# Modelling Future Health: Predicting Health with changing obesity using Micro Simulation

Johns Hopkins Global Center on Childhood Obesity April 9<sup>th</sup> 2013

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Chair: UK Health Forum (was National Heart Forum)

Micro Health Simulations





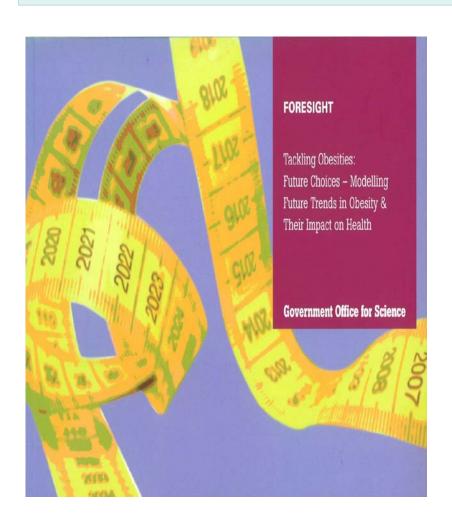
#### Where Systems Science meets Public Health - and Public Policy?

Lord Turner
UK Pensions Commission - 2005
A New Pension Settlement for the 21stCentury

"Poor lifestyle trends such as increasing obesity among young adults and children may in the long-term reduce the increase in life expectancy, but over the next 30 years they could make the burden on the working population worse, since {these trends} may reduce the number of healthy working-age people more than they reduce the number of elderly pensioners. "

(two later references, but no follow up)

#### Foresight Tackling Obesities 2007



#### Fore sight

Tackling Obesities: Future Choices – Modelling Future Trends in Obesity and the Impact on Health

2<sup>nd</sup> Edition

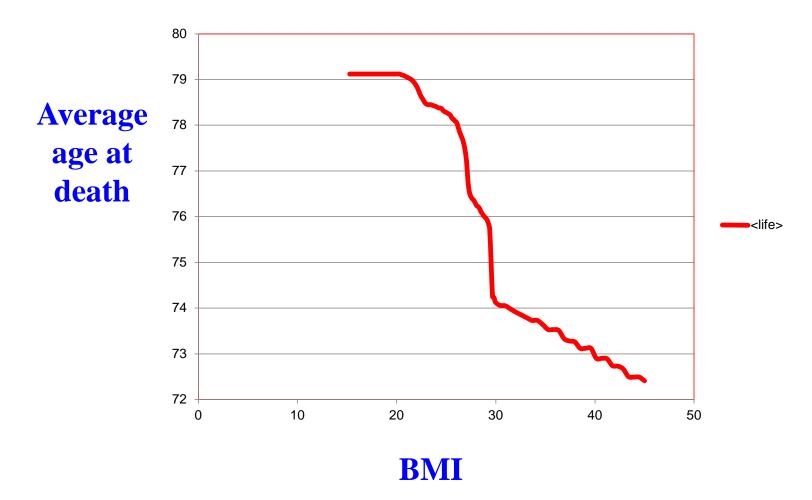
Klim McPherson, University of Oxford Tim Marsh, National Heart Forum Martin Brown. Martin Brown Associates

This report has been produced by the UK Government's Foresight Programme. Foresight is run by the Government Office for Science under the direction of the Chief Scientific Adviser to HM Government. Foresight creates challenging visions of the future to ensure effective strategies now.

Details of all the reports and papers produced within this Foresight project can be obtained from the Foresight website (www.foresight.gov.uk). Any queries may also be directed through this website.

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### BMI and Male Life Expectancy, age 25 in 2010. From micro simulation.....





#### Foresight

Scoping

#### What Foresight did -<del>2005-7</del>

Underpinning review of evidence base **Systems mapping Qualitative modelling** of policy response impact **Scenario development Development of quantitative** 

**Analysis** and **implications** for policy

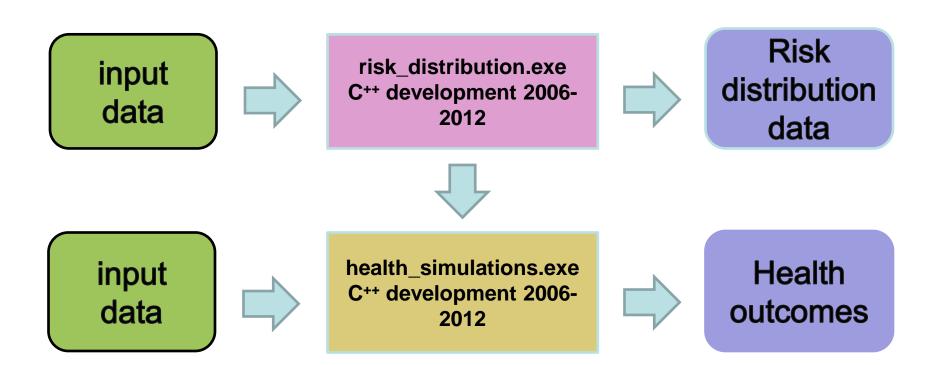
model and analysis

#### Questions

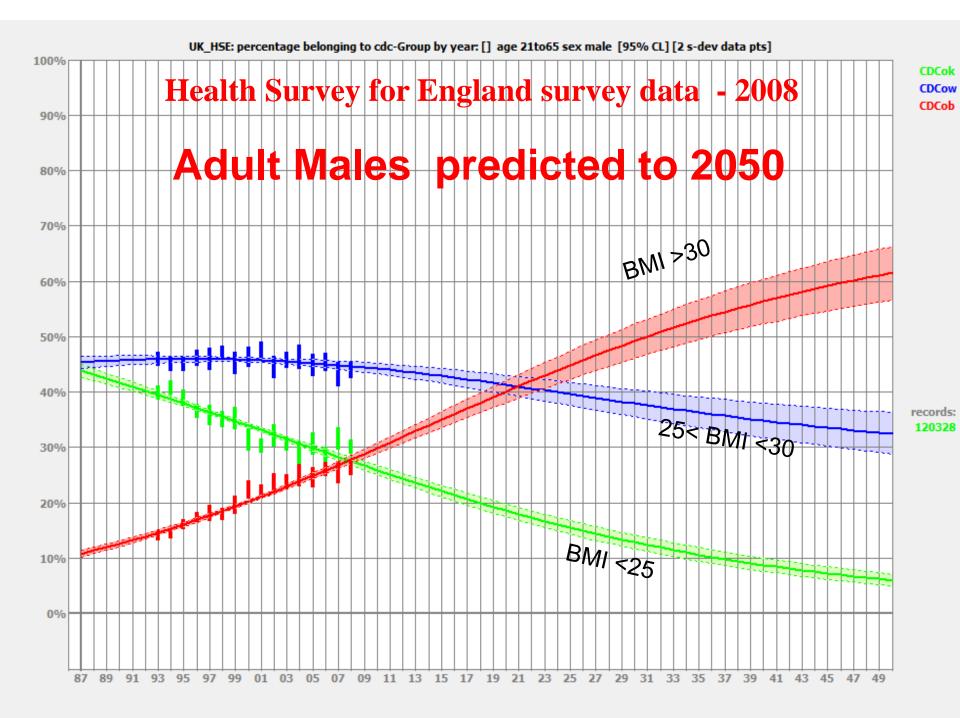
- What are the distributions of obesity, among whom, how are they likely to develop over the next forty years (by age, gender, ethnicity.....)
- What are the likely health consequences of extrapolated obesity trends and
- By how much can these consequences be attenuated with different interventions



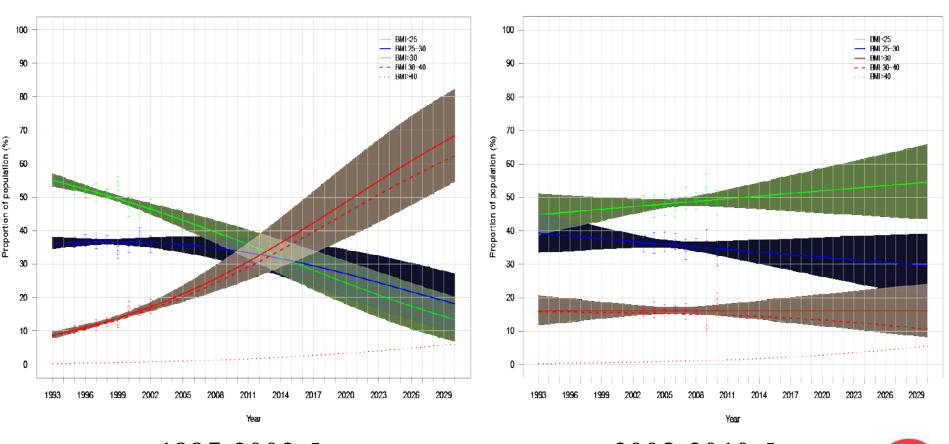
#### Our response: Two systems responses







#### Age 16-39 M

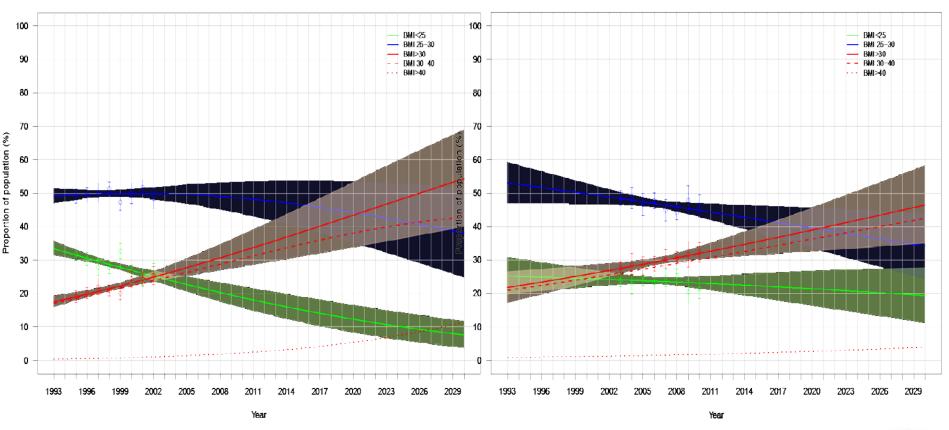


1995-2002 data

2003-2010 data



#### Age 40 - 59 M



1995-2002 data

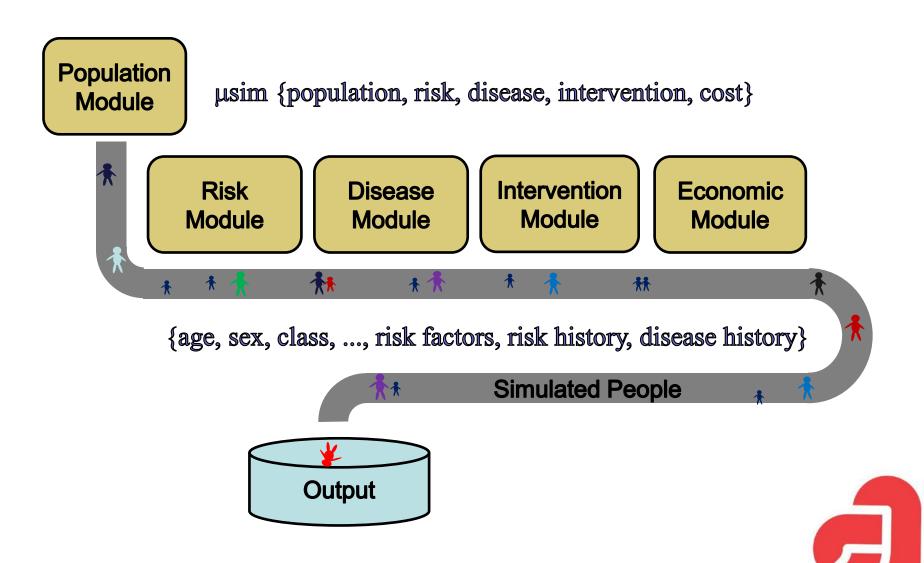
2003-2010 data



#### Module 2: Micro-Simulation

- Computer model of a specified population (1993-2050)
- Population accurately reflects age profiles, birth, death and health statistics to make future projections
- Model specifically targets the relationship between individuals' evolving risk factors and disease incidence (several million individuals)
- Risk factor distributions are determined by predictions & specified health interventions
- The model can simulate and compare the impact and cost of various public health interventions, with no intervention
- Simulations for over 70 countries at present

#### Micro-Simulation



#### 

#### **Basic epidemiology**

People are stochastically generated from known, or forecast, demographic, behavioural, econometric, multiple disease-risk factor and disease prevalence distributions.

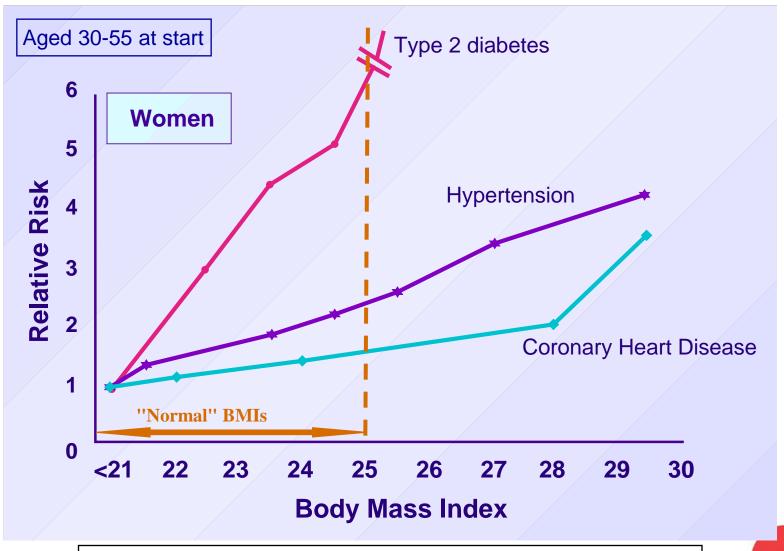
In their simulated lives people stochastically acquire any number of common diseases, depending on exposure, age and sex and risk.

A disease, once acquired, will be modelled by its own disease model.

Disease models allow for survival, remission, basic costs, quality of life and death and, subject to available data, may be expanded to include costed treatment models

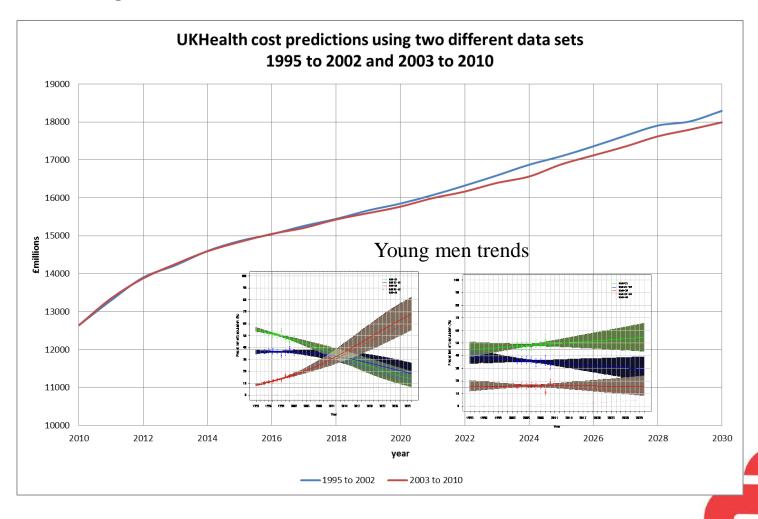
Massively data dependent and greedy. Fidelity essential – must be open and scrupulously and publicly validated

## Risks markedly increase within "normal" BMI range

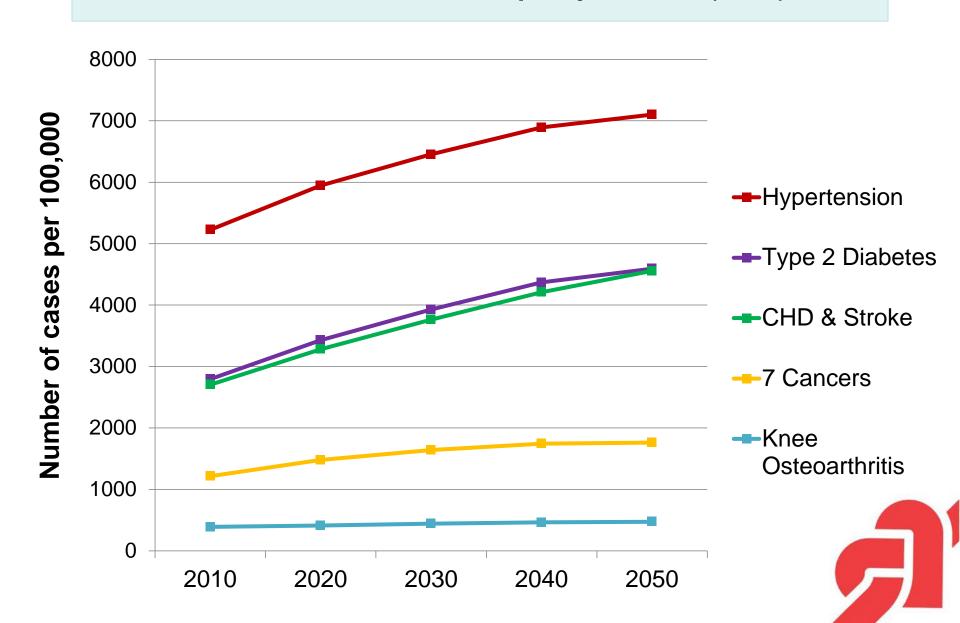


Adapted from Willett, Dietz & Colditz, NEJM, 1999; 341, 426-434

#### Projected UK NHS costs



#### Prevalence cases projected (UK)





-164 -366

#### Interventions

- The micro-simulation enables us to test various policy interventions
- Next we have tested the impact of a 1% and 5% decrease of the mean BMI across the entire population
- Outputs are for disease prevalence and healthcare costs

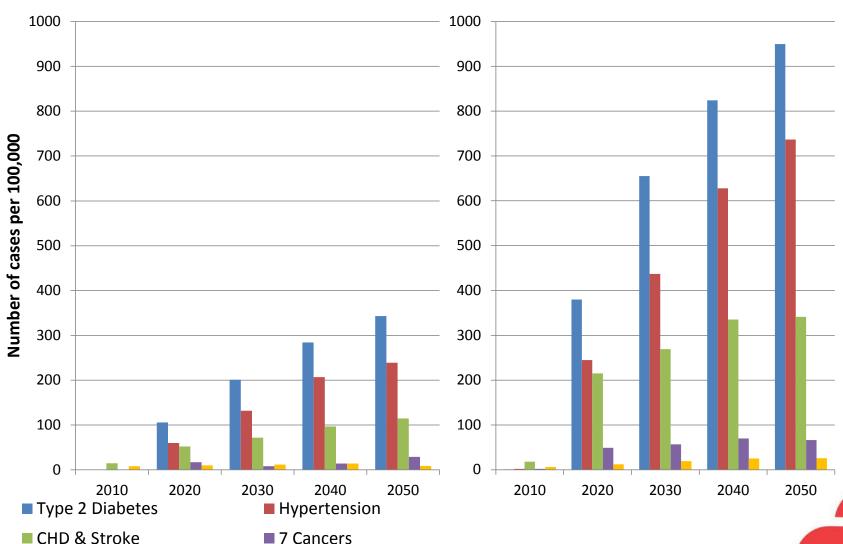


#### Prevalence cases avoided (UK)

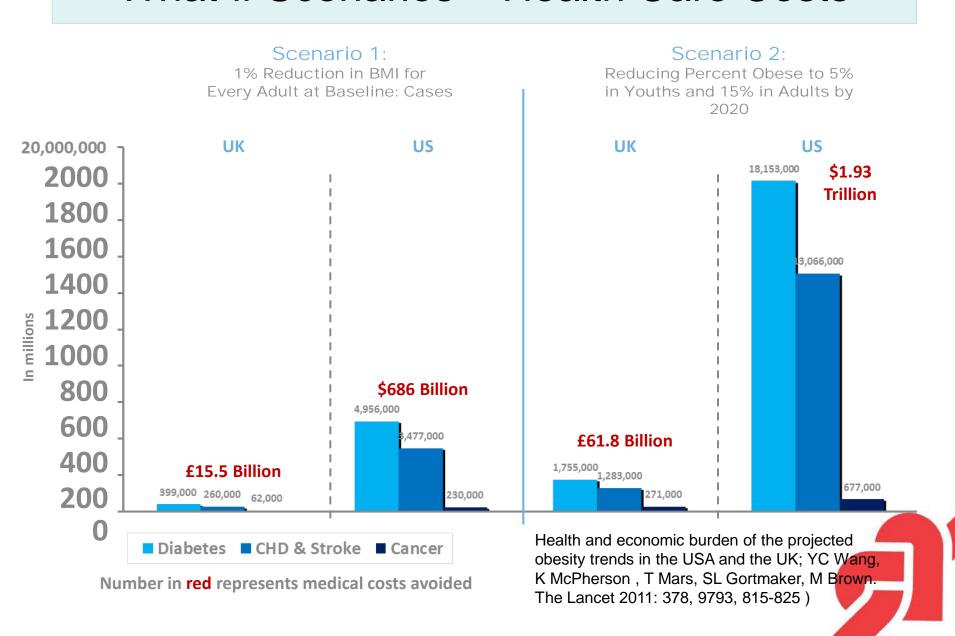


Knee Osteoarthritis

#### 5% decrease in mean BMI



#### What-if Scenarios – Health Care Costs



# Test evidence based PH policy options: Health Gain and reduced health expenditures

- Taxes and subsidies
- Socially responsible investments
- Labelling and marketing
- Independent health monitoring, particularly of self regulation
- HIA integrated into wider economic appraisal
- Product standards
- Etc

To be fully implemented



#### Reports





#### Collaborators

- World Health Organisation (Global), Euro and PAHO
- OECD
- DG Sanco
- NICE, Department of Health (England)
- Governments: US, Russia, Brazil, Portugal Mexico, Ireland
- UK Universities: LSHTM, UCL, Cambridge, Oxford, Liverpool, Bristol
- Johns Hopkins, Harvard, Columbia, Helsinki, Warsaw, Groningen, Kaunas, Moscow, Sao Paulo

#### Work in progress and the future

- Obesity (over 70 countries)
- Tobacco
- Physical Activity
- Alcohol
- Salt
- Saturated Fat
- CVD
- Respiratory disease
- Type 2 Diabetes
- Kidney Disease
- Alzheimer's



#### The OECD overview on modelling



"The NHF microsimulation model projects public health expenditures associated with leading diseases where obesity is a significant risk factor. The model simulates and evaluates how future trends may change in response to policies to reduce the prevalence of obesity...

...New work has extended the model to focus on smoking and smoking-related diseases and the model is extensible to a broader range of risk factors and diseases."

#### Thank you!

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#### Work throughout the World



#### Public health commissioning in the NHS from 2013

Department of Health sent this bulletin at 15-11-2012 02:36 PM GMT

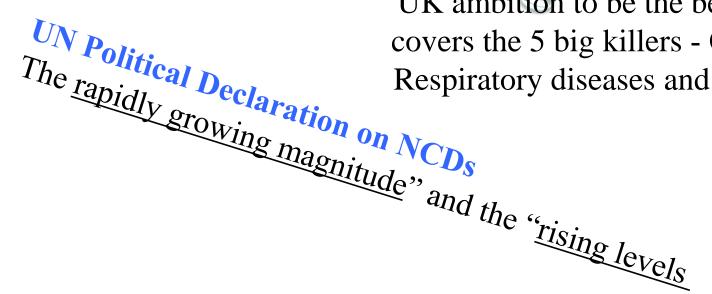
Public health commissioning in the NHS from 2013

15-11-2012 01:50 PM GMT

# Public Health England – Avoidable Mortality

Focus under 75's,

UK ambition to be the best in Europe,
covers the 5 big killers - CVD, Cancer,
Respiratory diseases and Liver disease





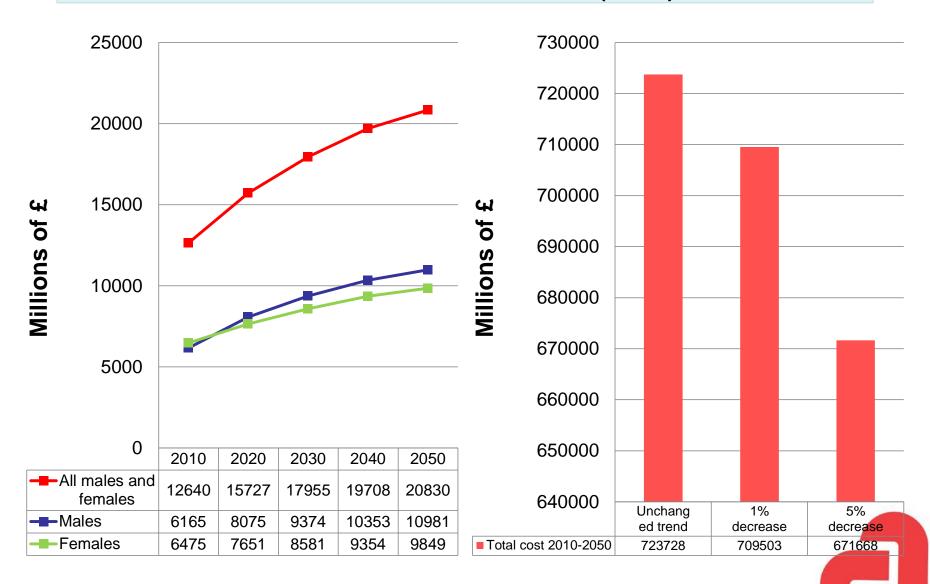
# Ability to reliably project these into the future, by age, gender, place, SES and ethnicity — ANNUALLY

No reliable theory on the form.

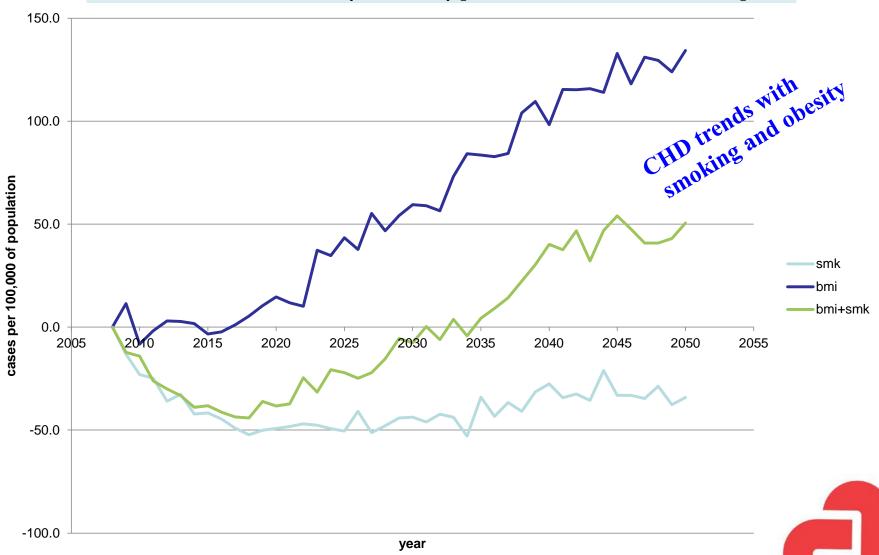
Has to be empirical and data driven

Need more experience

#### Economic burden (UK)



## Additional (relative to 2008) incidence of CHD in England allowing for future tobacco consumption (smk), obesity growth (bmi), and a combination of both (bmi+smk) [1 million Monte-Carlo trials]



#### Health care cost savings (US \$)



