Department of Health & Social Care

The Rùm Model Technical Annex - an explainer

Assessing the impact of test, trace and isolate parameters on COVID-19 transmission in an October-like environment

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Introduction

Background

In response to the COVID-19 pandemic, governments worldwide have implemented large scale testing and contact tracing programmes, along with legal duties and support for infected and exposed individuals who need to self-isolate. These sets of collective activities are described as test, trace and isolate (TTI) capabilities and are standard health protection functions. They reduce transmission by:

- promoting isolation of symptomatic individuals
- identifying infected people
- tracing and notifying their contacts (who are at heightened risk of infection), and thus
- promoting successful non-symptomatic self-isolation.

In England, most TTI delivery is through NHS Test and Trace. This forms part of the wider government strategy aiming to keep the reproduction number (R) below 1.

The latest NHS Test and Trace Business Plan was published in December 2020 and referred to modelled estimates of the impact that testing, tracing and self-isolation could be having on transmission. It also referred to potential future impact estimates calibrated on service improvement targets for March 2021, if other variables remained similar to October 2020. The plan committed to publishing the mathematical approach taken to reach those estimates in a Technical Annex.

The Technical Annex details the approach, known as the ‘Rùm’ model, and its key structural assumptions. We also describe the approach used to determine parameters for the model. Modelling was used for this task as real-world observational studies would be infeasible and comparison experiments would be impossible or unethical to undertake. The current iteration of the model is based on assumptions determined by available data. The model is being developed following further peer review feedback, for which we are very grateful to colleagues in academia.

This was a collaboration between analysts within the Joint Biosecurity Centre and NHS Test and Trace. External experts from academia, including members of The Alan Turing Institute, reviewed the approach as the Business Plan was being developed and regarded the core assumptions and structure as appropriate given the constraints. We have developed the model further based on their feedback, as documented in the Technical Annex.

The Rùm model and scenarios considered

The ‘Rùm’ model uses a probabilistic approach, and is based on epidemiology, behaviours and performance of NHS Test and Trace in October 2020. It considers second order contacts: individuals who have been infected by the contacts of an infected person. The model estimates the proportion of those individuals who would have avoided infection due to cases self-isolating, either on symptom onset or following contact tracing.

The vast majority of testing in October 2020 was used by people with symptoms; hence we assume symptomatic testing only in this model. Contact tracing times are distributed according to those observed in October 2020.

Taking these factors and assumptions into account, the model estimates that the combination of testing, tracing and self-isolation in October 2020 resulted in an R reduction of 18-33%, compared to a scenario with only social distancing restrictions and no self-isolation. The impact of contact tracing alone reduced the R number by 2-5% (with testing and self-isolation accounting for the remaining 16-28%). An 18-33% reduction corresponds to a reduction in the R number of 0.3-0.6, given the official estimate in October 2020 was around 1.2

If NHS Test and Trace were to meet the operational targets it set in the Business Plan, but circumstances otherwise were similar to October 2020, the model estimates that transmission would reduce by 33-42%. Here, the impact of contact tracing alone would contribute a 7-10% reduction in the R number. In October, a 33-42% impact on transmission would have meant an R reduction of 0.5-0.8.

Separating the components due to symptomatic self-isolation, testing, and tracing

We report the estimated total impact of test, trace and isolate, and the component due to contact tracing alone.

We do not estimate the component due to testing alone, as this depends on key behavioural parameters that we are not yet confident we can quantify. We recognise the importance of doing this, however, and it is the subject of ongoing work. For this next step, we will need to characterise the proportion of symptomatic individuals who self-isolate on the onset of symptoms but who, absent a positive test, would not remain in self-isolation for the full self-isolation period. We will also need to characterise the proportion of individuals who would only self-isolate (even if symptomatic) after receipt of a positive test.

How far an individual and their household might self-isolate without a test could vary according to symptom severity and duration, the number of times they experienced COVID-like symptoms, their employer's willingness to let them self-isolate without proof of a positive test, or their ability to access financial support.

Moreover, we will need to quantify the proportion of people who could or would tell their close contacts that they think they might have caught COVID-19 without having been able to take a test or without support from contact tracing. How many of their contacts would

then be able to self-isolate or choose to do so, and to what degree, will also need to be estimated.

Given the number and complexity of these policy and behavioural unknowns, we only report here the two aspects for which we have reasonable confidence:
the collective impact of testing, tracing and the efforts of the public to self-isolate (due to contact by NHS Test and Trace or not), and the component of that due to contact tracing alone.

TTI and the Government's COVID-19 strategy

A combination of testing, tracing and isolating alongside other interventions is needed to keep R below 1. The interventions with the greatest R reduction ability are also the toughest both socially and economically, and TTI capabilities help reduce the severity of restrictions that are needed to bring the R number down. When R is close to 1, small improvements can have large consequences in bringing transmission under control.

Changes to prevalence, national restrictions and the emergence of new variants mean the real world has changed significantly compared to the 'October 2020-like environment' the model simulates. Future modelling will need to consider these changes, as well as the impact of vaccine rollout, and the increases in asymptomatic testing NHS Test and Trace has delivered since October.

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