Climate forecast: Looking beyond net-zero mortality predictions

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Climate change and the transition actions responding to it have a host of compounding and conflicting impacts on mortality. It's easy to assume that they all wash out to around zero overall for life insurers but watch out for uneven reinforcing factors and complicated interconnecting effects. In this article we share our initial findings from building a prototype causal model to explore the interactions of various climate and socioeconomic factors on excess mortality.

Mortality risks from a changing climate and secondary impacts

When considering the impact of climate change on mortality, some factors come to mind more easily than others—namely direct impacts on deaths as a result of dramatic events such as floods, extreme heat waves and wildfires. But whilst the direct factors typically make the news, the longer-term impacts and indirect factors may be of greater influence. A recent US study compared the official government statistics of 24 direct deaths following a tropical cyclone with a measurement of 7,000 -11,000 excess deaths when the longer-term impacts are considered.[1]

These longer-term, second-order impacts may occur as a direct result of extreme weather events—think waterborne diseases from wrecked sanitation systems and floods, overwhelmed healthcare systems during a disaster and destroyed infrastructure which cannot supply food, water or essential items. Other second-order impacts on mortality could be linked to more indirect factors, namely pandemics from reduced biodiversity as a result of a changing climate or changes in the long-term availability of food and water from droughts.

Less dramatically, climate change may have a more gradual population-wide impact, e.g., higher temperatures and wildfires magnifying air pollution leading to chronic health problems and diminished liveability of outdoor space, reducing activity levels. Impacts may not all be negative—the last few decades have seen a global reduction in cold-related excess death ratios.[2]

1. Stanford Report (2 October 2024). Study links hurricanes to higher death rates long after storms pass. Retrieved 2 February 2025 from https://news.stanford.edu/stories/2024/10/study-links-hurricanes-to-higher-death-rates-long-after-storms-pass.

2. Zhao, Qi et al. (2021). Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: A three-stage modelling study. The Lancet. Retrieved 2 February 2025 from https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00081-4/fulltext.

At the same time, the green transition could have its own set of influences, possibly with positive outcomes: healthier diets, walking- and cycling-friendly cities; reduced air pollution in cities from lower emissions;[3] and more resilient infrastructure. Albeit some transitions may be negative—for example, potentially worse diets due to the greater difficulty and expense of sourcing nutritious food and a greater reliance on ultraprocessed foods.

Adding to the complexity, all these aspects will interconnect with prevailing macroeconomic and social factors. The National Health Service (NHS) is facing severe capacity pressures as a result of record demand, post-COVID-19 backlog, an ageing population and inflation.[4] Some of these issues could well be exacerbated by climate change, namely inflation and demand for healthcare. At the same time as a changing climate, the UK population will continue ageing with a projected 22 million people aged 65 or over in the UK by 2072; up from around 13 million people aged 65 or over in 2022.[5] The nation's general economic state could also impact the availability of healthcare and general health. This has the potential to create a feedback loop as poor health reduces productivity, adding further economic strain to a system that could simultaneously be struggling with shocks from climate change and potentially fundamental changes in the job market due to artificial intelligence (AI).

Understanding how these impacts interconnect and how they could affect any specific country is a tricky task. Moreover, analysis on the impact of climate on mortality has tended to focus more on single drivers, e.g., heat, and direct impacts from climate, often stopping before getting to second-order impacts and interactions with macroeconomic and social factors. At Milliman we have researched the development of a causal model to look more holistically at the impact of a changing climate on mortality. We also considered second-order impacts and interactions. Our research has resulted in a protype model that has allowed us to examine the degree to which conclusions of modest impacts on mortality would be robust and areas to investigate that could lead to different outcomes.

Exploring how climate risk drivers affect mortality

Causal modelling techniques are particularly well suited to examining interconnections and second-order impacts. A causal model aims to capture how a system operates by placing the modelling emphasis on causal links between different factors, assessing how they interact and interrelate. In this, a causal model allows us to explore offsetting and amplifying factors.

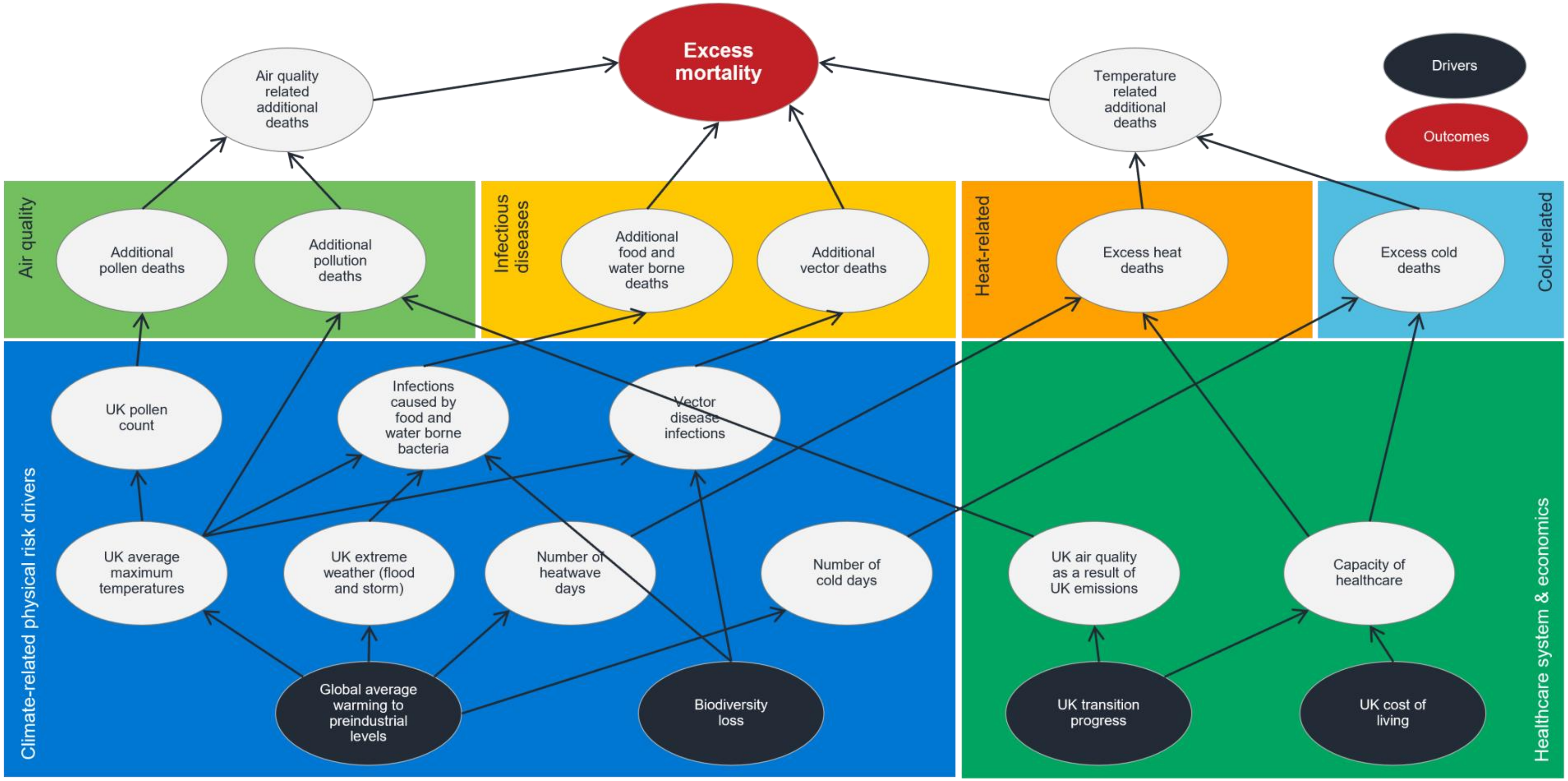
The model we have developed is a prototype for attempting to get to grips with the complexity of climate-related mortality drivers and second-order impacts. It was developed based on desktop research to define the structure of the model and determine the key climate-related mortality influences to include within the model. There are of course multiple other factors and influences that could have been included, but our aim for this prototype model was to focus on a few key variables. Future iterations can be extended to include additional drivers and interactions. Calibration was performed through a combination of desktop research and expert judgement for the UK market. This resulted in the causal model shown in Figure 1.

3. A further example of the interconnectedness of risks is seen in studies showing that reducing air pollution (in the form of aerosols) may amplify global warming. See, e.g., Hansen et al. (2023), Global Warming in the Pipeline, available at https://academic.oup.com/oocc/article/3/1/kgad008/7335889.

4. Powell, T. et al. (16 July 2024). Capacity pressures in health and social care in England. UK Parliament. Retrieved 2 February 2025 from https://commonslibrary.parliament.uk/capacity-pressures-in-health-and-social-care-in-england/.

5. Barton, C. et al. (16 July 2024). The UK's changing population. UK Parliament. Retrieved 2 February 2025 from https://commonslibrary.parliament.uk/the-uks-changing-population/.

FIGURE 1: STRUCTURE OF THE MILLIMAN CLIMATE MORTALITY MODEL



Source: Milliman

The structure of our model was deliberately specified to be able to explore climate pathways with future increases in global average temperatures ranging from +1°C to +3°C relative to the 1986-2006 period. The scenario projections underlying these temperature changes broadly align to a Network for Greening the Financial System (NGFS) net-zero scenario through to its "hothouse" world scenarios. These global average temperatures were translated into plausible corresponding UK average temperatures and extreme weather events using insights from the Climate Analytics climate impact explorer.[6] It is critical to model local impacts relevant to mortality groups because local climate variations, and particularly impacts on extreme temperature, differ considerably.

The UK climate will be influenced by global emissions. However, there are other non-weather factors that could impact mortality. For example, air pollution, which will depend on both temperatures and local transition away from burning fossil fuels. Therefore, the model also makes allowance for other factors separate from weather, such as UK transition progress, UK healthcare capacity and levels of biodiversity loss globally.

Each of the drivers can take on different states and it is through driver-state configuration that we are able to explore different scenarios within the model:

- As mentioned above, global average warming to preindustrial states ranges from +1°C to further global warming of +3°C from a base case, where the base case is the counterfactual state in the model.
- Biodiversity loss has been calibrated as low, medium and high; with low representing the current level of biodiversity globally.
- The UK's progress in transitioning to a net-zero economy is rated on a scale from 1 to 5, with 1 signifying the current level of policies and regulations, and 5 being the state of net zero.
- The UK's cost of living as an indication of inflation levels in the local economy ranging from low to high.

Excess mortality in the model is influenced by three main factors: air quality, extreme temperatures and infectious diseases. These main factors are linked to exacerbating factors in the physical environment and changes in economic and social factors, with the impact flowing through to a distribution of excess deaths as the outcome of the model.

Naturally, each of these factors is interconnected, and there are anticipated ways that these could co-occur, but odd combinations are possible, e.g., a future where the UK reaches net zero but limited global action leads to a hothouse world, or where biodiversity is overlooked and climate action prevents the worst temperature rises but does not prevent a nature collapse with related mortality implications. Scenarios can be created acknowledging the likely connections between these settings, but also looking for unexpected interactions.

How do you calibrate a model like this?

The sheer scale of the model does make calibration a challenge, with a range of research and data sources necessary to understand likely causal impacts. From previous experience with similar climate models, narrowing down the use case for the model does help simplify the calibration to some degree—in this case we have calibrated the model for the UK and its general population.

To illustrate our approach, we have set out below the high-level steps taken to calibrate the model for cold-related deaths:

- Met Office data can tell us the number of days with frost and the average minimum temperature over each winter flu season.[7]
- Statistics compiled by the UK Health Security Agency estimate the number of deaths attributable to influenza, COVID-19 and cold weather for each flu season between 2012 and 2024. Note that, in order to assess cold weather impacts rather than pandemic impacts, the winters from late 2019 to mid-2022 are removed from the analysis.[8]

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6. See the Climate Analytics climate impact explorer at https://climate-impact-explorer.climateanalytics.org/impacts/?region=GBR&indicator=tasmaxAdjust&scenario=h_cpol&warmingLevel=3.0&temporalAveraging=annual&spatialWeighting=area&compareYear=2030.

7. Met Office. Historic station data. Retrieved 2 February 2025 from https://www.metoffice.gov.uk/research/climate/maps-and-data/historic-station-data.

8. Gov.UK (20 January 2025). Official Statistics: Surveillance of influenza and other seasonal respiratory viruses in the UK, winter 2023 to 2024. Retrieved 2 February 2025 from https://www.gov.uk/government/statistics/surveillance-of-influenza-and-other-seasonal-respiratory-viruses-in-the-uk-winter-2023-to-2024/surveillance-of-influenza-and-other-seasonal-respiratory-viruses-in-the-uk-winter-2023-to-2024#mortality.

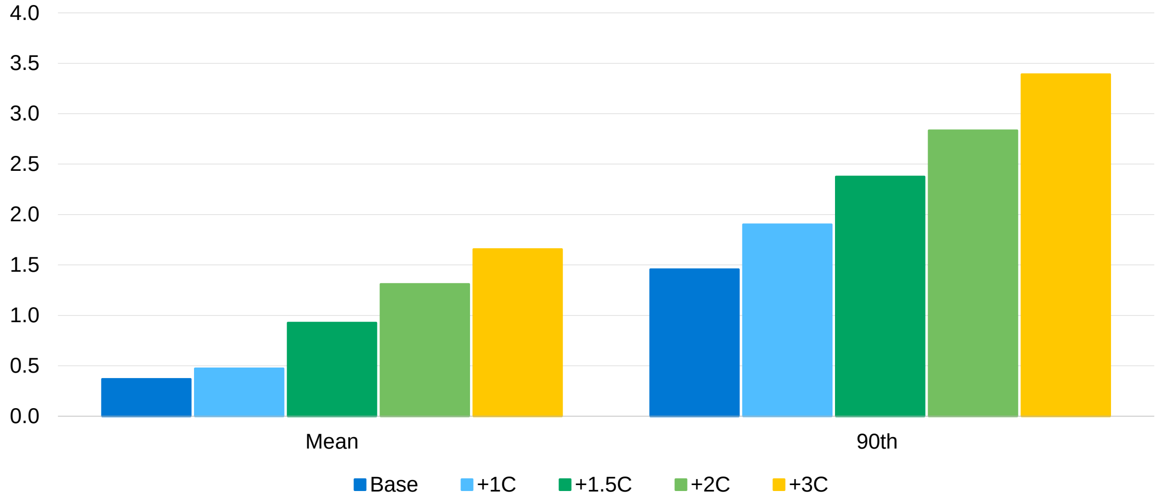
- From this we can explore what is a good proxy prediction of excess mortality due to cold weather—it turns out that the number of frost days has had a higher correlation with excess deaths than the variation of average temperatures in winter months alone.
- We can therefore calculate the average excess deaths for different levels of winter severity (e.g., when there are less than 10 frost days, 10-20 frost days etc.). These averages are used as the mean for a set of truncated normal distributions, one for each winter severity scenario. The standard deviations were set by expert judgement.
- Research by the UK Climate Resilience Programme provides an estimate of how many frost days (under 0°C) the UK could expect in a world with different levels of global warming.[9,10] The model is therefore configured such that the choice of warming level determines which distribution is used to model excess deaths.
- Mortality in the UK is also affected by the state of the UK healthcare system. This is modelled by a scalar affecting the distribution mean, increasing expected deaths when the system is strained, typically during winter, and reducing them when the system is running well. This scalar was set by expert judgement in consultation with Health practice experts within Milliman.
- Some further specific adjustments were made—for example, winter deaths have been normalised to remove the baseline level of winter deaths seen in a typical year in the UK such that the level of excess deaths is captured.

Similar steps were taken to connect the other factors within the model. While imprecise, these linkages illustrate a general scale and direction of impact, which allows us to explore different scenarios.

Initial model insights: Temperatures and pandemics

Initial analysis from the model indicates a gradual increase of, on average, +30% excess deaths for the factors included in the model across the distribution, per degree of increase in global average temperatures. The degree of transition of the UK economy, impacting pollution levels and healthcare funding, has an insignificant impact within our current model on the overall level of additional deaths from climate-related factors in the UK.

FIGURE 2: EXCESS MORTALITY DISTRIBUTION MEAN AND 90TH PERCENTILE FROM CLIMATE FACTORS (PER 1,000 POPULATION) UNDER DIFFERENT GLOBAL AVERAGE TEMPERATURES

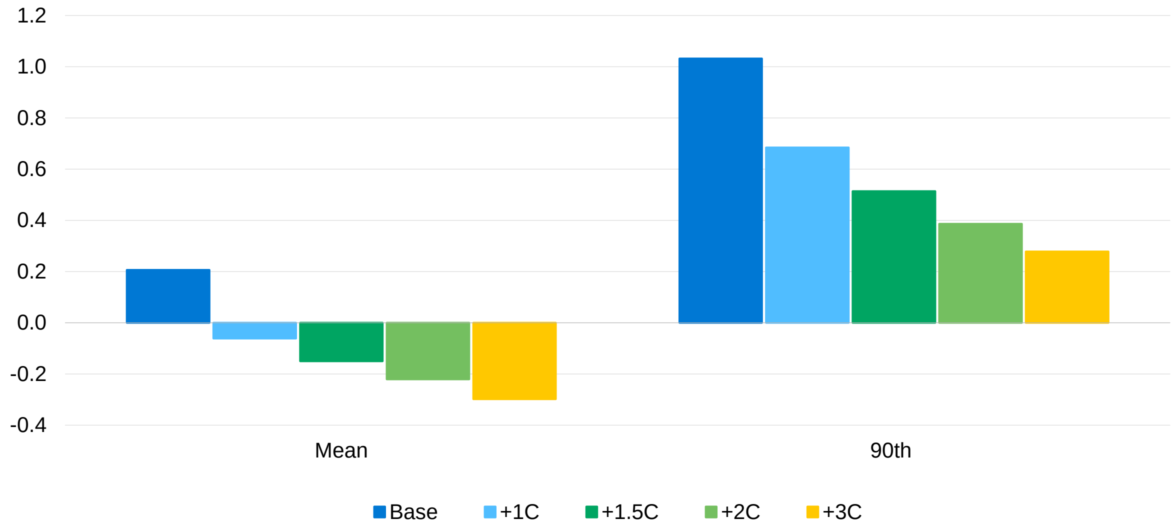


9. UK Climate Resilience Programme. Climate Change Shifting UK's High-Impact Weather. Retrieved 2 February 2025 from https://www.ukclimateresilience.org/news-events/climate-change-shifting-uks-high-impact-weather/#:~:text=The%20likelihood%20of%20cold%20conditions,chance%20of%20ice%20and%20snow.

10. Met Office. UK and global extreme events – cold. Retrieved 2 February 2025 from https://www.metoffice.gov.uk/research/climate/understanding-climate/uk-and-global-extreme-events-cold.

On further investigation we noted that a significant amount of this increase in the excess mortality distribution is driven by additional deaths from vector diseases, i.e., the increased potential for future pandemics from warmer average temperatures. If we instead minimise the influence of vector disease on excess deaths within the model, then we see a reduction in excess deaths for the UK. This is as a result of the relative influence of excess cold-related deaths compared to heat-related deaths currently in UK data.

FIGURE 3: EXCESS MORTALITY FROM CLIMATE FACTORS (PER 1,000 POPULATION) UNDER DIFFERENT GLOBAL AVERAGE TEMPERATURES REDUCING THE IMPACT OF VECTOR DISEASE

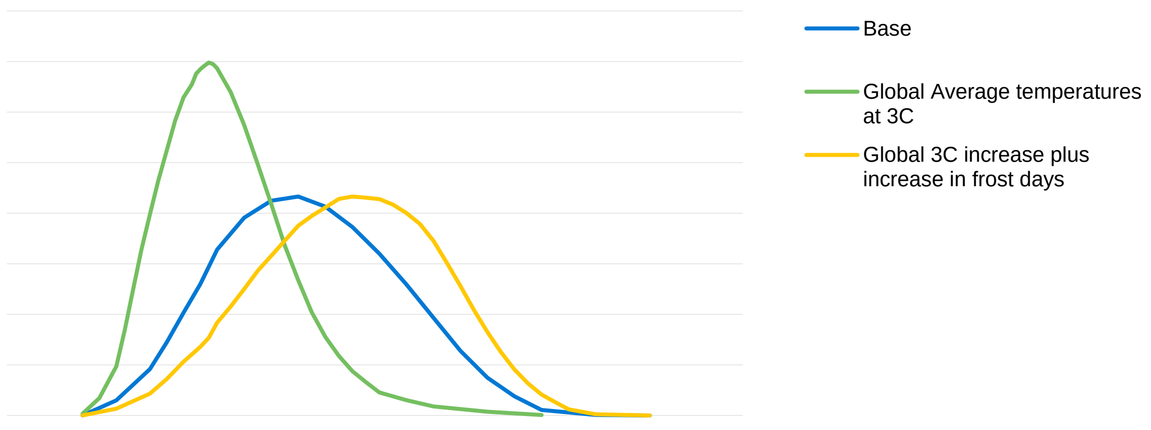


However, these high-level results do not necessarily show the true picture.

TEMPERATURE-RELATED DEATHS

Research shows that cold-related deaths vastly outnumber heat-related deaths at a ratio of around 9:1 globally;[11] our model exhibits this relationship as well and Figure 4 shows a reduction in excess deaths when global average temperatures alone are increased.

FIGURE 4: EXCESS MORTALITY PROBABILITY LOSS DISTRIBUTION UNDER THREE SCENARIOS REDUCING THE IMPACT OF VECTOR DISEASE IN THE MODEL TO EXPLORE THE IMPACT OF INCREASED AVERAGE TEMPERATURE AGAINST MORE COLD DAYS



Source: Milliman

11. Zhao, Qi et al. (2021), op cit.

On digging into this impact further, we found that there could be an element of the extremes in relation to severe cold days or hot days which is not yet correctly captured in the data used to calibrate the model. For example, heat-related deaths arise as an exacerbation of underlying conditions like cardiovascular disease, diabetes and asthma. Therefore, current excess deaths due to heat could be underestimating the impact of extreme and chronic temperature changes due to comorbidities. One study suggests that, in Australia at least, heat-related mortality might be underestimated by 50-fold due to underreporting.[12] Mapping out the comorbidity pathways is an area we would like to develop in detail in future iterations of the model to explore this area of uncertainty.

The reduction in cold-related deaths from warmer average temperatures could also be significantly lower than expected. Currently our model is calibrated to the number of frost days anticipated in the UK for increasing average temperatures from our research. However, the link between higher average temperatures, and therefore fewer frost days, and extreme cold weather events has not been fully explored. For example, research on the autumn sea ice variability in the Barents-Kara Seas indicates that low sea ice, from warmer average temperatures, could result in severe cold anomalies across Europe due to disrupted typical weather patterns.[13] The disruption of weather patterns, particularly over Greenland and the Barents Sea, redirects polar air masses southward into mid-latitude countries such as the UK. These conditions could include increases of up to roughly six additional cold days and up to four additional cold nights during peak winter months like February, with Central and Eastern Europe experiencing pronounced cold air penetration and extended freezing conditions. Therefore, warmer average temperatures in the UK could still come with some severe cold snaps and, unintuitively, more frost days that would impact on mortality experience. Milliman France has also conducted research in this area which concludes that rising temperatures from climate change will not necessarily eliminate winter epidemics.[14] We have set up this scenario in our model as demonstrated in Figure 4; an increase in global average temperatures combined with an increase in the number of frost days increases excess mortality significantly.

Another factor that could come into play with regard to cold-related deaths is the availability of healthcare services during peak times. During UK winters the demand for healthcare services typically increases.[15] Experience is expected to be particularly poor over the 2024/25 winter period due to pressures at all levels in the healthcare system, general practitioners (GPs), hospitals and emergency care, while waiting lists have been increasing.[16] As such, the offset of fewer cold-related deaths needs to be considered alongside healthcare capacity at peak times as the offset may not progress linearly.

Related research we have conducted on the impact of climate on inflation indicates that several climate and sustainability factors could contribute to higher and more volatile inflation in the future.[17] The transition alone is expected to be inflationary as we move to a world where we are paying for natural resources to a capacity that we have not paid for these resources before. In addition, there will be costs to rectify the damage that has been done in the past. This could result in persistent cost-of-living strain and further strain on governments and thereby budgets for healthcare services. Any reduction in cold-related deaths needs to be considered alongside the availability of healthcare services during peak times to understand whether temperature alone is enough to offset mortality experience due to a reduction in the number of frost days.

12. Longden, Thomas et al. (May 2020) Heat-related mortality: An urgent need to recognise and record. The Lancet. Retrieved 2 February 2025 from https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(20)30100-5/fulltext.

13. Cai, D. et al. (28 February 2024). The linkage between autumn Barents-Kara Sea ice and European cold winter extremes. Front Clim. Retrieved 2 February 2025 from https://www.frontiersin.org/journals/climate/articles/10.3389/fclim.2024.1345763/full.

14. Titon, E. et al. (November 2024). The Impact of Climate Change on Winter Mortality: A Complex Phenomenon With an Uncertain Future. Milliman White Paper. Retrieved 2 February 2025 from https://www.milliman.com/-/media/milliman/pdfs/2024-articles/11-22-24_0161lf_the-impact-of-climate-change-on-winter-mortality.ashx.

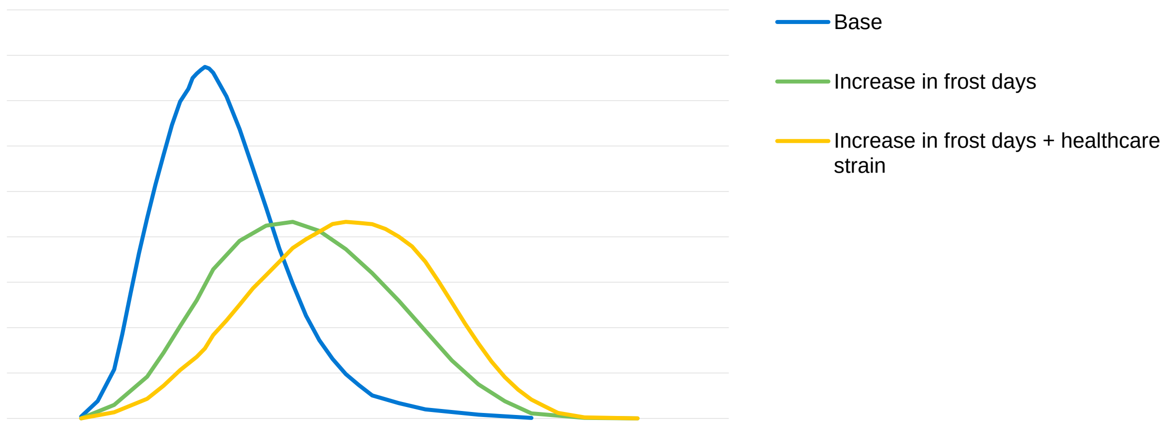
15. Gojjar, D. & Burnett, H. (28 October 2024). NHS readiness for winter 2024/25. UK Parliament. Retrieved 2 February 2025 from https://commonslibrary.parliament.uk/research-briefings/cdp-2024-0139/.

16. NHS (14 November 2024). NHS busier than ever going into winter. Retrieved 2 February 2025 from https://www.england.nhs.uk/2024/11/nhs-busier-than-ever-going-into-winter/.

17. Drew, A. et al. (14 August 2024). Inflation as a major climate-related risk. Retrieved 2 February 2025 from https://www.milliman.com/en/insight/inflation-as-a-major-climate-related-risk.

The current structure of our model allows us to explore this scenario. See Figure 5. As before, we can see an increase in excess deaths from base, by a shift in the probability loss distribution to the right, of more frost days. However, this increase in excess deaths shifts even further to the right if we reduce the availability of healthcare services in the model. Currently this has the effect of increasing the mean of the distribution by about 30% and the 90th percentile by about 15%; however, the calibration is currently based on expert judgement and further model development is needed to refine this picture.

FIGURE 5: EXCESS MORTALITY PROBABILITY LOSS DISTRIBUTION UNDER THREE SCENARIOS REDUCING THE IMPACT OF VECTOR DISEASE IN THE MODEL TO EXPLORE THE IMPACT OF MORE COLD DAYS IN THE UK ALONGSIDE HEALTHCARE WINTER STRAIN



Source: Milliman

FUTURE PANDEMICS

Climate change and the potential for infectious diseases are interconnected in a number of complex ways, namely:

- The types and levels of vector-borne diseases experienced in the UK.[18]
- An increase in biodiversity loss, which reduces the resilience of ecosystems and makes it easier for pathogens to spread.[19]
- Changing farming practices in the UK which could be linked to climate factors, such as high-density animal housing and long-distance transport, have been linked to a rise in zoonotic diseases. These practices elevate stress levels in animals, making them more susceptible to infections, thus increasing the spread of zoonotic pathogens.[20]
- Climate-induced migration, rapid urbanisation and increased global travel have been identified as significant factors in the spread of infectious diseases.[21]
- An increase in waterborne diseases from extreme weather events which contaminate water supplies and disrupt sanitation infrastructure.[22]

18. Centers for Disease Control and Prevention (2 March 2024). Vector-Borne Diseases. Retrieved 2 February 2025 from https://www.cdc.gov/climate-health/php/effects/vectors.html.

19. Coleman, C. et al. (11 January 2024). House of Lords Library: UK biosecurity: Infectious disease threats. UK Parliament. Retrieved 2 February 2025 from https://lordslibrary.parliament.uk/uk-biosecurity-infectious-disease-threats/.

20. CIFW Report: Zoonotic Diseases, Human Health & Farm Animal Welfare. Retrieved 10 February 2025 from https://www.ciwf.org.uk/media/3756123/Zoonotic-diseases-human-health-and-farm-animal-welfare-16-page-report.pdf

21. BMJ (26 October 2020). Strengthening the global response to climate change and infectious disease threats. Retrieved 2 February 2025 from https://www.bmj.com/content/371/bmj.m3081.

22. World Health Organisation (30 September 2011). Guidance on water supply and sanitation in extreme weather events. Retrieved 2 February 2025 from https://www.who.int/europe/publications/i/item/9789289002585.

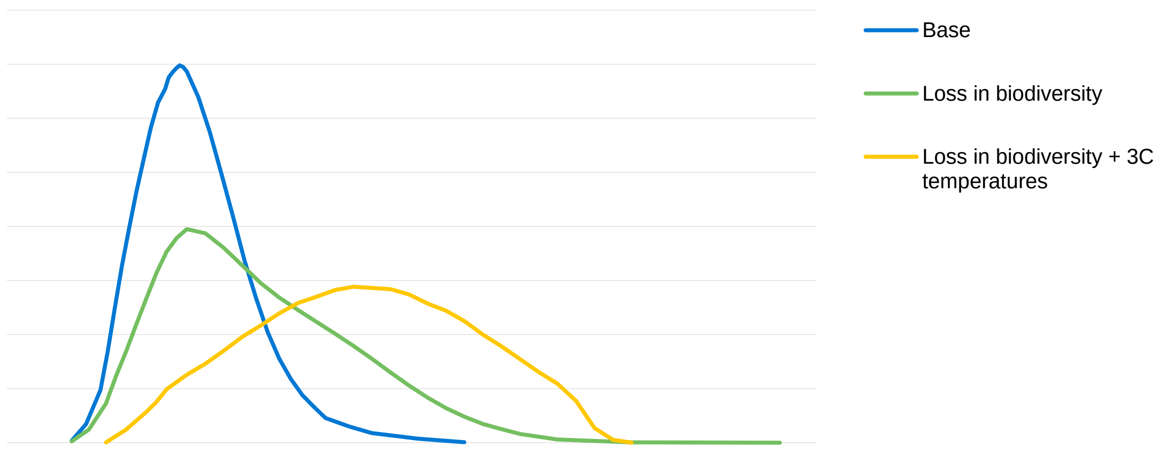
The model has focussed on vector-borne and waterborne diseases and future pandemics as a result of climate change. As the model is calibrated to UK population mortality, vector disease outweighs foodborne and waterborne diseases as a cause of excess mortality. Within the model it is expected that the outbreak of vector diseases will be more frequent and potentially affect a larger proportion of the population; while the mortality impact from foodborne and waterborne diseases is expected to remain relatively low in developed countries.[23,24,25] Our initial research has also suggested that vector-borne and waterborne diseases could be more influential on morbidity, and therefore this is an area to explore in more detail in future.

Currently the model also does not allow for the impact of healthcare strain on mortality from vector diseases. The vector disease mortality factor was calibrated using COVID-19 numbers, therefore some healthcare strain is implicit in the data. Naturally, however, this could have a different impact in future, and particularly could have worse outcomes if the healthcare system is already strained from an extreme weather event combined with a pandemic outbreak. This is another area to explore further in the model in future.

Within the current model we explored scenarios where there is a significant loss in biodiversity. This materially increases the probability of vector disease outbreaks but has a much less pronounced impact on excess mortality from foodborne and waterborne diseases. From Figure 6 you can also see that this scenario increases the uncertainty in the outcomes by increasing the spread of the distribution of excess mortality.

If we create a scenario with high average global temperatures and high biodiversity loss, then we observe a more pronounced impact on excess deaths from both sources of infections; i.e., an increased chance of extreme weather events leads to higher chances of foodborne and waterborne infections, while the impact from higher average temperatures further increases the impact from vector diseases. Overall, this scenario leads to a significant increase in expected additional deaths from infectious diseases.

FIGURE 6: EXCESS MORTALITY PROBABILITY LOSS DISTRIBUTION UNDER THREE SCENARIOS SHOWING THE IMPACT OF LOSS IN BIODIVERSITY AND INCREASE IN GLOBAL TEMPERATURE



23.Holland, D. et al. (24 June 2020). Estimating deaths from foodborne disease in the UK for 11 key pathogens. BMJ Open Gastroenterol. Retrieved 2 February 2025 from https://pmc.ncbi.nlm.nih.gov/articles/PMC7319714/#:~:text=We%20estimate%20that%20there%20are,efforts%20to%20reduce%20these%20infections.

24. Morand, S. & Lajaunie, C. (23 March 2021). Outbreaks of Vector-Borne and Zoonotic Diseases Are Associated With Changes in Forest Cover and Oil Palm Expansion at Global Scale. Sec. Parasitology. Retrieved 2 February 2025 from https://www.frontiersin.org/journals/veterinary-science/articles/10.3389/fvets.2021.661063/full.

25. Suprenant, A. (15 May 2024). How climate change affects vector-borne diseases. Wellcome. Retrieved 2 February 2025 from https://wellcome.org/news/how-climate-change-affects-vector-borne-diseases.

CHRONIC VS. EXTREME IMPACTS

Some of the impacts discussed above could be chronic, i.e., expected to last and/or repeat in the future—representing a change in mortality trends; and some impacts will be one-off shocks, representing pandemic-like events. Shock events, however, can increase in frequency and severity with time due to a changing climate. The countervailing impacts from trend and shock factors illustrate the complexities in this area.

Currently our model is calibrated to explore excess mortality impacts from changing conditions on an annual basis, combining shock and chronic drivers. In future iterations of the model, we will look to develop a chained year-on-year model and explore the development in excess mortality from chronic and acute impacts in more detail. When chain-linking models, there would be a need to consider the impact of potential adaptive measures such as heat-wave alerts and public information campaigns to better manage these stresses.

Using models to examine tipping points and other acute stresses

Alongside complexities with acute and chronic climate drivers, another area of complexity in climate modelling relates to climate tipping points. The Earth Systems Institute has identified more than 25 tipping points in its 2023 Global Tipping Points report.[26] This report notes that five major tipping points are already at risk of being crossed due to current warming, with three further tipping areas threatened in the 2030s. Examples of tipping points include the Barents-Kara Seas, mentioned above, and also subpolar gyre (SPG) and Atlantic Meridional Overturning Circulation (AMOC) collapses, which would significantly impact UK and Northern Europe.[27]

The paper “The Security Blind Spot,”[28] from the Institute for Public Policy Research (IPPR), states that the probability of an SPG collapse is up to 45% this century. The paper reports that potential impacts include greater probability of more severe winters as well as, perversely, the potential for even more summer heat waves. An AMOC collapse is less certain but is likely to have even more severe consequences. The IPPR paper reports one study that had projected an AMOC collapse could reduce average temperatures in London by up to 10°C, with great impacts in winter (15ºC reductions) and even colder conditions further north.

Distinct from traditional risk models, our causal approach allows us to explore the potential impacts of tipping points. In the scenario above, where we increased the number of frost days experienced in the UK, despite an increase in global average temperatures, we have used a proxy method to explore a potential tipping point for the UK. More specific tipping points can be built into the model as needed. Any significant tipping point is likely to come with significant economic and public infrastructure strains so it is important to use modelling techniques that can capture the interconnected nature of the impacts.

The model could also be used to examine the potential impact of more localised intersections. Consider an example: Hurricane Beryl created a power blackout that impacted two-thirds of homes in Houston and lasted more than a week for some. A few days later a heat wave occurred. It is estimated that, if the heat wave had been more severe, combined with the power blackout, there could have been an additional 600 to 1,500 deaths compared to the estimate of 50 deaths for the same heat wave without a loss of power.[29] Similar vulnerabilities could exist in the UK and Europe for cold, winter storms and loss of heating.

26. The Global Tipping Points Report 2023 is available at https://global-tipping-points.org/.

27. Global Tipping Points Report 2023, available at https://global-tipping-points.org/.

28. Laybourn, L. et al. (9 October 2024). The security blind spot: Cascading climate impacts and tipping points threaten national security. IPPR. Retrieved 2 February 2025 from https://www.ippr.org/articles/security-blind-spot.

29. The Washington Post (13 September 2024) The disaster no major U.S. city is prepared for. Retrieved 2 February, 2025 from https://www.washingtonpost.com/climate-environment/interactive/2024/hurricanes-power-outages-heat-wave-risk/

Making climate scenario modelling decision useful

Exploring the types of scenarios described in this paper is only a starting point for climate scenario analysis. To put this model to a business use it would need to reflect specific liabilities, vulnerabilities and geographies of the lives in question.

It would also need to be tailored to key business outcomes—for example to understand material shifts in profitability or reserving. For the UK, the core climate mortality scenario impact may remain quite modest and well within risk appetites. However, business-level insights may emerge from considerations of tipping points and large shifts in climate behaviour.

Even with a tipping point, it may take a cascade of circumstances to have a material impact. For example, a scenario might need to combine a protracted storm that lands on a geographically concentrated area, with higher health vulnerabilities, whilst there are also weaknesses in public infrastructure and healthcare. At one level, the need for such a cascade to go “wrong” will be reassuring. At another, it helps executive planning. Firstly, it can help directly manage such tail events with reinsurance or other means. Secondly, it can help identify precursor events which themselves may be only modest risks but have the potential to reinforce and magnify the outcomes. On their own, a modest level of risk for individual factors may not create an alert on a traditional risk register unless the cascading implications have been explored and appreciated.

Adding situational context, such as power outages or current healthcare capacity levels, alongside business-relevant context (e.g., concentrations of business in South West England) makes scenarios more personal and more ”real” to senior executives and board members. When the impact is also illustrated on key business indicators, such as profitability, it then can help overcome complacency and focus the mind on what specific actions can be taken to improve preparedness. Ultimately, these scenarios may be risk-accepted, but scenarios in which executives can “see how something like this could actually happen,” and impact compensation metrics, tend to focus their minds.

Conclusion

Our climate mortality model cannot accurately predict how climate factors might play out, but can help hypothesise about possible futures, allowing an insurer to assess whether it would see the changes coming and be resilient to its impacts. As a prototype, the model has allowed us to explore, on a high level, the interactions of various climate and socioeconomic factors on excess mortality and identify specific areas that require refinement in future iterations.

With so many factors and uncertainties at play that can affect mortality, understanding the range of possibilities and testing against them is more crucial than ever. Whilst on the surface the core outcomes for UK lives appear to not be significant, the emerging focuses on tipping points and the potential for significant shifts in climate may highlight stresses that are not currently considered. Additionally, as our model demonstrates, considering only direct impacts from climate in any excess mortality investigation will not capture the full picture. There is a need to develop more in-depth knowledge of second order impacts as well as interconnections with broader macroeconomic, nature- and social-related risks.

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