Continuous Mortality Investigation

Institute and Faculty of Actuaries

SIAS

Staple Inn Actuarial Society

Outlook for mortality improvements

Discussion hosted by SIAS and the CMI Mortality Projections Committee

19 July 2023
Staple Inn Hall, London

The views expressed in this presentation are those of the presenters and not necessarily those of their employers, the CMI or the Staple Inn Actuarial Society.

Agenda

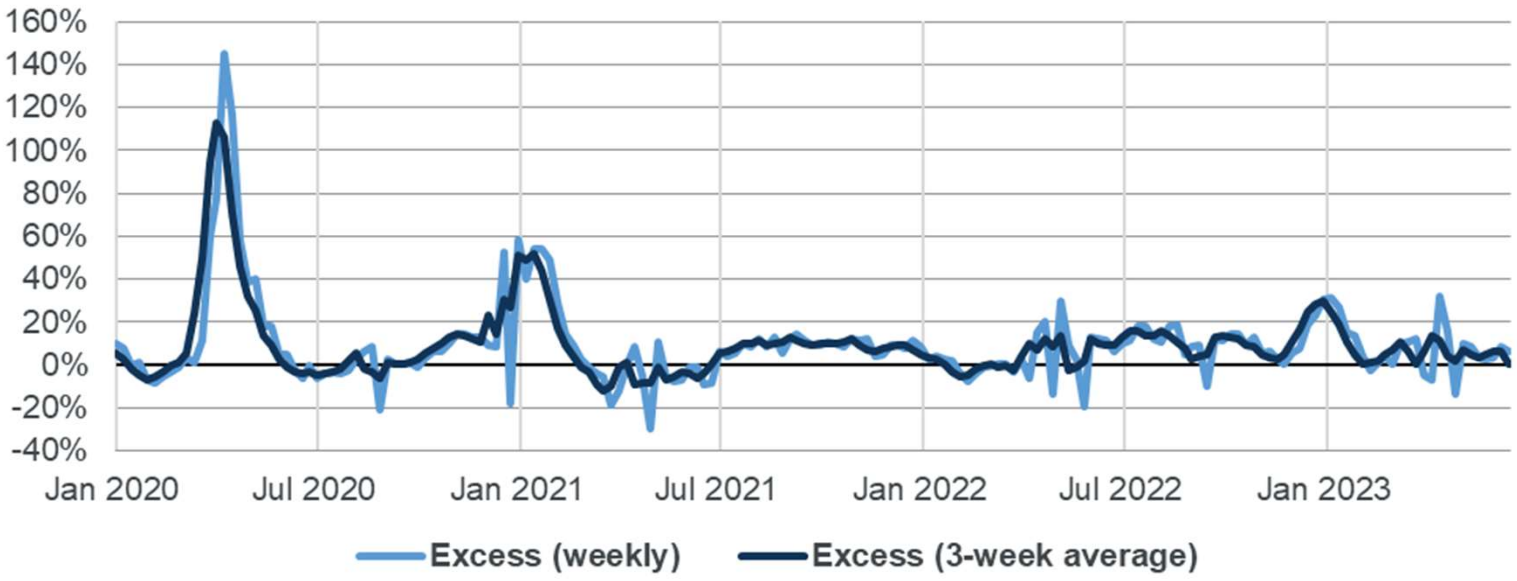
- **Welcome and introduction**
  - Cobus Daneel (CMI)
- **Census, recent mortality and CMI_2022**
  - Piero Cocevar (CMI)
- **Outlook for mortality improvements**
  - Ian Collins and Mike Wilson (Pacific Life Re)
  - Adam Strange and Daniel Meier (Swiss Re)
- **Discussion**

Recent mortality and CMI_2022

Piero Cocevar
CMI Mortality Projections Committee

Recent mortality

Excess mortality since the start of the pandemic

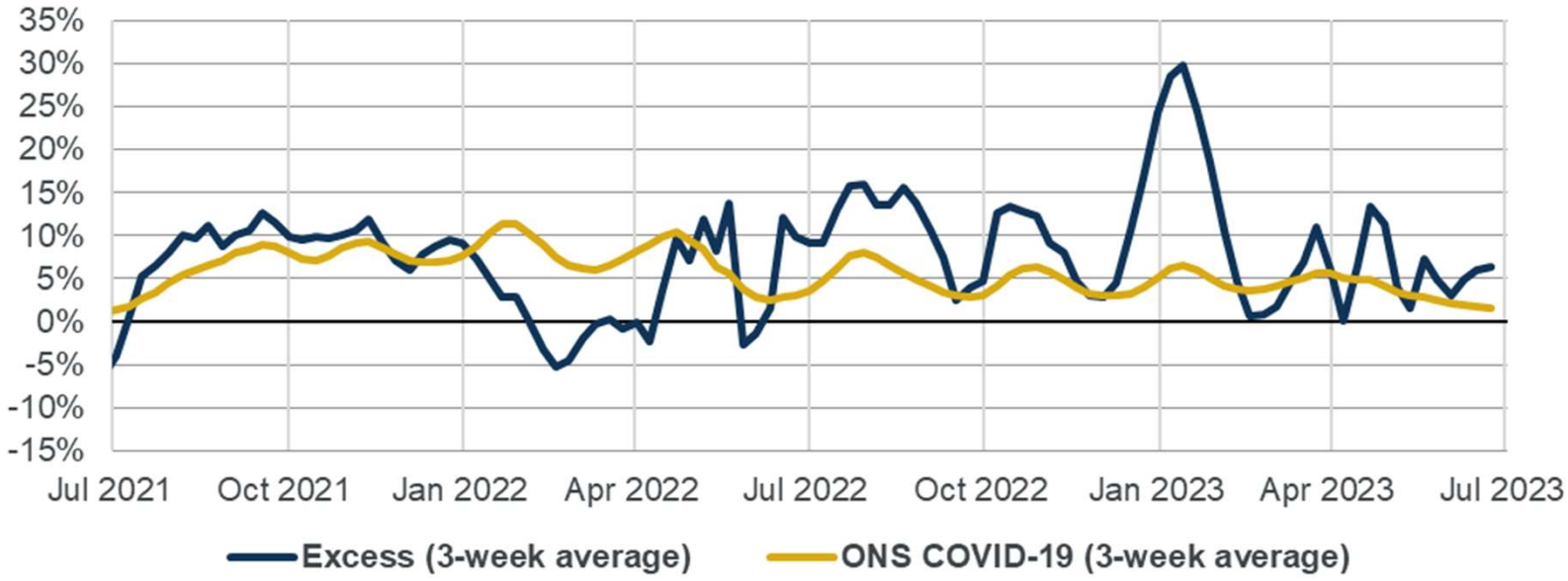


Source: CMI calculations, to 30 June 2023, based on ONS provisional weekly deaths data for England & Wales

Excess mortality is measured relative to 2019

Recent mortality

Excess mortality since July 2021



Source: CMI calculations, to 30 June 2023, based on ONS provisional weekly deaths data for England & Wales

Excess mortality is measured relative to 2019

CMI_2022

- CMI_2022 incorporates mortality data to 31 December 2022, updated to reflect the 2021 census
- 2022 data given 25% weight in the Core version, following consultation
  - 2020 and 2021 data given 0% weight – not indicative of future mortality
  - 2022 mortality less volatile – so somewhat indicative of future mortality
  - But 100% weight for 2022 would lead to excessive fall in life expectancy
- We encourage users to consider which parameters to use, particularly:
  - Weights – to reflect the impact of the pandemic
  - Initial improvements – to reflect the composition of their population
  - Long-term rate – to reflect the impact of the pandemic and other factors
- Cohort life expectancies at age 65 in CMI_2022 are around six months lower than in CMI_2021

CMI_2022

Impact on life expectancy at age 65

Using S3 tables, and illustrative long-term rate of 1.5% p.a.

Allowing for differences in improvements since S3 tables (2013)	Male	Female
CMI_2022 relative to CMI_2019	-3.2%	-2.4%
CMI_2022 relative to CMI_2021	-2.7%	-2.1%

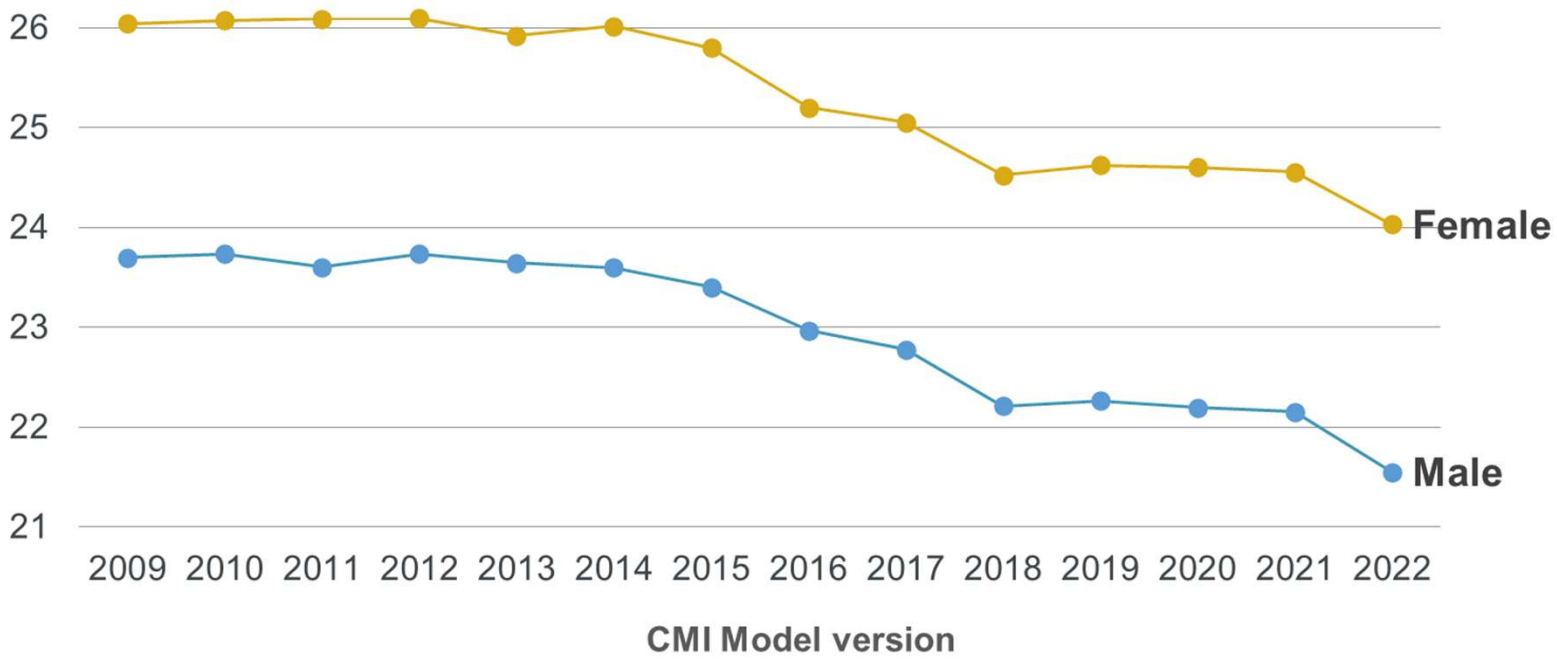
Allowing for differences in improvements only from 2023	Male	Female
CMI_2022 relative to CMI_2019	-1.8%	-1.4%
CMI_2022 relative to CMI_2021	-1.4%	-1.1%

Impact of the 2021 census

- The ONS intends to publish its revised population estimates for 2012 to 2020 in September 2023. Its more detailed methods and data may give a different answer.
- We have allowed for the 2021 census in the mortality monitor and in CMI_2022 using a relatively simple approach for now.
- The results of the 2021 census change imply, at pensioner ages:
  - lower populations than previously thought
  - higher mortality rates
  - lower recent mortality improvements
  - lower cohort life expectancy (around one month at age 65)

Progression of cohort life expectancy

Age 65, CMI Model, S3PxA, illustrative long-term rate of 1.5% p.a.



Source: CMI calculations

Future plans

- Continue frequent mortality monitoring for the time being, but gather views on frequency, content and methods.
- Third survey benchmarking use of the Model by insurers
  - To be issued in July, with results in September
- Once revised ONS population estimates are available, compare to our estimates and review the impact on the CMI Model and the mortality monitor
- Annual “interim update” working paper, with various analyses to assist users of the CMI Model
- Publish CMI_2023 in March 2024
  - Communicate view on weights by the end of this year

Outlook for mortality improvements

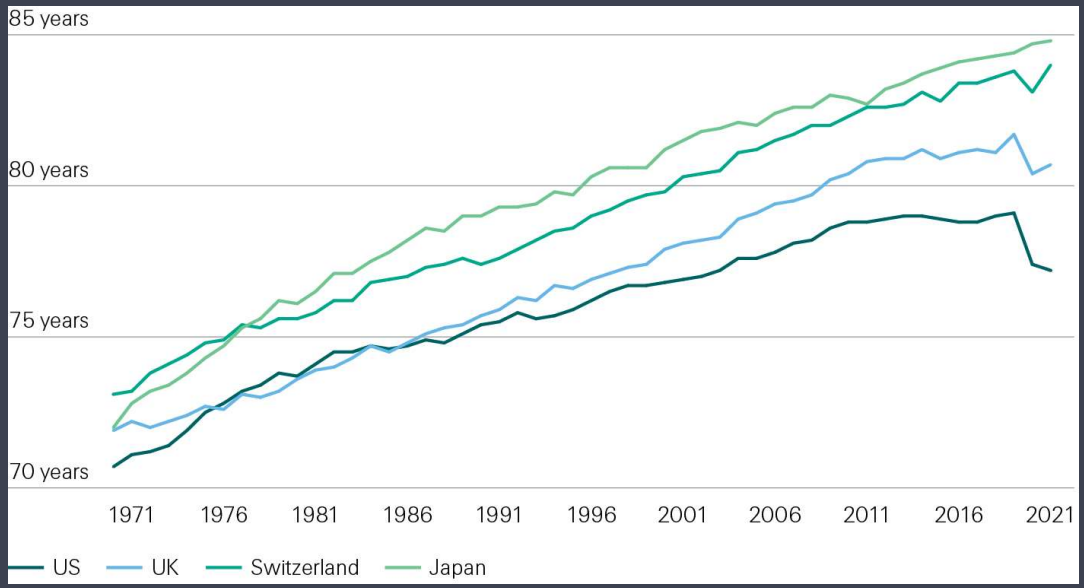
Adam Strange and Daniel Meier
Swiss Re

Swiss Re

The past, present and future of mortality improvements

Daniel Meier
Adam Strange

Global life expectancy improvements, COVID-19 exacerbated differences



Region	2019	2021
Japan	84.4	84.8
Switzerland	83.8	84
UK	81.7	80.7
US	79.1	77.2
China	78	78.2
High income	81.2	80.3
Less developed	71.3	69.6
World	72.8	71
Africa	62.7	61.7
Asia	74.2	72.5
Europe	79.1	77
LatAm	75.1	72.2

Mortality improvements by age and year

8-year moving averages

Substantial gains

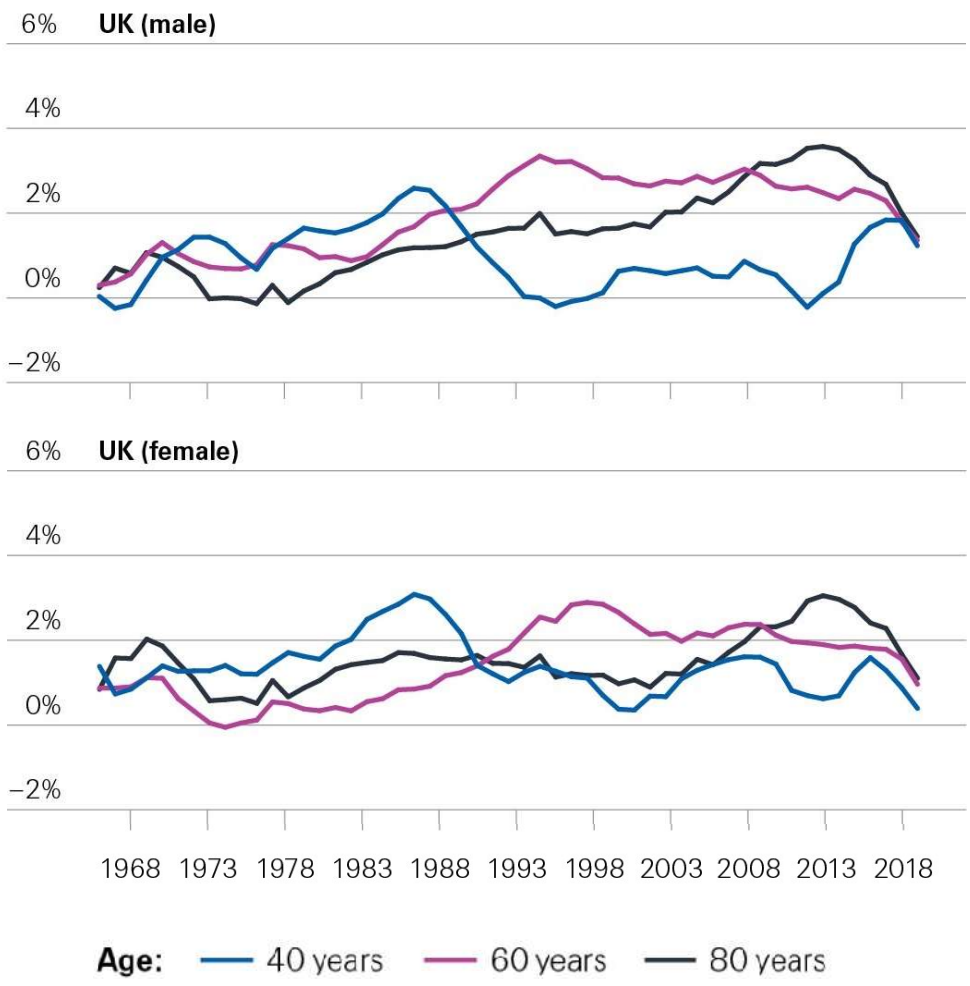
Since the 1960s, with clear peak & trough cyclicality throughout the generations

70% mortality improvement

1966-2010 – reduction in CVD, limited ongoing HIV mortality and better oncology

Slower improvements today

Boosted longevity as a single greatest lifestyle factor change of the 20th century



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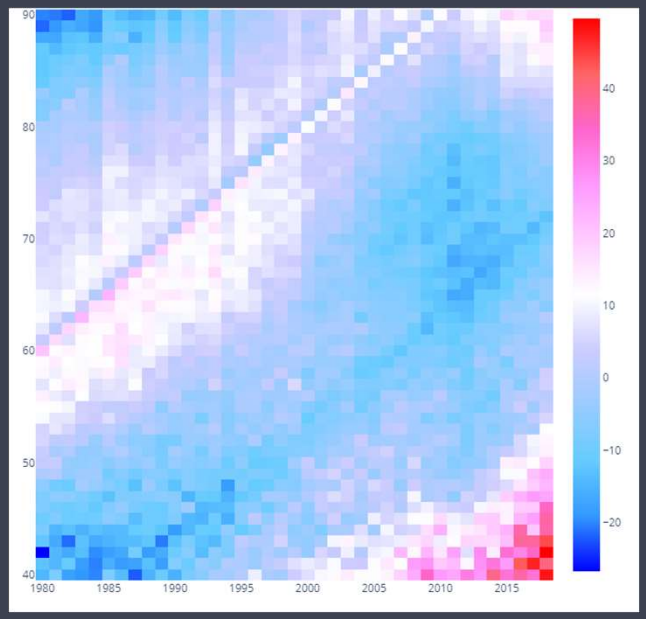
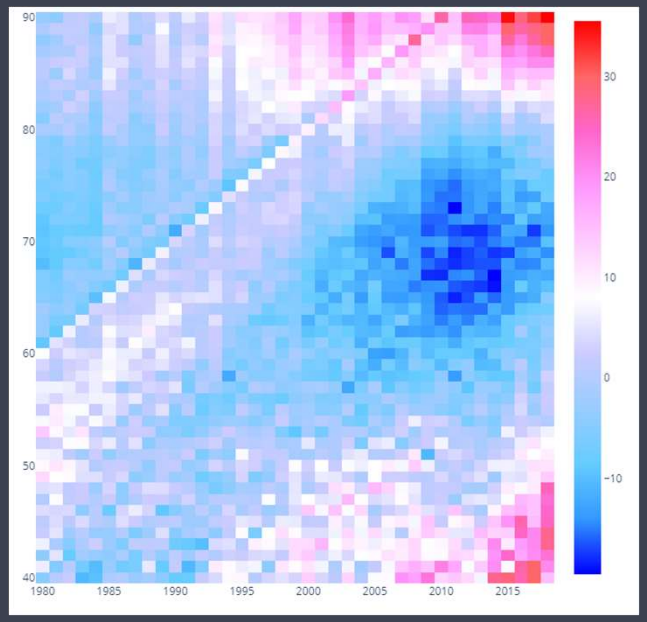
Historical Mortality Improvements, structure-free,1980-2019

Showing deviations from fitted plane to log-mortality rates in percent



UK males
1980-2019
ages 40-90

Avg. MI **2.11%**



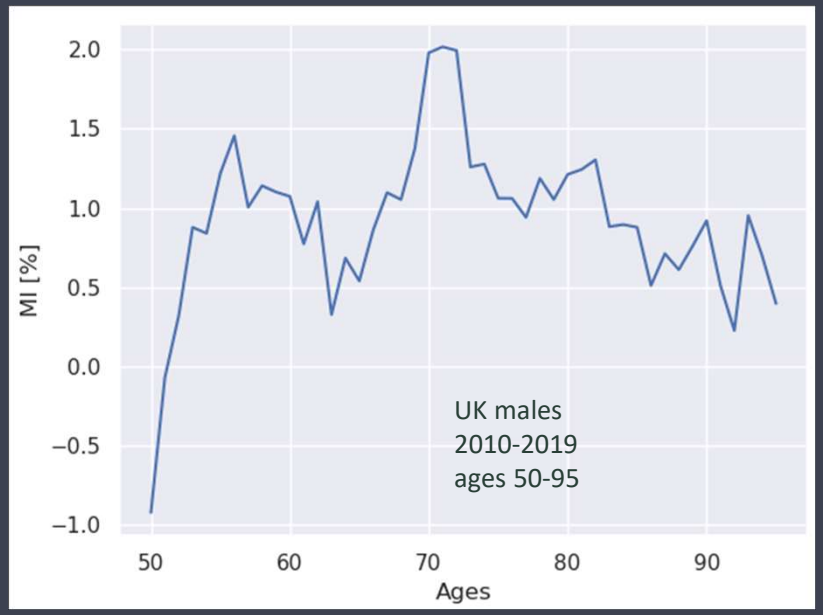
UK females
1980-2019
ages 40-90

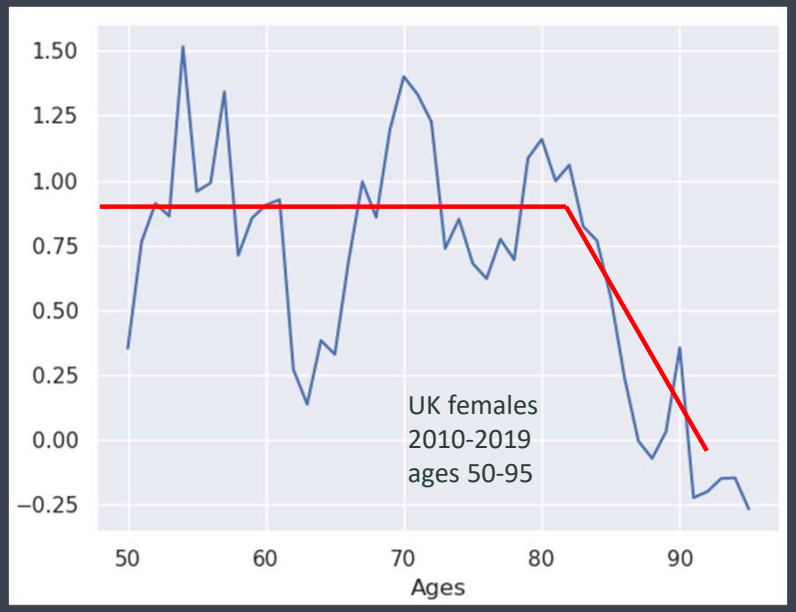
Avg. MI **1.72%**

Data source: mortality.org

- Strong overall mortality improvements over past decades
- Slow down of improvements since around 2010 – in particular by younger cohorts born 1970+, which presumably will carry **worse mortality to higher ages**

Historical Mortality Improvements, structure-free, 2010-2019





- UK females currently confirm the commonly applied long-term pattern (red line, illustration)
- Despite being one of the oldest mortality models, the **Lee-Carter** model is a good choice for analysing historical trends

Future Mortality Improvements Benchmarks

Benchmark	Mortality improvement	Age grading start	Age grading end	Time
US SSA	0.85%	65+	100+	Data up to 2019
US Technical Panel	1.30%	65+	100+	Data up to 2019
Canada SS	0.80%	90	100+	Data up to 2015
UK ONS	1.20%	90	110	Data up to 2019
US SOA MIM 2021	1.35%	65+	110	Data up to 2019
US SOA 2019 Survey	0.73%	75+	100+	Conducted 2019
US SOA 2022 Survey	0.76%	75+	100+	Conducted 2022
Canada CIA	1.00%	90	105	Data up to 2013
Netherlands AG2020	1.70%	75	120	Data up to 2019

This table shows our interpretation of publicly available information

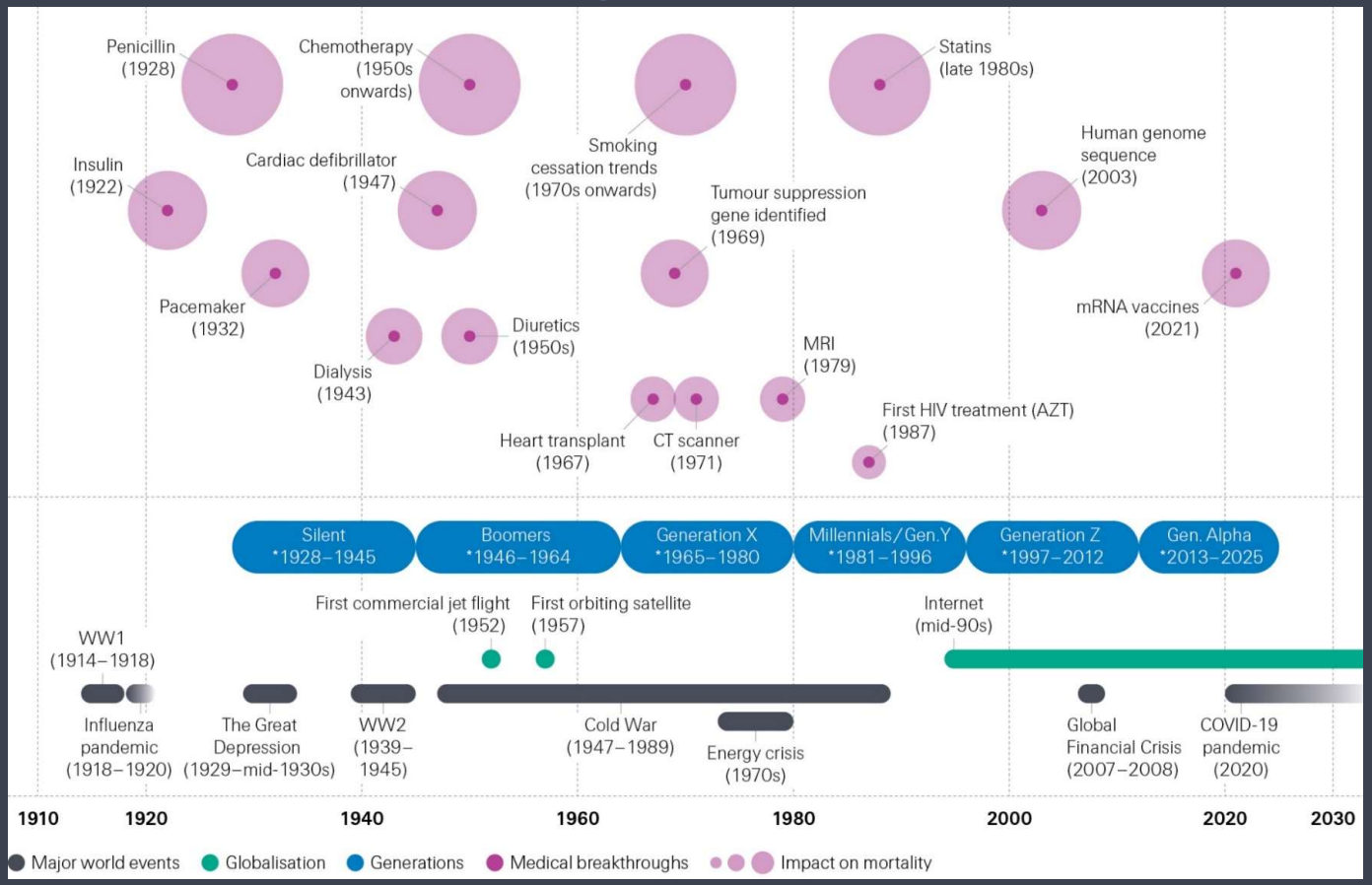
Considerations for long term mortality trends

Cyclicality

Socio-economic divergence

Medical & lifestyle factors

A century's worth of progress and setbacks to extending lifespans



Great strides

Disruptors

Three main causes of death

Cardiovascular diseases

- Vast improvements over the last few decades
- Behavioral factors and secondary societal/policy changes

Cancer

- Incremental cancer improvements are likely to be greater than CVD
- Treatments become more personalized to treat an individual's cancer type.

Ageing & neurodegenerative diseases

- Positive changes are expected in a 20+ year time frame
- Shared common baseline risk factors

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Cardiovascular disease

Gains of the past

Major cause of death

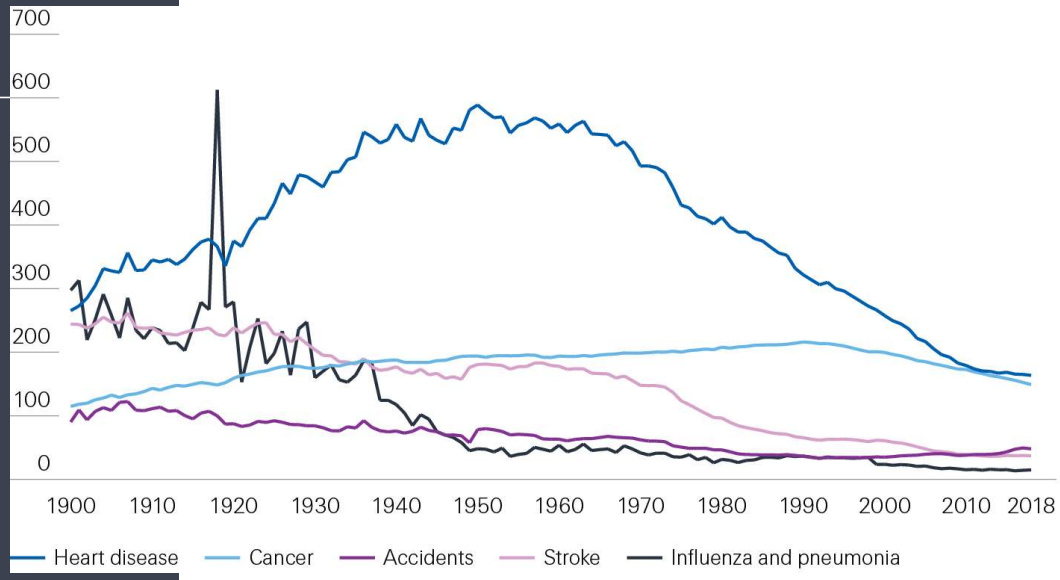
Heart disease related deaths have been a on a steady decline since the 1970s

New drugs

Anti-hypertensives and statins (1980s) reduced premature mortality

Smoking cessation

Boosted longevity as a single greatest lifestyle factor change of the 20th century



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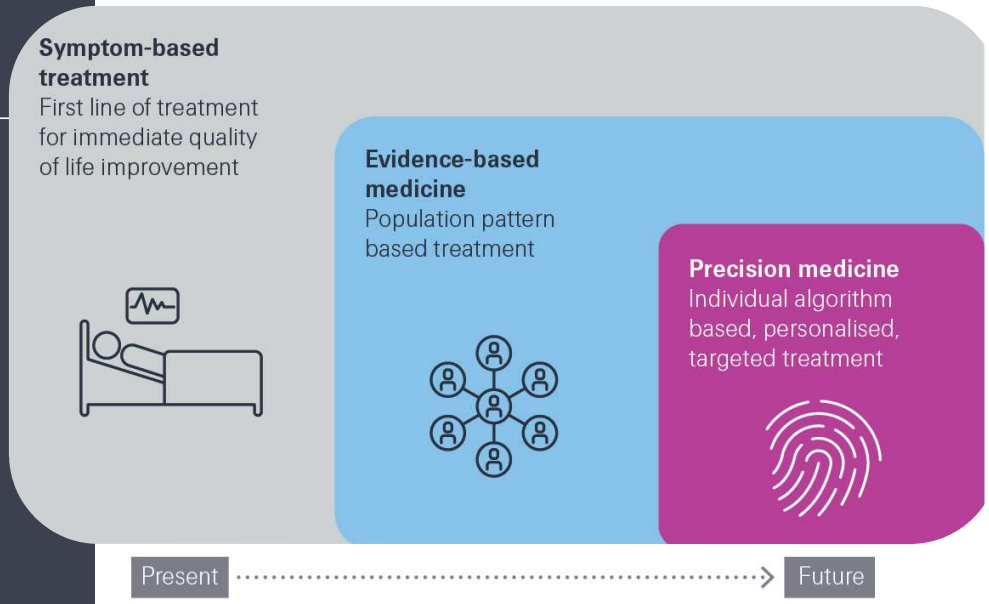
Cancer

Shifting towards precision medicine

Screening
AI and tech to propel monitoring and aid faster diagnosis of certain cancers

Diagnostics
Liquid biopsies to supplement existing tissue biopsies

Treatments/therapies
Key avenues for personalized medicine in cancer therapies – mRNA vaccines & immunotherapies (T-cell strategies)



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Neurogenerative disease

New ageing challenges

Alzheimer's disease

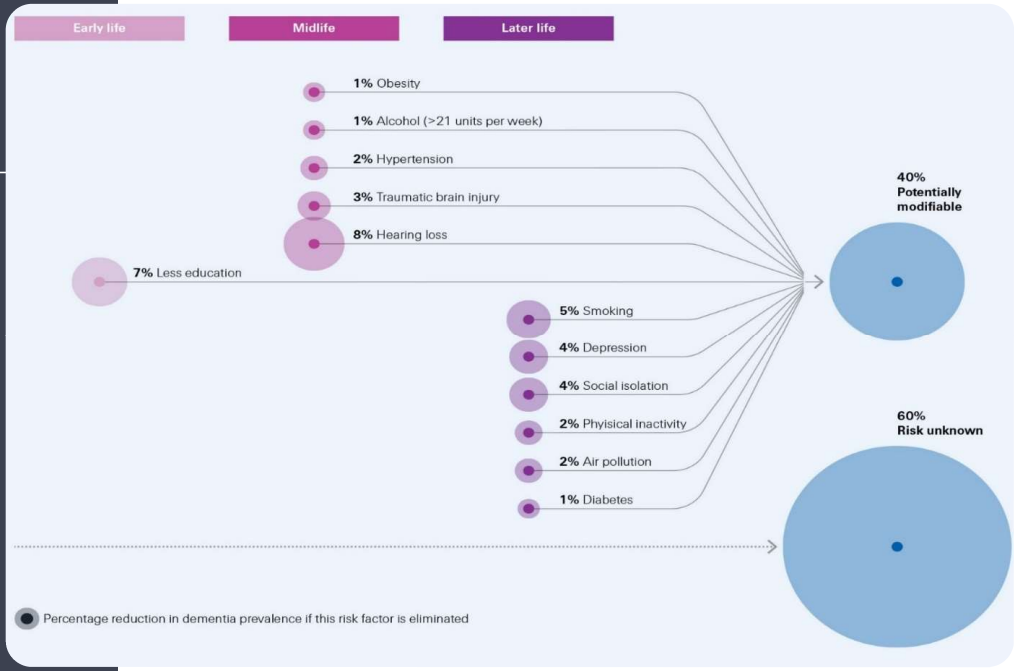
Remains the leading cause of dementia

Dementia – a modifiable risk?

40% are potentially modifiable or avoidable behaviors and activities throughout life.

Remaining risks are unknown

Likely comprising genetic factors, as yet unidentified lifestyle factors and other determinants



Source: *Dementia prevention, intervention, and care: 2020 report of the Lancet Commission* - The Lancet, reproduced by Swiss Re

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Lifestyle factors

Metabolic health

- All-encompassing term for obesity, hypertension, high triglycerides and cholesterol and high blood sugar.
- Obesity and diabetes are on the rise - major contributors to a various causes of death and premature mortality

Personal health monitoring

- Despite new medications, focus is shifting to the role of physical health alongside nutrition
- Technological developments expected to improve how people interact with their health - wearables monitoring physical activity, sleep and other real-time health metrics such as continuous glucose monitoring

Detractors of health

- Smoking rates have generally been on the decline, there has been some uptick noted in vaping amongst younger groups – long term implications unknown
- Opioid epidemic continues within certain strata of US society

Emerging risks

Navigating the potential challenges of tomorrow

Ongoing monitoring and vigilance will remain important for continued assessment of threat levels and impact

Climate change

- Three key drivers (extreme heat, air pollution and vector-borne diseases)
- Increased risk in vulnerable populations
- Direct exposure, sensitivity to risk factors, adaptive capability and access to mitigation tools, determine overall risk

Antimicrobial resistance

- Global public health concern
- Infections harder to treat -potentially fatal outcomes such as sepsis
- Pronounced risk in vulnerable populations
- Limits further treatment options, increases healthcare costs and reduced effectiveness of heath interventions

Others

- Zoonotic diseases: Animal-to-human spill over from wildlife more frequent. Climate change exacerbates this
- Social disruption and war risk are elevated
- Reducing investment in health

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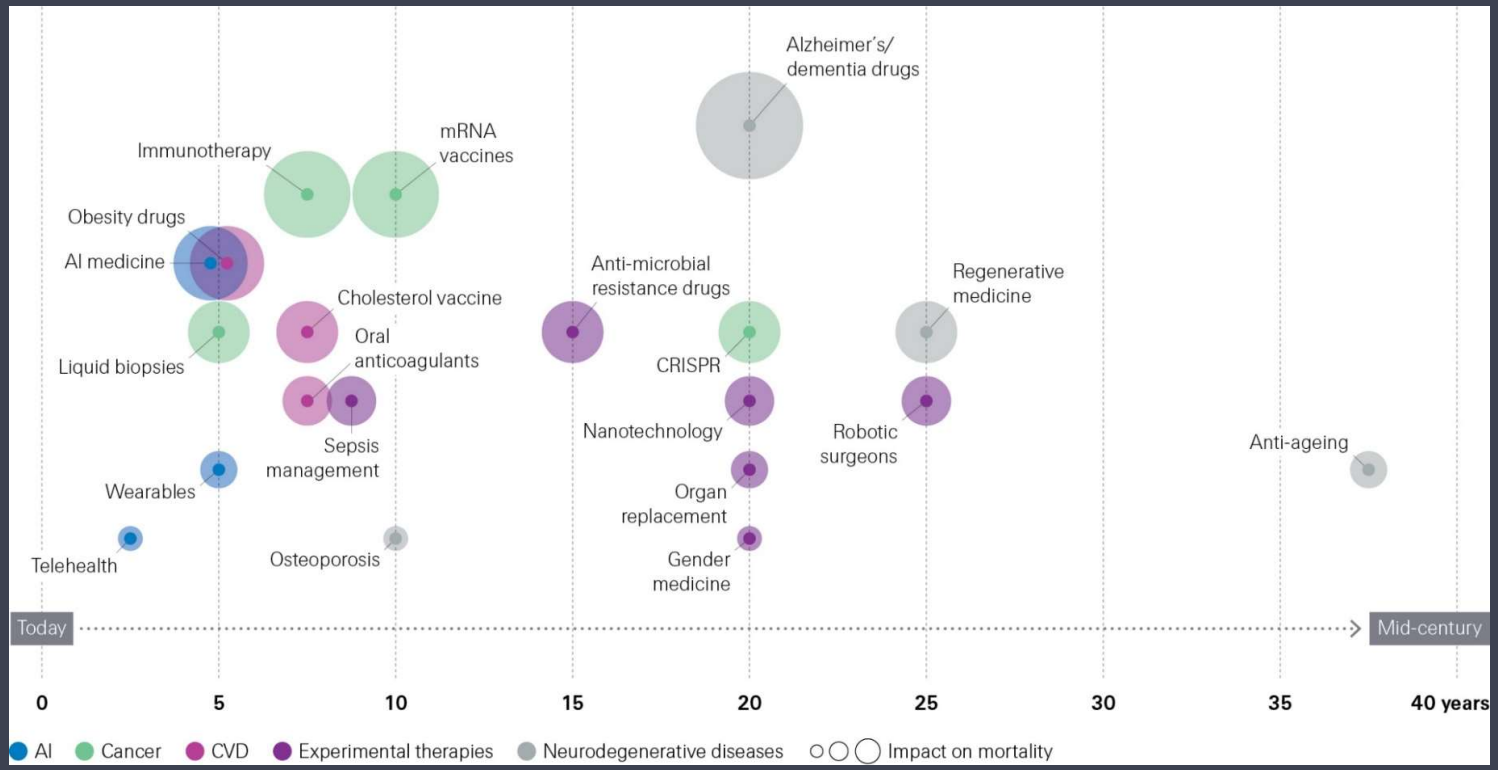
Future medical advancements: many promising technologies but timing & uncertainty is high



Tech progress

Long timelines

Outlook for mortality improvements

Ian Collins and Mike Wilson
Pacific Life Re

PACIFIC LIFE RE

NHS under pressure:

What does it mean for mortality?

Ian Collins & Mike Wilson

Background: understanding 2022

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A UK case study

- Despite a waning contribution from COVID-19 the UK suffered a sustained period of excess deaths for most of 2022 including a spike in December coinciding with well-publicised pressures on the NHS

The 'NHS crisis'

- There is clear evidence that the NHS' ability to deliver core services was compromised in 2022 e.g. long ambulance response times and high A&E wait times
- In the immediate aftermath of these events PL Re conducted research to consider links between worsening delivery of care and significant patient outcomes, especially deaths

Goals of this presentation

- To share our findings and highlight the complex factors that we believe were at play

What is 'the NHS'?

NHS
NHS SCOTLAND
GIG CYMRU NHS WALES
HSC Health and Social Care

The defining feature of all of these is that they are **free at point of use** and '**single payer**', meaning a single public system covers all costs. Funding is almost exclusively (i.e. 99%) from general taxation and National Insurance contributions

Four key questions

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In our research we sought to address the following:

- **Key question 1**: **Have there been excess deaths in the UK in 2022**, to what extent, and over what period?
- **Key question 2**: **Has there been an 'NHS crisis'** and to what extent might this have contributed to observed patterns of mortality?
- **Key question 3**: What **other competing or contributory causes** might also impact recent mortality?
- **Key question 4**: **What are the implications for Insurance companies?**

1: Have there been excess deaths in the UK in 2022?

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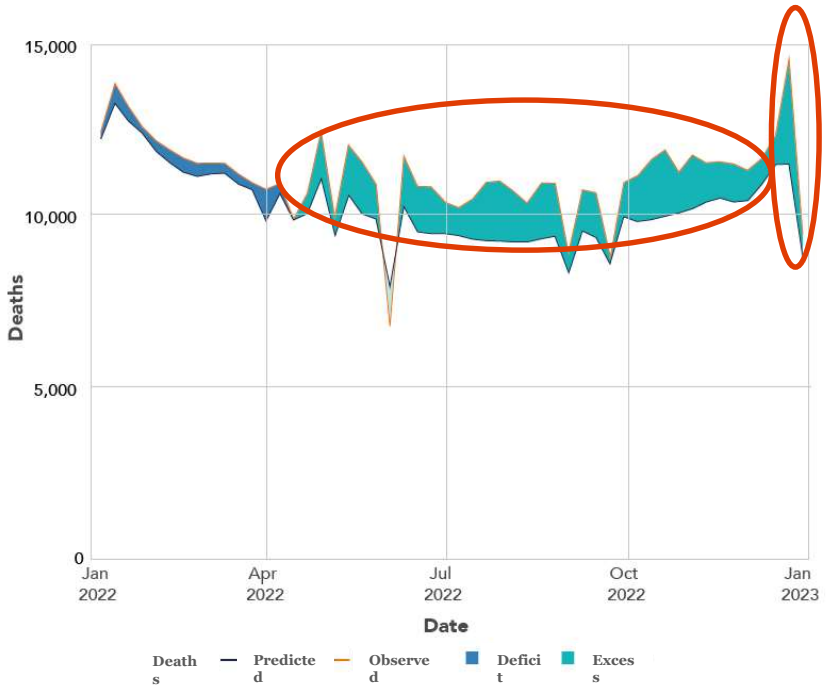
- The UK has been in a period of excess deaths almost continuously since April 2022.
  - Excesses increased further during a brief period in December 2022
  - but have since returned to the lower excesses of the previous months
- Excess deaths were most significant at **younger (i.e. protection) ages** relative to the baseline implied by our internal pricing assumptions
- However, part of this reflects the fact that our expectations for 2022 had already been adjusted to allow for significant higher mortality at the older ages as a result of the pandemic
  - The chart to the right uses a less heavily adjusted baseline to make the picture clearer [1]



1. Predicted deaths are forecast from a GLM fitted to weekly data from 2010-2019 that allows for population growth and aging, linear trends in mortality, major influenza outbreaks and reporting patterns in weeks affected by bank holidays.

2. Has there been an 'NHS crisis'?

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Highly visible evidence of **acute** system failure in December 2022:

- Ambulance response times at record levels
- Waiting times within A&E exceptionally high
- Long trolley waits (i.e. admission from A&E to hospital)
- High bed occupancy levels
- Increasing % of patients ready for discharge

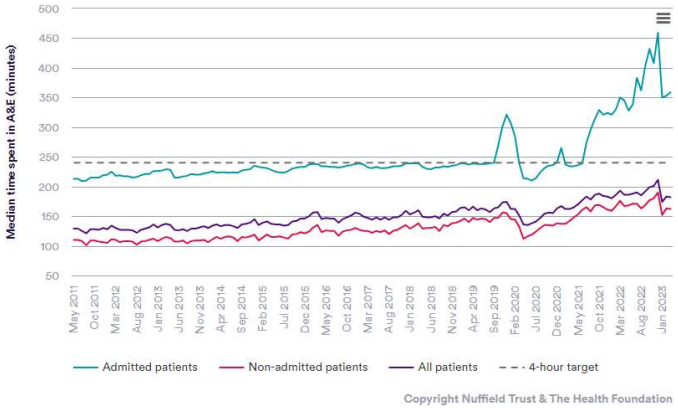
The NHS shows signs of '**acute on chronic**' problems impacting delivery of services:

- i.e. recent stresses must be seen in the context of longer-term issues reducing resilience to stress
- Unprecedented size of treatment waiting lists and wait times

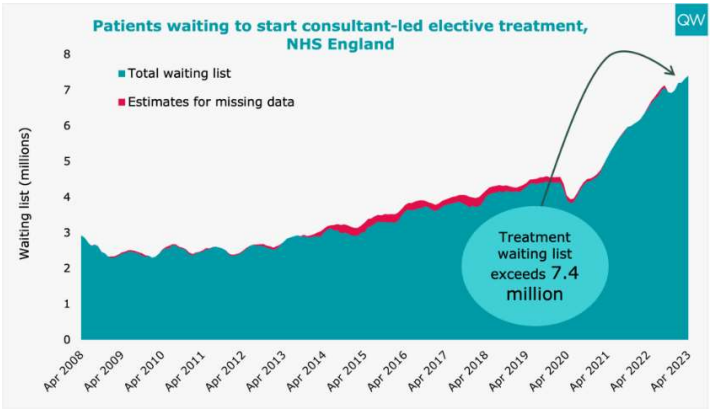
This occurs in the context of **longer-term** issues:

- An ageing population demanding more services
- Spending high but barely keeping up with increased demand
- Reduction in bed capacity
- Pressures on staffing numbers (and morale)

A&E waiting times, England, 2011-2023



NHS England Elective Treatment Waiting List, 2008-2023



2. Has the NHS Crisis caused deaths?

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Several estimates of impact based on a single study from Royal College of Emergency Medicine

- Based on all-cause mortality within 30 days
- Increasing mortality for wait times over 4 hours
- More mortality for longer waits
- 1 additional death for every 72 patients waiting 8 to 12 hours prior to admission

Typical estimates of **250-500 'additional' deaths per week** during the peak of the crisis

These figures **are not** estimates of excess deaths attributable solely to the NHS

- Some deaths from these causes are in baseline
- Some deaths have other causes

Projected impact of A&E wait times on 30-day all-cause mortality

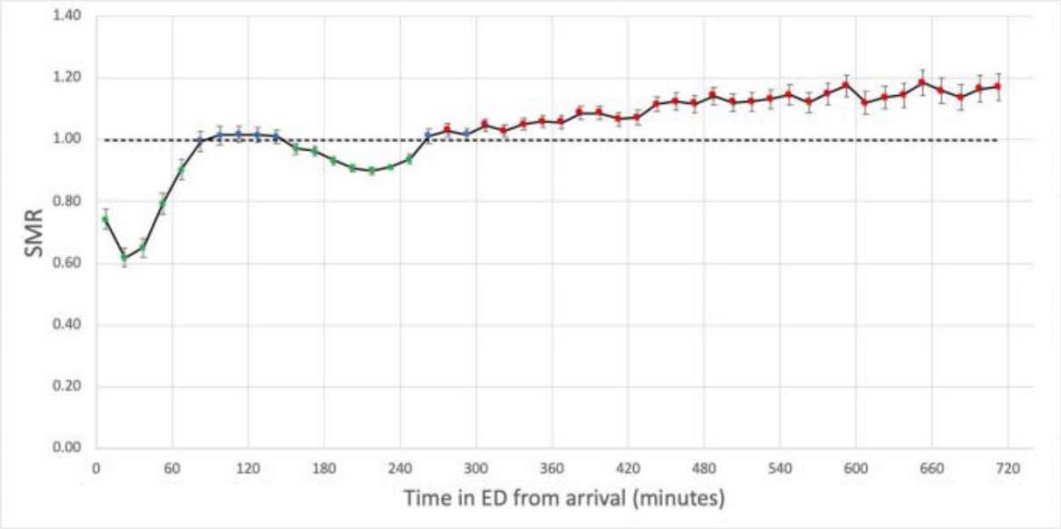

Figure 1 Thirty-day standardised mortality ratio (SMR) referenced to duration in an emergency department (ED) from time of arrival.

Source: Mason S, Knowles E, Boyle A. *Association between delays to patient admission from the emergency department and all-cause 30-day mortality.* Emerg Med J. 2022;39(3):168-173

3. Other competing or contributory causes – short term

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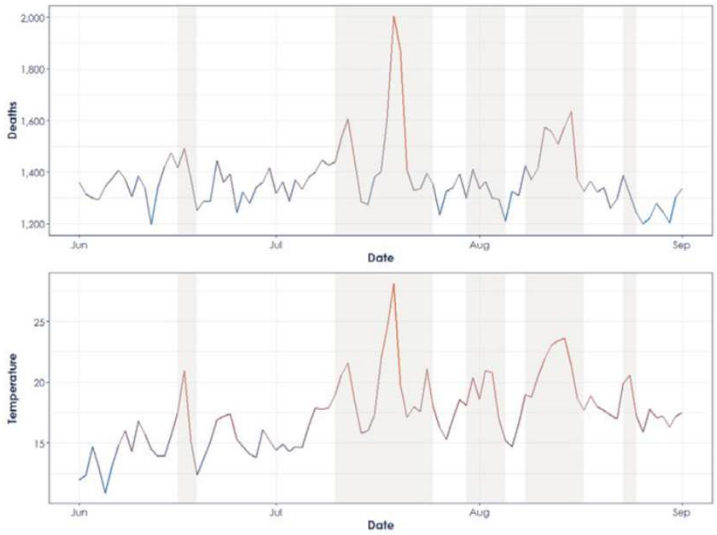
Two notable **extreme weather** "events" during 2022:

1. 2022 contained extended periods of extreme heat by UK standards[1]



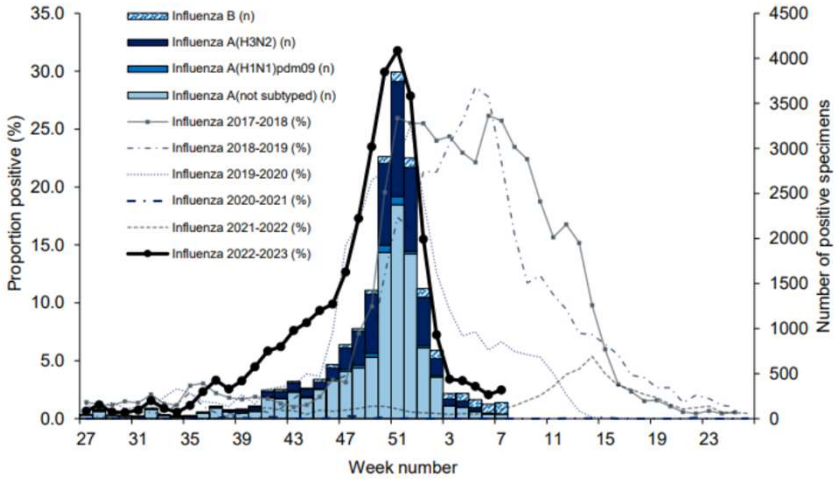
2. Mean CET was below 0 Celsius for 10 consecutive days between 10 and 19 December

1. Central England Temperature >20C in shaded periods

An early return of seasonal **Influenza**:

- Sharp early peak but otherwise not atypical in terms of overall infection rates
- High hospitalisation rates coinciding with cold weather period and RSV infections

Figure 10: Respiratory DataMart samples positive for influenza and weekly positivity (%) for influenza, England



3. Other competing or contributory causes – long term

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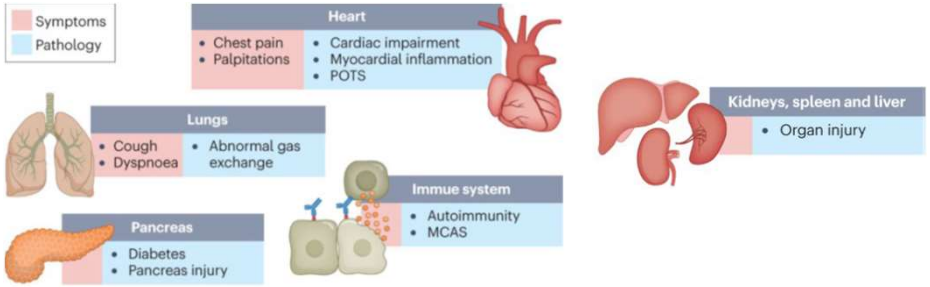
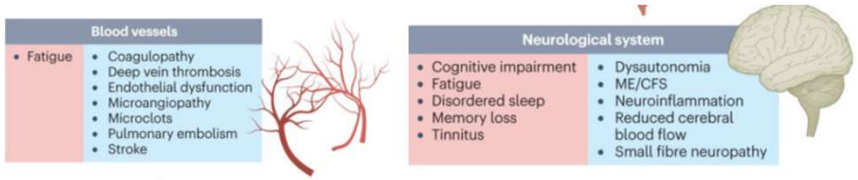
Long COVID & other indirect impacts:

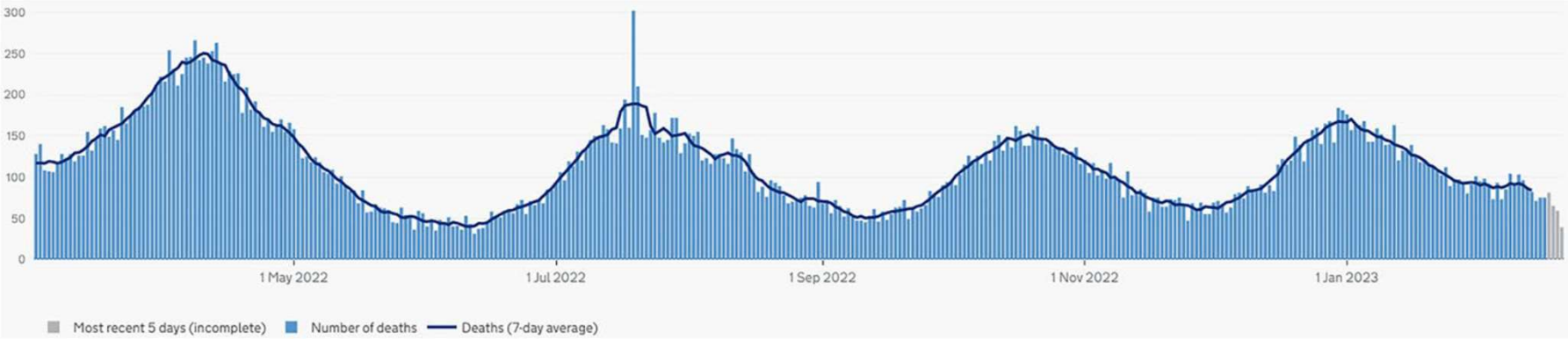
- Lasting organ damage often following hospitalisation e.g.:



- Complex syndromes of disabling conditions including fatigue, pain, 'brain fog'



Acute COVID-19 set to become endemic:
Four waves since Spring 2022:



3. Other competing or contributory causes – long term

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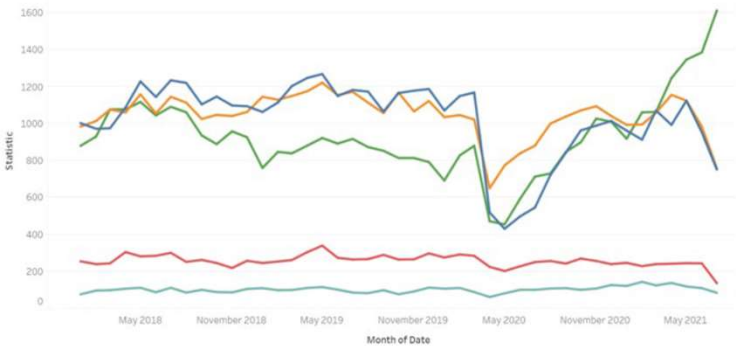
Legacy of missed diagnoses & delayed treatments

- Around 50,000 fewer **Cancer** diagnoses leading to latent untreated conditions and worse outcomes

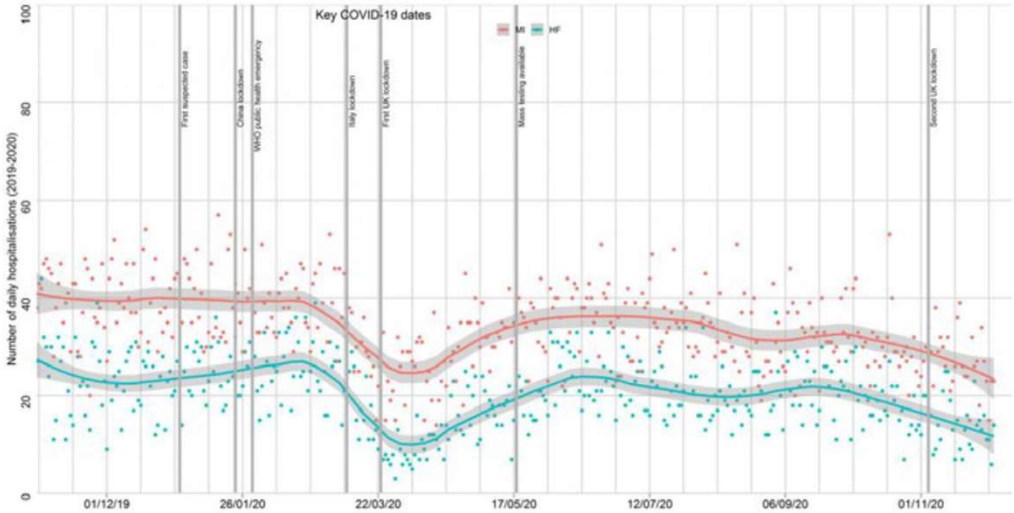


Example: breast cancer

Demographic
- Stage 1
- Stage 2
- Stage 3
- Stage 4
- Unknown

1. British Heart Foundation

- Impacts on incidence of **heart attack** (red) and **heart failure** (blue) in the early stages of the pandemic



- The impact was mostly seen in fewer NSTEMIs (a less severe type)
- Perhaps around 10,000 each of heart attacks and strokes 'missed' during that period

3. Other competing or contributory causes - overview

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Nature of Driver		Contributory Cause	Estimated Materiality of Impacts – General Population: **Excess Mortality** April 2022 → Nov 2022	Estimated Materiality of Impacts – General Population: **Excess Mortality "Spike"** December 2022
Short Term	Immediate Causes	Extreme weather	Prolonged heatwaves Summer 2022	Cold snap mid-December
		Influenza, RSV etc.		Wave slightly earlier than normal and coincided with COVID-19 wave
		Cost of Living crisis	Exacerbated extreme weather impacts	Exacerbated extreme weather impacts
		Nursing / Ambulance strikes		Low impact, so far
	COVID-19	Acute COVID-19	Four waves since Spring 2022	Coincided with 'flu and cold
Long Term		Long COVID (PASC)	Subset of severe cases; i.e., not those with milder symptoms	Exacerbated extreme weather & respiratory impacts
		Missed Cancer / Cardio treatments	Especially cardiovascular causes Limited evidence of higher cancer mortality	Exacerbated by high-impact factors
		Vaccines	Protective benefits greatly outweigh potential damage	
	Behavioural	Obesity	New obesity not yet impacting mortality	
		Alcohol	Significantly increased sources of mortality since 2021. Alcohol more material.	Increased ill-health adds stress to system. Increased stress to system impacts provision of care
		Drugs		
		Mental health	No discernible impact so far	More pressure on Mental Health care
	Structural	Demographics	These factors reduced resilience of health service to stress over the longer-term	
		Funding		
		Staffing		

Mortality Impact Key

- High
- Moderate
- Modest
- Low
- n/a

4. What are the implications for insurance companies?

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Nature of Driver		Contributory Cause	Estimated Materiality of Impacts: General Population: Apr - Nov	Estimated Materiality of Impacts: General Population: Dec	RISK FILTRATION	Risks adjusted for Insured Lives 2022: After Socio-economic adjustment	Risks adjusted for Insured Lives 2022: After accounting for U/W Benefit (New business only)
Short Term	Immediate Causes	Extreme weather				Wealth correlates with ability to regulate temperature	Underwriting ineffective
Short Term	Immediate Causes	Influenza, RSV etc.				Better 'flu vaccine take up	Minimal impact from underwriting comorbidities
Short Term	Immediate Causes	Cost of Living crisis				Worst affected likely not insured	n/a
Short Term	Immediate Causes	Nursing / Ambulance strikes					n/a
Short Term / Long Term	COVID-19	Acute COVID-19				Unusually, parts of 2022 saw worse excesses among wealthy	Protection against current cases, and some comorbidities associated with worse outcomes
Long Term	COVID-19	Long COVID (PASC)				Worst outcomes correlate with comorbidities/obesity	Risk factors for mortality believed to correlate with typically declined cases
Long Term	COVID-19	Missed Cancer / Cardio treatments				Cancer relatively significant for insured lives	Good protection only if significant condition has manifested
Long Term	COVID-19	Vaccines				Insured book better protected	n/a
Long Term	Behavioural	Obesity				Existing obesity lower	Worst cases rated/declined
Long Term	Behavioural	Alcohol				Some socioeconomic protection	Some protection, but misrepresentation common
Long Term	Behavioural	Drugs				Mostly uninsured	Strong protection
Long Term	Behavioural	Mental health					Some protection, but misrepresentation common
Long Term	Structural	Demographics				Wealthier/healthier groups tend to need health services less	n/a
Long Term	Structural	Funding					
Long Term	Structural	Staffing					

Mortality Impact Key
High
Moderate
Modest
Low
n/a

4. What are the implications for insurance companies?

PACIFIC LIFE RE

The report recommends a number of actions:

Review trend assumptions

Review key assumptions over 2023 in light of potential impacts relating to:

- recent period of excess deaths for **mortality** business
- interrupted patterns for **Critical Illness** business

Experience analysis

Difficult decisions regarding the appropriateness of including each of 2020-2022 in any forward-looking assumption setting.

- The profile of acute COVID-19 deaths on 2020-21 are not essentially a strong predictor of the near future….
- ….it is harder to ignore 2022.
- Ignoring all 3 years leaves a large gap and heavily reduces credibility

Trend stresses

To the extent that recent years imply an increase in the uncertainty of predicting mortality and morbidity rates into the future, a review of trend stresses may become necessary.

- However, it may need a sustained increase in annual volatility in order to justify such a change depending on the approach taken to modelling trend stresses

Summary of key points

PACIFIC LIFE RE

Key facts at a glance...

In 2022, we believe the NHS crisis plausibly contributed to... ...between 1/4 – 1/2 of excess deaths

Average ambulance response times rose from 20-25 mins pre-pandemic to over 90 mins in December

1 in 10 people waited over 3½ hours for an ambulance in December
a 50% increase since 2019

The number of patients, waiting over 12 hours to be seen exceeded 50000 in a week for the first time late in 2022

Bed occupancy reached 96.9% in early January the highest level ever recorded

In August 2022 it was estimated that 13% of all beds were occupied by patients medically fit to be discharged

The ONS estimate 3-4% of all people in the UK each had COVID-19, influenza and RSV all at roughly the same time in December

The WHO estimates 1/3 of global excess winter deaths relate to cold homes
Cold weather is associated with increased respiratory and cardiovascular deaths

COVID-19 was the 6th leading cause of death in England in 2022 and is also associated with additional deaths from cardiovascular causes

Demand for NHS services is estimated to be 10.5% higher in 2028 than 2018 reflecting population growth & ageing

In 2021/22 1.5 million people worked in adult social care compared with 1.2 million people working in the NHS
However, the social care sector typically receives far less funding than the NHS

Access the full report

Health of the Nation:

Pressures on the NHS

Questions

Comments

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

Continuous
Mortality Investigation

Institute and Faculty of Actuaries

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19 July 2023