UK Health Security Agency

The Canna model: explainer

Assessing the impact of NHS Test and Trace on COVID-19 transmission: June 2020 to April 2021

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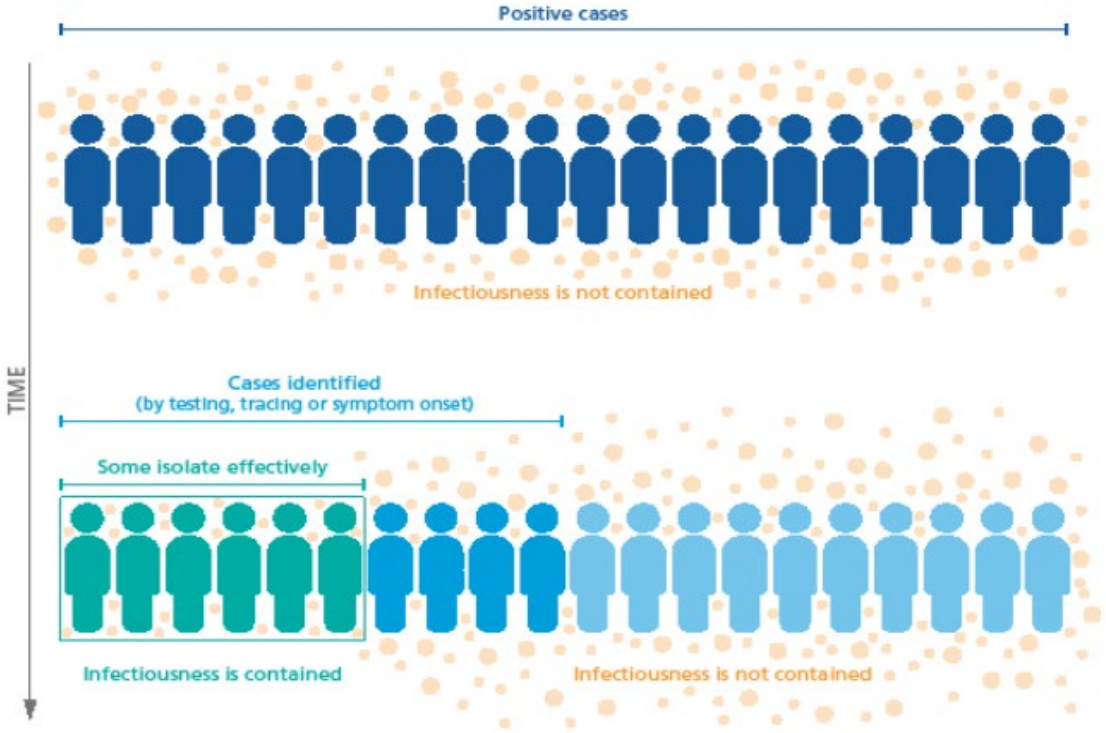
The Canna model

In February 2021 NHS Test and Trace provided an estimate of the impact of test, trace and self-isolation on coronavirus (COVID-19) transmission in October 2020 using the Rùm model[1]. The Canna model[2] uses an updated framework to estimate the historical impact, in England, from June 2020 to April 2021. The analysis was developed by the Joint Biosecurity Centre, together with a panel of independent academic advisors.

The modelling framework

The model uses test and trace data to calculate the number of individuals who self-isolated as a result of either; becoming a case after receipt of a positive test result or becoming a contact after being traced and told to isolate. Some additional individuals are also assumed to isolate based on COVID-19 symptoms, without ever engaging with test and trace. We recognise that not all individuals self-isolate according to the rules, so we used survey data to estimate the average level of compliance. Cases or contacts are detected a few days after becoming infectious so in our model we also account for the timing of isolation. We used the ONS infection survey to estimate the total number of infections over time. We compare this to the number of infectious people effectively self-isolating in order to estimate the level of transmission reduction. External study data was used to help us estimate the proportion of contacts that are infected.

Figure 1: A simplified illustration of the Canna model



[1] The Rùm Model technical annex
[2] Canna is a neighbour to Rùm, among the Small Isles in the Inner Hebrides.

The modelling framework is illustrated in Figure 1. Transmission reduction occurs as a result of identification and then self-isolation of infectious individuals. The amount of transmission reduction is determined by the proportion of total infectiousness that is contained. In this study we determine this at a population level by comparing the total number of isolations from test, trace and self-isolate to the total number of infectious individuals, derived from ONS incidence estimates.

The counterfactual scenario

We constructed a hypothetical counterfactual scenario in which we assumed that individuals with COVID-like symptoms would self-isolate together with their household contacts. The counterfactual was set at the very upper limit of what is plausible without testing. In reality, we expect a positive test result will significantly increase isolation compliance. However, it is impossible to accurately determine the scale of this effect.

The counterfactual was developed to determine the marginal impact of NHS Test and Trace. We assume that this will lie somewhere between the full impact from test, trace and self-isolate and the impact above the counterfactual.

Transmission reduction estimates

Based on our modelling, we estimate that since August 2020, the transmission reduction from test, trace and self-isolate (TTI) varied over time from 10 to 28% (across a 90% confidence interval). In the counterfactual this reduced to 6 to 19%. The transmission reduction from TTI, above the counterfactual varied over time from 4 to 16%.

In June and July 2020, when cases remained relatively low, the transmission reduction from TTI was generally lower than for the remainder of the study period (6 to 14%).

Figure 2: Transmission reduction estimates

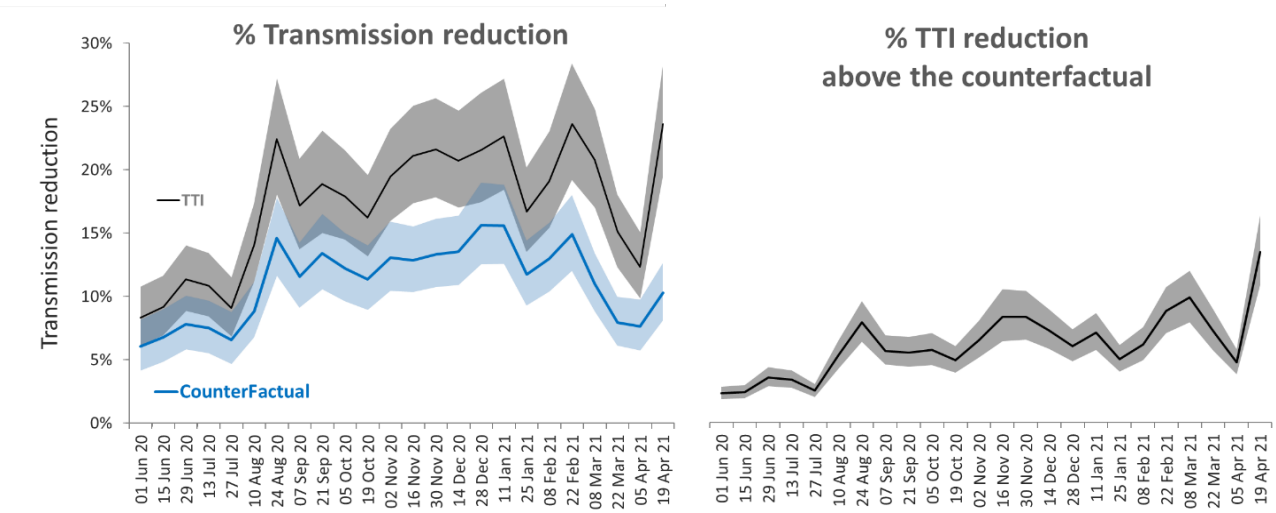


Figure 2 shows the estimates from the Canna model for the percent of transmission reduction. The plot on the left shows the range in the reduction from test, trace, and self-isolation (labelled 'TTI') and the counterfactual scenario as shown by the blue line. The plot on the right shows the range in the difference between them. Shaded regions show the 90% confidence interval. We expect the marginal impact from NHS Test and Trace will lie somewhere above the range shown by the grey region on the right, and below the grey region on the left.

The impact on the reproduction rate (Rt)

Since August 2020, the reduction in the reproduction rate[3] (Rt) from test, trace and self-isolation varied over time from 0.10 to 0.44; the Rt reduction above the counterfactual varied from 0.04 to 0.22.

In several periods (August 2020, November 2020, January to April 2021) our central estimates, shown in Figure 3, show that test, trace and self-isolation would have been critical in reducing the reproduction rate, Rt, to below 1, thereby preventing exponential growth in infections.

Figure 3: Estimates for impact of Test and Trace on Rt

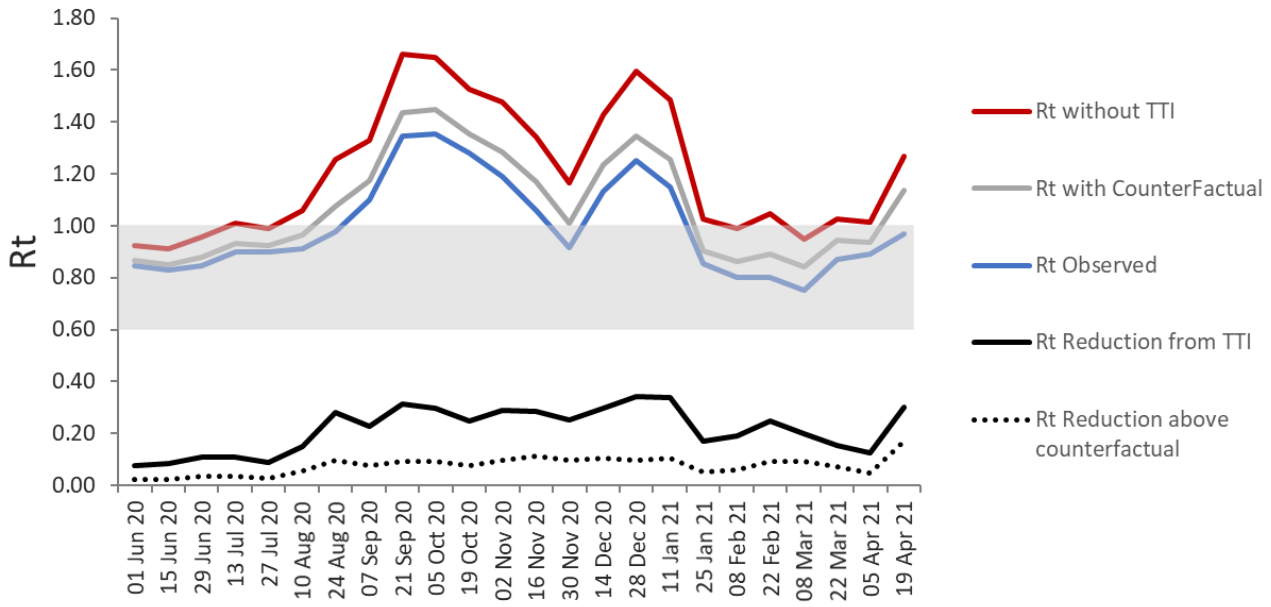


Figure 3 shows the central estimate for the impact on the reproduction rate, Rt. The blue line shows the level of Rt that was observed. The transmission reduction estimates are used to calculate Rt without test, tract and self-isolation and then subsequently Rt under the counterfactual. The solid and dashed lines indicate the reduction in Rt that can be attributed to test, trace and self-isolation (black line) and the level of reduction that exceeds the reduction expected from the counterfactual alone (dashed line). The shaded region has been added to highlight periods where Rt has been brought below 1.

[3] The R value and growth rate

The prevention of secondary cases

It is extremely difficult to estimate the number of cases prevented by a reduction in transmission rates. Preventing a single infection at the right time could prevent a full outbreak and during times of exponential growth the number of onward transmissions could be very high. However, it is impossible to know how other interventions might have responded differently. In this study we therefore only estimated the cases directly prevented by each isolation.

We estimate that isolations occurring due to TTI over the full period of the study directly prevented 1.2 to 2 million secondary cases, 0.3 to 0.5 million above the counterfactual. We expect that the true number of cases prevented will be significantly higher because we have not considered the impact on any onward chains of transmission.

Isolation with and without test and trace

NHS Test and Trace notified around 11 million individuals to isolate over the course of the study period. further 21 million individuals would have been required to isolate for a short time prior to a household member receiving a negative test. In the counterfactual scenario 25 million individuals would have been required to isolate for the full isolation period, significantly more than with test and trace.

Pillar 1 testing

Our study does not account for the impact of Pillar 1 testing in hospitals, which would have had significant additional benefits in preventing hospital outbreaks and ensuring that the right treatments were provided to those in care.

About the UK Health Security Agency

The UK Health Security Agency is an executive agency, sponsored by the Department of Health and Social Care.

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