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OF MEN'S HEALTH
MOUSTACHES LOVE RESEARCH

The Real Face of Men's Health

modelling the cost of men's ill health in the UK and the impact of increased uptake to health checks on CHD, lung cancer, colorectal cancer, stroke, and COPD in the population of England from 2024 to 2040 - conducted by health lumen in 2024

SUMMARY OF PHASE 1 AND 2 METHODOLOGY



Phase 1:



OVERVIEW

This study assessed the cost of men's ill health across six countries: Australia, Canada, Ireland, New Zealand, the United Kingdom, and the United States.

The 2019 Global Burden of Disease study by the Institute of Health Metrics and Evaluation was used to identify the top five leading causes of years of life lost (YLL) in these countries (Table 1) (1). Direct healthcare costs and indirect costs for the diseases of interest were also identified through a literature search. Official government sources were considered the most robust and accurate estimate of disease cost. If no official government sources were identified, costs from the published literature or grey literature sources were identified.

HEALTH ECONOMICS

National and per-patient costs were included in this analysis. Where national cost estimates were chosen, costs were divided by the estimated patient population from the cited cost year, to obtain per-patient costs. These costs, as well as any per-patient costs identified, were then multiplied by the projected estimate of the male patient population in 2023, to obtain male disease cost estimates. Costs were then converted to the country's local currency, and inflated using the CCEMG-EPPI purchasing power parity (PPP) tool from the cited cost year to 2023 for phase 1, and to 2024 for phase 2, using International Monetary Fund (IMF) 2022 data (2,3).

Preventable costs of disease were calculated by multiplying the estimated male cost in 2023 by the proportion of disease caused by mitigatable factors. Suicide and drug use disorder were assumed to be completely preventable. The proportion of avoidable coronary heart disease (CHD) costs was calculated by multiplying the cost of disease by the percentage of cases that are in men aged under 75 and then multiplying by the relevant percentage of disease that is found to be preventable.

Male disease cost estimates were also used to estimate the cost per male of the diseases of interest. This was achieved by dividing the male disease cost estimates by the total estimated male population of the country of interest in 2023, taken from the United Nations, World Population Prospects 2022 data (4).

Costs used in this study were estimated through various cost approaches across the published literature, and as such, costs between diseases are likely to be incomparable.

TABLE 1: TOP 5 LEADING CAUSES OF YEARS OF LIFE LOST PER COUNTRY

COUNTRY OF INTEREST	LEADING CAUSES OF YLL
Australia	COPD, CHD, lung cancer, stroke, and suicide.
Canada	COPD, CHD, colorectal cancer, lung cancer, and suicide.
Ireland	COPD, CHD, colorectal cancer, lung cancer, and suicide.
New Zealand	COPD, CHD, lung cancer, stroke, and suicide.
United Kingdom	COPD, CHD, colorectal cancer, lung cancer, and suicide.
United States	COPD, CHD, colorectal cancer, lung cancer, and suicide.

COPD, chronic obstructive pulmonary disease; CHD, coronary heart disease

Phase 2:

OVERVIEW:

This study utilises a well-validated microsimulation model which has been well validated across multiple studies globally (5-7).

The model is comprised of five modules:

Population
Risk Factors
Disease epidemiology
Economic
Intervention

And these modules require demographic, epidemiological and economic data inputs to build simulated outputs. Each virtual individual within the model is assigned an age, sex and a risk value each for body mass index (BMI), blood pressure and smoking status. These factors then in turn confer a risk of developing, dying from or surviving colorectal cancer, chronic obstructive pulmonary disease (COPD), CHD, lung cancer, and stroke.

POPULATION MODULE:

To simulate a virtual population representative of the England population, we used data derived from the Office for National Statistics (ONS), including age-sex disaggregated population statistics and projections, total deaths in 2024, number of births by mother's age in 2024, and the total fertility rate of England (8).

The population is created in the start year specified by the microsimulation, and uses population projections to propagate the population throughout the years. This data is used to make the population dynamic, accounting for births, deaths, and migration. Individuals within the model can die of specific diseases or from other causes. The mode was run from 2024 to 2040, with 80 million individuals being simulated.

RISK MODULE:

BMI, smoking, and blood pressure are leading risk factors for several different non-communicable diseases and are routinely assessed in the NHS health check. The risk module projects BMI, smoking, and systolic blood pressure (SBP) trends forward to 2040. BMI and SBP data was obtained from the Health Survey for England (9), and smoking data was obtained from the Annual Population Survey (10).

BMI categories are defined as 'normal weight' (BMI 25), 'overweight' (BMI 25 - 30), and 'obese' (BMI 30). SBP categories are defined as 'normotensive' (120 mm/Hg), 'pre-hypertensive' (120 - 140 mm/Hg), and 'hypertensive' (140 mm/Hg). Smoking status categories are defined as 'never-smoker', 'ex-smoker' and 'current-smoker'. Smoking refers only to cigarette smoking and does not include vaping due to the lack of available data. Individuals who have never smoked can become smokers, and smokers can become ex-smokers dynamically. The ex-smoker population is defined at the start year, and once an individual becomes an ex-smoker, they cannot move into other categories. BMI and SBP change dynamically throughout the simulation. Logistic multinomial regressions were performed for BMI and SBP using data between 2009 and 2019, and for smoking using data between 2016 and 2021. Regression projections were disaggregated by sex and 5-year age groups, with the exception of the under 20 and over 75 groups, where larger groups were included due to small sample size. These regressions are extrapolated forward to provide annual estimates of the proportion of people who fall into each risk category between 2024 and 2040. These probabilities are constrained to a total value of 1. Each individual in the model has a discrete SBP and BMI value, which are obtained through a Gaussian distribution of continuous data obtained through the aforementioned logistic multinomial regressions of HSE data. Individuals also have a probability of being a smoker and ex-smoker.

DISEASE MODULE:

We modelled five diseases as outcomes for this study: colorectal cancer, COPD, CHD, lung cancer, and stroke. Data on disease incidence, prevalence and mortality disaggregated by sex and five-year age groups was taken from the 2019 Global Burden of Disease study by the Institute of Health Metrics and Evaluation (IHME) (1). Lung and colorectal cancer survival data was taken from the Cancer Research UK Cancer Statistics Data Hub 2021 (11), whilst survival for the other non-communicable diseases was calculated using incidence, prevalence and mortality rates in the microsimulation. Relative risks for smoking status were obtained for each disease, whilst relative risks for BMI and systolic blood pressure were obtained for colorectal cancer, CHD and stroke, due to the lack of conclusive associations with COPD and lung cancer (12-17). Individuals' probability of an incident disease in a particular year depends on their age, sex, blood pressure level, BMI, and smoking status, in that year. Relative risks are applied to all individuals in the microsimulation.

INTERVENTION MODULE:

Both a baseline scenario and intervention scenario are simulated. The baseline scenario is the continuation of standard of care, so no changes are implemented. The intervention scenario is the uptake of NHS health checks to 75% attendance (from 38.03% in males, and 43.96% in females in 2017-2018 (22)) of individuals between the ages of 40-74 who did not have CHD or stroke at time of assessment, and did not attend health checks in the baseline scenario, probabilistically determined through the aforementioned attendance rates. Individuals are assessed every 5 five years on eligibility for an NHS health check, and if they meet the criteria above, they have a 59.65% chance if male, and a 55.39% chance if female, to attend an NHS health check in the model.

Virtual individuals who attend the NHS health check experience impacts on their risk factor levels. The impacts of health checks on BMI, SBP and smoking status are: BMI reduces by **0.3 kg/m²** if the individual's BMI is 30 kg/m² at the time of their health check; SBP reduces by **3.22 mm/Hg** if their SBP is 140 mm/Hg at the time of their health check; and smokers who attend a health check have a **6.35%** chance of quitting (23-25).

Changes to BMI and SBP are assumed to occur in the year following their health check and remain sustained along dynamic risk factor trends through to their next health check, the end of the simulation or until death. If an individual remains in the high-risk BMI and SBP groups in any subsequent health check, the same intervention effect occurs. Individuals who quit smoking as a result of the health check move from the smoker to ex-smoker risk group.

Both those that did attend an NHS health check in a specific year, as well as those that didn't but were eligible to receive one, return to the general population, and become eligible again to receive an NHS health check after 5 years.

MODEL OUTPUTS:

Outputs of the microsimulation of the baseline scenario are: annual and cumulative incidence, and cumulative direct and indirect costs. Outputs of the intervention scenario also include outputs mentioned for baseline scenario, as well as: cumulative incidence avoided, cumulative direct and indirect costs avoided, and cumulative years of working life years and QALYs gained. Risk factor trends are also outputted.

LIMITATIONS OF MICROSIMULATION MODEL AND INTERVENTION SCENARIO:

There are some limitations involved with microsimulation modelling, as well as the health check intervention scenario. Firstly, this study is unable to account for future changes in treatments, technology or policies that may occur over subsequent years. Differential impacts of health checks on BMI, SBP, and smoking, in different age or sex groups, in addition to original risk level are not captured due to the lack of available data. In the intervention, individuals who become ex-smokers are assumed to never become a smoker again: this has partially been addressed by using one-year quit rates, as opposed to quit rates of shorter duration. We have also assumed that every eligible person would receive an invitation, and that the NHS would have appropriate capacity and resources to deliver the increased number of health checks and carry out the appropriate follow-ups.

Prevalence, incidence and mortality estimates for modelled diseases were taken from the international Global Burden of Disease study, which does not solely draw from UK sources: as such, estimates used here may differ from country specific estimates.