Addendum: Assumption of perfect case isolation within the home when estimating the effect of a change in case isolation policy

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In the reports [1] *Estimating the effect of Covid Protection Framework policy scenarios on the effective reproduction number of COVID-19 in Aotearoa: August 2022,* and [2] *Estimating the effect of changes in case isolation on the effective reproduction number of COVID-19 in Aotearoa: September 2022,* we varied the effectiveness of case isolation and household contact quarantine with respect to transmission from a confirmed case to contacts **outside the household**.

An important caveat in these previous reports was that in all the simulations we assumed that once the first case is detected in a household, all individuals within that household isolate perfectly from each other, i.e. there will be no further transmission **within the household** after the first case is detected. This includes transmission from infected household contacts who are not yet confirmed cases, as well as transmission from the confirmed case(s) themselves.

In order to test the sensitivity of the results to this assumption, we now run simulations where the assumption of perfect intra-household isolation is replaced with the assumption of no reduction in transmission within households. **Table 1** and **Figure 1** show the estimates for the transmission rate increase with the assumption of perfect intra-household isolation (copied from [2]), and **Table 2** and **Figure 2** show the corresponding results with this assumption removed. Because the public health guidance for confirmed cases is to try to reduce spread within their household, the reality is likely to be somewhere between these new results and the results in the original reports.

In these new results when we allow transmission within the household after the first case is detected we find that:

1. The estimate of the transmission increase due to removing household contact quarantine and removing the COVID-19 Protection Framework is increased slightly from 11.4% to 12.7% (this manifests as an increase of the value at the 'origin' (0%, 0%) of **Figure 1** and **Figure 2**); and
2. The estimates of the transmission increases due to reducing case isolation are decreased slightly, and there is no longer a substantial difference in the impact on Rt of a large fraction of people taking some actions versus a smaller fraction of people taking highly effective action. The contours in **Figure 2** are closer to 45 degrees than they are in **Figure 1**.

		Reduction in *effectiveness* of actions				
		0%	**25%**	**50%**	**75%**	**100%**
Reduction in *proportion* of people taking action	**0%**	11.4%	15.2%	18.1%	20.5%	22.2%
	25%	16.0%	18.5%	20.4%	22.1%	23.5%
	50%	20.0%	21.7%	22.9%	24.0%	24.8%
	75%	24.0%	24.5%	25.2%	25.6%	26.2%
	100%	27.3%	27.4%	27.5%	27.3%	27.4%

Table 1: *Estimated percentage increase in Rt relative to baseline of August 2022, when changing case isolation behaviour factors. These results assume perfect intra-household isolation and are copied from the September 2022 report [2].*

		Reduction in *effectiveness* of actions				
		0%	**25%**	**50%**	**75%**	**100%**
Reduction in *proportion* of people taking action	**0%**	12.7%	15.8%	18.1%	19.8%	21.5%
	25%	15.3%	17.5%	19.1%	20.6%	21.9%
	50%	17.9%	19.2%	20.2%	21.3%	22.2%
	75%	20.3%	21.0%	21.5%	22.1%	22.5%
	100%	22.7%	22.7%	22.8%	22.9%	22.9%

Table 2: *Estimated percentage increase in Rt relative to baseline of August 2022, when changing case isolation behaviour factors. These results assume no reduction in transmission within households.*

The explanation for the increased impact of removing household contact quarantine is that in these new results there is more transmission within the household, this means that more household contacts become infected, and thus there is more potential for community transmission from household contacts if they are not required to quarantine. In [1] we found that removing household quarantine and only recommending household contacts test if they develop symptoms leads to a ~5% increase in Rt. Comparing the (0%, 0%) 'origin' values between **Table 1** and **Table 2**, we find that removing the assumption of perfect intra-household isolation increases the estimated impact of removing household quarantine from ~5% to ~6% (one percentage point).

The explanation for the change in the case isolation impact estimates is that in the earlier results, when there was no transmission within the household from confirmed cases, case isolation in our simulations was doing more to reduce transmission - both within and between households. This means that reducing or removing it would be expected to have a larger effect on Rt in the population overall.

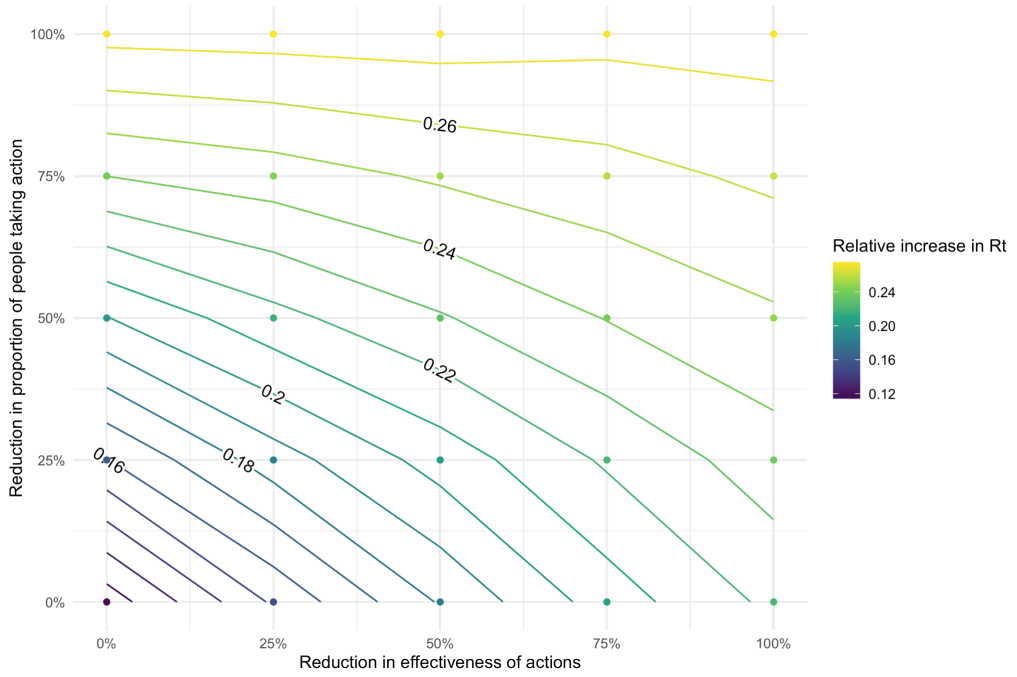

Figure 1: *Contour plot showing the relative increase in Rt due to a change in case isolation behaviour factors compared to an August 2022 baseline from the September 2022 report [2] (assuming perfect intra-household isolation).*

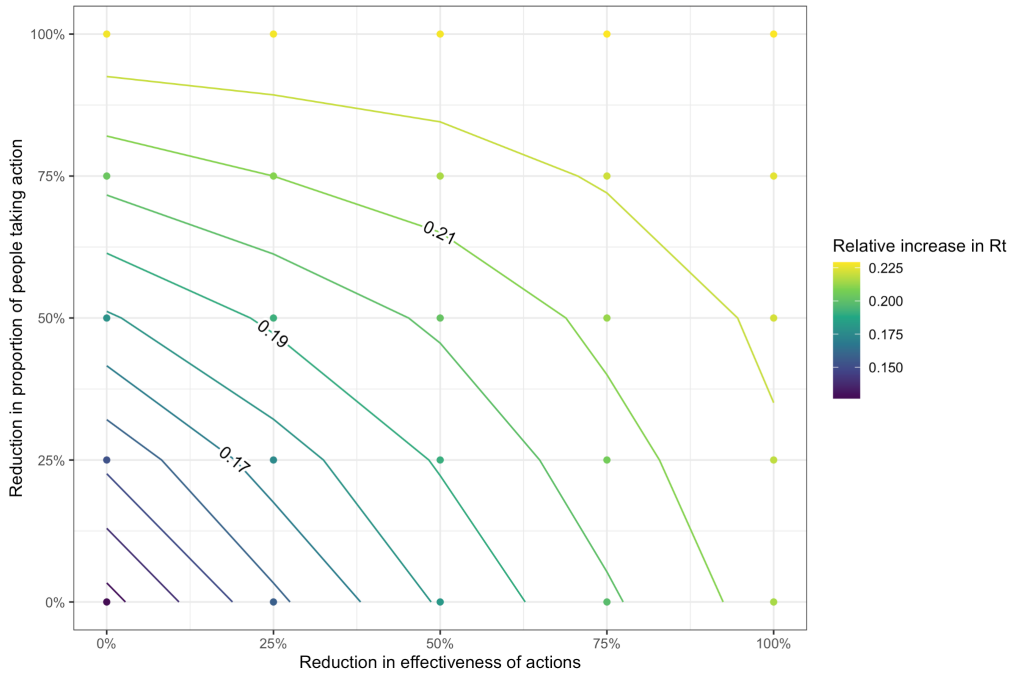

Figure 2: *Contour plot showing the relative increase in Rt due to a change in case isolation behaviour factors compared to an August 2022 baseline, assuming no reduction in transmission within households.*

Implications for prior conclusions

When we assume that there is no action taken to reduce transmission within households after cases are confirmed, the finding in [2] that "a large fraction of people taking some action leads to a smaller increase in Rt than a small fraction of people taking a highly effective action" is not as strong. However, the public health guidance for confirmed cases is to try to reduce spread within their household, so the reality is likely to be somewhere between these new results and the results in the original reports. We conclude therefore that this finding from [2] is still valid, although the effect size is likely less strong.

Additionally, these results are for simulations where household contacts do not quarantine and only test if they develop symptoms. This means that there is no flow-on transmission reduction impact except for the case isolation itself. If instead we assume that household contacts do take some precautions, and do test even if they don't have symptoms, then we would expect similar findings to earlier work [2]. I.e. a large fraction of people taking some action (in this case the action would be increasing the testing rate and precautions for their household contacts, as well as their own isolation behaviour) would lead to a smaller increase in Rt than a small fraction of people taking a highly effective action.

References

[1] Harvey, E. et al. (2023) *Estimating the effect of Covid Protection Framework policy scenarios on the effective reproduction number of COVID-19 in Aotearoa: August 2022*, https://covid19modelling.blogs.auckland.ac.nz/estimating-the-effect-of-covid-protection-framework-policy-scenarios/

[2] Harvey, E. et al. (2023) *Estimating the effect of changes in case isolation on the effective reproduction number of COVID-19 in Aotearoa: September 2022*, https://covid19modelling.blogs.auckland.ac.nz/estimating-the-effect-of-changes-in-case-isolation/