



Modelling a pandemic

The Pandemic Task Force

In 2022 the International Actuarial Association (IAA) established the Pandemics Task Force (PTF). A special working group with the purpose to study and advise on the actuarial, financial, and risk-management implications of pandemics. The PTF published in 2024 two papers: *Lessons Learned from Pandemics* and *Implications of COVID-19 Protection Gaps*.

In the first paper the PTF presented a high-level view of the lessons we have learned to date, primarily from the COVID-19 pandemic, but also built on lessons learned from other pandemics such as HIV/AIDS and the 1918 influenza pandemic. That paper reflected various actions and analyses in which members of the actuarial profession have been involved and considered several actuarial practice areas in order to provide education for the profession to respond to future pandemics.

In the second paper a protection gap was defined as the difference between the total potential losses resulting from a future uncertain event and reimbursable losses resulting from that potential uncertain event. In that paper protection insurance gaps arising from COVID-19 such as business interruption coverage, travel and event cancellation coverage were discussed. Recently (November 2025) the last paper of the PTF has been published: *Implications of COVID-19: Data and Modelling a Pandemic*. This paper examines key lessons learned from the COVID-19 crisis and explores how actuaries can contribute to better data collection, modelling, and decision-making in future pandemics. The conclusions of this paper are presented below.

DATA COLLECTION

Data is critical in decision-making. In a crisis such as a pandemic, existing models projecting potential outcomes will be refreshed and new models will be built to adapt to the circumstances of the pandemic. To feed all of these models, data needs to be collected, aggregated and adapted to align with the needs of the models. Actuaries are often tasked with analyzing data and determining how to use it in their models. The outputs provide pertinent information to make key decisions. The models that are built by actuaries are often multi-state stochastic processes in which the probability of what happens next depends on the attained state and not on the route taken to get there.

These models can be adapted to modelling the future of a pandemic and they are very much the same family of models that are used by epidemiologists, for example, in their work on forecasting the impact of a disease. In examining and analyzing data, it is critical to understand:

- How to segregate the data;
- How to identify which measures are likely to be robust for modelling purposes;
- How to compute more reliable measures;
- How to identify the exposed-to-risk for a particular outcome; and
- How to ensure that the measure of the outcome is correctly aligned with the exposure.

Drs. K. Thiers is chair of the Insurance Committee of the Royal Dutch Actuarial Association (AG).



MODELLING

Actuaries are experienced in data analysis and dealing with uncertainty surrounding the data. This includes sensitivity to understand any bias in the data and the influence of selection effects, as well as identification of key drivers that should be taken into account in possible future outcomes. Actuarial models normally consider the need to model separately by age and gender, as well as by many other potential characteristics, in order not to conflate different influences that could lead to spurious projections for heterogeneous groups. A key skill in this sort of modelling is deciding what degree of homogeneity to accept as a plausible model representation of massive real-life heterogeneity.

The availability and relevance of data make a significant difference to the analysis that can be carried out. It is therefore critical to establish the data requirements as early as possible. The complexity of a pandemic makes it difficult to gather complete, comprehensive and consistent data, particularly during the early stages, when understanding of the pandemic is limited. In order to prepare better for future pandemics, professional bodies and health authorities should work closely together to develop a consistent framework for assessing pandemic-related mortality and morbidity.

As regards mortality, some actuarial bodies monitored the number of 'excess deaths' resulting from the pandemic. This approach benefits from not relying on a pre-defined definition for 'pandemic related death' and focusses on the increase in mortality rates rather than absolute numbers of deaths, which makes comparisons more meaningful. Although inevitably involving a lag before the relevant data can be brought together, the excess deaths approach is a powerful tool to support analysis around the implications of a pandemic over an extended period. All actuarial associations should consider how to put in place some form of 'continuous mortality investigation' in order to carry out research into mortality and morbidity experience on a regular basis and be in a position to respond to data evaluation in the context of a future pandemic.

INTERNATIONAL COOPERATION

There is obviously significant opportunity to leverage international sharing of data and models to a significantly greater extent than happened in practice during the two most recent global pandemics – HIV/AIDS in the 1980s and 1990s, and COVID-19 in 2020–22. Some

pandemic models could be quite transferable between different countries. Care needs to be taken in parameterizing models to fully take into account the situation pertaining to the country being studied, as many aspects, such as the risk factors of the underlying population, the rate of transmission of the virus, definitions, the reliability and consistency of available data, the approach to testing, treatment and vaccination may all differ markedly from one country to another.

DECISION-MAKING IN FUTURE PANDEMICS

Actuaries operate within a strong code of professional conduct that focuses on serving society as well as the immediate client – and the need for effective communication of results. The nature of actuarial work is to focus on the impact of the results of the models on different groups and to take into account the broader context in which the work is carried out. Actuaries are used to working in multi-disciplinary teams, both within insurance companies and more recent areas like climate risk and biodiversity. In modelling a pandemic there will usually be considerable value in bringing together the expertise of epidemiologists, public health experts, medical professionals and actuaries.

In relation to COVID-19, a range of other expertise was needed, encompassing areas such as economics, social science and behavioural science, to evaluate the likely responses to different policy proposals and come to an overview of the impact on society and the economy. Making the cooperation as broad as possible will ensure greater diversity of thought, reduce the potential for group-thinking and bring all the advantages that diversity of background conveys to decision-making. Actuaries should build contacts and networks with other professionals to facilitate cooperation in a future pandemic.

One of the lessons of the COVID-19 pandemic is the importance of responsible actors (such as public bodies) preparing for future pandemics by ensuring that data are as suitable as possible for analysis – as well as the key role of actuaries. Such preparation would enable decision-making to be timelier and better founded. ■