What can we learn from mortality by cause of death?

Presentation by Dov Raphael
14 July 2021
What can we learn from mortality by cause of death?

A project of the Mortality Working Group (MWG) of the International Actuarial Association
Content of the presentation

• The Mortality Forum
• Introduction – why are causes of death important?
• Sources of information
• The Excel model
• Examples of results
• The cohort effect
• Data consistency and reliability
• Conclusions and summary
The Mortality Forum

- A forum of the International Actuarial Association
- Exists to promote and support international actuarial research in mortality and longevity
- Purpose: To serve as a forum within the IAA devoted to the worldwide study of mortality, particularly mortality impacts on insurance (including life, pension and living benefits) products or on government or world organisation (such as WHO and the UN) sponsored programs. Studies of the mortality experience of general populations, insured life and other population subsets are within the scope of the MWG
- Currently represents 31 countries on 5 continents
Mortality Forum

Knowledge
- Country reports
- Research updates
- Sharing at meetings
- Conferences
- Visiting speakers

Research
- MWG research projects
- Own research
- Papers
- Presentations
- International: HMD, supranationals

Fellowship
- Joint projects
- Dinners
- Shared research
- Worldwide contacts

Resource library
- Open access on web to -
- Minutes and papers
- Country reports
- Information Base
- www.actuaries.org/mortalityinfo

Dissemination
- Updates in 13 languages
  - promoted to associations
- Actuarial educators
- IAA seminars with PIWG
- In-country seminars
- Supranational meetings

www.actuaries.org/mortality

What can we learn from mortality by cause of death? – slide 5
Some recent projects of the MF

- E-cigarettes (Sam Gutterman)
- Recent Developments in Longevity Internationally (Brian Ridsdale)
- Drivers of Future Mortality by (Al Klein)
- The search for new sources of mortality improvement - moving from remedial to curative medicine (Daniel Ryan)
- Underwriting Around the World (Al Klein)
- Epidemics and Pandemics – an Actuarial View (Sam Gutterman)

The current project on **Mortality by Cause of Death (COD)** was compiled by Dr Ayse Arik, Prof. Yair M. Babad and Dov Raphael
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- The Mortality Forum
- **Introduction – why are causes of death important?**
- Sources of information
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- Conclusions and summary
What can we learn from mortality by Cause of Death? - Objectives

• To catalogue, assess and analyse existing data on mortality by cause of death (COD), including: comparisons by country, trends over time, and possible implications for mortality forecasting

• To investigate to what extent the data are consistent, and how they might be influenced by changes in categorization or reporting preferences

• The database and its associated graphs and tables were created for this study as a compilation of existing actuarial data, in order to enable users to make effective use of the information available while being aware of its limitations.
Why are CODs important?

Mortality forecasting models look for patterns in **overall** mortality rates
e.g. APC (Age-Period-Cohort):

\[
\text{logit}(q_{x,t}) = \beta_x + \kappa_t + \gamma_{t-x}
\]

Lee-Carter

\[
r_{x,t} = \ln(m_{x,t}) = \alpha_x + \beta_x k_t + \epsilon_{x,t}
\]

- Why is there a combination of period/cohort?
- Why do periodic improvements vary by age?
Why are CODs important?

The overall mortality rates in Fig. 1.1 are log-linear ($e, e^{0.9}, e^{0.8} \ldots$)

What happens if we extrapolate for the next 5 years?

A fictitious example of mortality rates over time – years 1–5 (observed)

The central mortality rate (or central death rate) for the year of age $x$ to $x+1$ is denoted as $m_x = d_x / e_x$
Now, let us suppose that the mortality shown here is a result of two CODs, Cause A and Cause B.

Each cause behaves differently.

Extrapolation of the previous graph for the next 5 years
Why are CODs important?

Cause A decreases log-linearly but more rapidly.

Cause B has been increasing but is now close to stability.

The combined result is 1.38 instead of 1.11!
Why are CODs important?

Projected mortality (years 6–10) – comparison of the two methods
Why are CODs important?

Other considerations:

• Some COD are important at older or younger ages: looking at overall mortality obscures this.
  → Examine CODs by age group

• The cohort effect is relevant to specific causes
  → We developed a measure of “cohortness” to identify the relevant CODs and countries.
Early interest in causes of death

Ancient Jewish prayer, source of Leonard Cohen’s “Who by fire”:

On the New Year will be inscribed and on the Day of Atonement will be sealed – how many will pass from the earth and how many will be created; who will live and who will die; who will die after a long life and who before his time; who by water and who by fire, who by sword and who by beast, who by famine and who by thirst, who by upheaval and who by plague, who by strangling and who by stoning...

John Graunt’s mortality table – London, 1662

“[Graunt] observed that about one-third of all deaths occurred from ‘Thrush, Convulsion, Rickets, Teeth, Worms, Abortives, Chrysomes, Infants, Overgrown and Overlaid’, which he guessed all related to children under four or five years old. He guessed also that perhaps half of the deaths from ‘Smallpox, Swinepox, Measles and Worms without Convulsions’ might be children under six years old … About 7 per cent of the total deaths were described as ‘aged’, which he guessed as meaning over age 70.”
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International Classification of Diseases (ICD)

- International standard for reporting diseases and health conditions
- Diagnostic classification standard for all clinical and research purposes
- Allows easy storage, retrieval and analysis of health information for evidenced-based decision-making
- Allows data comparisons in the same location across different time periods
- The current “standard” for reporting is ICD-10, which was approved in 1990
- There are conversion tables from previous versions of ICD in order to capture data from earlier periods.
Immediate cause of death: “The final disease or condition resulting in death”

Underlying cause of death: “The disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury"

Multiple causes: causes of death including not only the underlying cause but also immediate cause of death and all other intermediate and contributory conditions entered by the certifying physician

On death certificates, causes of death are entered sequentially starting with immediate cause and ending with the underlying cause

The physician may also record “other significant conditions contributing to death but not resulting in the underlying cause”.

What can we learn from mortality by cause of death? – slide 18
### International Classification of Diseases (ICD)

An example from A. Minino, MPH (Centers for Disease Control and Prevention) –

<table>
<thead>
<tr>
<th>Cause</th>
<th>ICD-10 code</th>
<th>Onset to death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate cause</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebral haemorrhage</td>
<td>I61.9</td>
<td>1 month</td>
</tr>
<tr>
<td>Underlying cause</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nephritis</td>
<td>N05.9</td>
<td>6 months</td>
</tr>
<tr>
<td>Initiating underlying cause</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cirrhosis of liver</td>
<td>K74.6</td>
<td>2 years</td>
</tr>
</tbody>
</table>
## Cause-of-death groupings

<table>
<thead>
<tr>
<th>Major category</th>
<th>Minor category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CANCER</td>
</tr>
<tr>
<td>1.01</td>
<td>Cancer of digestive system and oral cavity</td>
</tr>
<tr>
<td>1.02</td>
<td>Colorectal cancer</td>
</tr>
<tr>
<td>1.03</td>
<td>Cancer of trachea, bronchus and lung</td>
</tr>
<tr>
<td>1.04</td>
<td>Cancer of breast, uterus and ovary</td>
</tr>
<tr>
<td>1.05</td>
<td>Cancer of prostate and urinary organs</td>
</tr>
<tr>
<td>1.06</td>
<td>Other malignant neoplasms</td>
</tr>
<tr>
<td>2</td>
<td>HEART AND CIRCULATORY</td>
</tr>
<tr>
<td>2.01</td>
<td>Hypertensive/rheumatic heart disease</td>
</tr>
<tr>
<td>2.02</td>
<td>Ischaemic heart disease</td>
</tr>
<tr>
<td>2.03</td>
<td>Other heart disease</td>
</tr>
<tr>
<td>2.04</td>
<td>Cerebrovascular</td>
</tr>
<tr>
<td>2.05</td>
<td>Circulatory</td>
</tr>
<tr>
<td>3</td>
<td>OTHER MEDICAL</td>
</tr>
<tr>
<td>3.01</td>
<td>Infectious diseases</td>
</tr>
<tr>
<td>3.02</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>3.03</td>
<td>Other metabolic</td>
</tr>
<tr>
<td>3.04</td>
<td>Substance abuse</td>
</tr>
<tr>
<td>3.05</td>
<td>Mental</td>
</tr>
<tr>
<td>3.06</td>
<td>Nervous system</td>
</tr>
<tr>
<td>3.07</td>
<td>Acute respiratory</td>
</tr>
<tr>
<td>3.08</td>
<td>Other respiratory</td>
</tr>
<tr>
<td>3.09</td>
<td>Digestive</td>
</tr>
<tr>
<td>3.10</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>3.11</td>
<td>Genitourinary</td>
</tr>
<tr>
<td>3.12</td>
<td>Other/unknown</td>
</tr>
<tr>
<td>4</td>
<td>EXTERNAL</td>
</tr>
<tr>
<td>4.01</td>
<td>Suicide</td>
</tr>
<tr>
<td>4.02</td>
<td>Homicide</td>
</tr>
<tr>
<td>4.03</td>
<td>Road accidents</td>
</tr>
<tr>
<td>4.04</td>
<td>Accidental poisoning</td>
</tr>
<tr>
<td>4.05</td>
<td>Other accidents</td>
</tr>
</tbody>
</table>
Sources of information

Existing sources:

1. The Human Cause of Death Database (HCD) (16 countries)
2. The Cause-of-Death section of the Human Mortality Database (HMD-COD) (8 countries)
3. The WHO mortality database (over 140 countries)

In the WHO database, for many countries the population size is too small, or the data period is too short or not continuous. Unlike the two previous databases, there is no information about exposure to risk (which is required to calculated mortality rates), but only population data.

Our study uses a combination of sources 1 and 2.
## Sources of information

<table>
<thead>
<tr>
<th>Country</th>
<th>Acronym used in graphs</th>
<th>No. of years covered</th>
<th>Average population size over this period</th>
<th>Approx. exposure in billion life-years</th>
<th>Life expectancy at birth (LE)</th>
<th>LE correct at year</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>USA</td>
<td>57</td>
<td>247.2</td>
<td>14.1</td>
<td>78.9</td>
<td>2017</td>
</tr>
<tr>
<td>Russia</td>
<td>RUS</td>
<td>50</td>
<td>134.9</td>
<td>6.7</td>
<td>70.9</td>
<td>2014</td>
</tr>
<tr>
<td>Japan</td>
<td>JPN</td>
<td>67</td>
<td>103.4</td>
<td>6.9</td>
<td>84.4</td>
<td>2018</td>
</tr>
<tr>
<td>Germany</td>
<td>DEU</td>
<td>19</td>
<td>81.8</td>
<td>1.6</td>
<td>80.9</td>
<td>2017</td>
</tr>
<tr>
<td>E&amp;W</td>
<td>ENW</td>
<td>67</td>
<td>50.7</td>
<td>3.4</td>
<td>81.3</td>
<td>2016</td>
</tr>
<tr>
<td>France</td>
<td>FRA</td>
<td>58</td>
<td>54.4</td>
<td>3.2</td>
<td>82.4</td>
<td>2017</td>
</tr>
<tr>
<td>Spain</td>
<td>ESP</td>
<td>33</td>
<td>42.1</td>
<td>1.4</td>
<td>83.1</td>
<td>2016</td>
</tr>
<tr>
<td>Ukraine</td>
<td>UKR</td>
<td>49</td>
<td>45.3</td>
<td>2.2</td>
<td>71.4</td>
<td>2013</td>
</tr>
<tr>
<td>Poland</td>
<td>POL</td>
<td>58</td>
<td>33.7</td>
<td>2.0</td>
<td>77.8</td>
<td>2016</td>
</tr>
<tr>
<td>Czechia</td>
<td>CZE</td>
<td>68</td>
<td>9.7</td>
<td>0.7</td>
<td>79.0</td>
<td>2018</td>
</tr>
<tr>
<td>Sweden</td>
<td>SWE</td>
<td>61</td>
<td>8.3</td>
<td>0.5</td>
<td>82.5</td>
<td>2018</td>
</tr>
<tr>
<td>Norway</td>
<td>NOR</td>
<td>62</td>
<td>4.1</td>
<td>0.3</td>
<td>82.8</td>
<td>2018</td>
</tr>
<tr>
<td>Lithuania</td>
<td>LTU</td>
<td>54</td>
<td>2.9</td>
<td>0.2</td>
<td>75.7</td>
<td>2017</td>
</tr>
<tr>
<td>Latvia</td>
<td>LVA</td>
<td>54</td>
<td>2.1</td>
<td>0.1</td>
<td>74.8</td>
<td>2017</td>
</tr>
<tr>
<td>Estonia</td>
<td>EST</td>
<td>54</td>
<td>1.3</td>
<td>0.1</td>
<td>78.2</td>
<td>2017</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>821.8</strong></td>
<td><strong>43.2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Repr. countries</strong></td>
<td></td>
<td></td>
<td><strong>626.2</strong></td>
<td><strong>33.2</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Combining the data from sources “1” and “2” enables a view of ~50 years for most countries.

The graphs shown in the presentation relate to 6 “representative” countries out of the 15.
Life expectancy – countries in the study

Life expectancy at birth for the countries in the database

For illustration only – LEs are for the latest year available and so are not exactly comparable.
Challenges of combining sources

- Data from the two “actuarial” databases are similar but not identical
- In most cases the differences are not significant for the current study
- The two databases are independent and seek to achieve different goals
- HMD-COD: access to unadjusted cause-of-death data series for as many of the HMD countries as possible with periodic updates as new data become available
- HCD: a one-time to provide access to historical cause-of-death series for a limited number of countries, adjusted for changes in ICD.
From the HMD we have four dimensions:

- Country (15 countries)
- Observation year (between 19 and 68 available years, average 54)
- Gender (M/F)
- Age (0-1, 1-4, 5-9, 10-14, … 75-79, 80-84, 85 and up)

We now add a 5th dimension:

- Cause of death (4 major categories, 28 sub-categories)

The database has ~900,000 cells for death counts, and ~30,000 cells for exposures.

An Excel spreadsheet enables “views” which freeze three dimensions and show results for the remaining two dimensions.
The combined database – a 5-dimensional “data cube”

- The “cube” includes the following metrics:
  - Exposure
  - Number of deaths
  - Mortality rate \( (m_x = \text{deaths} / \text{exposure}) \)
  - Change in \( m_x \) since earliest year in graph
  - Annual mortality improvement (moving average)

as well as a new metric “Weighted years of life lost” (WYLL) which is the expected number of years of life lost (relative to the maximum life expectancy – Japan F) resulting from the COD being measured, per 1000 lives. This enables a “view” of all ages together, for comparison over time or across countries.
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Mortality trends by cause of death: comparison by country and year

<table>
<thead>
<tr>
<th>Axes:</th>
<th>Countries</th>
<th>All</th>
<th>CLICK Formulae/Calculate Sheet TO UPDATE TABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years - from</td>
<td>1965</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed values:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COD group:</td>
<td>C lung</td>
<td>Cancer of trachea, bronchus and lung</td>
<td>3</td>
</tr>
<tr>
<td>Ages from:</td>
<td>70</td>
<td>to 85</td>
<td>70-85</td>
</tr>
<tr>
<td>Gender:</td>
<td>1</td>
<td>(1=M,2=F,3=both)</td>
<td>M</td>
</tr>
<tr>
<td>Not updated!!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mark up to 6 columns (1,2,3...) to be shown on graphs:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Table of results

<table>
<thead>
<tr>
<th>Country:</th>
<th>USA</th>
<th>RUS</th>
<th>JPN</th>
<th>DEU</th>
<th>FRA</th>
<th>ENW</th>
<th>ESP</th>
<th>UKR</th>
<th>POL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>23,290,806</td>
<td>19,553,371</td>
<td>16,422,793</td>
<td>6,447,861</td>
<td>6,048,844</td>
<td>6,855,651</td>
<td>4,341,637</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>23,472,789</td>
<td>19,340,201</td>
<td>16,514,861</td>
<td>6,479,863</td>
<td>6,121,799</td>
<td>6,778,391</td>
<td>4,354,438</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>23,837,382</td>
<td>19,200,377</td>
<td>16,779,528</td>
<td>6,571,872</td>
<td>6,218,677</td>
<td>6,712,050</td>
<td>4,414,396</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1968</td>
<td>24,357,757</td>
<td>19,010,487</td>
<td>17,209,961</td>
<td>6,685,546</td>
<td>6,296,446</td>
<td>6,630,957</td>
<td>4,483,491</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What can we learn from mortality by cause of death? – slide 28
A brief view of the Excel model

Mortality rates per mille - Cancer of trachea, bronchus and lung - M ages 70-85

Weighted years of life lost - Cancer of trachea, bronchus and lung - M
A brief view of the Excel model

Mortality rates relative to 1965 - Cancer of trachea, bronchus and lung - M ages 70-85

Annual mortality improvement (5-yr MA) - Cancer of trachea, bronchus and lung - M ages 70-85
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Overview of results by major categories

41% of deaths in the countries studied were from heart and circulatory diseases (down from 48% fifty years ago), but the next slide shows disparities between the countries.
Overview of results by major categories

The proportion of deaths from heart and circulatory diseases in Eastern Europe is ~60%, in most other countries ~30%
The higher proportion of heart disease among women is found mainly in Eastern Europe. In the US the shares are almost the same (30% for men, 31% for women).

Deaths from external causes are much higher for men than for women.
Weighted years of life lost (WYLL) by cause of death – lung cancer

- Males: Russia, US and England improving; Japan deteriorating; France and Sweden static
- Females: in most countries the situation has worsened, but Russia, US and England now static.
The lowest (best) values are seen in Japan, but with a worsening trend.

England and Wales - very high until 1990, since then a significant improvement.
Japan, France: low and stable

US, England, Sweden: initially high (esp. males), decrease of about two-thirds

Russia: increasing until about 2000, some improvement since then.
Most countries: improvement have tapered off

Russia: increasing until about 2000, a significant improvement since then.
US and France in particular show the effect of AIDS in 1980s and 1990s
Russia: since 2000, much higher than other countries
Female mortality much lower, but increasing in Russia since 2000.
• Male and females similar
• Increase for US males – does not give full expression to increase in incidence of diabetes
• Perhaps other medical complications of diabetics appear as the cause of death?
Main contributor to the increase is dementia

Not seen in all countries

Higher rates for females, perhaps an indirect result of female longevity
Much higher for males
Males in Russia – highest but a significant decrease since 2000
Probably under-reported.
Russia in the lead for both genders
Are these really accidents?
Dramatic increase in US in recent years.
Mortality improvements at higher (85+) and younger (25-40) ages are less than at the intermediate ages.
In the past, dominant CODs at older ages were heart, CVA and acute respiratory (pneumonia).

This has now been overtaken by dementia – a dramatic increase.

Increasing longevity or higher awareness?
Mortality at younger ages

- Most CODs at these ages are external
- An increase in accidental poisoning
- Substance abuse: dramatic increase in the 1990s – why the sudden decrease?

What can we learn from mortality by cause of death? – slide 46
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### Measuring the cohort effect

Heat map of mortality improvements by age group and year of observation: England and Wales, males, lung cancer

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group: 35-40</td>
<td>-0.2%</td>
<td>1.0%</td>
<td>5.4%</td>
<td>3.3%</td>
<td>3.1%</td>
<td>3.3%</td>
<td>5.2%</td>
<td>4.1%</td>
<td>8.0%</td>
<td>3.1%</td>
<td>-2.7%</td>
<td>5.2%</td>
</tr>
<tr>
<td>40-45</td>
<td>0.4%</td>
<td>1.9%</td>
<td>1.4%</td>
<td>4.4%</td>
<td>5.3%</td>
<td>2.3%</td>
<td>3.3%</td>
<td>2.2%</td>
<td>6.7%</td>
<td>2.7%</td>
<td>2.8%</td>
<td>2.1%</td>
</tr>
<tr>
<td>45-50</td>
<td>0.3%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>2.0%</td>
<td>4.9%</td>
<td>4.0%</td>
<td>2.8%</td>
<td>4.2%</td>
<td>4.6%</td>
<td>3.6%</td>
<td>4.7%</td>
<td>1.2%</td>
</tr>
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<td>50-55</td>
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<td>55-60</td>
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<td>60-65</td>
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<td>65-70</td>
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<td>70-75</td>
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</table>

- Measured by observation year, mortality changes are fairly uniform on the diagonals, but differ from one diagonal to another
- Let's rotate by 45° to show the heat map by year of birth.
### Measuring the cohort effect

Heat map of mortality improvements by age group and year of observation: England and Wales, males, lung cancer

<table>
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<tr>
<th>YOB close to</th>
<th>35-40</th>
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</tbody>
</table>

Standard deviation of averages: 3.4%
Average of standard deviations: 0.9%
Cohort effect index: 390

*What can we learn from mortality by cause of death? – slide 49*
The “measure of cohortness”

<table>
<thead>
<tr>
<th></th>
<th>For causes of death with a cohort effect</th>
<th>For other causes of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvements for a particular year of birth across all ages</td>
<td>Similar</td>
<td>Random</td>
</tr>
<tr>
<td>Improvements at different years of birth</td>
<td>Different</td>
<td>Slight differences (often a gradual improvement)</td>
</tr>
<tr>
<td>Measure of cohortness = (SD of averages) / (Average of SD)^2</td>
<td>&gt;100</td>
<td>&lt;100</td>
</tr>
</tbody>
</table>
# The “measure of cohortness”

<table>
<thead>
<tr>
<th>MALES</th>
<th>USA</th>
<th>RUS</th>
<th>JPN</th>
<th>FRA</th>
<th>ENW</th>
<th>SWE</th>
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<tr>
<td>All</td>
<td>74</td>
<td>11</td>
<td>91</td>
<td>214</td>
<td>216</td>
<td>147</td>
<td>13</td>
<td>66</td>
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<tr>
<td>C digestive system</td>
<td>77</td>
<td>112</td>
<td>163</td>
<td>124</td>
<td>73</td>
<td>21</td>
<td>61</td>
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<tr>
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<td>220</td>
<td>94</td>
<td>96</td>
<td>63</td>
<td>27</td>
<td>106</td>
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<tr>
<td>C lung</td>
<td>375</td>
<td>131</td>
<td>115</td>
<td>182</td>
<td>390</td>
<td>73</td>
<td>64</td>
<td>137</td>
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<tr>
<td>C urinary</td>
<td>49</td>
<td>92</td>
<td>81</td>
<td>66</td>
<td>53</td>
<td>25</td>
<td>48</td>
<td>74</td>
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<tr>
<td>C other</td>
<td>225</td>
<td>136</td>
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<td>135</td>
<td>101</td>
<td>76</td>
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<td>67</td>
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<td>HT/rheumatic heart</td>
<td>24</td>
<td>27</td>
<td>14</td>
<td>11</td>
<td>28</td>
<td>4</td>
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<tr>
<td>Ischaemic heart</td>
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<td>16</td>
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<td>78</td>
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<tr>
<td>Nervous system</td>
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<td>8</td>
<td>39</td>
<td>23</td>
<td>15</td>
<td>13</td>
<td>7</td>
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<tr>
<td>Acute respiratory</td>
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<td>5</td>
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<td>8</td>
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</tbody>
</table>

*What can we learn from mortality by cause of death? – slide 51*
The “measure of cohortness” - some observations

- Cohort effects are more prominent in male mortality data
- Cohort effects are almost entirely confined to cancer
  - Most prominently lung cancer
  - Also breast and uterine cancer
  - Consistent with studies on the cohort effect
- In France and Sweden, overall mortality rates exhibit a cohort effect higher than any of the individual cohortness measures
- In Russia (males and females) there is no indication of a cohort effect for all-cause data, but cancer (especially colorectal) has a high degree of cohortness.
Content of the presentation

• The Mortality Forum
• Introduction – why are causes of death important?
• Sources of information
• The Excel model
• Examples of results
• The cohort effect
• **Data consistency and reliability**
• Conclusions and summary
Data consistency and reliability

- ICD-10 “underlying cause” seems to be well defined
- But are recording practices completely uniform across countries or over time?
- Mortality attributed to mental and nervous diseases: not recognised in the past?
- A sudden death from external causes could be accident, homicide or suicide
- Changeover to ICD-10 affected the rules for determining the underlying cause of death
- Some researchers have investigated the reliability of COD recording, and advise caution
- We found some clear inconsistencies in the databases, e.g. Belarus, Canada
Data consistency and reliability

Apparent “change over” from one COD to another (country-specific)
Content of the presentation

• The Mortality Forum
• Introduction – why are causes of death important?
• Sources of information
• The Excel model
• Examples of results
• The cohort effect
• Data consistency and reliability
• Conclusions and summary
Conclusions and summary

- We have attempted to give a comprehensive observation of mortality by COD
- Source: actuarially-based data associated with the HMD
- A new grouping: 4 major groups, 28 sub-groups of actuarial interest
- Appropriate metrics: death rate, weighted years of life lost, measure of “cohortness”
- Each cause has its own characteristics – sometimes similar across the countries studied, but often showing important differences
- The cohort effect is restricted to certain causes (mainly cancer), and not in all countries
- The studies confirm and quantify that the rapid improvements in mortality from heart disease and related conditions may well be close to the lowest mortality that medical technology can achieve.
Conclusions and summary

- At older ages the situation is complex: reductions in heart and other diseases, but an enormous increase in deaths attributed to dementia and Alzheimer’s disease.
- At younger ages, medical improvements were counteracted by accidents, suicide and substance abuse.
- This study did not look at dependency (reduction in mortality from a specific COD may increase mortality from other causes) – we have referenced some studies on this.
- Taking into account different behaviours and trends in the mortality data based on these variables should add value to mortality projections.
Questions?

Verbal capabilities have been turned off however questions or comments can be submitted by clicking on the Q&A icon at the bottom of your screen.
Thank you for joining the webinar.

Should you have any further questions or comments, please send them directly to technical.activities@actuaries.org