

# Translation of modelling for public health impact

How should we evaluate modelling work for outbreak response?

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[https://epiforecasts.io/slides/who\\_hub\\_20241008.html](https://epiforecasts.io/slides/who_hub_20241008.html)

LONDON  
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**centre *for***  
**mathematical**  
**modelling *of***  
**infectious diseases**

*"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

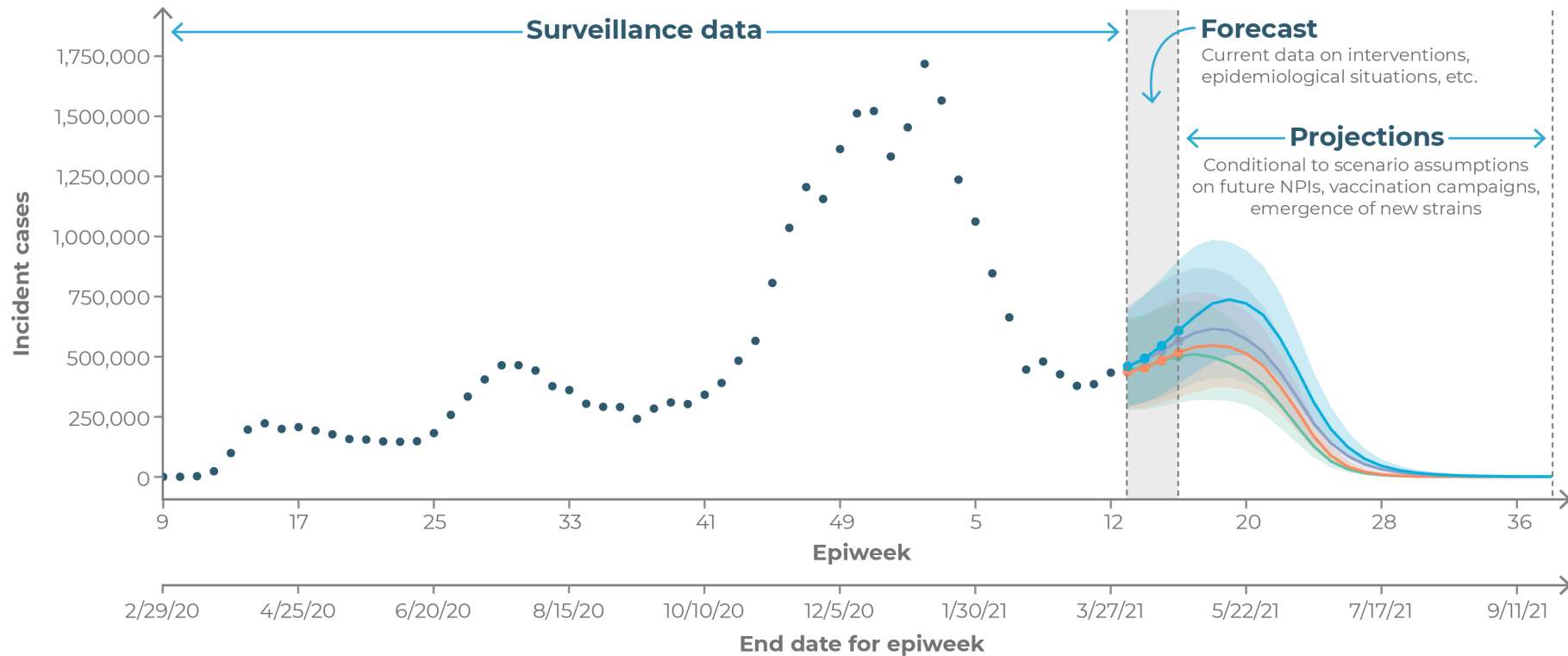
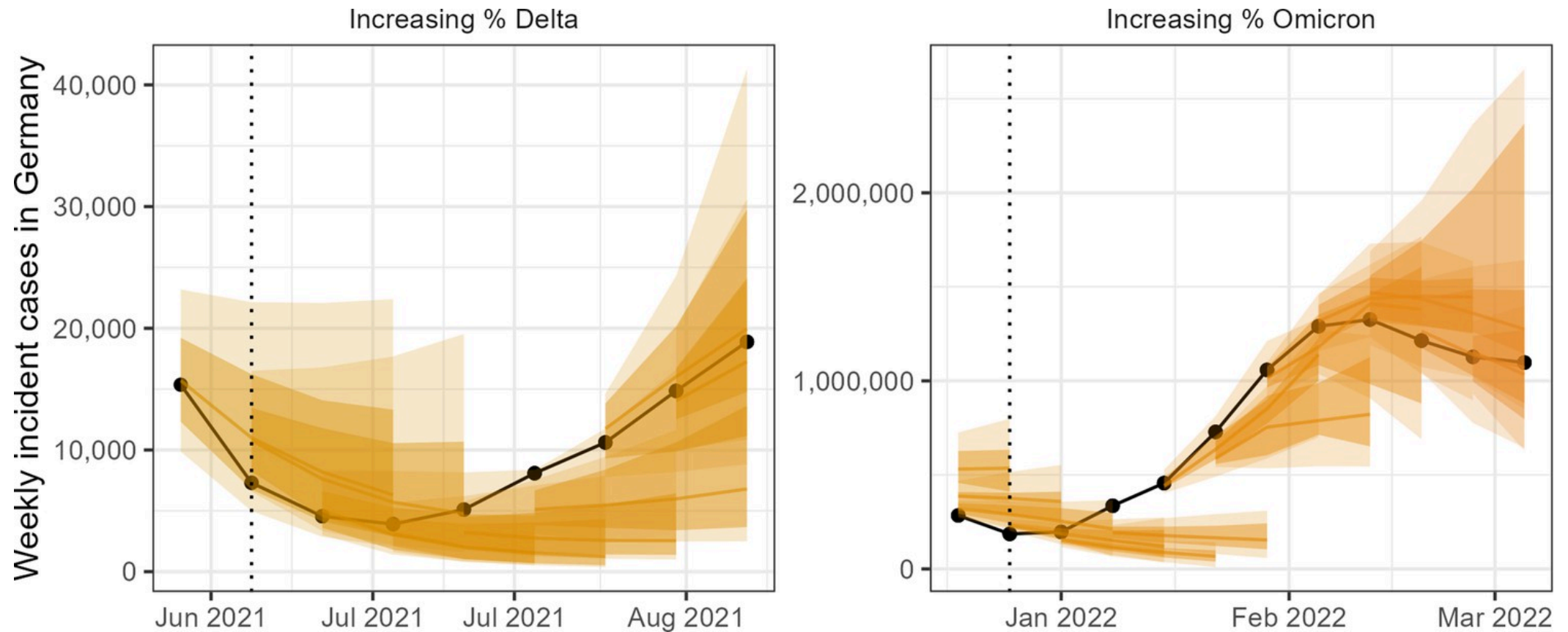


Image from: <https://covid19scenariomodelinghub.org/>

# Evaluation of forecasts

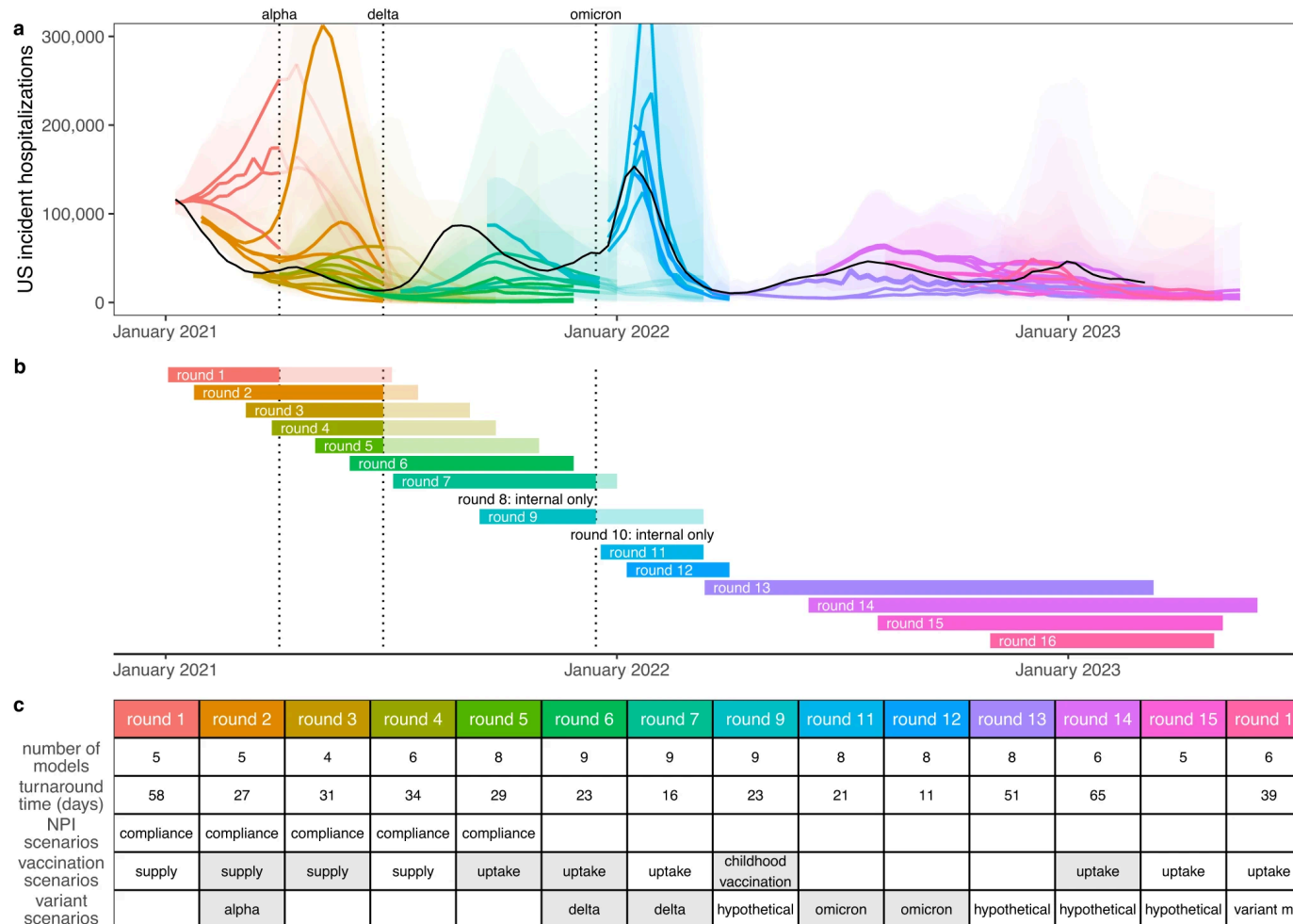
Assess quality of models by how closely prediction matches reality



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

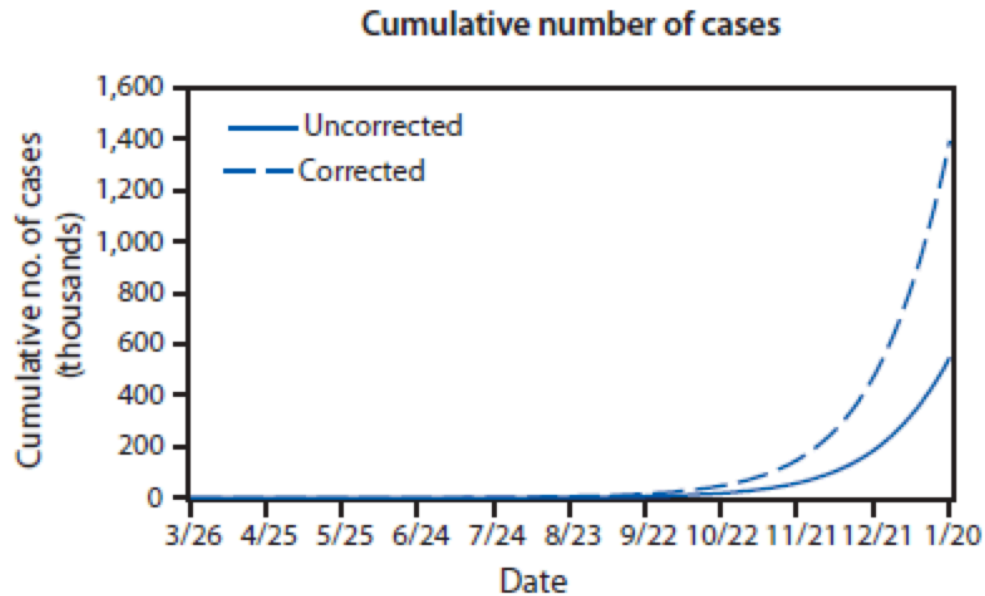
offered by Kenneth Arrow. During the Second World War he was a weather officer in the US Army Air Corps working on the production of month-ahead weather forecasts, and this is how he tells the story [74]:

*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.

# 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

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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 Owek<sup>1</sup>, Fatuma Guleid<sup>2</sup>, Justinah K Maluni<sup>3</sup>, Joyline Jepkosgei<sup>3</sup>, Vincent Were<sup>4</sup>, So Yoon Sim<sup>5</sup>, Raymond Hutubessy<sup>2</sup>, Brittany L Hagedorn<sup>6</sup>, Jacinta Nzinga<sup>2</sup>, Jacquie N Oliwa<sup>3</sup>

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

**Authors:** Liza Hadley<sup>a,b</sup>; Caylyn Rich<sup>c</sup>; Alex Tasker<sup>d</sup>; Olivier Restif<sup>e</sup>; Sebastian Funk<sup>b</sup>.

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

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

## 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.