Appendix: Contact tracing and testing – some counterfactuals

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Dynamic causal modelling

What follows are simulations of what might have happened – and what could happen – under different testing and contact tracing scenarios. These quantitative analyses are based upon dynamic causal models of viral spread and behavioural responses, i.e., social distancing and lockdown. This kind of modelling encompasses all the factors that influence community transmission. As such, its predictions are about mitigated outcomes. This can be contrasted with conventional epidemiological forecasts that generally consider unmitigated outcomes, in the absence of interventions or behavioural responses.

What are we aiming for?

A containment strategy that enables contact tracing to suppress community transmission without national (mandatory) lockdowns – and accompanying costs.

What does this aim entail?

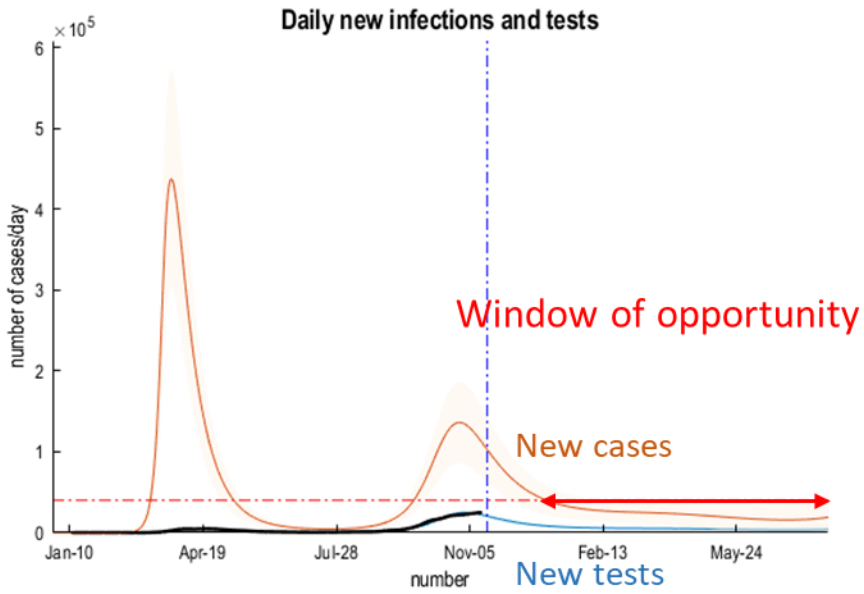
It requires two things.

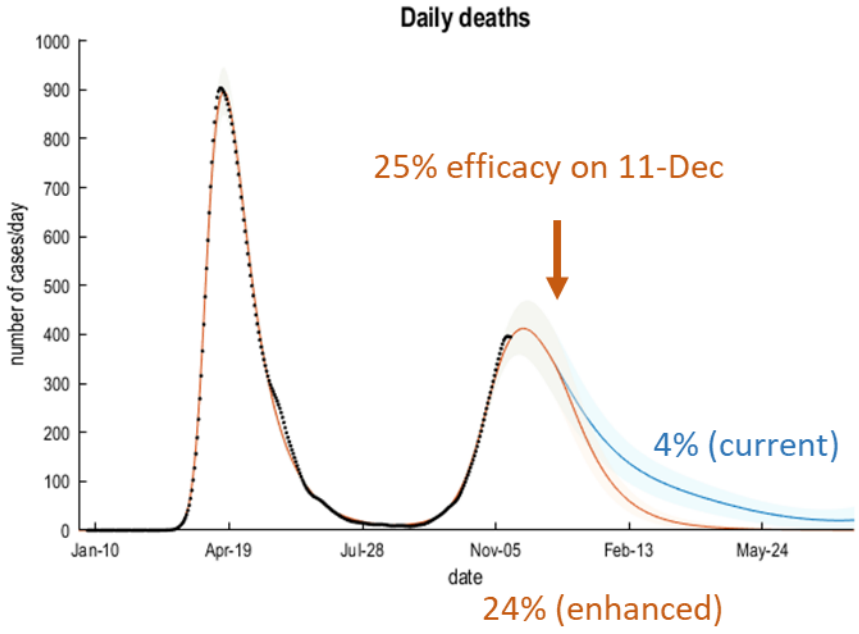
- First, the prevalence of infection has to be sufficiently low to ensure that a sufficient proportion of new cases can be identified, and their contacts traced.
- Second, it requires a sufficient proportion of new contacts to be supported involuntary self-isolation.

What is sufficient?

With an enhanced local contact tracing program (supplemented with clinical surveillance), the prevalence of infection should be about **40,000 new cases per day**; i.e., about **10,000 new confirmed per day** at current testing capacity (across the UK). Locally, this translates into about **100 new confirmed cases per hundred thousand, per week** or roughly **100 new cases per hundred thousand, per day** (because we are picking up about a quarter of new cases with PCR and lateral flow testing).

This implies a **window of opportunity** that may appear in a few weeks (see Figure 1 – black dots are data and coloured lines are estimates with 90% credible intervals).





What is a sufficient proportion of new contacts?

If 24% of the contacts of new cases can be isolated, this would be sufficient to suppress and eliminate community transmission.

Is 24% reasonable?

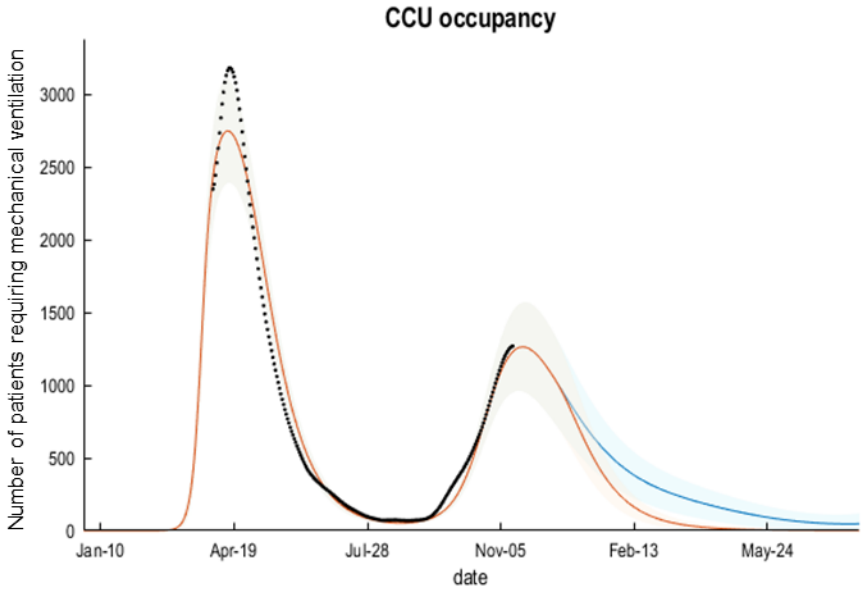
Yes. If current testing can be supplemented with (local) clinical surveillance so that about 30% of new cases are identified each day – and 80% of their contacts can be supported in self-isolation – this corresponds to a 30% x 80% = 24% efficacy of contact tracing and isolation.

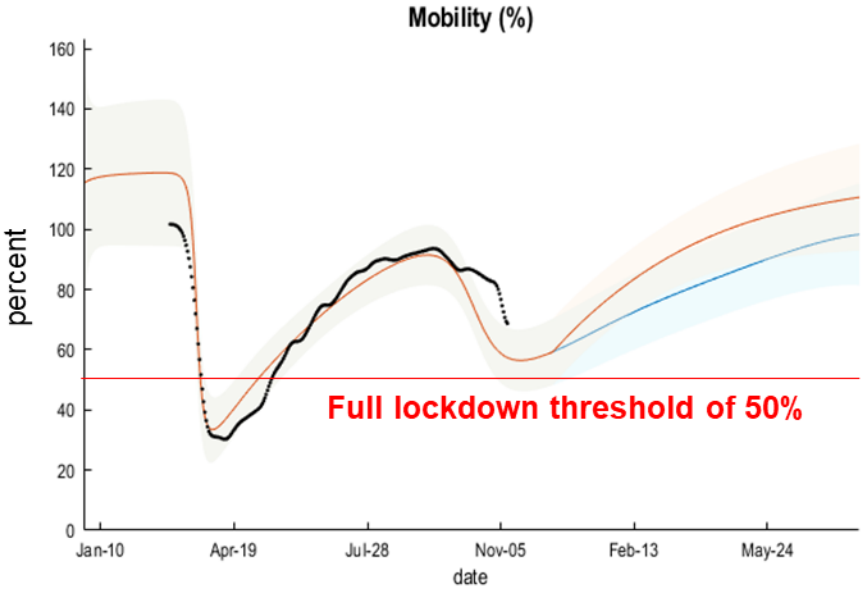
When will this be possible?

Dynamic causal modelling of enhanced contact tracing – within the above window of opportunity – suggests suppression of community transmission is achievable after the current secondary wave has subsided (see figure above). In the absence of an enhanced efficiency (from an estimated level of 3.6% at present to 24%) cases will start to rise again – engendering a tertiary wave in spring.

Will this ensure hospitals are not overwhelmed?

Yes. Hospital occupancy will not exceed the maximum levels during the first or secondary wave. This is shown below in in terms of patients requiring mechanical ventilation in critical care units (CCU), with and without enhanced contact tracing (blue 4% and orange 24%)



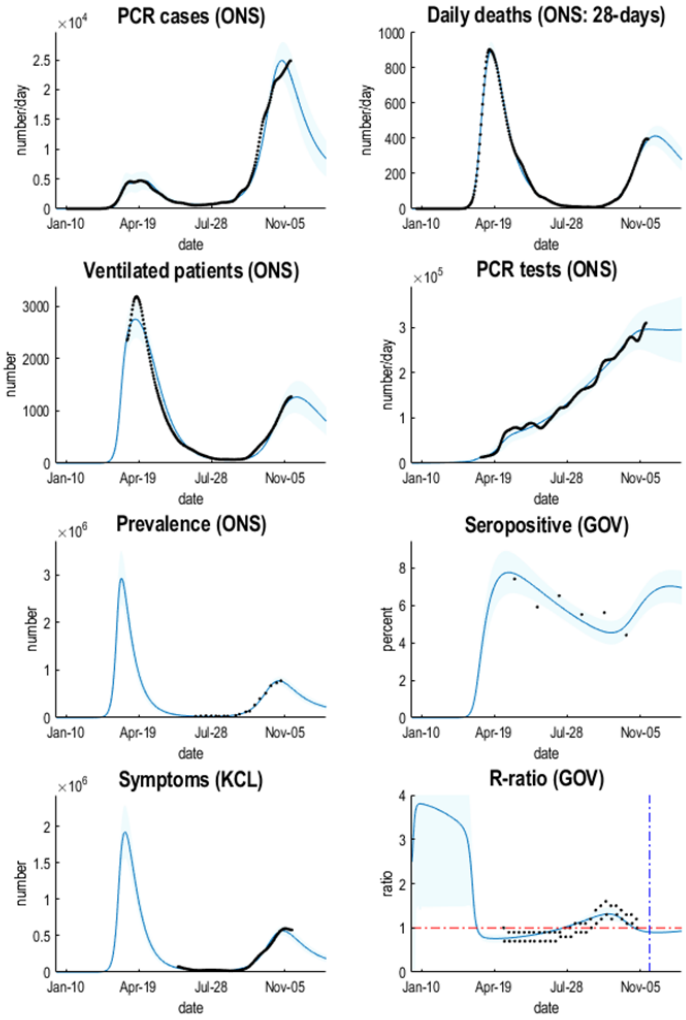


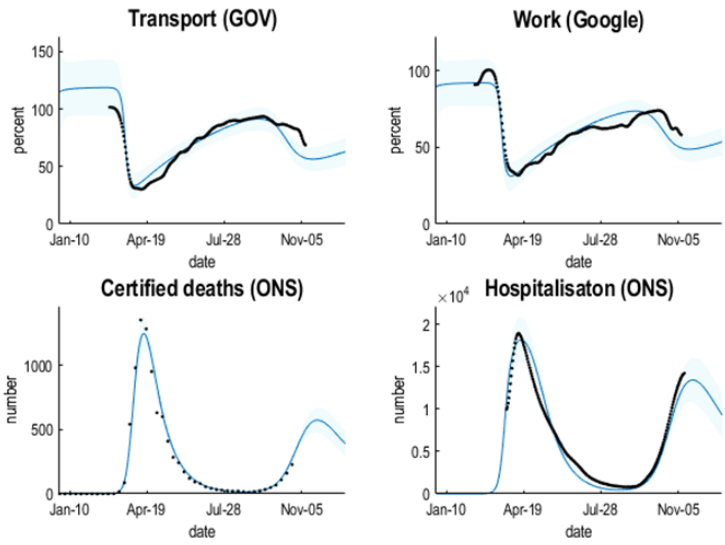
Will this mean further national lockdowns?

No. Social distancing and supported self-isolation should be sufficient – and result in a sustained reduction in mobility compared to pre-COVID levels; however, national lockdowns should not be necessary. This is shown above in terms of car usage as assessed by the Department for Transport, with and without enhanced contact tracing (blue 4% and orange 24%).

Take-home message: *As soon as the incidence of confirmed cases falls below a 100 per hundred thousand confirmed cases per week or (per hundred thousand actual cases per day), an enhanced – but realisable – contact tracing program could, in principle, suppress community transmission and preclude a third wave*

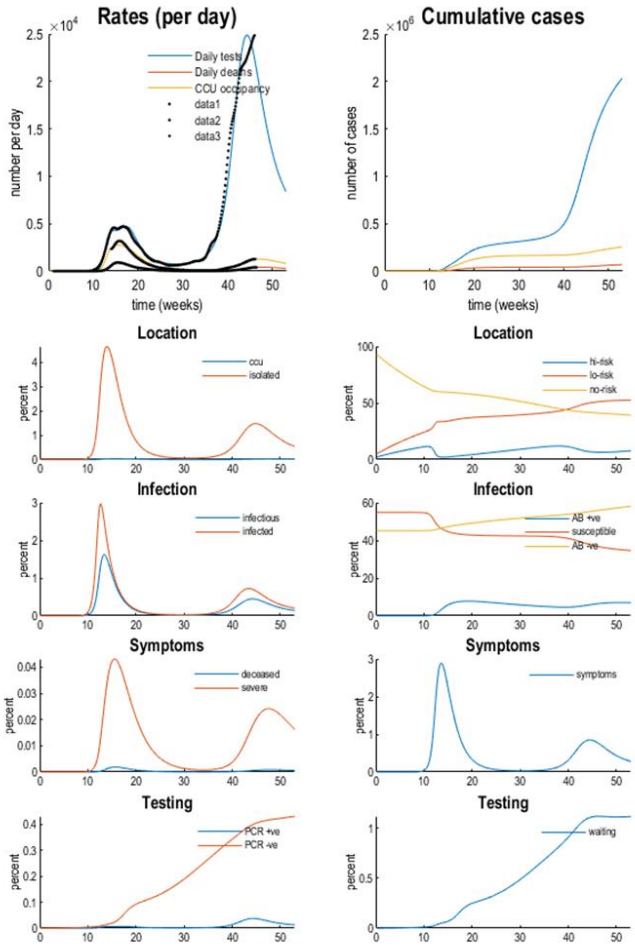
Supplementary material





Appendices: posterior predictive densities over various outcome measures. See for details:

https://www.fil.ion.ucl.ac.uk/spm/covid-19/dashboard/



Appendices: posterior expectations of latent epidemiological states. See for details:

https://www.fil.ion.ucl.ac.uk/spm/covid-19/dashboard/

Data sources:

https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/coronaviruscovid19infectionsurveydata
https://www.ndm.ox.ac.uk/covid-19/covid-19-infection-survey/results
https://coronavirus.data.gov.uk/
https://covid.joinzoe.com/data#levels-over-time

Modelling sources and resources: https://www.fil.ion.ucl.ac.uk/spm/covid-19/