



Institute
and Faculty
of Actuaries

Setting biometric assumptions in a post-COVID world

Ben Johnson, Rob Mellows, Craig Armstrong

Post-pandemic biometric assumption setting
working party

What we'll cover today

- Working party objectives, scope and background
- Options for setting mortality assumptions
- Overview of risk drivers
- Practical application of driver-based approach



Working Party objectives

- Produce a reference paper for Chief Actuaries on setting biometric assumptions in a post-pandemic era
- Bring together findings from existing research in one place
- Complementary to CMI Working Paper 177



Working Party scope

- Longevity and mortality – IN SCOPE
- Morbidity – NOT DIRECTLY IN SCOPE
- Lapse – OUT OF SCOPE
- Best estimate assumptions for UK lives
- **Principles** not precise assumptions

**** Paper release expected by end September ****



Institute
and Faculty
of Actuaries

Working Party – use-cases of paper

1. Sense check for existing risk driver approaches
2. Support construction of a risk driver approach
3. Example of simple risk driver comparison to core CMI model





Institute
and Faculty
of Actuaries

Setting assumptions

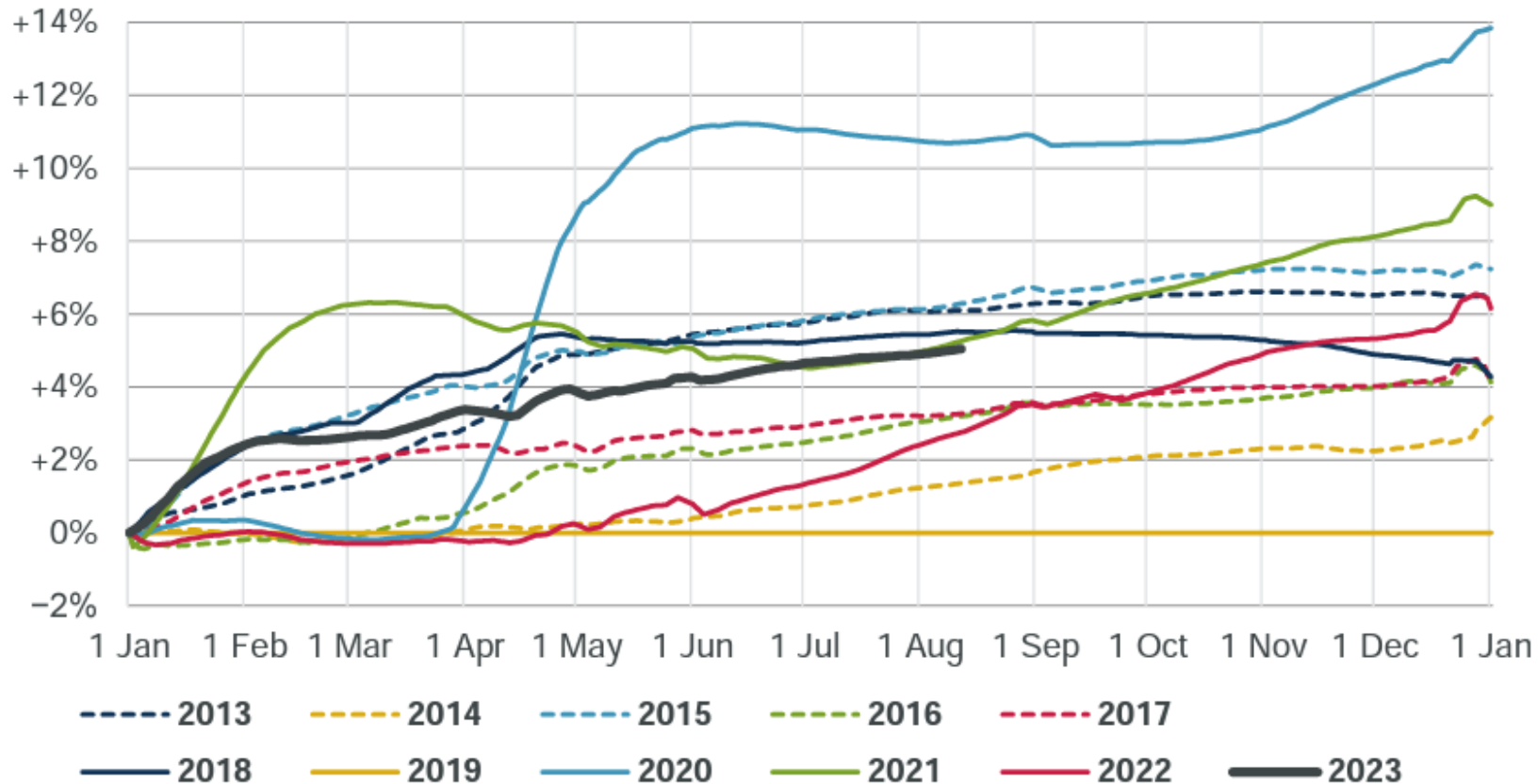
Pre- and post-pandemic

Background: setting assumptions Pre-COVID-19

- Stable methodologies relying on adding most recent year of data
- Data sources for mortality base table and improvements:
 - Base tables -> portfolio of experience
 - Improvements -> population data e.g. CMI model
- The drivers of mortality improvements can be investigated to help answer questions:
 - Will historically important factors continue to be so in the future?
 - How will changing medical practices impact on mortality improvements?
 - How to adjust mortality improvements for socioeconomic group and level of underwriting?
- COVID-19 challenges the existing practice



Background: Post-2019 mortality data



- Cumulative standardised mortality rates relative to 2019
- Without COVID-19, you'd expect 2020, 21, 22 and 23 lines to track successively lower in the negative axis
- Cumulative standardised mortality to week 32 of 2023 is 5.0% above 2019

Source: CMI mortality monitor as at 22nd Aug 2023



Institute
and Faculty
of Actuaries

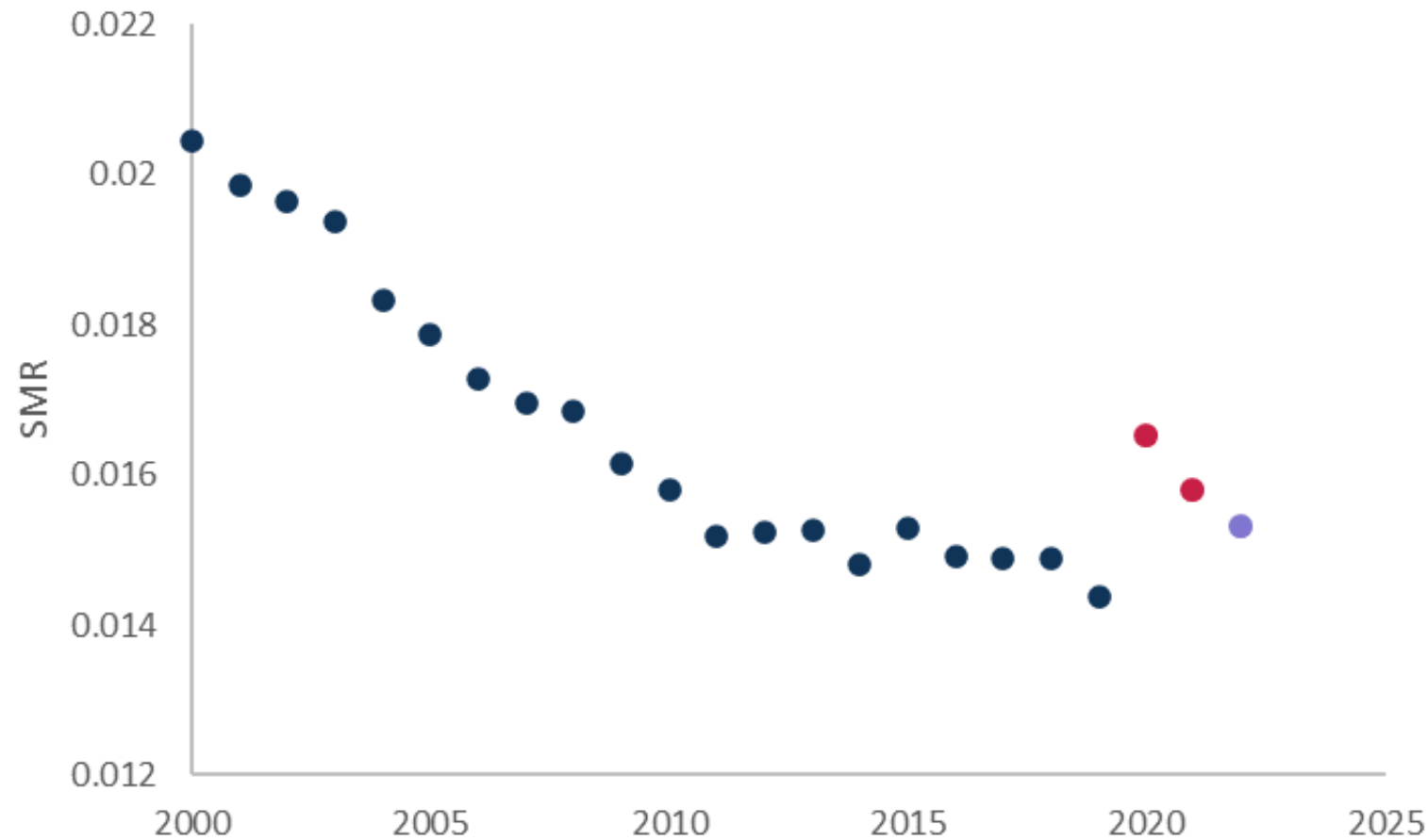
Options for setting assumptions Post-COVID-19

- Material changes to the data:
 - Mortality spikes in 2020 and 2021
 - Excess deaths in 2022 and 2023
- What should we do with the data? Typical options used by firms fit under 3 options:
 - Option 1:** Ignore or down-weight data impacted by COVID-19
 - Option 2:** Adjust data impacted by COVID-19
 - Option 3:** Carry out a bottom-up analysis of the risk drivers



Option 1

Ignore or down-weight data impacted by COVID-19



Institute
and Faculty
of Actuaries

Option 1

Ignore or down-weight data impacted by COVID-19

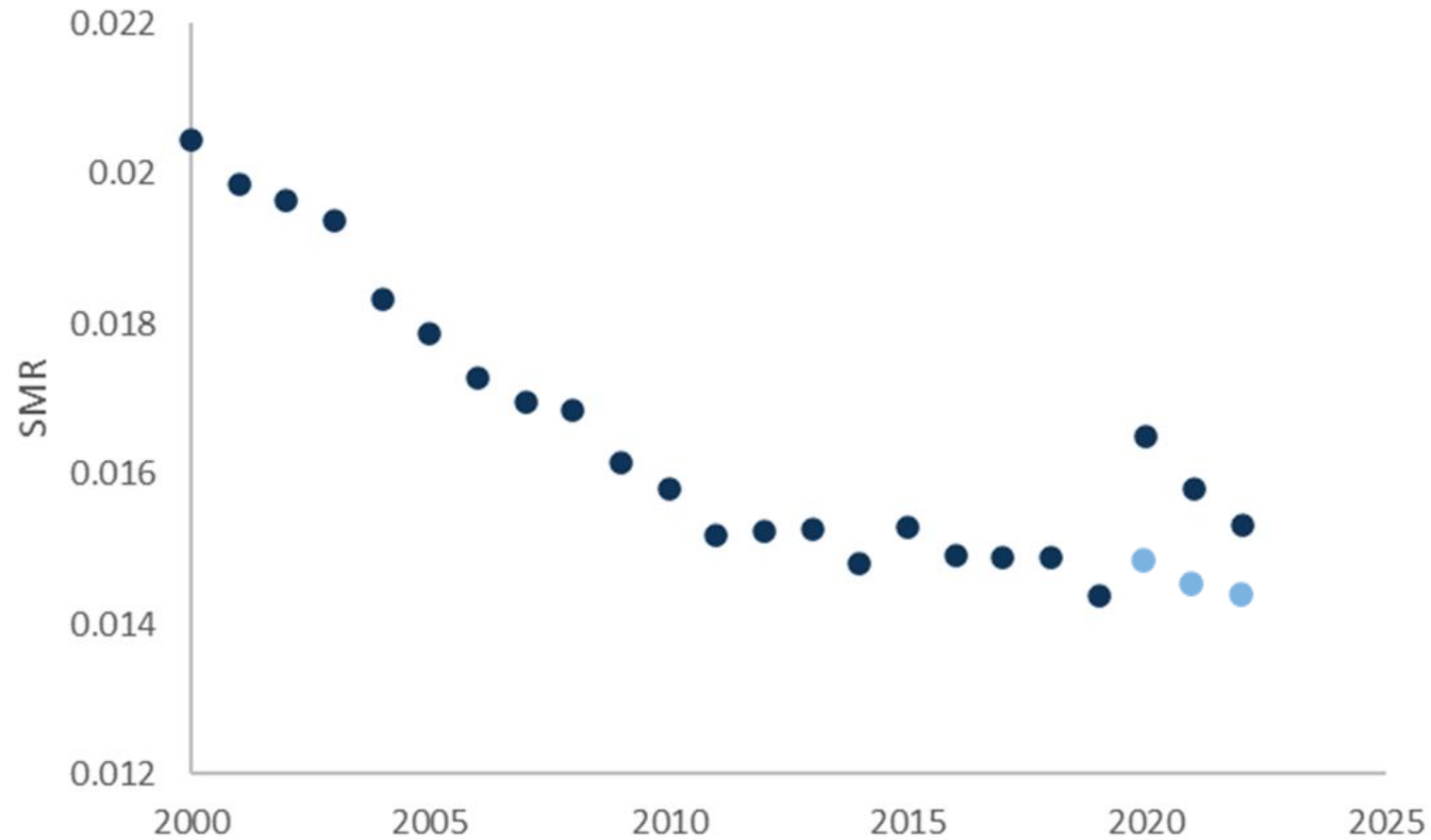
Advantages	Disadvantages
Simple to apply	Lost insights from ignored data
Easy to rationalise for 2020 and 2021	Unclear what approach appropriate for 2022

- Exclusion of 2020 & 2021 data continues to be reasonable
- Simple 2022 weighting approach may be appropriate for smaller books
- Note core parameterisation of CMI model with 25% weight to 2022 data



Option 2

Adjust data impacted by COVID-19



*adjustment is illustrative only



Institute
and Faculty
of Actuaries

Option 2

Adjust data impacted by COVID-19

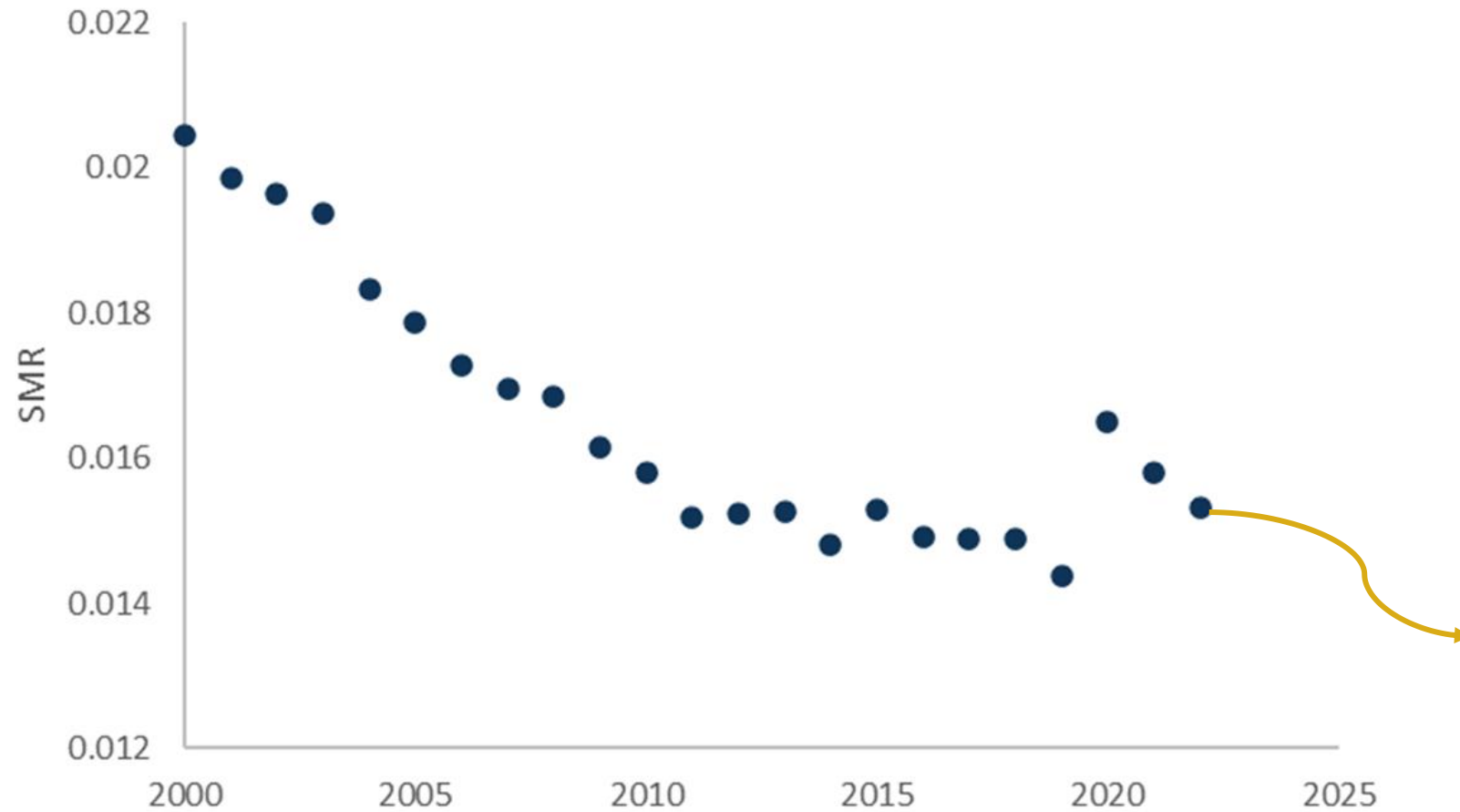
Advantages	Disadvantages
Significant mortality impacts still captured	Difficulty of identifying “COVID deaths”
Retain insights into other drivers	Inaccuracy of approximate adjustment methodology

- Treats direct COVID-19 deaths as entirely short-term and indirect excess deaths as permanent
- Crude approach but could be reasonable for very immature or less material portfolios



Option 3

Driver-based approach



Option 3

Driver-based approach

Advantages	Disadvantages
Insights should lead to better-informed assumption	Resource intensive
Can consider impacts over different time periods	Requires expert judgement

- Comprehensive approach which requires investment of resources to identify and quantify mortality drivers
- A version of this approach may well be most appropriate for material books





Institute
and Faculty
of Actuaries

Drivers of post-pandemic mortality

Driver-based approach

Why?

- Need to understand the drivers of heavy 2022/23 mortality to determine which simpler methods might be reasonable (e.g. weight on 2022 experience, CMI22 model)

How does this working paper help?

- Shortlist the potentially key drivers
- Categorise “probably high” v “probably low” materiality
- Help focus on high materiality ones
- Introductory analysis → signpost important papers + suggestions for further analysis
- Considerations for projection

The WP has aimed to provide useful guidance but doesn't provide “the answer”



Institute
and Faculty
of Actuaries

Shortlisted drivers



Further Spikes of COVID-19



Endemic COVID-19



Adverse Health Implications of COVID-19 Infections and the Pandemic



Reduced Respiratory/Influenza Deaths



Changes to Economic Environment



Health Service Disruption



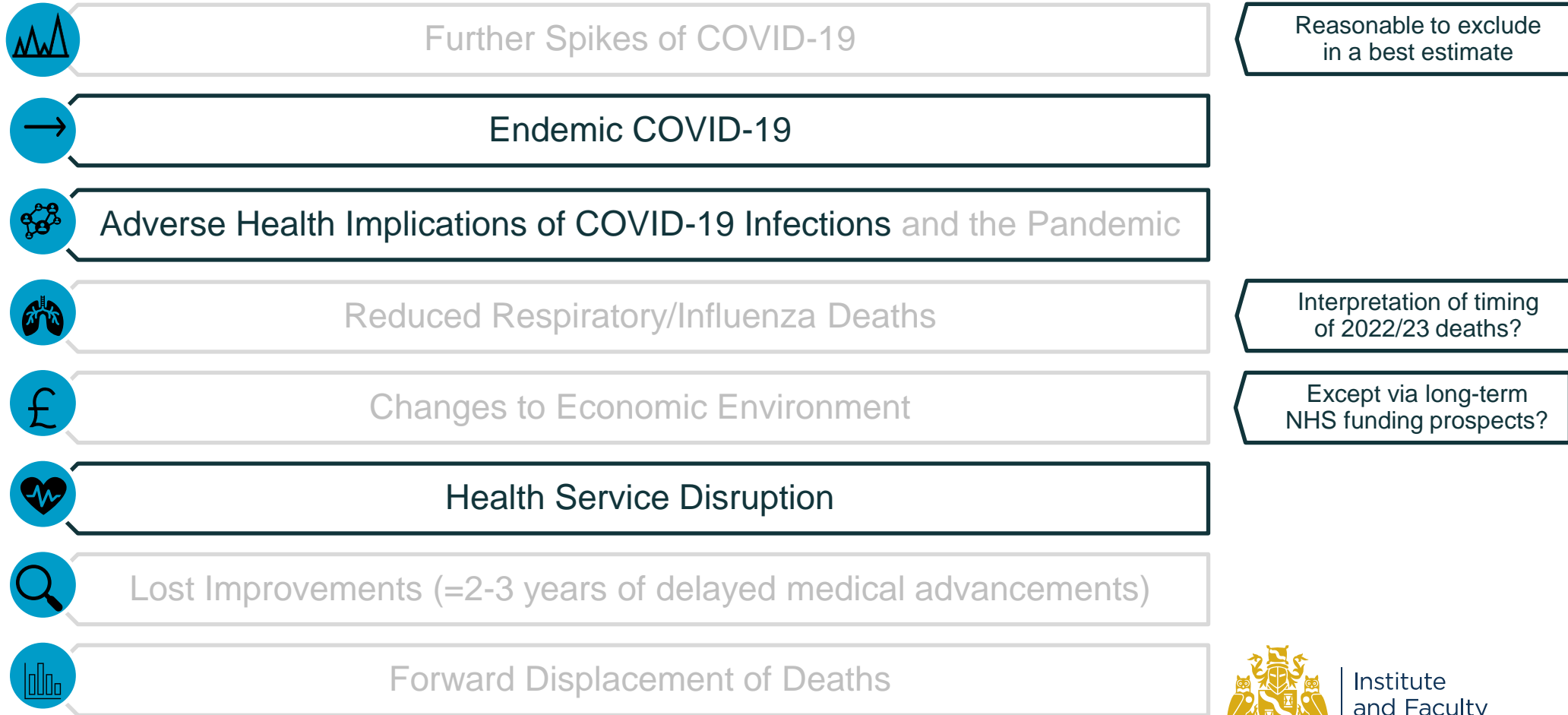
Lost Improvements (=2-3 years of delayed medical advancements)



Forward Displacement of Deaths



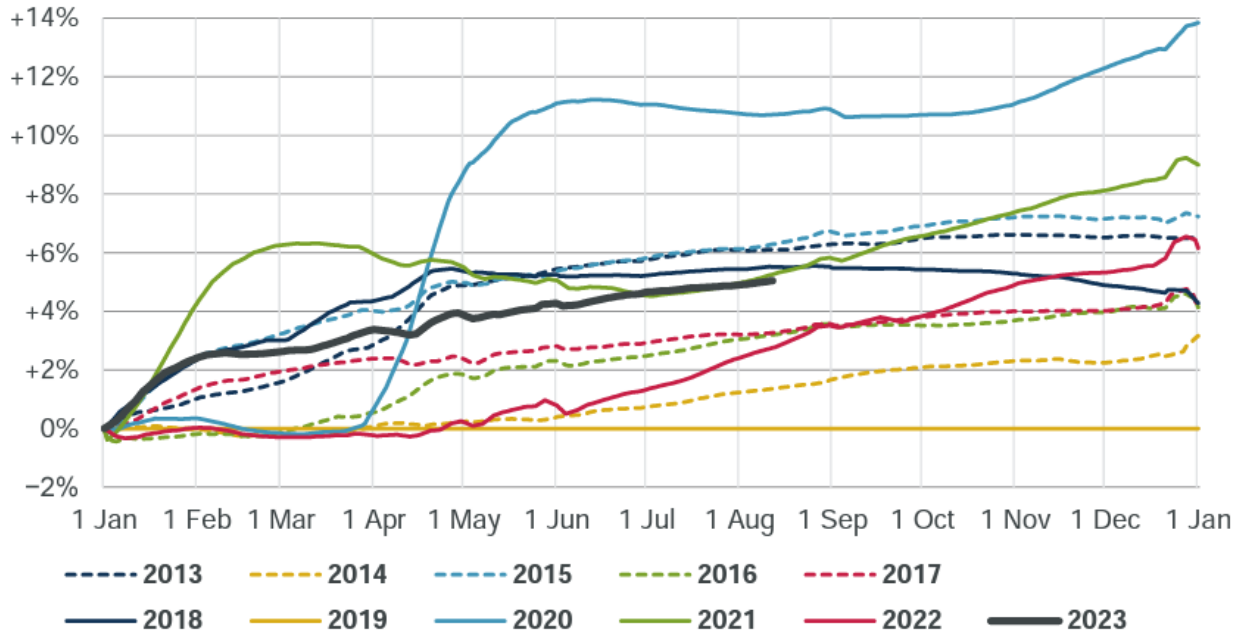
Shortlisted drivers



Reduced Respiratory/Influenza Deaths

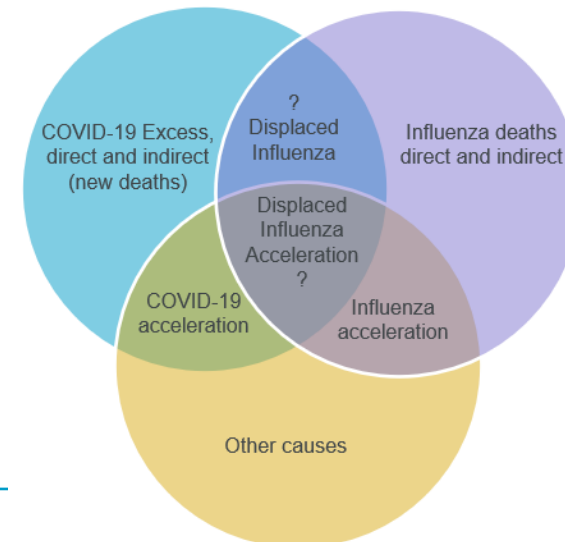


Interpreting 2022/23 – timing of deaths



Conclusion looking forward

- Short term: Likely stabilisation of influenza mortality at similar pre-pandemic levels, with some risk of increased severity in the short term.
- Medium/Long term: Potential for some reduction in mortality compared to the short term from mRNA technology developments.
- [Interaction with endemic COVID – competing causes]



Institute
and Faculty
of Actuaries

Endemic COVID-19

Deaths in England & Wales involving COVID-19

- Left: Deaths by year of registration and age-band.
- Right: Deaths involving COVID-19 expressed as a percentage of all other (non-COVID-19) deaths registered in the year and age-band.

Age-band	2020	2021	2022	2023 YTD		Age-band	2020	2021	2022	2023 YTD
0-24	54	120	88	20		0-24	1.1%	2.2%	1.6%	0.7%
25-49	1,445	2,452	740	158		25-49	6.7%	11.4%	3.4%	1.4%
50-74	18,940	22,163	7,094	2,144		50-74	13.1%	15.7%	4.9%	2.7%
75+	60,391	51,359	25,218	9,360		75+	16.7%	15.0%	6.8%	4.5%
Total	80,830	76,094	33,140	11,682		Total	15.2%	14.9%	6.1%	3.9%

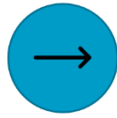
- Source: figures are derived from ONS death registration data. 2023 YTD is to end-June.

Contribution to 2022 and 2023 excess deaths?

- Death certificates: deaths “due to” COVID are ca. 2/3 of deaths “involving” COVID in 2022 and 2023.
- Some over or under reporting possible
- Competing causes?



Endemic COVID-19



Conclusion looking forward

- Endemic: here to stay
- Short term: Likely stabilisation of mortality at similar levels to recent experience.
- Medium/Long term: Likely reduction in mortality compared to recent experience, due to a reduction in disease severity and improvements in treatment.



Adverse Health Implications of COVID-19 and Pandemic



Acute Post COVID-19 Sequelae

- **Impact:** Likely to have a material impact in the short term and a small impact in the medium/long term if the endemic steady-state of COVID infections is low.
- **Rationale:** Recent studies suggest mortality rates are significantly heightened in the 6-18 month period immediately following the acute phase of a COVID-19 infection:

nature medicine



Article

<https://doi.org/10.1038/s41591-022-02051-3>

Acute and postacute sequelae associated with SARS-CoV-2 reinfection



ESC
European Society
of Cardiology
Cardiovascular Research (2023) 119: 1718–1727
<https://doi.org/10.1093/cvr/cvac195>

Association of COVID-19 with short- and long-term risk of cardiovascular disease and mortality: a prospective cohort in UK Biobank

nature
medicine

ARTICLES

<https://doi.org/10.1038/s41591-022-01689-3>



OPEN

Long-term cardiovascular outcomes of COVID-19

- Hazard ratios of between 1.5 and 5.0 reported, so the effect is significant.
- These studies consider periods of up to 18 months and so it is not possible to say how long the heightened risk will last. Assuming some run-off with time since infection seems reasonable, but it remains possible that it persists to the longer term
- Reasonable to assume that the severity of sequelae follow the severity of initial infection, so run-off with cohort also a reasonable assumption



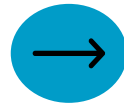
Institute
and Faculty
of Actuaries

Overall direct COVID view?

Explanation of 2022/2023 excess



More detailed exploration might separately consider:



Endemic COVID-19

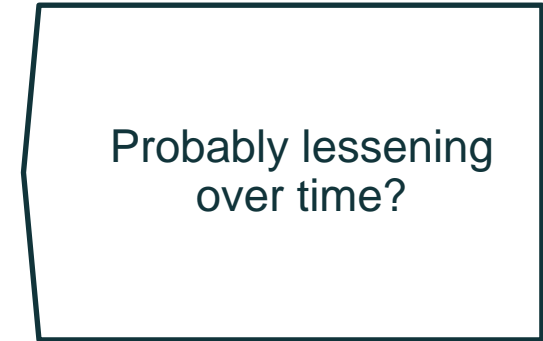


Adverse impacts of prior infection



Competition/interaction with flu & other respiratory diseases

Projection?

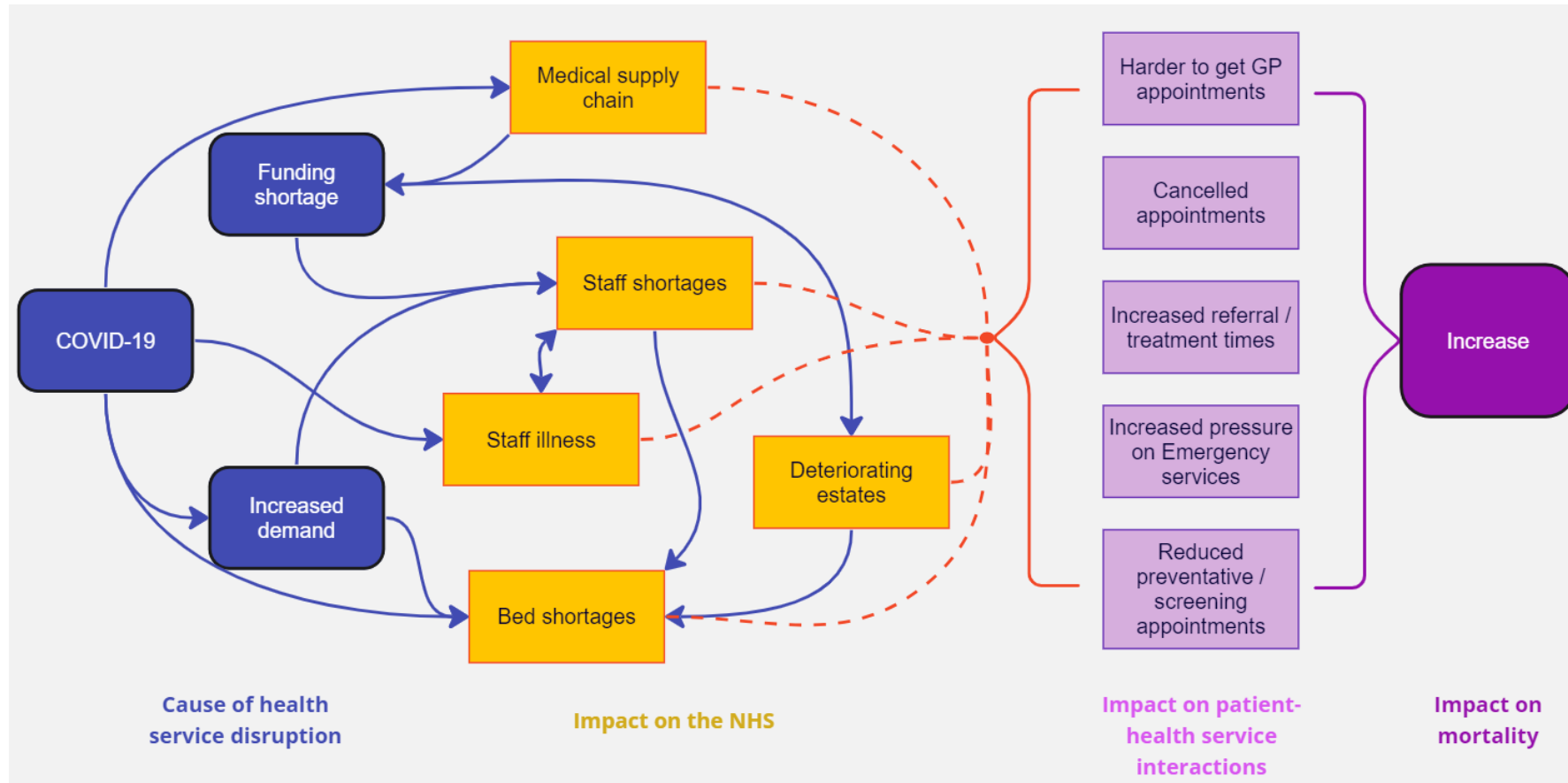


Institute
and Faculty
of Actuaries

Health Service Disruption



Complicated interaction between a number of issues



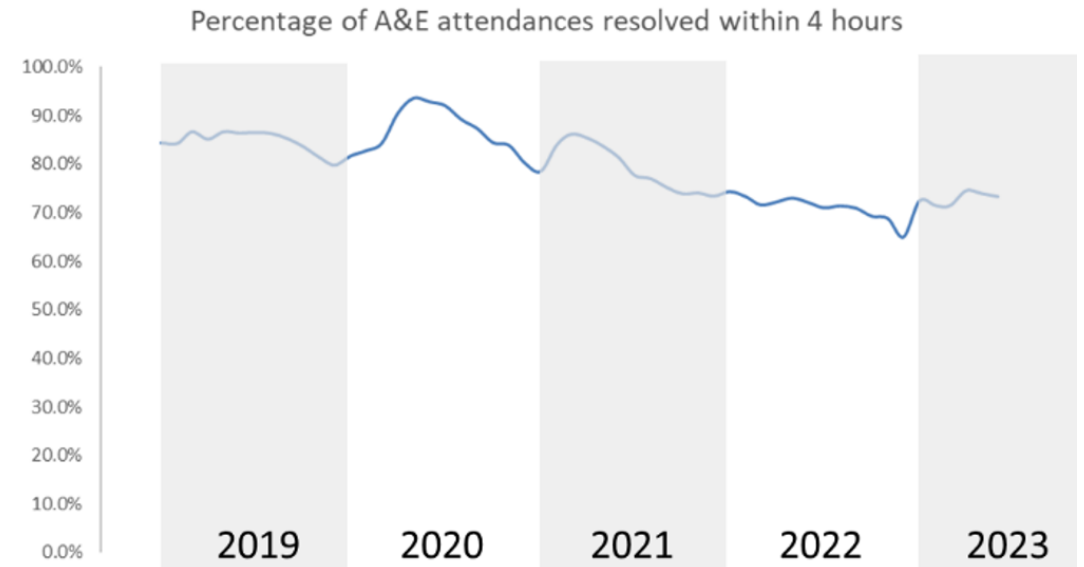
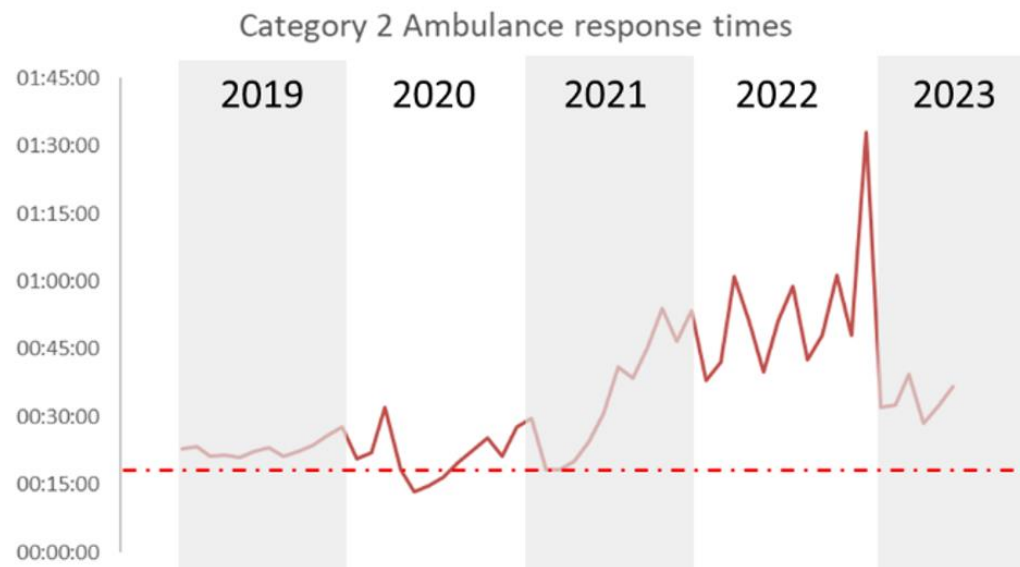
Institute and Faculty of Actuaries

Health Service Disruption



Emergency care waiting times

- Left: category 2 (emergency) average ambulance response times vs the target of 18 minutes since the start of 2019 .
- Right: The percentage of A&E attendances resolved within 4 hours from arrival to admission, transfer, or discharge



- Source: NHS England



Institute
and Faculty
of Actuaries

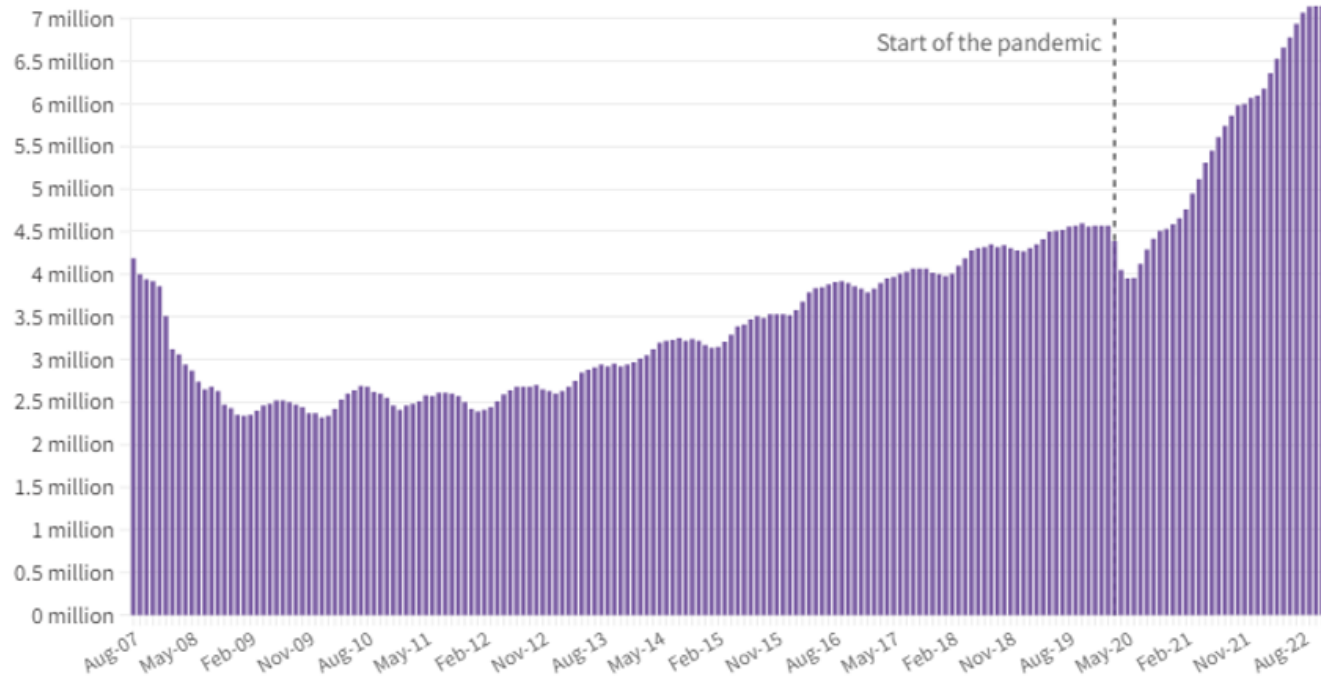
Health Service Disruption



Elective care waiting times

- Number of people on NHS waiting list for consultant-led elective care August 2007-Dec 2022

Number of people on NHS waiting lists for consultant-led elective care



- Source: NHS England



Institute
and Faculty
of Actuaries

Health Service Disruption



Quantification?

- **A&E waiting times:**

- Research by Lane Clark & Peacock estimates that more than 400 additional deaths a week (between Sept 2022 to Feb 2023) could be due to long delays in accessing emergency care. Not all these deaths could be typically defined as excess deaths but could all be considered ‘avoidable’
- Example – if ca. 200 deaths pw were excess then 10k p.a. = ca. 2% of annual E&W mortality.

- **Elective care waiting times:**

- Lancet Oncology 2020 paper modelled substantial increases in the number of avoidable cancer deaths in England from diagnostic delays → 3-4k additional deaths within 5 years.
- 2020 collaboration between GAD, DHSC, ONS, Home Office estimated that delays to elective care could lead to around 12.5k excess deaths over a 5-year period.

- **CVD risk factor management:**

- The British Heart Foundation ‘Tipping Point’ report estimates that the reduction in control of hypertension could lead to 11,190 additional heart attacks and 16,702 additional strokes over a three-year period.

Slower to emerge into mortality statistics?



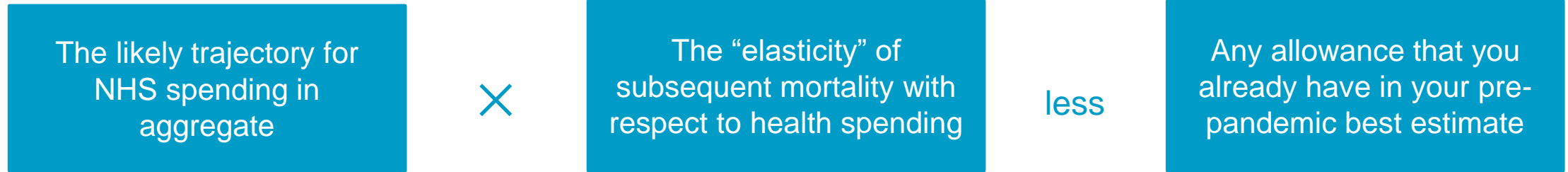
Wait watchers



Institute and Faculty of Actuaries

Health service impact in the medium/long-term?

- Granular modelling of different drivers (e.g. A&E waits v cancer waits) more difficult in the longer term.
- An alternative approach is to take a view on:



- What to assume for the relationship?
 - A range of views exist on the size and timing of this relationship
 - For example, analysis in the November 2020 IFOA longevity bulletin noted the results of a regression analysis that suggested each 1% additional funding received by the NHS might give rise to a 0.4% decrease in mortality rates, coming through over the subsequent 10 years



Longevity Bulletin
From the Institute and Faculty of Actuaries



The coronavirus issue

Issue 13

November 2020



Institute
and Faculty
of Actuaries

Health Service Disruption



Conclusion looking forward

- Short term: Excess mortality is likely to persist in the immediate future with the potential for it to increase as a result of delays to diagnoses/treatment and the challenges facing emergency and social care.
- Medium/Long term: Impact on mortality is dependent on the NHS hitting their targeted path to recovery.
- There are plans in place to fix the biggest issues facing the NHS, but it is a large and complex entity so the impact of any positive changes will likely only be felt over a long period rather than in the short-term.

Implicit assumptions from the pre-pandemic period likely to be important



Institute
and Faculty
of Actuaries

Summary of overall view?

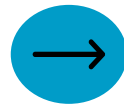
Explanation of 2022/2023 excess

COVID-19

NHS-related issues

Other drivers probably smaller

More detailed exploration might separately consider:



Endemic COVID-19



Adverse impacts of prior infection



Competition/interaction with flu & other respiratory diseases



Emergency waiting times



Non-emergency waiting times (e.g. cancer consultations)



Longer term funding prospects

Projection?

Probably lessening over time?

?



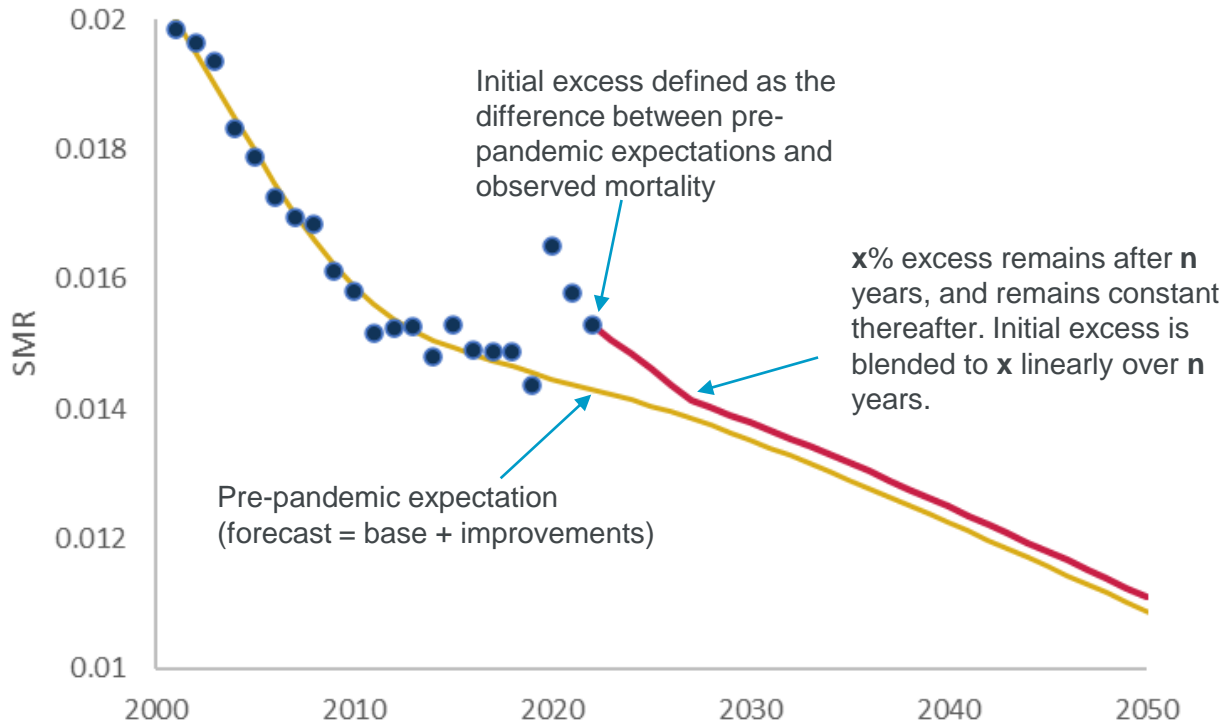


Institute
and Faculty
of Actuaries

A practical driver-based approach

Framework and insights

A practical driver-based approach



Age 50
 Baseline EoL 36.46
 Initial excess 10%

Runoff (n)

Remaining (x)	Runoff (n)		
	5	10	20
0.0%	-0.02	-0.04	-0.10
2.5%	-0.23	-0.25	-0.29
5.0%	-0.44	-0.45	-0.47
7.5%	-0.64	-0.64	-0.66
10.0%	-0.83	-0.83	-0.83
12.5%	-1.03	-1.02	-1.01

Age 70
 Baseline EoL 17.49
 Initial excess 5%

Runoff (n)

Remaining (x)	Runoff (n)		
	5	10	20
0.00%	-0.02	-0.05	-0.12
1.25%	-0.10	-0.12	-0.18
2.50%	-0.18	-0.20	-0.23
3.75%	-0.26	-0.27	-0.28
5.00%	-0.34	-0.34	-0.34
6.25%	-0.41	-0.41	-0.39

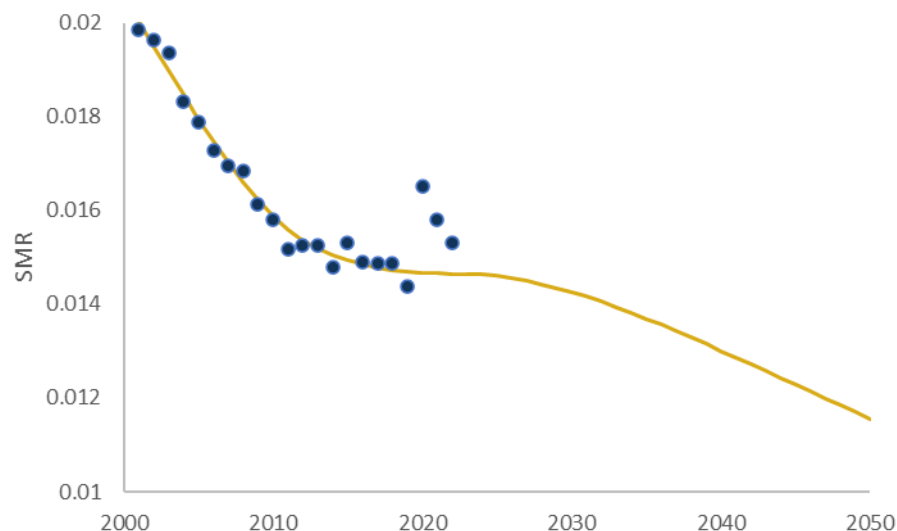
Changes in EoL
 (as at 2023)

Excess mortality is expressed as a percentage uplift to pre-pandemic expectations

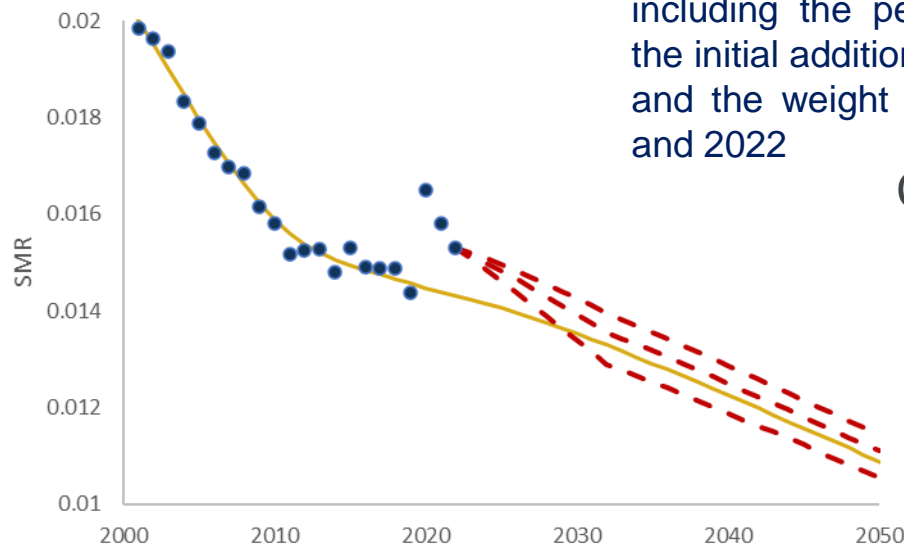


Institute
 and Faculty
 of Actuaries

Other use-cases



- CMI 2022, males
- **25% weight on 2022**
- LTR = 1.5% (with core taper)
- S3PMA base table
- Core parameters elsewhere



- CMI 2022, males
- **0% weight on 2022**
- LTR = 1.5% (with core taper)
- S3PMA base table
- Core parameters elsewhere
- **n = 10**
- **x = ?**



...we encourage users of the Model to consider the impact of different choices for Extended and Advanced parameters, including the period smoothing parameter, the initial addition to mortality improvements, and the weight parameters for 2020, 2021 and 2022

CMI WP177



What value of x gives the same cohort expectations of life as the data-weighting approach?



Institute
and Faculty
of Actuaries

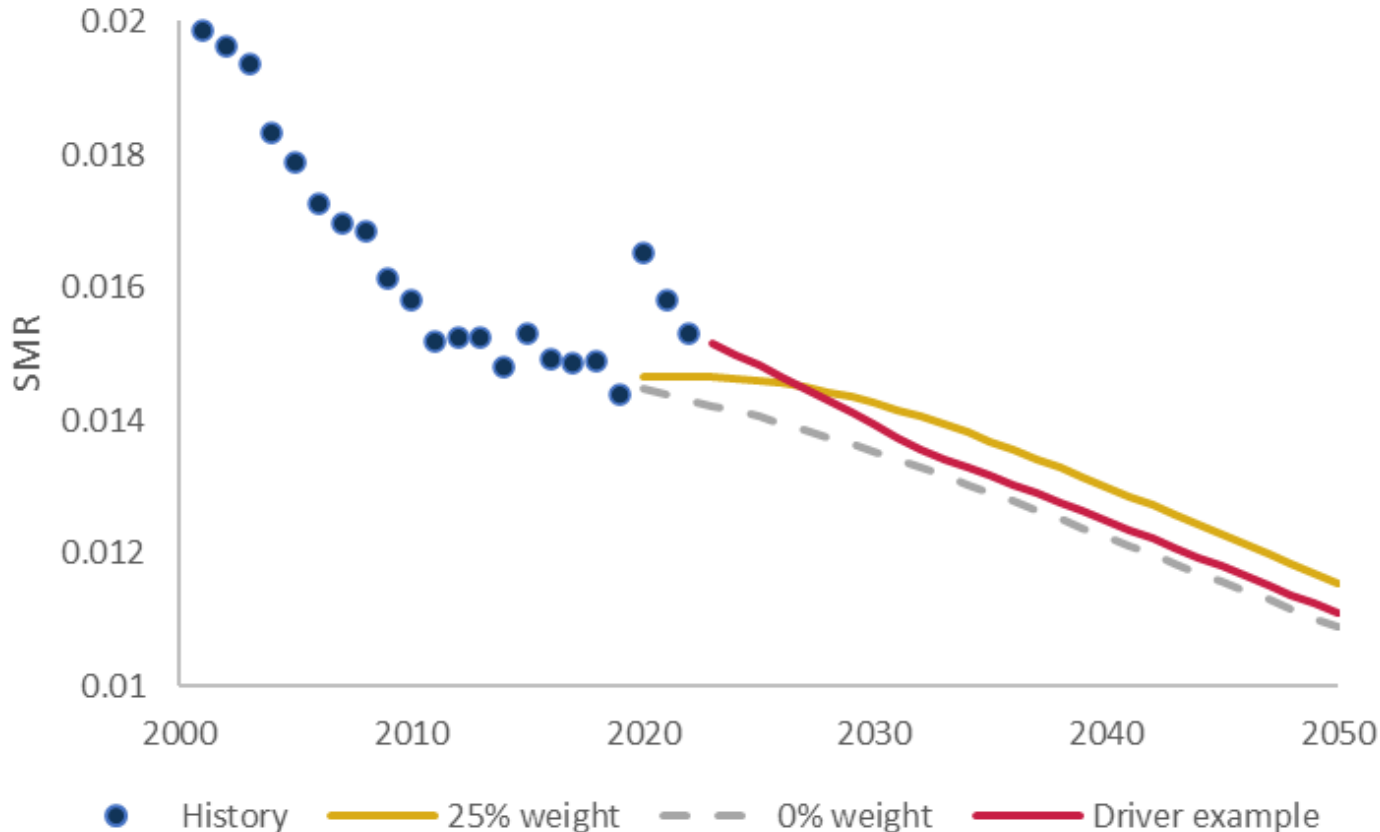
Other use-cases

Age	cEOL 25 pc weight	cEOL 0 pc weight	Initial 2022 excess	Remaining excess at yr 10
50	35.9	36.5	10.0%	5.9%
60	26.2	26.6	5.0%	5.9%
70	17.1	17.5	5.0%	5.3%
80	9.5	9.8	5.0%	4.1%

- 25% weight on 2022 data is equivalent to significant excess remaining at year 10 under a driver-based approach
- At some ages it is equivalent to an increase to the excess
- The result is sensitive to many of the other model assumptions. In particular the length of the LTR convergence periods.



Shape vs strength



- Equivalent expectations of life does not mean equivalent projections
- The shape of a driver-based projection will differ from that of the data-driven approach, because the driver-approach will start from the level of the most-recent datapoint
- The data-driven approach gives 25% to the 2022 data, and will project from a lower initial mortality rate



Practical approaches - conclusions

A driver-based approach can be made simple

- Even a high-level view of how current excess will evolve relative to a pre-pandemic view is useful
- A two-parameter “model” of excess mortality can give useful scenario-based insights into impacts

Alternative methods and viewpoints are useful in times of uncertainty

- Judgement is more important than ever when setting future improvement assumptions
- Being able to approach the problem from different angles is useful

There is no right answer

- All models are wrong, but some are useful!



Acknowledgements

- Working party members:
 - Craig Armstrong, Laura Benton, David Cartmill, Colin Dutkiewicz, Jonathan Finn, Oliver Hampson, Ben Johnson, Hai Luc, Paul Malloy, James Malone, Robert Mellows, Richard Montgomery, Jon Palin, Joanne Wells, Nay Wynn
- Richard Willets for sharing insights as the working party were planning the work
- Thomas Honeywell for checking some of the technical work



Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenter.



Institute
and Faculty
of Actuaries