Kao group and COVID – lessons learned

Dr Anthony Wood

CERSE Meeting, Roslin Institute

31 May 2023

Me

- *2011 - 2015* **MSci Theoretical Physics** (Nottingham)
- *2015 - 2019* **PhD Theoretical Physics** (Edinburgh)
  - *Nonequilibrium statistical mechanics*
  - *Mathematica, MATLAB, pen and paper*
  - Learned: how to go about solving a problem

- *2019 - 2021* **Industry** (fintech)
  - Automating *reconciliation* of trading data from different sources (traders, banks, Bloomberg etc)
  - *SQL, Excel*
  - Learned: how to deal with high-freq/high-volume/messy/"real" data

- *2021 -* **Postdoc @ Roslin, Kao group**
  - Applying data science to understand patterns in infectious diseases
  - *R*
  - Learned: how to pull insightful things from data

Kao group

Mix of vets, mathematicians, physicists, software engineers, computer scientists

Present

- **Rowland Kao**
- **Anthony Wood**
- **Tijani Sulaimon**
- **Anna Gamza**
- ☆ **Chris Banks**
- **Ewan Colman**
- ☆ **Aeron Sanchez**
- **Muhammad Bilal**

☆ **Software Engineers**

Past

- Paul Bessell
- Anne-Sophie Ruget
- ☆ Tom Doherty
- Sam Lycett
- Gianluigi Rossi
- Jess Enright
- Gavrila Puspitarani

Collaborators

- Anne Marie MacKintosh
- Martine Stead

Models of infectious disease transmission (often informed by "big" data)

- **Networks**
  - Derived from populations, trading patterns, sewers, commutes, Twitter…
- **Genetic sequences**
  - Comparing samples to infer who-infected whom

Current diseases

- Rift Valley fever
- Avian influenza
- Bovine viral diarrhoea
- "Rumours and behaviour"
- Bovine TB
- COVID-19

What happened in COVID-19?

Kao group

- **Early access** to detailed data
- Experience in disease modelling

Kao group

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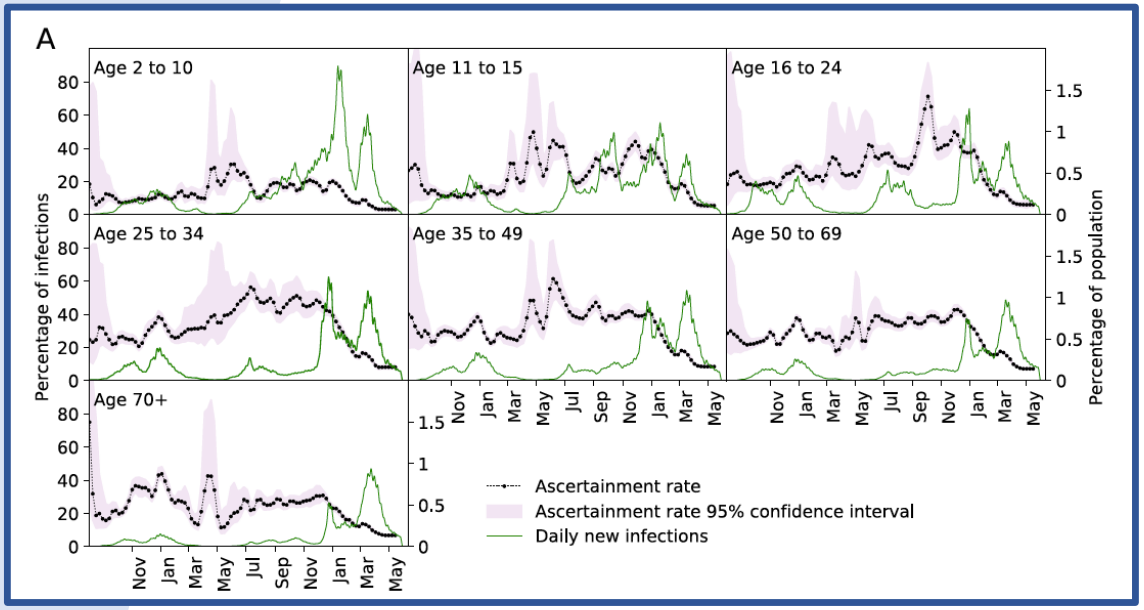
Modelling case ascertainment
Estimating true number of infections as opposed to cases

Colman et al. 2023
Journal of Theoretical Biology
https://doi.org/10.1016/j.jtbi.2022.111333



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Real-time analysis of COVID-19 outcomes
Emphasis on variation with socioeconomic deprivation

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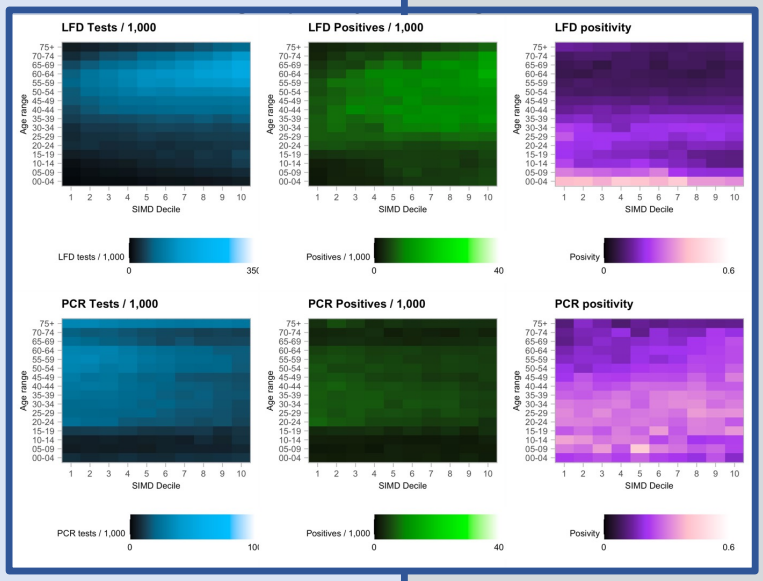

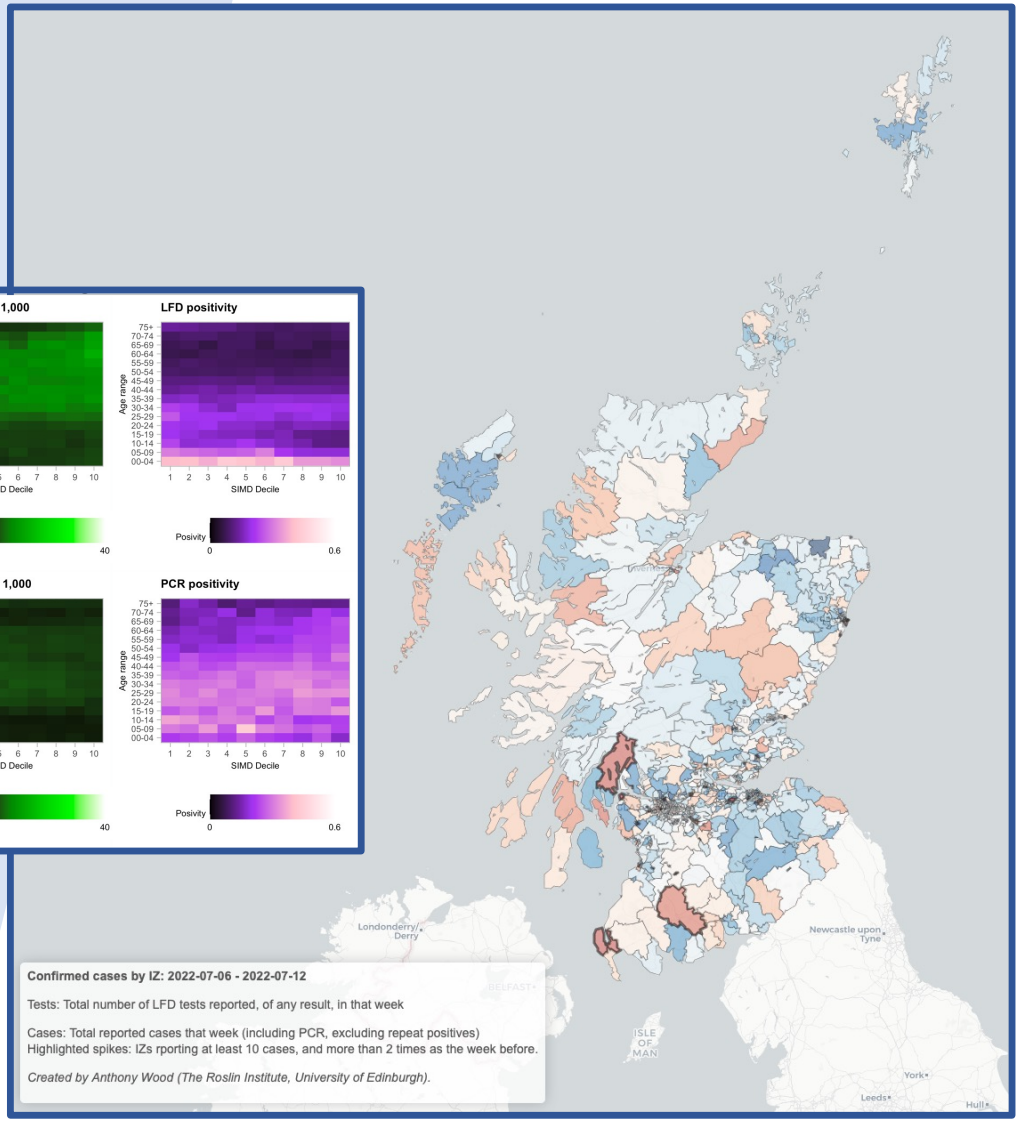

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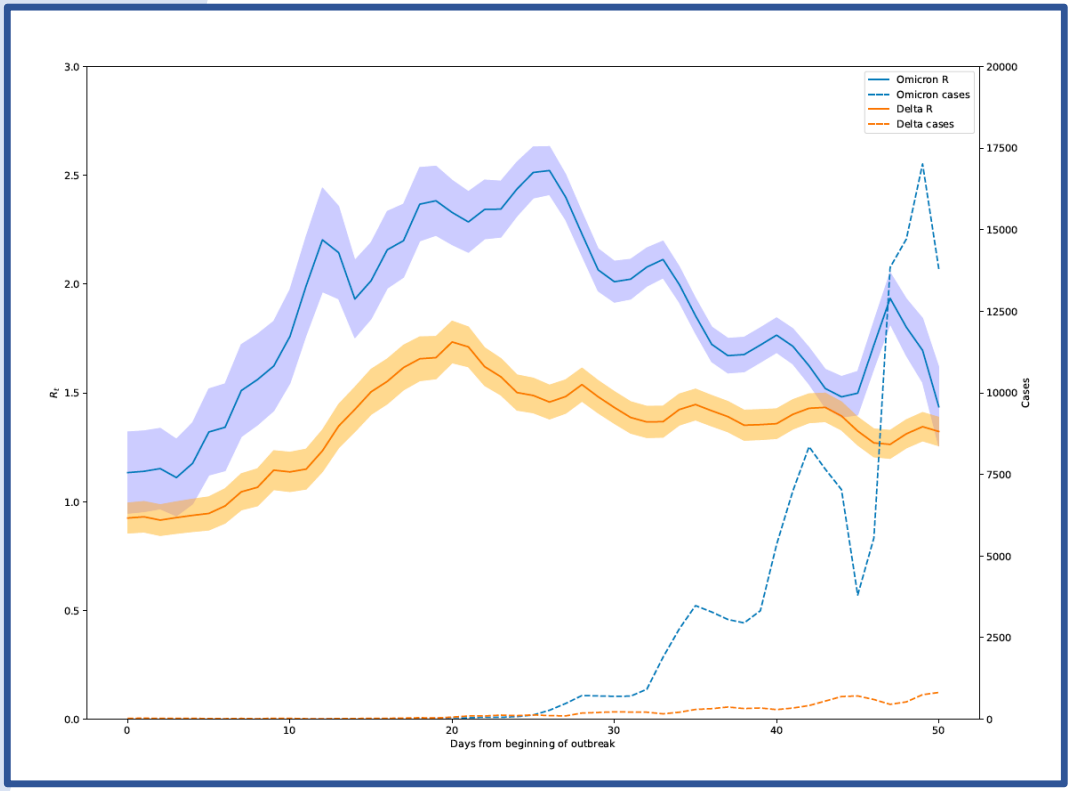
R-value estimates

Using existing case numbers to estimate past + present R-value locally

Chris Banks, Aeron Sanchez



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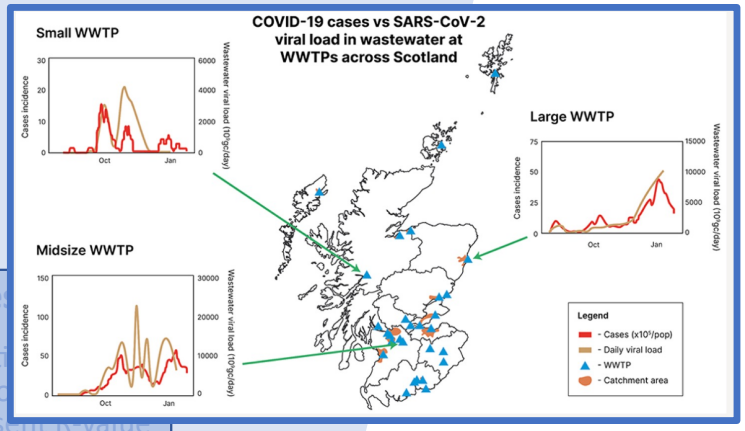
Prevalence vs shedding concentration

Optimal monitoring strategies with limited budget

Fitzgerald, Rossi et al
Environmental Science & Technology
https://doi.org/10.1021/acs.est.1c05029



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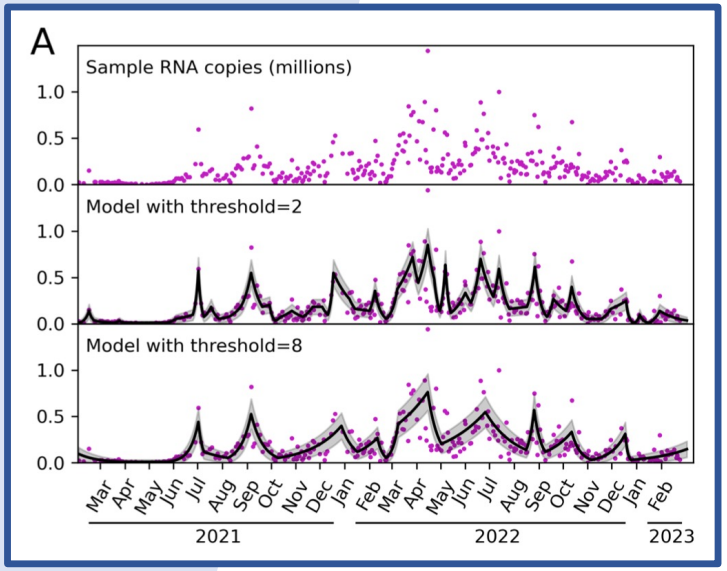

Anthony Wood, Jess Enright, Rowland Kao
Ongoing work

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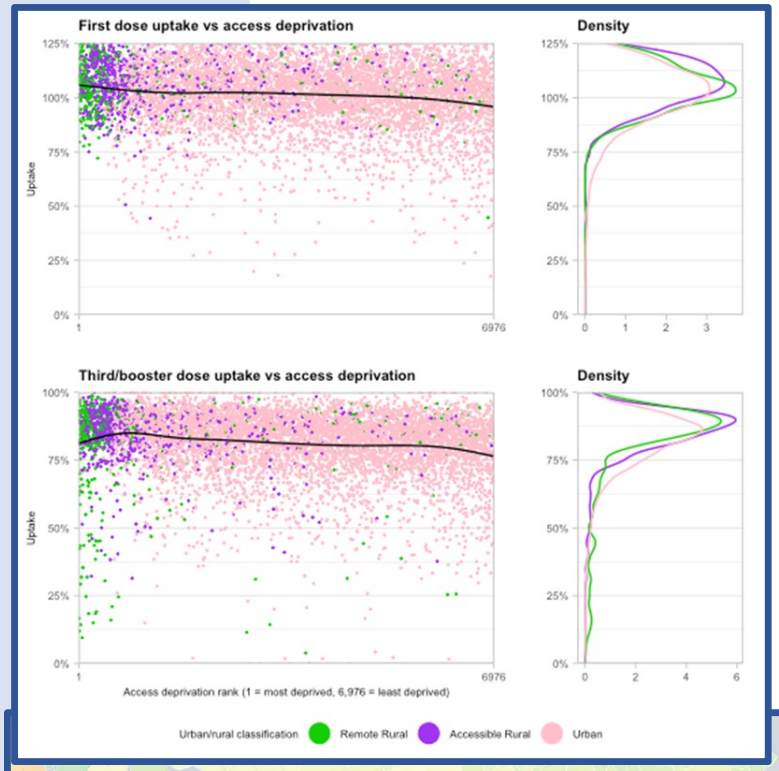
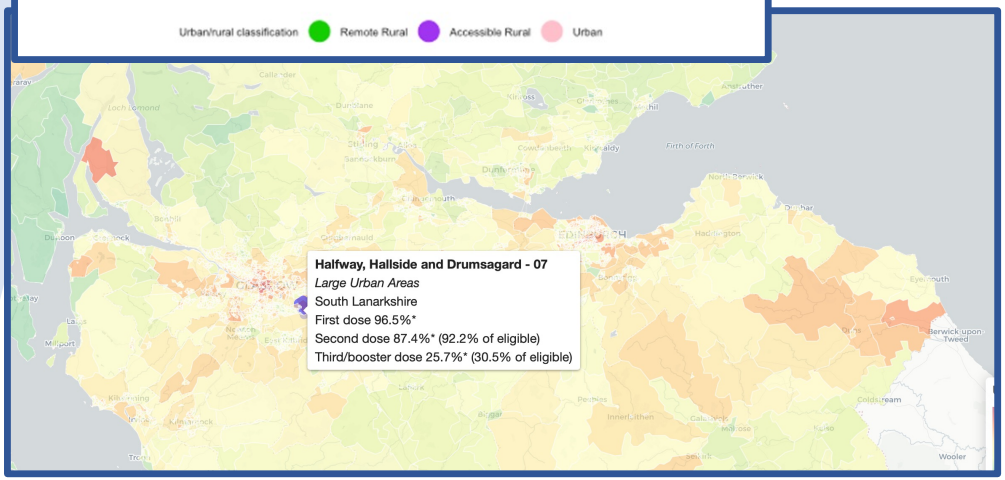


Anna Gamza *(in prep.)*



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Predictive models of future vaccine uptake
Predicting variation in uptake "fall-off" with future boosters

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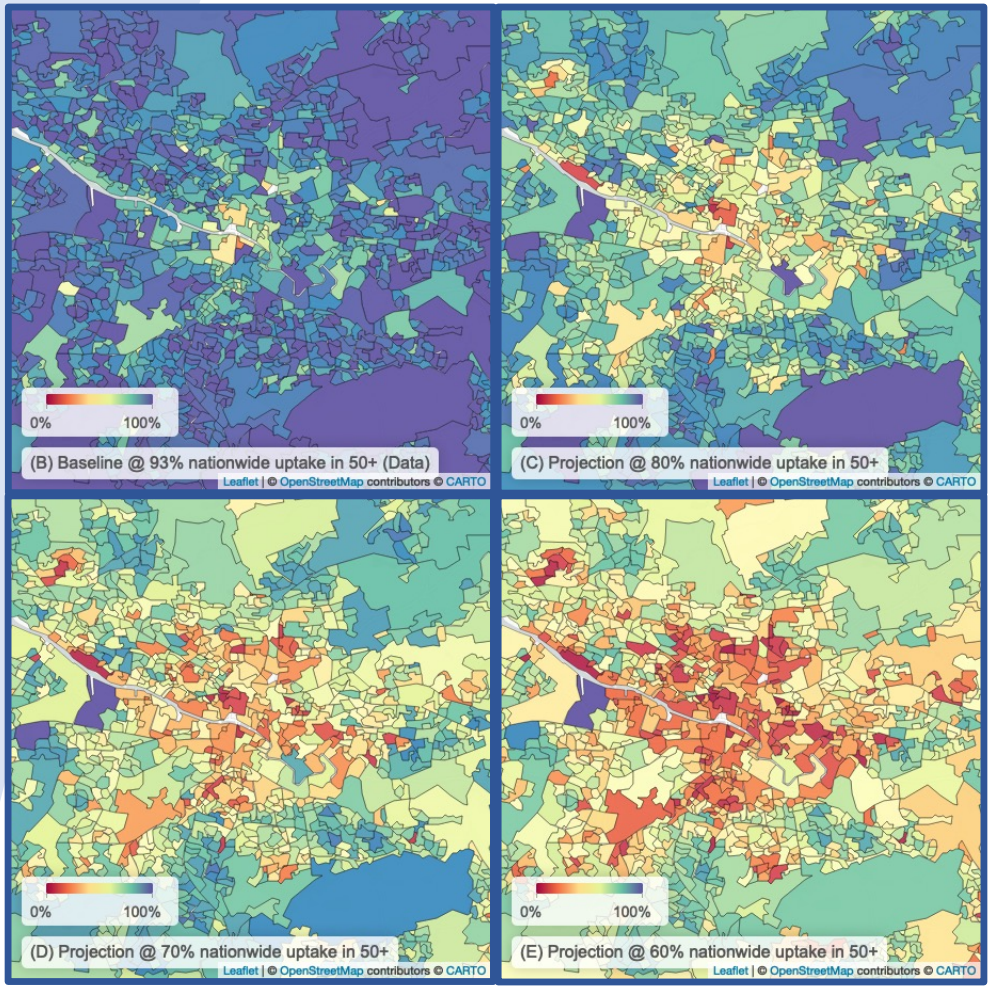

Predicted vaccine uptake in Central Glasgow

Kao group

- **Early access** to detailed data
- Experience in disease modelling

SCoVMod: Scotland's Coronavirus Model

Individual-level model of disease spread across Scotland

Forecasts under different restrictions

Cattle disease model, rapidly adapted (early 2020) to COVID/humans by RSE

- Test driven development
- Paired programming

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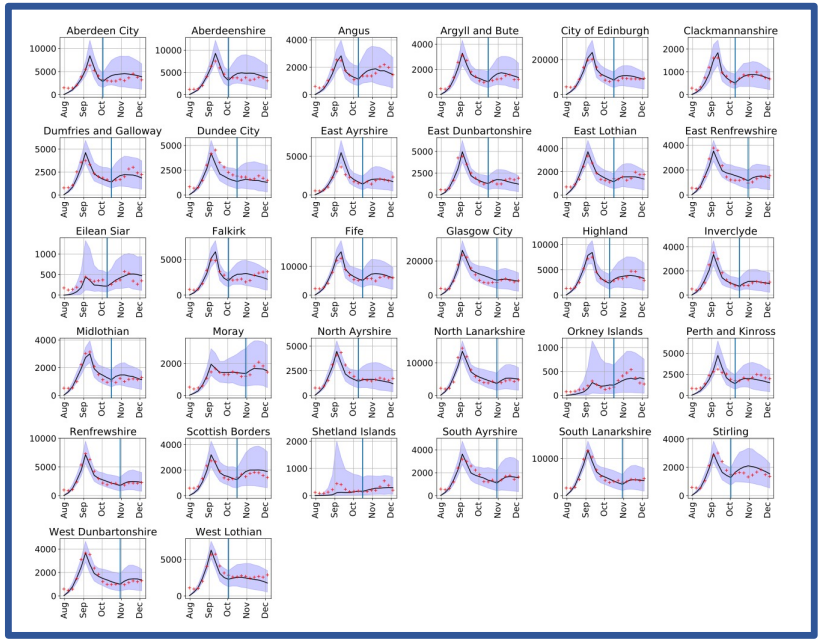

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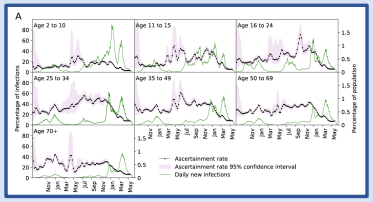

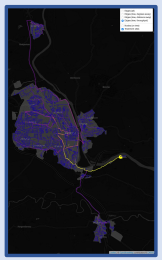

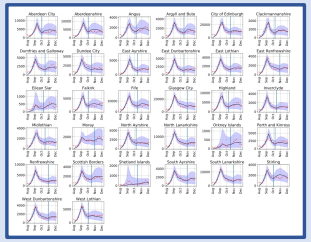

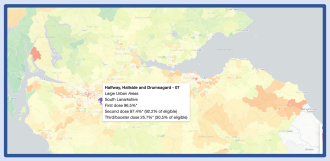

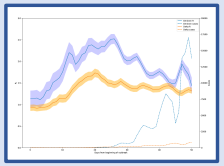

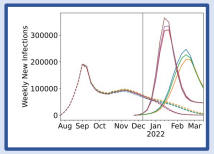

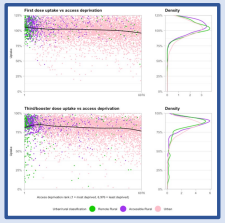

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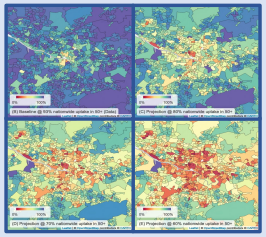

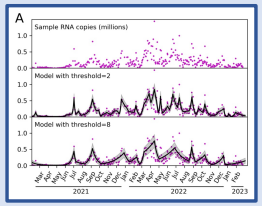

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Weekly
Daily
Ad-hoc

- **SPI-M / SAGE**
- **Public Health Scotland**
- **Scottish Government**

Coronavirus lockdown 'avoided thousands of deaths' in Scotland

30 June 2020

By David Cowan
BBC Scotland

A study has suggested between 7,000 and 40,000 people could have died from coronavirus in Scotland if the country had not gone into lockdown.

Scientists have tried to estimate would have happened if Scotland had copied the approach taken in Sweden, where a lockdown was not imposed.

Rowland Kao, a professor of epidemiology and data science at Edinburgh University, led the team which carried out the research for BBC Scotland.

He said: "An obvious question to ask is if Scotland had done something similar to Sweden, would we have had a similar outcome without all the restrictions."

Although there was no lockdown, Sweden relied on voluntary social distancing, banning gatherings of more than 50 people and halting visits to elderly care homes.

"We took the relative amount of transmission going on in Sweden, translated that over to Scotland and looked at what the resultant number of deaths would have been had we taken that approach."

Scottish Government
Riaghaltas na h-Alba

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Publication - Research and analysis

Coronavirus (COVID-19): modelling the epidemic (Issue No.107)

Published: **1 September 2022**
From: Director-General Health and Social Care
Directorate: Constitution Directorate
Part of: Coronavirus in Scotland
ISBN: **9781804359105**

Latest findings in modelling the COVID-19 epidemic in Scotland, both in terms of the spread of the disease through the population (epidemiological modelling) and of the demands it will place on the system, for example in terms of health care requirement.

Supporting documents

This document is part of a collection

one Disclosure

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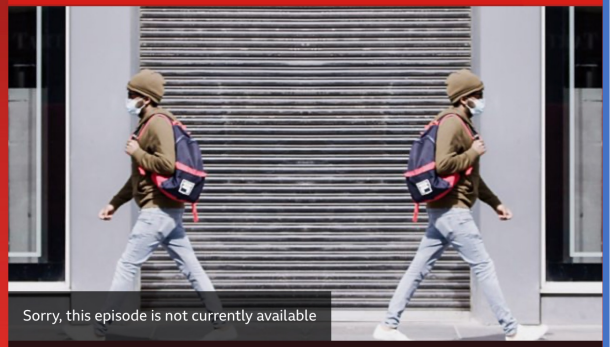


Sorry, this episode is not currently available

Scotland's Lockdown

Series 2

Investigation into government handling of the Covid 19 pandemic. Reporter Mark Daly investigates the decisions made and asks whether Scotland could or should have locked down sooner. Disclosure speaks to scientists desperate to keep us safe and meets the families hardest hit by the virus.

29 minutes

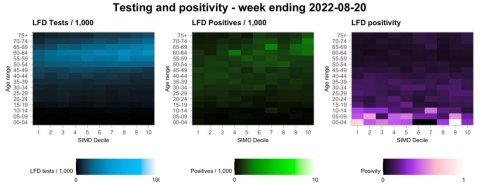
Summary of spatial analysis of Covid-19 spread in Scotland

Researchers at the Edinburgh Roslin Institute have conducted spatial analysis of COVID-19 Spread in Scotland. A summary of findings from data up to 25th August 2022 is included here.

Rates of LFD and PCR testing are stabilising, albeit at very low levels (1-2 LFD tests reported, per week, per 1,000).

The distribution of lateral flow/LFD tests being reported varies substantially by both age and deprivation status, with many fewer tests reported in younger adults across all deciles of deprivation, and for children in more deprived deciles. The high level of LFD positivity in the latter category is marked, and when compared to the high number of positives amongst the least deprived, suggests that ascertainment may be lower in younger people in deprived areas.

Figure 11: Variation in testing outcomes comparing Lateral Flow and PCR testing considering age and deprivation status of the data zone of record based on data in week ending 20th August 2022



My experience

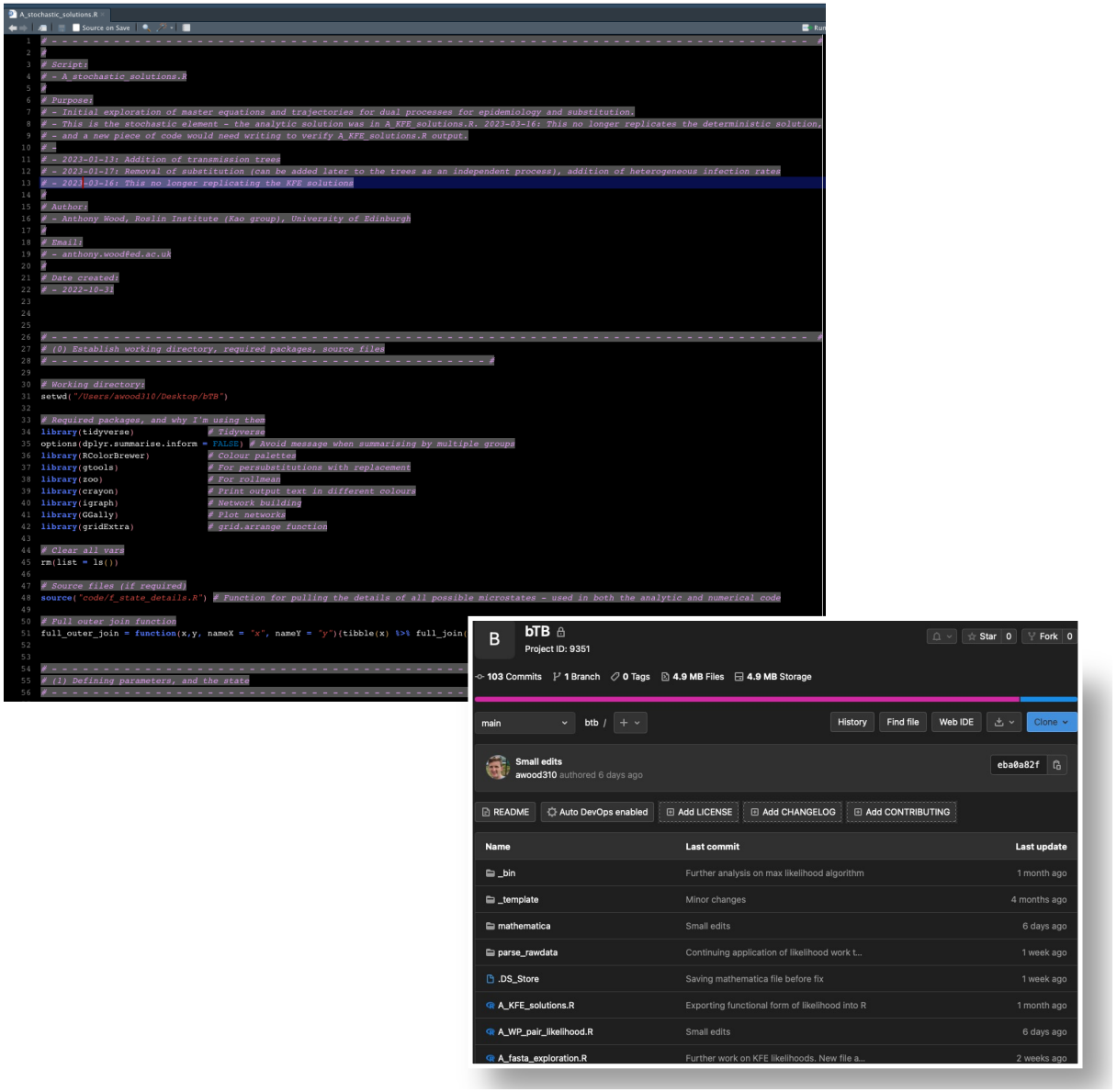
Notable development in my programming

- from smaller, self-contained code to perform simpler tasks

to

- "large", complex scripts that
  - Are central to work that ends up in peer-review
  - Require extreme care with storage of data
  - Have spin-offs with short turnarounds

- Essential that the work is **reproducible**
  - My process for COVID was good *enough*, but very manual and caused some headaches later on

Resolutions

- At the start of a new project, take time to set up processes for **version control**, **sharing**, standardising of **code structure**
- Essential for my next project: The *aim* is to develop methods to be used by others!
- 2-3 days spent at the start of a project learning some basic git commands saves weeks later on!