The Impact of Medical Advances and Lifestyle on Mortality

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Background

1. Mortality Scoping Project
2. Social Policy Board

Actuaries' Panel on Medical Advances

Terms of Reference:

"*To identify major medical advances and changes in environment or habits that have altered levels of mortality and health needs …*"

(a) IHD & stroke: Smoking, statins & obesity

(b) Breast cancer: Trastuzumab - Herceptin

Scoping Mortality Research

Report of the findings of the
Actuarial Profession's Mortality
Developments Scoping Project

UK Actuarial Profession's Mortality Developments Scoping Group

- Set up late 2006
- Includes representatives from the actuarial profession, medicine, medical sociology, demography and ONS

Aims of the Mortality Developments Scoping Group

- To provide an overview of research undertaken by:
  - The actuarial profession
  - Medicine
  - Epidemiology
  - Gerontology
  - Demography
  - Health economics
  - Medical sociology
  - Social policy
  - Psychology
- Identify overlaps and gaps in the research

Methodology

- Challenges
- Identification of key people working in various disciplines
- Expert recommendations

Methodology – weaknesses and strengths

- Weaknesses
  - Not a comprehensive review of the literature
  - Potential for bias in selection of the experts

- Strengths
  - Literature compiled from experts recommendations
  - Creation of an informal network aware of Actuarial Profession's interest in mortality developments

Results

- 38 experts contacted of whom 22 contributed a list of research

- Generating a list of over 90 pieces of research

Themes

- The role of medicine
  - Recommended by experts from medicine and medical sociology
  - Research recommended considered the overall contribution of medicine to the decline all-cause mortality

- Lifestyle and environment
  - Smoking
  - Socio-economic circumstances
  - Obesity
  - Alcohol
  - Diet
  - Physical activity

Themes

- Causes of death
  - Coronary heart disease
  - Stroke

- Age groups
  - Childhood and younger adults
  - Middle age
  - Oldest-old

Themes

- Active life expectancy
- The cohort effect
  - 1925-44 cohort
  - Early life influences
- Actuarial views on the future of life expectancy

Questions raised

- What role does medicine play in mortality decline and what role will medicine play in any future declines?
- What is the relative contribution of medicine and risk factor reduction to the decline in mortality from coronary heart disease?
- What causes ageing?
- Is ageing a separate condition from disease?
- Is ageing an underlying cause of death?
- Is there a maximum limit to human longevity?
- Will longevity continue to increase in the future? will the 1925-44 cohort continue to see greater mortality improvement than those born on either side of these dates?

Areas of overlap

- Overlap in research being conducted by different disciplines
- Overlap amongst papers recommended by experts in different disciplines

Gaps in the research recommended

- Diet, obesity, alcohol and physical activity
- Causes of death other than CHD and stroke
- Adverse influences on future longevity increase
- Effect of climate change

Conclusion

- Scoping project only first step in mapping field of mortality developments
- Generation of interest in subject and potential future research and collaboration

Applications of a Model for Ischaemic Heart Disease and Stroke: Smoking, Statins and Obesity

Tushar Chatterjee, Angus Macdonald & Howard Waters

IHD & Stroke: Model

- Individual life history model
  - IHD, stroke, Death
- Data
  - Framingham Heart Study (1948 – 1998)
  - Health Survey for England (2003)

Risk factor	Risk Factor	Levels
Age	Body Mass Index (BMI)	5
Sex	Diabetes	2
Smoking	Hypertension	4
	Hypercholesterolaemia	4

Application - Smoking

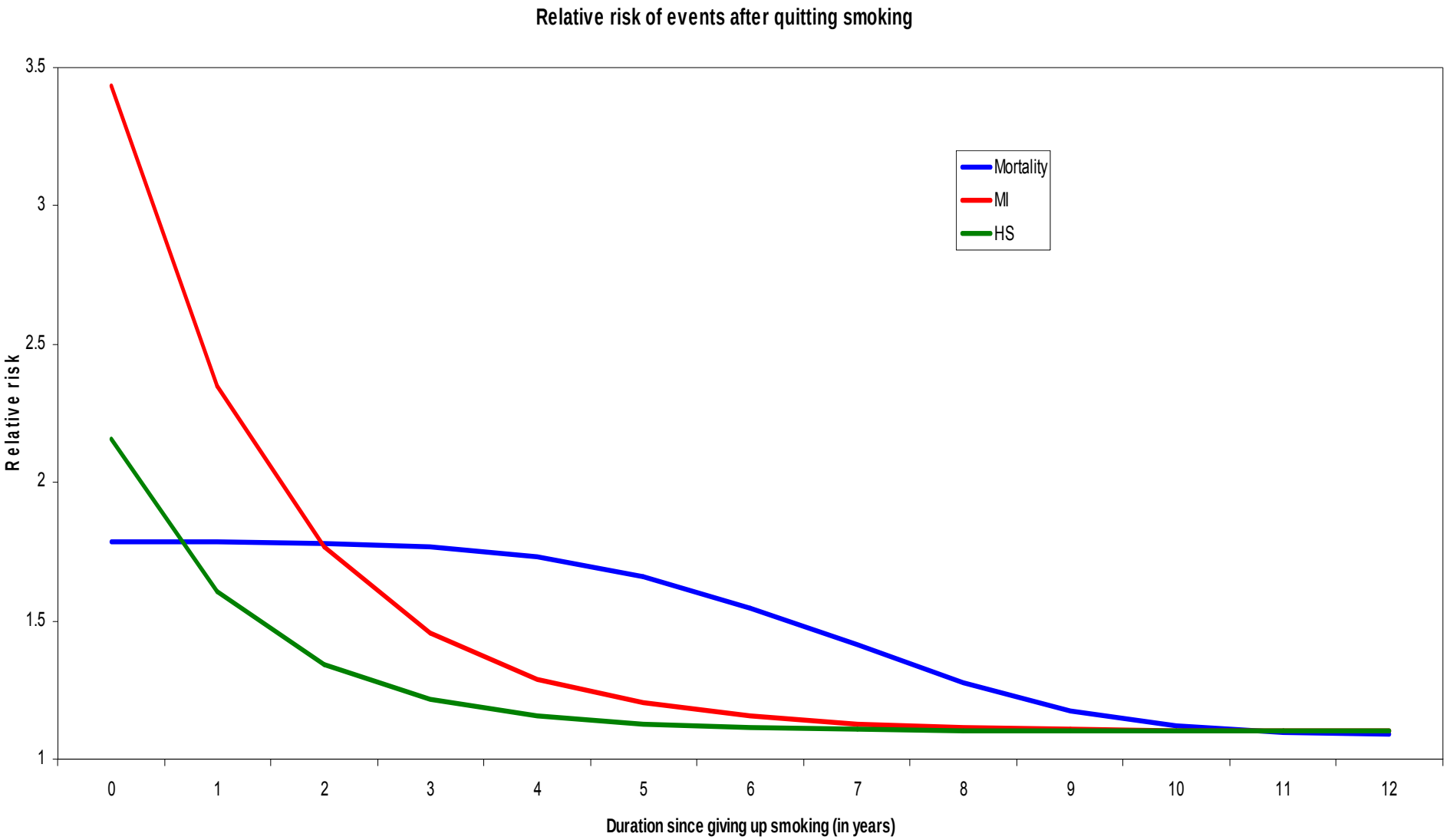
Direct risk factor for:

- IHD
- Stroke
- Mortality

Models for relative risk:

- Depend on smoking profile: current smoker, never smoked or duration since stopping
- Do not depend on sex or age
- Do not depend on number of cigarettes smoked
- Do not depend on years as a smoker

Application - Smoking



Application - Smoking

	Expected future lifetime from age 20		Expected future `Event free' lifetime from age 20	
Smoking profile	Male	Female	Male	Female
Never smokes	58.6	62.4	53.2	58.2
Gives up at age 30	57.2	61.2	51.8	56.9
Gives up at age 50	55.8	60.2	50.0	55.7
Gives up at age 70	52.7	57.8	46.8	53.0
Always smokes	51.5	56.1	45.8	51.4

Application - Statins

Hypercholesterolaemia is a direct risk factor for IHD and mortality, but not stroke.

Statins:

- are drugs which lower cholesterol (LDL)
- a standard dose reduces LDL by 1.8 *mmol/L*
- reduce the relative risk of IHD and stroke whatever the initial level of LDL
- were first licensed in 1987
- have been developing since then (Rosuvastatin 2003)
- have been widely prescribed since the mid-1990s

Application - Statins

Standard dose: reduction in relative risk

- Data: Wald and Law (BMJ 2003)
- Stroke: 17%
- IHD (MI):

Year of treatment	Reduction in relative risk %
1	19
2	39
3 - 5	51
6 +	55

Application - Statins

Treatment protocol: Males aged 50+, Females aged 60+

(Prof R Boyle, National Director for Heart Disease and Stroke, July 2007)

	Expected future lifetime from age 20*		Expected future `Event free' lifetime from age 20*	
	Males	Females	Males	Females
Treated	59.2	62.7	54.3	58.8
Untreated	58.6	62.4	53.2	58.2

* Never smokes

Application - Obesity

Body Mass Index = (Weight kgs)/(Height mtrs)^2

Category	BMI range
Underweight	BMI ≤ 18.5
Lightweight	18.5 < BMI ≤ 25
Overweight	25 < BMI ≤ 30
Moderately obese	30 < BMI ≤ 40
Morbidly obese	40 < BMI

Application - Obesity

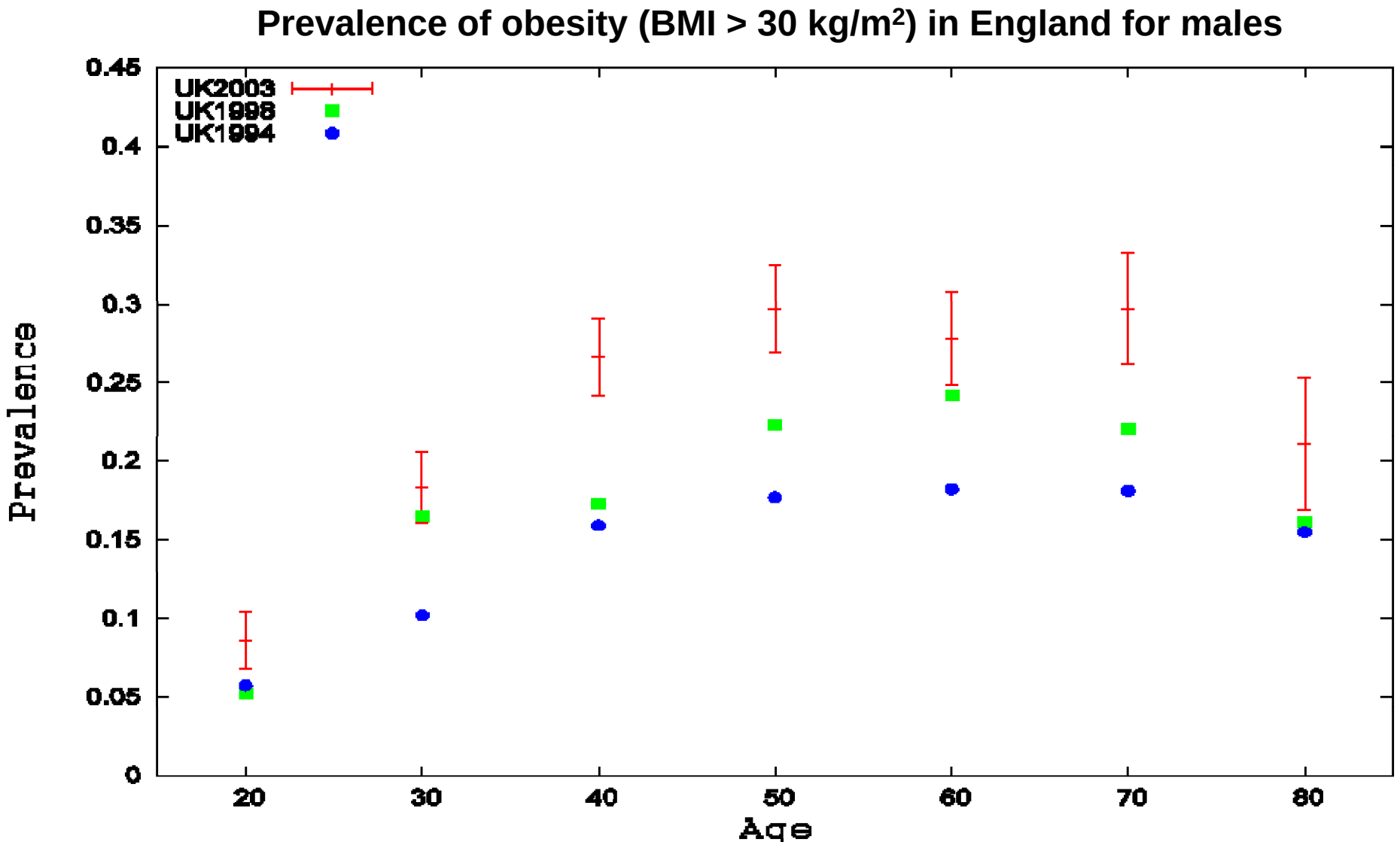
BMI is a direct risk factor for:

- Diabetes
- Hypertension
- Mortality

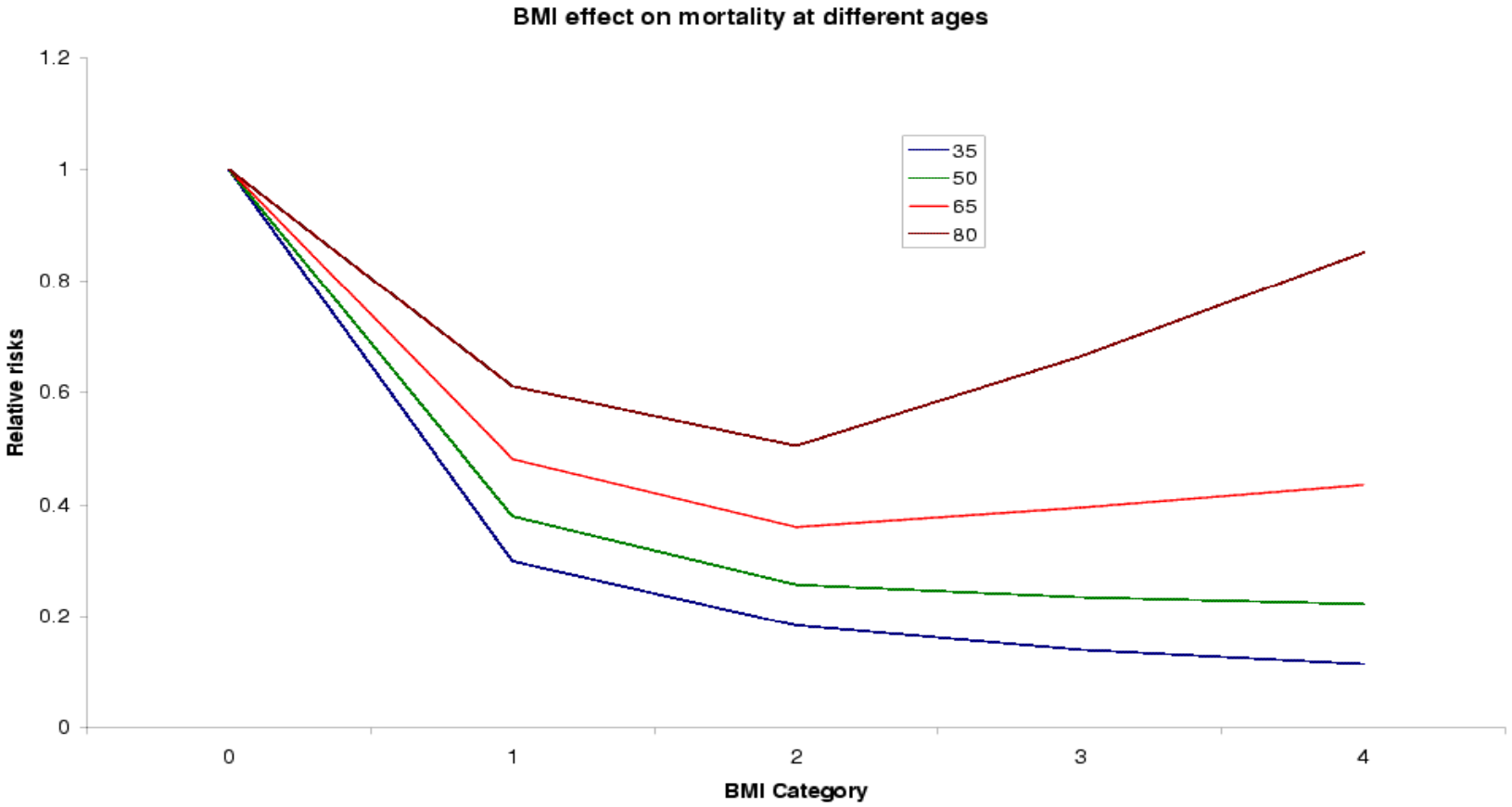
BMI is an indirect risk factor for:

- IHD (through diabetes and hypertension)
- Stroke (through hypertension)
- Mortality (through diabetes, hypertension, IHD and stroke)

Application - Obesity



Application - Obesity



Application - Obesity

Three models for changes in an individual's BMI

All matching prevalence in England in 2003

I No calendar time trend

II Matches prevalence in 1994 and changes to 2003, with changes continuing for a further 20 years

III Matches prevalence in 1994 and changes to 2003, with changes continuing indefinitely

Application - Obesity

Predicted prevalence (%) of obesity for females starting from age 20:

	Age			
	20	40	60	80
England 2003	13.1	22.2	27.9	26.3
Model I	13.1	23.3	29.9	30.7
Model II	13.1	60.4	82.3	80.0
Model III	13.1	60.4	93.5	97.5

Application - Obesity

Expected future lifetime and prevalence of diabetes, hypertension and IHD/stroke at age 70: males, non-smokers, starting from age 20

BMI model	EFL **years**	Diabetes **%**	H'tension **%**	IHD/stroke **%**
I	58.6	12.6	56.0	19.2
II	58.2	17.4	64.1	20.1
III	57.9	18.5	65.4	20.2

How Will Trastuzumab Affect Life Insurance?

Angus Macdonald & Edward Roche

Heriot-Watt University, Edinburgh

The HER2 Gene

- Promotes cell division => potential oncogene
- Can be amplified in breast tumours
  - Multiple copies in each cell
  - Overexpression of gene product
  - More aggressive tumour, worse prognosis
- HER2-positive in 15-25% of cases

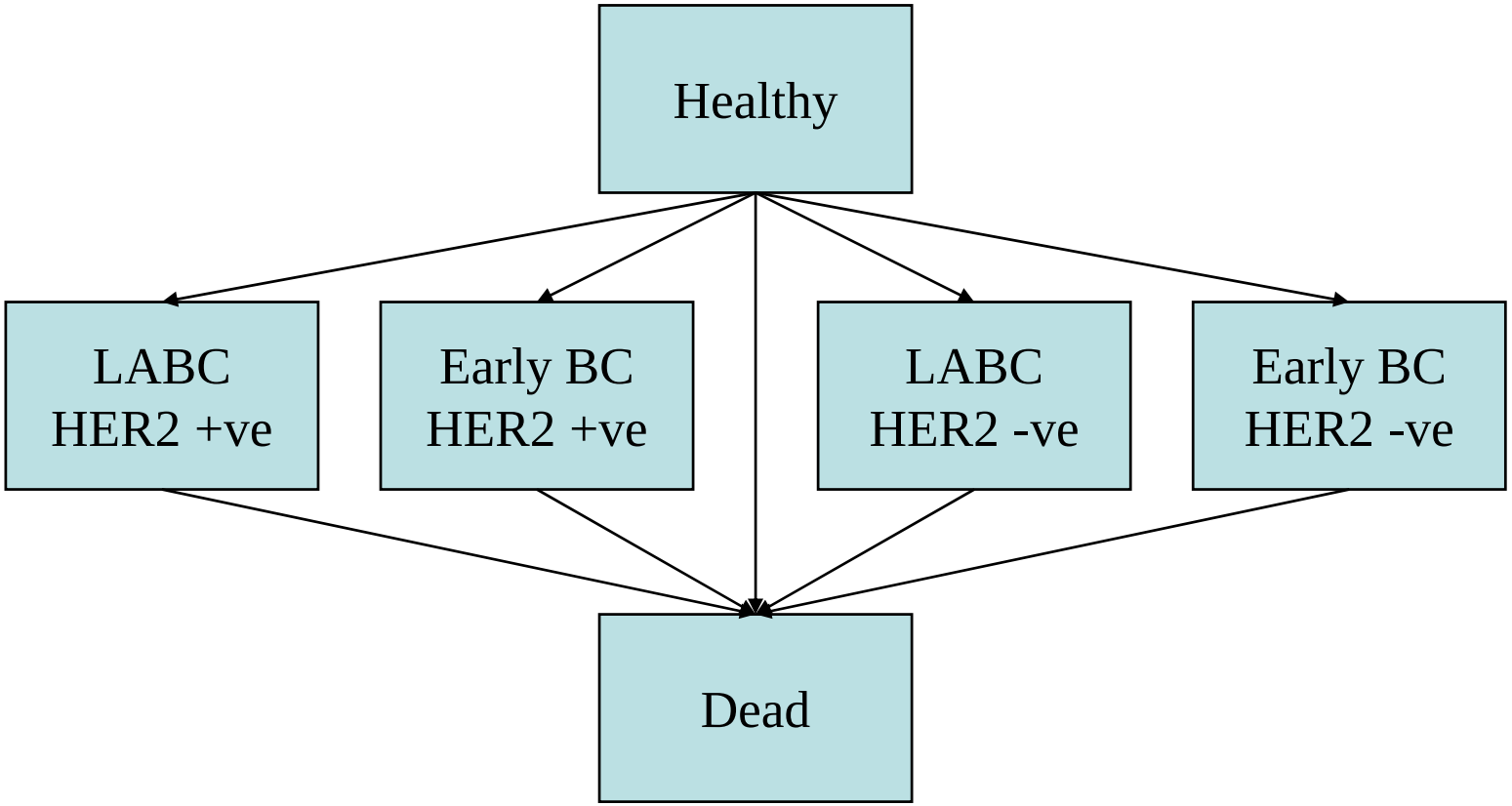
Trastuzumab (Herceptin)

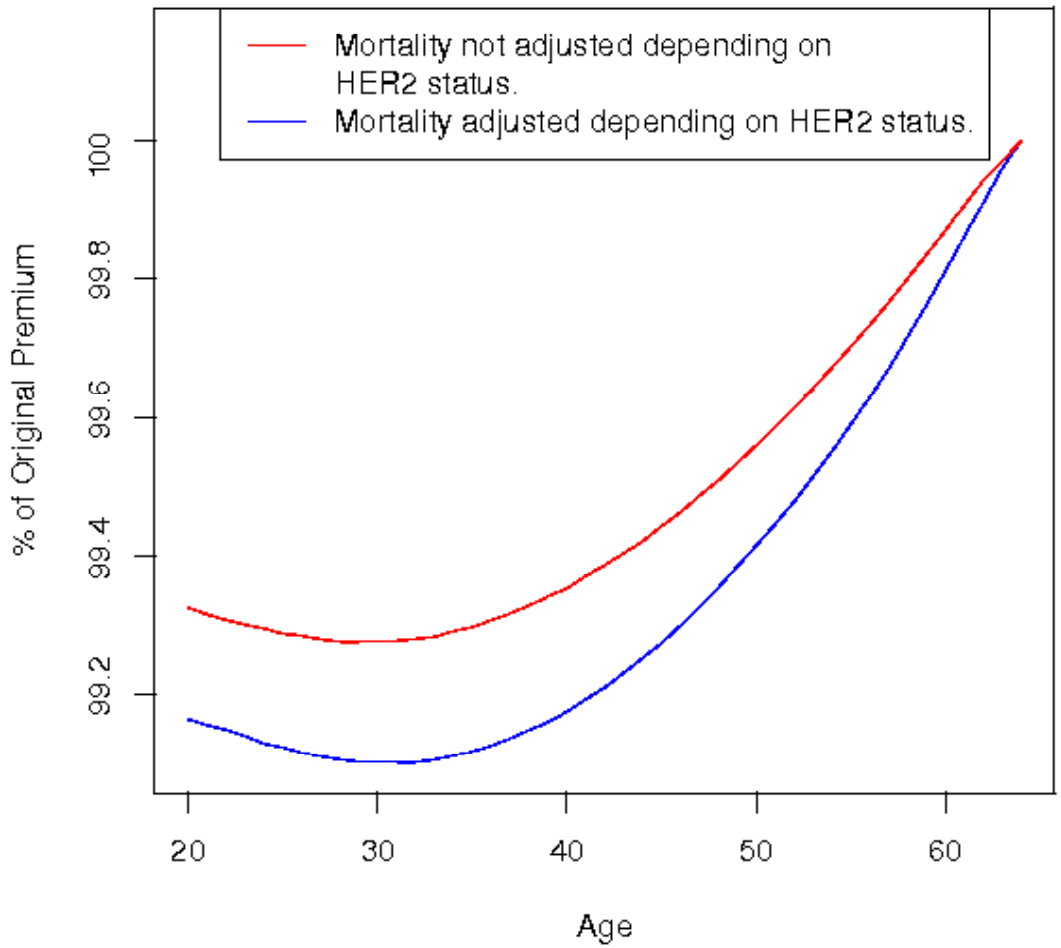
- Monoclonal antibody
  - Targets HER2 gene expression
  - Effective against HER2-positive tumours
  - Given after normal treatment (chemotherapy)
- Much publicity
  - NICE (in England)
  - Campaign led to Ministerial interference

The Herceptin Adjuvant Trial

- Smith *et al*., 2007; Piccart-Gebhart *et al*., 2005
- 1,703 women given 1 year's treatment and 1,698 controls
- Up to 3 years of follow-up
- 3-year survival probabilities 0.924 in treatment group and 0.897 in control group

The Model


Healthy
LABC
HER2 +ve
Early BC
HER2 +ve
LABC
HER2 -ve
Early BC
HER2 -ve
Dead


Mortality not adjusted depending on HER2 status.
Mortality adjusted depending on HER2 status.
% of Original Premium
99.2
99.4
99.6
99.8
100
20
30
40
50
60
Age

Comments

- About 1% reduction in premiums: small …
- … but one treatment for one disease …
- … and the first of a new class of drugs.
- Great uncertainty – unavoidable when modelling new epidemiology
- Great effort needed to set up model
- Lessons for (a) APMA (b) longevity forecasters

Papers

Macdonald C

Scoping mortality research: A report by the actuarial profession

www.actuaries.org.uk/files/pdf/confidential/ScopingMortalityReport_draft.pdf

Chatterjee T, Macdonald A S & Waters H R

A model for ischaemic heart disease and stroke

I: The model

II: Modelling obesity

III: Applications

www.ma.hw.ac.uk/~andrewc/actuarial/#papers

Macdonald A S & Roche E

How will Trastuzumab affect life insurance?

www.ma.hw.ac.uk/ams/girc/publications.php