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Continuous Mortality Investigation

Institute and Faculty of Actuaries

COVID-19 Working Party

WORKING PAPER 139

Considerations relating to COVID-19 for mortality and morbidity assumptions

October 2020

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Summary

The COVID-19 pandemic has led to significant changes in mortality (and likely morbidity) experience in the general population in 2020. This paper sets out considerations for setting best estimate mortality and morbidity assumptions in light of this and provides considerations and possible approaches for setting base and future mortality and morbidity assumptions.

We also provide considerations in respect of the uncertainty of these mortality and morbidity assumptions, which may have changed as a result of the abnormal data for 2020.

Population level mortality data

A wide range of general population data (for example, in 2019 and prior years) is available for benchmarking the experience so far observed in 2020 against. There are several sources of UK data: in particular data on weekly deaths published by the ONS for England & Wales, NRS for Scotland and NISRA for Northern Ireland. Various additional items of COVID-19 related data are published alongside these datasets, and it is important to consider exactly what the data in each of the available datasets represents before it is used.

Impact of the pandemic on population mortality in 2020

The pandemic has led to a significant number of excess deaths in the England & Wales general population. We set out a summary of research into this area, which is referred to later in the paper.

Adjustment method for abnormal years of data

Mortality experience in the remaining part of 2020 is unknown. We set out approaches for estimating data for the remaining part of 2020 and methods for adjusting data already collected in 2020 to remove excess deaths.

Considerations for setting mortality and morbidity assumptions

The COVID-19 pandemic has led to an abnormally high number of excess deaths in 2020 (compared to mortality in 2019), and a corresponding high negative mortality improvement (–10.4% up to week 38 of 2020). Excess mortality is correlated with age, with the highest age bands seeing the highest excess mortality, but does not appear to be strongly correlated with socio-economic status (based on IMD). There are a number of considerations when setting best estimate future mortality and morbidity assumptions, for CMI committees and others, and we set these out in Sections 5.1 to 5.4.

Uncertainty of best estimate assumptions

Mortality experience in 2020 appears to be an outlier when considered in the context of recent years of experience. We analyse the impact that excess deaths may have on point estimate confidence intervals and find that the impact is likely to be relatively small. We also set out considerations for users of stochastic models.

Consultation questions

We seek responses to several consultation questions by 1 November 2020:

1. Are there any areas you would like to see analysis extended or considered? For example:
    a. An indicative experience analysis showing the impact on results of including or excluding abnormal experience.
    b. An extension of Tables 4.1 and 4.2 (which gives excess deaths per 100k split by age band in the general population of England & Wales) to cover gender, region, socio-economic status etc.
    c. An investigation of implications of the pandemic on high age mortality.

2. Would you find a second working paper useful? If so, would it be helpful to have this working paper:
    a. In early 2021, to summarise responses to this working paper and set out future plans.
    b. In 6 to 12 months' time, when more information is available on COVID-19.

3. Are there any further areas that you would like the CMI involved with to help Subscribers?

Contents

Reliances and limitations

The purpose of this paper is to provide readers with information relating to COVID-19 and its impact on mortality, and specifically on the work of the CMI. Anyone using this paper and the associated outputs should review the external papers in the References section.

The CMI aims to produce high-quality outputs and takes considerable care to ensure that the results and the accompanying documentation are accurate. However:

- We cannot guarantee their accuracy (see the Disclaimer on the last page of this document).
- We have relied on data published by the ONS.

We have asked several consultation questions in this paper, but we may choose not to publish a response to feedback on these questions.

1. Introduction

The CMI COVID-19 Working Party was set up in July 2020 to investigate the implications of COVID-19 on the CMI and to produce a consistent methodology that could be adopted by the CMI investigation committees. It is also hoped that any methodology developed will be useful to CMI Subscribers for their own internal analyses.

This paper describes considerations for setting base and trend mortality and morbidity best estimate assumptions in the context of the ongoing COVID-19 pandemic.

Although the scope of this paper includes morbidity (and Critical Illness and Income Protection are both likely to be heavily affected by the pandemic), the limited time and data available have led to the focus of the paper being on deaths (for both base and trend). However, many of the principles we develop are applicable to morbidity products.

1.1 Background

Mortality in 2020 to date has been abnormally high, with the majority of excess deaths attributed to the COVID-19 pandemic. The current pandemic makes 2020 mortality highly unusual when compared to historical data, as well as possibly being unrepresentative of future mortality. Therefore, the CMI experience investigations will need to formulate an approach to allow for this data in their analyses. The Mortality Projections Committee are currently considering a proposed modification to the CMI Mortality Projections Model in Working Paper 137.

It is likely that the areas the CMI committees will need to consider will be informative for a wider public audience, and so we have published our research in this working paper.

1.2 Activity by CMI committees during the COVID-19 pandemic

The CMI 'experience analysis' related committees (Assurances, Annuities, SAPS and Income Protection) have been considering Subscribers' needs in respect of data collection and experience monitoring for 2020. Their work has focused on:

- Determining what data the CMI could request from data providers that would assist with identifying and/or quantifying COVID-19-related mortality or morbidity.
- Understanding the data collection issues and potential impacts on experience analysis work.
- Investigating whether any new or extra data could be obtained consistently from data providers.

A summary of the conclusions reached by these Committees is as follows:

- The Annuities Committee was able to accelerate the collection of experience data for the first half of 2020 (which would otherwise have been collected in late-2021). An analysis of this data will be published in early October.
- The Assurances Committee is currently communicating with its data contributors to understand whether the provision of accelerated experience data for 2020 would be feasible.
- The SAPS Committee has agreed that, as data is collected from actuarial consultancies and is often only available following the completion of a pension scheme's statutory actuarial valuation, it would not be feasible to collect accelerated experience data for 2020. It is therefore likely that the first analysis of experience for 2020 by the SAPS Committee will be in autumn 2021.
- The Income Protection Committee has decided not to request accelerated experience data for 2020 from its data providers. It is, however, considering collecting more detailed data for 2020 (and earlier and later years) that will help it to identify claims resulting from, or relating to, COVID-19.

The CMI Mortality Projection Committee has published more regular updates of its mortality monitor; these are shorter, and focused on the all-cause mortality of the general population, based on data published by the Office for National Statistics (ONS) for England & Wales. The regular monitoring was weekly during the peak phase of the pandemic, but has since reduced in frequency as population mortality returned to more normal levels.

Working Paper 137 assesses the impact of the abnormal 2020 population mortality experience on the CMI Mortality Projections Model and consults with Subscribers on options for adapting the CMI Mortality Projections Model through either applying weights to different calendar years or through adjusting the data.

1.3 Contents

The Working Party has identified the following main areas that are covered in this paper:

- The use of general population level data (Section 2).
- The impact of the pandemic on mortality in the England & Wales general population (Section 3)
- Methods for adjusting for abnormal years of data (Section 4).
- Considerations when setting best estimate mortality and morbidity assumptions, for both base and trend assumptions and for sub-populations of insured lives and pension scheme members (Section 5).
- Estimating uncertainty associated with best estimate assumptions, both in the context of point estimation and stochastic models (Section 6).

Our work is intended to be largely methodological, with any numbers produced to provide context and illustration of materiality and impact. Data and insights from the pandemic continue to evolve, and as such our work is intended to provide illustrative results rather than "the answer".

1.4 TAS compliance

This paper provides considerations for setting base and trend mortality and morbidity assumptions in the context of the COVID-19 pandemic. This paper complies with the principles in the Financial Reporting Council's Technical Actuarial Standard "TAS 100: Principles for Technical Actuarial Work". Any person using this paper should exercise judgement over its suitability and relevance for their purpose.

1.5 Feedback

In Section 7 we have asked several consultation questions which we welcome feedback on by **1 November 2020**. We would be very pleased to receive any other comments or questions on this paper; please email Covid19WP@cmilimited.co.uk.

1.6 Acknowledgements

The members of the COVID-19 Working Party were largely drawn from the CMI investigation committees, to ensure consistency of approach. Specifically, the members involved in the production of this paper were: Steve Bale (Chair), Matthew Fletcher, Robert Kairis, Chean Khoon Low, Martyn McGuigan, Brian Sewell and Hamish Wilson.

The Working Party would also like to thank Jack Carmichael, Matthew Edwards, Dave Grimshaw and Jon Palin for reviewing this working paper.

2. Population-level mortality data

In order to benchmark mortality data for 2020, a suitable estimate of "normal" population-level mortality is needed. The ONS publishes a weekly update of total deaths registered in the general population (split by age band and gender) of England & Wales, which can be compared to previous years' experience to estimate the number of excess deaths that were reported in the year to date. This data rarely changes significantly once published. As noted in Section 3, the CMI's mortality monitor makes use of this ONS data. Data for Scotland and Northern Ireland is also available, from National Records for Scotland (NRS) and Northern Ireland Statistics and Research Agency (NIRSA) respectively, although weekly registered deaths are published as a total figure (combining all ages). Given that England & Wales represents the majority of the UK, we use England & Wales data only in this paper.

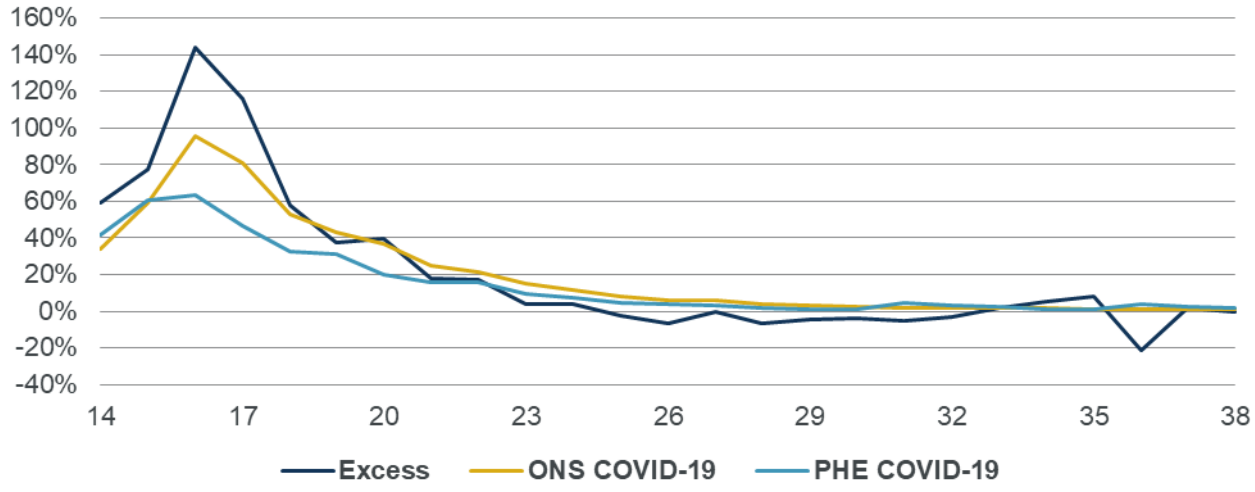
The ONS have also published details of the number of registered COVID-19 deaths on a weekly basis alongside the release of the all-cause deaths data. This is in addition to data on COVID-19 deaths published by Public Health England (PHE) for England and the Department for Health and Social Care (DHSC) for the devolved administrations of Northern Ireland, Scotland and Wales. It might be expected that having details of COVID-19 deaths could help to disaggregate the impact of the pandemic from the general background level of mortality, leading to a broadly "neutral" estimate of mortality for 2020. However, great care is needed when using cause-specific mortality data in this way, as there are a number of differences in the data collected for each dataset:

- The data cover different geographic areas.
- The data have different criteria for deaths to be included.
- The data are split into different groups (for example, the data available from the ONS is split by gender and 5-year age band for a given week, whereas the PHE data gives a total figure for all ages and both genders for a specific day).

Overall, this means that the data in each of the datasets can differ significantly, even if comparable dates are used. This is shown in Chart 2A, which shows excess all-cause mortality (defined as the level of actual mortality minus the level of "expected" mortality and discussed further in Section 3.1) to week 38 of 2020 (18 September 2020) compared to two other direct measures of COVID-19 deaths for England & Wales:

- "ONS COVID-19" deaths are those where COVID-19 was mentioned on the death certificate.
- "PHE/DHSC COVID-19" deaths are those published by PHE and DHSC for people who have had a positive test result for the coronavirus confirmed by a Public Health or NHS laboratory.

Chart 2A: Excess and COVID-19 deaths as a proportion of expected in 2020, by week (males and females combined for all ages)



The number of all-cause excess deaths was much higher than both measures of COVID-19 deaths in weeks 13 to 17, but this is not the case in later weeks. There are likely to be several causes behind the discrepancies between the reported deaths in each dataset:

- During the early stages of the pandemic when there was limited testing available for COVID-19, it is likely that a number of deaths that were actually caused by COVID-19 were not recorded as such as the death did not have a positive test. Further analysis of this excess mortality not directly attributable to COVID-19 has been published by the ONS[1].
- Only considering deaths directly caused by COVID-19 misses deaths indirectly caused by COVID-19, such as a fall in A&E admissions and the cancelling of some treatments.
- The approach used to define COVID-19 deaths has changed over time in the datasets:
  - The definition of what should be recorded as a COVID-19 death in the PHE and DHSC datasets has changed during the course of the pandemic.
  - The PHE and DHSC datasets have been "recalibrated" at several points, which has affected the number of reported COVID-19 deaths.
  - Up to April, the PHE and DHSC data included only deaths in hospital for those testing positive for COVID-19. From April, deaths in other settings, conditional on a positive test, were included. Over time, this measure became less appropriate as testing became more extensive and the possibility of a large time period between testing and death meant that a death from a cause unrelated to COVID-19 would be more likely to be attributed to the disease. Starting from August, DHSC published three separate figures for COVID-19 deaths, representing different lengths of time elapsed between a positive test and death (up to 28 days, up to 60 days, no limit).
  - The ONS dataset, on the other hand, has been relatively unchanged over the course of the pandemic (other than a change to publish deaths data in more granular detail).
- ONS data is based on all deaths in England & Wales where COVID-19 was mentioned on the death certificate, whereas the DHSC deaths are based on deaths with a positive test for COVID-19. The ONS COVID-19 total deaths figures were initially much higher than the DHSC total because the ONS's data coverage was much wider (as it covers deaths where COVID-19 was suspected in the death but not necessarily tested for). More recently, the "all deaths" figure published by the DHSC has been slightly higher than the ONS equivalent. DHSC have retrospectively adopted the 28-day figure as the preferred measure, which means that their total deaths figure is now much lower than the ONS figure.

Given these uncertainties in deaths at the population level, the CMI has preferred to use total (and excess) deaths rather than attempting to isolate COVID-19 deaths from the wider total. It is to be expected that gathering separate COVID-19 deaths data for other sub-populations (such as insured lives) may also lead to issues with consistency of reporting. In general, unless cause of death is specifically required for a given analysis, it is likely to be more robust to consider total all-cause deaths. Considering all-cause excess mortality has the additional benefit that it can allow for more consistent comparison of the mortality experience in the pandemic within regions in the UK, as well as with territories outside of the UK.

[1] ONS analysis of excess mortality: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/analysisofdeathregistrationsnotinvolvingcoronaviruscovid19englandandwales28december2019to1may2020/28december2019to10july2020

3. Impact of the pandemic on population mortality in 2020

This section summarises the analysis undertaken by the CMI into the abnormal mortality observed so far in 2020, which is referenced in this paper.

3.1 Excess mortality

There are various ways to measure the mortality impact of the pandemic to date, but (for the reasons given in Section 2) perhaps the most objective is by looking at excess all-cause mortality.

Excess mortality is the approach the CMI has so far used in the analysis it has published during the COVID-19 pandemic. An example of this is in the pandemic mortality monitors, which compare the estimated number of deaths that would have been seen in a particular week of 2020 if the standard mortality rates for each gender and age-group had been the same in that week of 2020 as in the corresponding week of 2019. These standard mortality rates have been calculated for ages 20 to 100 and standardised to remove the ageing population effect using the European Standard Population for 2013. Clearly, other equally valid methods of measuring excess mortality exist (for example, the ONS now also assesses excess mortality but it compares actual numbers of deaths in 2020 to a five-year average of deaths in 2015 to 2019).

3.2 Analysis of excess mortality in 2020 for England & Wales general population

Appendix 1 sets out analysis published by the CMI into the England & Wales general population mortality in 2020 using the above definition of excess mortality. The key conclusions of this analysis are:

- At the peak of the pandemic in week 16 of 2020, excess mortality reached 144% (i.e. mortality rates were almost 2½ times their normal level).
- The cumulative standardised mortality improvement to week 38 is –10.7% for males and –9.9% for females. This results in a combined total improvement to week 38 of –10.4% for males and females, compared to +0.1% as at week 12 (before the COVID-19 pandemic had a material impact).
- The relative impact has been broadly similar regardless of socio-economic status (measured using the Index of Multiple Deprivation).
- There are significant differences in the main pre-existing conditions associated with COVID-19 deaths by age group.

4. Adjustment method for abnormal years of data

An immediate concern of holders of mortality or morbidity data for abnormal years (such as 2020) is likely to be how to best utilise that data in the setting or base mortality and morbidity assumptions. The key choice is likely to come down to whether to:

- Ignore this data entirely; or
- Use this data, possibly with adjustments (including making an allowance for data so far unknown in the remaining part of the year).

This section sets out considerations when making the choice between these two approaches, and possible methods for adjusting the data for abnormal years (given the ongoing pandemic, we refer to 2020 for simplicity). We also provide example indicative future mortality scenarios, which may be helpful in assessing the appropriateness of any adjustment method adopted.

This section has been set in the context of when this paper is written (i.e. September 2020) and so also initially considers approaches to estimating mortality for the remainder of 2020, before setting out of adjustments methods that could equally apply in in future years.

There is a large operational risk in introducing non-standard processes so users should balance the levels of complexity, ease of implementation and robustness of methods over time.

4.1 Ignore the abnormal data

As noted above, one option could be to completely ignore the abnormal data for 2020. This approach could be taken if it is believed that the data in 2020 is not representative of data in prior and future years (and therefore that data for 2021 and future years will return to "normal" levels). Under this approach, a reasonable method may be to undertake experience analyses for the period up to the end of 2019 and not consider data for 2020 until more data is collected and more information is known.

An alternative approach that makes some allowance for data for 2020 could be to construct data for 2020 based on data for 2019 and the observed improvement in 2020 up to the start of the pandemic (for example, the mortality improvement to week 12 in the England & Wales general population was +0.1%). However, this approach will ignore any improvement in 2020 observed since the start of the pandemic (such as any change in improvement as a result of the winter period at the end of 2020) and may be impractical for smaller populations with insufficient data to credibly measure the improvement in the first part of 2020 before the pandemic.

Another possible issue with this approach is that 2021 and subsequent years may also exhibit abnormal data (due to future additional COVID-19 related deaths or recent deaths being an acceleration of deaths that would have occurred shortly anyway) and thus might also need to be excluded.

4.2 Use the abnormal data

Given how abnormal data has been for 2020, it may be more appropriate to make some allowance for this data when setting base mortality and morbidity assumptions. Below, we set out a number of considerations and methods when using this abnormal data.

Estimating mortality data for the whole of 2020

Portfolio data for any particular calendar year may not typically be considered when setting assumptions at that specific year-end, as it is likely to miss a considerable number of IBNR claims (which we will refer to as deaths in this section for simplicity) until several months after the year-end. However, given the abnormal experience in 2020, it may be helpful to understand what 2020 data could look like and the impact this may have on setting best estimate assumptions.

General population deaths data could be used as an initial crude estimate for portfolio-specific deaths data. This estimate can be improved by adjusting the general population data to better match the characteristics (e.g. age, gender, socio-economic status, geographic location etc.) of the specific portfolio under consideration. However,

differences such as the impact of medical underwriting and any further residual effects of insured-life experience relative to the general population will also need to be considered as they could have material effects.

Estimating year-to-date data

One possible approach is to consider the number of excess deaths that have occurred in 2020 to date in the general population, and then make portfolio specific adjustments. As noted in Section 2, the ONS publishes deaths data for England and Wales by week of registration and split by sex and age bands. By comparing data for available data for 2020 to the data for 2019, we can calculate the number of excess deaths that have occurred in 2020 for each age and sex subgroup. We can then weight these results to better match the specific portfolio in question.

Table 4.1 shows a simplified example of this based on age differences between the portfolio and the standard population, with cumulative excess deaths between weeks 12 and 38 of 2020 from the CMI pandemic mortality monitor. Up to 2019, the ONS published weekly deaths in relatively wide age bands (particularly at younger ages) which limits the scope of this analysis to these wide age bands (data for 2020 is available in more granular 5-year age bands, and the CMI has asked the ONS about obtaining this more granular data for 2019 and prior years). Table 4.2 shows the cumulative excess deaths for each of the populations: England and Wales, the indicative protection portfolio and the indicative annuity portfolio.

Indicative protection and annuity portfolios are shown for comparison. These have been constructed based on the Working Party's views and experience of a "typical" portfolio, and they are only intended to be indicative. The indicative annuity portfolio is intended to be applicable to both life annuitant portfolios and the in-payment pensioners of a pension scheme.

Table 4.1: Excess deaths in 2020 compared to 2019 between weeks 12 and 38 of 2020

Ages	Cumulative excess deaths between weeks 12 and 38 of 2020 (per 100k)	General population age mix (based on 2019 mid-year population)	Protection portfolio age mix	Annuity portfolio age mix
15-44	0.6	46%	70%	
45-64	25.7	31%	30%	
65-74	113.7	12%		50%
75-84	345.1	7%		40%
85+	1,165.6	3%		10%

Table 4.2: Cumulative excess deaths for each population, calculated using the general population excess deaths and indicative portfolio mix

	General population age mix (based on 2019 mid-year population)	Protection portfolio age mix	Annuity portfolio age mix
Cumulative excess deaths per 100k for population	83.1	8.1	311.4

Table 4.2 shows that for the indicative protection portfolio, the cumulative excess deaths adjustment is lower than for the general population as the indicative portfolio is typically made up of individuals under age 65 and cumulative excess deaths at these younger ages have been lower than the general population. On the other hand, the indicative annuity portfolio has a higher cumulative mortality adjustment than the general population, as it is made up of individuals aged 65 and above where cumulative excess mortality has been higher.

Charts 4A and 4B show how cumulative all-cause excess deaths per 100k of population for the indicative protection and annuity portfolios vary in 2020 between weeks 12 and 38, and show excess deaths increased rapidly during the early weeks of the pandemic, before flattening as the lockdown measures started to have an impact. Both curves follow a similar shape, suggesting that excess mortality in both indicative populations followed a broadly similar pattern during the pandemic (although with different relative impacts).

Chart 4A: Cumulative excess mortality per 100k of population for indicative protection portfolio, by week

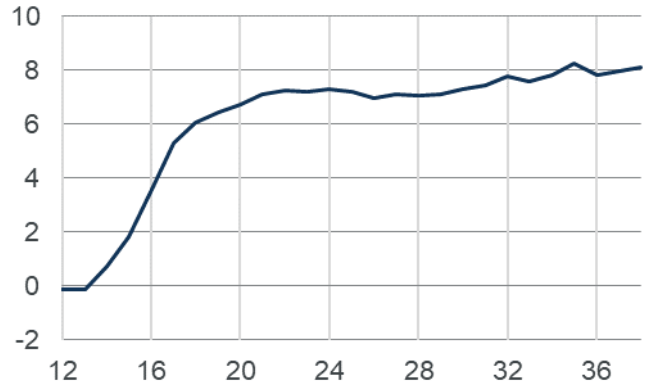
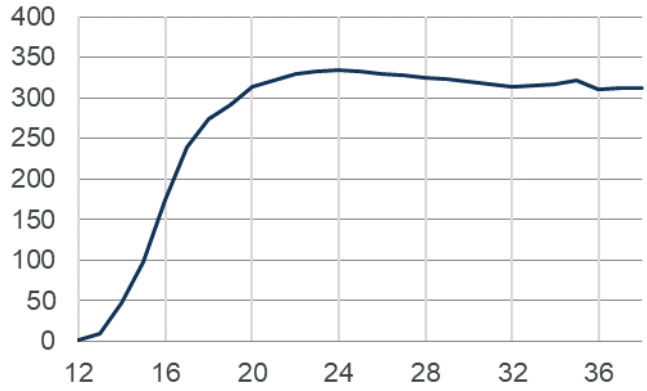


Chart 4B: Cumulative excess mortality per 100k of population for indicative annuity portfolio, by week



A similar approach could be taken for socio-economic status or region using the data published by the ONS to that taken for adjusting by sex and age, above.

A similar approach could be developed for population data by looking at the cumulative percentage increase in mortality, rather than the cumulative rate per 100k.

Validation against partial 2020 portfolio data

Although the most recent portfolio-specific data is likely to be missing a considerable number of IBNR deaths, if reliable portfolio-specific deaths data is available for the period of abnormal mortality in Q2 2020, we could use this to validate the estimated number of extra deaths calculated using the approach of adjusting the population data described above.

If the actual number of portfolio deaths observed is materially different from the population based estimate, we may need to consider whether a further adjustment should be applied to population-based estimates and to any estimate of the remainder of year. Practitioners should exhibit caution if the results are very different. This could be due to a small sample size; administration reporting delays which were amplified during the pandemic; or other portfolio specific reasons. It may also be helpful to compare this analysis against studies of pooled experience, such as the accelerated 2020 experience analysis due to be published by the Annuities Committee in early October.

Estimating data for the remainder of 2020

The CMI's most recent mortality monitor includes data for deaths registered up to week 38 of 2020. In recent weeks, excess mortality in the general population has been slightly below the level expected based on the same period in 2019 (although excess deaths in weeks 35 and 36 are affected by the timing of the bank holidays in 2019 and 2020).

To estimate the number of deaths that will occur over the remainder of 2020, practitioners will need to form a view on the future pattern. A high death and low death potential scenario are set out below:

- The number of deaths is around 5% (broadly in line with the level of excess mortality observed in weeks 24 to 32) below the level typically seen for the time of year, and might be attributed to:
  - better hand-hygiene;
  - higher take up of flu vaccines;

  - the impact of continued social distancing; and
  - the surviving population being less frail.
- The number of deaths increases 10% (broadly in line with the negative mortality improvement observed as a result of the first wave of excess COVID-19 deaths) above the level typically seen for the time of year, due to:
  - a second peak in SARS-CoV-2 infections; or
  - other causes starting to arise due to missed or delay treatments.

One possible approach to estimating 2020 mortality is then to combine the expert judgement for the period that remains of 2020 with the year-to-date excess deaths calculated for the specific portfolio based on the population data (outlined above), to get an estimated impact for all of 2020. There are alternative approaches, such as assuming deaths in the remaining part of 2020 will be in line with the level of deaths observed over the same period in 2019.

4.3 Options for using 2020 data

Consider a simple setup whereby four years of portfolio data are used to set the current best estimate assumptions. If the data for 2020 is deemed inappropriate to be used without adjustment, what are the options for using it?

Option 1: Excess deaths

One approach is to adjust the dataset, although the choice needs to be made between using a measure of all-cause excess mortality (for example, the CMI's approach of comparing 2020 to expected deaths based on mortality for 2019) or removing deaths linked to COVID-19 (such as the registered deaths with COVID-19 listed on the death certificate published by the ONS).

For year-end 2020, removing population excess deaths is equivalent to saying that the experience for 2020 is in line with expected experience. So for this approach, we would consider the actual experience for 2017 to 2019 and assume that 2020 is at 100% of the expected level. A slightly more complex approach is to allow for a level of improvements in 2020, such as the level of improvements observed to the start of the pandemic. This approach would be similar to ignoring the abnormal data for 2020. At subsequent year-ends, portfolio specific data will be available for 2020 so removing portfolio-specific excess deaths may give a more meaningful result in future years.

Option 2: Remove deaths identified as COVID-19

The alternative approach is to remove only deaths where COVID-19 was specified as the cause of death, instead of removing all excess deaths. A potential problem with this is that the approach for determining whether a death should be attributed to COVID-19 has changed over time and may be different in different locations, which is discussed further in Section 2. Another concern is that in the early part of the pandemic, the number of excess deaths was considerably higher than those directly attributed to COVID-19, which seems likely to be as a result of too few deaths being attributed to COVID-19 due to limited testing being available at this time. It is therefore likely to be difficult to formulate a sufficiently robust approach for this method. A further consideration is that holders of data may have cause of claim listed in that data, and so they may be able to make a direct modification to their data based on these COVID-19 cause of death mentions (noting that there may be significant reporting delays with this data to the point where it is unusable and for similar reasons to the general population COVID-19 deaths there may be an underreporting of COVID-19 deaths in the portfolio).

On balance, based on the data currently available, it is likely that the most robust approach to adopting an adjusted 2020 mortality dataset will be to use a measure of excess deaths rather than using a COVID-19 specific mortality dataset. Similarly for morbidity, the excess deaths approach is likely to be more robust (particularly as there are likely to be limited available datasets to use for measuring morbidity claims as a result of COVID-19).

Option 3: Implementation of adjustment using the improvement assumption

With any of these approaches to adjusting the actual (or estimated) 2020 data, a similar effect can also be achieved by adjusting the expected rate of mortality improvement assumed to have occurred in 2020, which could be done using the general population data. A benefit of this approach is that it might be easier to

implement in existing tools, as an expected rate of mortality is already required to be input. This technique may also be useful when setting assumptions for new blocks of business. However, as noted in Working Paper 110, consideration should be given to whether it is appropriate to adopt the CMI Mortality Projections Model for a protection portfolio.

However, care should be taken when rolling forward a mortality table to a future date using annual mortality improvements, as the experience may have varied considerably over the calendar year. For example, if we were considering an exposure period of four years to 31 March 2020, allowing for 3/12ths of the actual 2020 mortality improvement may not be appropriate as the abnormal mortality experience started to be observed from April 2020.

4.4 Future mortality scenarios

Beyond the short-term impacts, there is also a high degree of uncertainty regarding the medium- and long-term impacts on mortality. These impacts depend on a number of factors.

In Tables 4.2 and 4.3 below we have provided five indicative future mortality scenarios which readers may find helpful for considering future scenarios on their mortality models. These scenarios were used by the Mortality Projections Committee while deciding on an approach to modify CMI_2020; they are intended to be indicative only and are not supported by any expert evidence. We have provided these scenarios primarily to assist readers to sensitivity test their models to possible future mortality scenarios; they should not be taken as the CMI's view on future mortality and we ascribe no probability to the likelihood of these scenarios. Indeed, it is likely that a combination of these scenarios will occur in the future and actual future experience may be a mix of all these scenarios.

The scenarios have been devised in terms of relative mortality compared to levels of mortality observed in 2019, with the corresponding mortality improvements also shown.

Table 4.2: Mortality scenarios, expressed in terms of terms of mortality relative to levels in 2019

Scenario	2020	2021	2022	2023	2024	2025
Pandemic only affects 2020	+10%	0%	0%	0%	0%	0%
Mortality displacement	+10%	-4%	-3%	-2%	-1%	0%
Short-term impairments	+10%	+4%	+3%	+2%	+1%	0%
Long-term higher mortality	+10%	+5%	+5%	+5%	+5%	+5%
Second wave in 2021	+10%	+10%	0%	0%	0%	0%

Table 4.3: Mortality scenarios, expressed in terms of mortality improvements

Scenario	2020	2021	2022	2023	2024	2025
Pandemic only affects 2020	-10%	+10%	0%	0%	0%	0%
Mortality displacement	-10%	+14%	-1%	-1%	-1%	-1%
Short-term impairments	-10%	+6%	+1%	+1%	+1%	+1%
Long-term higher mortality	-10%	+5%	0%	0%	0%	0%
Second wave in 2021	-10%	0%	+10%	0%	0%	0%

4.5 Consider options in context of modifications made to CMI_2020

As detailed in Working Paper 137, the Mortality Projections Committee is consulting on a proposed modification to CMI_2020 to ensure it is appropriate in the context of the abnormal 2020 deaths. The proposed approach is to allow users to place a weight on the data for 2020 (or any other year). It is likely that a low or zero weight would be assigned to data for 2020, in which case life expectancies would be similar to those produced by CMI_2019. Assuming that the calibration of CMI_2020 produces mortality improvements that are not significantly different to those produced by CMI_2019, then the fitted mortality improvement rate for 2020 from CMI_2020 will likely be significantly higher than the observed improvement for 2020 (which is –10.4% as at week 38).

As noted above, for the purposes of calculating current base mortality rates, we may wish to adjust the annual improvement for 2020 that is used to calculate the expected number of deaths to more closely reflect the actual mortality improvement. This may be achieved using a lower value of the period smoothing parameter, S_κ, to the Core value of 7 such that the historical mortality improvements fit closer to the actual data.

5. Considerations in setting mortality and morbidity assumptions

The abnormally high level of mortality in 2020 has implications for setting mortality and morbidity best estimate assumptions. This section discusses considerations (both direct and indirect) for insured lives and pension scheme members.

5.1 Future considerations for mortality and morbidity experience

It is currently unclear how the pandemic will affect future mortality, both in the short and long term. There is considerable uncertainty about:

- the virus itself – including seasonality, and immunity to multiple infections; and
- how the impact of the virus and the pandemic can be managed – including possible treatments and vaccines, government policy, and public behaviour.

Different aspects of the pandemic could lead (directly or indirectly) to increases or decreases in mortality in future years. Table 5.1 (reproduced from Working Paper 137) shows how a selection of factors could affect mortality (and will also factor into morbidity considerations). It is intended to show the broad range of potential factors that could be considered, and is not exhaustive.

Table 5.1: Possible impacts of different aspects of the pandemic on future mortality (reproduced from Working Paper 137)

	Direct impact	Indirect impact
Increased life expectancy	Selection effect, if survivors have higher life expectancy than those who died Stronger resistance to either future virus pandemics or influenza strains	Lower incidence of other infections (e.g. due to better handwashing and use of masks) Public health focus (e.g. tackling obesity)
Unknown impact		Future government spending on health and social care
Reduced life expectancy	Further deaths from the pandemic Impairment to survivors through 'long COVID' (e.g. organ damage)	Delays to medical diagnoses and treatments Impact of economic recession

We consider some of these potential impacts further below. These will manifest in different ways regarding size of impact, timing, and also the age range most affected. We do not seek to quantify any of these aspects.

Further deaths

How mortality will develop in the remaining part of 2020 and subsequent years remains highly uncertain. The virus itself is still circulating in the general population and is likely to continue circulating until a vaccine is produced. At the current time (late September 2020), deaths are relatively low compared to the earlier months of the pandemic (although, in recent weeks, the number of positive tests and hospitalisations has started to rise and increased deaths could follow).

One key consideration will be the effect on mortality of the Government's "lockdown" policy, including all related aspects such as social distancing measures, restrictions on work practices, gatherings, etc.

Lessons learned from the first peak of deaths will assist in the planning for future peaks. The better understanding of the virus' asymptomatic transmission, the expansion of the testing capacity, the introduction of the test and trace program, the wider availability of PPE for healthcare workers, and the better understanding of

treatment regimens, should contribute to future outbreaks being better controlled and result in lower excess deaths.

Selection effect

There is an argument that that the pandemic may have accelerated deaths that would otherwise have occurred in the near future. A similar argument is sometimes made with regards to winters in previous years with higher than normal levels of mortality, suggesting that the following summer or winter would have lighter than normal mortality. However, this is not always borne out, and certainly the kinds of medical conditions which appear to be strong risk factors would not necessarily be associated with people who had a significantly short life expectancy before the pandemic. For example (as shown in Chart A1H in Appendix 1), between 10% and 15% of total COVID-19 deaths for those age 69 and younger did not have a significant existing condition. As age increases, we expect lives to have an increasing number of pre-existing conditions.

However, there is still an argument that, if the majority of excess deaths were associated with an existing medical condition then (all else being equal) the remaining population would be expected to have a higher average life expectancy following the pandemic.

Stronger resistance to current pandemic

Much is still unknown about the effects of COVID-19 on the immune system, but the consensus appears to be that survivors will enjoy a degree of immunity for a period to future reinfection of COVID-19 (or at least to have the potential to reduce the severity of a future infection).

Impairments to survivors

Little is yet known about the long-term health effects of COVID-19 but there is increasing recognition of a condition generally termed 'long COVID" (whereby many weeks or months after infection, an individual still suffers lasting symptoms from an original COVID-19 infection). This may affect survivors of comparatively mild cases as well as the severe cases that required hospitalisation.

Lower incidence of other infections

The behavioural changes that have been encouraged during the pandemic (for example, hand-washing, social distancing and wearing of face-masks) may reduce normal levels of other infectious diseases.

Public health focus

There may be positive effects from the focus that the pandemic has created on our general health. An example of this may be the Government's new targeted focus on obesity and the 'Better Health' campaign launched in July 2020.

Policy on health & social care

The Government has indicated its willingness to support the NHS with additional resources, if these are required, although it is unclear at this stage what form this will take (or if it will be required). However, given there is a "maximum" amount that the Government can spend as part of its annual budget, any funding decisions taken may affect future mortality and morbidity improvements. In addition to spending, changes in policy around social care in particular (given the problems observed during the pandemic) may affect high-age mortality.

Delays to diagnosis and treatment

In order to free capacity to deal with the initial peak of the pandemic, the NHS reduced, or even shut down, many areas of non-COVID-19 related care. Combined with changes in patient behaviour (not wanting to burden a stretched health service or to visit hospitals) this has led to a backlog of cases, which could take a considerable time to get back to normal levels as those services are reopened.

Impact of recession

Unsurprisingly, given the significant impact of the lockdown restrictions, the UK economy experienced a record contraction in GDP of 20.4% during the second quarter of the year. Research into the effect on mortality rates of economic recession remains conflicting, with different pieces of research suggesting that mortality rates may fall or rise during recessions.

5.2 Additional considerations for the mortality/morbidity of insured lives and pension scheme members

The CMI engages with data providers for a range of insurance products to understand the experience of those products. We set out below the key areas for consideration for setting assumptions for insured lives and pension scheme members.

Portfolio Makeup

The absolute impacts of the pandemic may potentially vary by different risk factors (age, gender, pre-existing conditions etc). Therefore, the degree to which a financial service product will be affected will depend on the makeup of the portfolio underlying the product. As an example, the impact on mortality of COVID-19 appears to be higher at older ages, suggesting that a pension scheme or lifetime annuity portfolio (typically consisting of individuals with an older average age) will be more severely affected than a term assurance portfolio (typically consisting of individuals with a younger average age). More subtle differences in the portfolio may need to be considered, such as regional variations in mortality rates that may affect some localised portfolios of insured lives and pension scheme members (for example, a pension scheme where all the members are localised in a particularly region).

Underwriting

As part of medically underwriting a new product, given what is currently understood about the possible long term health implications of catching and surviving COVID-19, in the future it is likely that whether the individual has been infected by COVID-19 will be asked as part of the process. Many insurers have already added additional medical underwriting questions covering COVID-19 infection or related symptoms to their application processes.

As the severity of COVID-19 appears to be affected by pre-existing conditions, the risk of a portfolio to COVID-19 will be more easily managed for relatively new business than for a portfolio with a longer duration since being written. This is because the new business will have been underwritten more recently, and so the level of pre-existing conditions present in this business will be more clearly understood than for a portfolio with a longer duration (which would have had a longer period since being underwritten to develop further medical conditions).

Guaranteed acceptance whole of life products have no underwriting, but claims made shortly after the commencement of a policy would be limited by the moratorium period, and experience in this moratorium period can be assessed to assist in informing the impact of COVID-19 on the wider portfolio.

For some longevity-linked financial products (such as life annuities and pension schemes), there is typically no underwriting before the commencement of payments. If COVID-19 does lead to long-term health impairments, then insurers and pension schemes may be over-funding / over-reserving for these liabilities (as assumed mortality rates would be understated).

There is also a useful distinction to be drawn between "open" (such as a protection portfolio for an insurer still writing business) and "closed" (such as a pension scheme closed to new members) portfolios. Open portfolios will have a steady stream of newly underwritten business, which will allow it to be better insulated against significant changes to the health of individuals in the portfolio. Closed portfolios, on the other hand, will have been underwritten a number of years in the past, and will not be able to get an updated view of the underlying health characteristics of individuals in the portfolio.

Socio-economic status

Whilst initial evidence at the population level (as shown in Charts A1F and A1G in Appendix 1) shows that there is little relative variation by socio-economic class (as measured by IMD), the impact may vary by underlying socio-economics of each portfolio within a product class if the relatively broad IMD measure hides the impact for specific socio-economic sub-groups. For example, it may also be that other measures of socio-economic status (such as income or education level) are more strongly linked to the impact of COVID-19. In general, the average socio-economic class of portfolios of insured lives and pension scheme members tend to be from higher socio-economic groups than the general population, but this may depend on the distribution channel of those products.

Incurred but not reported (IBNR) claims

Delays in the reporting of deaths and/or morbidity related claims is a further area for consideration. Consideration may need to be given to possible delays in receiving diagnoses for terminal illness, critical illness and income protection claims during the lockdown, when there was limited access to medical diagnoses. This could lead to an increase in late reporting, and may also affect the outcome of some claims (for example, a delayed terminal illness may then be claimed as a death).

Economy

The general health of the economy may have a material (indirect) impact on mortality and morbidity. In this regard, there are a number of different considerations:

- During a recession, tax income for the Government typically falls as unemployment levels rise and output falls. This typically results in cuts to Government spending, which may affect mortality and morbidity.
- The impact of the health of the economy on persistency for regular premium paying products. It is likely that there will be competing factors that need considering, as higher persistency due to the perceived increase in value of life products in the context of a pandemic is balanced against the financial pressures on ability to maintain the premiums in an economic downturn.
- Some financial services companies offered payment flexibility, including premium holidays during 2020, and there may be a one-off sharp increase in lapses should these arrangements come to an end. Consideration should also be given to any second order effects, such as anti-selective lapsing, where individuals with health issues may be more likely to maintain their policies.
- Income protection claim costs may rise during periods of economic downturn (particularly as a result of higher unemployment), driven by both higher incidence of claims and lower terminations. However, this correlation is typically delayed (and is likely to be even more delayed due to the existence of the furlough scheme currently in place).

5.3 Impact on high age mortality

We have not yet assessed what the impact of the pandemic might be on high ages (ages 85 and above) given we await the final 2020 estimates of deaths and any potential impact on the high age population of the 2021 Census. As shown in Chart A1E in Appendix 1, the abnormal mortality in 2020 to September 2020 has affected older lives more than younger ages.

The largest changes to population estimates following the 2011 Census occurred at the youngest and oldest ages, as reported in Working Paper 110, with changes in the population estimates of the order of 5% for ages 90 and above. Updates to population estimates will need to consider both the impact of the abnormal experience on population experience in 2020, as well as the impact of restating previous population estimates prior to 2021 given the extreme event in the preceding year of the census.

5.4 Considerations for the Mortality Projections Committee

The Mortality Projections Committee released a consultation in Working Paper 137 which included a proposed approach to allowing for abnormal experience in the smoothing of historical population mortality within the APCI framework using a "weight" for the data for 2020, rather than adjusting data for the abnormal year. This proposed approach, which involves applying weights to different calendar years (likely with a low weight being applied to 2020 data), recognises the challenges of adjusting data for 2020:

- Issues due to changes to data recording.
- Uncertainty as to the length of the pandemic.
- Any future short or medium term mortality outcomes.
- The choice of data source to use for adjusting excess 2020 mortality.

The Mortality Projections Committee will consider feedback from Subscribers in developing the CMI Mortality Projections Model to meet Subscriber needs. The deadline for responses to that consultation is 1 November 2020.

As part of the updates to the CMI Mortality Projections Model for the abnormal 2020 data, the Mortality Projections Committee also consulted on a proposed approach to reduce the maximum age to which the CMI Mortality Projections Model is calibrated to from age 100 to age 90. This was in response to findings that the smoothed mortality improvements produced by the CMI Mortality Projections Model do not closely follow that of the crude mortality improvements data. We have commented elsewhere in this paper of the impact of the census and pandemic on high age population estimates and recommend that the Mortality Projections Committee consider these in future reviews of fitting the model at the higher ages.

6. Uncertainty of best estimate assumptions

As previously noted, a significant level of excess deaths has so far been observed in 2020. This sudden change in mortality will lead to difficulties in calculating and illustrating uncertainty, both for base mortality and in forward-looking (stochastic or deterministic) longevity models. Although there is less available information for morbidity claims, the considerations in this section are likely to be relevant for estimating uncertainty of morbidity assumptions. In this section we will refer to deaths as an overall term for deaths and claims, and considerations for forward looking mortality models.

6.1 Base mortality

Impact on confidence intervals

The sudden change in mortality experience over 2020 will increase the uncertainty around point estimates of mortality; this increase can be assessed by considering the confidence interval around the actual level of mortality compared to an expected level (referred to here as 100 Actual/Expected, or 100A/E). One approach to estimate uncertainty for 100A/E is by assuming the number of deaths follows a Normal distribution using the formula:

$$95\%\ \text{Confidence interval} = [100A/E - 1.96\sigma,\ 100A/E + 1.96\sigma]$$

where:

$$\text{Standard deviation, } \sigma = \sqrt{A/E \div E} \times 100$$

$$A = \text{actual deaths (claims) in that age band in those years}$$

$$E = \text{expected deaths (claims) in that age band in those years according to the comparator table}$$

Using this approach means that an increase in the number of actual deaths results in an increase in the confidence interval by an amount which is independent of the absolute number of expected or actual deaths, as the confidence interval is proportional to $\sqrt{A}$. For example, a 10% increase in actual deaths (i.e. a –10% mortality improvement) would result in the confidence interval increasing by $\sqrt{1.1}$.

Table 6.1 sets out an indicative example of this, assuming expected deaths in the general population of England & Wales of 600,000 and an example insured lives portfolio of 1,000 and a –10% mortality improvement in 2020. The table shows that the relative impact on confidence intervals (an increase of 5%) is small. It is also important to note that this relative change will be even smaller, as experience analyses are typically based on several years of data.

Table 6.1: Indicative example of impact on confidence intervals of COVID-19 deaths in 2020 (using indicative –10% mortality improvement in 2020)

	England & Wales	Example insured lives portfolio
Confidence interval for a 2020 mortality improvement = 0%	±0.25	±6.20
Confidence interval for a 2020 mortality improvement = –10%	±0.27	±6.50
Relative impact on confidence interval	105%	105%

In this context, the choice of whether to use data for 2020 in an experience analysis is not materially affected by the impact of that data on the confidence interval of the experience analysis. Instead, the choice of whether or not use the data for 2020 is more affected by considerations over whether to use the data unadjusted, or adjusted to remove the impact of COVID-19 (as discussed in Section 4).

Impact on credibility factor

A further consideration relating to uncertainty is credibility theory, where observed experience is used to modify prior assumptions on deaths.

A typical approach is to adjust the prior assumption as follows:

$$\text{New expected assumption} = Z \times \text{observed experience} + (1 - \text{Z}) \times \text{current expectation}$$

Where:

$$\text{Z} = \text{Credibility factor}$$

In a typical year, higher numbers of claims would lead to a higher credibility factor, because the data would be assessed as being more credible – this would lead to a higher weight being placed on observed experience and a larger change to the expectation.

Using this approach without modification could mean that the high number of claims relating to COVID-19 would place more weight on 2020 deaths. If 2020 is viewed as likely to be a one-off extreme observation, this outcome is undesirable. As such it will be important to consider whether an adjustment to either the data or the methodology will be needed when applying credibility theory.

An important underlying assumption for the application of credibility theory is that the expected assumption is relevant to the portfolio under consideration. As such, if COVID-19 is believed to have permanently changed the expected mortality for the portfolio, or made the expected assumption for the portfolio effectively irrelevant, the validity of using credibility theory should again be reconsidered.

6.2 Forward-looking longevity models

Future mortality is uncertain even in 'normal' times, and the COVID-19 pandemic has added a new layer of uncertainty. As set out in Section 5.1, there are reasons to think that future mortality experience may be temporarily lighter than a "typical" year (because of COVID-19 deaths being brought forward and the selection effect of healthier individuals having survived) or heavier (because survivors of COVID-19 have significantly impaired mortality). This means that uncertainty associated with future mortality assumptions is also likely to be higher than it has been in the past.

Deterministic mortality models

Users of deterministic models to project future mortality, whether aggregate models (such as the CMI Mortality Projections Model) or more complex models (for example, those based on causes of death) will need to consider how much allowance to make for the actual observed mortality in 2020, as well as whether and how to incorporate reasonable expectations of reversion to typical mortality in future years. Cause-based models are likely to see a large increase in deaths in 2020 at older ages from all causes, but in particular from infectious disease, as a result of the pandemic. However, using these observations to calibrate the model is very likely to produce inappropriate projections for future years. As set out by the Mortality Projections Committee, using 2020 data unadjusted (even in an aggregate mortality model) is unlikely to produce projections in line with plausible expectations of mortality over future years.

Stochastic mortality models

Stochastic models of mortality and morbidity are typically used for setting value at risk figures (either with a one-year or a longer duration) as well as in decision-making for actions such as pricing and reserving for insurance companies or measuring risk exposure for pension schemes. The calibration of these models is likely to require re-consideration. As with other models, when calibrating stochastic models practitioners will need to consider to what extent 2020 experience should be factored into the model, both in terms of setting the base level of mortality in 2020 and to what degree the probabilistic model used for modelling future deaths should be amended to allow for a likely different expected future (both due to direct and indirect changes in future mortality).

Consideration will also need to be given to whether the distribution of outcomes should change based on 2020 experience – again, it is likely that a business as usual model (adding unadjusted 2020 experience without

changing the structure of the model) will lead to both significantly lower central estimates of future life expectancy, and significantly higher uncertainty in future projections. With a stochastic model, it will be important to anticipate and investigate the impact of 2020 (and any other abnormal years of experience) on both the best estimate and the range of outcomes.

In addition, observed mortality in 2020 is likely to be in the tail of death distributions for most stochastic mortality models. Users of such models may wish to consider whether the model being used is robust to extreme (and potentially one-off) experience, and whether it may be appropriate to consider model structures which explicitly allow for more variation in the data.

Similar to considerations for uncertainty of base mortality, a key decision therefore comes down to whether to use the data for 2020, and if it is adopted whether to adjust it (although with the further consideration of whether models using the data also need to be adjusted).

7. Conclusions and consultation questions

This paper has set out a number of areas for consideration for setting base and trend mortality and morbidity best estimate assumptions in the context of the COVID-19 pandemic. We summarise below our conclusions for considerations for both the CMI committees and for readers setting mortality and morbidity assumptions.

Considerations for setting mortality and morbidity assumptions

Overall, we believe that the key decisions for those involved with setting best estimate assumptions are:

- Should data for 2020 be used? If so, which data sources are most relevant?
- If the decision is taken to ignore data for 2020, what areas should be considered when taking this decision?
- If data for 2020 is used, should it be adjusted? If so, what areas should be considered when adjusting this data?
- What are the considerations for setting future mortality and morbidity assumptions?

This paper looks to provide assistance in deciding on the approach to take, and in particular discusses the following areas:

- The available sources of data for use in modelling and analysing the impact of COVID-19 on the general population, including data produced by the ONS, PHE and DHSC, and the advantages and disadvantages of using the data in each dataset. We note that changes and differences in reporting between the datasets leads to discrepancies in the level of reported deaths related to COVID-19, and as a result we prefer the use of excess all-cause mortality in assessing the impact of COVID-19 (rather than the reported COVID-19 deaths).
- A summary of published analyses looking at the impact that COVID-19 has had on mortality in the general population, including analysis split by gender, age band, socio-economic status and links to pre-existing conditions.
- Possible approaches that could be taken to setting base mortality and morbidity assumptions, such as:
  - Estimating year-to-date data for 2020 for a portfolio
  - Estimating data for the remaining part of 2020
  - Considerations when using data for 2020
  - Possible future mortality scenarios
- The considerations when setting future mortality and morbidity assumptions, which should take account of the underlying portfolio, product type, impact on future health, the economic impact and a range of factors that may affect the future development of the pandemic. As noted above, we prefer the use of excess all-cause mortality when determining the impact of the current pandemic.
- The impact of COVID-19 on the uncertainty of mortality and morbidity point estimates is relatively low, and so a key consideration is the initial choice of data to use. However, users of deterministic or stochastic forward-looking models may want to consider whether models calibrated prior to the pandemic require recalibration in light of the pandemic.

Considerations for CMI Committees

The early indicator for potential mortality experience has been through the CMI's regular publications of general population mortality, analysing weekly deaths registered, along with additional mortality-related ad-hoc analyses, published by the ONS. Subscribers will naturally be interested in how insured life and pension scheme experience differs from that of the general population, for pricing and reporting purposes, and for that information to be provided in a timely manner.

Most CMI investigations committees have published experience investigations for data up to 2018 and are collecting and analysing data for 2019. As mentioned previously, the CMI investigation committees have been liaising with data contributors to see what consistent COVID-19 related data can be obtained in a timely manner.

We welcome this approach and would suggest that, where possible, 2020 (as well as 2019) insights can be produced, with early insights being published ahead of the regular more detailed analyses.

The CMI committees will, at some point, need to consider the impact of the abnormal mortality and morbidity experience on the mortality or claim decrement table graduation process. Much will depend on how the pandemic evolves. For example, if 2020 is a "one-off blip" in abnormal experience then there is the option to ignore 2020 data, or adjust the datasets (where there is the ability to do so). If the pandemic and its knock-on impacts last into successive years then further consideration may need to be taken as to the data and methodology approach, such as:

- Ability to adjust datasets if the pandemic is short lived in duration
- Methodology changes to allow weights to be applied to different calendar year experience.

The CMI committees who choose to roll forward their graduated tables to a more recent date using population-based improvements will also need to consider an approach that is consistent with the approach to graduating the base rates.

We have previously noted that the abnormal mortality experience has the most impact at oldest ages, as well as noting that the 2021 Census will likely result in a historical update to population estimates. Revising population estimates for a dataset with a period of abnormal mortality may result in changes in the approach. The CMI, and particularly, the Mortality Projections Committee, will need to consider carefully how this might impact their work on high age population estimates, graduating rate tables and mortality projection.

Members of the Mortality Projection Committee are currently collaborating with the Mortality Research Steering Committee on constructing a robust cause of death dataset and considering how this can be used to form plausible mortality improvement projections. The pandemic is likely to affect the mix of deaths by cause, as well as potential short-term spikes and possible medium- and long term-trend changes. We recognise the potential for these two committees to continue to retain links with the ONS on population-based research, as well as applying their combined skillset to provide further insights about forward-looking mortality and morbidity considerations.

7.1 Consultation questions

We have set out several consultation questions which it would be helpful to gather your views on.

Please send your responses to Covid19WP@cmilimited.co.uk. We would like to receive responses by **1 November 2020**.

1. Are there any areas you would like to see analysis extended or considered? For example:
    a. An indicative experience analysis showing the impact on results of including or excluding abnormal experience.
    b. An extension of Tables 4.1 and 4.2 (which gives excess deaths per 100k split by age band in the general population of England & Wales) to cover gender, region, socio-economic status etc.
    c. An investigation of implications of the pandemic on high age mortality.

2. Would you find a second working paper useful? If so, would it be helpful to have this working paper:
    a. In early 2021, to summarise responses to this working paper and set out future plans.
    b. In 6 to 12 months' time, when more information is available on COVID-19.

3. Are there any further areas that you would like the CMI involved with to help Subscribers?

8. References

The following table sets out the references in this paper, and indicates the reasons for their inclusion.

Reference	Location in this paper	Relevance of the reference
Working Paper 110: "Using the CMI Mortality Projections Model for assured lives " (2018)	Section 4.3, Section 5.3	Impact of change in Census 2011 data on population estimates
Week 26 CMI Mortality Monitor	Section 3.2	Analysis of excess deaths by age band and IMD
Working Paper 137: "CMI_2020 consultation" (2020)	Section 4.8, Section 5.1, Section 5.4	Possible future mortality scenarios, proposed modifications to be made to CMI_2020

Appendix 1: Impact of COVID-19 on the general population

This appendix summarises the analysis published by the CMI into general population mortality in 2020 using the definition of excess mortality set out in Section 3.1.

Chart A1A shows excess mortality observed in England & Wales to 4 September 2020 (week 38 of 2020) relative to expected deaths over the same period in 2019. At the peak of the pandemic in week 16 of 2020, excess mortality reached 144%. Excess mortality was negative for weeks 24 to 32, as well as for weeks 36 and 38 (note, however, that excess mortality in weeks 35 and 36 is likely to be distorted by the August bank holiday being in week 35 of 2019 and week 36 of 2020).

Chart A1A: Excess standardised mortality in each week in 2020 (relative to expected number of deaths based on mortality in 2019) based on data to week 38, for males and females

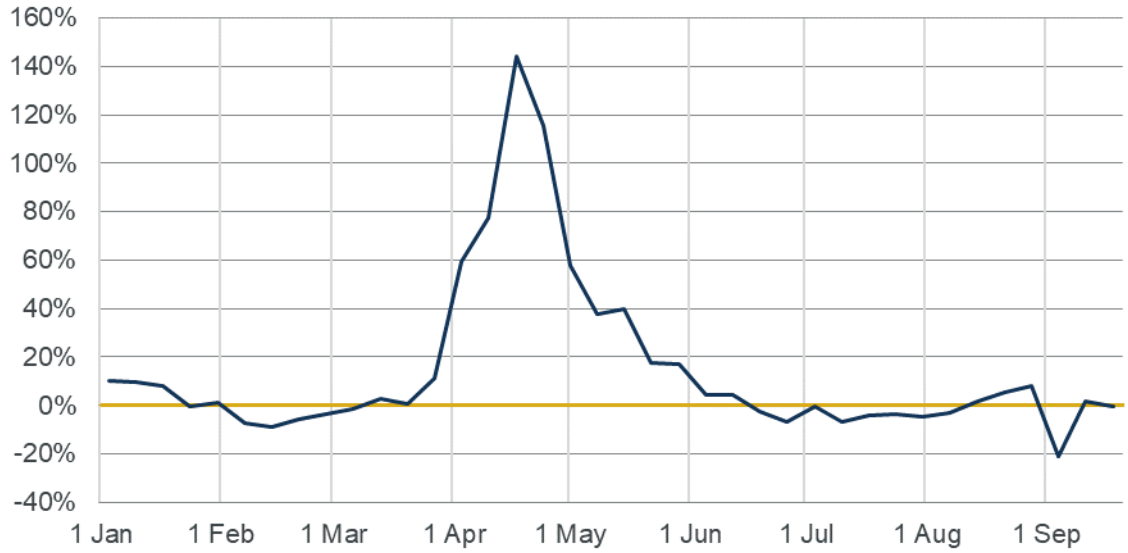
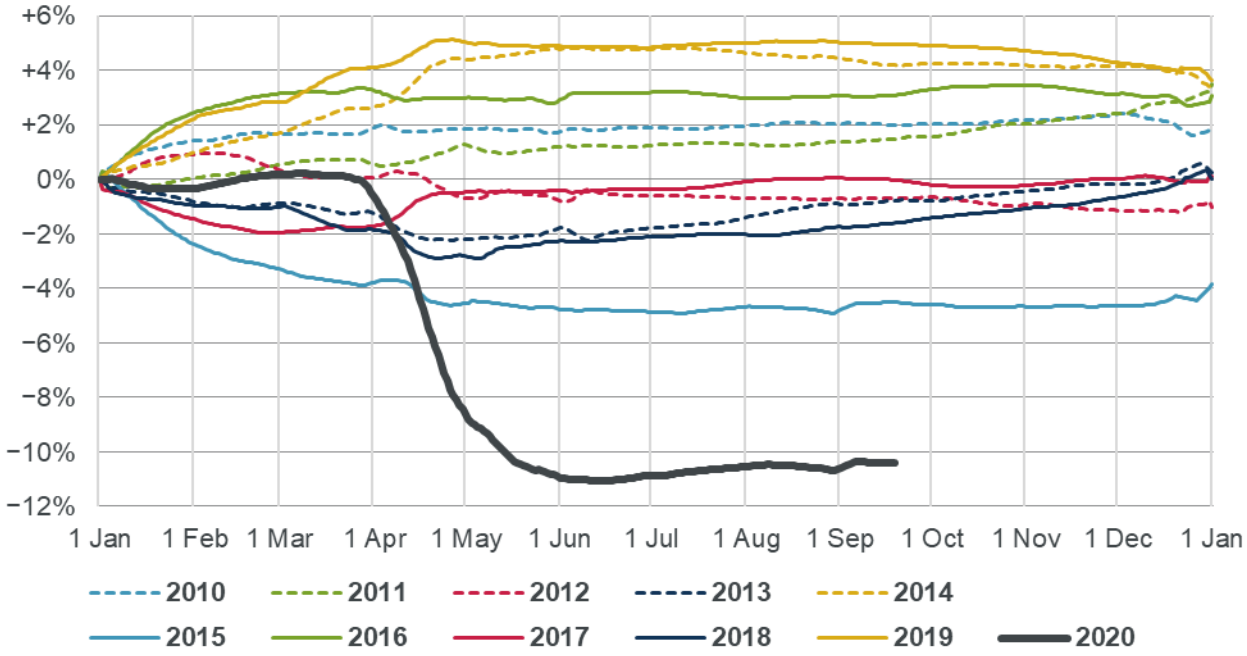


Chart A1B shows the cumulative annual standardised mortality improvement in 2020 (as published in the CMI's pandemic mortality monitor). This measure of mortality improvements is calculated such that, if mortality rates for the remaining period of 2020 are the same as for the corresponding part of 2019, the overall mortality improvement for the year will be approximately equal to the current cumulative standardised mortality improvement.

The cumulative standardised mortality improvement to week 38 is –10.4%, compared to +0.1% as at week 12 (before the COVID-19 pandemic had a material impact). If the mortality improvement over the whole of 2020 remains at this level, this would be an unprecedented scenario (and even more so when considering this level of mortality improvement was driven by experience in a 12-week period).

Chart A1B: Cumulative annual standardised mortality improvement based on data to week 38, for males and females



However, looking at total population age standardised results obviously hides a lot of the underlying detail and therefore it is informative to investigate the impact on different sub-populations of the general population.

Impact by gender

Charts A1C and A1D show the cumulative standardised mortality improvement for males and females in 2020, and show that the impact has been slightly more significant for males (with a cumulative standardised mortality to week 38 of –10.7%) than for females (with a cumulative standardised mortality to week 38 of –9.9%).

Chart A1C: Cumulative annual standardised mortality improvement based on data to week 38, males

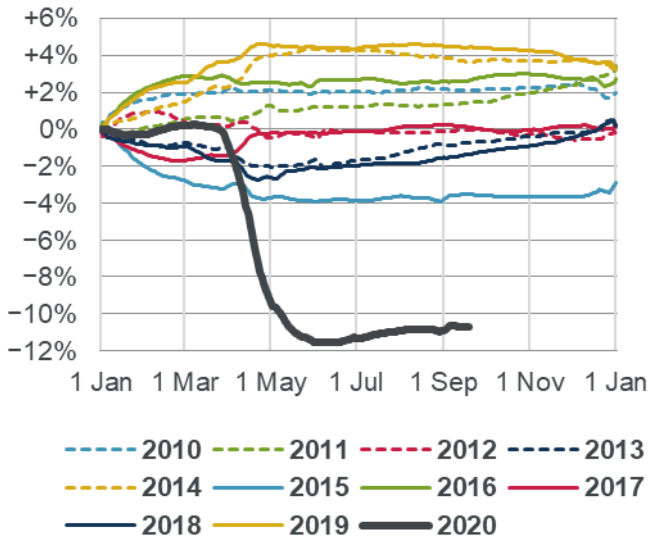
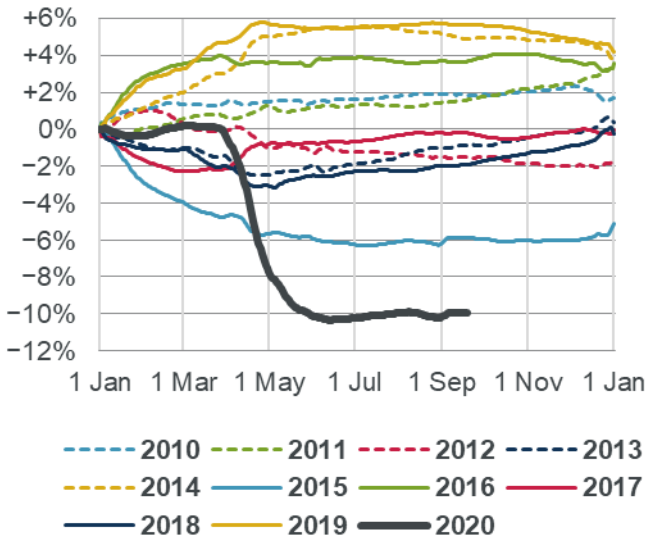


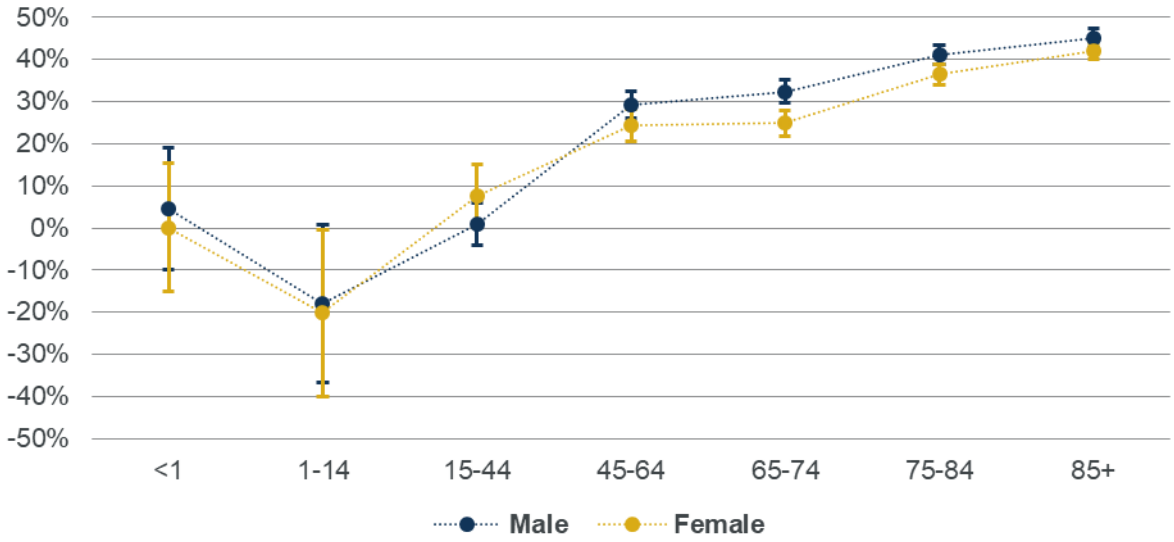
Chart A1D: Cumulative annual standardised mortality improvement based on data to week 38, females



Impact by age

Another informative approach is to review the impact by age. Chart A1E shows cumulative excess deaths by age bands for weeks 11 to 26 inclusive (during the peak of the pandemic), as a proportion of expected for the same period, together with 95% confidence intervals, as published in the week 26 pandemic mortality monitor. The calculation method is consistent with Chart A1A.

Chart A1E: Excess deaths for weeks 11 to 26 relative to expected deaths



At younger ages (below age 44), absolute numbers of deaths are relatively low, which leads to relatively wide confidence intervals and so it is difficult to draw conclusions from this data, but overall the impact of the pandemic looks low. From age 45 onwards, the relative increase in excess mortality appears to slightly increase with age. At these higher ages, male excess mortality is consistently higher than female excess mortality, which is consistent with the conclusion drawn from Charts A1C and A1D.

Impact by socio-economic class

Socio-economic class is a widely-used approach for assessing relative mortality, and a key population statistic for this purpose is the Index of Multiple Deprivation (IMD) which classifies specific "output areas" in the UK into deciles (with decile 1 indicating the most-deprived areas and decile 10 indicating the least-deprived areas). Charts A1F and A1G are from the week 26 mortality monitor, and show excess standard mortality by IMD for males and females based on monthly deaths for March, April and May 2020.

In other sections of this paper we have compared actual mortality to expected mortality, using standardised mortality rates in 2019 for the expected mortality. We do not have monthly standardised mortality rates by IMD for 2019, so we cannot do the same comparison here. Instead, we compare the monthly standardised mortality rates for March, April and May 2020 with one-twelfth of the standardised mortality rate for 2018 – the latest full year for which data is currently available. While this does not allow for seasonal variations during 2018, it provides a broad indication of how changes in mortality during the pandemic have varied by IMD.

Charts A1F and A1G suggest there has been limited variation in the impact of the pandemic by socio-economic class, with mortality in all IMDs increasing by a similar relative amount.

Chart A1F: Standardised mortality rate as a proportion of 2018 by IMD decile – England males

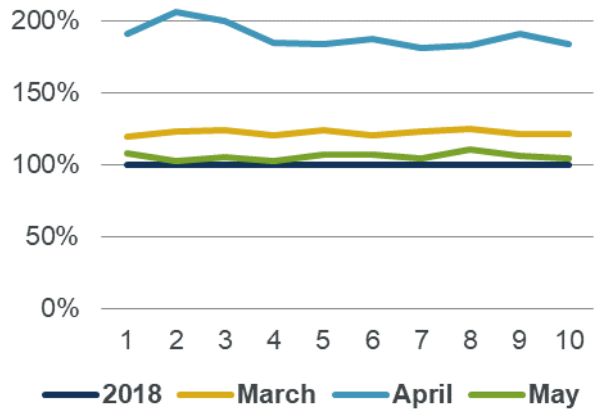
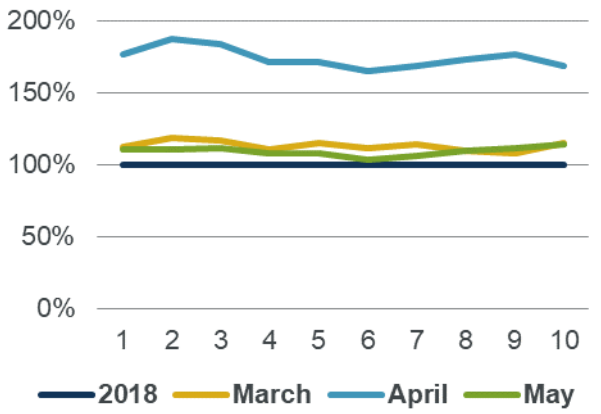


Chart A1G: Standardised mortality rate as a proportion of 2018 by IMD decile – England females



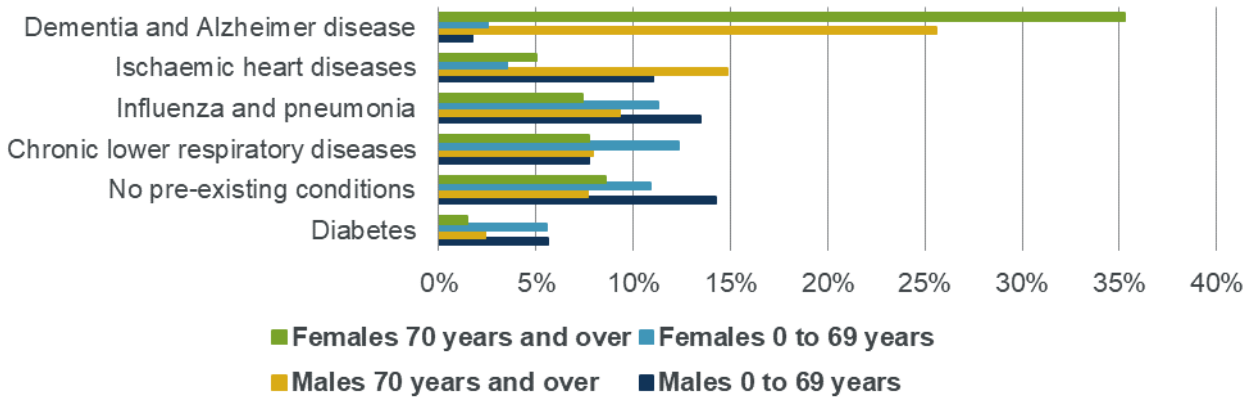
Impact of pre-existing conditions

The ONS[2] has published an analysis of pre-existing conditions in deaths involving COVID-19 between March and June 2020.

Chart A1H shows the main pre-existing condition (that is, the one pre-existing condition that is, on average, most likely to be the underlying cause of death for a person of that age and sex had they not died from COVID-19) for deaths involving COVID-19. The most common main pre-existing condition was "Dementia and Alzheimer disease" (25.6% of all deaths involving COVID-19), although Chart A1H shows that there is a significant difference by age group of the main pre-existing conditions:

- For ages 70 and above, "Dementia and Alzheimer disease" are involved in a significant proportion of COVID-19 deaths, but a very limited number of COVID-19 deaths of those aged under 70 (although this is also likely to be true for mortality unrelated to COVID-19).
- For ages below 70, "Diabetes", "No pre-existing condition" and "Influenza and pneumonia" are more significant main pre-existing conditions.

Chart A1H: Main pre-existing conditions for deaths involving COVID-19.



[2] ONS analysis: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsinvolvingcovid19englandandwales/deathsoccurringinjune2020#pre-existing-conditions-of-people-who-died-with-covid-19

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