Using R for mathematical modelling of SARS-CoV-2

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5 May 2022

Throughout the pandemic, ongoing questions about who should be prioritised for vaccine delivery, e.g.:

➢ Within countries (e.g. healthcare workers, the elderly, working-age, priority groups)?

➢ Equitable and efficient global distribution of doses?

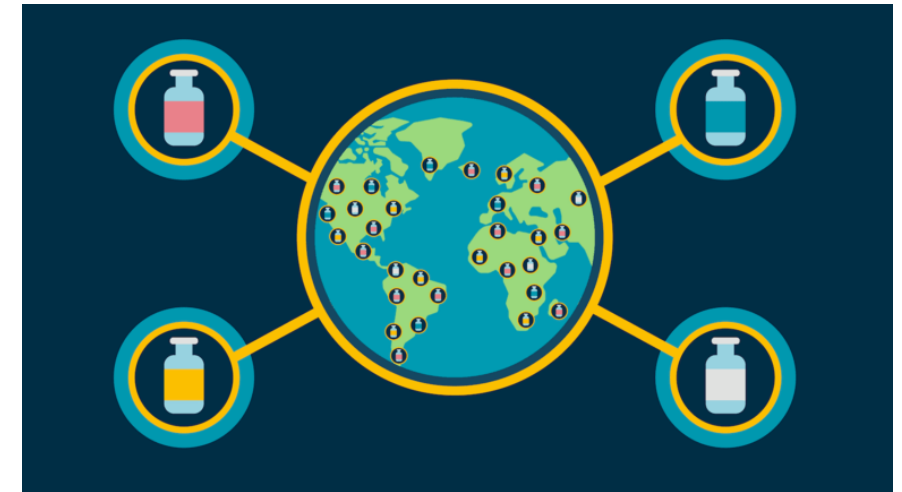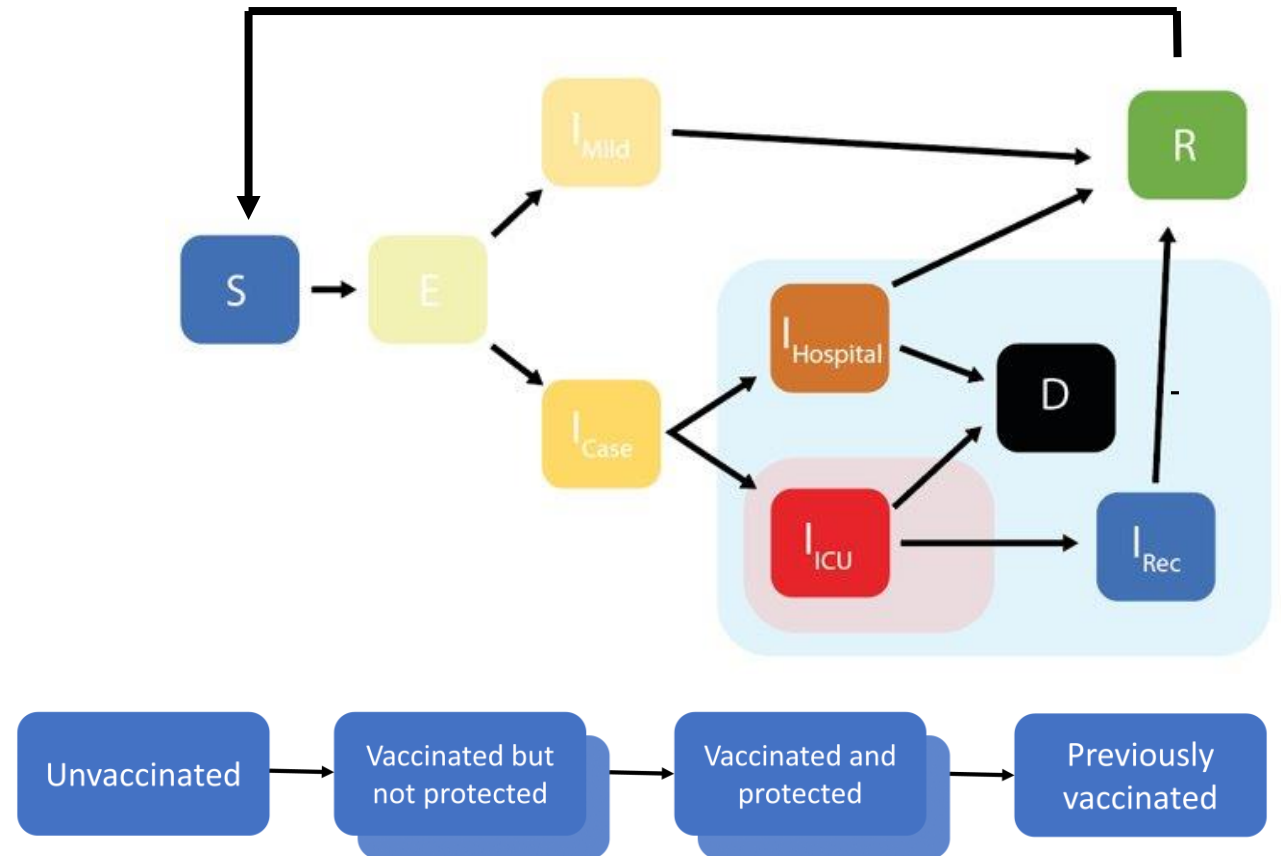➢ How to allocate doses once program is underway?

Image credit: wellcome.org

SARS-CoV-2 transmission model

- Age-structured deterministic SEIRS model (17 five-year age groups) with expanded healthcare component
- Age-dependent disease severity
- Setting-specific healthcare capacity, contact patterns, and demography
- Vaccination incorporated by replicating compartments across vaccine states
- Vaccines:
  - modes of action (infection, disease, and transmission)
  - age-targeting and prioritisation
- Fully open source as an R package

https://github.com/mrc-ide/nimue

Package developers: Oliver Watson, Patrick Walker, Charlie Whittaker, Peter Winskill, Giovanni Charles

Patterns of mixing between age-groups.

Age structure (UN World Population Prospects)

Setting specific healthcare capacity –for both general hospital and ICU beds.

Age- and healthcare-capacity-dependent COVID-19 mortality
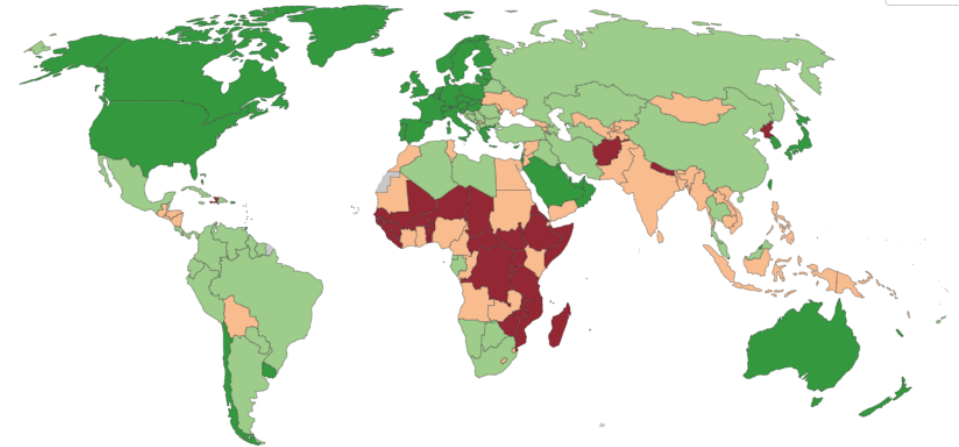
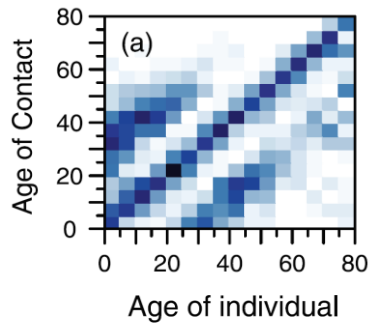Walker, Whittaker, Watson *et al*. Science, 2020

World Bank's Income Groups, 2016
The World Bank's income classifications split countries into one of four categories determined by the country's gross national income (GNI) per capita in US$. The GNI thresholds between income groups has changed through time based on World Bank definitions.

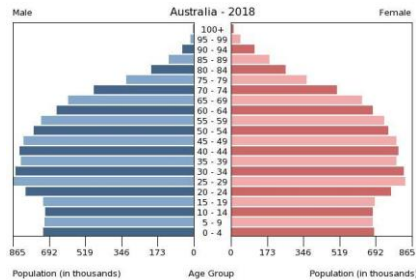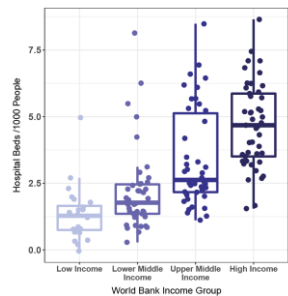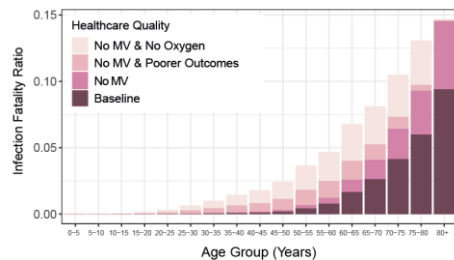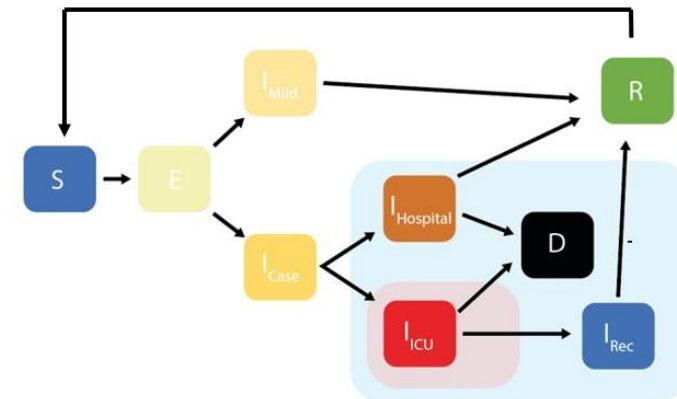High income   Low income   Lower-middle income   Not categorized   Upper-middle income

Acknowledgements

Peter Winskill

Oliver J Watson

Patrick G T Walker

Charles Whittaker

Marc Baguelin

Katy A M Gaythorpe

Giovanni Charles

Farzana Muhib

Katharina Hauck

Neil M Ferguson

Azra C Ghani

Imperial College

COVID-19 Response Team

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Professor Azra Ghani

Charlie Whittaker

Giovanni Charles

Dr Oliver Watson

Resources

- Code for today's session:

https://github.com/abhogan/covid_model_workshop

- Paper on which today's modelling is based:

https://www.sciencedirect.com/science/article/pii/S0264410X21004278?via%3Dihub

- Code base for the paper above:

https://github.com/mrc-ide/covid_vaccine_allocation

- Documentation for the package *nimue:*

https://mrc-ide.github.io/nimue/