Mortality by cause of death and by socio-economic and demographic segmentation

Brian Ridsdale and Adrian Gallop UK

With thanks to: Timothy Lee, Sally Grover

Mortality by cause of death and by socio-demographics

Purpose of paper

- **part of IAA Mortality Task Force work**
- **gather information on behalf of the profession**
- **update following this conference**
- **provide a source of reference for the future**
- **including hyperlinks**

Mortality by cause of death and by socio-demographics

Purpose of this presentation

- **illustrate the conclusions**
- **update with recent developments**
- **promote discussion, especially**

   Projections by cause

   Other actuarial applications

Mortality by cause of death and by socio-demographics

Areas to cover

- **Conclusions**
- **Socio-demographic stratification**
- **Cause of death**
- **Risk factors**
- **Projections**
- **Actuarial uses**
- **Follow-up**
- **Discussion**

Conclusions

- **Most developed countries have seen substantial improvements in mortality**
- **There is a strong relationship between socio-economic group and mortality**
- **A small number of major "cause of death groups" have contributed the bulk of improvements**
- **Future longevity (in developed countries) may be driven more by social change than by medical improvements**
- **Projecting mortality by cause is valuable but complex**
- **Actuaries are using information to obtain competitive advantage**
- **Multi-disciplinary research is needed**

Mortality by cause of death and by socio-demographics

Areas to cover

- **Conclusions**
- **Socio-demographic stratification**
- **Cause of death**
- **Risk factors**
- **Projections**
- **Actuarial uses**
- **Follow-up**
- **Discussion**

# *What can we learn from* socio-demographic stratification?

International and national data point to the same conclusions

- social class and other demographics matter throughout the range
  - it is not just an issue of poverty
- there is a *gradient* by social class and other factors
- class, income, education, ethnicity and postcode are all differentiators

Life expectancy and social class

Male period life expectancy at age 65: 1972 - 2005
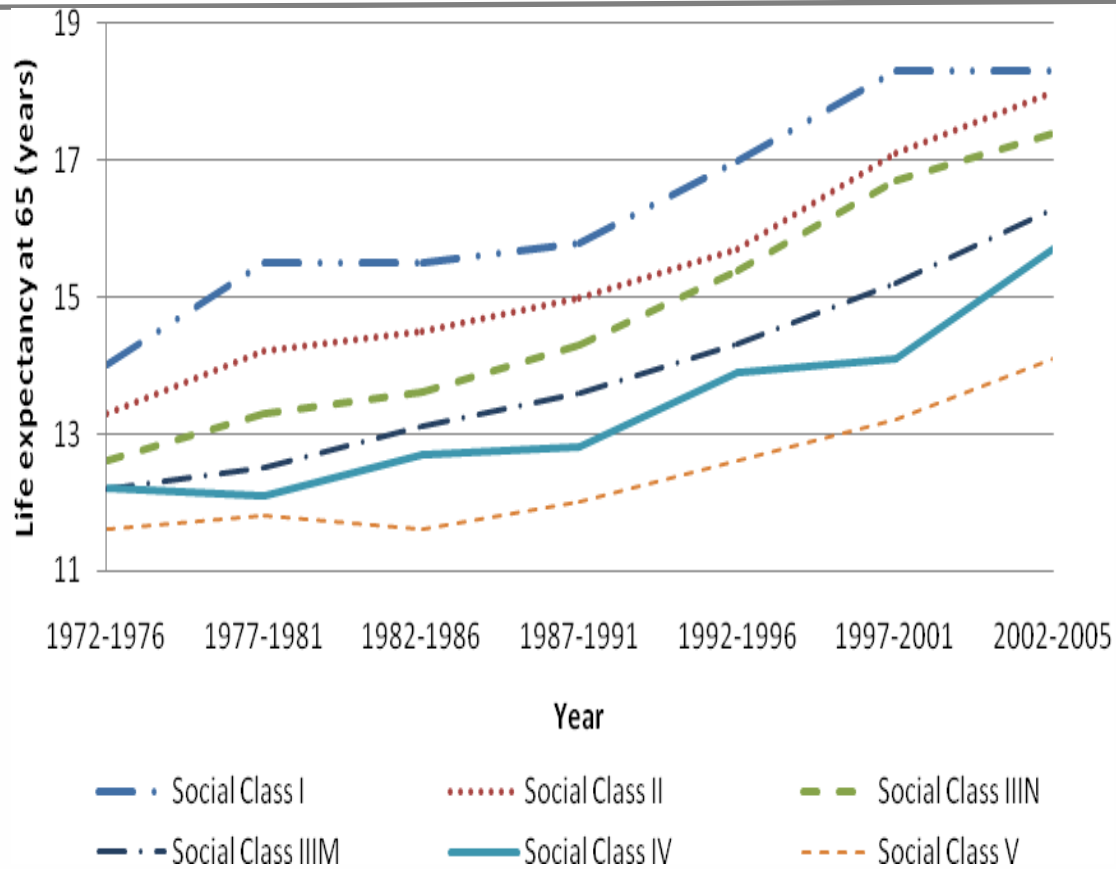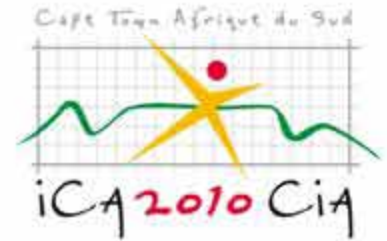
Source: ONS (2006), "Life Expectancy and Social Class"

Mortality by cause of death and by socio-demographics

Areas to cover

- **Conclusions**
- **Socio-demographic stratification**
- **Cause of death**
- **Risk factors**
- **Projections**
- **Actuarial uses**
- **Follow-up**
- **Discussion**

What can we learn from mortality by cause of death?

- **There have been substantial reductions in mortality in much of the developed world**
  - *but not all*

- **A few "cause of death groups" have driven these improvements**
  - in the first part of the 20th century: infectious diseases
  - later: coronary heart disease

There are some issues with mortality by cause of death
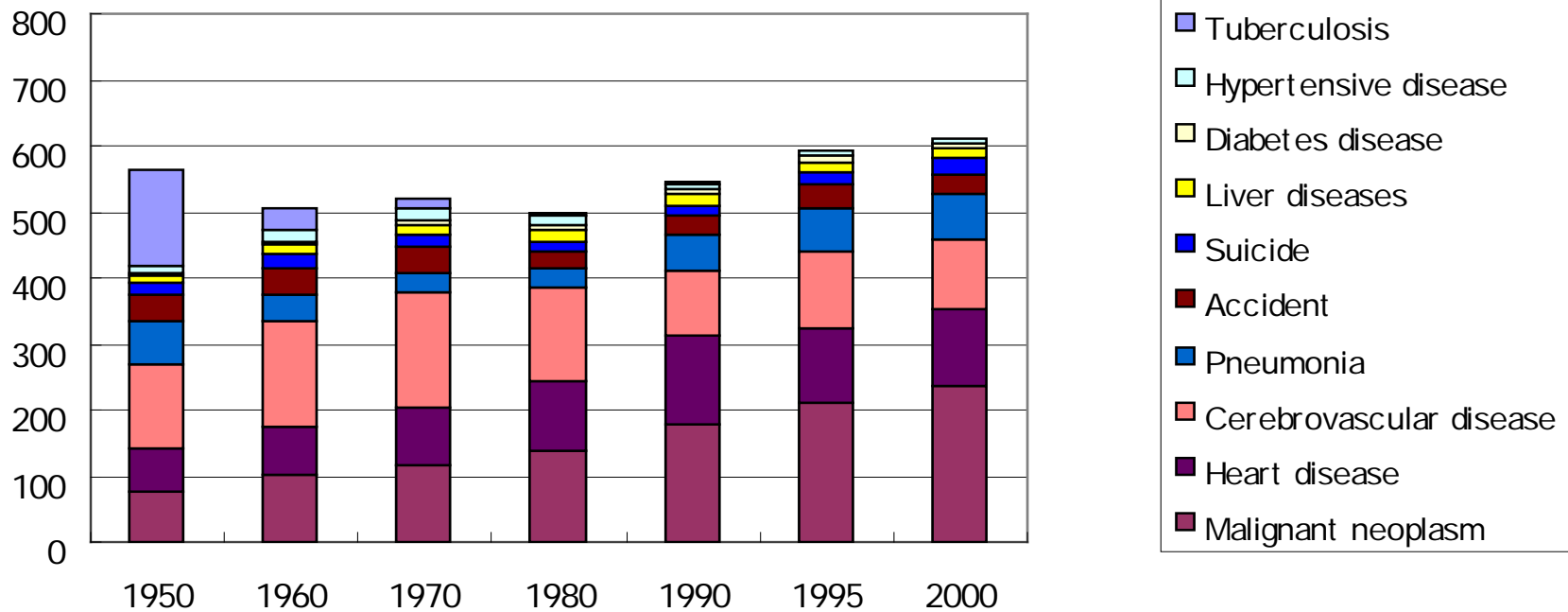
What are you interested in?

Medical, pensions, social security, life assurance?

- – Differing data and conclusions

- – Age-standardisation

- – Scales of improvement

- – Gender and age

- – Determining cause: misclassifications, changes in classification, co-morbidities

Mortality by cause of death Japan 1950 - 2000
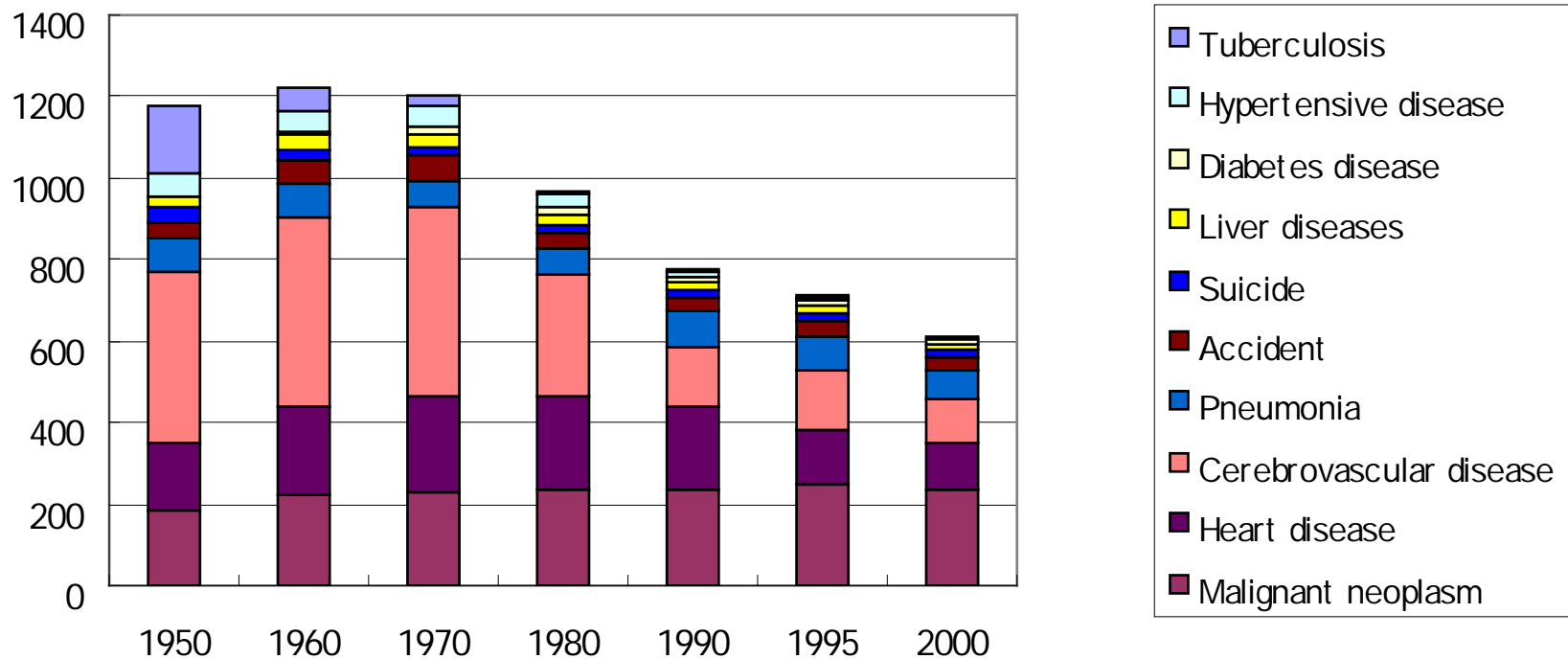

Japan-Death rates by cause

Legend:
- Tuberculosis
- Hypertensive disease
- Diabetes disease
- Liver diseases
- Suicide
- Accident
- Pneumonia
- Cerebrovascular disease
- Heart disease
- Malignant neoplasm

Mortality by cause of death Japan - age-standardised

Japan- Death rates (age adjusted) by cause

Legend:
- Tuberculosis
- Hypertensive disease
- Diabetes disease
- Liver diseases
- Suicide
- Accident
- Pneumonia
- Cerebrovascular disease
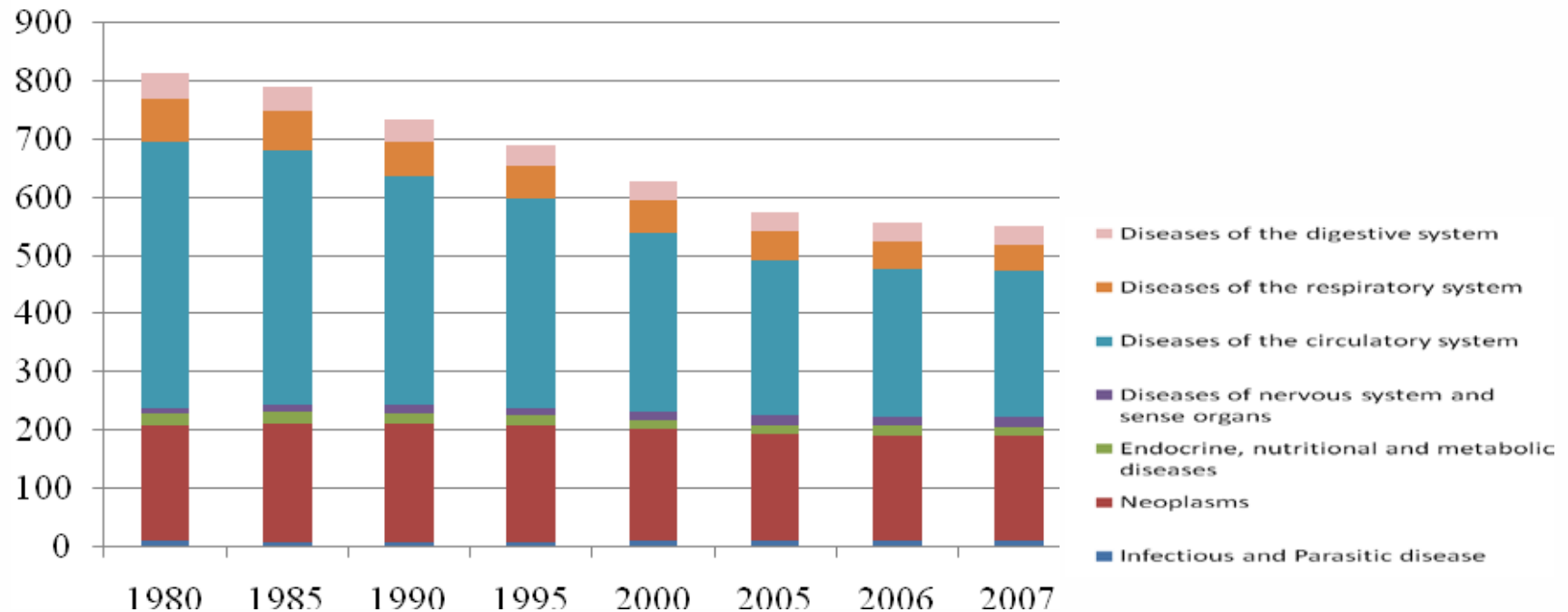- Heart disease
- Malignant neoplasm

A few "cause of death groups" have driven improvements

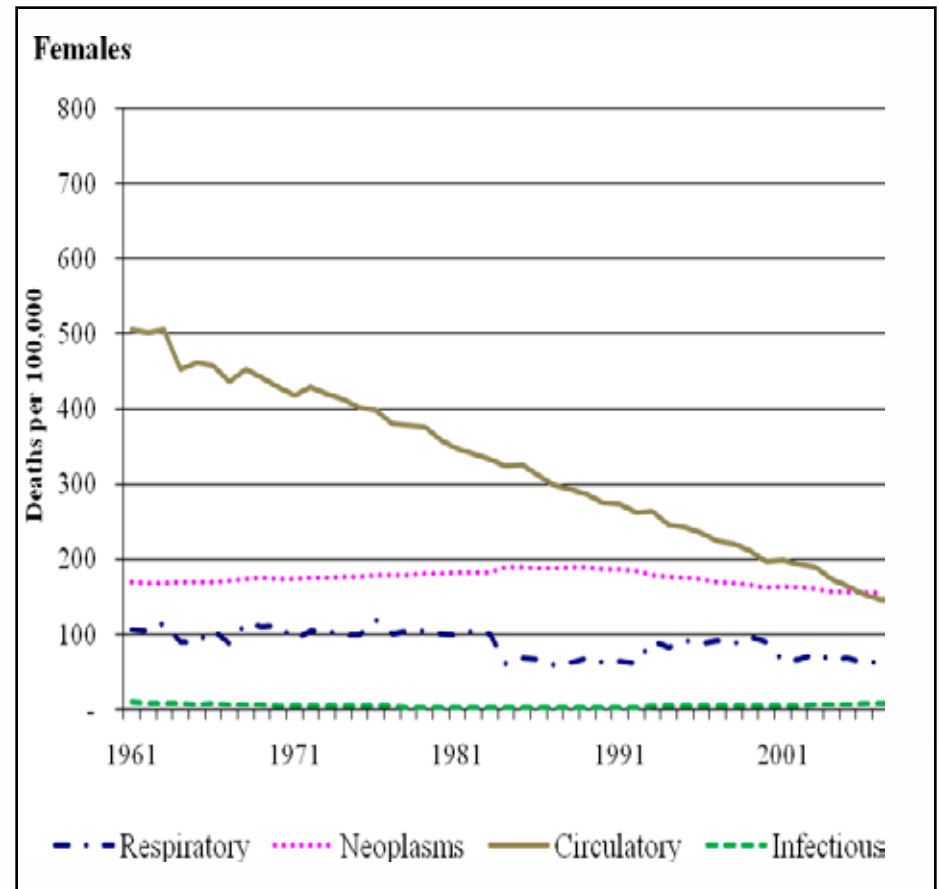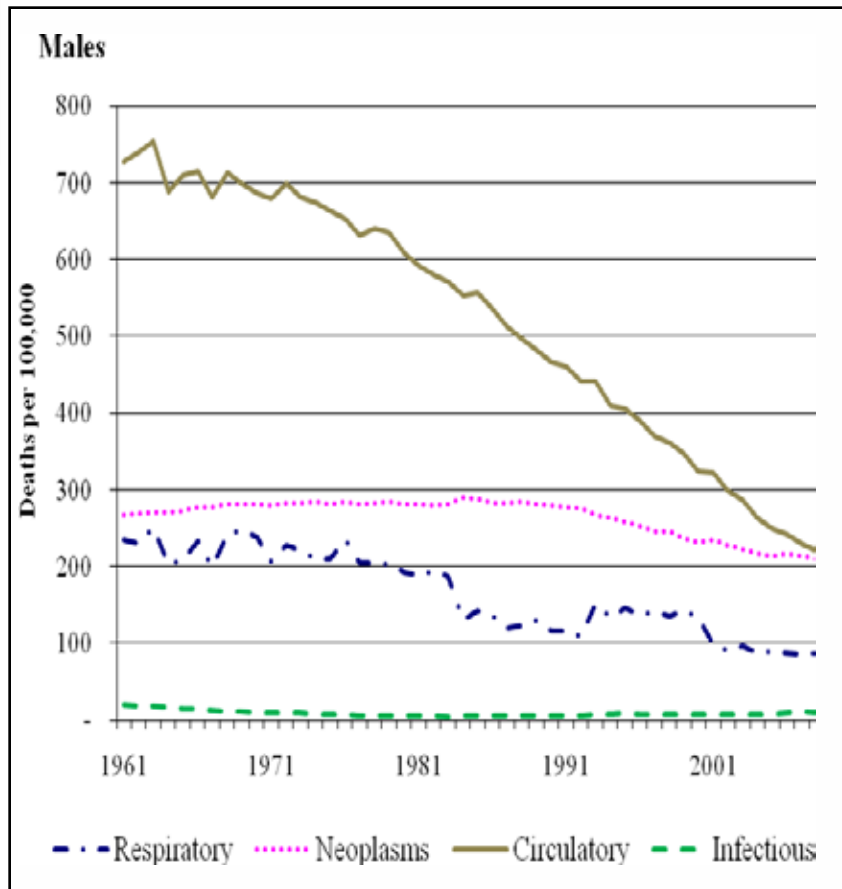**Trends in age-standardised mortality rate per 100k popn by major cause of death groups**

EU

Source: European Mortality Data Base

Mortality by major cause group UK
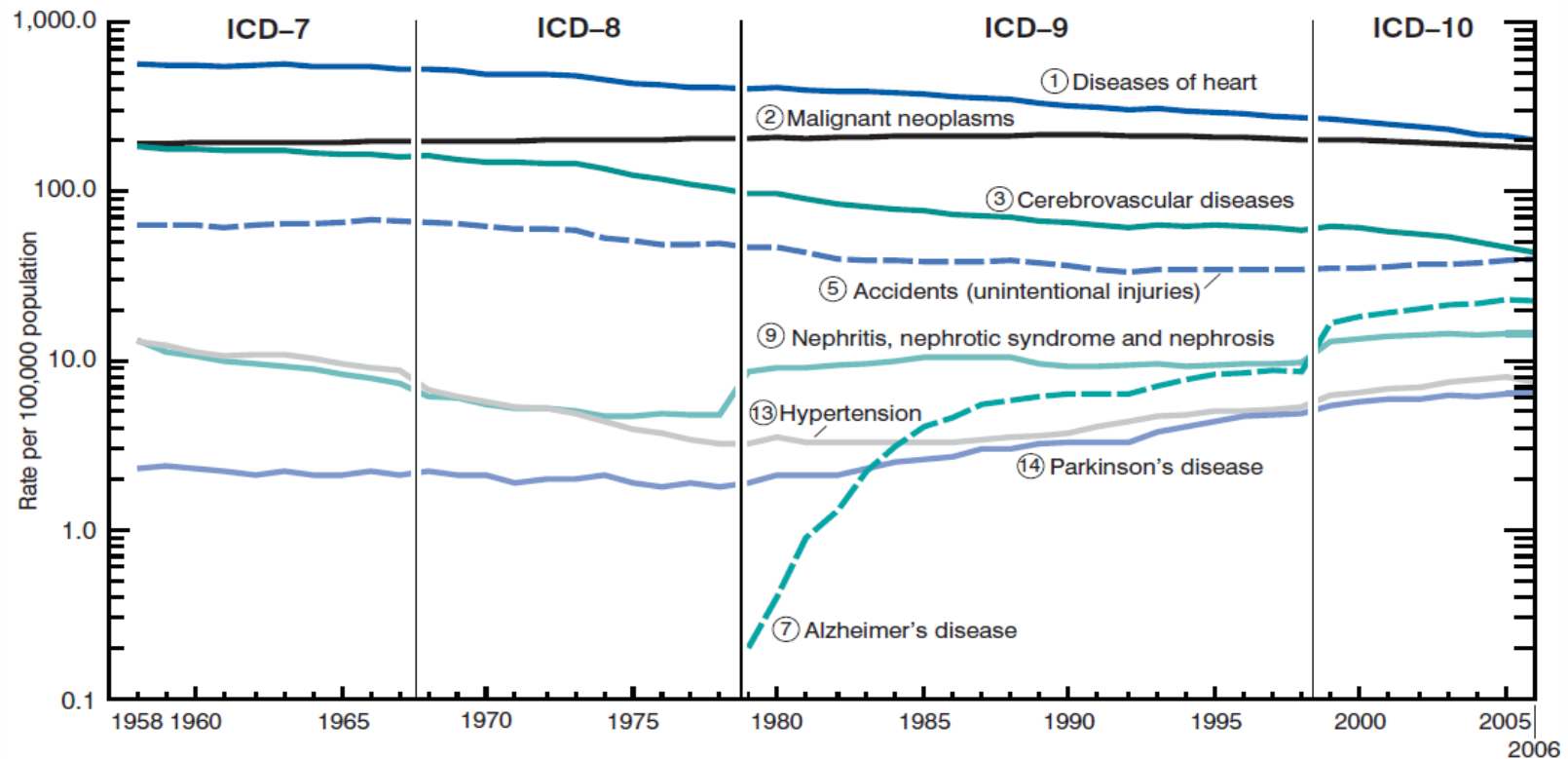## 1961 – 2006   Linear Scale   Source, ONS

Mortality by major cause group USA
1958 – 2008 Logarithmic Scale

Age-adjusted death rates for selected leading causes of death


NOTES: ICD is the *International Classification of Diseases*. Circled numbers indicate ranking of conditions as leading causes of death in 2006.
Age-adjusted rates are per 100,000 U.S. standard population; see "Technical Notes."
SOURCE: CDC/NCHS, National Vital Statistics System, Mortality Statistics Branch.

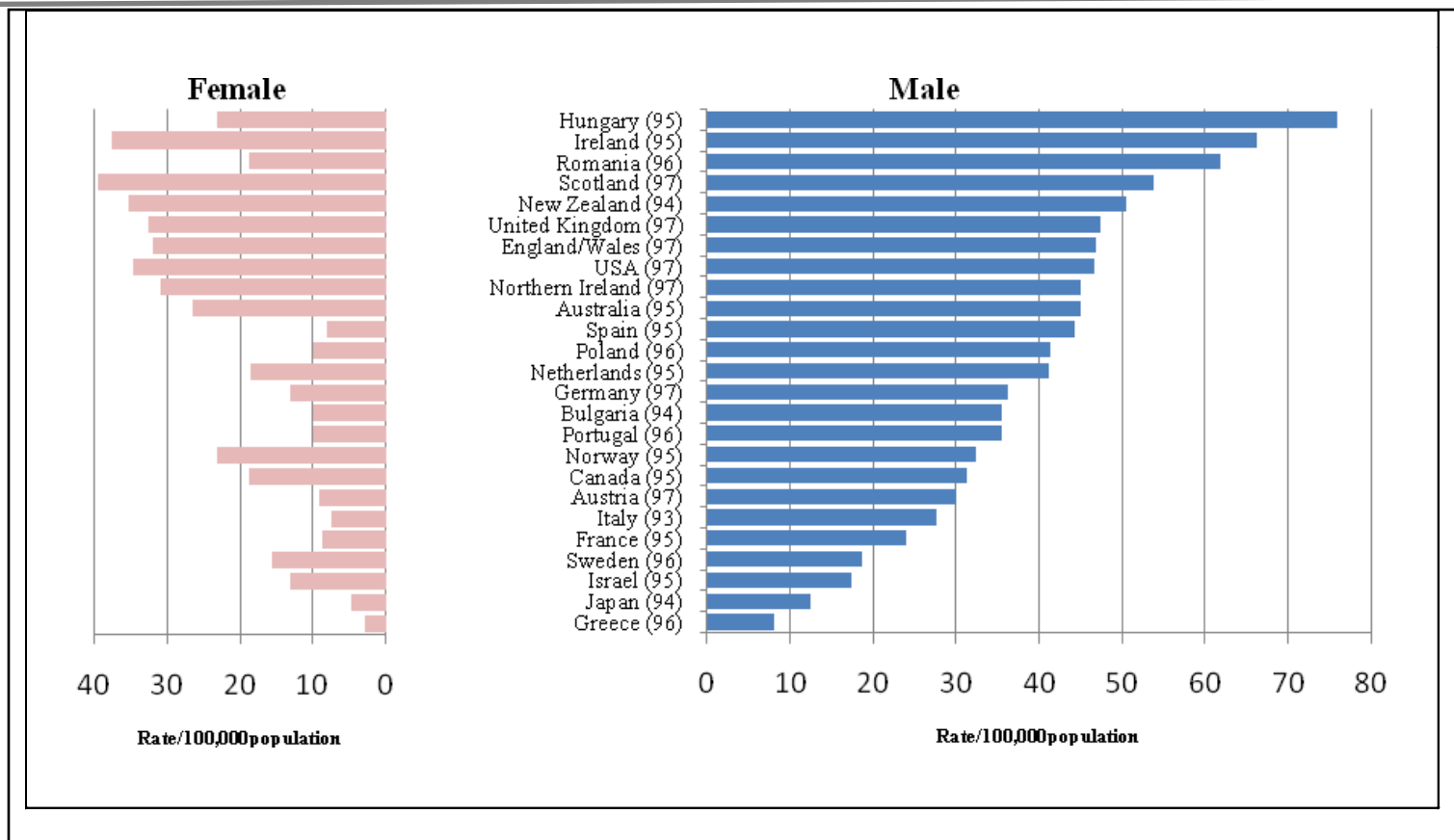# Mortality by cause, age and sex England and Wales
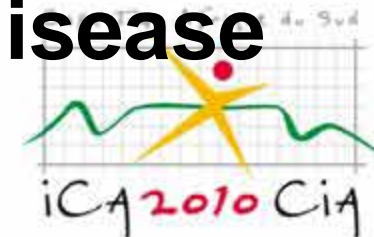*Source: ONS 2009 Stat Bn*

Leading causes of death in 2008 in England and Wales by age groups
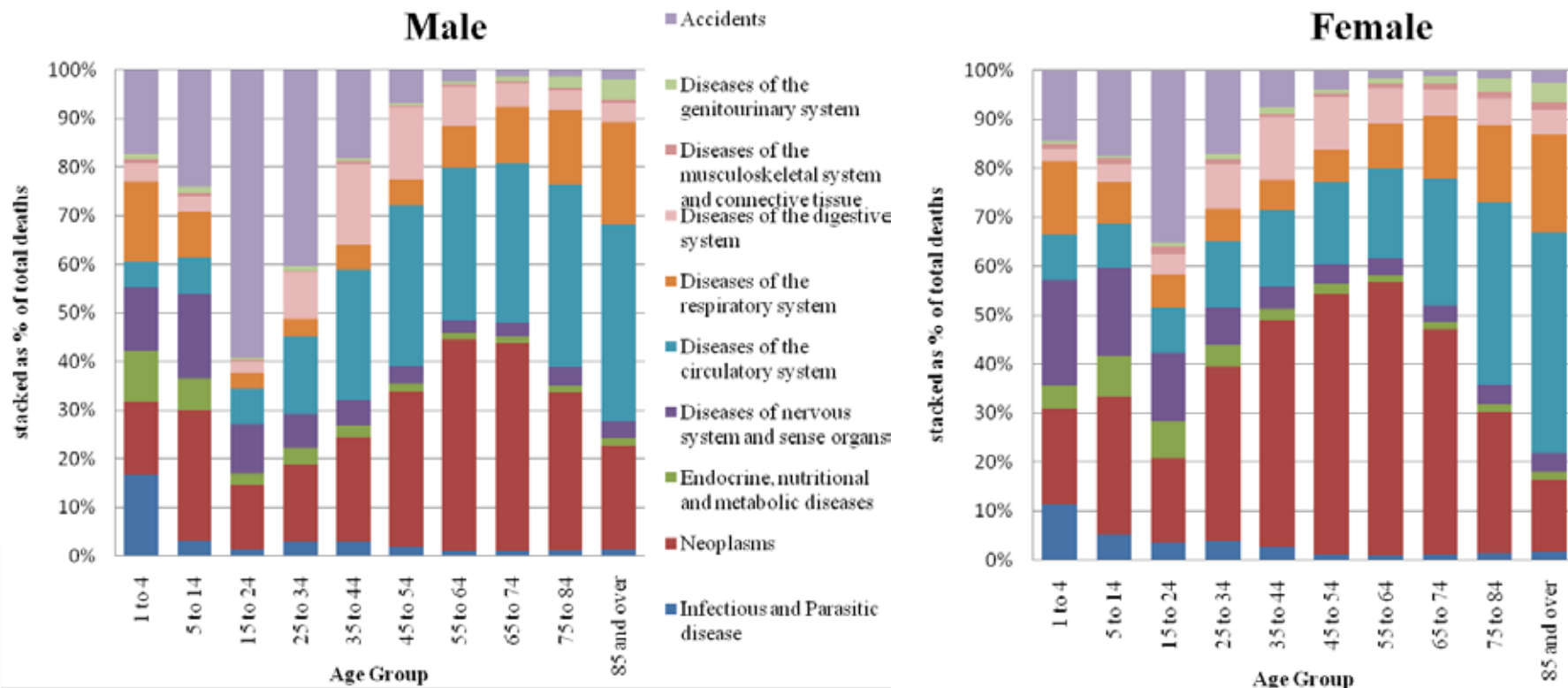
Chronic obstructive pulmonary disease

Age adjusted death rates: individuals aged 35 - 74

Source: World Health Statistics Annual, WHO (unpublished)

What can we learn from mortality by cause of death?

- **There have been substantial reductions in mortality in much of the developed world**
  - *but not all*

- **A few "cause of death groups" have driven these improvements**
  - in the first part of the 20th century: infectious diseases
  - later: coronary heart disease

Mortality by cause of death and by socio-demographics

Areas to cover

- Conclusions
- Socio-demographic stratification
- Cause of death
- **Risk factors**
- Projections
- Actuarial uses
- Follow-up
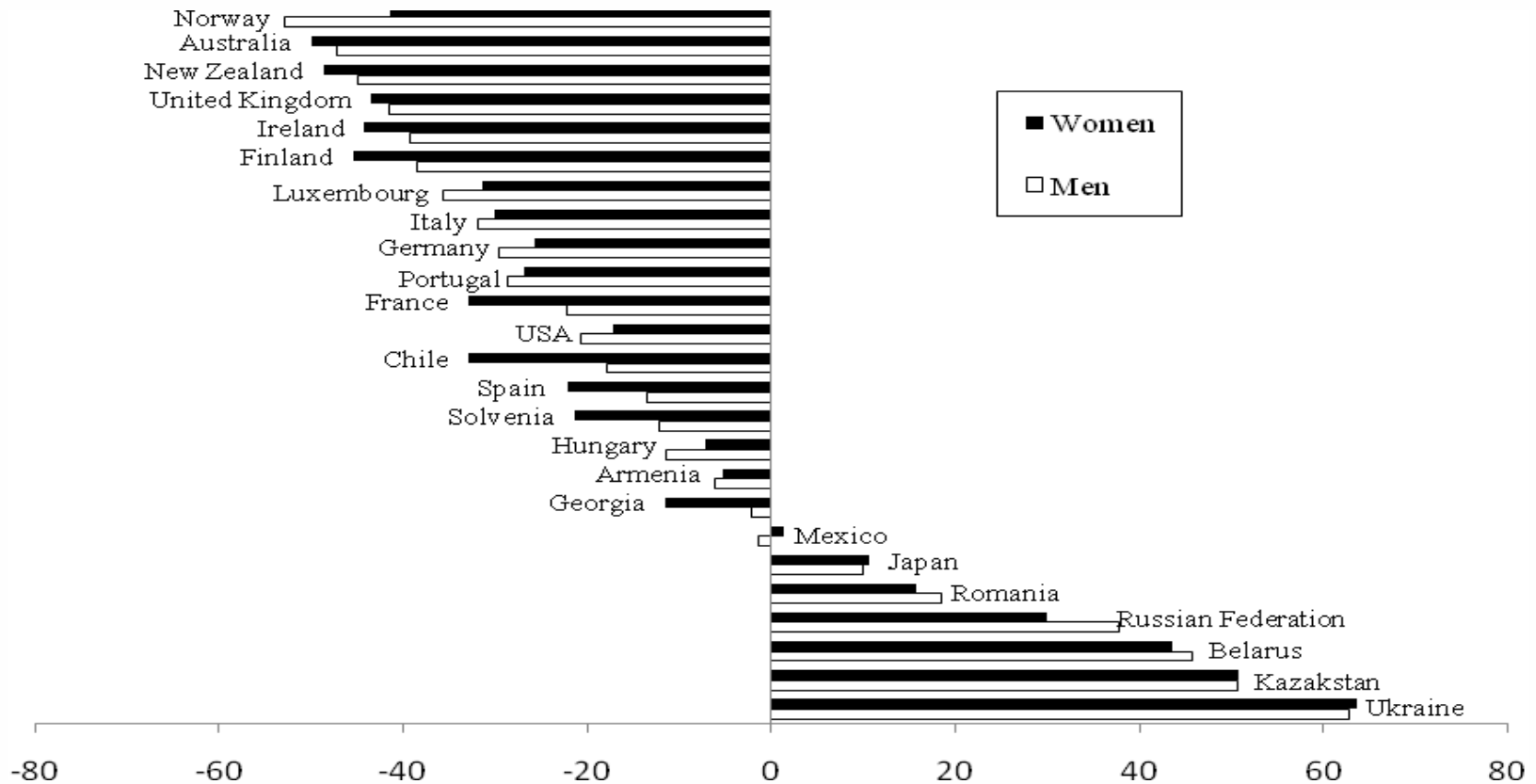- Discussion

Leading risk factors worldwide

- **high blood pressure**
- **tobacco use**
- **alcohol abuse**
- **high cholesterol**
- **high blood glucose**
- **physical inactivity**
- **overweight and obesity**

quite a lot of interaction here

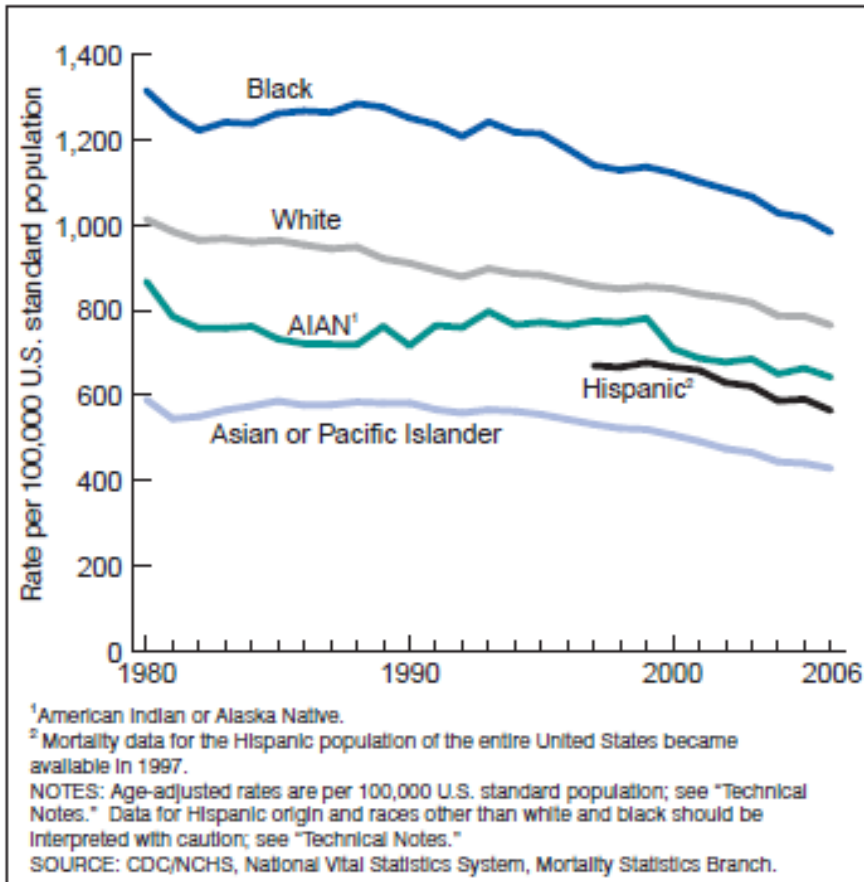# Changes in death rates from CHD
Men and women aged 35-74, from 1990 to 2000

Source: Capewell and O'Flaherty (2008), Heart, Volume 94, Issue 9, page 1105-1008

Death rates by race - USA

Source: Heron et al. National Vital Statistics Reports, Vol 57, No 14: Final deaths for 2006 (2009)

"the AIAN advantage is due in large part to the underreporting of AIAN mortality on death certificates"

"Hispanic origin on the death certificate is underreported by an Estimated 5%"

"Net effect of reporting problems...
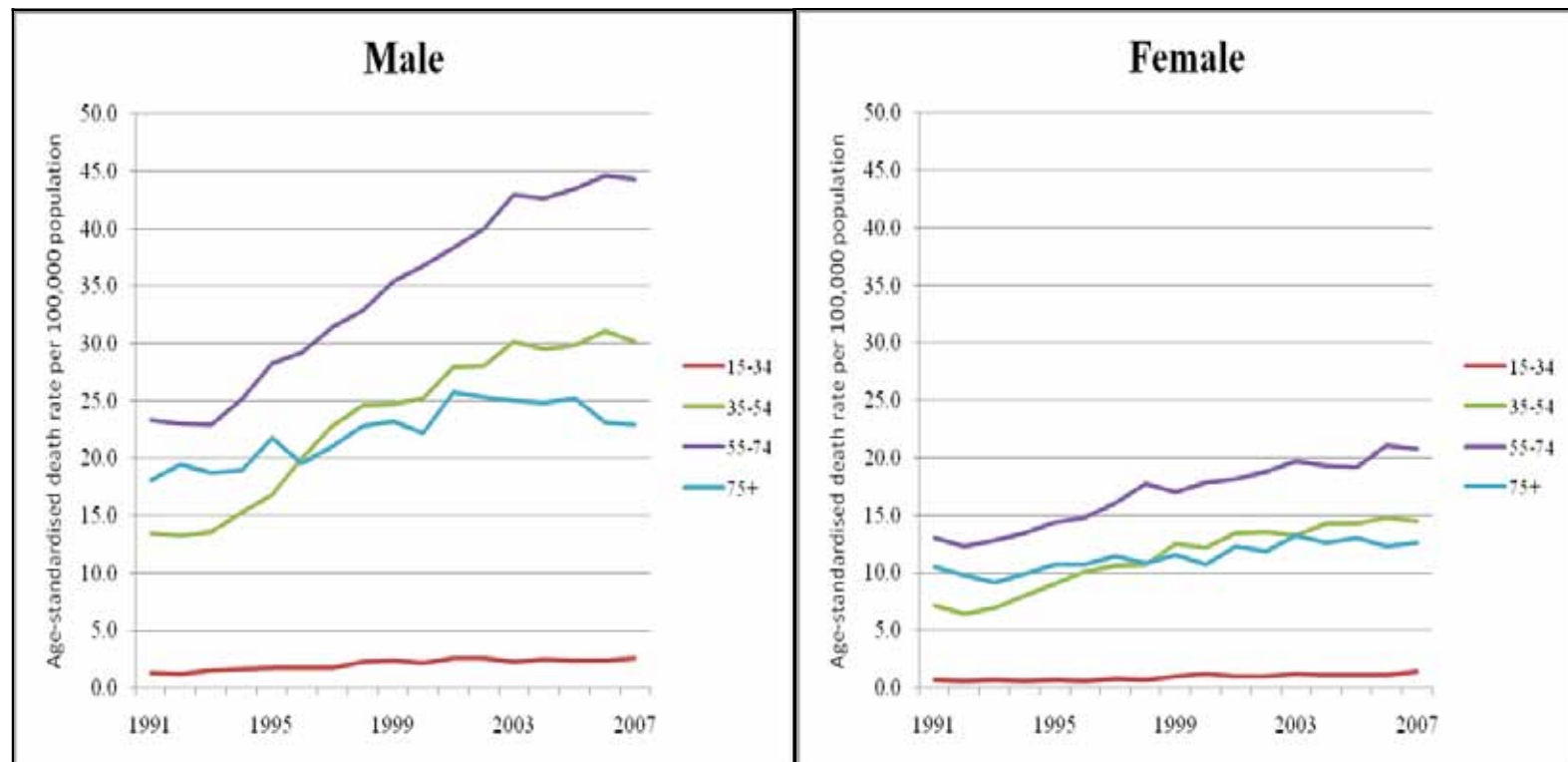AIAN: 30% approx
API: 7% approx"

AIAN: American Indian or Alaska Native

Alcohol related death rates

Age standardised 1991 - 2007

Figure 1.   **Age-standardised alcohol-related death rates: by sex and age group, 1991-2007**

Source: ONS (2009b), Health Statistics Quarterly 41

Risk factors

are related to:

- **living conditions**
- **relative poverty**
- **social class behaviours**
- **smoking and drinking**

WHO and individual countries are aiming to drive change

Mortality improvements may depend more on social change than medical advances

Mortality by cause of death and by socio-demographics

Areas to cover

- **Conclusions**
- **Socio-demographic stratification**
- **Cause of death**
- **Risk factors**
- **Projections**
- **Actuarial uses**
- **Follow-up**
- **Discussion**

Cause-specific projections? Why do it?

Medical, demographical, projecting mortality of sub-populations or aggregate populations

a variety of methodologies

Issues:

- changes in diagnosis or classification over time make trends difficult
- different models for different causes of death
- anomalies when recombined to provide aggregate mortality rates

Cause-specific projections?
Why do it?

Medical, demographical, projecting mortality of sub-populations or aggregate populations

a variety of methodologies

Benefits:

• unavoidable for many medical purposes

• helps understand past

• useful for short-term projections and scenarios

• useful to test aggregate projections

WHO projected deaths by cause for high, middle and low income countries
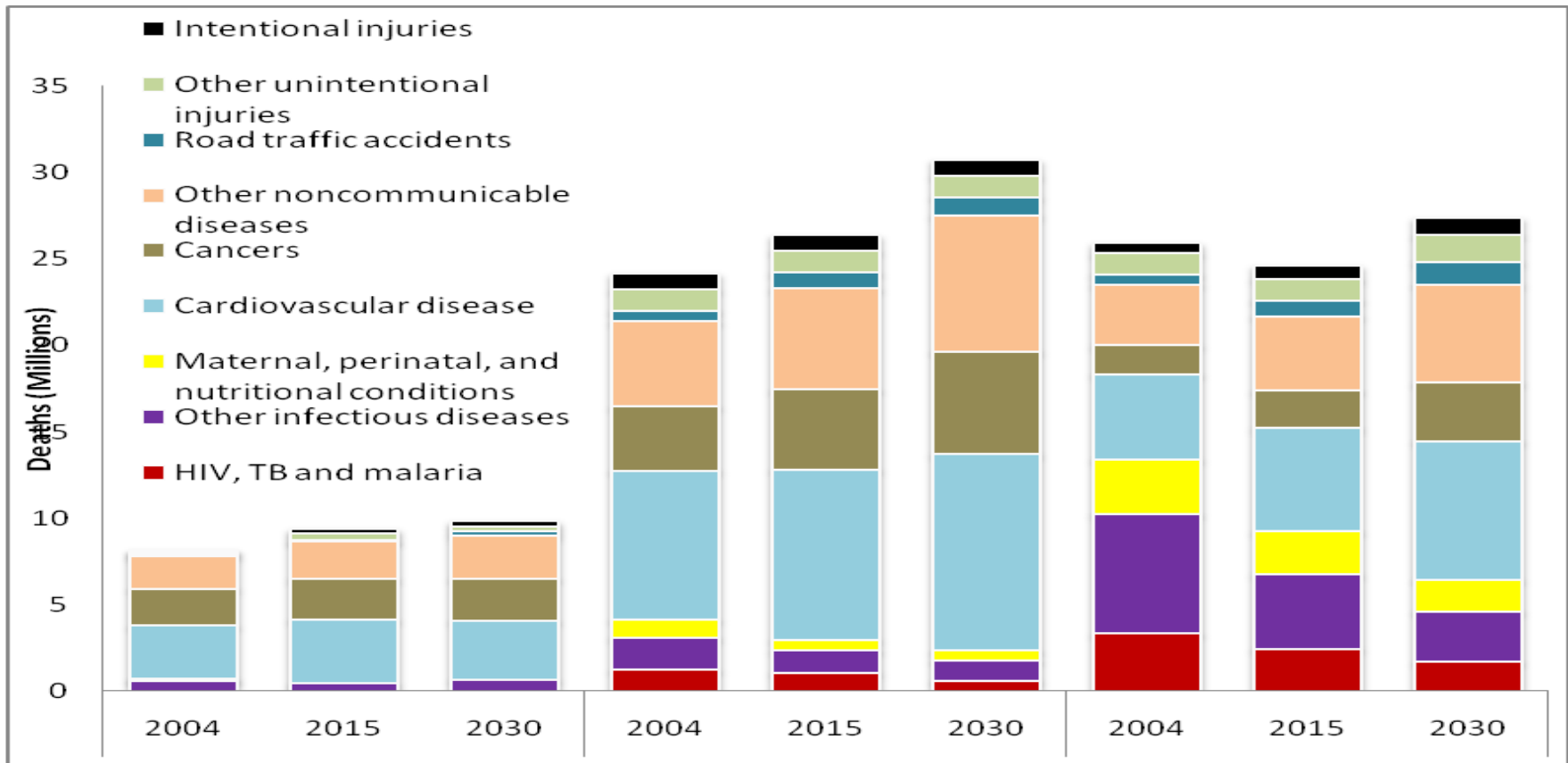
Source: WHO (2008c), World Health Statistics 2008

Mortality by cause of death and by socio-demographics

Areas to cover

- **Conclusions**
- **Socio-demographic stratification**
- **Cause of death**
- **Risk factors**
- **Projections**
- **Actuarial uses**
- **Follow-up**
- **Discussion**

How do actuaries use the information?

Making the best of the data that is available with proxies for unobtainable risk factors: eg

- **Traditionally –**
  - Blood tests for smoking and alcohol
  - Height and weight for obesity
  - Benefit amount for wealth
- **Recently**
  - Postcode for socio-economic status
  - Pre-retirement income (rather than pension)

How do actuaries use the information?

Life assurance: a few examples

- South Africa underwriting by gender, smoker category, age and rating class
- USA - preferred life underwriting
- UK - postcode underwriting

Annuities and pensions: a few examples

- substandard annuity underwriting: USA, UK
- postcode-based annuity and pensions reserving

Postcode-based reserving

Postcode effects - all ages (males)

Example: Towers Watson Postcode Mortality Tool
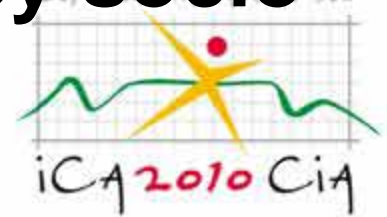
- ¾ Map shows combined effect of all four postcode clustering factors used (males, all ages)

- ¾ Map summary at postcode sector level, aggregating the postcode level results

- ¾ **Red** areas have average mortality 200% that of **blue**
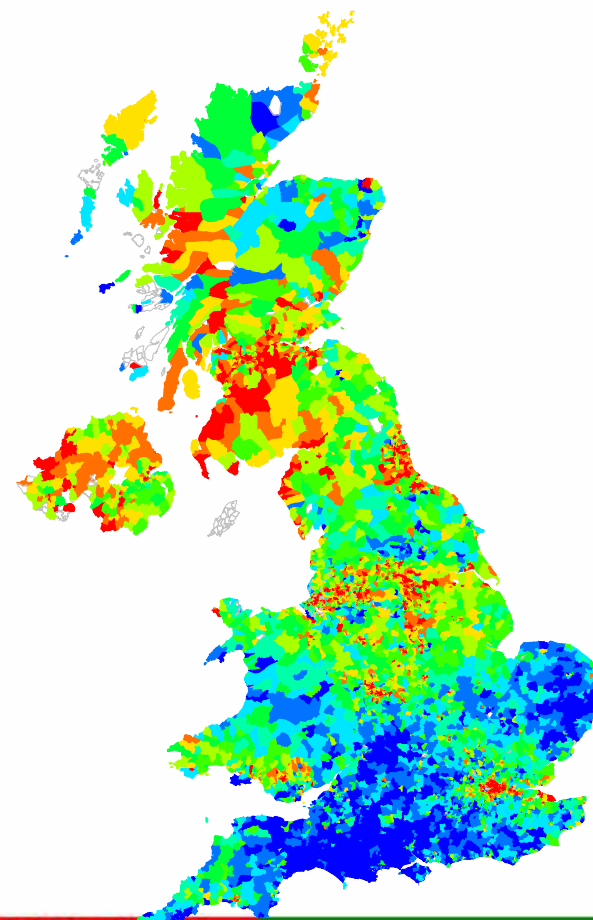
Source: Matthew Edwards, Towers Watson

Mortality by cause of death and by socio-demographics

Areas to cover
- **Conclusions**
- **Socio-demographic stratification**
- **Cause of death**
- **Risk factors**
- **Projections**
- **Actuarial uses**
- **Follow-up**
- **Discussion**

Follow-up

We welcome more information on actuarial applications, especially

– Projections by cause

– Use in life, pensions and other applications

We will

– Update with recent developments

– Promote discussion, especially highlighting anything we've missed out

– Make the paper and hyperlinks available on the web

Conclusions

- **Most developed countries have seen substantial improvements in mortality**
- **There is a strong relationship between socio-economic group and mortality**
- **A small number of major "cause of death groups" have contributed the bulk of improvements**
- **Future longevity (in developed countries) may be driven more by social change than by medical improvements**
- **Projecting mortality by cause is valuable but complex**
- **Actuaries are using information to obtain competitive advantage**
- **Multi-disciplinary research is needed**

Mortality by cause of death and by socio-economic and demographic segmentation
Brian Ridsdale and Adrian Gallop UK

With thanks to: Timothy Lee, Sally Grover

Madhavi Bajekal, David Blane, Robert Brown, Simon Capewell, Myer Glickman, Peter Goldblatt, Dave Grimshaw, Brian Johnson, Paul Lewis, Mike Murphy, Stephen Richards, Yoshihiro Takahashi

and Martin Stevenson and the IAA MTF