

Continuous Mortality Investigation

Institute and Faculty of Actuaries



Mortality improvements outlook 2018+

Discussion hosted by SIAS and the CMI Mortality Projections Committee

3 April 2018 Staple Inn Hall, London

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CMI

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To produce high-quality impartial analysis, standard tables and models of mortality and morbidity for long-term insurance products and pension scheme liabilities on behalf of subscribers and, in doing so, to further actuarial understanding.

Our vision is to be regarded across the world as setting the benchmark for the quality, depth and breadth of analysis of industry-wide insurance company and pension scheme experience studies

Agenda

- 10 mins Introduction / scene setting
- 30-40 mins Panel presentations with 5 to 10 minutes per speaker
 - Sacha Dhamani, M&G Prudential
 - Matthew Edwards, Willis Towers Watson
 - Alice Woolley, RMS
 - Sven Wiesinger, Hannover Re
- 30-40 mins Comments and questions from the floor
- 5 mins Wrap up / close

Male standardised mortality ratio (SMR)

Male SMR (log scale) for England & Wales ages 50 to 89



Quarterly mortality update (provisional)

Quarterly moving average of Standardised Mortality Rate (England & Wales)



CMI Model versions

- CMI_2009 to CMI_2015
 - Annual updates to data; and some tweaks to method
- CMI_2016
 - Larger changes in method, although same principle
 - Addition of period smoothing parameter to control responsiveness
 - Change in shape of long-term rate
 - Overhaul of software faster, simpler, more transparent
- CMI_2017 (published on 1 March 2018)
 - "Business as usual" update Working paper 105
- CMI_2018 (due by end of March 2019)
 - May refine high age (85+) exposure data (c.f. Working Paper 100)

Progression of cohort life expectancy

Age 65, CMI Model, illustrative long-term rate of 1.5% p.a.



Initial rates of mortality improvement

Initial mortality improvements and components in CMI_2017



Mortality improvement by socio-economic group



Calculations by Aon Hewitt using ONS data for England & Wales.

Mortality rates have been standardised using European Standard Population 2013 for ages 50 to 89 inclusive.

Improvements are $-\Delta \log SMR_t$.

Discussion

1. What will happen to mortality improvements in the national population?

2. How do improvements vary for specific portfolios?

Sacha Dhamani Head of Longevity, M&G Prudential

Male standardised mortality ratio (SMR)

Male SMR (log scale) for England & Wales ages 50 to 89



Change in Mortality Improvement?



Significant Disruption



Possible Interpretations



Elephant in the Room

Austerity

Social Care Expenditure



Long Term Drivers

Cardiovascular

Cancer

Behaviour

Technology

Short Term Drivers

Economics

Government Policy

Alzheimer's

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Mortality Experience

Brexit

2022 GE

Alzheimer's Treatments

Matthew Edwards Director and mortality lead in the life practice of Willis Towers Watson

Where have improvements come from?

The 'default option' for change is 'no change'

• There are specific reasons for the very large improvements seen 1975-2010



Mortality rates by cause of death



Source: Willis Towers Watson based on data published by ONS. SMRs are estimates based on age banded data

What's going to happen now?

'Change' doesn't have to be universally positive



Smoking – effect of further reductions will be much smaller

Health expenditure will decrease in real per capita terms

CVD deaths will start showing the diabetes effect

Diabetes trends

- Diagnosed diabetes has increased by a factor of 2.6 over the period 1994-2016 in the UK for men, x 3.3 (F)
- Diabetics have mortality approximately double that of non-diabetics in older ages
- Current nutritional guidelines (low fat, high carb) may be partly responsible in which case the problem will deteriorate
- □ Similar picture can be painted of obesity
- Massive problem for CVD, cancer, and Alzheimer's



Prevalence of diabetes (Health Survey for England, NHS Digital)

Diabetes – the doughnut's perspective

For an average 20-year-old American, the lifetime risk of developing type 2 diabetes increased from 20% in 1985-89 to 40% in 2000-11 for men, while lifetime risk for women increased from 27% to 39%.

The Lancet Diabetes & Endocrinology Gregg, Dr. E. et al

Morbid obesity prevalence is projected to vary from 4% (in Scottish men aged 16–24 years old) to 54% (in English men aged 75 and older) by 2035.

The Lancet Keaver, L. et al Diabetes Explosion

World Health Organisation Diabetes Deaths

WHO projects diabetes deaths to double by 2030

The prevalence of diabetes ... will increase by 54% to more than 54.9m Americans between 2015 and 2030; annual deaths attributed to diabetes will climb by 38% ...; and total annual medical and societal costs related to diabetes will increase 53% to more than \$622bn by 2030.

> Population Health Management, Feb 2017 Rowley, W. R. et al

Disease-based multi-state model



PulseModel improvement assumptions



What's the answer?

Opinions from ten medical advisers across the seven disease groups

- Allow for likely pharma / medical advances and lifestyle / NHS trends
- Probably very predictive up to around 10-15 years
- Feed into the multi-state disease model
- **Answer?** A 'constant additional improvement' rate in the 0-1% range (depending on age, gender, socio-economic profile)

Longer-term

- We have also developed driver-based models ('cause of cause of death') based on likely scenarios regarding NHS/ social care £, smoking trends, etc
- These may be more predictive from the (say) 10 or 15 year point
- Tend to give answers around 1% (but with only 'positive' drivers)

Alice Woolley Principal Consultant, RMS

Winter mortality continues to be a challenge



- 2 main factors: Influenza & NHS resource constraints
- Deaths have again been high for the 2017/18 season

Source: Public Health England, National flu report surveillance: 22 March 2018: (https://www.gov.uk/government/statistics/weekly-national-flu-reports)

Healthcare spending has stagnated, despite ageing, growing population



- UK public health spending grew by ~1.3% p.a. between 2009/10 and 2015/16 lowest 5-year average since records began in 1955/56
- ~0.4% p.a. once adjusted for ageing and population growth

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Lung Cancer Case Study: **Potential for further mortality improvements?**

Total mortality for England and Wales, 2016



- Other cancers
- NSCLC Non small cell lung cancer
- SCLC Small cell lung cancer
- Other diseases

Potential Mortality Reduction

Lifestyle

- Elimination of smoking can lead to up to 83% reduction in lung cancer deaths
- ~25,000 deaths for England and Wales in 2016
- ~5% of total mortality

Health Environment

 ~10% additional reduction with lower professional / environmental exposure

Medical intervention

- Localized tumors (Stage I-III): surgery, chemotherapy and radiotherapy
- Metastatic cancer (Stage IV): targeted therapy and **immunotherapy**

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Sources: Office for National Statistics, 2018; Bender, E., 2014. Nature 513, S2; Chan, B.A., Hughes, B.G., 2015. Transl. Lung Cancer Res. 4, 36–54.

Lung Cancer Case Study: Immunotherapy: Mechanism

- Immune checkpoint inhibitors
 - Blocks pathways (checkpoints) that cancer cells use to suppress immune system surveillance
 - This unleashes preexisting latent immunity against cancer
- Approved agents: PD-1
 - Nivolumab (Opdivo)
 - Pembrolizumab (Keytruda)
- Approved agents: PD-L1
 - Atezolizumab (Tecentriq)
 - Durvalumab (Imfinzi)





Week 12



Week 52









Tumor site

T-cell infiltration

Lung Cancer Case Study: Immunotherapy: Potential Impact

Progression-free Survival among Patients with High Tumor-Mutation Burden



Target population

 Stage IV NSCLC: ~13,000 deaths (2.5%)

Mortality Improvement

- With immunotherapy, survival improves from < 20% to up to ~40% (can reach 75% in some cases)
- Translates to ~2,800 to 7,400 deaths avoided each year or approximately 1% of all deaths.

3 April 2018

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35

Sources: Carbone, David P., Martin Reck, Luis Paz-Ares, Benjamin Creelan, Leora Horn, Martin Steins, Enriqueta Felip, et al. 2017. New England Journal of Medicine 376 (25): 2415-26.

Lung Cancer Case Study: Immunotherapy: Pace of Adoption

Agent	FDA approval	NICE approval
Nivolumab	2014	2017
Pembrolizumab	2014	2016
Atezolizumab	2016	Under review
Durvalumab	2017	Under review

- Following FDA approval, cancer drug utilization peaks at 7-10 years
- Immunotherapy drugs also have the potential to treat many other cancers:
 - **Nivolumab** approved for advanced melanoma, advanced non-small cell lung cancer, advanced renal cell carcinoma, classical Hodgkin lymphoma, advanced squamous cell carcinoma of the head and neck, urothelial carcinoma, MSI-H or dMMR metastatic colorectal cancer, and hepatocellular carcinoma...

Cost & Socio-economic Implications

- Immunotherapies cost >£100,000 per patient per year
- NHS is struggling to afford cancer drugs
- NICE guidelines: a drug should cost no more than £20,000-£30,000 per QALY (quality-adjusted life year) gained to be considered cost effective
 - Some cancer drugs have been rejected for use on the NHS
- Costs may be a barrier to adoption, and potentially widen socio-economic differences

Dr Sven Wiesinger Actuary, Hannover Re

Puzzling news (1)

- Improvements in medical science and medical care, e.g.
 - Early detection of cancer using proteins in blood samples [Cohen, Li, et al., Science 359 (2018), 926-930]
 - Establishment of standards for better clinical care of elderly [Berian, Rosenthal, et al., Annals of Surgery 267 (2018), 280-290]
- **Impact** of changes in socio-economics and lifestyle, e.g.
 - Reduction in dementia rates, clearly correlated to increase in level of education

[Weden, Shih, et al., Amer. J. of Preventive Medicine 54 (2018), 164-172]

=> expectation of continued increases in life expectancy

Puzzling news (2)

- Population mortality **improvements in the UK down** for some years
 - see e.g. current and recent work of the CMI
- Canada: OAS (Old Age Security) data analysis until 2016: Male improvements down from around 3% to slightly below 2% per annum, female improvements generally weaker throughout [Old Age Security (OAS) Program Mortality Experience Fact Sheet (2018), http://www.osfi-bsif.gc.ca/eng/oca-bac/fs-fr/Pages/oas_pme.aspx]

=> how does this fit together?

Taking a closer look

- Fluctuations in improvements are concentrated on socio-economically weaker parts of the population
 - Until 2010: "Deprivation paradox" in several datasets,
 "blue-collar" have had higher improvements than "white-collar" [Haberman, Kaishev, et al. (2014), Longevity basis risk. Research report (IFoA and LLMA)]
 - After 2010: Multiple analyses indicate relation between public funding of health care and social care, and mortality
 - Effects of health and social care spending constraints in England [Watkins, Wulaningsih, BMJ Open 7 (2017), e017722]
 - Longitudinal study on social services and health care in Canada [Dutton, Forest, et al., CMAJ 190 (2018), e77-e71]
- 2017 PLSA Longevity Model indicates clear distinction in improvements between "comfortable" and "less comfortable" pensioner groups

- "Political volatility" increasingly stronger driver of mortality trends
 - Social care funding (including general public service like transport)
 - Funding for health care, long-term care
- The more a population group **relies on public support**, the more they are impacted

- ... to use an **over-simplified** general picture: Recent history
 - convergence to divergence



- **Divergence** in mortality trends will not remain indefinitely
 - But how quickly will things change, and how far?



 In 2007, nobody predicted 3-4% improvements indefinitely ... predicting the current low levels for long term does not seem like a good idea, either.



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