COVID-19 modelling & open outbreak science

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INI workshop

May 2020

centre for mathematical modelling of infectious diseases

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Acknowledgements

CMMID COVID-19 working group (order generated randomly):

Jon C Emery, Graham Medley, James D Munday, Timothy W Russell, Quentin J Leclerc, Charlie Diamond, Simon R Procter, Amy Gimma, Fiona Yueqian Sun, Hamish P Gibbs, Alicia Rosello, Kevin van Zandvoort, Stéphane Hué, Sophie R Meakin, Arminder K Deol, Gwen Knight, Thibaut Jombart, Anna M Foss, Nikos I Bosse, Petra Klepac, Katherine E. Atkins, Billy J Quilty, Rachel Lowe, Kiesha Prem, Stefan Flasche, Carl A B Pearson, Rein M G J Houben, Emily S Nightingale, Akira Endo, Damien C Tully, Yang Liu, Julian Villabona-Arenas, W John Edmunds, Kathleen O'Reilly, Sebastian Funk, Rosalind M Eggo, Mark Jit, Eleanor M Rees, Joel Hellewell, Samuel Clifford, Christopher I Jarvis, Sam Abbott, Megan Auzenbergs, Nicholas G. Davies, David Simons

+ The many colleagues, collaborators & partners working on the response

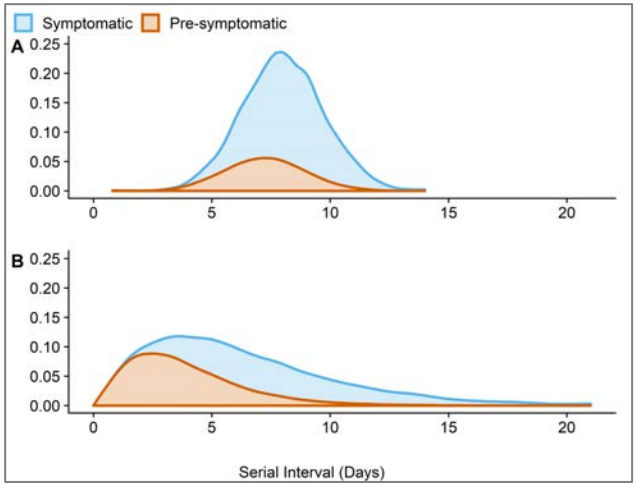
Outline

1. Understanding the infection
2. Exploring control scenarios
3. Situational awareness
4. Open science in outbreaks

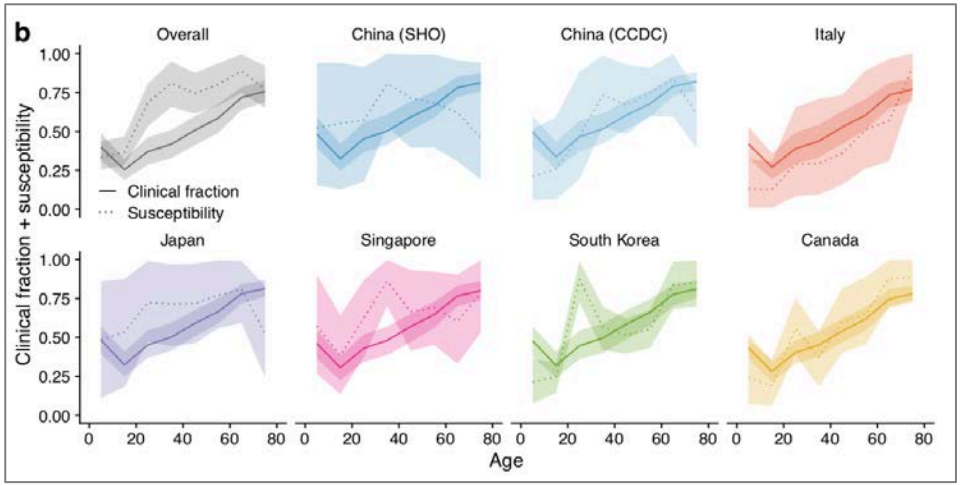
1. Understanding the infection

- Early dynamics of transmission/control in Wuhan
- Estimation of pre-symptomatic transmission
- Infection/case fatality risk estimation
- Age-dependency in symptoms/susceptibility
- Settings linked to transmission
- Length of hospital stay

Pre-symptomatic transmission



Age patterns of severity



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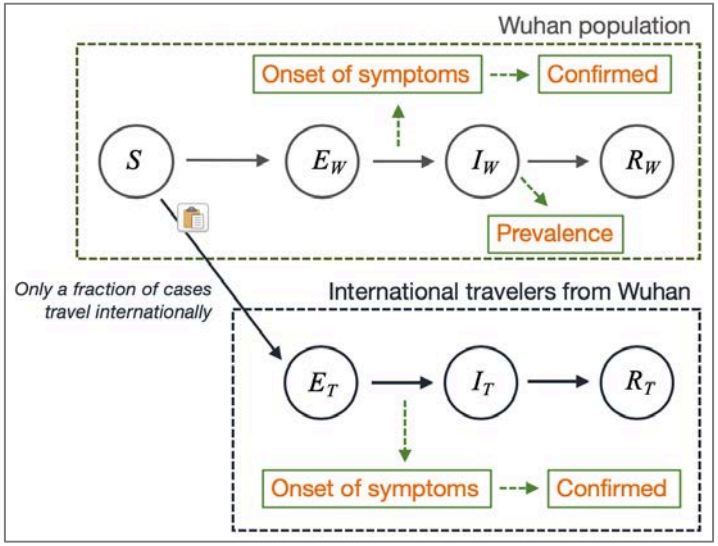
1. Understanding the infection

Some considerations:

- Results often have limited shelf-life (e.g. estimated case fatality risk in absence of serology). Being roughly correct now more important than being precisely correct months later.
- Evidence synthesis: each dataset has caveats, so combine data with models to try and obtain more robust insights
- Design models with expectation that data will arrive (e.g. didn't have subnational data early on, but knew it would come)

Linking domestic/exported cases



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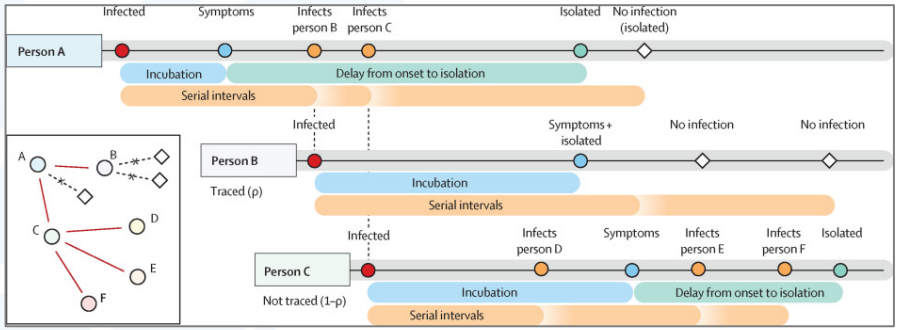
2. Exploring control scenarios

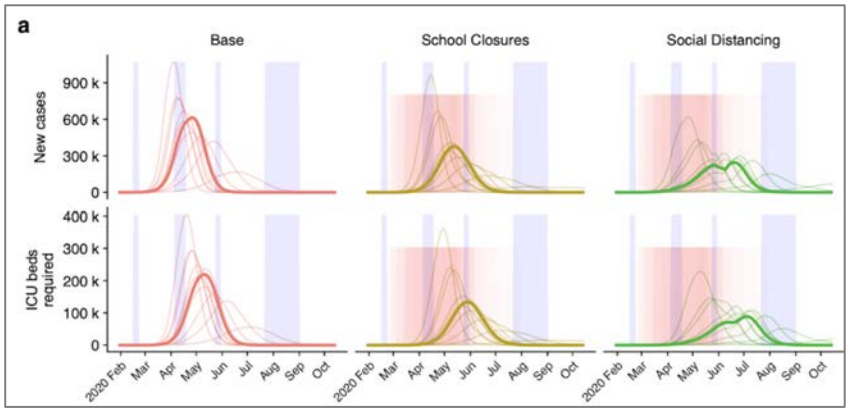
- Case isolation, contact tracing and quarantine
- Traveller screening and follow-up
- Large-scale social distancing strategies

Often focus on UK response (via SPI-M/SAGE) but also extend to other settings

Early isolation/contact tracing modelling



Early UK scenario modelling



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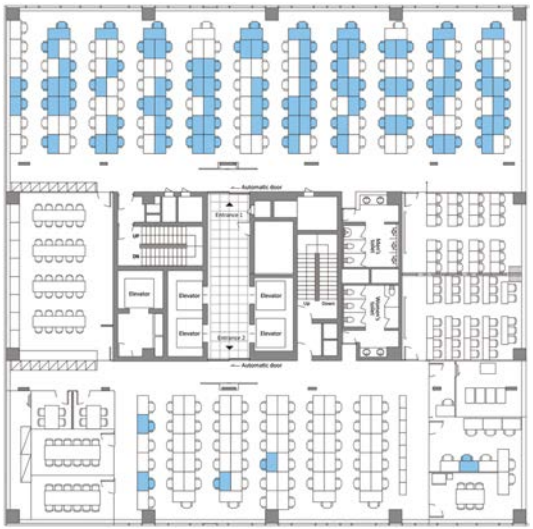
2. Exploring control scenarios

Next steps:

- Evaluation of measures, e.g. Korea/Hong Kong: remote working, school closures, reclosures, testing, contact tracing. Which is most important?
- Exploration of combined approaches, e.g. how can physical distancing complement contact tracing?
- Potential for targeted measures? Increasing evidence R is overdispersed/setting specific. Possible to control without extensive distancing?

Call centre outbreak, Korea



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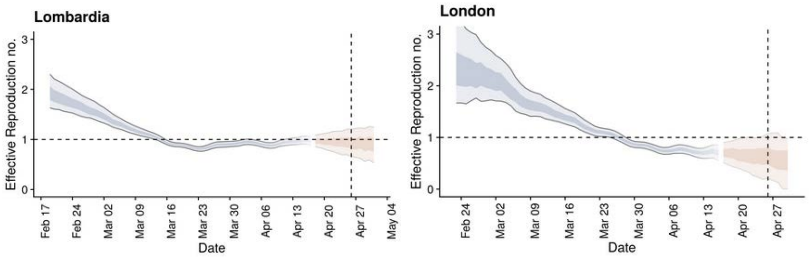
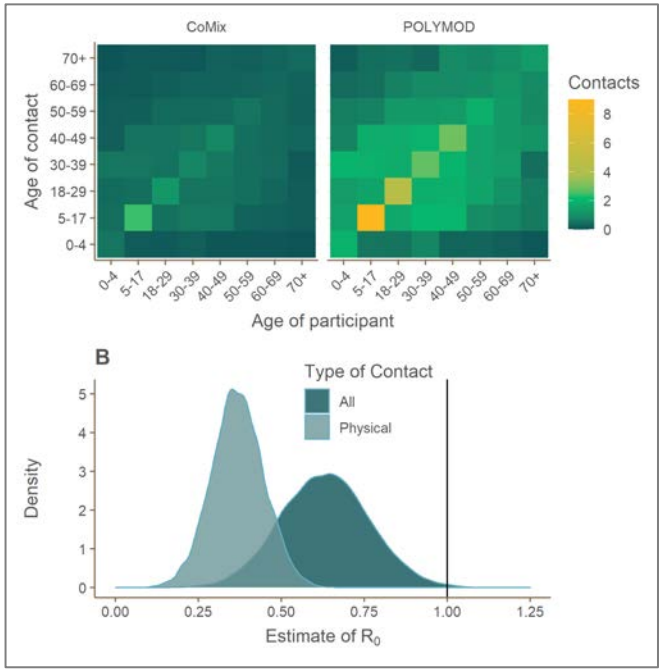
3. Situational awareness

- Estimation of infection curves, R and short-term forecasts
- Inferring undetected epidemics from severe outcomes
- Using cases & deaths to estimate proportion of symptomatic cases reported
- Understand changes in social behavior: contact surveys, Google/Facebook data

R estimation from epiforecasts.io



Real-time social mixing surveys:



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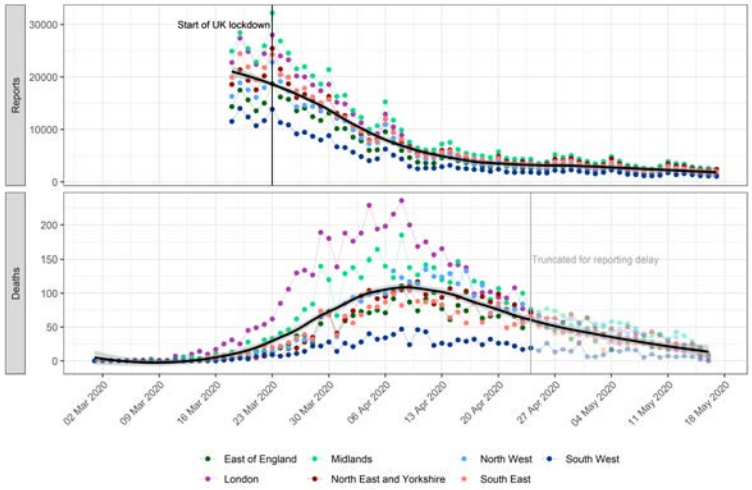
3. Situational awareness

Some applications:

- Estimates of dynamics can inform:
  - planning relaxation of measures
  - post-lockdown monitoring
- Estimates of true case numbers can inform:
  - testing/contact tracing requirements
  - planning surveillance/serosurveys
  - imported case risk

Using NHS calls (111/999) to estimate dynamics



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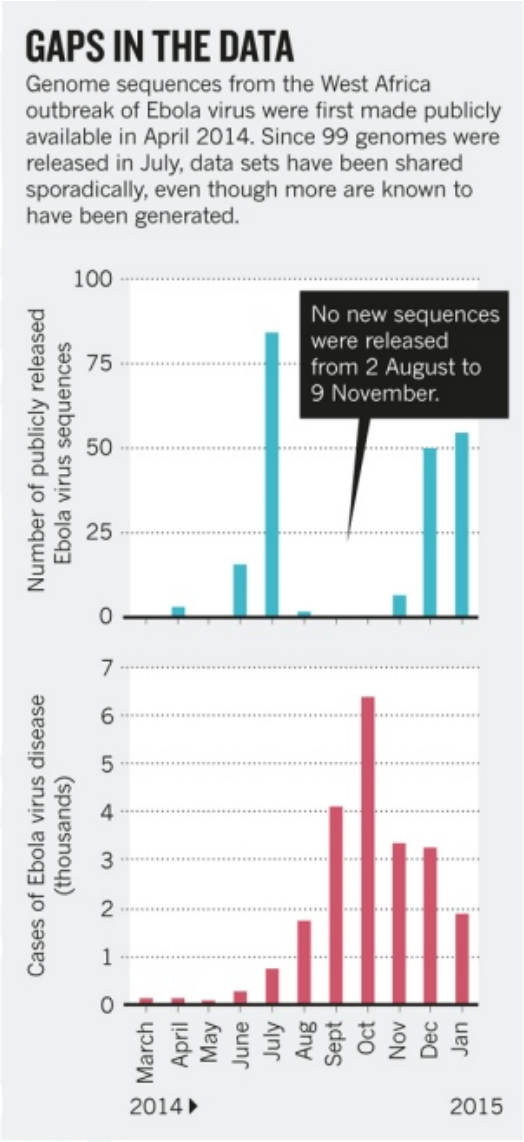
4. Open science in outbreaks



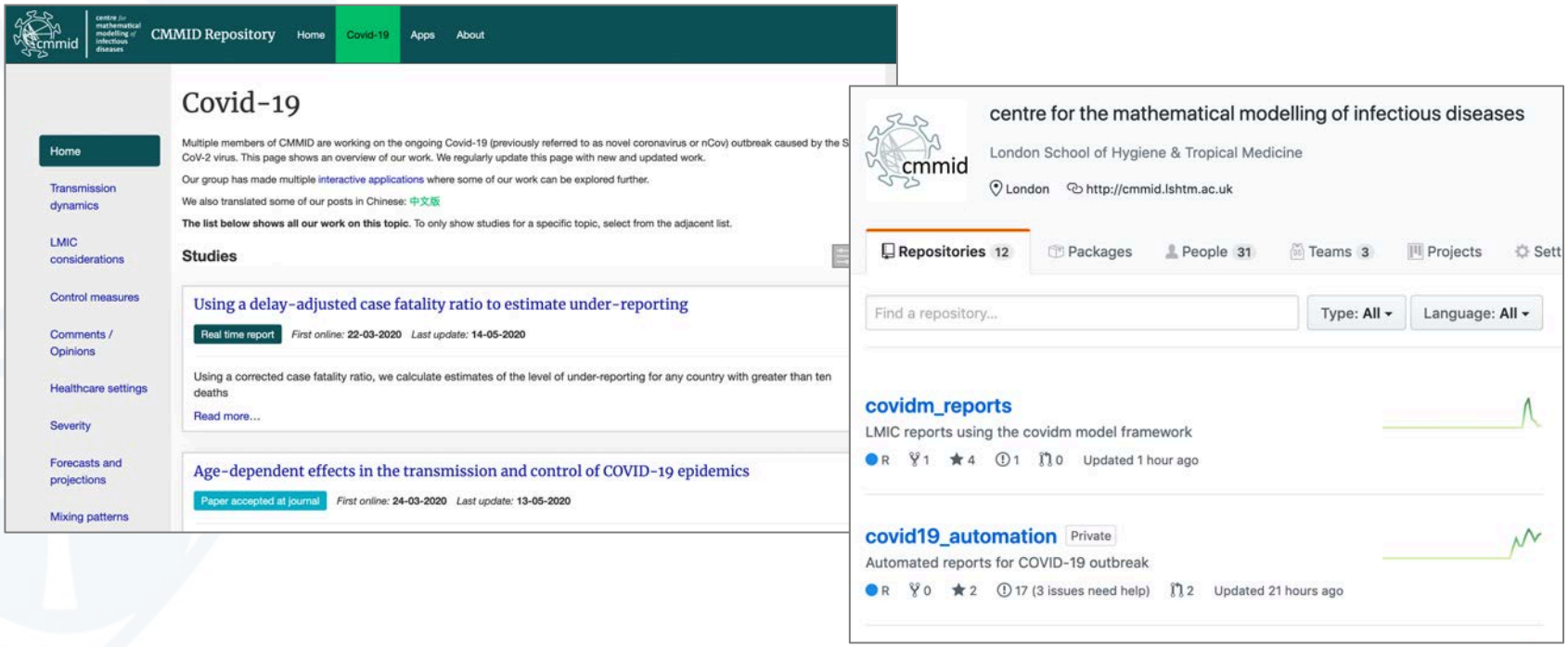
Yozwiak et al Nature, 2015

Outbreak science needs to be:

- Fast
- Open
- Collaborative
- Peer-reviewed

Fast research

- Traditional journals too slow in fast-moving outbreak
- Noticed pre-print servers quickly overwhelmed, ~5-day processing time
- Set up dedicated online repository – went live on 28th Jan
- For papers, generally simultaneous upload + pre-print + journal submission



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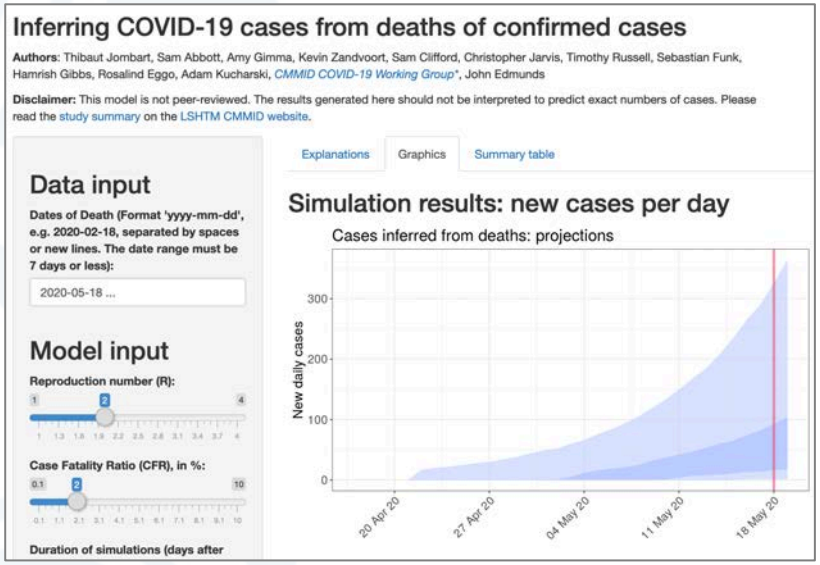
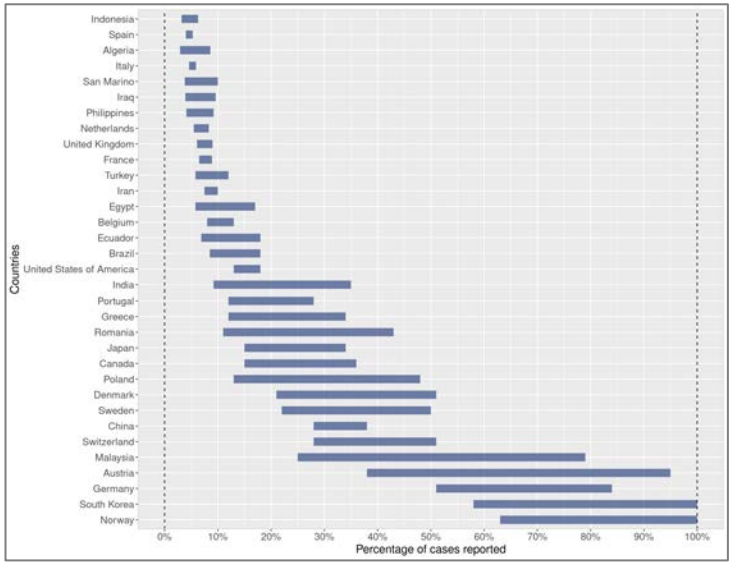
Open research

- Aim to make all code & data available alongside reports/papers
- Dashboards/apps can share early results while follow-up analysis happening





- Also strongly encourage code adaptation/reuse (+ support where possible)

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Collaborative research

- During outbreaks, lots of important work not always visible or publishable (e.g. data extraction/cleaning, literature reviews, code maintenance).
- Created 'CMMID COVID-19 working group' to ensure every resulting output credited this large team
- Major contributors to specific papers are named as authors, working group covers all other contributions
- Where possible for external dissemination/media: "if you've done the work, you present the work"

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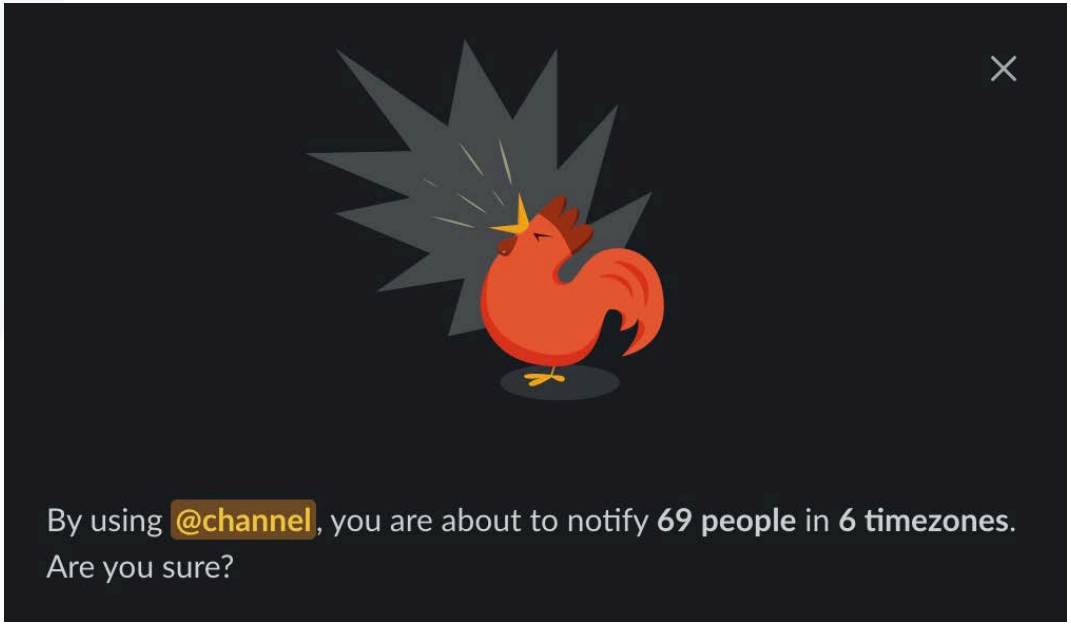
Peer-reviewed research

- Before any CMMID analysis goes online, undergoes 'internal peer-review' by working group. Also submit to traditional journals.
- Internal review: post Google doc on Slack with ~48-hour deadline for comments. Crowd sources feedback so no one person has large review burden.
- Work doesn't go online until major comments/revisions are addressed.



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Summary

Outbreak modelling useful in many ways:

1. Understanding the infection
2. Exploring control scenarios
3. Situational awareness

Open science in outbreaks has made progress, but still long way to go…

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