Strategic Policy, Planning and Performance Report

Subject: **Estimate of instantaneous reproduction number (R_t) for Covid-19 in Jersey**
Date: **16 December 2020**

Background - What is the R_t number?

The instantaneous reproduction number (R_t) of an infection describes how quickly the infection is spreading. It can be thought of as the number of subsequent infections that are introduced into a population by each infection. If this number is below 1, each successive generation of infections is smaller than the previous, and the number of infections dies out over time. Any number above 1, and the number of new infections will grow.

R_t may vary due to aspects of the infection itself, as well as the size and behaviour of the susceptible population. Producing an estimate of R_t through time can give useful insight into changes in the rate of spread of infection during different phases of mitigation, and indicate the likelihood of infection numbers increasing.

There are several methods for modelling R_t, and each will produce a slightly different estimate. The estimation method[1] used here uses the time-series of new incidences (i.e. the numbers of positive confirmed cases over time) to estimate R_t with a 95% credible interval. The 95% credible interval indicates a range of likely values of the R_t estimates. The width of the 95% credible interval indicates the uncertainty around the estimates.

December 2020 Update

Over the summer, prevalence of the virus was low in Jersey, and it was not appropriate to attempt to calculate the instantaneous reproduction number R_t, as the model requires a minimum incidence level (number of confirmed positive cases within a certain time period). With the higher number of confirmed on-Island positives from mid-autumn, it became possible to resume estimation of R_t.

A central assumption of the model is that testing effort is constant over time. Jersey's testing policies continue to adapt in response to the pandemic, and this means there have been changes in both the number of Covid-19 tests carried out, and where that testing is targeted. Average daily testing (excluding borders testing, see Appendix) has risen from **250 per day** in early October to **1450 per day** as of 15th December (see Figure 1 in Appendix). This is greater than a 5-fold increase in testing rate over 10 weeks. This increase in testing has been due to, for example, a wider workforce screening programme (launched 2nd November), and the extensive contact tracing as case numbers have risen. This changing testing rate means a central assumption of the model is not met. Therefore, estimates of R_t for Jersey should be treated with caution, and considered in the context of the many other metrics used to track the coronavirus situation in Jersey. Key metrics (such as testing rate, positivity rate and more) are published regularly in the "Coronavirus Weekly Update":

https://www.gov.je/SiteCollectionDocuments/Health%20and%20wellbeing/ID%20Coronavirus%20weekly%20update.pdf

In larger jurisdictions with higher populations, hospital admission rates and/or death rates can be used to validate estimates of R_t, as these metrics are not as sensitive to changes in testing rates. However, as Jersey's population is small, the numbers of admissions and deaths are small, and it is not statistically appropriate to base models on such low numbers. In a small jurisdiction like Jersey, the R_t number should not be used in isolation to understand the spread of coronavirus locally. Decision makers use these R estimates in conjunction with other public health intelligence metrics in order to build a detailed picture of the local coronavirus outbreak.

[1] Cori et al. (2013) "A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics", American Journal of Epidemiology, Vol 178, No. 9

Weekly estimates of R_t

The table below shows the estimated range of R_t at the end of each week over the last month. The range indicates the 95% credible interval of likely values of the R_t at that point in time.

The estimated range of R_t is colour coded as follows:
Red when the range is above 1 (Highly likely that the infection is spreading exponentially)
Amber when the range straddles values both above and below 1 (Some likelihood the infection is spreading exponentially, but also possible that the rate of infection is slowing)
Green when the range is below 1 (Likely that the rate of infection is slowing)

Table 1. Weekly estimates of the likely range of instantaneous reproductive number (R_t) for Covid-19 in Jersey.

Week Ending	Range
22/11/2020	0.8-1.1
29/11/2020	1.4-1.8
06/12/2020	1.4-1.7
13/12/2020	0.9-1.1

Discussion of Results

The reproduction number (R_t) is likely to have been above 1 during late November and early December (Table 1). This means that each infected person was on average passing the virus to one or more other people. The model estimates a range of likely values of R_t, and when this range straddles values both above and below 1, the model cannot confidently conclude whether the infection is spreading exponentially or beginning to slow. Whilst the most recent estimate of R_t for 13th December is lower than the week before, the estimate straddles values both above and below 1 (0.9 – 1.1), meaning the model does not conclusively show that the rate of infection is slowing or quickening.

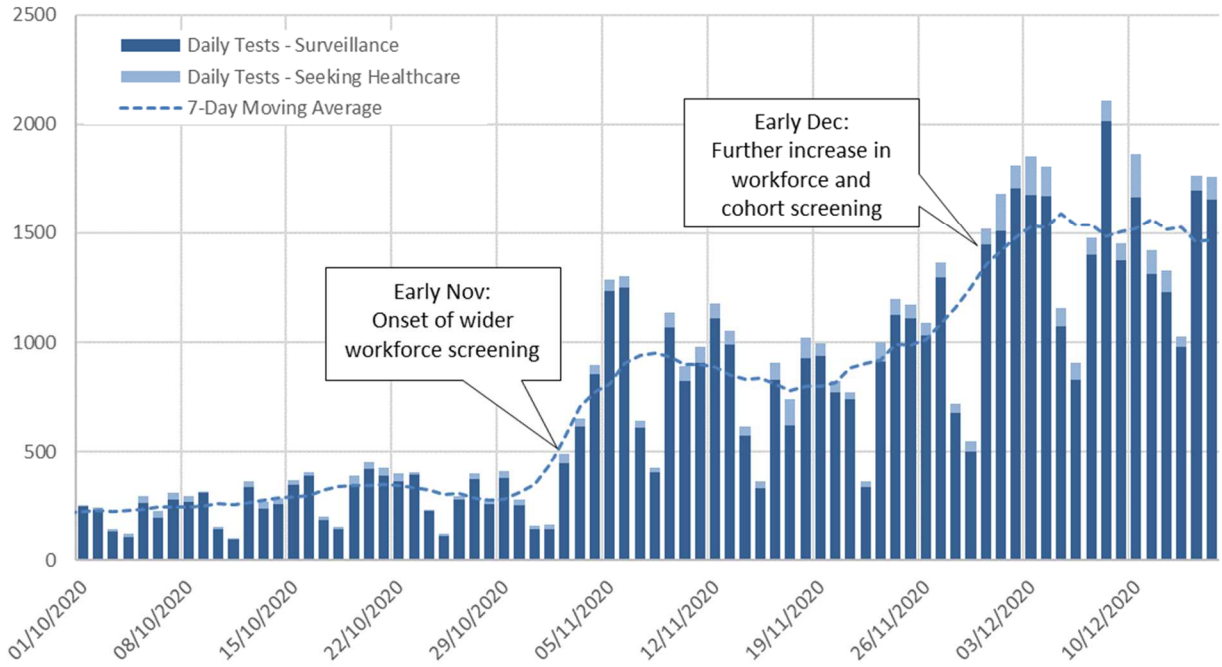
These estimates of R_t are produced with the best available data to date and may be subsequently revised as more information comes to light. The estimate of the range of R_t will continue to be monitored, and these estimates will be used in conjunction with other key indicators to assess the effectiveness of mitigation measures on local infection rates.

Appendix

Model Notes and Assumptions

1. Jersey's rigorous borders testing programme means we are able to distinguish between "seed" coronavirus cases (picked up at borders screening) and other "non-seed" cases picked up by on-island testing. Using incidence of non-seed cases only (those identified through contact tracing, workforce and admission screening, and testing of symptomatic individuals) allows us to more accurately assess the local reproduction number.
2. The model requires an estimate of the distribution of the "serial interval" – the time between someone developing symptoms, and the persons they infect developing symptoms. A serial interval of 5.19 days was used for this modelling, with a standard deviation of 3 days, following the findings of a recently published metanalysis[2] of data available for Covid-19 infectious pairs.
3. Symptomatic cases are recorded against the date of symptom onset, whilst date of swab is used for asymptomatic cases.

Figure 1. The changing rate of Covid-19 testing in Jersey since 1st October (excluding Borders Testing)



[2] Rai et al. (2020) "Estimates of serial interval for COVID-19: A systematic review and meta-analysis", Clinical Epidemiology and Global Health