from rates per 100,000 (as output by the model) to a projected UK population.

Monte Carlo uncertainty values ($\pm 1.96 \times StdErr$), presented in square brackets within this report, are Monte Carlo errors and represent the accuracy of the microsimulation as opposed to the confidence of the input data itself. Errors around the input data were not available.

# 4 Results

## 4.1 Smoking prevalence

Smoking trends over the 20-year period, for all four scenarios, are shown in Figure 3.

In the baseline scenario, it was projected that the percentage of adults aged 20+ who smoke would reach 5.8% [±0.1] in 2039. This rate was projected to be higher in males (6.7%) than females (4.9%), and highest in the 20–39 age group (6.9%, Figure 4). In 2030, the UK Government's target date for a smokefree England (≤ 5% adult smoking prevalence), smoking prevalence was predicted to be 8.7% [±0.1].

All three intervention scenarios significantly improved on this outcome. In 2030, smoking prevalence reached 6.4% [±0.1] in the VBA with referral scenario, 6.7% [±0.1] in the VBA with prescription scenario, and 6.2% [±0.1] in Ottawa scenario (Figure 3; Figure 4). Each of these are two percentage points lower than the baseline scenario, which would be equivalent to a reduction of ~1.08 million people who smoke, based on an ONS-projected population of 54,160,979 adults aged 20+ in 2030[29]).

By 2039, smoking prevalence was 4.0% [±<0.05], 4.3% [±<0.05], and 3.9% [±<0.05] in the VBA with referral, VBA with prescription, and Ottawa scenarios, respectively. This corresponds to an approximate one-in-three reduction in smoking prevalence in all three intervention scenarios relative to the baseline. A smokefree UK (≤ 5% adult smoking prevalence) would be achieved by 2034 in the Ottawa scenario, by 2035 in the VBA with referral scenario, and by 2036 in the VBA with prescription scenario, but not until after 2039 in the baseline scenario.

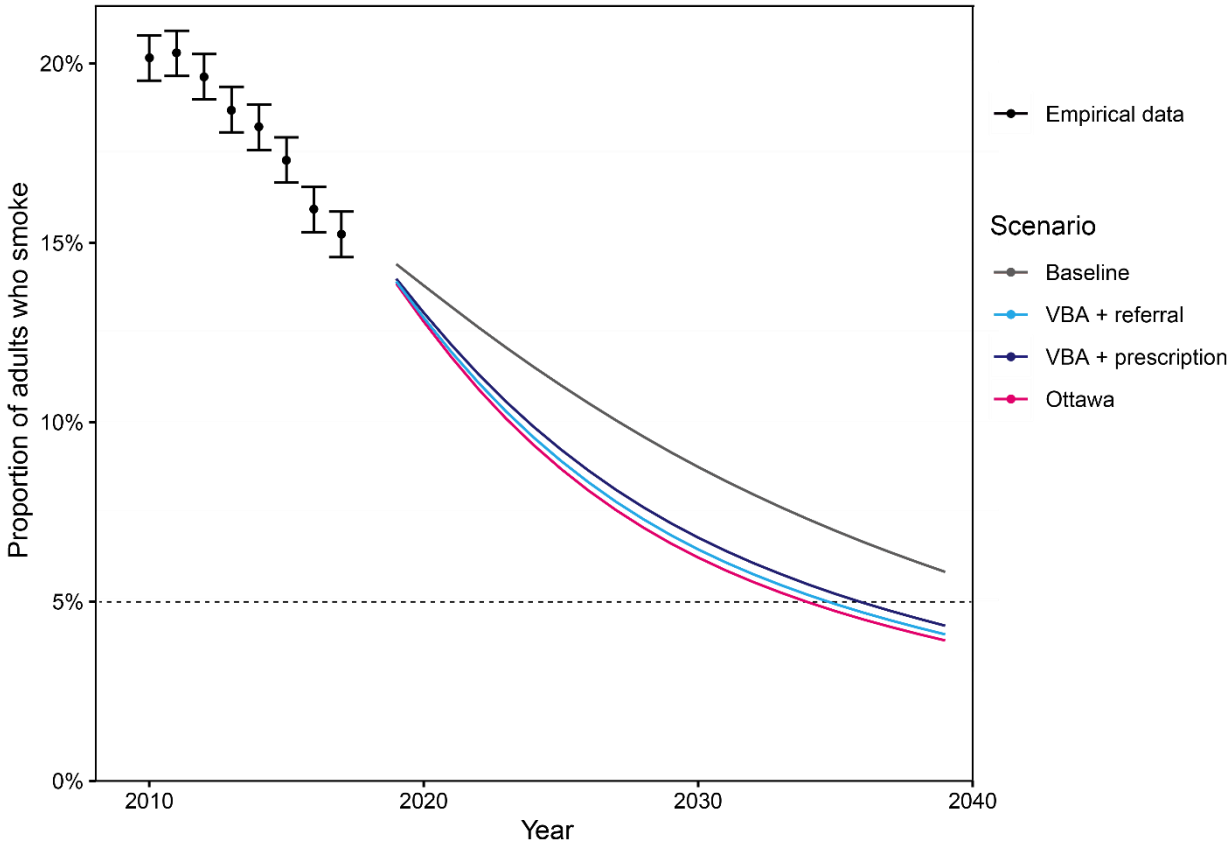



Figure 3: Proportion of adults (age 20+) who smoke in the UK in 2010–2017, and projected for 2019–2039 by the HL Microsimulation mode

*Empirical data is from ONS[28]. Error bars = 95% confidence interval. Dotted line = 5% smoking, below which is a "smokefree" generation.*

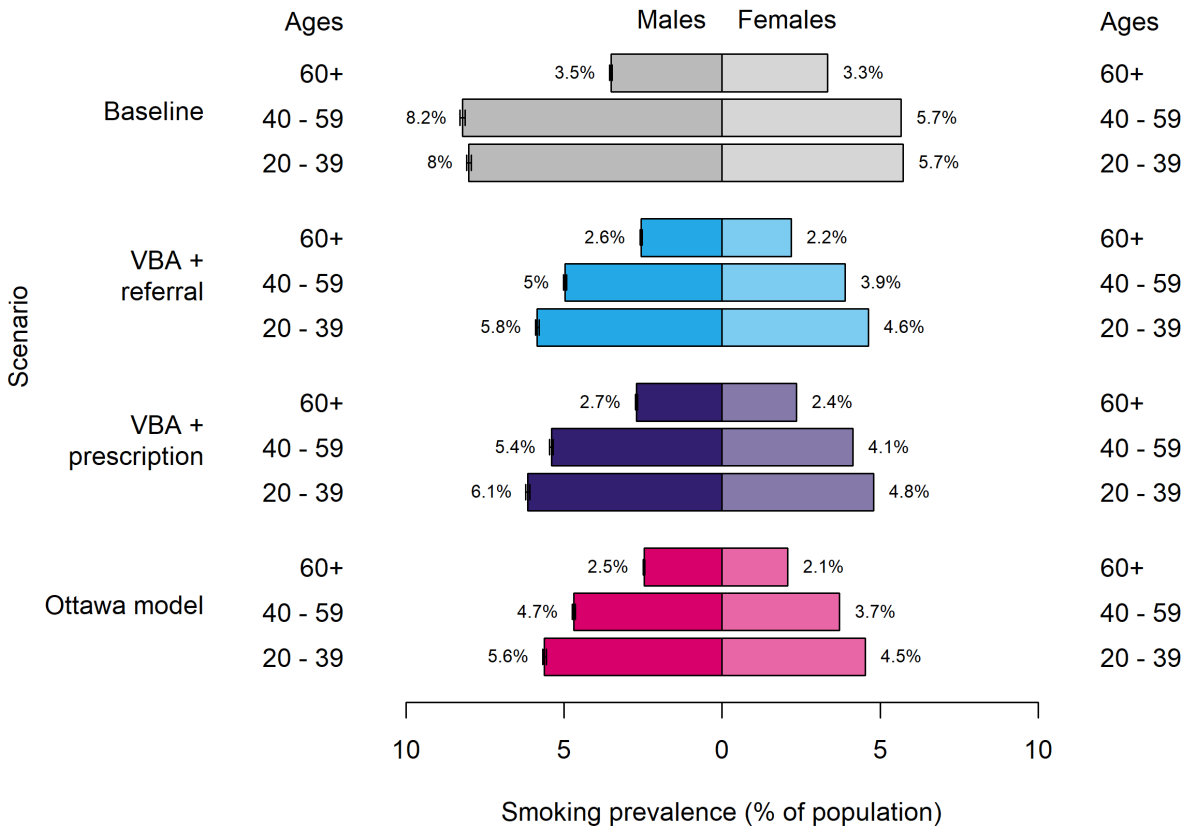



Figure 4: Proportion of smokers in the UK in 2039, by scenario, age and sex.
*Error bars = 95% confidence interval.*

## 4.2 Disease incidence

It was predicted that there will be around three million (2,974,220 [±10,871]) cases of disease attributable to smoking in the UK between 2019 and 2039 should current trends continue. Lung cancer and CHD contributed the largest share of attributable disease (Figure 5), with 21.6% (643,545) and 14.3% (423,957) of smoking-attributable cases coming from these diseases, respectively. Collectively, cancers comprised 31.2% (1,046,485) of smoking-attributable diseases.

Of the intervention scenarios, implementation of the Ottawa Model was predicted to be the most effective at reducing the burden of disease associated with smoking, avoiding 457,294 [±11,595] cases of disease over the 20-year period. Similarly, the simulation predicted that 455,119 [±11,595] cases of smoking-related disease would be avoided in the VBA with referral scenario, and that 433,378 [±11,595] cases would be avoided in the VBA with prescription scenario.

The diseases where most cases were avoided in the intervention scenarios include lung cancer, stroke, COPD, depression, type 2 diabetes, and CHD (Figure 6). Under all three interventions, over 200,000 cancer cases, including around 120,000 cases of lung cancer, were avoided over the 20-year modelled period.

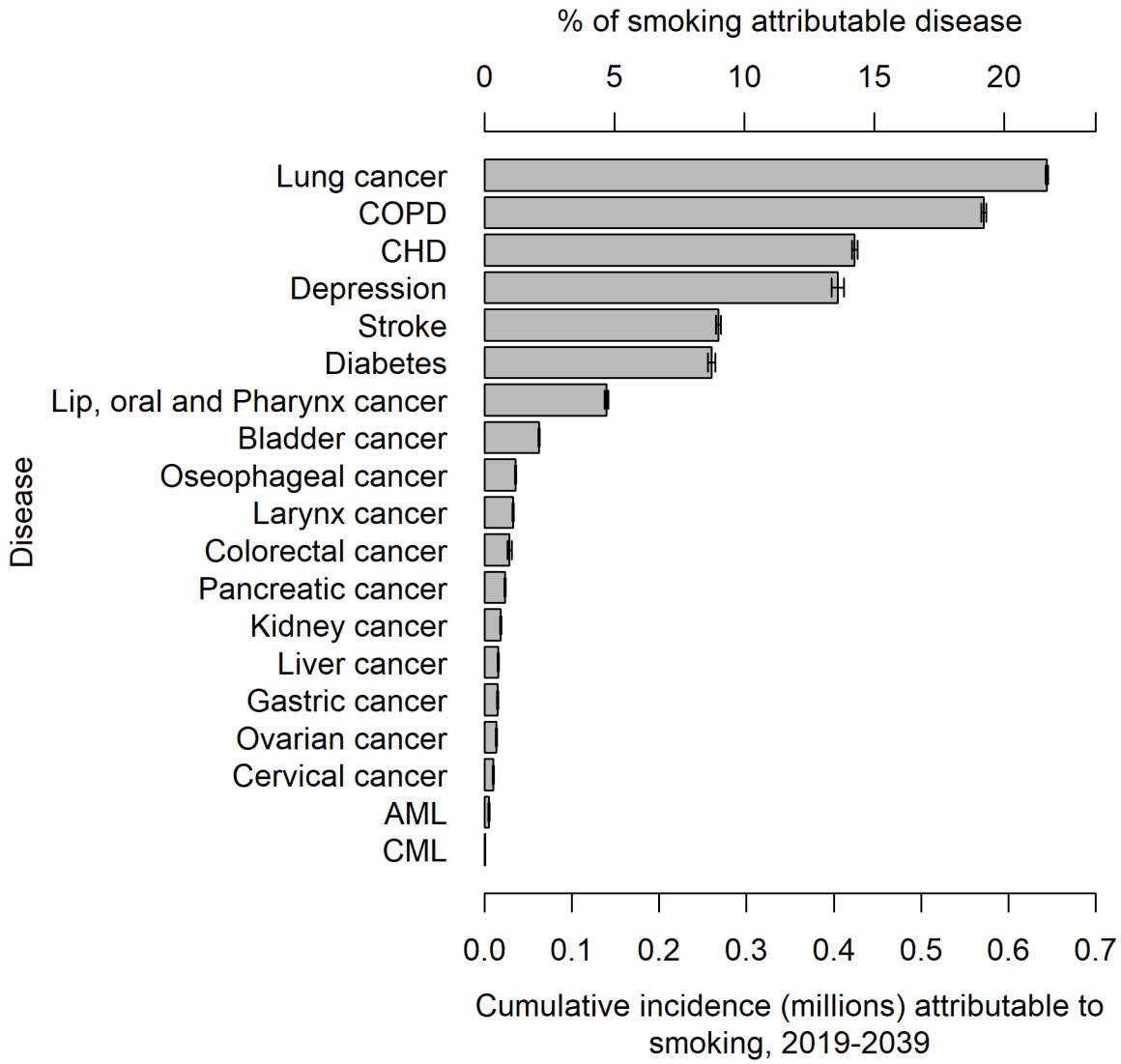



Figure 5: Cumulative disease incidence in the UK attributable to smoking by disease, as estimated by subtracting a 0% smoking prevalence scenario from the baseline scenario, 2019–2039.

*"Diabetes" is type 2 diabetes only. Error bars = 95% confidence interval.*

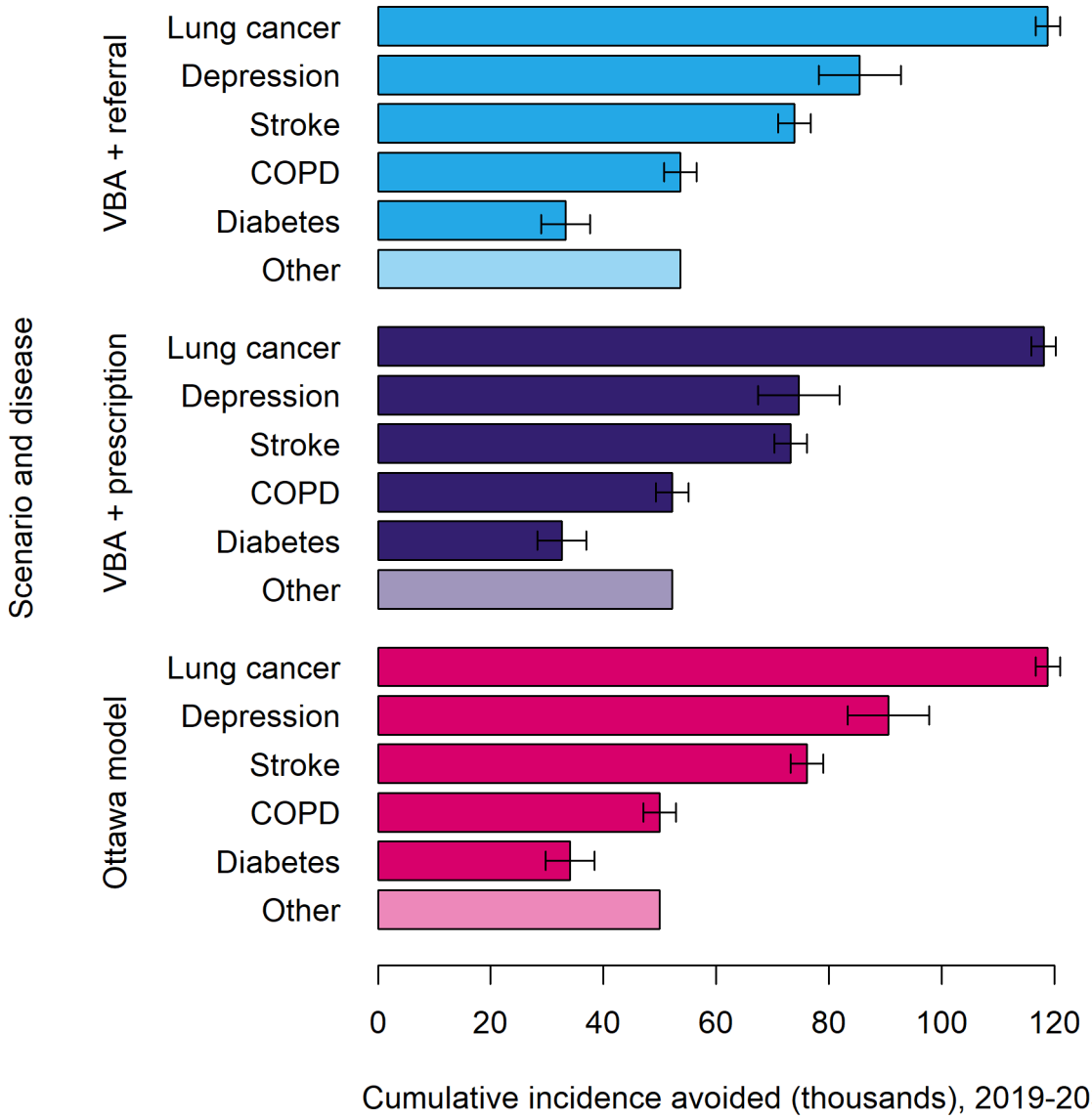



Figure 6: Cumulative disease incidence avoided in intervention scenarios relative to baseline, by disease, 2019–2039.
*Only top five diseases shown for each scenario. "Diabetes" is type 2 diabetes only. Error bars = 95% confidence interval.*

## 4.3 Premature mortality

Should trends continue, 552,025 [±9,618] premature deaths (that is, death before the age of 75) could be attributed to smoking between 2019 and 2039.

In the VBA with referral and VBA with prescription scenarios scenario, 89,299 [±9,618] and 88,578 [±9,618] premature deaths were predicted to be avoided relative to baseline, respectively. This number was similar in the Ottawa scenario at 90,808 [±9,618].

## 4.4 Primary care costs and GP appointments

Should current trends continue, primary care costs of £8.10 [±0.02] billion were projected to be attributable to smoking between 2019 and 2039, which would be enough to fund 276.9 [±0.6] million GP appointments. Note that, as primary care costs were only available for six of the nineteen modelled diseases, this is likely to be an underestimate.

Over this period, primary care cost savings for the VBA with referral, VBA with prescription, and Ottawa scenarios were £716.8 [±18.2] million, £703.6 [±18.2] million, and £656.8 [±18.2] million, respectively. This is the approximate equivalent to a saving of 24.4 [±0.6] million, 20.4 [±0.6] million, and 22.3 [±0.6] million GP appointments, respectively, or over 3,000 appointments per 10,000 patients.

## 4.5 Hospitalisations

Following current trends, it was predicted that 3,882,734 [±10,193] hospitalisations would be attributed to smoking between 2019 and 2039.

Of the intervention scenarios, Ottawa showed the greatest reduction over the modelled period, with 727,453 [±10,646] fewer hospitalisations than baseline. In the VBA with referral and VBA with prescription scenarios, it was predicted that 706,692 [±10,648] and 713,120 [±10,648] hospitalisations would be avoided, respectively.

## 4.6 Total healthcare costs

In the baseline scenario, it was projected that £60.9 [±0.17] billion in healthcare costs would be attributable to smoking in the UK over the next 20 years. COPD would cost the health service the most in this scenario, at £15.7 billion over the 20 years, with cancers collectively contributing £20.8 billion of this cost, and lung cancer contributing £10.0 billion (Figure 7).

In the VBA with referral scenario, the reduction in smoking-related disease incidence (relative to baseline) was projected to save the health service £9.83 [±0.17] billion in healthcare costs over the modelled period. The reduction in lung cancer cases alone would save the health service over £1.8 billion over the 20-year period (Figure 8).

In the VBA with prescription scenario, the reduction in smoking-related disease incidence (relative to baseline) was projected to save the health service £9.60 [±0.17] billion in healthcare costs over the modelled period. The largest costs avoided were lung cancer and stroke, where reductions in these diseases would save around £1.8 billion and £2.5 billion, respectively, during the 20-year period (Figure 8).

In the Ottawa scenario the massive reduction in incident cases also reduced the health service costs of smoking-related diseases by £9.84 billion [±0.17] over the next 20 years. More than half of the costs avoided come from a reduction in the incidence of stroke (£2.8 [±0.06] billion), lung cancer (£1.9 [±0.03] billion) and depression (£1.4 [±0.10] billion) (Figure 8).

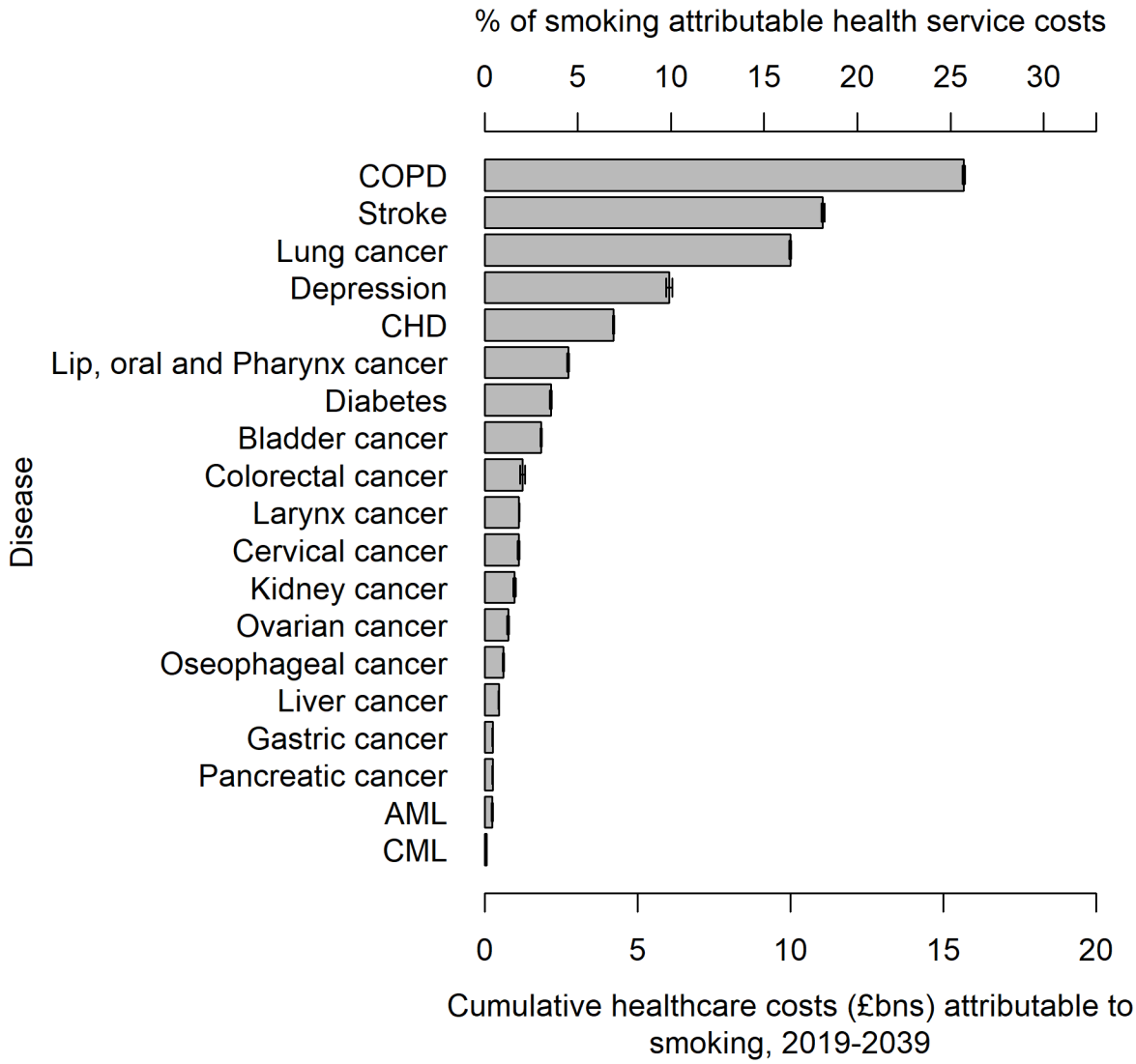



Figure 7: Smoking-attributable healthcare costs, by disease, as estimated by subtracting a 0% smoking prevalence scenario from the baseine scenario, 2019–2039.

*"Diabetes" is type 2 diabetes only. Error bars = 95% confidence interval.*

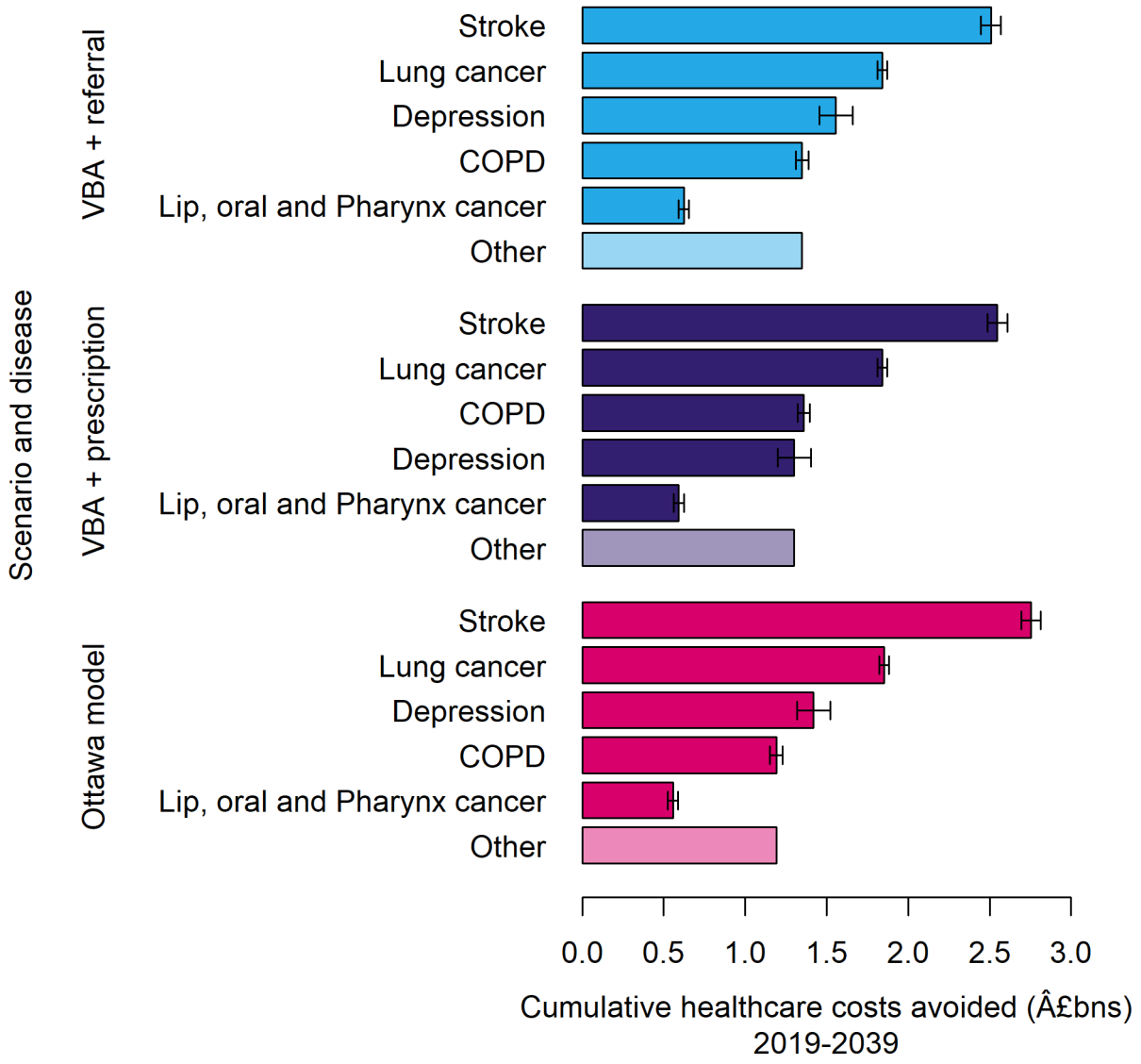



Figure 8: Healthcare costs avoided in intervention scenarios relative to baseline, by disease, 2019–2039.
*Only top five diseases shown for each scenario. "Diabetes" is type 2 diabetes only. Error bars = 95% confidence interval*

## 4.7 Wider societal costs

In the baseline scenario £106.7 [±1.0] billion of wider societal costs were predicted to be attributable to smoking over the next 20 years. Of this, £95.7 billion (89.7%) was related to morbidity costs, with the remaining £10.9 billion from mortality costs (Figure 9).

In the VBA with referral scenario £17.32 [±1.05] billion of wider societal costs were predicted to be avoided over the 20 years of the simulation. In the VBA with prescription scenario, this saving was £15.60 [±1.05] billion. Morbidity costs made up 90.0% and

88.7% of these costs for VBA with referral and VBA with prescription, respectively.

The Ottawa Model scenario reduced the wider societal costs associated with smoking by £16.28 [±1.05] billion between 2019 and 2039, relative to the baseline. The associated morbidity cost savings are highest, with £14.5 billion avoided relative to the baseline scenario.

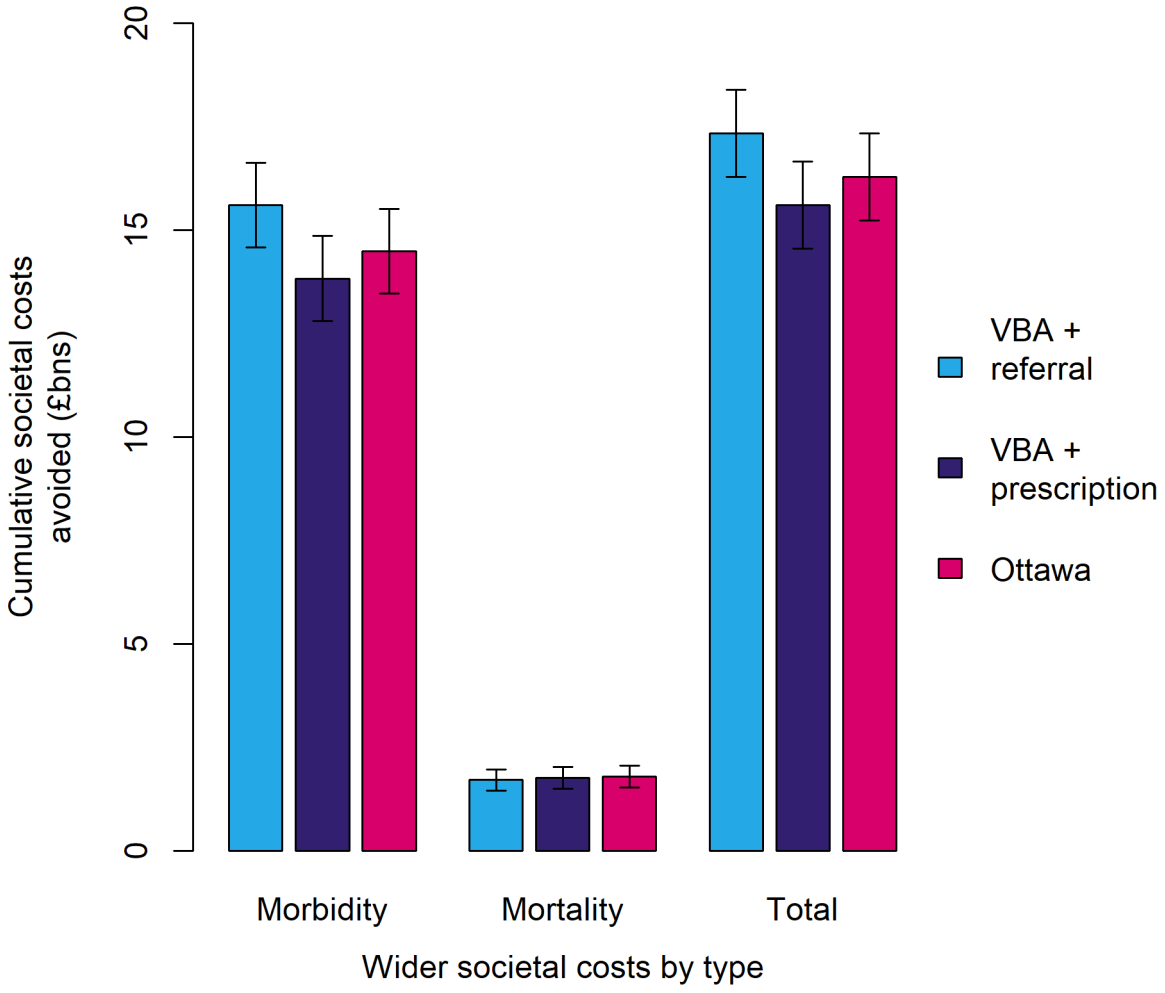



Figure 9: Wider societal costs avoided in each intervention scenario, 2019–2039.
*Error bars = 95% confidence interval*

## 4.8 Summary

A summary of cases and costs attributable to smoking, assuming current trends, can be found in Table 1. A table comparing intervention scenario outcomes can be found in Table 2.

Table 1: Cases and costs attributable to smoking, 2019–2039, assuming current trends.

| Measure | Cumulative output by 2039 |
|---|---|
| Cumulative disease incidence attributable to smoking, 2019–2039 | 2,974,220 [±10,871] |
| Premature mortality attributable to smoking, 2019–2039 | 552,025 [±9,618] |
| Healthcare costs attributable to smoking, 2019–2039 | £60.9 [±0.2] billion |
| Wider societal costs attributable to smoking, 2019–2039 | £106.7 [±1.0] billion |
| Primary care costs attributable to smoking, 2019–2039* | £8.3 [±<0.05] billion |
| GP appointments attributable to smoking, 2019–2039* | 276.9 [±0.6] million |
| Hospitalisations attributable to smoking, 2019–2039 | 3,882,734 [±10,193] |

*Square brackets = 95% confidence interval. *note that this is based on primary care costs for a subset of diseases only (CHD, COPD, type 2 diabetes, lung cancer, colorectal cancer and stroke)*

Table 2: Summary of scenario outcomes.

| | Scenario | | | |
|---|---|---|---|---|
| Measure | Baseline | VBA with referral | VBA with prescription | Ottawa Model |
| Smoking prevalence, 2039 | 5.8% [±0.1] | 4.0% [±<0.05] | 4.3% [±<0.05] | 3.9% [±<0.05] |
| Reduction in disease incidence, 2019–2039 | - | 455,119 [±11,595] | 433,378 [±11,595] | 457,294 [±11,595] |
| Avoided premature mortality, 2019–2039 | - | 89,299 [±9,618] | 88,578 [±9,618] | 90,808 [±9,618] |
| Healthcare costs avoided, 2019–2039 | - | £9.8 [±0.2] billion | £9.6 [± 0.2] billion | £9.8 [±0.2] billion |
| Wider societal costs avoided, 2019–2039 | - | £17.32 [±1.05] billion | £15.60 [±1.05] billion | £16.28 [±1.05] billion |
| Primary care costs avoided, 2019–2039* | - | £732.3 [±18.9] million | £719.0 [±18.9] million | £670.3 [±18.9] million |
| Average cost avoided per practice* | - | £85,658 [±2208] | £84,104 [±2208] | £78,403 [±2209] |
| GP appointments avoided, 2019–2039* | - | 24.4 [±0.6] million | 24.0 [±0.6] million | 22.3 [±0.6] million |
| Average per practice* | - | 2,855 [±74] | 2,803 [±74] | 2,613 [±74] |
| Hospitalisations avoided, 2019–2039 | - | 706,692 [±10,648] | 713,120 [±10,648] | 727,453 [±10,646] |

*Square brackets = 95% confidence interval. *Note that this is based on primary care costs for a subset of diseases only (CHD, COPD, type 2 diabetes, lung cancer, colorectal cancer and stroke)*

# 5 Discussion

This study used a microsimulation model to estimate the health and economic benefits of improving provision of smoking cessation interventions in general practice in the UK. Three intervention scenarios were modelled. The first two scenarios modelled GPs implementing VBA for smoking cessation and either prescribing people who smoke with smoking cessation pharmacotherapies or referring them to a SSS. The third scenario modelled GPs using the Ottawa Model for Smoking Cessation in primary care to provide smoking cessation support. Several conclusions can be made from the results of this simulation.

### Smoking will continue to be a major burden on our society if appropriate action is not taken to support people who smoke to quit

Despite reductions in smoking prevalence, smoking will continue to impact our society unless consistent, coordinated and evidence-based action is taken.

The baseline scenario, as modelled in this study, could be interpreted as a scenario where tobacco control policy and clinical practice continues to be implemented, and corresponding smoking prevalence continues to decline, at the same rate as the period on which the modelling was based (2010 to 2017). In this baseline scenario, this study predicts that adult smoking prevalence would reach 5.8% by 2039, and therefore fail to meet government targets of a smokefree England by 2030 and a tobacco-free Scotland by 2034.

Even if smoking prevalence continues to decline at current pace, smoking would continue to be a massive burden on our health service, with around three million cases of disease, and over half a million premature deaths, attributable to smoking between 2019 and 2039. This would cost the health service an estimated £60.9 billion over the modelled 20-year period, including over 276 million GP appointments, and 3.7 million hospitalisations attributable to smoking. Reducing the burden on the health service is critical for a workforce that is struggling to keep up with the increasing demand of a growing and ageing population. Wider societal costs from smoking-associated mortality and morbidity could amount to over £100 billion.

### Smoke cessation interventions delivered by GPs can substantially improve health and economic outcomes

All three general practice smoking cessation scenarios (VBA with referral, VBA with prescription, and Ottawa) showed vast reductions in disease (> 430,000 reductions), mortality (> 88,000 reductions), primary care costs (> £650 million), GP appointments (> 20 million), hospitalisations (> 700,000), total healthcare costs (> £9.6 billion saved), and wider societal costs (> £15 billion saved) over the modelled period of 2019 to 2039, demonstrating the impact of GP's supporting their patients to quit on population health and the reduced burden on the healthcare system and economy.

Under all three intervention scenarios, a smokefree ambition would be achieved by 2039; however in none of the scenarios was this ambition met by 2030. This emphasises that, although improving smoking cessation support delivered by GPs plays an important role in reducing smoking rates, it needs to be implemented as part of a comprehensive tobacco control strategy to achieve current government targets.

All three intervention scenarios resulted in similar outcomes by 2039. NICE guidance for England and Wales already recommends implementation of VBA across primary care, but evidence suggests that guidelines are not routinely followed[6]. This study indicates that greater compliance with this guidance would be beneficial to health and economic outcomes.

In this model, it was assumed that each intervention would be delivered to 75% of those who smoke attending their GP, in addition to those currently receiving interventions during GP appointments. This is a pragmatic estimate of what could realistically be achieved, and we would expect full implementation (i.e. delivering the intervention to everyone who smokes) to provide greater results.

For simplicity, this study only considered the impact of interventions delivered by GPs. Delivery of stop smoking interventions across the entire primary care system by a range of health professionals, including practice nurses, pharmacists, dentists, and other professionals, would provide greater opportunity for people who smoke to quit, and therefore potentially better outcomes than modelled in this study. Existing and emerging integrated healthcare systems, such as Primary Care Networks in England, have a role to play in prioritising and embedding evidence-based smoking cessation interventions in primary care.

### Smoking cessation should be provided in primary care as a complement to local SSS

Both VBA scenarios (VBA with referral to a SSS, and VBA with prescription) resulted in generally similar outcomes in this study.

Research demonstrates that use of SSS is one of the most effective ways to quit, with a success rate around three times higher than completely unaided quit attempts[18]. The combination of behavioural support and prescription offered by SSS is thought to be approximately additive[79], meaning that a quit attempt using a SSS is more likely to be effective than an offer of prescription alone. This benefit is reflected in the "VBA with referral" scenario's input parameters (Figure 2).

Patient uptake of SSS referrals is however relatively low. This may in part be explained by availability. The way in which SSS are delivered across the four UK nations varies significantly, with services being delivered across pharmacies and GP practices, specialist healthcare settings, in the community and through outreach teams depending on the local situation. Cuts to funding have also had an adverse impact on the availability of SSS, primarily in England, and in 2019 only 59% of local authorities in England commissioned a SSS open to all local people who smoke[7].

In contrast, VBA leading to prescription may show lower effectiveness, but greater uptake[32], something that was reflected in the "VBA with prescription" scenario's input parameters (Figure 2). The greater potential for uptake means that GP delivery of advice with prescription may reach many people who smoke who would otherwise not follow up on a SSS referral.

Although this study considered VBA with prescription and VBA with referral to SSS as separate scenarios, we would expect a combination of these interventions to be more effective than either delivered in isolation. It is therefore integral that any action in primary care should complement, rather than replace, locally-available SSS. Greater funding of SSS is a necessary part of ensuring that the best treatment is available to the largest number of people.

# Strengths and limitations

The simulation approach enables smoking cessation interventions to be quantified at a population level over many years where randomised designs may not be feasible due to expense and complexity. This is important as the impact of an intervention may only be observed many years into the future when non-communicable diseases have developed. Furthermore, the simulation approach allows a range of different interventions to be examined and compared concurrently.

To our knowledge, this is the first study to quantify the impact of increasing VBA in primary care on the future burden of smoking-related diseases and costs. This study also quantifies the impact of implementing the 'Ottawa Model for Smoking Cessation' in primary care in the UK. This is a well validated intervention which has been implemented in Canada but has currently not been trialled in UK primary care.

As with all predictive models, this work is based on past and current data, and does not take account major future changes in circumstances (e.g. new cessation drugs or technologies), or recent developments such as the menthol tobacco ban, and the COVID-19 pandemic that may impact smoking patterns. These effects could be estimated by altering parameters in the model, but these may increase model uncertainty. Given the time constraints of this study, it was not possible to carry out an in-depth uncertainty and sensitivity analysis. While we appreciate that this is good practice, there is a lack of validated datasets with which we can compare the outputs.

A drawback of the microsimulation method is that it is data intensive. Data are often obtained from a variety of sources, and therefore are not always standardised. Also, there are frequently data gaps, so sophisticated statistical techniques are required to calculate missing data from the information that is available. For example, current incidence and mortality data for diseases other than cancers were difficult to acquire. Where such data did exist, they were not always disaggregated by age for the UK. Costs were taken from the literature and thus rely on a variety of methodologies. Future iterations of the microsimulation model could incorporate a more sophisticated direct cost model that takes account of variation in cost based on disease progression and severity. Additionally, this model only includes a selection of 19 smoking-related non-communicable diseases. People who smoke are at higher risk from various respiratory infections including influenza, pneumonia, and tuberculosis[80,81], and by not including such communicable diseases the study may have underestimated the impact of smoking on health and economic outcomes.

Finally, as input parameters for scenarios (such as quit rates, uptake rates, etc.) have a level of uncertainty around them, comparison of scenarios should be considered for their overall magnitude rather than precision.

Further limitations regarding the microsimulation methodology and data are outlined in Appendix 1.

## Future work

A challenge to achieving further reductions in smoking prevalence is reaching the most at-risk groups, including those of lower socioeconomic status (SES) or those diagnosed with mental illness. A future project will build on this work by projecting smoking prevalence by socioeconomic group and assessing the effect of primary care smoking cessation support on smoking inequalities across socioeconomic groups.

# 6 Policy Recommendations

Smoking continues to harm and kill hundreds of thousands of the UK population every year, despite being entirely preventable. Across the UK, the introduction of robust tobacco control policies over a number of decades has led to significant declines in smoking rates, much of which can be attributed to reducing smoking uptake among young people[82]. But continued action across local and national governments and the health service is paramount to support people who smoke to quit and reduce the burden of smoking across our nation. Stopping smoking is one of the best things a person can do to improve their health, and interventions to support people to stop will not only help to build a healthier population but, will lower baseline demand on the health and social care system and improve its capacity to respond and recover from future threats to public health.

Recently, there has been greater emphasis on and commitment to treat smokers admitted to acute care across the UK, with the NHS England Long Term Plan committing to fund tobacco dependency treatment for all patients admitted to hospital by 2023/2[8]. However, these interventions impact a smaller number of people who are typically older, sicker and living with comorbidity. To provide a larger number of people with support to quit, more needs to be done in primary care.

This report has demonstrated that greater action in the health service to support smoking cessation, and specifically in general practice, will reduce morbidity and mortality rates, and reap substantial health service and cost savings for the UK. However, GPs comprise a small, albeit important, profession in the wider primary care workforce. To see even greater benefit for the interventions modelled, smoking cessation support could be delivered by a wider range of primary healthcare professionals including practice nurses and pharmacists. The recommendations outlined below are therefore applicable to primary care more broadly.

## Systematically embedding smoking cessation support in primary care

Three different models for delivering smoking cessation interventions in general practice were considered in this report – VBA followed by referral to a stop smoking service, VBA followed by prescription and the Ottawa Model for Smoking Cessation. This study found that increased implementation of all of these interventions individually showed similar but vast improvements to health and economic outcomes compared to usual practice. In fact, taking into account model error, in many instances there was no significant difference in outcomes between the modelled interventions. Systematically embedding VBA on smoking in primary care would provide substantial benefits and can be more easily integrated into current UK clinical pathways, as it is already recommended by NICE in England and Wales. The training modules are also readily accessible through the National Centre for Smoking Cessation and Training (NCSCT). In addition, evidence-based smoking cessation interventions (including pharmacotherapies and specialist SSS) are widely available across the UK and should be used as standard.

Therefore, we recommend that:

**Primary care professionals (including GPs, practices nurses and pharmacists) across the UK should systematically** deliver smoking cessation interventions to patients who smoke. In line with the NICE guidance for England and Wales, this means they should:

- Undertake training in delivering VBA on smoking.
- Routinely deliver VBA on smoking in consultations with patients who smoke.
- Offer evidence-based interventions to patients to support them to stop smoking, including systematically prescribing patients who smoke with pharmacotherapy for smoking cessation, accompanied with brief advice and, where available, referring them to local stop smoking services for further ongoing support.

In England, where the commissioning of stop smoking services (SSS) is the responsibility of local authorities, there has been significant reductions in the number of prescriptions made by the NHS for smoking cessation medications such as varenicline and nicotine replacement therapy[83]. As such, we recommend:

**Primary care commissioners should** repeal any restrictions placed on prescribing smoking cessation pharmacotherapy.

Furthermore, cuts to funding have had an adverse impact on the availability of SSS in England—and in 2019 only 59% of local authorities commissioned a SSS open to all local people who smoke[7]. Therefore:

**Local authorities in England should** ensure they offer a SSS, accessible to all those who smoke in their area, and promote this service to local primary care professionals.

This study looked at the economic and health benefits of delivering smoking cessation interventions to 75% of people who smoke attending GP appointments in addition to those already receiving these interventions. The potential benefits to the UK's health, health system and economy are significant, but reaping these rewards will require the widespread and systematic roll out of smoking cessation interventions in primary care. Driving this roll out must be a priority for national health services across the UK. Therefore, we recommend that:

**National health service commissioners should** introduce effective commissioning levers to make the delivery of smoking cessation interventions widespread and systematic throughout primary care.

# 7 Appendices

The appendices attached to this report describe further the methodology of the microsimulation, the input data and the scenario assumptions. The appendices are as follows

- Appendix 1: Technical appendix
- Appendix 2: Scenario assumptions and data
- Appendix 3: Direct health service costs by disease
- Appendix 4 Disease data inputs
- Appendix 5: Projected health and economic burden of smoking

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