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What's Hot in Mortality and Longevity Research

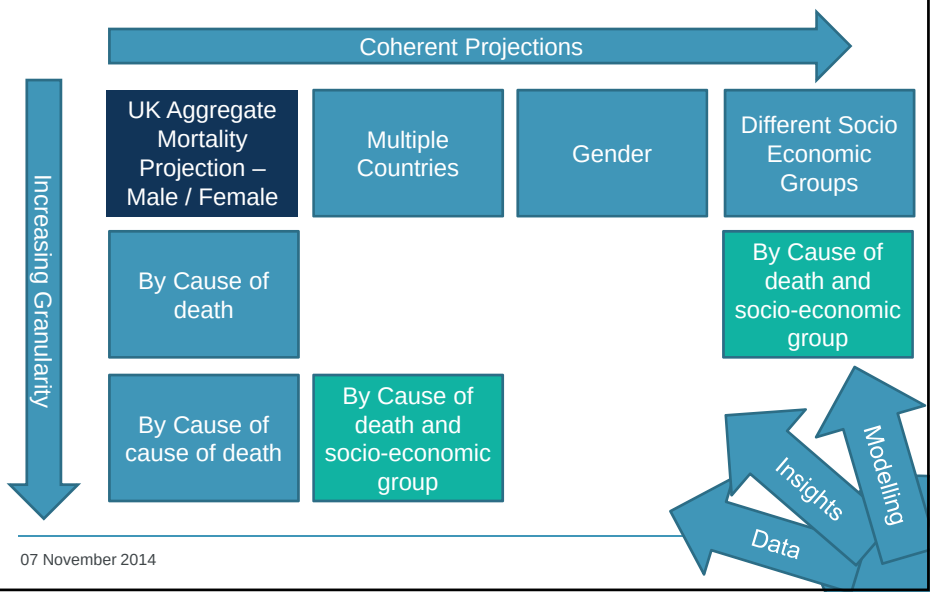
A debrief from the 2014 International Mortality and Longevity Symposium

Peter Banthorpe - Head of Biometric Research, RGA
Matthew Edwards - Senior Consultant, Towers Watson

Overview

- 22 Sessions
  - 6 Plenaries
  - 5 x 3 Workshop sessions
  - 1 pre-dinner speaker
- 3rd Residential Conference of the Mortality Research Steering Committee
- Overall symposium score: 4.7 / 5

Symposium Content – Conceptually



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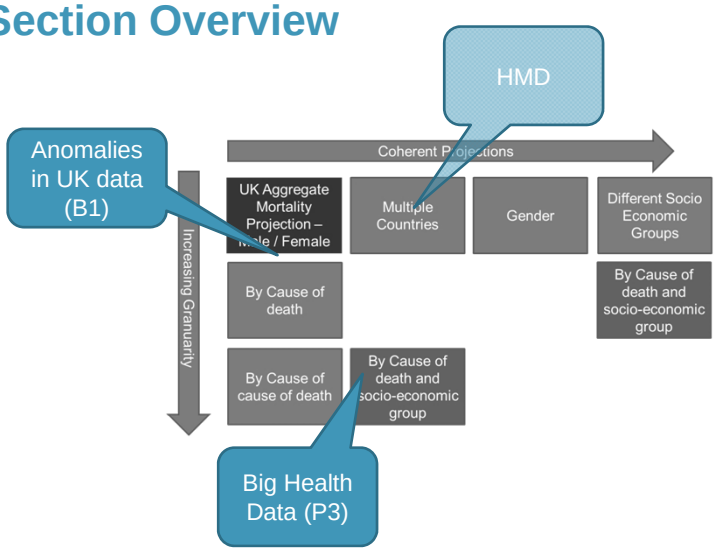
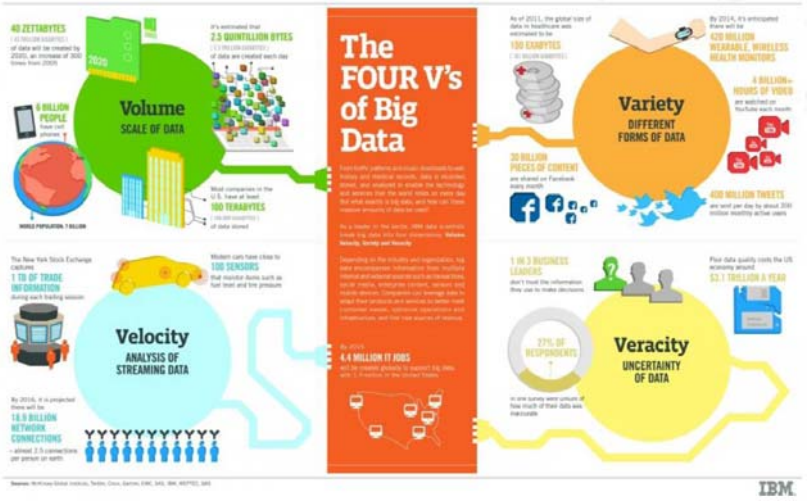
Section 1: Data

Section Overview



Big Health Data

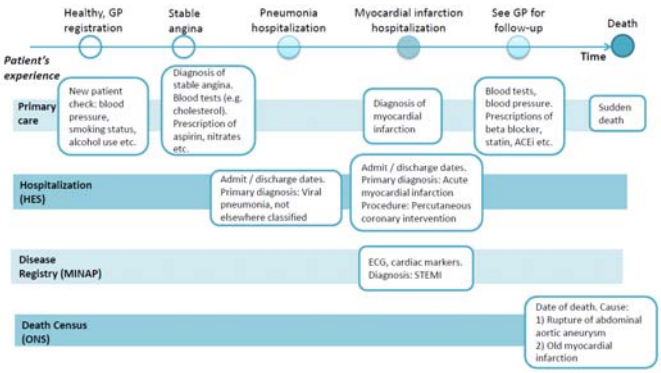
Professor Harry Hemmingway, Farr Institute



Big Health Data

Professor Harry Hemmingway, Farr Institute

Four nationwide EHR sources linked

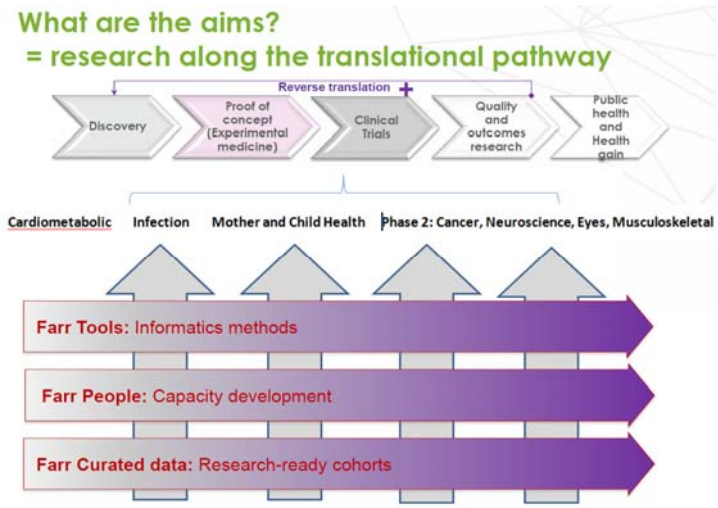


Denaxas et al, CALIBER, Intl J Epidemiology, 2012;41(6):1625-38.

Big Health Data

Professor Harry Hemmingway, Farr Institute

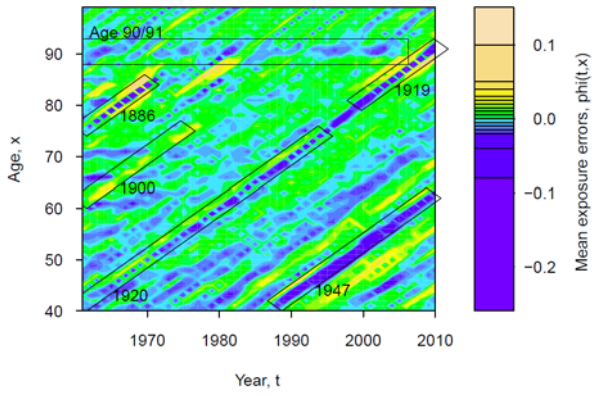
What are the aims?
= research along the translational pathway



Anomalies in UK Population Estimates

Professor Andrew Cairns, Heriot Watt University

Potential Errors in *post-2011* Population Estimates



Source data: ONS EW males deaths and *revised* population estimates.

Anomalies in UK Population Estimates

Professor Andrew Cairns, Heriot Watt University

Birth month	Age on 30/4/2001	Proportion	2001 census	ONS estimate	Age at mid-year	ONS mid-year
May-June 1918	82	2/12	72114	12019	83	
July 1918-April 1919	82	10/12		60095	82	} 79352
May-June 1919	81	2/12	115545	19257	82	
July 1919-April 1920	81	10/12		96288	81	

Birth month	No. of births	Age on 30/4/2001	Proportion	2001 census	CBD estimate	Age at mid-year	CBD mid-year
5-6/1918	113475	82	0.17785	72114	12825	83	
7/1918-4/1919	524566	82	0.82215		59289	82	} 72741
5-6/1919	99174	81	0.11642	115545	13452	82	
7/1919-4/1920	752725	81	0.88358		102093	81	

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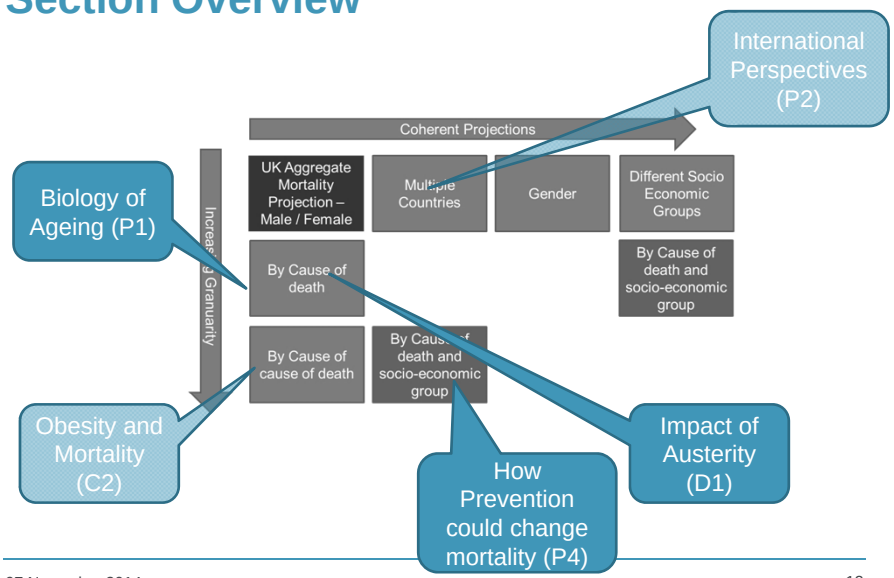
Section 2: Insights

Section Overview



Advances in the Biology of Ageing

Prof Richard Faragher, Chair, British Society for Research on Ageing

The long and short of it:

- Fundamental ageing mechanisms exist, are evolutionarily conserved and cause the things we think of as 'ageing changes', the things we think of as 'age-related diseases' and the things that compromise health in later life which we have trouble classifying (e.g. Menopause).
- Targeting them is a plausible and ergometric route to preventing later life morbidity.
- So why don't we do more work on ageing?
- Perhaps because ageing is seen as a 'natural process' distinct from 'unnatural' disease. This leaves us prey to..

Advances in the Biology of Ageing

Prof Richard Faragher, Chair, British Society for Research on Ageing

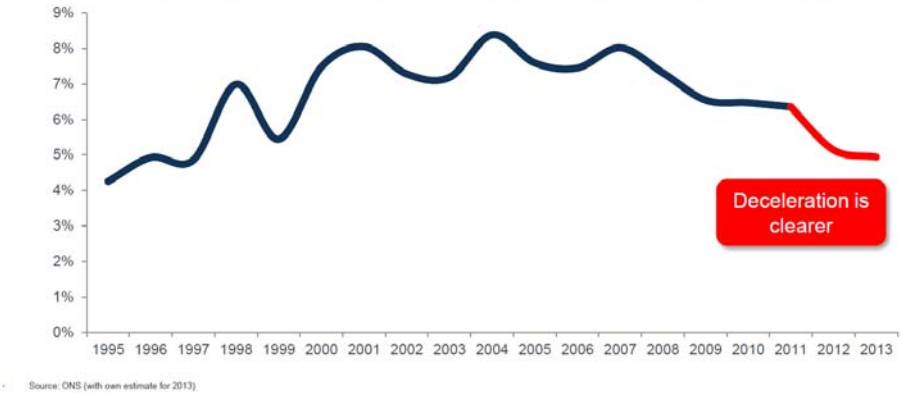
- Most plausible further outcome was compression of morbidity, perhaps associated with lifespan expansion
  - the distinction between ageing processes and age related diseases is a false dichotomy
- Two main mechanisms of ageing:
  - Nutrient Sensing Pathways, and
  - Tumour suppression mechanisms (leading to senescent cells)
- Suggestion that if current research in the lab could be translated to the clinic a 20% reduction in mortality by 2050 could be achieved.

Longevity in the age of Austerity

Richard Willets, Partnership

What does the most recent data show?

Increase in life expectancy for males in England & Wales aged 65 over previous 5 years, 1995-2013



Source: ONS (with own estimate for 2013)

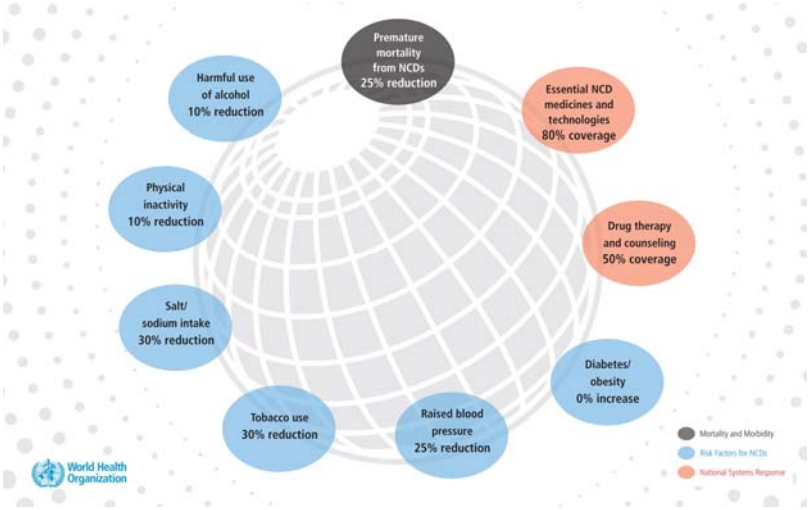
Longevity in the age of Austerity

Richard Willets, Partnership

- Many factors suggest improvement rates should be falling:
  - NHS Indicators suggest significant strain
  - Reduced spending on social care
  - Jump in deaths caused by dementia
  - Falling rate of improvement from Circulatory disease
- International comparisons suggest periods with highest rates of increase in life expectancy correlate high economic growth
- Impact can be different for different age groups (e.g. Ireland)

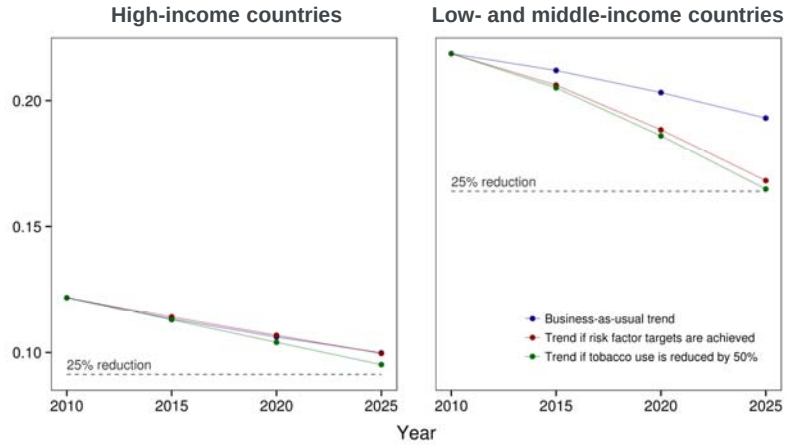
How Prevention Could Change Mortality

Professor Majid Ezzati, Imperial College



How Prevention Could Change Mortality

Professor Majid Ezzati, Imperial College



Kontis et al. *Lancet* 2014

How Prevention Could Change Mortality

Professor Majid Ezzati, Imperial College

The contribution of risk factors to reducing premature mortality from top 10 NCDs

Cause of death	BAU reduction	Reduction if risk factor targets are achieved	Risk factor contribution towards the 25×25 mortality target
Ischaemic heart disease	-17%	-33%	>100%
Stroke	-20%	-38%	>100%
COPD	-18%	-27%	>100%
Lung cancer	-3%	-12%	56%
Diabetes	+11%	-5%	51%
Liver cancer	-2%	-5%	17%
Stomach cancer	-10%	-19%	63%
Breast cancer	+3%	+3%	1%
Hypertensive heart disease	-19%	-43%	>100%
Colorectal cancer	-9%	-10%	10%
All CVDs	-18%	-34%	>100%
All cancers	-3%	-7%	26%
Chronic respiratory diseases	-16%	-24%	92%
Diabetes	+11%	-5%	51%
Four main NCDs	-10%	-21%	77%

Kontis et al. *Lancet* 2014

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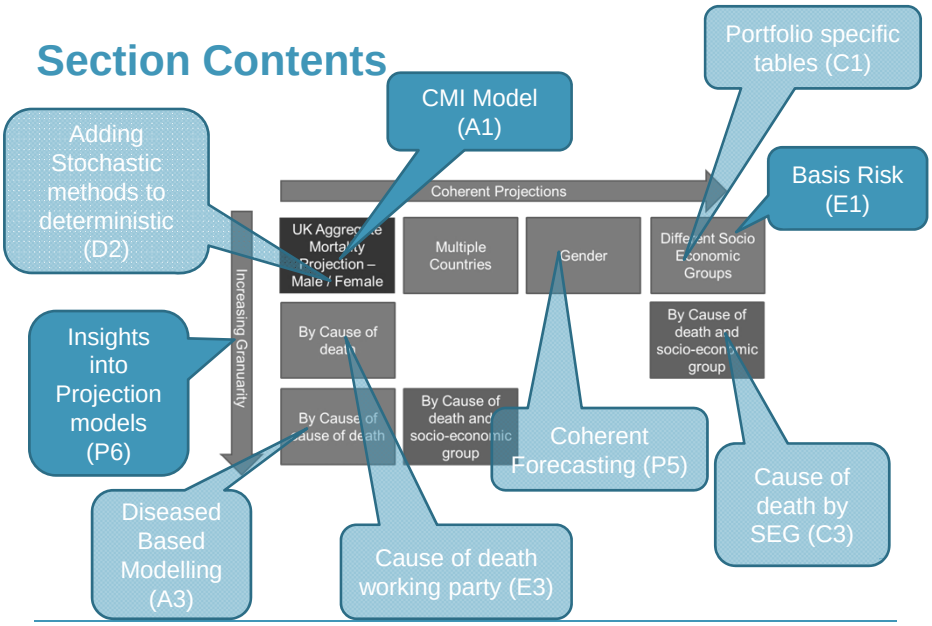
Section 3: Modelling

Section Contents



Innovations in the CMI's modelling approach

Tim Gordon and Jon Palin, CMI

- Data issues:
  - 1919 cohort
  - 1960s
  - Overdispersion
- Using Weekly death data
- Rolling data period (past 40 years)
- Co-Graduation

CMI Model

More generally

Towards an industry standard to assess longevity basis risk

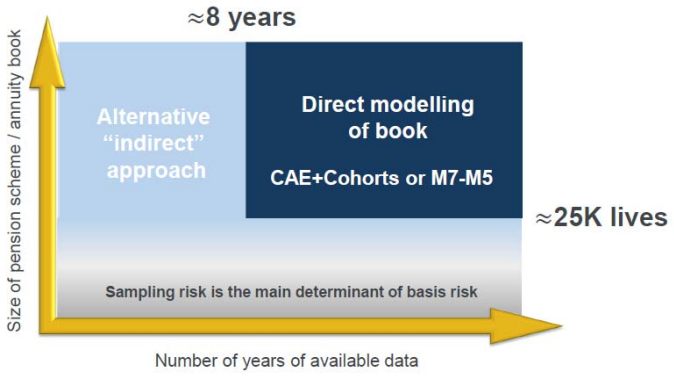
Steven Baxter, Hymans Robertson LLP and Andres M Villegas, Cass Business School

- Background:
  - Joint LLMA / IFoA work party commissioned research
  - Objective : Practical method for assessing basis risk in population index based swaps
  - Academic / Commercial partnership between Hymans Robertson and Cass won a competitive tender
  - Final results to be presented on 8 December at Sessional Meeting
- Major challenge is to assess the risks presented by demographic differences between portfolio and population

Towards an industry standard to assess longevity basis risk

Steven Baxter, Hymans Robertson LLP and Andres M Villegas, Cass Business School

Choice of two-population model



Applying Insights to Mortality Projection Models

Richard Willets, Joseph Lu and Dr Tim Crayford

- Three areas of influence for future mortality (Lu)
  - Socio-economics
  - Sciences
  - Health Care System
- Use of conceptual models which (Willets):
  - Develop models with (5-10) cause-of-death groups
  - Allow for changes in disease classification over time
  - Parameterise models for each cause group using historic data
  - Allow future projections to be modified to reflect expert opinion
  - Blend into aggregate model at high ages

Applying Insights to Mortality Projection Models

Richard Willets, Joseph Lu and Dr Tim Crayford

Practical solution (Crayford)

- Take a synthetic population with an 'average' mix of important diseases and risk factors at retirement (HES, GHS, CPRD)
- Model your future incidence rates (CPRD, HES, Cancer registries)
- Generate multivariate models at transition points during the life of the disease as per UKPDS methods. Derive mortality estimates.
- Make some real-world assumptions about risk-factor modification. Make assumptions about the impact of emerging new drugs / treatments. Make assumptions about catastrophes. Accept that human biology isn't evolving much.
- Derive bottom-up projections
- Triangulate with CMI projections
- POHEM (Canada)

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Section 4: MRSC and Future Research

The Mortality Research Steering Committee

- Established 2006 by the IFoA
- Aim to further the understanding of past, present and future mortality trends through collaboration with other disciplines
- Steers mortality research across the profession
  - Supporting the Research and Thought Leadership Committee

The Mortality Research Steering Committee - People

- Peter Banthorpe (Chair), Head of Biometric Research, RGA UK
- Madhavi Bajekal, Senior Research Fellow, UCL
- Adrian Gallop, GAD
- Carol Jagger, Professor of Epidemiology and Director of the Leicester Nuffield Research Unit
- Angus Macdonald, Director of the Genetics and Insurance Research Centre, Heriot-Watt University
- Sarah Mathieson, Head of Research, the Institute and Faculty of Actuaries
- Matthew Edwards, Senior Consultant, Towers Watson
- Brian Ridsdale, UK representative on the IAA Mortality Task Force
- Philip Simpson, Principal, Consulting Actuary, Milliman
- Trevor Watkins, Director of Education, the Institute and Faculty of Actuaries
- Lorraine Atherton, Research and Knowledge Assistant, the Institute and Faculty of Actuaries (Committee Secretary)

The Mortality Research Steering Committee – Research Themes

- Frailty
- Dementia

Seeking to build on

- UK Mortality Data Directory
- Cause of Death Modelling

Working on

- Antibiotic resistance
- Limits to Growth
- Obesity and Diabetes

Scoping

- Trends by Socio-economic classifications
- Long-term improvement rates

Seeking ideas

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Questions or comments?

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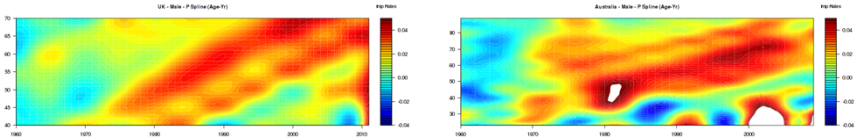
Supplemental Slides

Human Mortality Database

A Real Star, University of California, Berkeley and Max Planck Institute for Demographic Research

- Underpinned many of the presentations, posters and interaction opportunities
- Enables different countries' mortality to be rapidly compared, permits:
  - Wider validation of findings
  - Insights from comparing countries
  - International correlations to be reflected



Comparison of UK (Left) and Australian (Right) Mortality Improvements after P-Spline Smoothing
Data from HMD. Calculations and Plotting from Christopher Reynolds, Partner Re.

Obesity and Mortality

Sam Gutterman

Comparison of recent pooled data studies

BMI Range	Flegal (2013)	Berrington de Gonzalez (2010) Females	Males
< 18.5	excluded	1.47	1.37
18.5 – 19.9	1.00	1.14	1.01
20.0 – 24.9	1.00	1.00	1.00
25.0 – 29.9	0.94	1.13	1.13
30.0 – 34.9	0.95*	1.44	1.44
35.0 – 39.9	1.29*	1.88	2.06
40.0 – 44.9		2.51	2.93
>= 45.0	excluded		

* Obesity classes 1-3: 1.18

Obesity and Mortality

Sam Gutterman

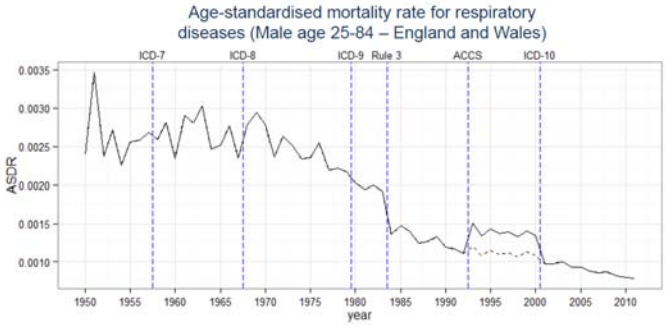
- BMI is not a good measure of obesity
  - Location of fat tissue more important
  - Waist circumference or waist to hip ratio may be better
- BMI categories wide and contains heterogeneous individuals
- Different impact at different ages
- Has the epidemic matured yet?
- Physical activity and overall fitness important
- Lots of these results are from meta-studies, which can be hard to combine in a non-biassed manner

Cause of Death by SEG

Andres M Villegas, Madhavi Bajekal and Steven Haberman, University College London, Cass Business School

Modelling mortality by cause of death

Cause of death coding changes



- Adjustment methods
  - Bridge coding and comparability ratios (e.g. ONS for ICD-9 to ICD10)
  - Statistical correction methods (e.g. Rey et al (2009), Park et al (2006))

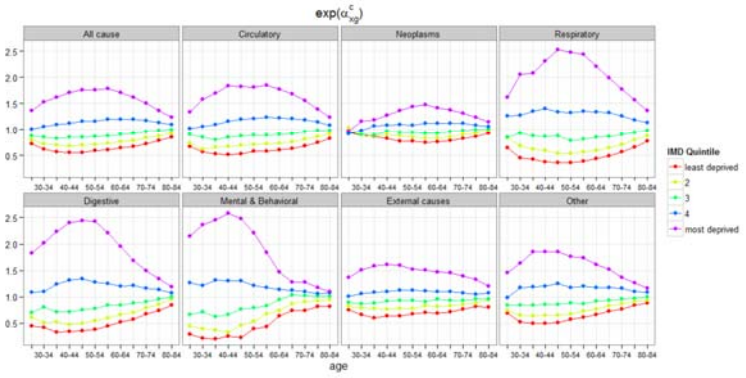
Cause of Death by SEG

Andres M Villegas, Madhavi Bajekal and Steven Haberman, University College London, Cass Business School

Case study: Mortality by deprivation in England

Level differences by deprivation quintile (Males)

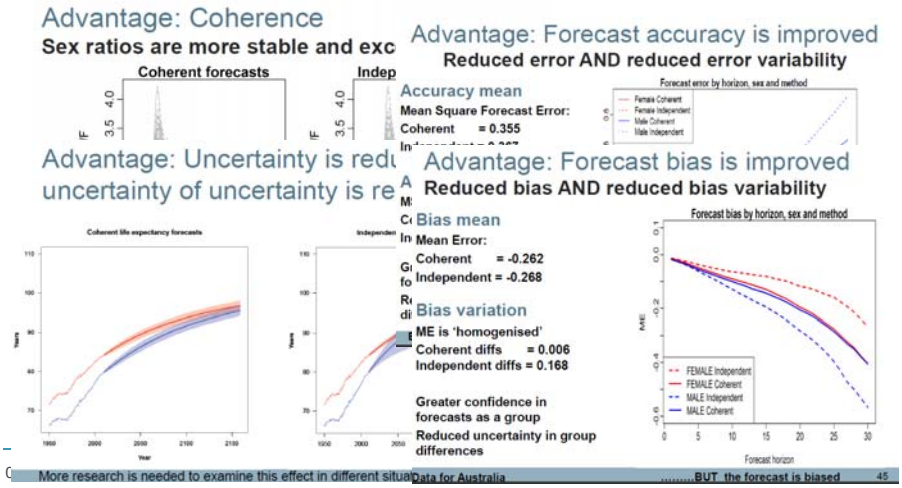
$$\log \mu^c_{xtg} = \alpha^c_x + \alpha^c_{xg} + \beta^{c0}_x \kappa^c_t + \sum_{i=1}^{k} \delta^{ci}_x \gamma^{(i)}_{t-x}$$



Coherent mortality forecasting of multiple populations

Dr Heather Booth, Australian Demographic &Social Research Institute

- Advantages of Coherent Projection:



Coherent mortality forecasting of multiple populations

Dr Heather Booth, Australian Demographic &Social Research Institute

Male – better accuracy:

- Sex-coherent
- Taking female mortality into account

Female – better accuracy:

- State-coherent
- Taking other female mortality into account

For both sexes, female mortality as 'other' tends to give a better forecast