Infectious Disease Modelling Team

Omicron and Delta serial interval distributions from UK contact tracing data*

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UK Health Security Agency

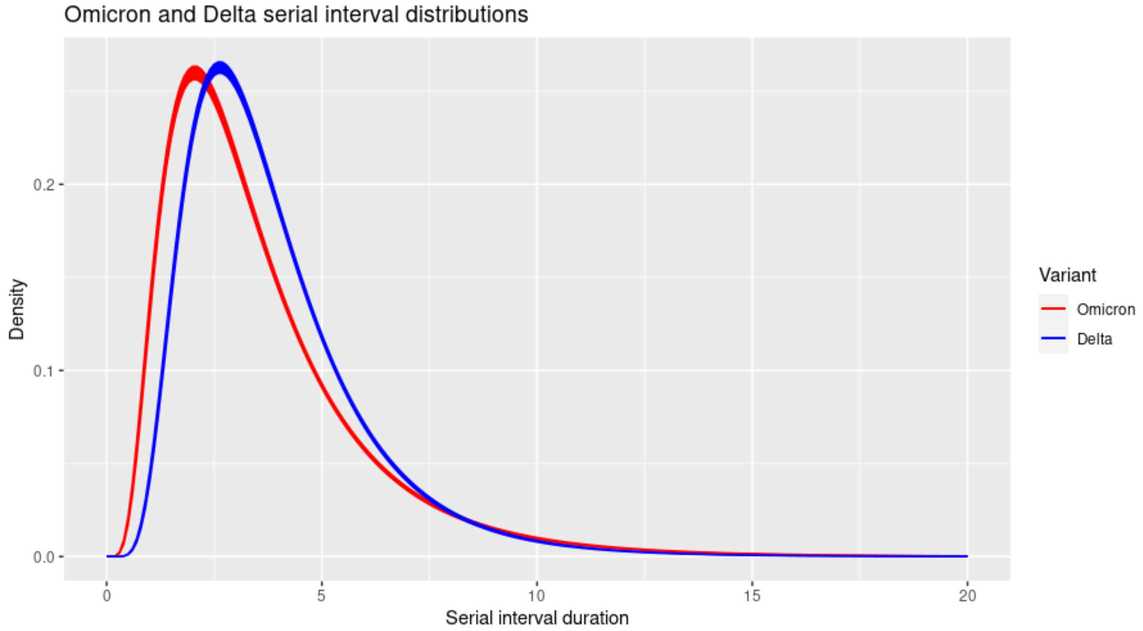
Omicron contact tracing serial interval analysis – 31/12/21

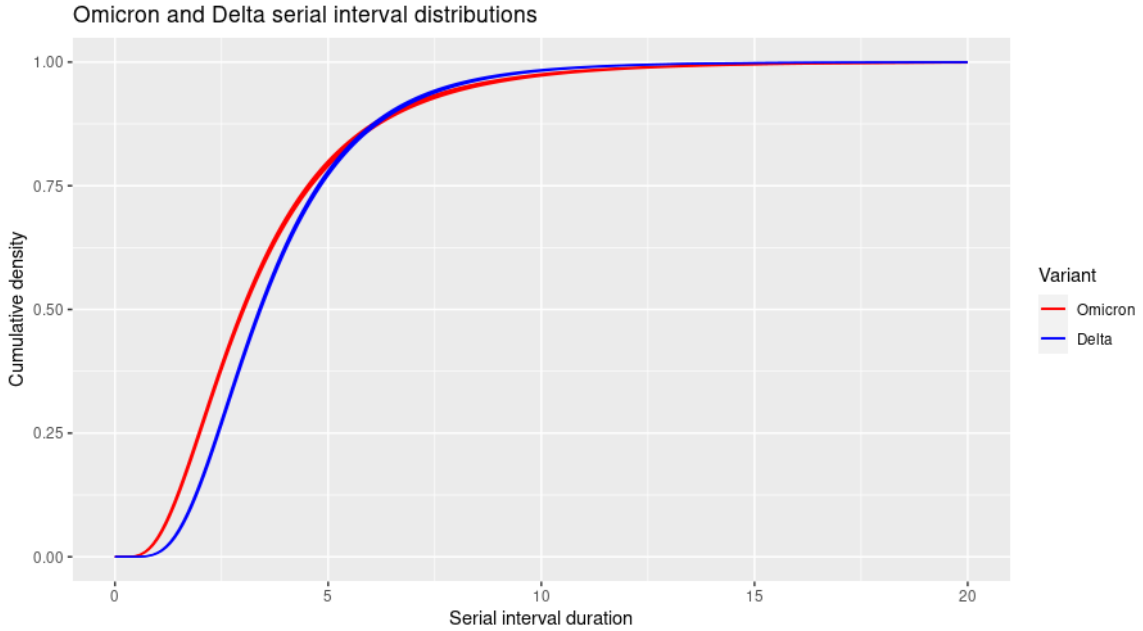
Executive summary

- Omicron and Delta have similar mean serial intervals in the contact tracing data, Omicron – 3.64 days (95% CI: 3.6, 3.68), Delta – 3.87 days (95% CI: 3.84, 3.9).
- However, the Omicron serial interval has much higher variance, so the median serial interval is shorter than Delta – 3.1-3.2 days compared to 3.5-3.6 days.
- The higher variance leads to the Omicron serial interval having a much heavier tail than Delta, with the 95th percentile falling between 8.3 and 8.6 days compared to 7.9 and 8.1 days.
- These are based on 11,240 Omicron observations and 12,353 Delta observations.

Caveats

- These serial intervals are overestimated due to the nature of the contact tracing data, which does not detect negative serial intervals. The missingness for negative serial intervals means that any difference between Delta and Omicron could be underestimated.
- This analysis does not control for type of contact, which may affect the serial interval distributions, since (i) within household contacts are likely to differ from between household contacts due to differences in the timing around the exposer-exposee linkages, and (ii) travel associated contacts are included, who may be over-represented in sequenced cases.
- Additionally, changes in testing behaviour and mixing throughout December, and the fast-changing dynamics with high community incidence, may affect the serial interval distributions.





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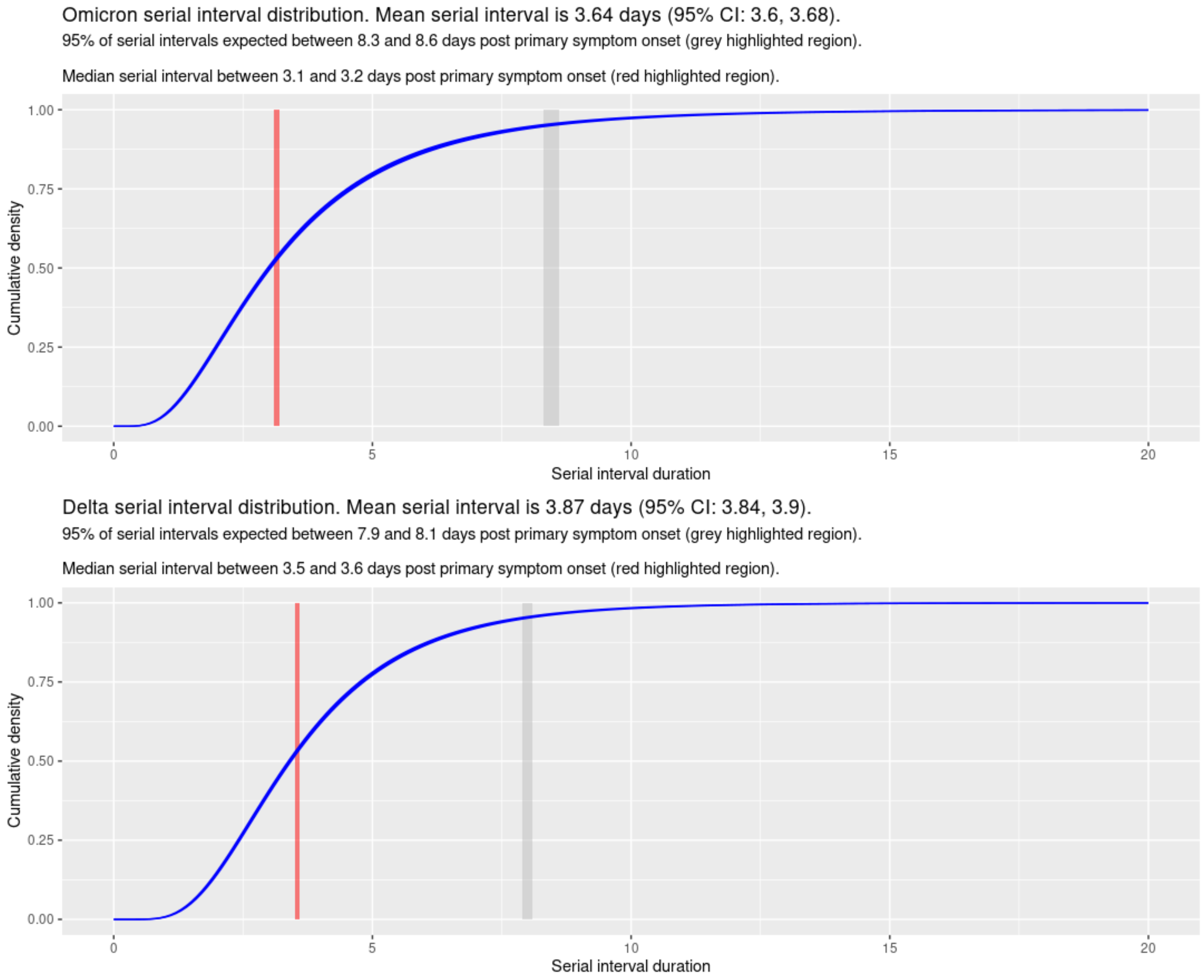

Figure 2: *Cumulative density functions for the serial interval, with overlaid confidence regions for the median and 95th percentile.*

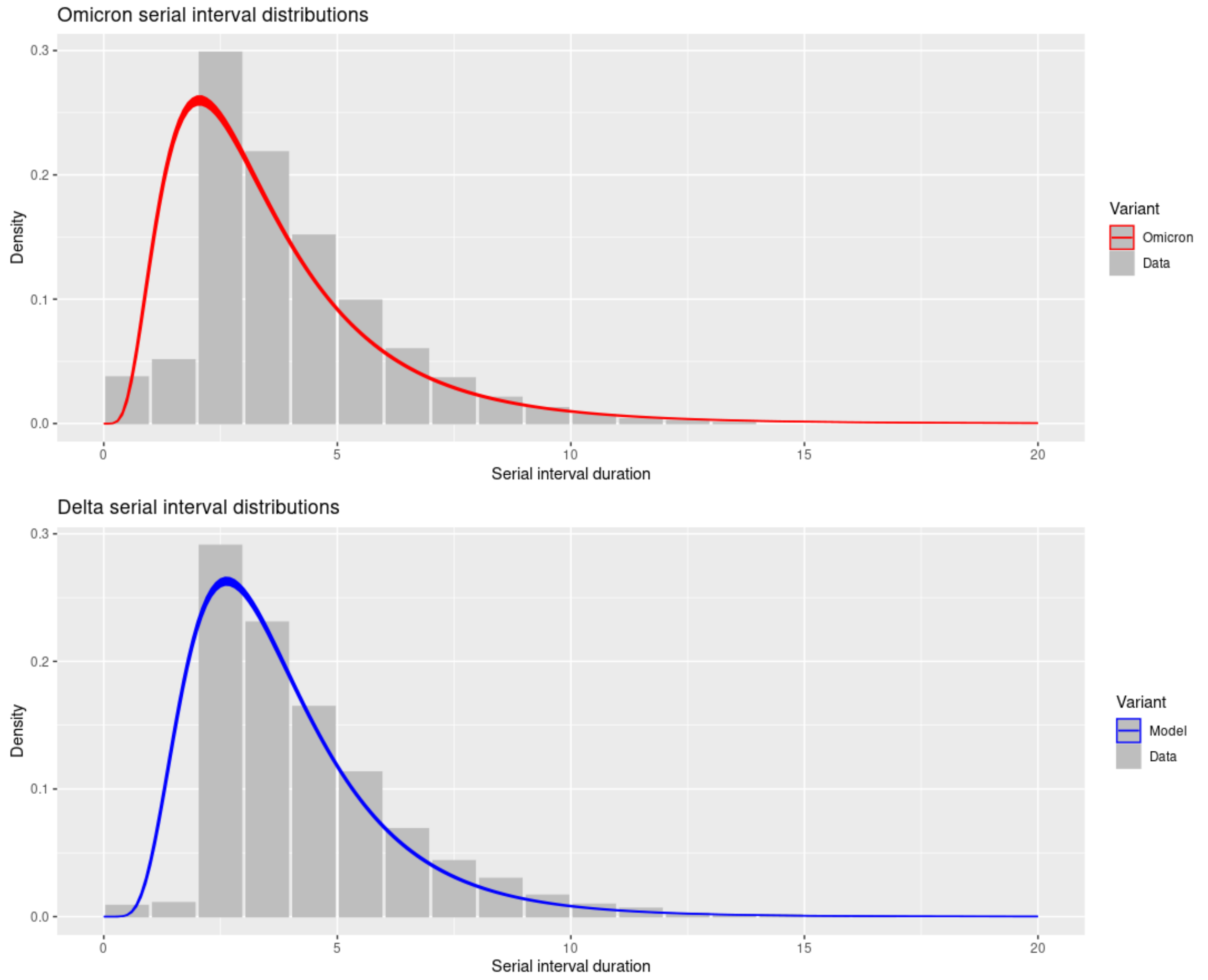

Figure 3: *Comparing the model fit density functions to histograms of the raw data. The model attempts to infer the shape of the missing data in the 0-2 day window, and adjusts for missingness in the tail caused by right truncation.*

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Data sources

- The data used to estimate the serial interval comes from the contact tracing data.
- These data are processed inline with guidance from the contact tracing team to identify transmission pairs.
- Individuals with incubation periods shorter than 2 days are removed, to facilitate better matching of transmission pathways. This means that every observed serial interval duration will be missing some density corresponding to individuals with shorter incubation periods. This applies to all serial interval lengths, but will affect shorter serial intervals more than longer serial intervals, and results in delays between 0-2 days having very low density (Figure 3).
- Therefore, serial intervals estimated from the contact tracing data will overestimate the true serial interval.
- Omicron serial intervals are only included if the primary symptom onset occurs after 10/12/21. Delta serial intervals are only included if the primary symptom onset occurs after 01/12/21. This is done because the serial intervals in the data prior to this point were very different.
- Variants are confirmed through sequencing only.

Methods

- We use a parametric model to fit the serial interval distributions.
- We assume the serial interval follows a lognormal distribution.
- Due to the exponential growth of Omicron, it is essential to correct for the right-truncation of the data, whereby we only observe a transmission pair if the symptoms occur before the final date of the sample.
- To adjust for this, we construct a right-truncation-corrected likelihood function,

$$(\boldsymbol{Y = y | X = x, Y < T}) = \frac{\boldsymbol{P(Y = y, X = x)}}{\boldsymbol{P(Y < T, X = x)}}$$

$$= \frac{\boldsymbol{P(X = x)P(SI = y - x)}}{\boldsymbol{P(X = x)P(SI < T - x)}} = \frac{\boldsymbol{f_\theta(y - x)}}{\boldsymbol{F_\theta(T - x)}},$$

which we fit using MCMC to capture uncertainty in the estimates.