A simulation modelling toolkit for organising dialysis services during a pandemic

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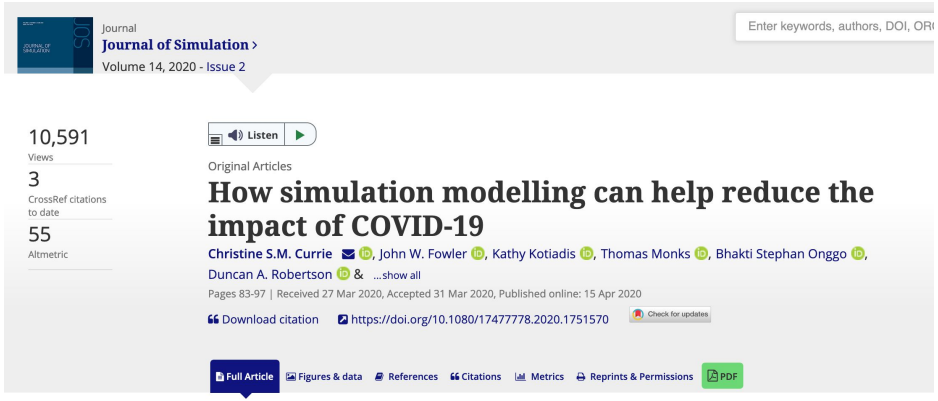
Paper: bit.ly/covid-sim-dialysis

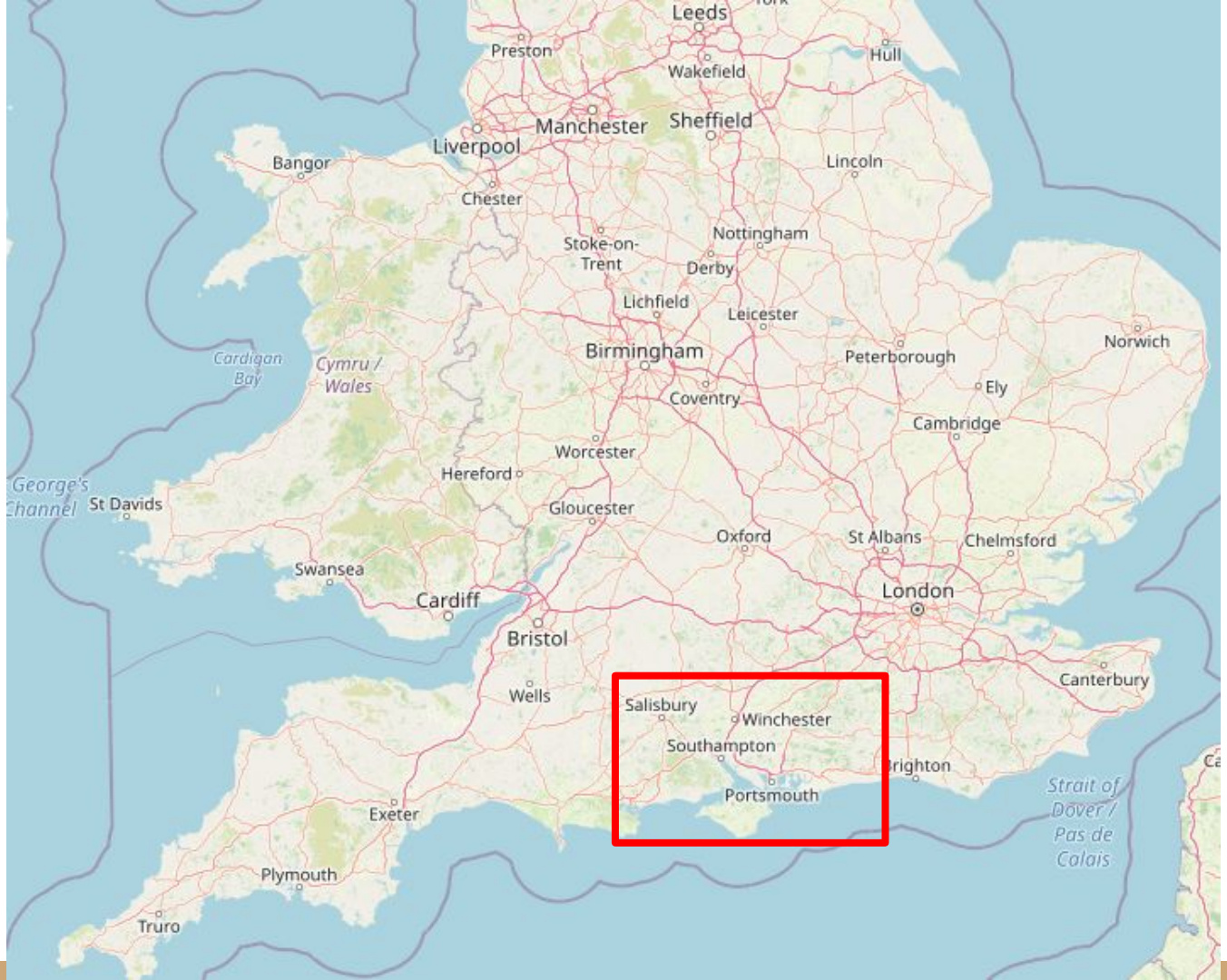
GitLab: bit.ly/dialysis-code



bit.ly/covid-simulation

Background

- In mid March 2020, the NHS substantially stepped up planning for Severe Acute Respiratory Syndrome corona-virus-2 and the disease it causes COVID-19.
- The NHS was planning services with the view that 80% of the population would become infected over a 3-6 months period.
- The UK was beginning to social distance, but vulnerable groups of patients such as those that require dialysis still need to travel for treatment and interact with the NHS.
- Infected patients need to be treated separately from uninfected patients.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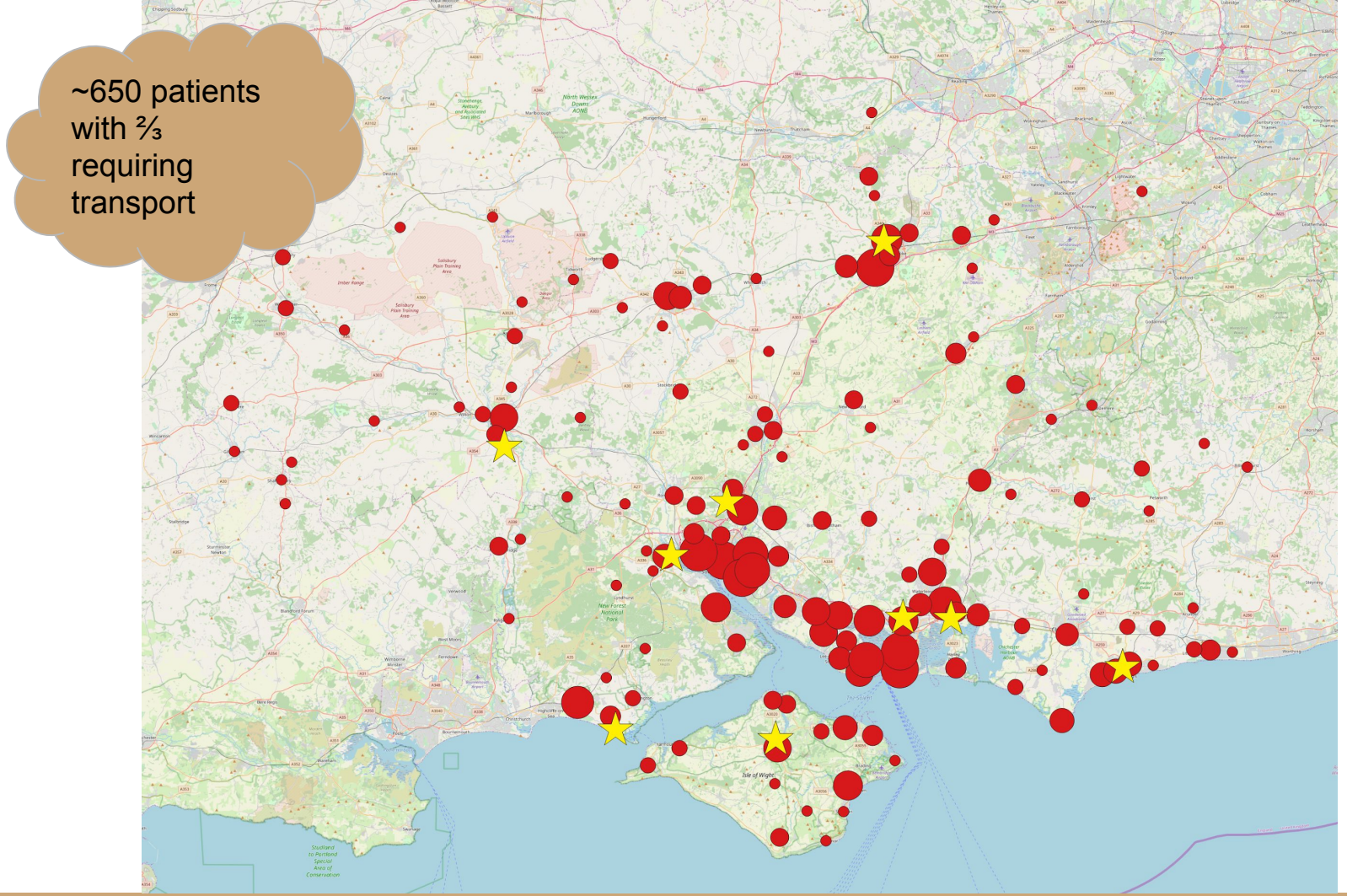

~650 patients with ⅔ requiring transport

Separating infected and uninfected patients

1. A special COVID-19 ambulance to transport one infected patient at a time
2. Centralise outpatient dialysis for infected patients to the largest site
3. While there is capacity allocate separate shifts for infected and uninfected
4. Build a wall

Study research questions and aims

Stress test the NHS service planning under a range of infection scenarios

1. What happens to outpatient and inpatient workload over time?
2. Are the patient transport plans feasible?
3. What impact is there on transport by allowing more than one infected patient in a ambulance?

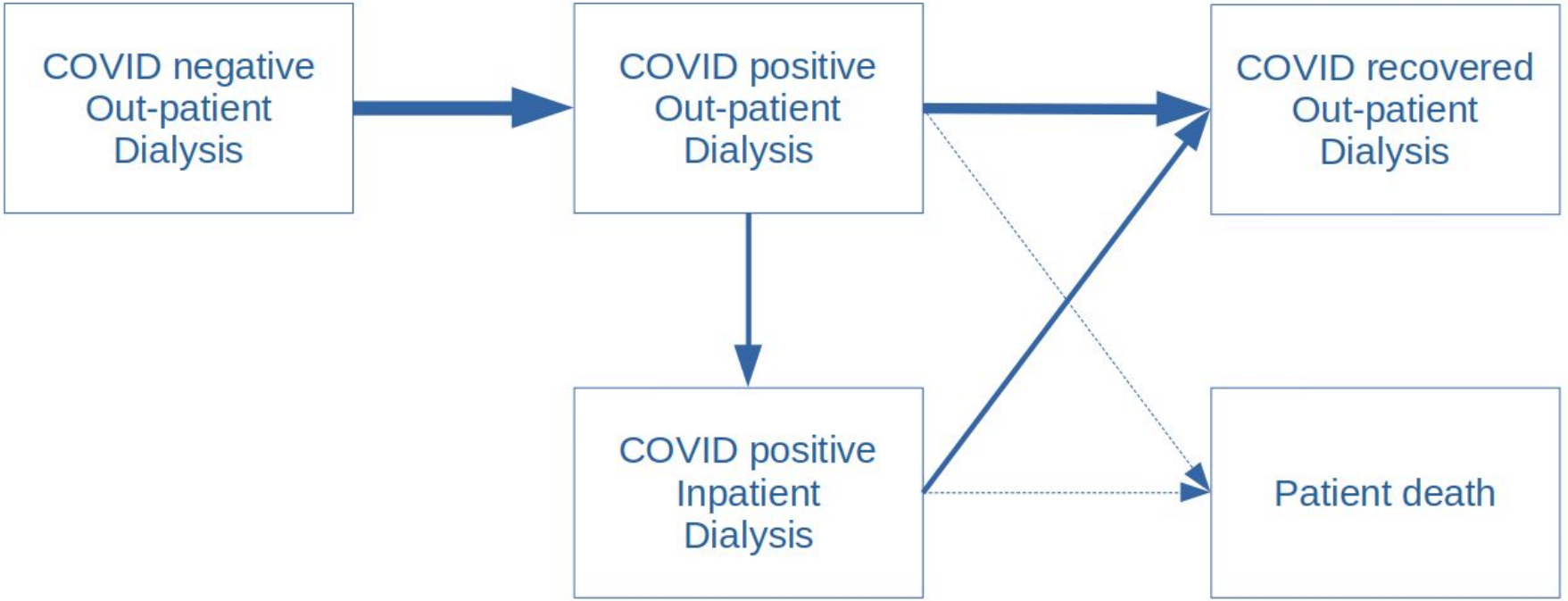
Develop tools that could be used by any dialysis service (in theory).

And … do this all very quickly

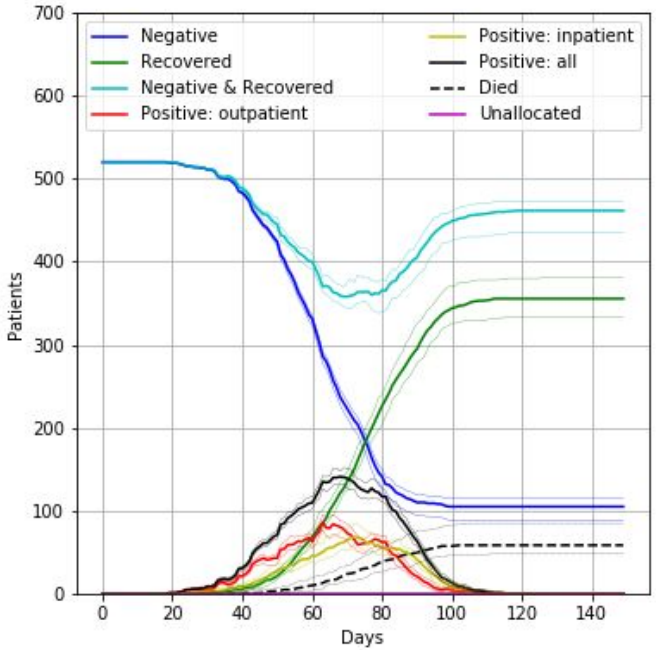
Methods

- Discrete-event simulation modelling of dialysis network workload
- Monte-carlo simulation and **heuristics** to model transport
- We used scenarios to handle uncertainty about the spread of COVID-19

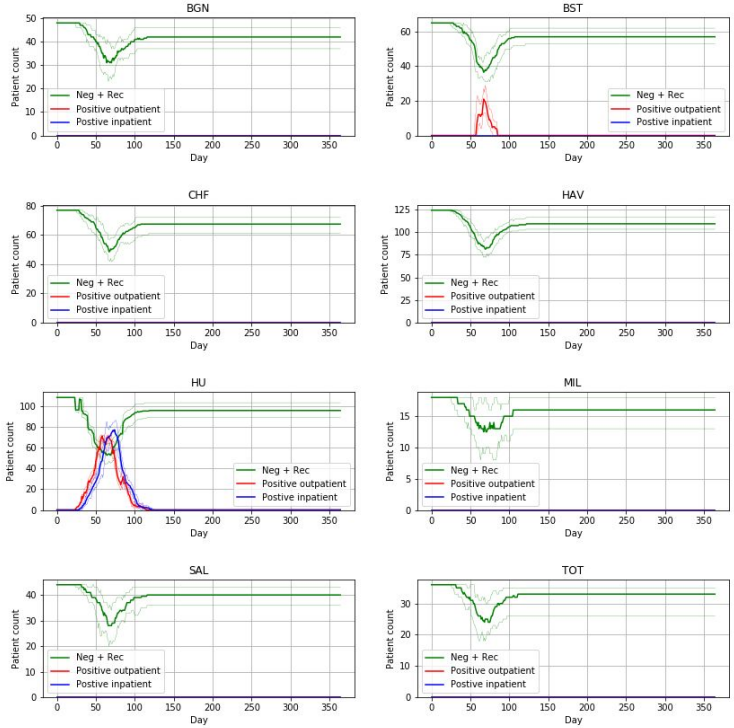
Discrete-event simulation



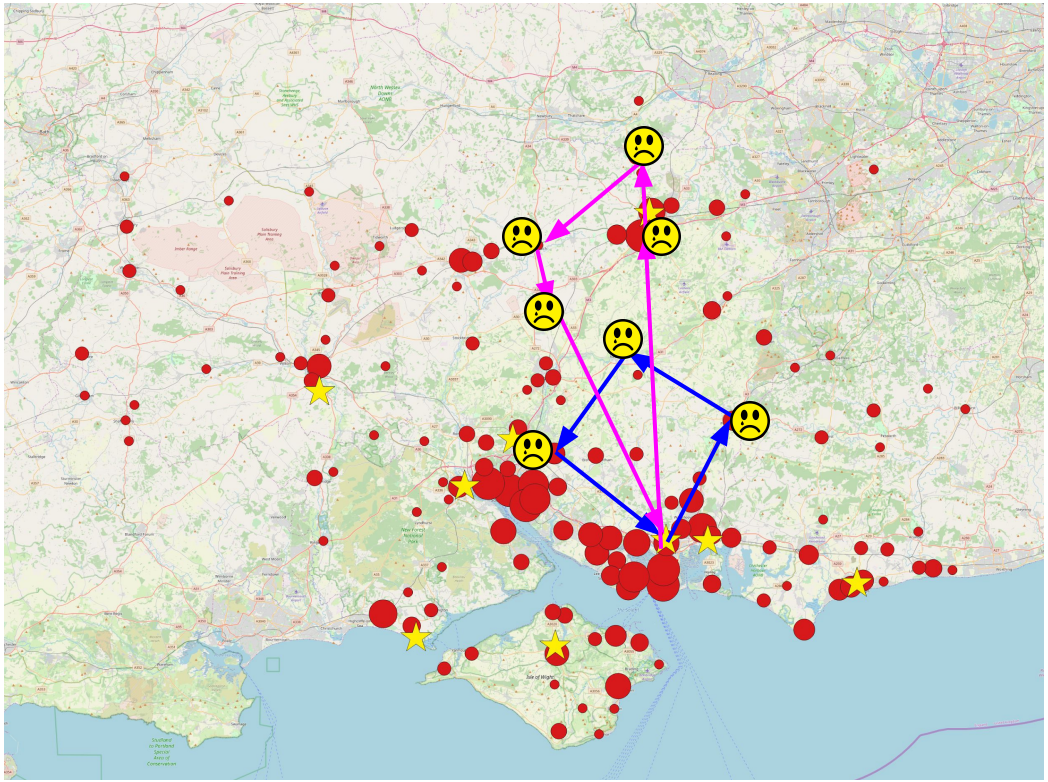
Simulated dynamics of infection



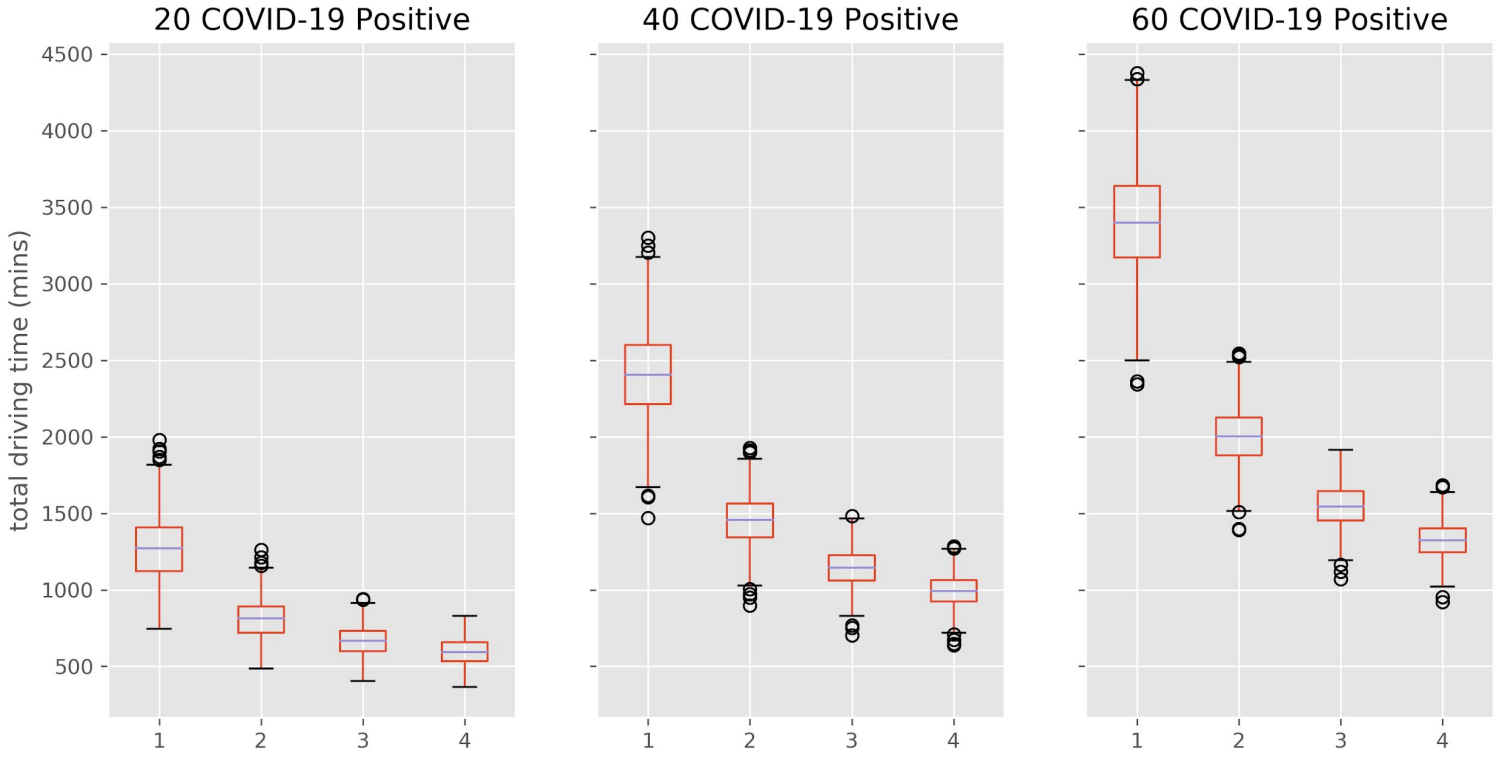
Simulated workload across the network



Patient Transport



Transport results



Findings

- If current outpatient capacity is maintained, the dialysis units should be able to cope with the worst-case scenario of rapid (three month) spread of COVID,
- But there will be overspill to a secondary site and workloads will shift to the central hospital (in the worst case)
- In-patient capacity at the centralised site likely to be breached
- The current practice of transporting COVID-positive patients individually appears unsustainable
- Relaxing policies on individual patient transport to 2-4 patients per trip can save 40-60% of drive time.
- In mixed urban/rural geographies steps may need to be taken to temporarily accommodate renal COVID-19 positive patients closer to treatment facilities.

What actually happened in practice...

- The dialysis service contacted UoE 18th March;
  - An initial web meeting took place on the 20th to scope the work
  - Anonymised data arrived ***within the hour!***
- We agreed between ourselves to deliver preliminary results within a week
  - We achieved that, but the situation evolved rapidly and at the end of week 1 we realised that there were two linked, but separate modelling problems
- To make this work we needed to talk to the NHS every few days
  - That's not always possible in practice, but in this case it worked!
- We delivered a full report on the 2nd April (2 weeks!)

Thanks for listening

GitLab: bit.ly/dialysis-code