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
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
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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

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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

Tuberculosis
Hypertensive disease
Diabetes disease
Liver diseases
Pneumonia
Cerebrovascular disease
Heart disease
Malignant neoplasm
Mortality by cause of death
Japan - age-standardised

Japan-Death rates (age adjusted) by cause

- 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

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.”
Leading causes of death in 2008 in England and Wales by age groups

**Male**
- Diseases of the circulatory system
- Diseases of the respiratory system
- Diseases of the digestive system
- Neoplasms
- Infectious and Parasitic disease
- Accidents
- Diseases of the nervous system and sense organs
- Endocrine, nutritional, and metabolic diseases
- Diseases of the musculoskeletal system and connective tissue
- Diseases of the genitourinary system

**Female**
- Diseases of the circulatory system
- Diseases of the respiratory system
- Diseases of the digestive system
- Neoplasms
- Infectious and Parasitic disease
- Accidents
- Diseases of the nervous system and sense organs
- Endocrine, nutritional, and metabolic diseases
- Diseases of the musculoskeletal system and connective tissue
- Diseases of the genitourinary system

Source: ONS 2009 Stat Bn
Chronic obstructive pulmonary disease
Age adjusted death rates: individuals aged 35 - 74

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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


“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

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1 American Indian or Alaska Native.
2 Mortality data for the Hispanic population of the entire United States became available in 1997.

NOTES: Age-adjusted rates are per 100,000 U.S. standard population; see “Technical Notes.” Data for Hispanic origin and races other than white and black should be interpreted with caution; see “Technical Notes.”

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
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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?

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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
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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

Example: Towers Watson Postcode Mortality Tool

- Map shows combined effect of all four postcode clustering factors used (males, all ages)
- Map summary at postcode sector level, aggregating the postcode level results
- Red areas have average mortality 200% that of blue

Source: Matthew Edwards, Towers Watson
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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

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- Future longevity (in developed countries) may be driven more by social change than by medical improvements
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