

Coronavirus variants of concern

UK System Dynamics Society
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Ice-breaker

- Of the following factors which are the most important when considering the entrance of a new variant of COVID in the UK population at the current time:
 - ✓ Transmissibility – how fast it spreads;
 - ✓ Severity – how likely it is for people to need hospital care;
 - ✓ Vaccine evasion – how resilient the variant is to the current vaccines;
 - ✓ Remaining susceptible population – how many people are there who haven't had COVID.

Use the chat-bar to make comment before we briefly discuss the trade-offs between these factors.

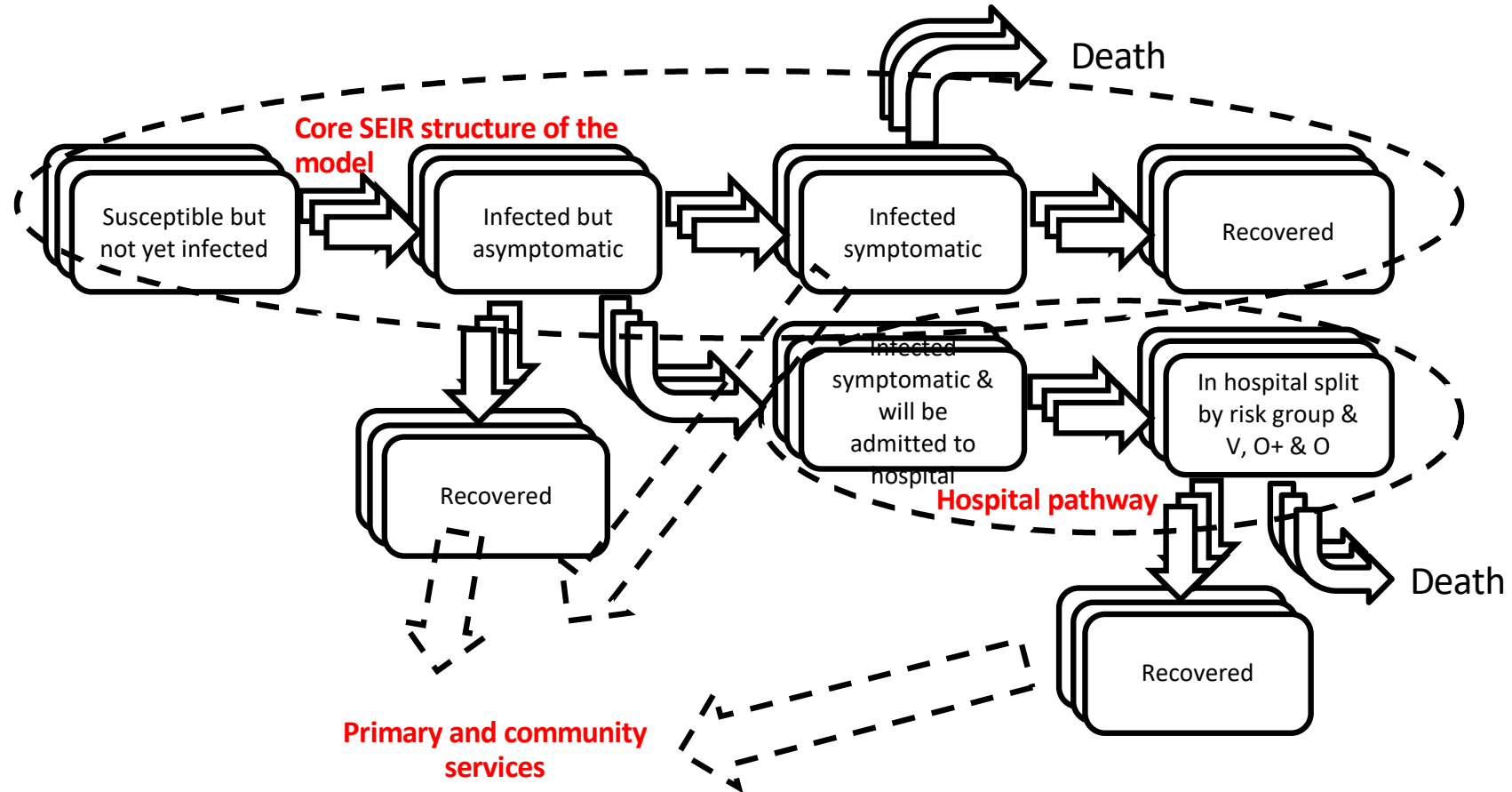
Background...

- Mid-March, ignorant of what was to come, but wary of the possible looming tsunami – WSP were supporting the K&M system at the early stages of population health management and segmentation programme tinkering with a simple system dynamics model built in R based on academic papers that studied previous SARS epidemics;
- 23rd March = lock-down!
- How could we build on our population health modelling using System Dynamics to model the pandemic and explore possible scenarios?
- A K&M modelling ‘cell’ was created and we began the journey...

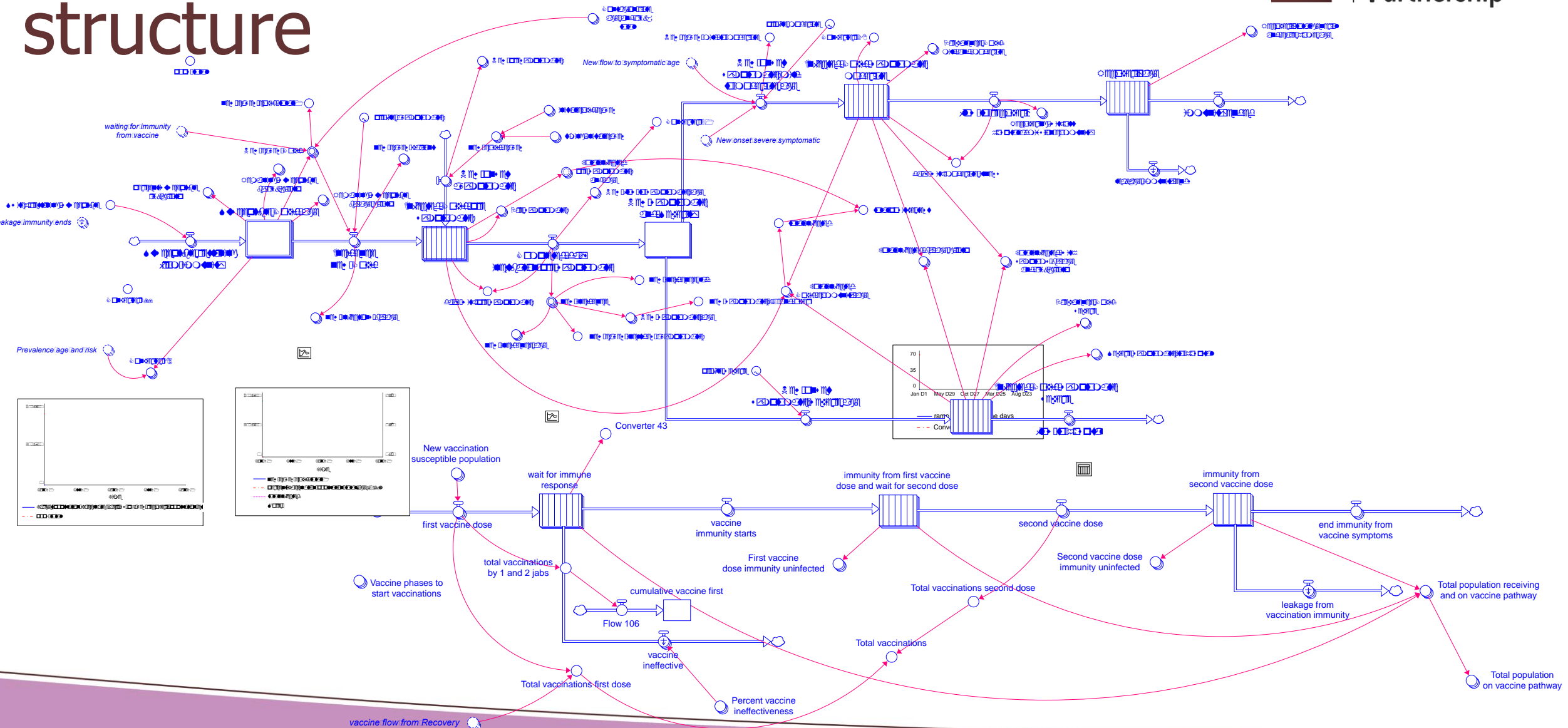
Process of modelling

- Due to the unknowns in the spread and impact of the virus we adopted an iterative learning approach to model development, gradually building confidence in the ability of the model to match actual data and therefore to provide ‘nowcasting’ outputs (3-6 week forecasts) on which local managers could base their plans;
- The modelling cell consisted of public health, CCG and analytics team members and involved regular liaison with local analysts and service managers;
- Key to the effectiveness of the approach was the ability and frequency with which the model assumptions could be refined to reflect the actuals as well as to anticipate national policy moves.

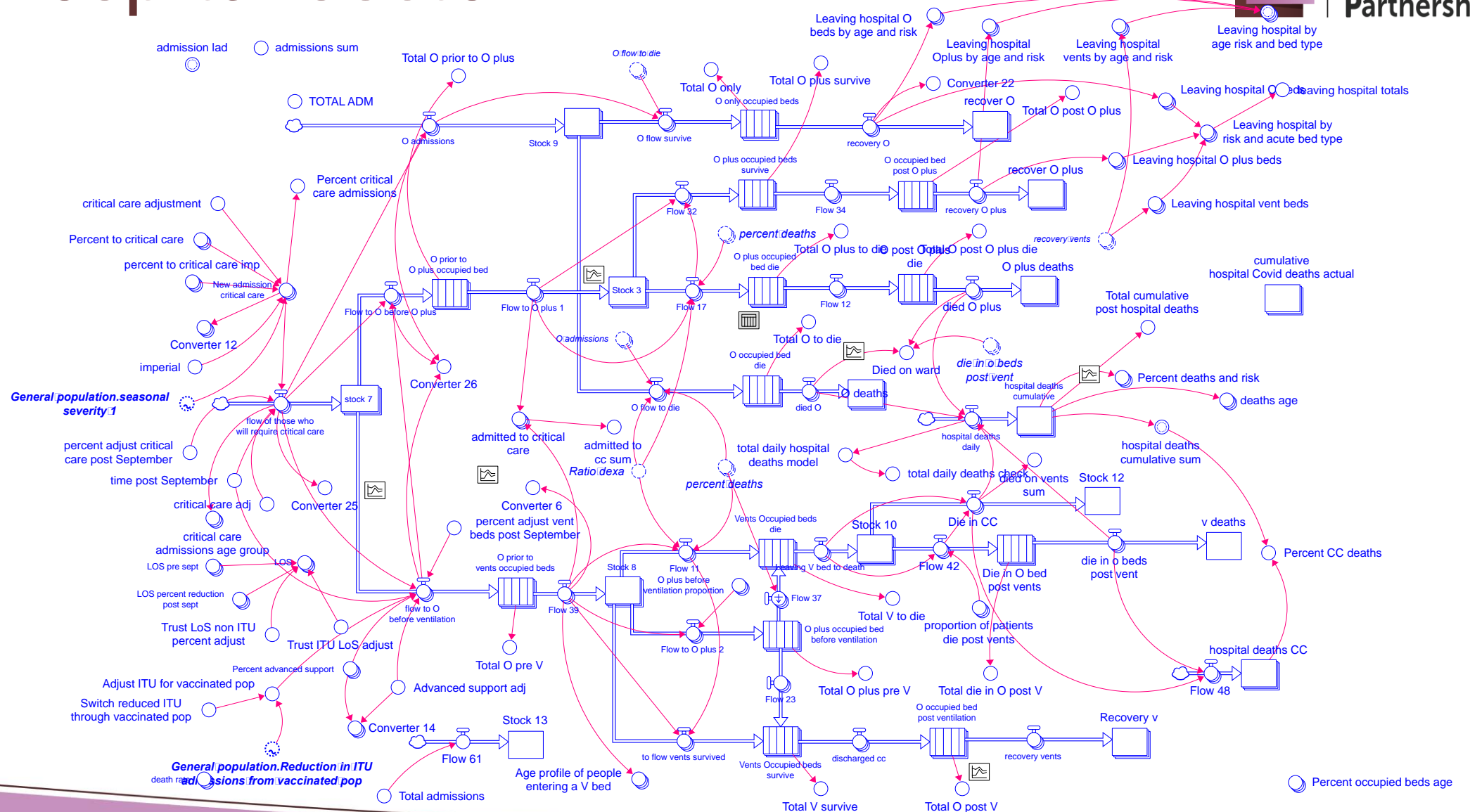
The core model



The core EPI & vaccination model structure



The hospital sector



Model structure

- Runs in days from January 1st 2020 initialised to a given population arrayed by 10yr age groups, vulnerability to COVID (low/med/high risk) and by COVID variant;
- Driven by pre-COVID assumptions about population mixing by age band in different contexts – work, education, family and recreational activities;
- Key drivers of the pandemic were assumptions about transmissibility and severity, moderated by ‘non-pharmaceutical’ interventions, i.e. lockdowns, social distancing, shielding, face masks etc;
- Supported by Test, Track and Isolate (TTI) function to minimise subsequent outbreaks after the first wave.

Model demonstration

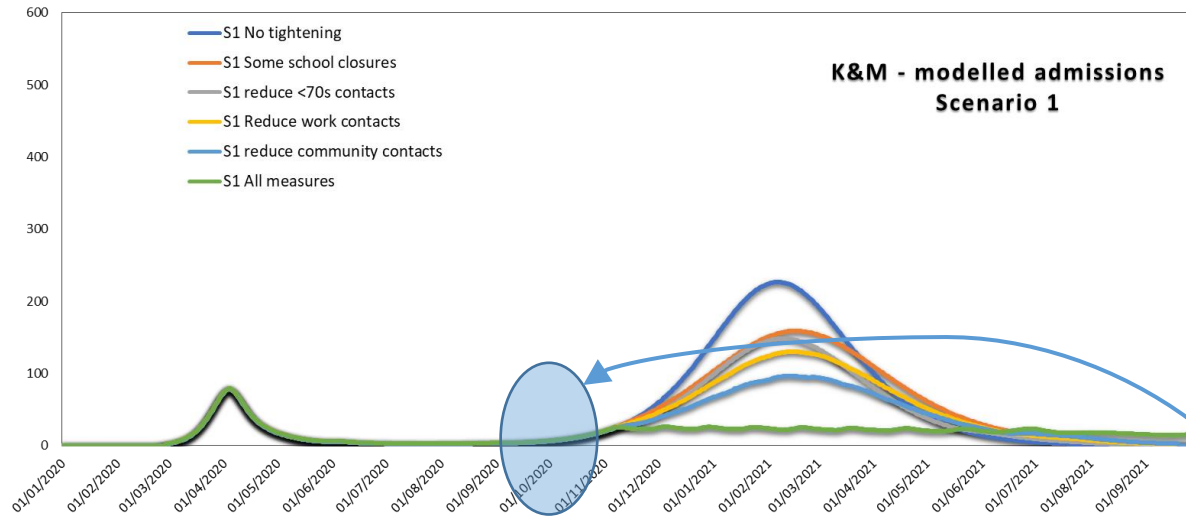
- The model we're going to use is calibrated to the Southampton hospital Trust catchment population (c.500,000) and is calibrated to actual hospital admissions over the whole of the pandemic, enabling reasonable confidence in the forecast barring uncertainties going forward relating to:
 - ✓ Continued uncertainties about the precise levels of immunity given by the vaccination programme – although it's clear they are good;
 - ✓ Policy and behaviours – ending the lockdown roadmap, residual advice, people's behaviours and uncertainties, and of course new variants....

Please post questions or raise your hand to clarify anything...

Learning from the Kent variant

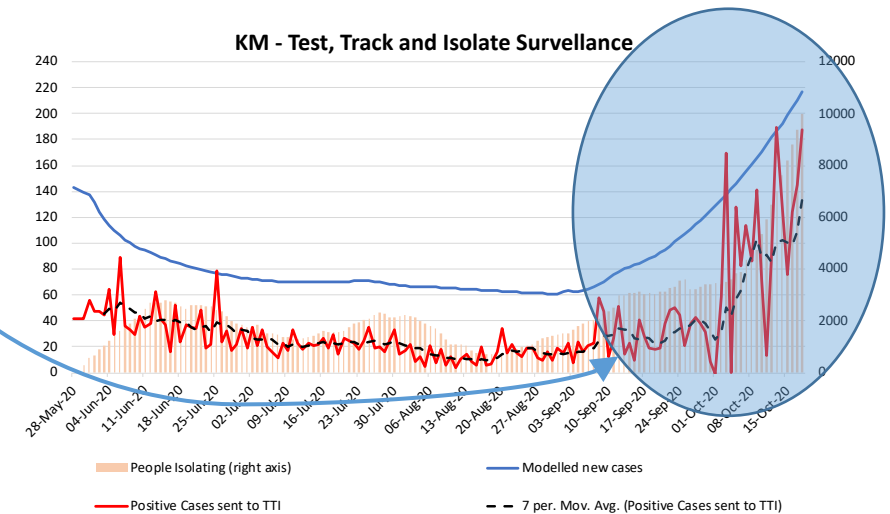
- During the summer of 2020 all our long-term eggs were in the vaccination programme basket, but with no guarantee of success given the unprecedented nature of the challenge, whilst in the short term the TTI service would enable us to keep on top of local outbreaks;
- Nobody believed, or wanted to believe, that a new variant of COVID would be anything but weaker and that it was therefore an insignificant risk in planning for the future;
- However, the first wave had infected less than 10% of the population meaning that we remained highly susceptible to new outbreaks – so what were we thinking might happen when using our model to forecast the coming winter, and how did the Kent Variant become evident?

The timeline – in brief



However, by early October we were observing an increase in cases that could not be explained by the model in its current form...

In July we generated model outputs that were based on the seasonality assumptions within the model, which would effectively ‘seed’ a second wave, and the likely measures that could moderate the impact.



Model demonstration of the advent of the Kent variant

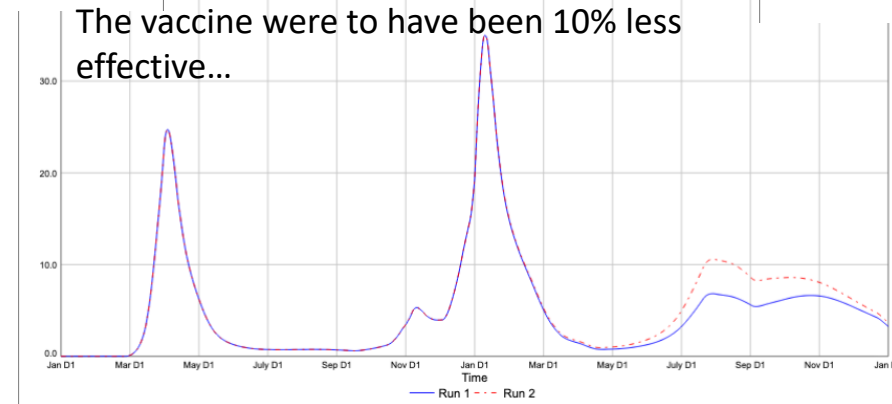
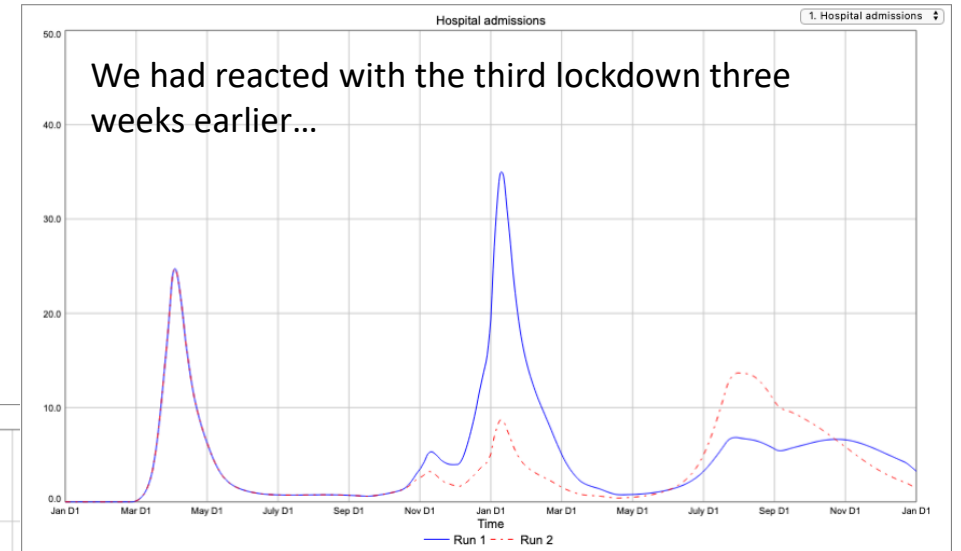
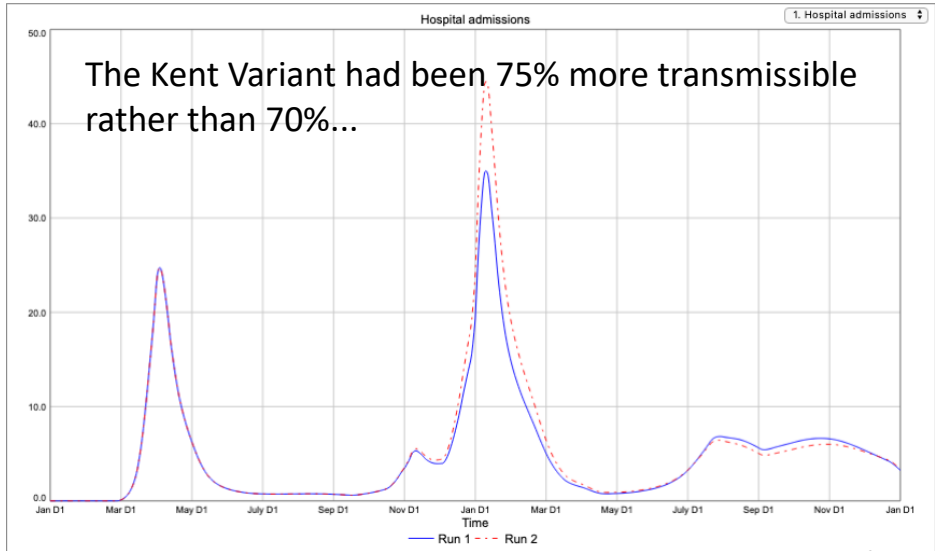
Model runs opposite show:

1. No Kent Variant, no third lockdown and no vaccination programme.
2. No Kent Variant, vaccination programme and no third lockdown.
3. The Kent Variant, no vaccination programme and the third lockdown as experienced.

Model output redacted

None of these were what happened but the outputs show us how vulnerable we were to significant new waves...

What if...



***What can we learn
from our experience
with the Kent Variant?***

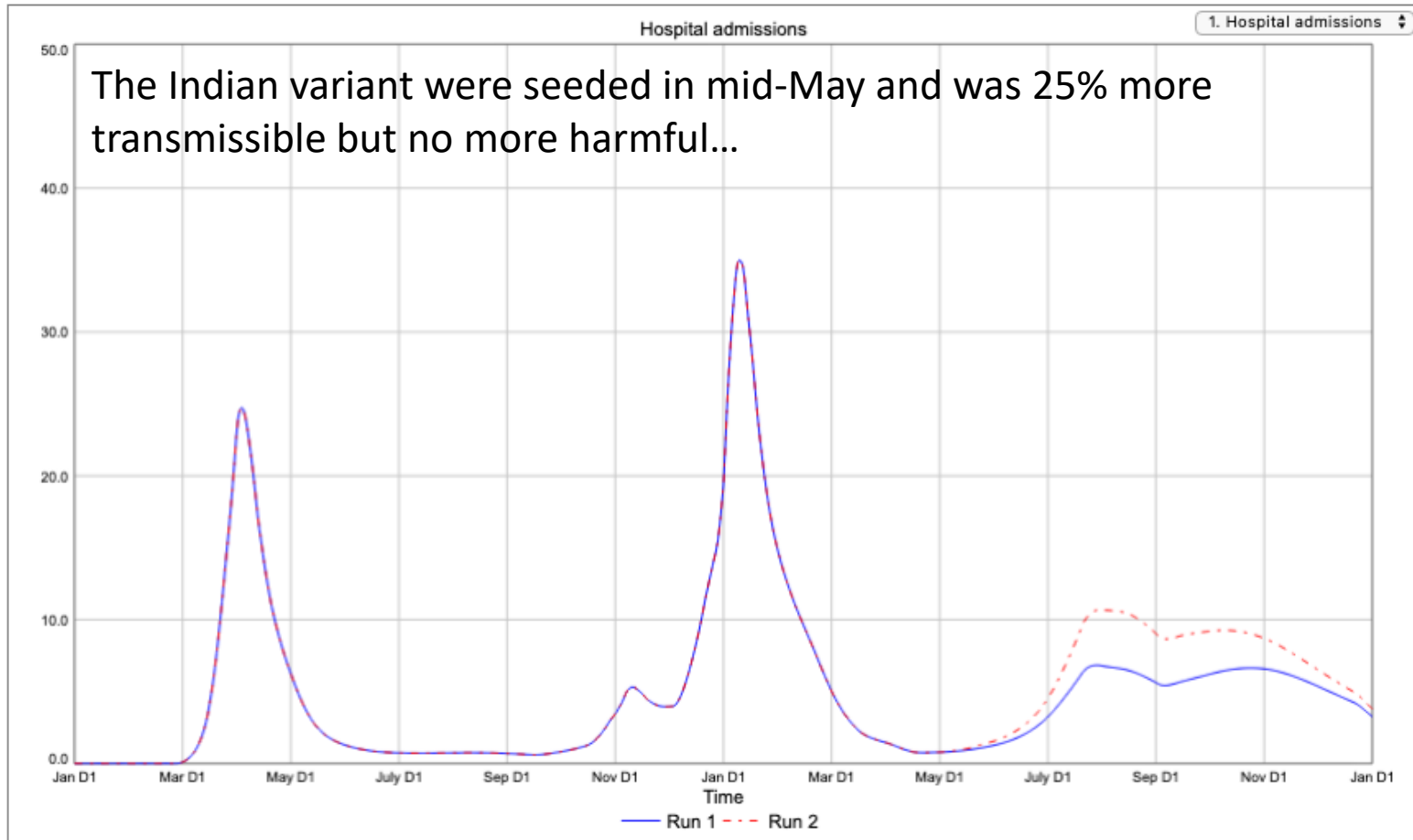
New variants – the virology...

- Virus's mutate regularly, and it's true that most mutations are relatively harmless – the genomic testing labs in the UK are tracking large numbers with only a few that make it to being 'of concern';
- The distinctive nature of COVID and how it causes severe disease is in how it stimulates a response from the body's natural system, which can go into over-drive – rather than the virus itself doing the harm it is a catalyst that causes subsequent damage potentially to multiple organs, potentially leading to death;
- With respect to the vaccines and their ability to address the challenge of new variants whilst there is benefit in 'tweaking' the vaccines as long as variants are just that then the vaccines designed to defend against the original virus still have good efficacy, as seen with the Kent Variant and now being claimed for the Indian Variant as well;
- A more significant development would be if two variants combined in a human cell and produced what is called a 'recombinant', which could be sufficiently different to the original to evade the vaccine.

What do we know about the Indian Variant

- Still with a high degree of uncertainty, but it seems that the Indian variant is:
 - ✓ Perhaps 20-30% more transmissible than the Kent Variant;
 - ✓ Is similar to the Kent and original variant in terms of severity of impact;
 - ✓ That the current vaccines have similar efficacy after two doses, but possibly with lower efficacy after only one.
- Other factors to consider include:
 - ✓ The relatively low levels of the Kent variant in the population currently making it easier for the Indian variant to become dominant;
 - ✓ The imported v's community transmitted cases – can cases be contained?
 - ✓ The BAME socio-demographic and genetic influences on the spread of the variant.

What if...



What policy options would you recommend in the light of this scenario?

What if...

In addition to the Indian Variant a further variant were seeded in mid-July that was similar to the Indian one in terms of transmissibility but against which the vaccine only had 20-25% efficacy instead of 60-90%...

Model output redacted

***What policy options
would you recommend
in the light of this
scenario?***

Re-visiting our ice-breaker

- Of the following factors which are the most important when considering the entrance of a new variant of COVID in the UK population at the current time:
 - ✓ Transmissibility – how fast it spreads;
 - ✓ Severity – how likely it is for people to need hospital care;
 - ✓ Vaccine evasion – how resilient the variant is to the current vaccines;
 - ✓ Remaining susceptible population – how many people are there who haven't had COVID.

Would you change your view or perhaps modify it in the light of the model outputs we have seen?

Thank you

Final questions?

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