

Mortality modelling and forecasting in the uncertain world

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Longevity 18 London



The Data Driven Approach

The CMI model What is it?

Model, considered gold standard

2-for-1:

Set current mortality level



Project initial improvement to LTR



Age-Period Cohort

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Note: Graphs and life expectancies generated under core calibration of CMI_2021_M [1.5%], using S3PMA tables with a calculation date of 1-Jan-2024



The CMI model Where is the uncertainty?

Theory:

- Trends in near future will follow recent past
- Trends in longer term uncertain
- Core parameters for everything <u>except</u> LTR
 - LTR set by user due to its uncertainty
- Most BPA insurers / reinsurers set LTR between 1% and 2% ⁽¹⁾
- LTR sensitivities show +/- 1% life expectancy change at age 75

	Life expectancy differences from core calibration, males ⁽²⁾		
	Age 65	Age 75	
LTR = 1.0%	-1.4%	-0.9%	
LTR = 1.5%	-	-	
LTR = 2%	+1.5%	+1.0%	



The CMI model How does the core model handle the pandemic?

- 2020-21 excluded from core calibration
- 25% weight applied to 2022
 - CMI state 2022 somewhat indicative of future
- Proposed 50% weight for 2023, 75% for 2024⁽¹⁾
 - Getting back to "Normal" from 2025
 - What does this mean?

"Taken together, this suggests that... mortality in 2022 may be indicative of future mortality to some extent. However, we note there is still considerable uncertainty."

CMI Working Paper 168: CMI_2022 Consultation

Table 2.1: Proposal from Working Paper 168

	<i>w</i> ₂₀₂₂	<i>w</i> ₂₀₂₃	<i>w</i> ₂₀₂₄	<i>w</i> ₂₀₂₅	W ₂₀₂₆
CMI_2022	25%	_	-	_	-
CMI_2023	25%	50%	-	_	-
CMI_2024	25%	50%	75%	_	-
СМІ_2025	25%	50%	75%	100%	-
СМІ_2026	25%	50%	75%	100%	100%



CMI_2023 model predictions We've made an estimate of CMI_2023

- Use CMI method to generate 2023 population
- Use 2023 weekly deaths up to week 33

Assume future 2023 weekly deaths equal 2022 weekly deaths



What happens under the BAU update of CMI model?

Cumulative standardised mortality rate compared to 2019





CMI 2023 Predictions What happens to base and trend?

Increase in base mortality...



Base and trend are entangled in the core calibration of the CMI model



S3PMA tables

and decrease in future trend!

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CMI_2023 & COVID-19 Where is the uncertainty?

- Weight parameter sets current mortality level <u>AND</u> future expectations of improvement
 - Both are highly uncertain!

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- Big change in life expectancies
 - Range of 7% vs 2% for LTR!
- Should it be a user input?

	Life expectancy differences from core calibration, males ⁽¹⁾		
	Age 65	Age 75	
$W_{2022} = 0\%$ $W_{2023} = 0\%$	+4.9%	+6.0%	
$W_{2022} = 25\%$ $W_{2023} = 50\%$	-	-	
W ₂₀₂₂ = 100% W ₂₀₂₃ = 100%	-0.7%	-1.0%	



Projected improvement comparison CMI_2021 vs CMI_2023

CMI_2021 Males



CMI_2023_Estimate Males







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CMI_2023 Is dis-improvement reasonable?

- Can't ignore pandemic! We have a new cause of death.
- By using 2022-23 data, the CMI model accounts for this in trend.

Watch out for double counting!

- More natural to think of COVID-19 as step-change in base mortality in 2020?
- Core calibration not suitable if modelling COVID-19 as step-change.
- R Do we need a different approach?



The Driver-Based Approach

Driver-based Approach



Start with recent excess mortality

2 What is driving the excess mortality?

3 How will the drivers evolve over time?

Views expressed relative to pre-pandemic expectations

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Drivers of Excess Mortality



A range of considerations

Medical, demographic, health, Epidemiological, etc

COVID Evolution



Evolution of Drivers over Time





Key considerations:

- Are the drivers temporary or permanent?
- Will these wear off over time?
- Will 'new' factors also emerge?

A fair degree of actuarial judgment

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Key Driver: COVID – 19





- Significant and persistent excess from the pandemic shock
- Thankfully, recent months have seen significant drop in the number of cases and covid-related deaths

SARS-CoV-2 – Future Outlook

A complex formula?

Possible future outcomes: Endemic state?





Key Driver: Non-Covid Deaths



Ambulance Response times

Source: NHS England, Ambulance Quality Indicators

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National Health Service (NHS) – Challenging times

A&E Admission times – Decision to proceed to admission, transfer or discharge



- Target for A&E cases: 95% of A&E cases must be handled within a 4hour window
- Target missed since late 2015

Source: Statistics » A&E Attendances and Emergency Admissions (england.nhs.uk)

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Healthcare Pressures – Future outlook



Not a new issue, but issue has worsened

- The pressures on the healthcare system is not a new issue
- The austerity period (in the 2010 to 2019) is suspiciously having a long-term impact
- The pandemic has been certainly worsened the issue



Will it recover?

- NHS Funding is the key
- Organisational reform
- Greater role by the private health sector



mRNA technology

Some therapeutics gave been accelerated by the pandemic



mRNA vaccines have been researched for over 30 years

The COVID 19 pandemic accelerated the development of therapeutics approved for human use

There have already been subsequent breakthroughs in developing improved influenza vaccines

mRNA-based cancer therapeutics are the next frontier

Source: Shuqin Xu, Kunpeng Yang, Rose Li, and Lu Zhang - Xu, S.; Yang, K.; Li, R.; Zhang, L. mRNA Vaccine Era—Mechanisms, Drug Platform and Clinical Prospection. Int. J. Mol. Sci. 2020, 21, 6582. https://doi.org/10.3390/ijms21186582, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=106937729



Rapid advances

Some therapeutics are progressing quickly despite the pandemic



Cancer diagnostics

Non-invasive detection and profiling of tumors



Weight-loss drugs

Recently shown to benefit heart health



Alzheimer's progress

Donanemab shown to slow the progression of the disease



A loading over Pre-pandemic Mortality Possible outcomes



- A range of possible outcomes
- Some possible paths will converge to pre-pandemic mortality sooner, some never at all

Conclusions

Conclusion Mortality modelling and forecasting in the uncertain world





Uncertainty in data driven approach no longer constrained to LTR



Core parameterization not necessarily default view



Need a combi approach in the uncertain world



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Thank You

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Questions? Comments?

