Translation of modelling for public health impact

How should we evaluate modelling work?

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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

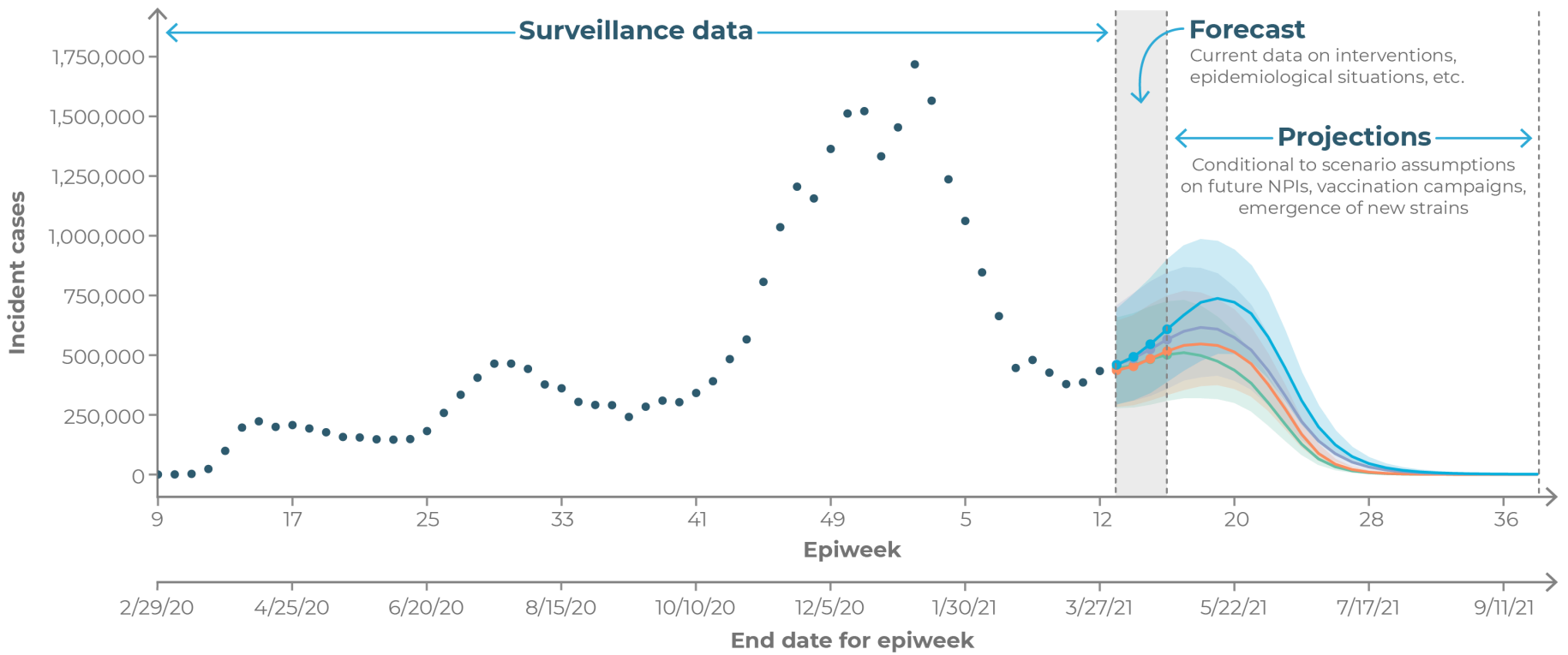
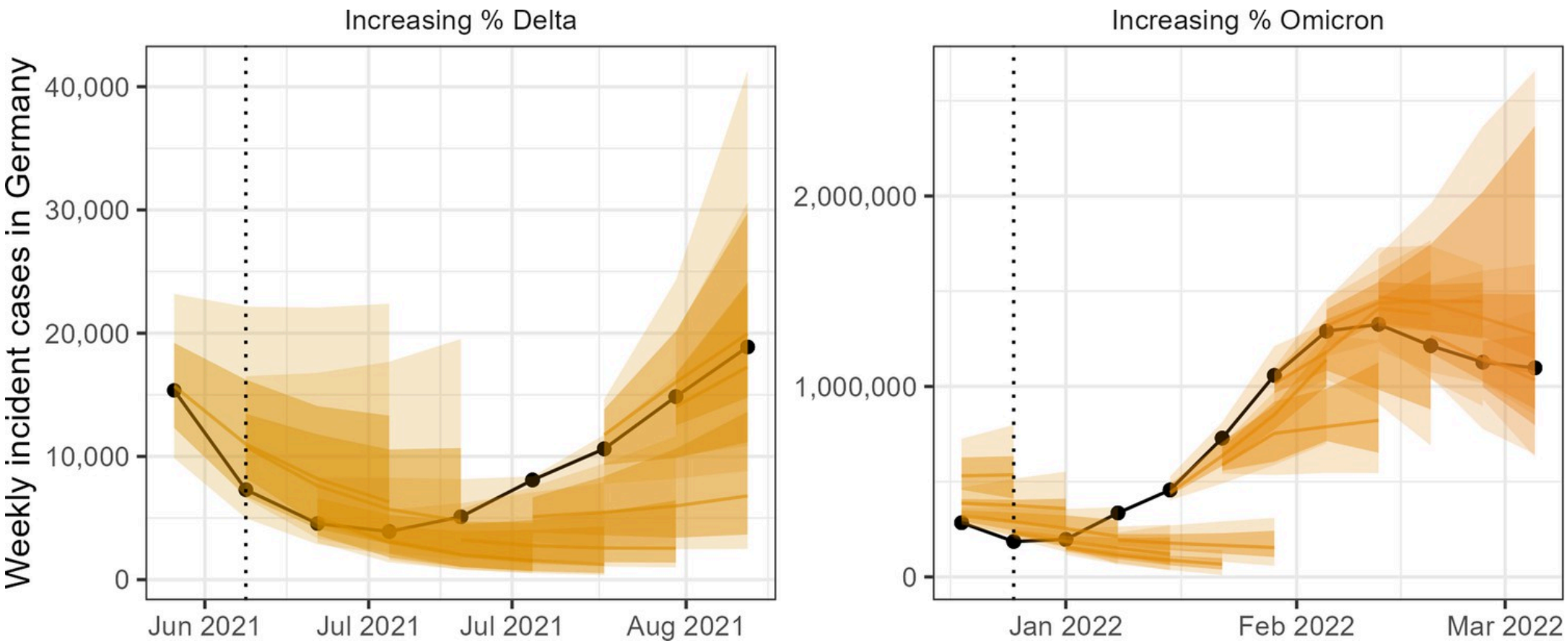


Image from: https://covid19scenariomodelinghub.org/

Evaluation of forecasts

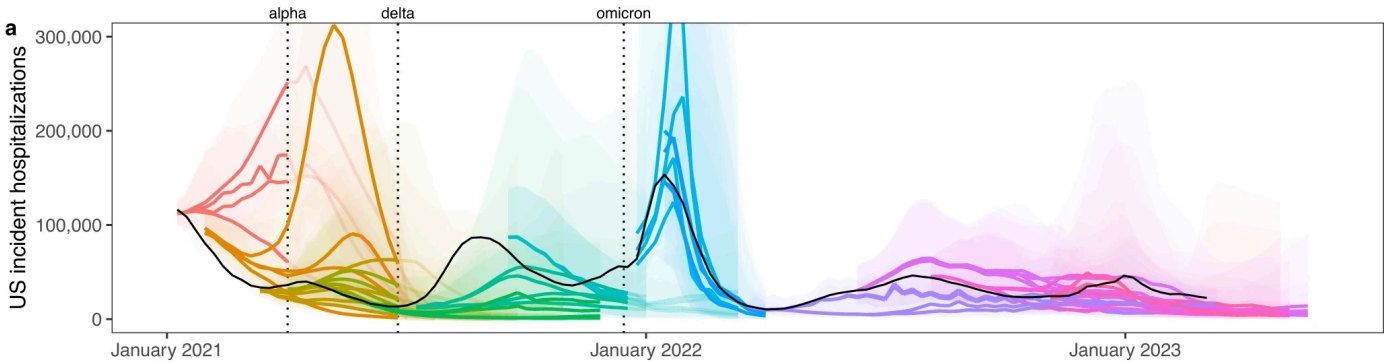
Assess quality of models by how closely prediction matches reality



Sherratt et al., *eLife*, 2023

Evaluation of scenario projections

Assessing predictions requires matching scenarios to reality.



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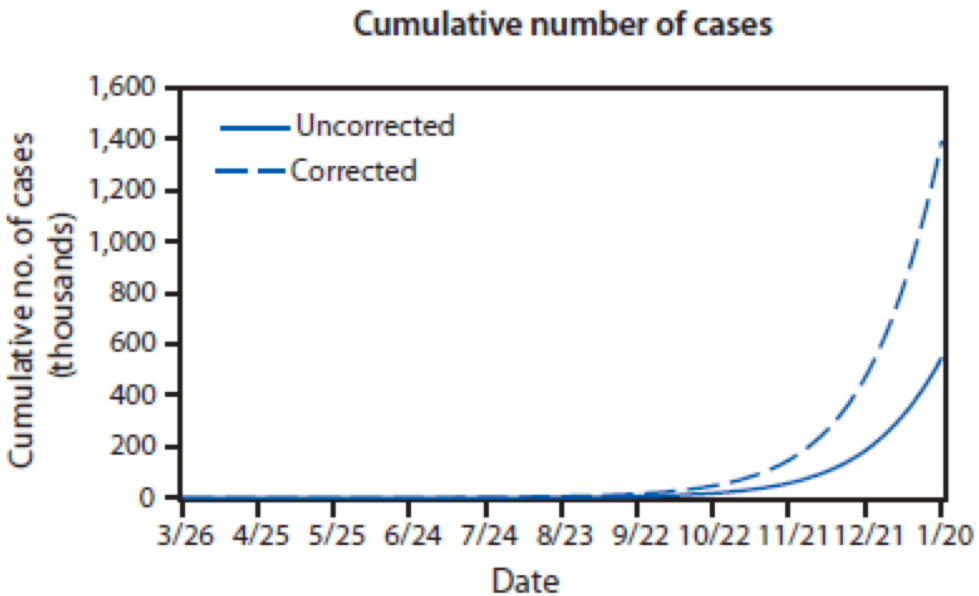
	round 1	round 2	round 3	round 4	round 5	round 6	round 7	round 9	round 11	round 12	round 13	round 14	round 15	round 16
number of models	5	5	4	6	8	9	9	9	8	8	8	6	5	6
turnaround time (days)	58	27	31	34	29	23	16	23	21	11	51	65		39
NPI scenarios	compliance	compliance	compliance	compliance	compliance									
vaccination scenarios	supply	supply	supply	supply	uptake	uptake	uptake	childhood vaccination				uptake	uptake	uptake
variant scenarios		alpha				delta	delta	hypothetical	omicron	omicron	hypothetical	hypothetical	hypothetical	variant mix

Howerton et al., *Nature Communications*, 2023

Evaluation of utility to policy makers

Assess utility by asking recipients of modelling advice?



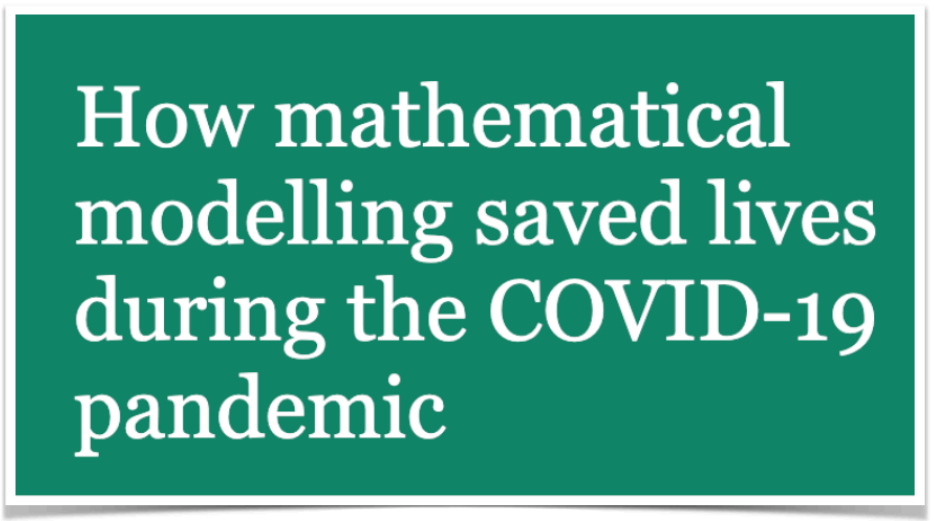
Epidemic Modeling

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



- 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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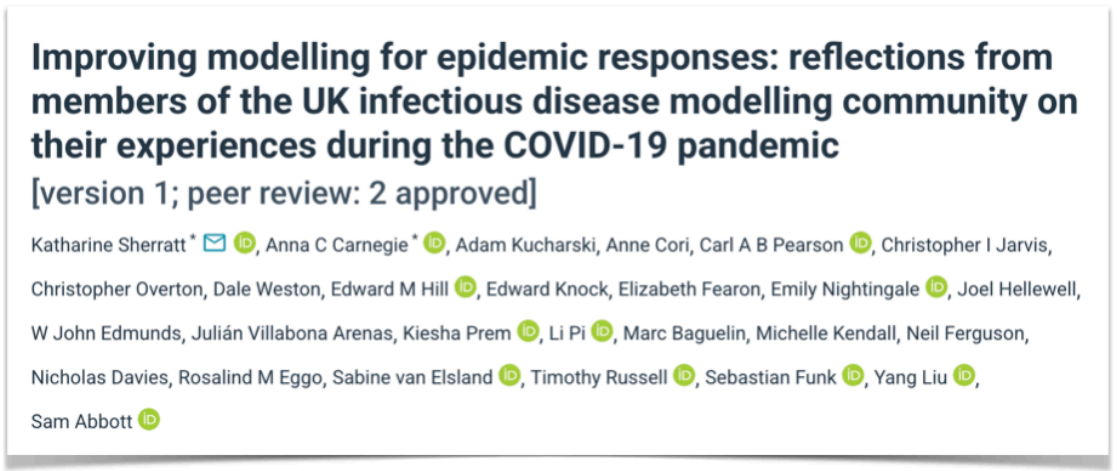
Evaluation of the process



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 directly relate** to 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 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[1], Fatuma Guleid[2], Justinah K Maluni[3], Joyline Jepkosgei[3], Vincent Were[4], So Yoon Sim[5], Raymond Hutubessy[5], Brittany L Hagedorn[6], Jacinta Nzinga[2], Jacquie N Oliwa[3]

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

Authors: Liza Hadley*[ab]; Caylyn Rich[c]; Alex Tasker[d]; Olivier Restif[a]; 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 [d,1], Thomas P. Van Boeckel [c,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