

Translation of modelling for public health impact

How should we evaluate modelling work for outbreak response?

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<https://epiforecasts.io>

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"All models are wrong, but some are useful"

George Box

- How do we know when models are useful?
- Does it matter how wrong they are?

To answer these questions, we need to *evaluate* modelling work.

What and how to evaluate?

Some examples

Evaluation of predictive modelling

Forecasts vs. Scenarios

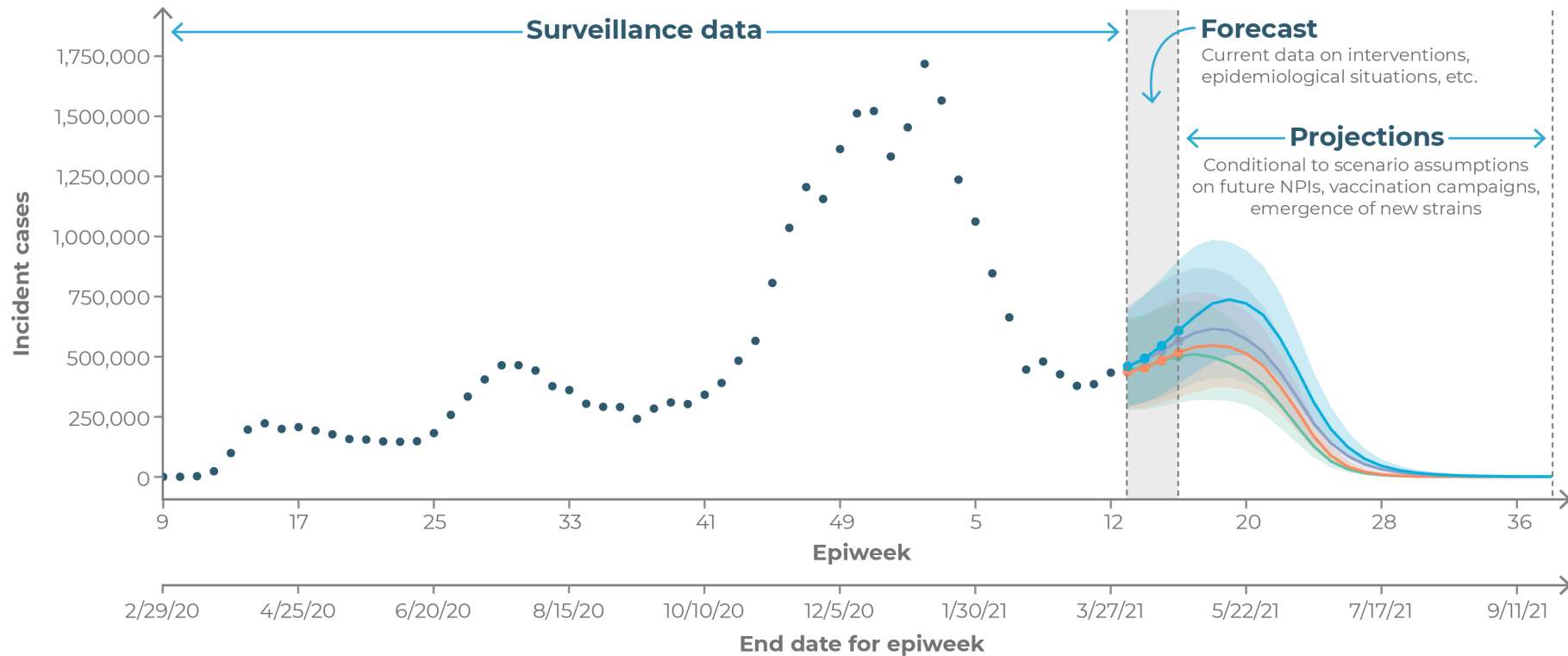
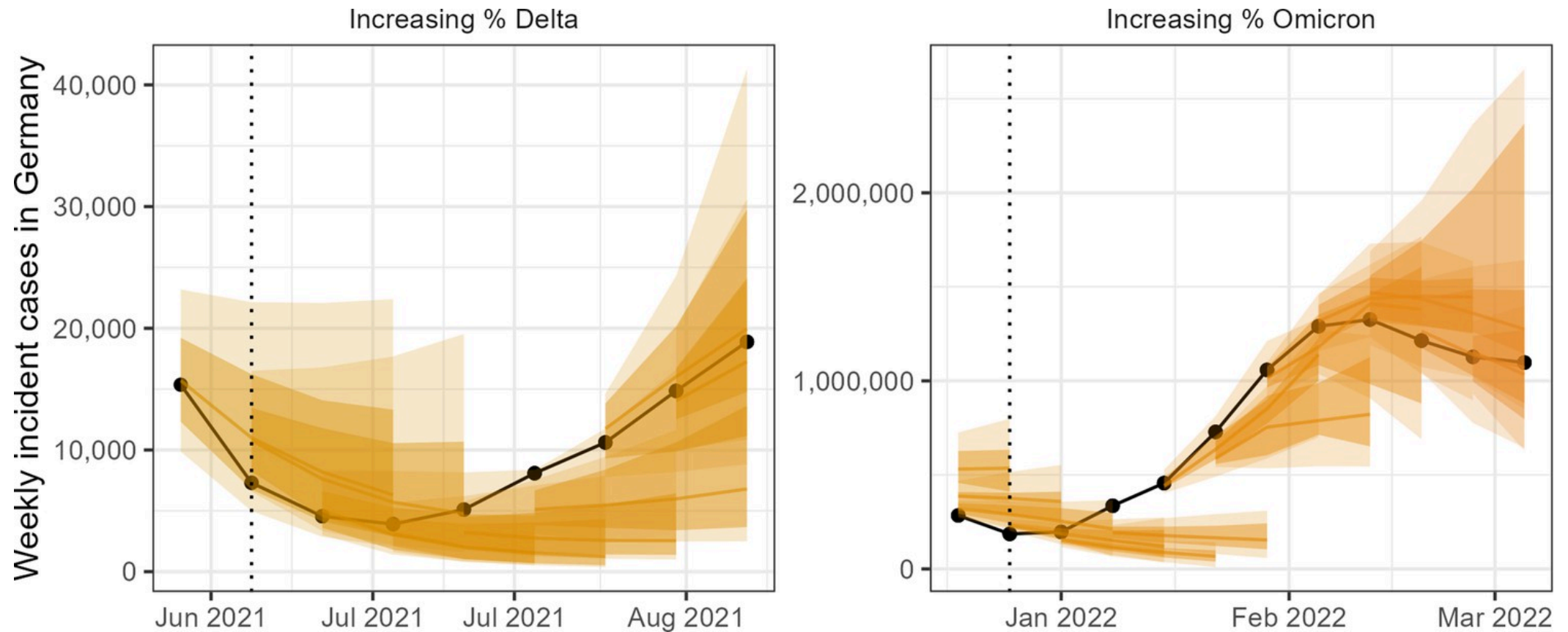


Image from: <https://covid19scenariomodelinghub.org/>

Evaluation of forecasts

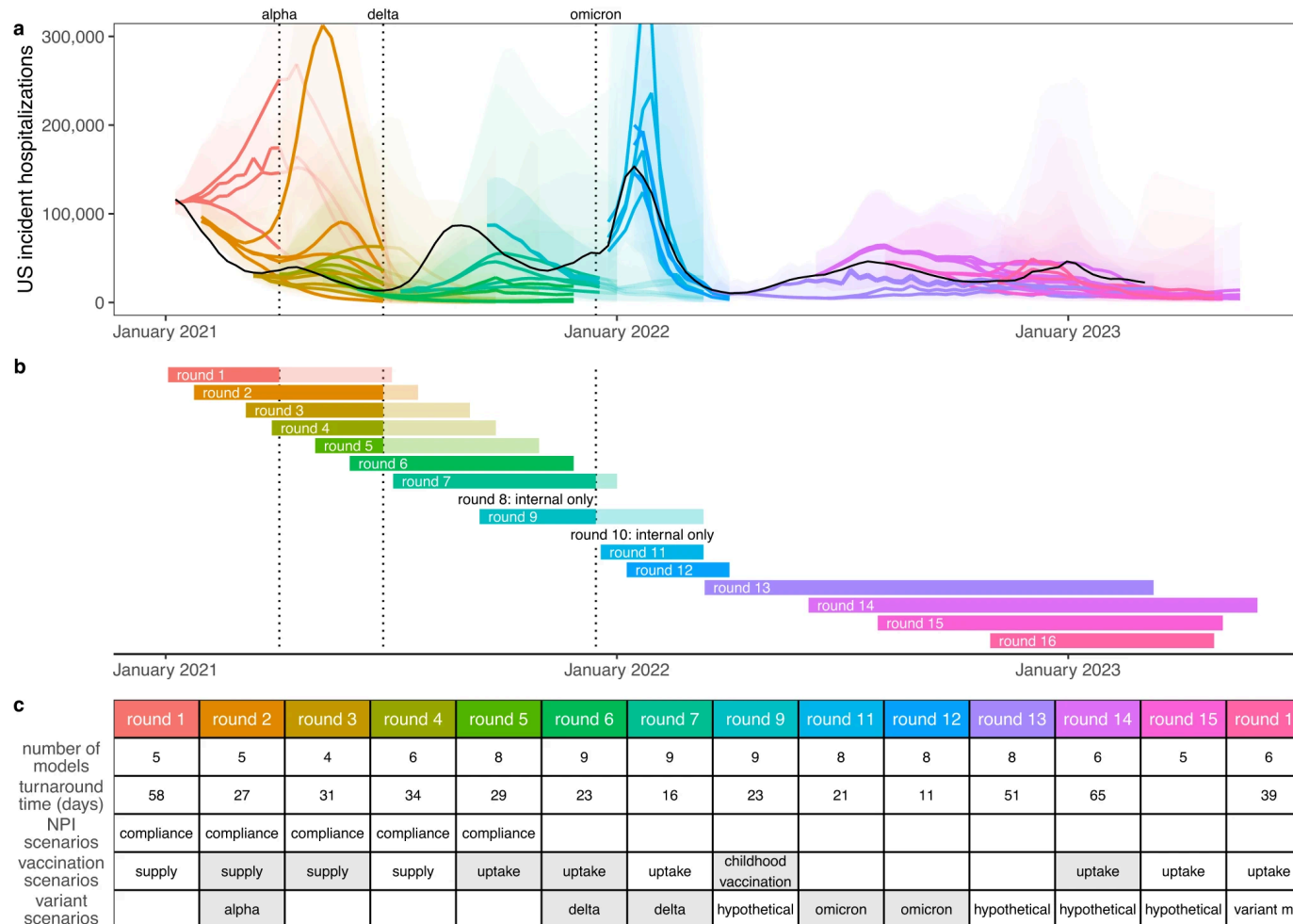
Assess quality of models by how closely prediction matches reality



Sherratt et al., *eLife*, 2023

Evaluation of scenario projections

Assessing predictions requires matching scenarios to reality.



Howerton et al., *Nature Communications*, 2023

Utility could be independent of predictive ability

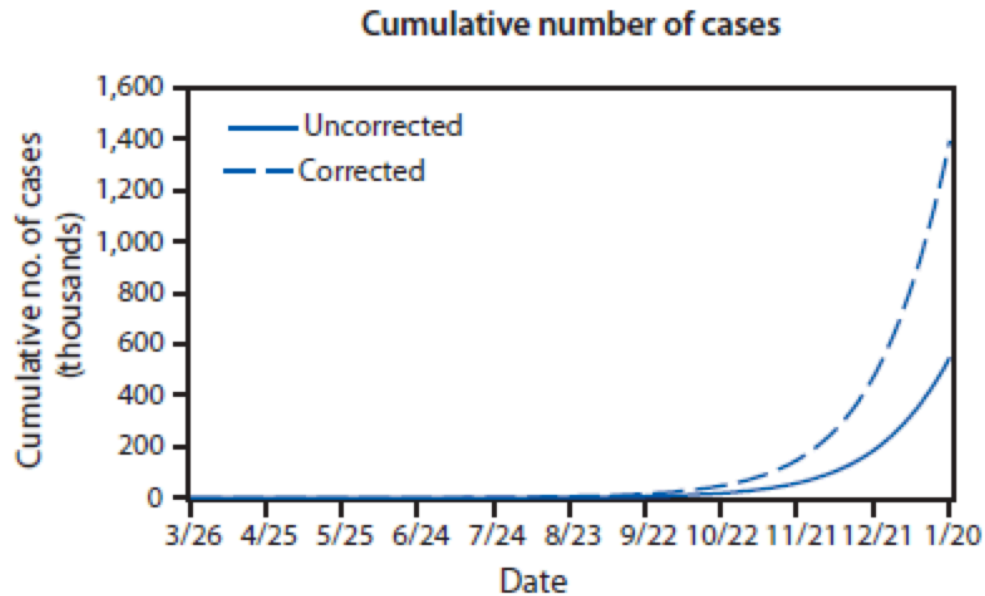
offered by Kenneth Arrow. During the Second World War he was a weather officer in the US Army Air Corps working on the production of month-ahead weather forecasts, and this is how he tells the story [74]:

The statisticians among us subjected these forecasts to verification and they differed in no way from chance. The forecasters themselves were convinced and requested that the forecasts be discontinued. The reply read approximately like this: “The commanding general is well aware that the forecasts are no good. However, he needs them for planning purposes”.

Saltelli, 2018

Evaluation of utility to policy makers

Assess utility by asking recipients of modelling advice?



Epidemic Modeling

A CDC model that projected the possible trajectory of the epidemic if the trend of rapid transmission through August 2014 continued unabated was key to increasing the speed and scale of the US and global response (22). The worst-case scenarios of the model made clear the need for urgent action and helped stimulate a massive global response.

Meltzer et al., *MMWR Weekly Report*, 2014

Frieden and Damon, *Emerg Inf Dis*, 2015

Evaluation of public health impact

**How mathematical
modelling saved lives
during the COVID-19
pandemic**

- Modelling can save lives, but it can also do harm. How do we tell one from the other?
- In order to assess the public health impact of modelling, we need to qualify and quantify it.

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Evaluation of the process

Improving modelling for epidemic responses: reflections from members of the UK infectious disease modelling community on their experiences during the COVID-19 pandemic [version 1; peer review: 2 approved]

Katharine Sherratt * , Anna C Carnegie * , Adam Kucharski, Anne Cori, Carl A B Pearson , Christopher I Jarvis, Christopher Overton, Dale Weston, Edward M Hill , Edward Knock, Elizabeth Fearon, Emily Nightingale , Joel Hellewell, W John Edmunds, Julián Villabona Arenas, Kiesha Prem , Li Pi , Marc Baguelin, Michelle Kendall, Neil Ferguson, Nicholas Davies, Rosalind M Eggo, Sabine van Elsland , Timothy Russell , Sebastian Funk , Yang Liu , Sam Abbott 

PERSPECTIVE

The COVID-19 response illustrates that traditional academic reward structures and metrics do not reflect crucial contributions to modern science

Adam J. Kucharski , Sebastian Funk , Rosalind M. Eggo 

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Sherratt et al., *Wellcome Open Res*, 2024

Kucharski et al., *PLOS Biology*, 2020

Summary / discussion points

- Evaluation can relate to model **correctness, process, impact**, etc.
- Correctness **does not always mean** greater/better impact (although there are good reasons to aim for quality and correctness)
- Evaluating **utility to decision makers** is not the same as evaluating **public health impacts** of modelling
- Any evaluation needs clarity on **what** is being evaluated and **how, before** the work is done

Ongoing activity in this space

LESSONS LEARNED FROM COVID-19 MODELLING EFFORTS FOR POLICY DECISION-MAKING IN LOWER- AND MIDDLE-INCOME COUNTRIES

Collins J Owek¹, Fatuma Guleid², Justinah K Maluni³, Joyline Jepkosgei³, Vincent Were⁴, So Yoon Sim⁵, Raymond Hutubessy⁵, Brittany L Hagedorn⁶, Jacinta Nzinga², Jacquie N Oliwa³

How does policy modelling work in practice? A global analysis on the use of modelling in Covid-19 decision-making

Authors: Liza Hadley^{a,b}; Caylyn Rich^c; Alex Tasker^d; Olivier Restif^e; Sebastian Funk^b.

A case for ongoing structural support to maximise infectious disease modelling efficiency for future public health emergencies: A modelling perspective

Epke A. Le Rutte^{a,b}, Andrew J. Shattock^{a,b}, Cheng Zhao^c, Soushieta Jagadesh^c, Miloš Balać^d, Sebastian A. Müller^e, Kai Nagel^{e,1}, Alexander L. Erath^{f,1}, Kay W. Axhausen^{g,1}, Thomas P. Van Boeckel^{e,g,h,1}, Melissa A. Penny^{a,b,*,1}

Workshop report

Advanced Analytics to Inform Decision Making During Public Health Emergencies

Participant Information Sheet – Survey

Bridging the Gap: Enhancing the Evaluation & Interpretation of Epidemic Forecasts for Researchers & Policymakers in Resource-Constrained Settings

Conducted by Paula Christen, Loice Achieng, Jeanette Dawa, Thumbi Mwangi, Charlie Whittaker, Lilith Whittles, Njoki Kimani, Maria Veras, Oliver Watson

KEMRI | Wellcome Trust

Framework to Guide the Use of Mathematical Modelling in Evidence-based Policy Decision Making

Policy Brief May 2023

Scoping review on evaluation of modelling work with Johanna Hanefeld, Emil Iftekhar, Julia Fitzner, Duaa Rao, Aleena Tanveer.