PPO Working Party Update - Mortality
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Session Overview

• About us
  – The purpose of the PPO Working Party Mortality Workstream is to be a focal point for the PPO Working Party on matters relating to the mortality of PPO recipients. This includes working in partnership with relevant third parties (e.g., universities, actuarial/insurance consultancies) to:
    o Carry out research into the mortality experience of PPO recipients in general and segregated according to the nature/severity of their impairment(s) and other relevant factors;
    o In the longer term, construct tables of mortality rates to be available for use by actuaries engaged in the management of PPO liabilities;
    o Keep abreast of medical or social developments that could affect future trends in mortality experience and make estimates of future developments in mortality rates

• This session will give an overview of the latest work being undertaken in this area and background, covering:
  – Sources of mortality data and relevant studies
  – Future research and development plans
  – The impact of varying the modelling approach and assumptions
For some companies, UK PPOs represent a large and growing percentage of their balance sheet. This covers companies based in the UK, as well as overseas motor insurers (e.g. based in Gibraltar which in recent times have captured up to c20% of the UK motor market). PPOs have now become a feature of the Irish market (from 1 October 2018).

Future care worker wage inflation (ASHE 6115) and future mortality experience define the PPO exposure, together with the impact of excess of loss reinsurance cover in place.

Calculating the best estimate liability under Solvency II requires a view of the probability that each future PPO instalment will be paid. Requires an appropriate set of mortality rates to be determined for each claimant. SCR then based on a 1 in 200 stress, with that being represented under Standard Formula by a 20% reduction in mortality rates. But how appropriate is that?

Setting mortality assumptions is relatively straightforward for a typical large book of pension annuities, but for a heterogeneous group of disabled lives it is more challenging:

- What is the right reference mortality table?
- How reliable are the opinions of medical experts on the expected lifespan for each case likely to be?
- What adjustments should be made for the individual in terms of force of mortality and shape?
- What allowance should there be for future mortality improvements?
Why Does Longevity Estimating Matter?

- PPO Solvency II liabilities represent a very long term annual payment linked to wage inflation (typically 80th percentile ASHE 6115) discounted using very low risk-free interest rates. This is equivalent to discounting the current nominal PPO amount at a negative rate of interest, meaning payments long into the future have more significance.

- Therefore, any increase in actual lifespan over expected (e.g. through mis-estimation) has a magnified impact on the actual liability value versus expected.

<table>
<thead>
<tr>
<th>Base PPO</th>
<th>Impairment of 11 years</th>
<th>Impairment of 5.5 years</th>
<th>No Impairment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount pa</td>
<td>£100k</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population Life Expectancy</td>
<td>54 yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life expectancy</td>
<td>43 yrs</td>
<td>48.5 (+12.5%)</td>
<td>54 (+25%)</td>
</tr>
<tr>
<td>BEL</td>
<td>£8.3m</td>
<td>£10.0m (+20%)</td>
<td>£11.9m (+43%)</td>
</tr>
</tbody>
</table>

Notes: (1) SII BEL for the typical PPO case is calculated as PV of probability weighted cash flows using assumptions at 1/7/2018 including the SII interest rate curve (2) Mortality rates are consistent with the 2014-based population projections published by the ONS (3) Gross PPO liability pre XOL reinsurance (4) Indexation based on RPI of 3.25% plus 0.5% margin for ASHE 6115.
Impact of Life Expectancy Mis-Estimation

- The impact of an extended lifespan has a more material proportional impact on the XOL reinsurance BEL compared to the cedant retained BEL.

Based on PPO of £100k pa with assumed ASHE 3.75% pa. Ignores Mortality. XOL cover with £5m retention (indexed from t=0). Assumes PPO starts at t=0.
Impact of Impairment on Life Expectancy

• The start point in considering the life expectancy of PPO recipients is the life expectancy of the general population. A range of factors affect life expectancy of the general population with even more amongst people with disabilities.

• Studies suggest that in non-progressive neurological disability (mainly traumatic brain injury, spinal cord injury and cerebral palsy), it is the disability itself that determines life expectancy rather than the cause of the disability.

• Disabled people are as prone to the negative impact of lifestyle factors as the general population and these factors are more common – e.g. smoking, excessive drinking, lack of exercise and obesity.

• Key additional factors that affect disabled lives include:
  – Immobility, with the degree of immobility being a longevity determinant. Consequent risks of pressure sores and osteoporosis leading to risk of limb fractures and more prone to respiratory and renal problems.
  – Incontinence and consequent risk of infections, kidney problems etc.
  – Swallowing difficulties, with those requiring tube feeding at risk of earlier death than self-feeders.
  – Epilepsy, depending on seizure type and frequency.

• Other factors that can affect an individual include chronic depression and suicide risk.

• Plus living circumstances of the individual and quality of the care and rehabilitation package.

• Do the factors that reduce life expectancy exert a separate or synergistic influence on survival?
The Future?

- As treatments for the complications associated with these medical conditions continue to improve and rehabilitation techniques develop though enhanced multi-disciplinary rehabilitation support, so does life expectancy.
- Also, new technologies may have a part to play.
Sources of Mortality Data and Relevant Studies
For the future, more broadly based “big data” studies

But in assessing each case, statistics need to be overlayed with medical “expert judgement” based on the available individual medical, lifestyle and circumstantial information.
Categorisation of Injury Type

- PPO claimants represent a heterogeneous group. 70% of PPO claims relate to traumatic brain injury and 20% to spinal cord injury with the degree of impairment being a determinant of expected lifespan.

- The PPO Working Party developed a categorisation with the intention that it became a standardised approach used by (re)insurers in the UK. Based on information covering 28% of motor PPO claims in the 2017 survey:

  - **Brain injury**
    - A - Any amputation
    - B1 - Persistent Vegetative State
    - B2 - Cannot walk, fed by others
    - B3 - Cannot walk, self feeds
    - B4 - Some walking ability
    - B5 - Walks well alone
    - B6 - No mobility issues
    - S1 - Tetraplegia Ventilator Dependent
    - S2 - High level Tetraplegia
    - S3 - Low level Tetraplegia
    - S4 - High level Paraplegia
    - S5 - Low level Paraplegia
    - O1 - Other

  - **Spinal injury**

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Mortality Experience of Actual PPO Claims
Observed PPO Mortality Experience

- Considering all PPO insurance claims combined, in total there have been 46 observed deaths since settlement.

- Compares to expected number of 11.5 deaths assuming unimpaired population mortality.

- Represents a multiplier of 4.0 (for male and female PPO claimants combined).

Observed PPO Mortality Experience

- Breaking the deaths down by age at settlement shows the following pattern:

- But caution as small volume of data and this is experience from a relatively short 10 year period (2006 – 2016) and represents experience during the initial years post trauma when expect increased risk of death, albeit with settlement delay. At longer durations post trauma, lower multiplier likely to apply. Also, a heterogeneous group of lives, so likely to be wide range of underlying multipliers for a cohort of PPOs.
International Mortality Studies
The Life Expectancy Project (“LEP”)

- The LEP is based at the University of California in San Francisco headed by statisticians Professor David Strauss and Robert Shavell. They study a wide range of conditions and the website has a wealth of information based on their own work and bibliographies of work by others. Widely used with PPOs and other medico-legal cases.

- Example is their 2015 study on the long term survival after traumatic brain injury. Based on two cohorts of long term survivors of TBI. The first cohort was 7,365 people from across the US who had received care in one of the specialist Traumatic Brain Injury Model Systems (TBIMS) units. The second of 5,116 people with TBI who had received long term services from the California Department of Developmental Services (CDDS).

- Confirmed that age, gender and level of disability were significant predictors of increased long term mortality rates.
Findings

- Authors conclude:
  - The life expectancy of persons with TBI varies considerably, from <40% of the normal life expectancy for those who do not walk and are fed completely by others to > 85% of the normal life expectancy for those who walk well alone.
  - Mortality rates did not improve and the standardized mortality ratio increased over the study period from 1988 to 2010.

"To summarize, the calculation of an individual’s life expectancy is a complex task. Although table 1 provides a rational starting point, many other factors must be considered. For completeness, we remind the reader that the actual survival time of any particular individual may well be longer or shorter than the life expectancies reported herein. The life expectancy is the average survival time."
The SCIMS Database has been in existence since 1973 and captures data from an estimated 6% of new SCI cases in the US. Since its inception, 29 federally funded SCI Model Systems have contributed data to the National SCIMS Database. As of March 2018, the database contained information on 33,016 persons who sustained traumatic spinal cord injuries. Michael De Vivo former Director.
Other Academic Studies

- Extensive number of academic studies from the UK and around the world. Some are now quite old dating from the 1990s and so not necessarily capturing most recent advances in rehabilitation or other medical interventions, but body of work continues to grow.

- An example from Israel
Proposed Research Study
Research Using UK “Big Data”

• The number of PPOs in force is currently small and extends over only a 10 year period and there is a question over how relevant studies from California or elsewhere are in a UK context. Therefore another source of data on lives which suffer from the impairments normally associated with PPOs in a UK context is required

• Two possible approaches:
  – **Period study**: considering the mortality experience of a large group of lives over a short period (e.g. 1 – 3 years) and deriving mortality rates according to, say, age, gender, type of impairment and severity of impairment. Depending on the size of the data base and the information available, other factors could be also brought into account – e.g. smoker status, geographical area, type of care being received
  – **Cohort study**: Following up a large number of lives over a prolonged period to enable trends in mortality experience to be identified

• There are large UK medical databases that potentially could be used as the basis for such a study and the PPO Working Party is developing a proposal to commission an academic institution to undertake such a study

• The Actuarial Research Centre has provisionally agreed to fund the study and is interested in attracting support from a small number of (re)insurers to help shape and fund that work

• The possible databases under consideration are CPRD and THIN.
UK Data Sources

CPRD – Clinical Practice Research Datalink

- A research service which is jointly sponsored by the Medicines and Healthcare Products Regulatory Authority and the National Institute for Health Research, as part of the Department of Health and Social Care
- Collects de-identified patient data from a network of GP practices across the UK, linked to a range of other health related data providing a longitudinal, representative UK based health dataset which is “invaluable for the study of chronic diseases or conditions”
- Data encompasses over 35 million patient lives, including 10 million currently registered patients

THIN – The Health Improvement Network

- Established in 2002, the THIN data available for research includes the electronic medical records from over 17 million patients in the UK, 3.1 million of which are registered with actively contributing THIN GPs
- Data is continuously updated and can be followed longitudinally
- Data includes non-identified data about demographics, consultations, medication etc.
An Example Current Actuarial Study

• A comparable study is the research programme “Use of Big Health and Actuarial Data for Understanding Longevity and Morbidity Risks” which is being undertaken by the School of Computing Sciences at the University of East Anglia and funded by the Actuarial Research Centre

• The UEA team is using The Health Improvement Network (THIN) primary care data to develop statistical models of longevity and morbidity

• In their presentation during the ARC Webinar on 17 September 2018 they explained:
  – The advantage of using individual level medical data is that it is possible to model both the uptake of medical treatment and the effect of that treatment on longevity conditional on the individual sociodemographic and health factors instead of the aggregated profile.
  – Survival models, usually the Cox’s regression, are fitted to individual level data with the conclusions being generalisable to the general population.
  – The conditions and interventions being considered by the project cover: • Statin prescription • Intensive systolic blood pressure control • Stroke • Diabetes Mellitus Type 2 • Hormone Replacement Therapy

• The hope is that this approach can be adopted to examine the various PPO disabilities

• Scoping work and tendering process planning underway. Initial results in 2019.
Modelling Considerations
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