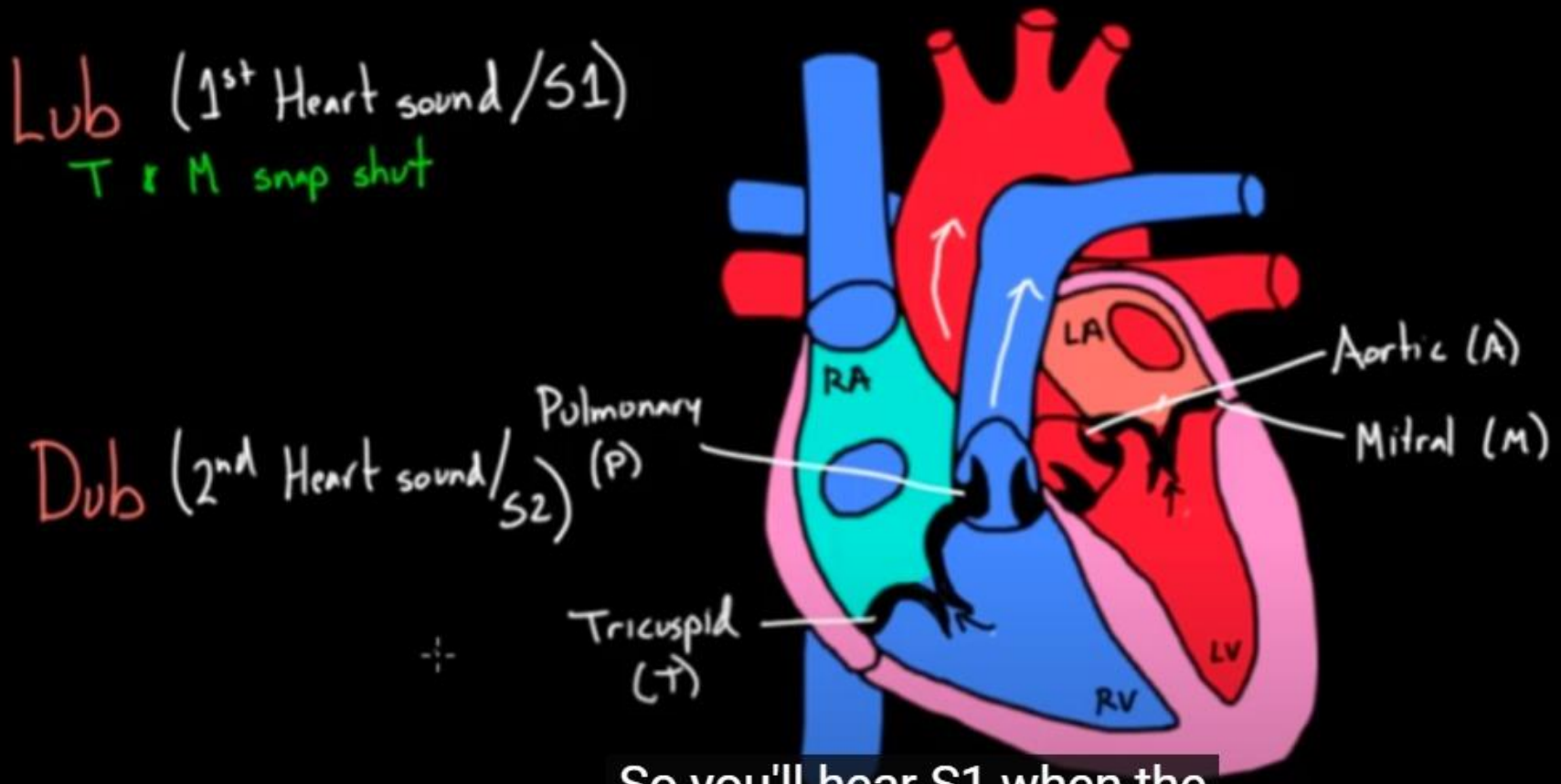
Supply and Demand Capacity Modelling for Acute Hospital Services

The Strategic Investment Board

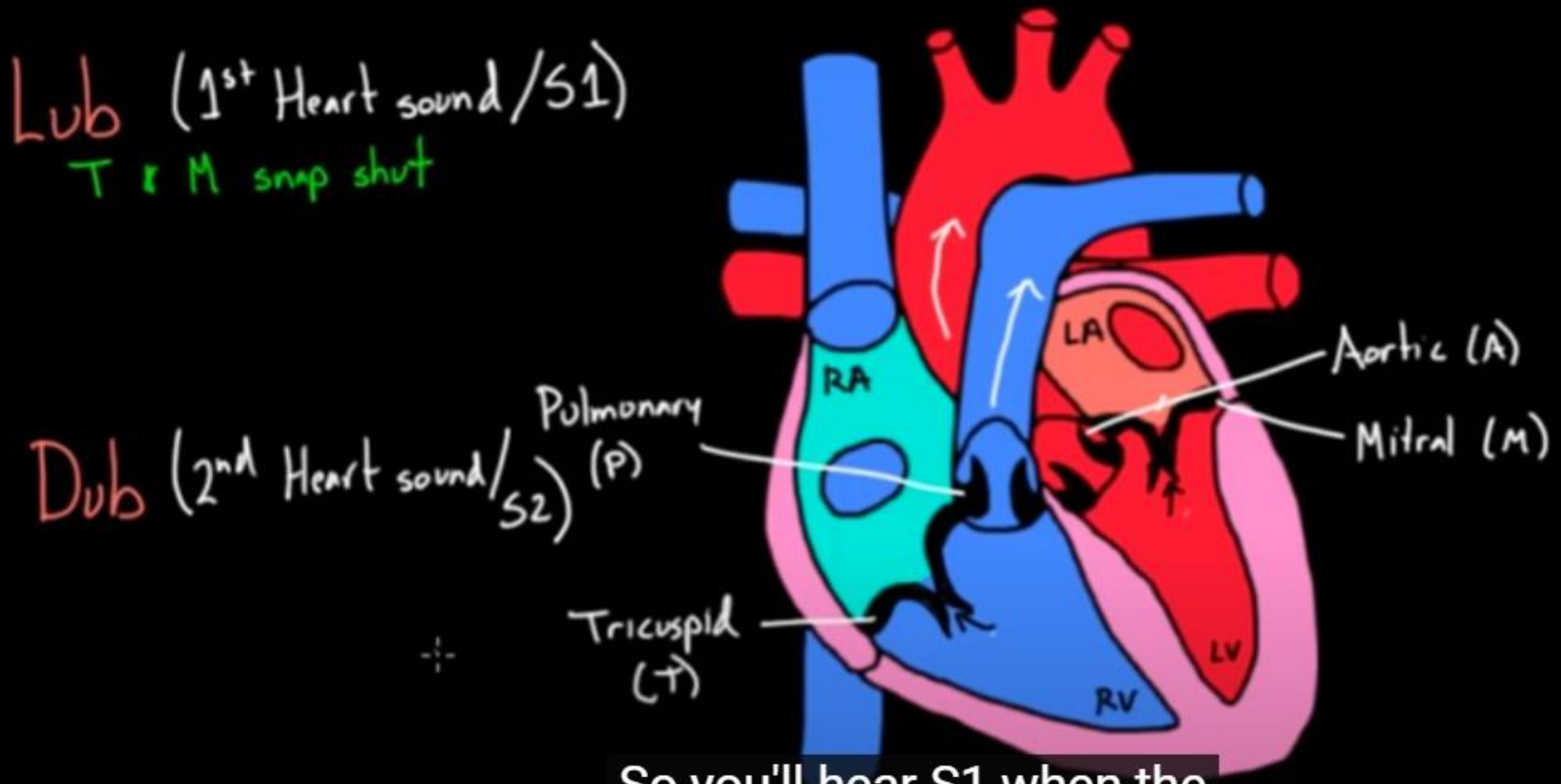
Sarah Wylie



Agenda

- Shock to the system and the thermostat – understanding fluctuations
- Surveillance modelling v. operational modelling
- The models (UKHSA/SAGE/SD)
- Resource modelling
- Group structures and perception of risk
- ….service design, stakeholder engagement, methodology.

The Pandemic: Did we *go* through it or *grow* through it?



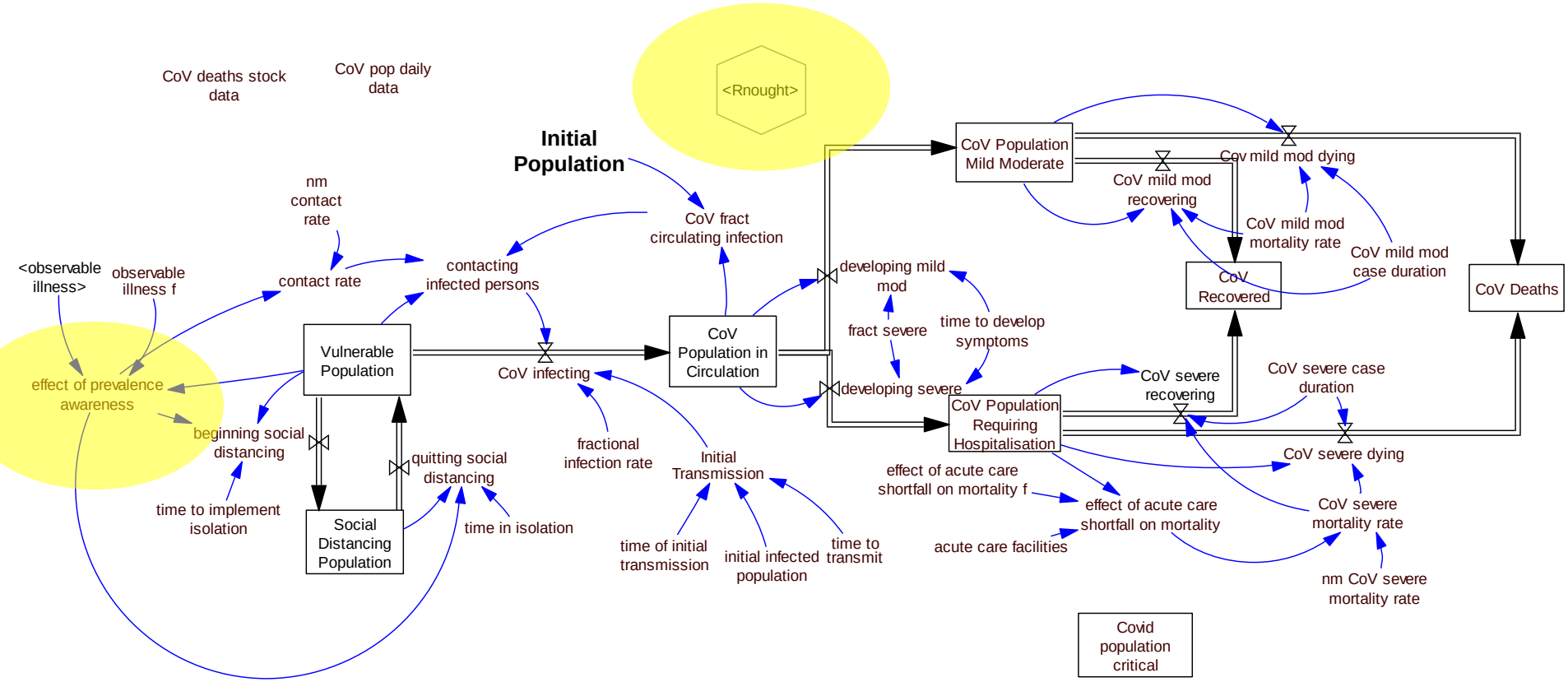
It takes time to change the temperature

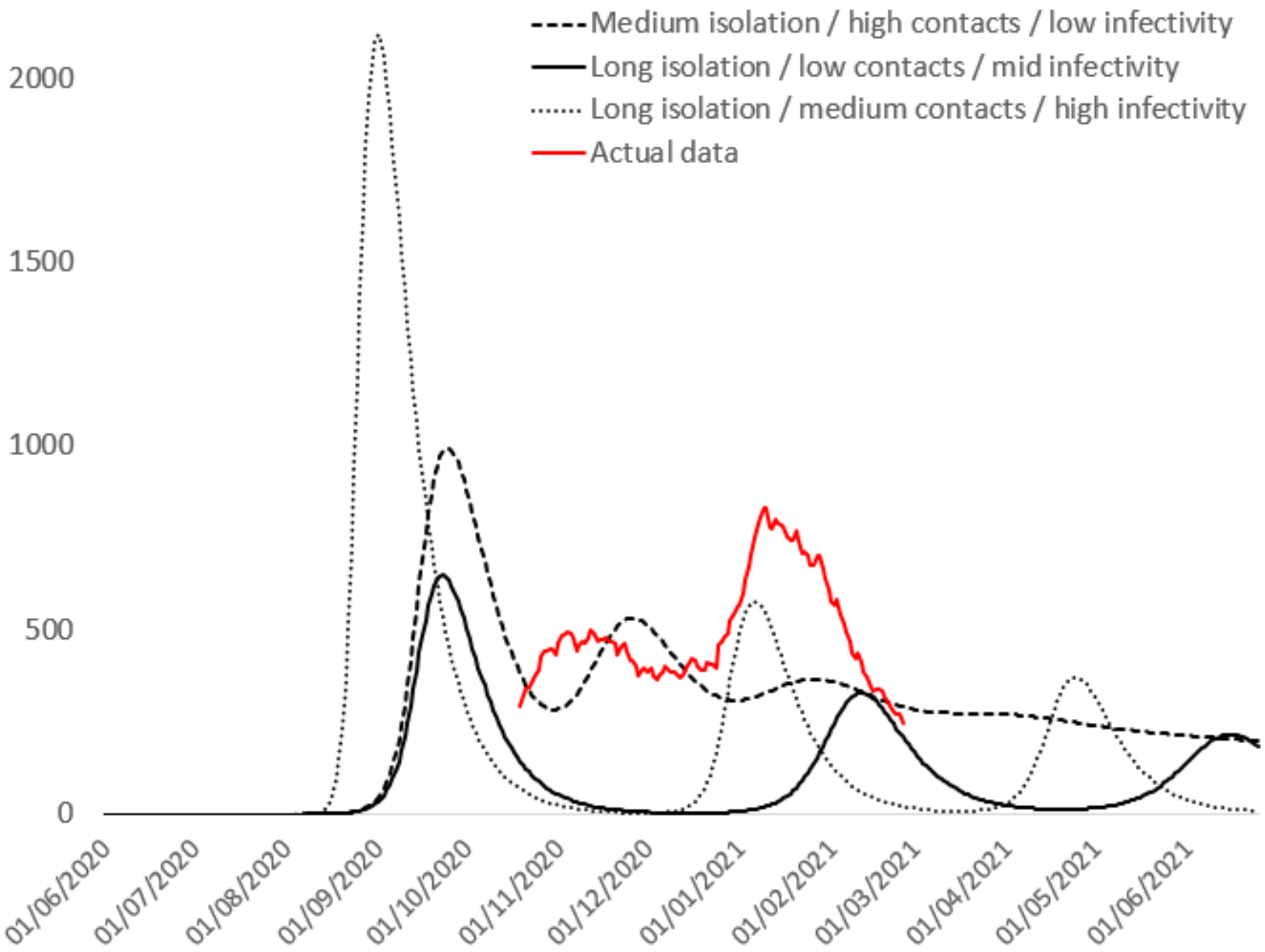
Forrester's appreciation of delays

- **Inventory** – why are there fluctuations in orders?
- Reminds Forrester of servo mechanics and heating / temperature regulation
- The first signals to come in from temperature sensors often report that the building is still too cold.
- Thus, the thermostat may continue dispensing heat, and the building becomes too hot.
- So then the thermostat signals for cooling, but once again, it takes time to change the temperature, and the building becomes too cold.
- The fluctuation has to do not with the actual outside temperatures but with the synchronization (or lack of it) between the heating and measuring devices.

Jim Thompson's Covid model

Perception matters…. And R-nought is an output, not a causal factor




Medium isolation / high contacts / low infectivity
Long isolation / low contacts / mid infectivity
Long isolation / medium contacts / high infectivity
Actual data
2000
1500
1000
500
0
01/06/2020
01/07/2020
01/08/2020
01/09/2020
01/10/2020
01/11/2020
01/12/2020
01/01/2021
01/02/2021
01/03/2021
01/04/2021
01/05/2021
01/06/2021

Surveillance modelling v. operational modelling

Most of the UK covid modelling was based on surveillance data vs. the operational and managerial stance of SD.

- Following the first wave of Covid, the SIB modelling suggested that any second wave was unlikely until *at least* April 2021.

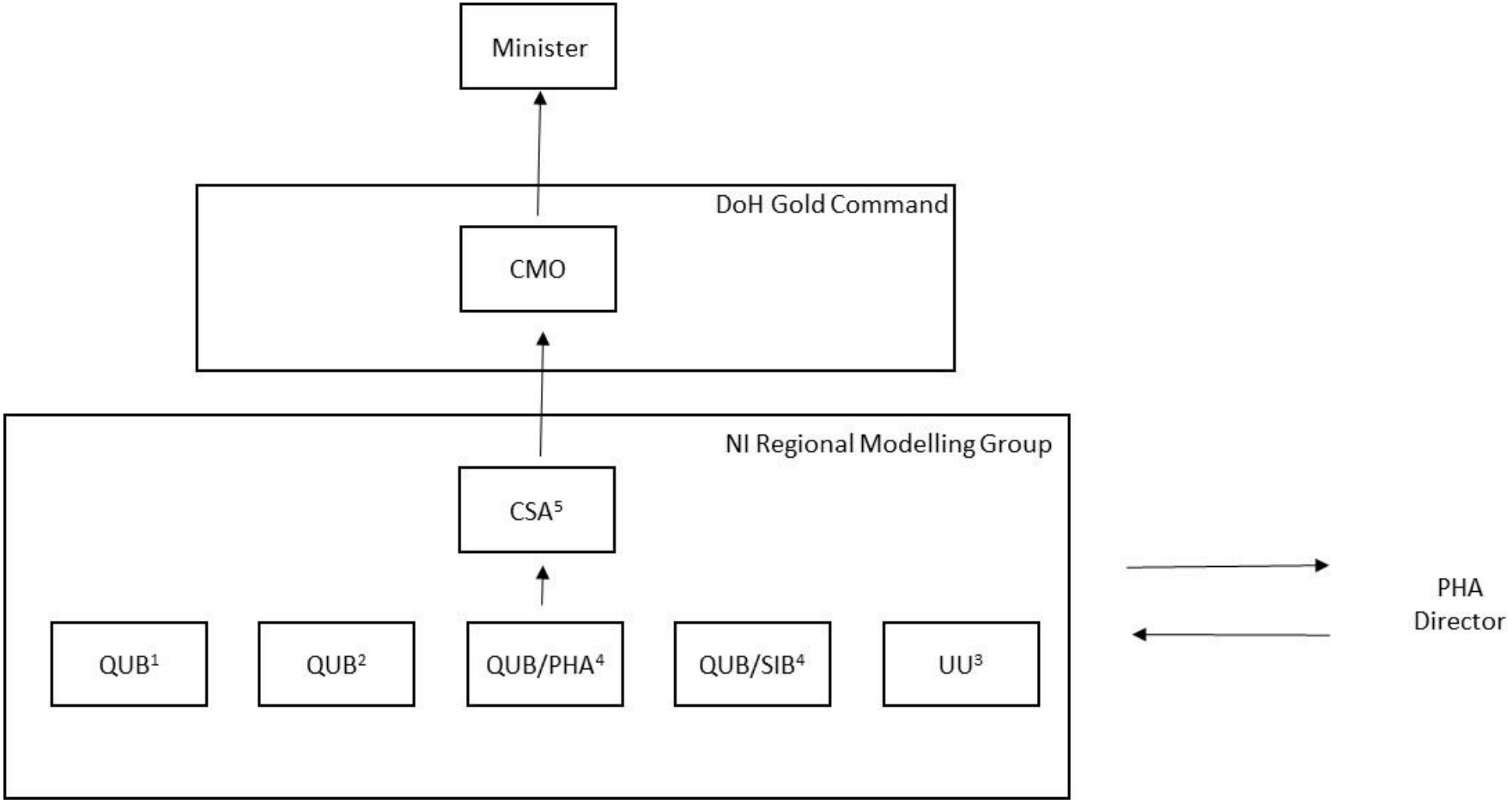
- Front-line staff and hospital managers were progressively concerned that this might not be accurate.

- A system dynamics model was produced in response to those concerns and offered an alternative position which was closer to the subsequent reality.

Surveillance Modelling

- Surveillance modelling is produced under the governance of the NI Regional Modelling Group.
- This group is convened by the Chief Scientific Adviser with the primary purpose of surveying and measuring R, the theoretical rate of transmission of SARS-CoV-2.
- The primary intention of this group and associated modelling is surveillance- to detect transmission in order to inform government policy around restrictions intended to limit transmission.
- Surveillance modelling uses data science and thereby harvests intelligence from established surveillance systems in order to provide insight.
- It then *infers* the probabilities of events or patterns based on what is contained within past data, using formal mathematical logic to transform statements of probability into insight.
- Surveillance modelling hospital admissions are the primary determinant of the R estimate.
- The UK's SAGE group provide assumptions into this modelling.

Surveillance Modelling



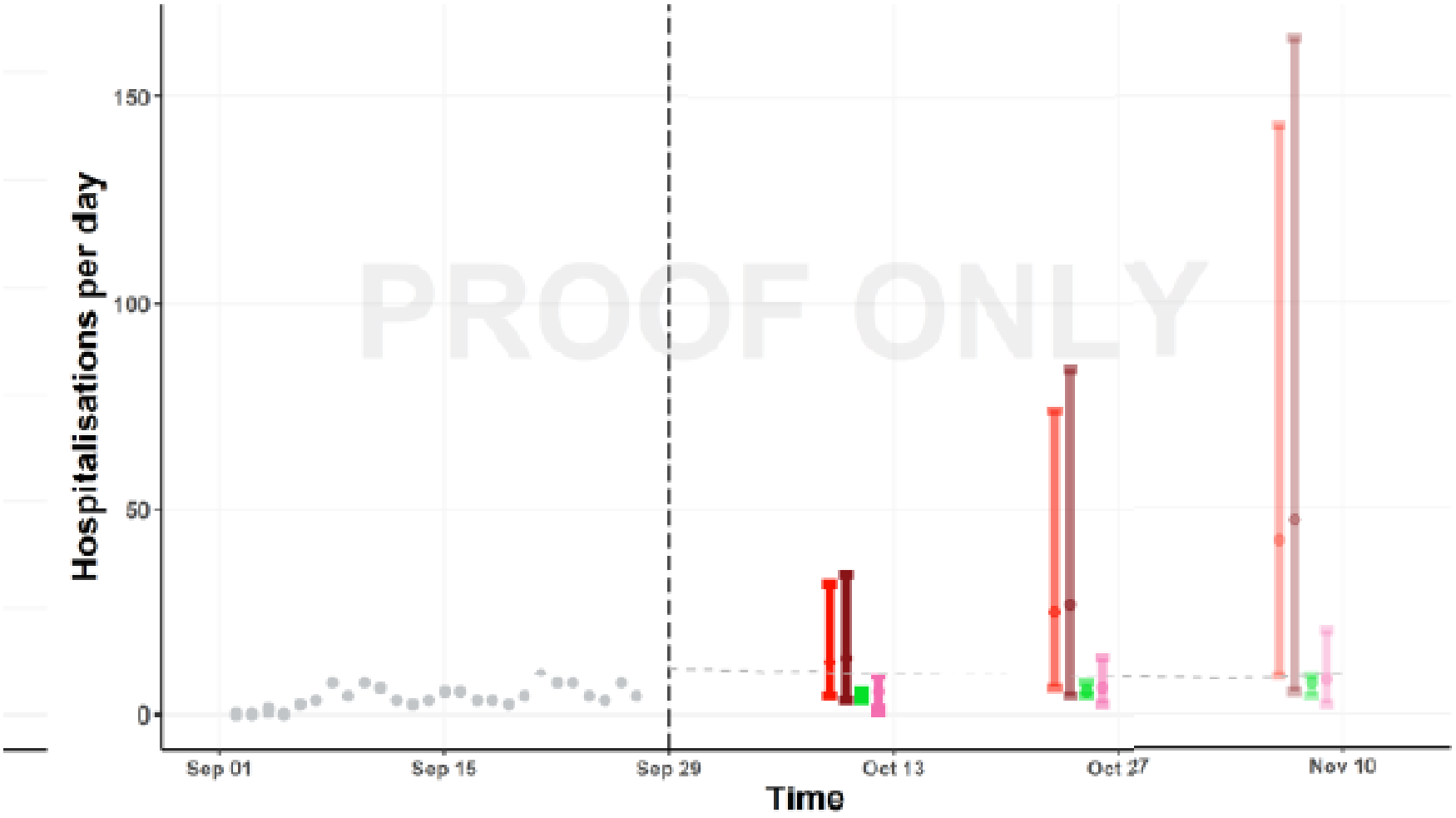
The problem with modelling?

"Previously, it seems to me, we have had two groups of persons in secret government: the circle of scientists who are knowledgeable about what is happening and which decisions must be made, and the larger circle of administrators and politicians to whom the scientists' findings have to be translated.

My worry is that the introduction of the computer is going to lead to a smaller circle still…we shall have a tin circle of computer boys, a larger circle of scientists who are not familiar with the decision rules and are not versed in the new computer art, and then, again, the large circle of politicians and administrators…I suspect that the chap standing next to the machine, who really knows how it makes decisions, and who has the machine under his command, is going to be in an excessively influential position."

C.P.Snow, in Martin Greenberger, (ed.) *Management and the Computer of the Future,* Cambridge, Mass, MIT Press, pp.10-11, 1962:

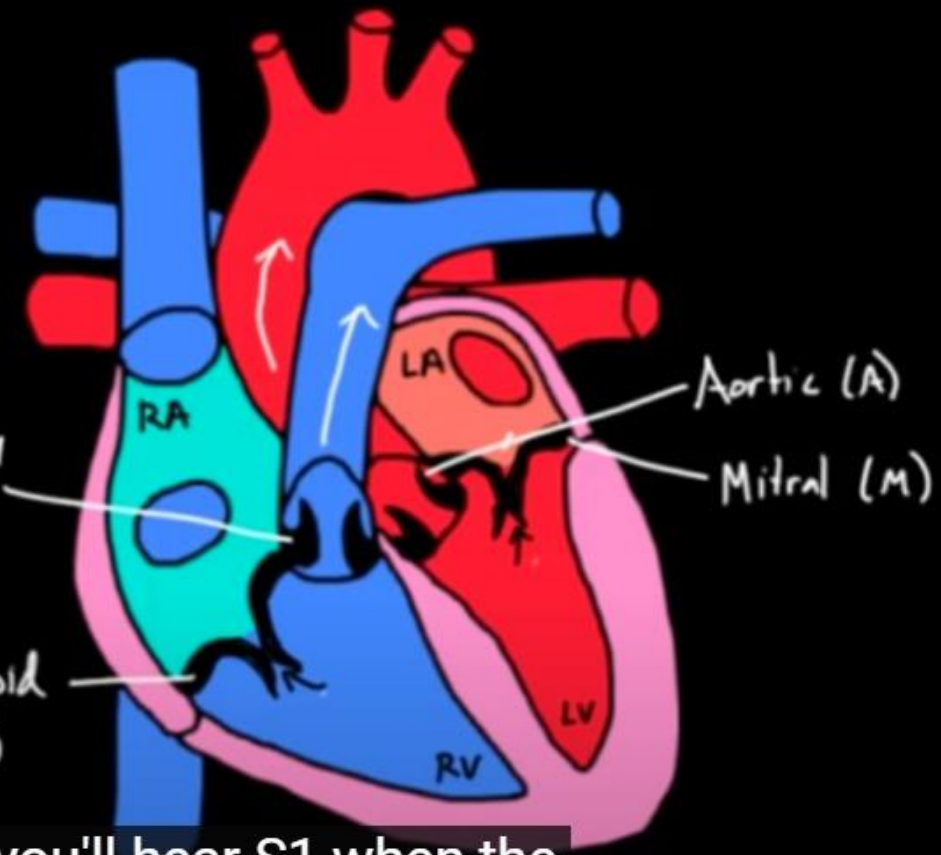
NORTHERN IRELAND



The importance of information and material delays.

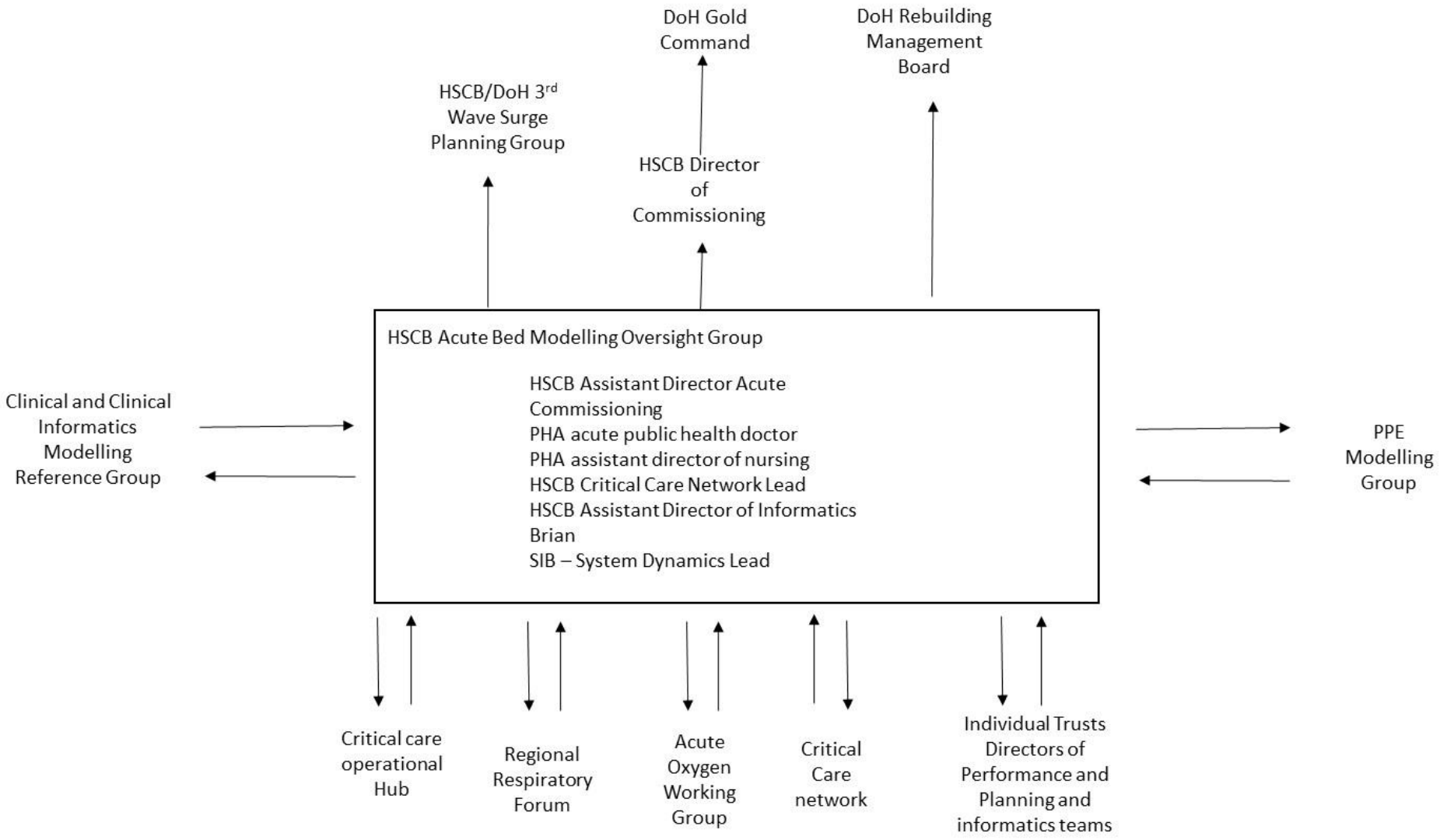
Lub (1st Heart sound/S1)
T & M snap shut

Dub (2nd Heart sound/S2)



So you'll hear S1 when the tricuspid and mitral valve

Operational modelling and the managerial stance



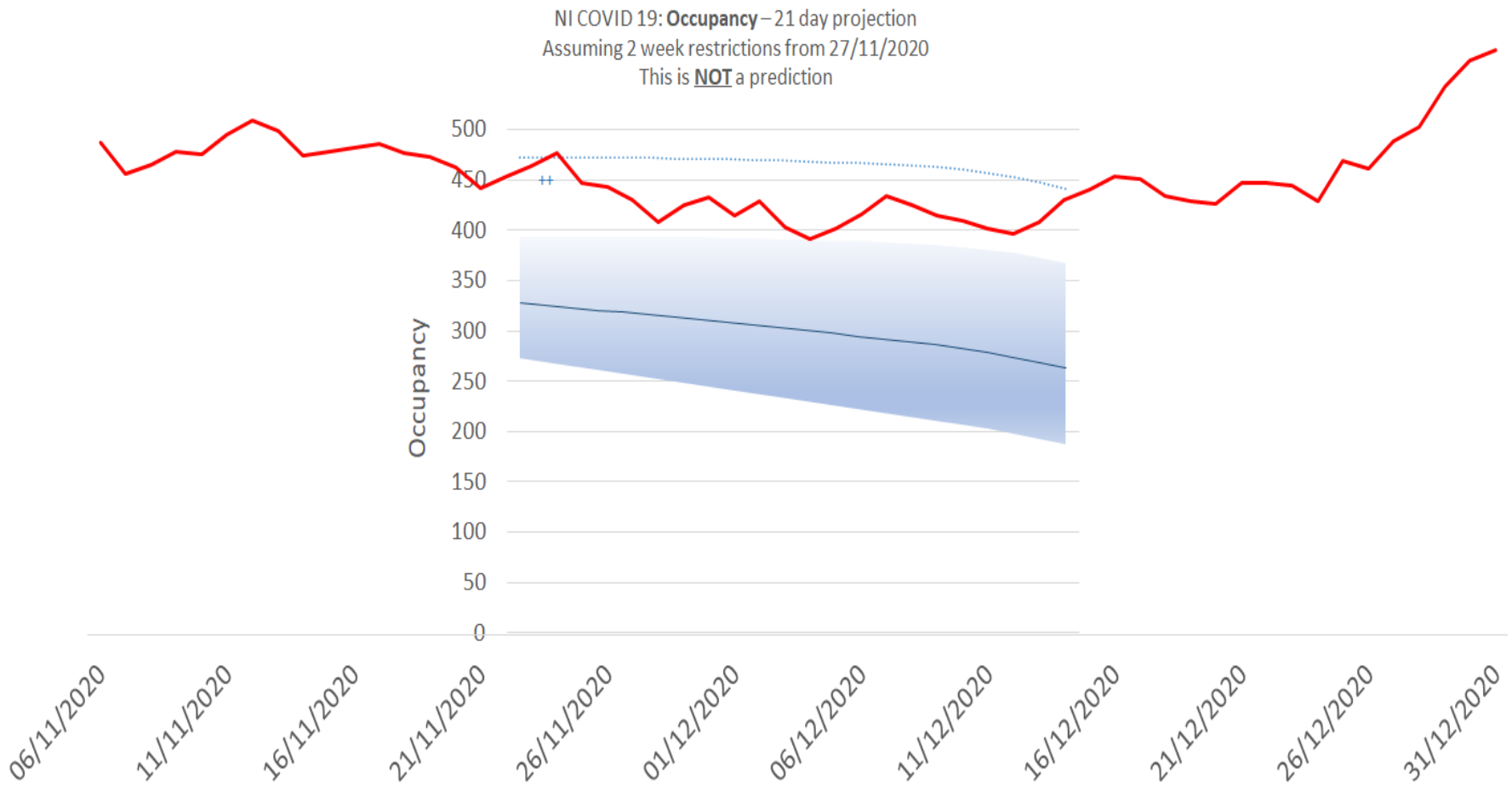
SD Covid modelling aims and objectives

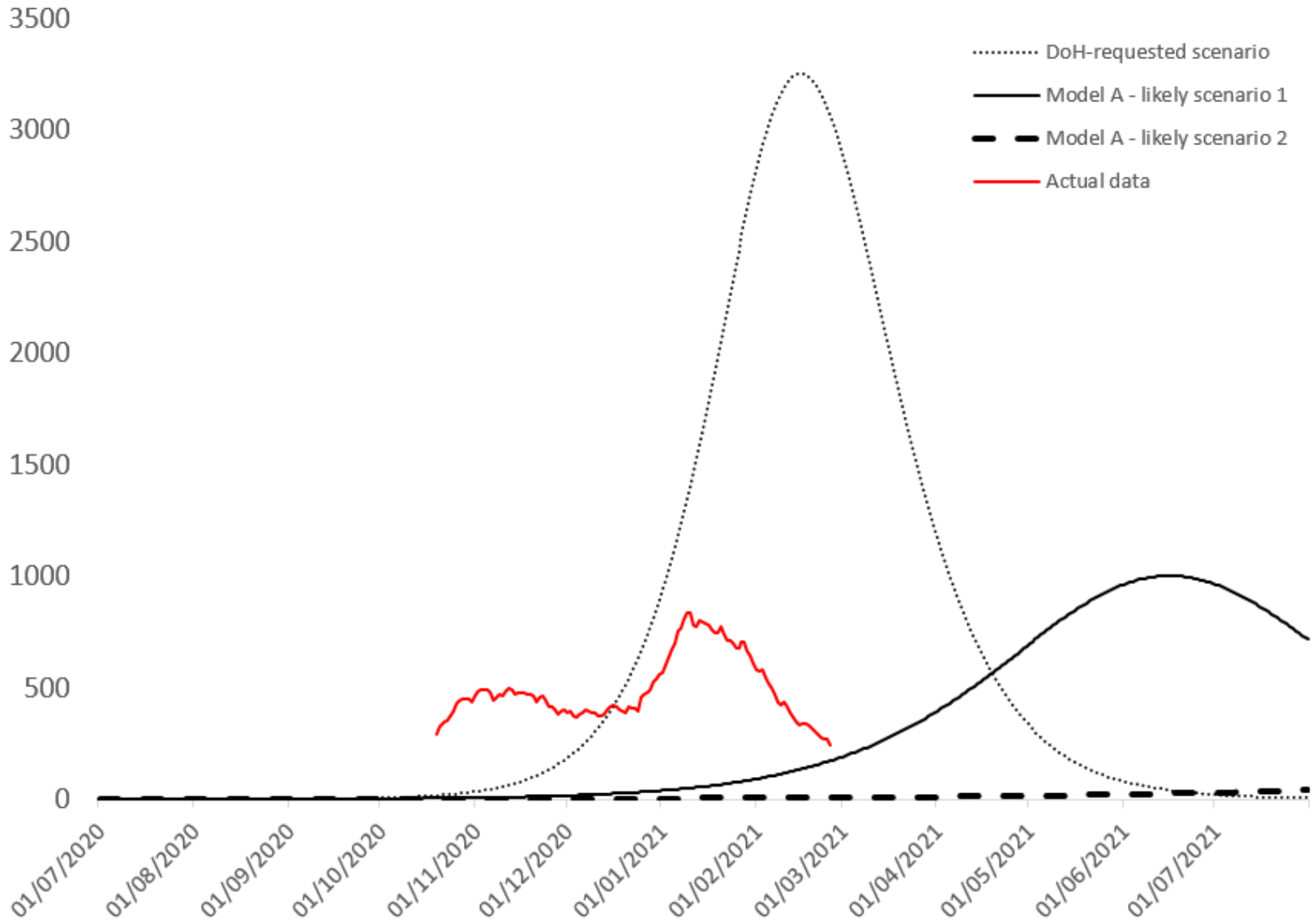
Aims.

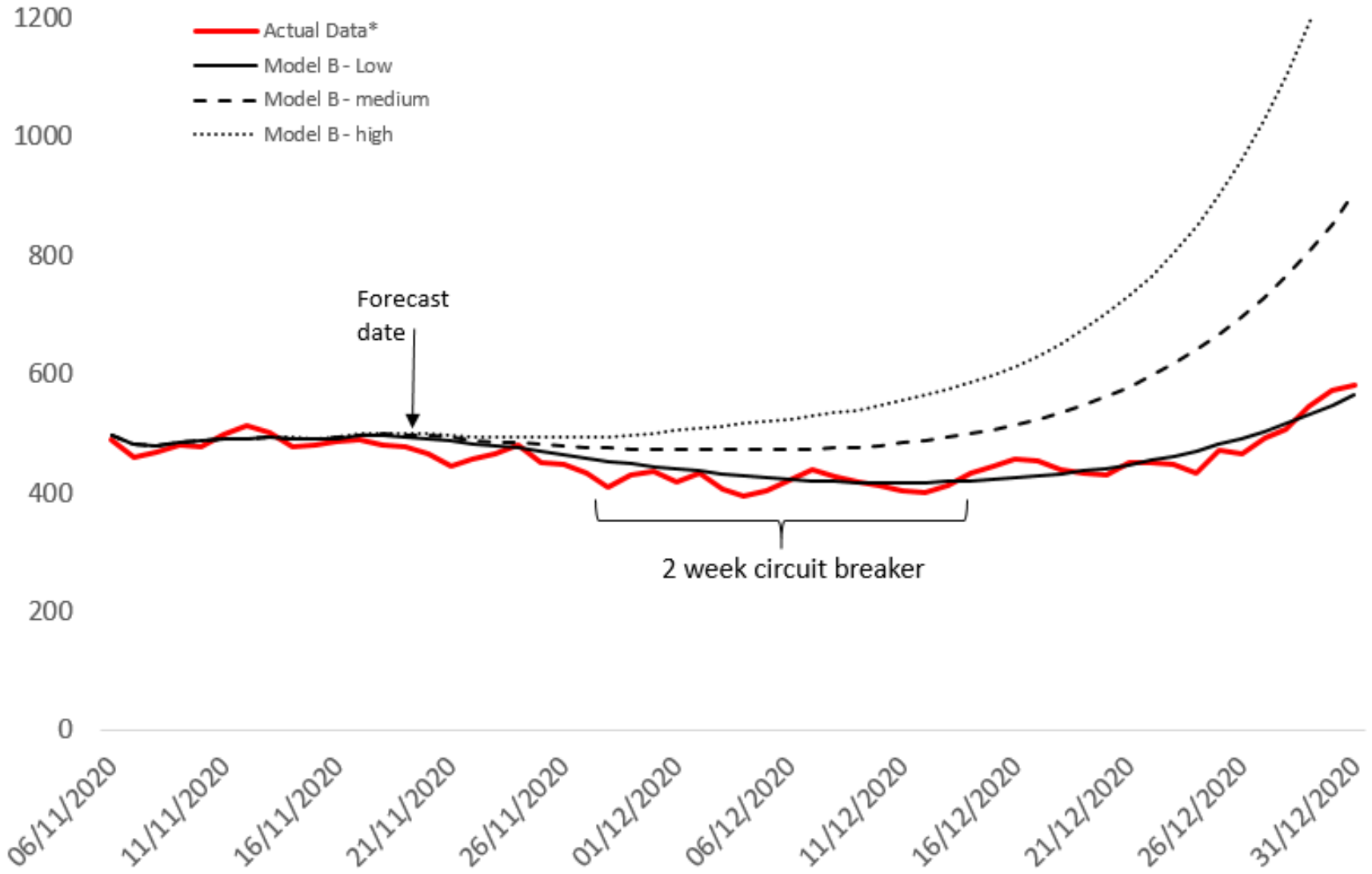
- Aim 1 - forecast COVID-19–related demand on top of expected non-COVID-19 demand
- Aim 2a. forecast when Covid demand will exceed baseline unscheduled care capacity and also interfere with elective capacity
- Aim 2b. Forecast when demand will exceed baseline unscheduled care capacity + all but the most urgent elective capacity
- Aim 3 – guide when extra capacity should be opened

What should the model do

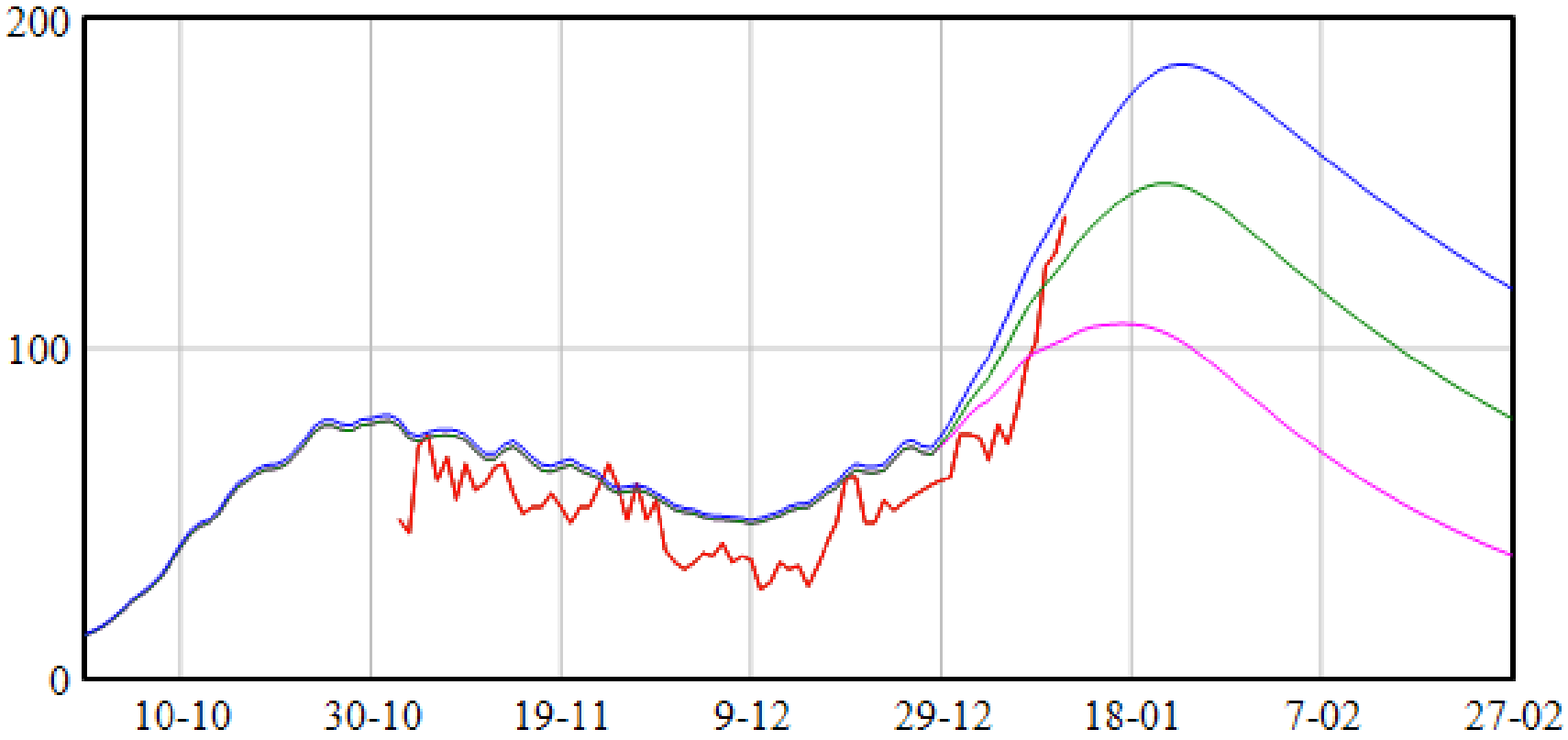
- The model must:
  - Identify signals that prompt actions by Trusts
  - Give advance warning of impending surge
  - Predict for ~6 weeks hospitalised / day / age
  - Answer questions posed by Trusts
- The model must not:
  - Micromanage Trusts


NI COVID 19: Occupancy – 21 day projection
Assuming 2 week restrictions from 27/11/2020
This is NOT a prediction
Occupancy
500
450
400
350
300
250
200
150
100
50
0
06/11/2020
11/11/2020
16/11/2020
21/11/2020
26/11/2020
01/12/2020
06/12/2020
11/12/2020
16/12/2020
21/12/2020
26/12/2020
31/12/2020


3500
3000
2500
2000
1500
1000
500
0
DoH-requested scenario
Model A - likely scenario 1
Model A - likely scenario 2
Actual data
01/07/2020
01/08/2020
01/09/2020
01/10/2020
01/11/2020
01/12/2020
01/01/2021
01/02/2021
01/03/2021
01/04/2021
01/05/2021
01/06/2021
01/07/2021

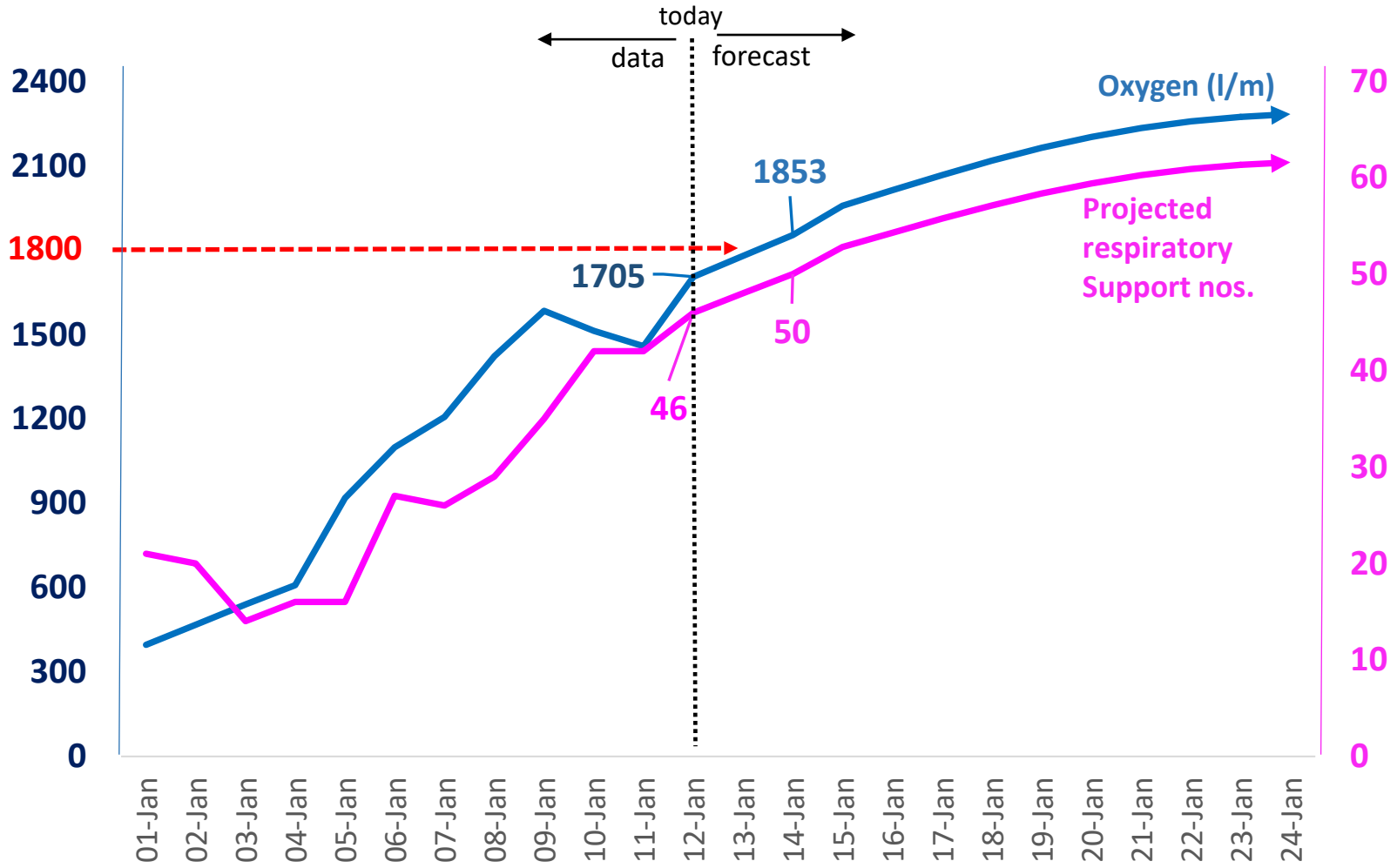

1200
1000
800
600
400
200
0
Actual Data*
Model B - Low
Model B - medium
Model B - high
Forecast date
2 week circuit breaker
06/11/2020
11/11/2020
16/11/2020
21/11/2020
26/11/2020
01/12/2020
06/12/2020
11/12/2020
16/12/2020
21/12/2020
26/12/2020
31/12/2020

Regional respiratory support forecast – no change



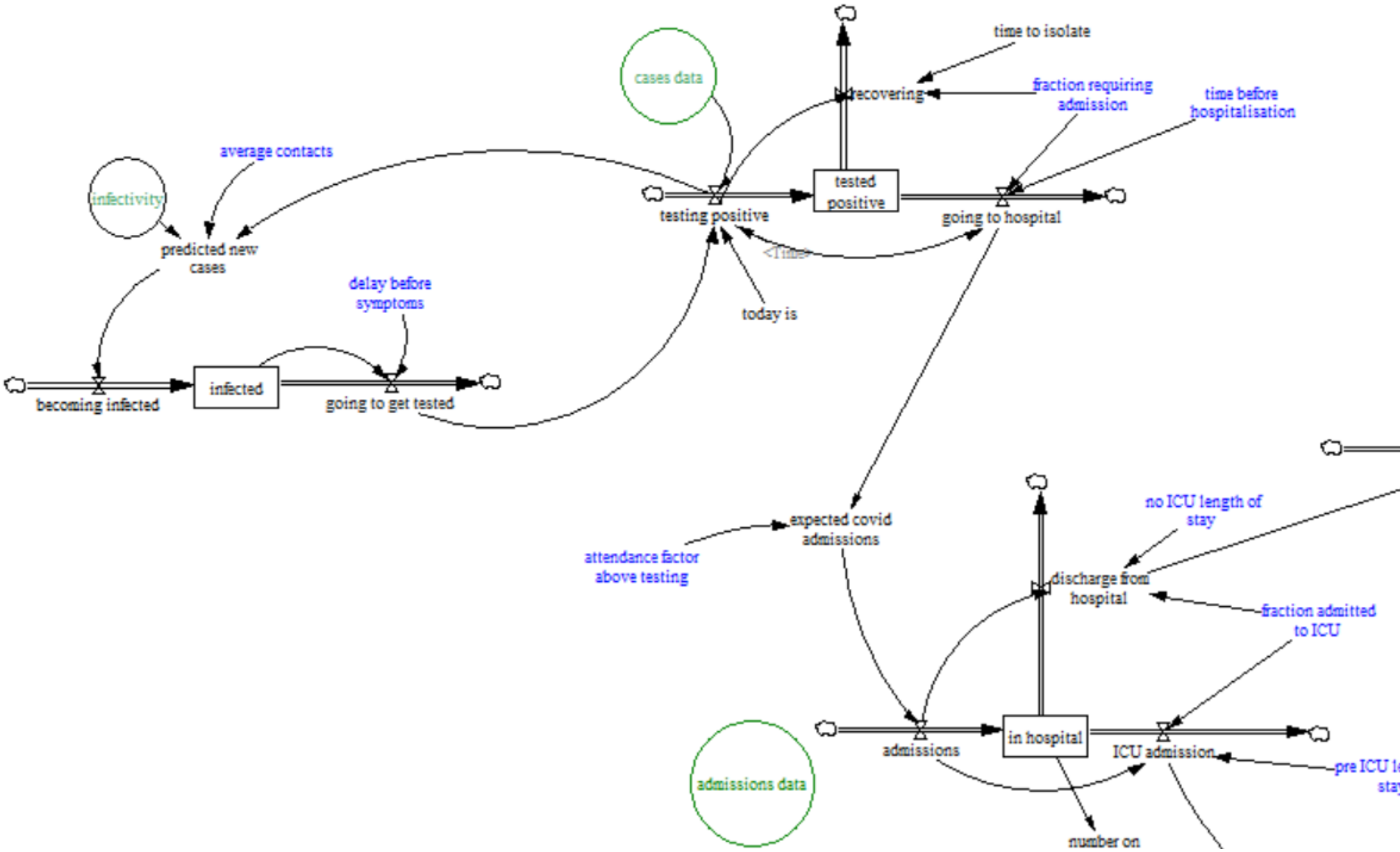
Craigavon oxygen usage tracks with respiratory support patients

Maximum oxygen supply in Craigavon is 1,800 l/m. Today 12 Jan there are an estimated 46 patients on CPAP/HFNO. If this rises above 50, the 1,800 l/m maximum will likely be breached. It is expected that the number of respiratory support patients required to breach the limit could already be inpatients at Craigavon.*

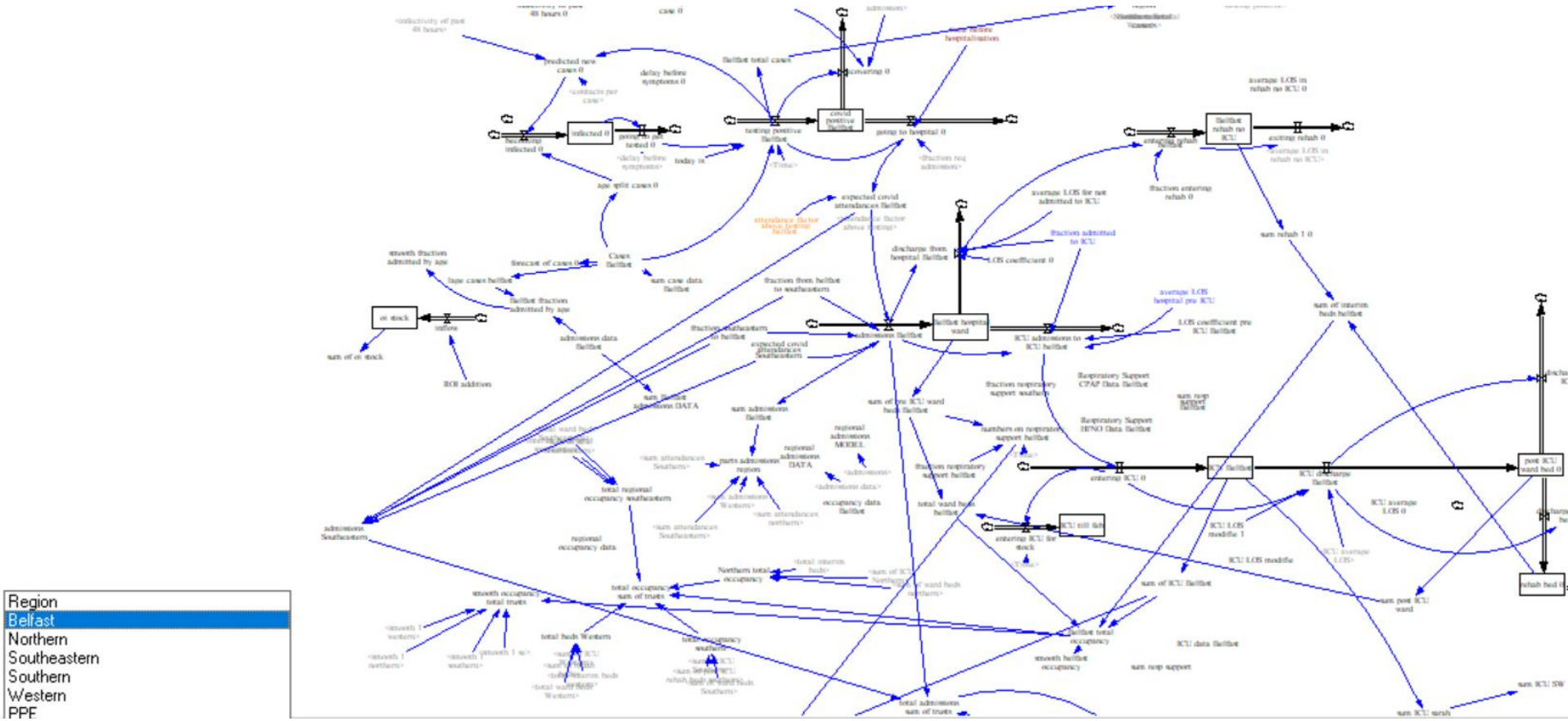


*While there is scope to go above this to 2,200l/min continuous use at this rate has not been tested. This limit is determined knowing that the system will have peaks and troughs beyond this average through the day, therefore is buffered in a standard way by +22% more capacity at 2,200 l/m.

SD Model technicalities



SD Model technicalities



The Pandemic: Did we *go* through it or *grow* through it?