

Reassessing global historical R_0 estimates of Canine Rabies

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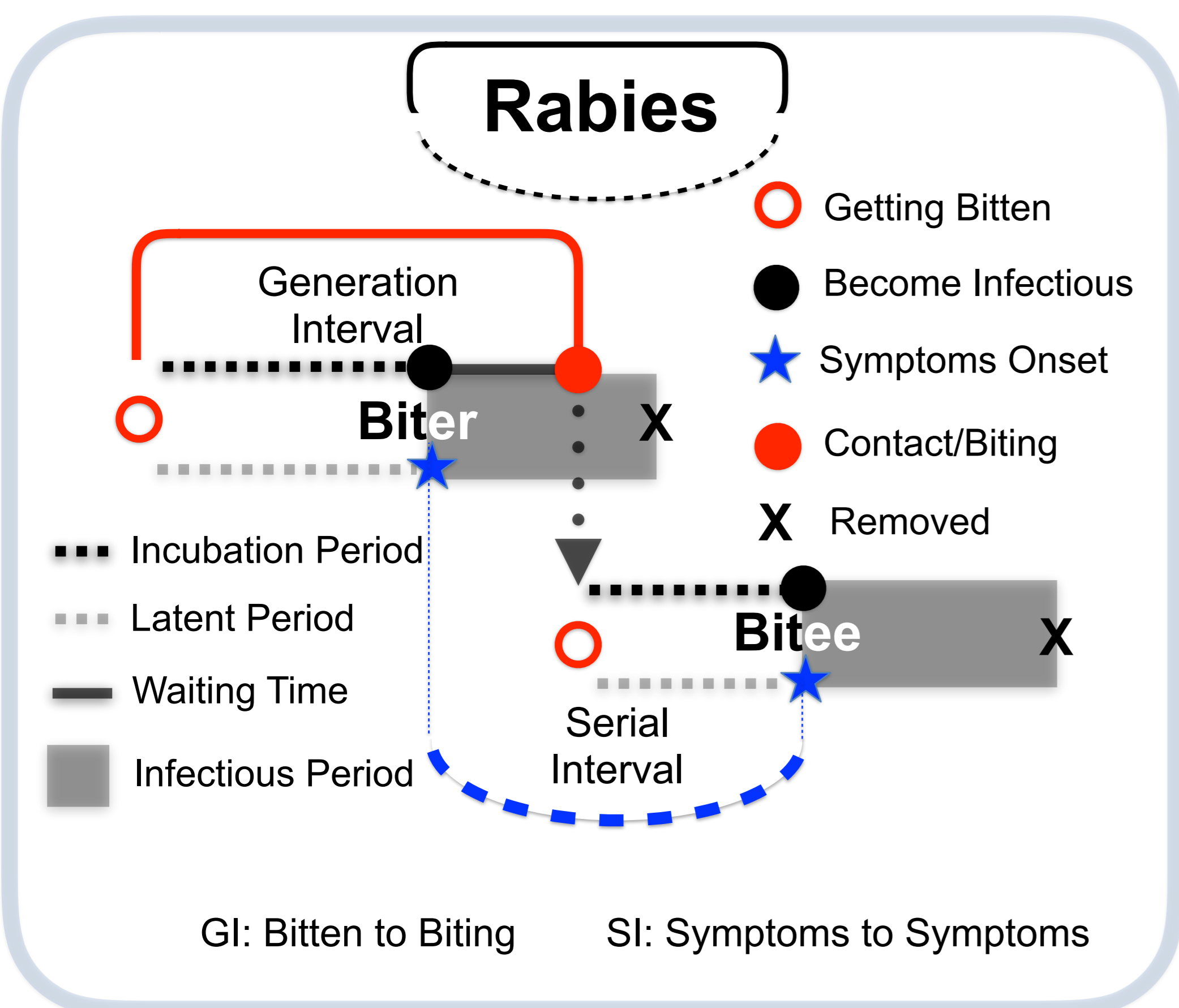
Rabies R_0 Puzzle

- Estimates of intrinsic reproductive number (R_0) from a wide range of times and locations are low (<2), with narrow confidence intervals.
- We would expect R_0 to vary widely, since dog densities and other factors do [1].
- The apparently narrow range of R_0 is a puzzle.

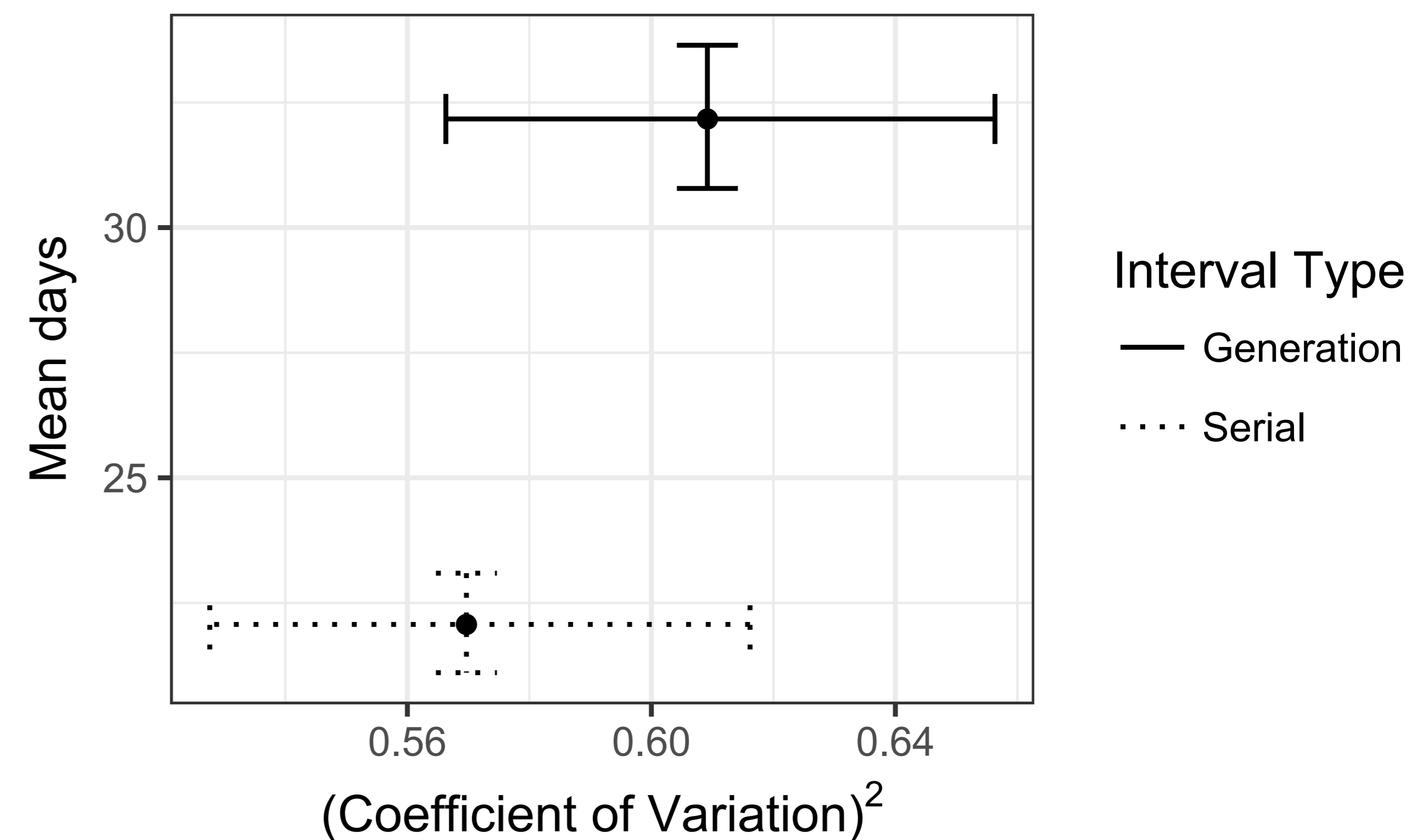
Objective

- Investigate rabies R_0 puzzle
- Clarify generation vs serial interval
- Use new and robust estimation technique to estimate R_0 and initial growth rate (r) for global historical rabies outbreak.

Anomaly in Generation Interval (GI) vs Serial Interval (SI)

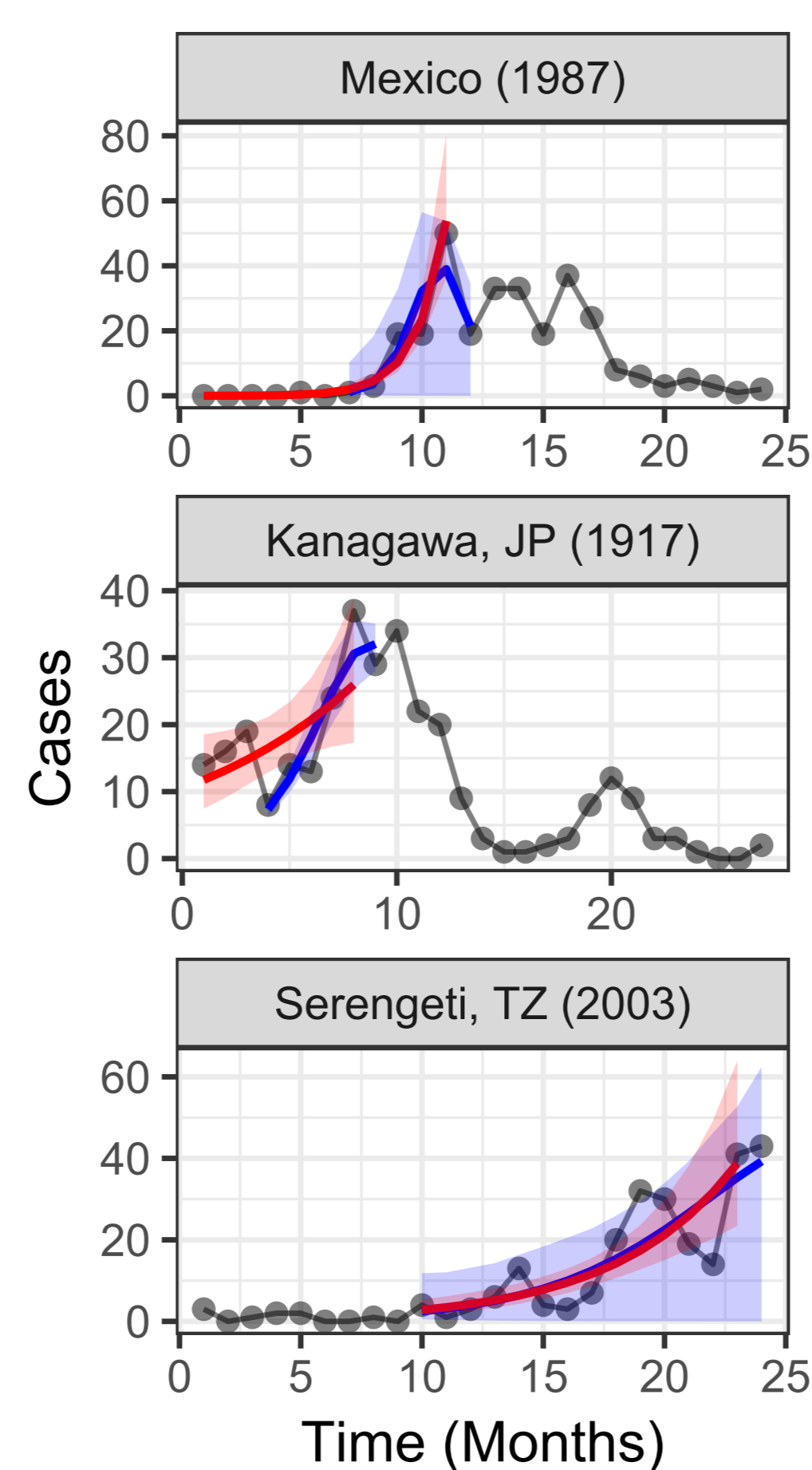
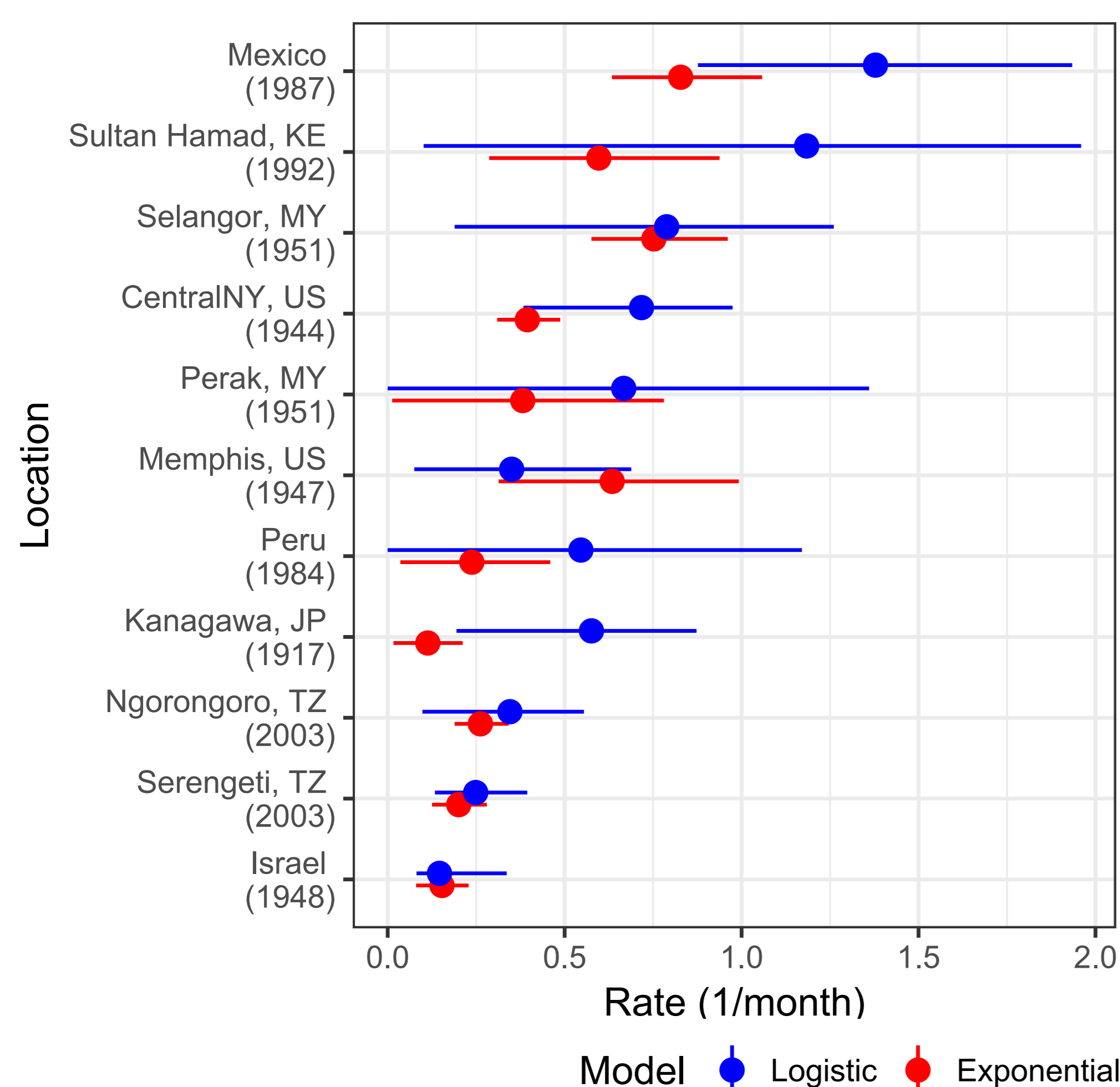


- People often treat GI and SI the same
- Expect GI & SI to be the same if "incubation = latent" period (and not correlated with transmission)
- Incubation and latent periods are generally the same for rabies (but not for all diseases)
- We expect the same mean for GI and SI more generally.
- GI can always be measured entirely from the point of view of an individual who transmits.

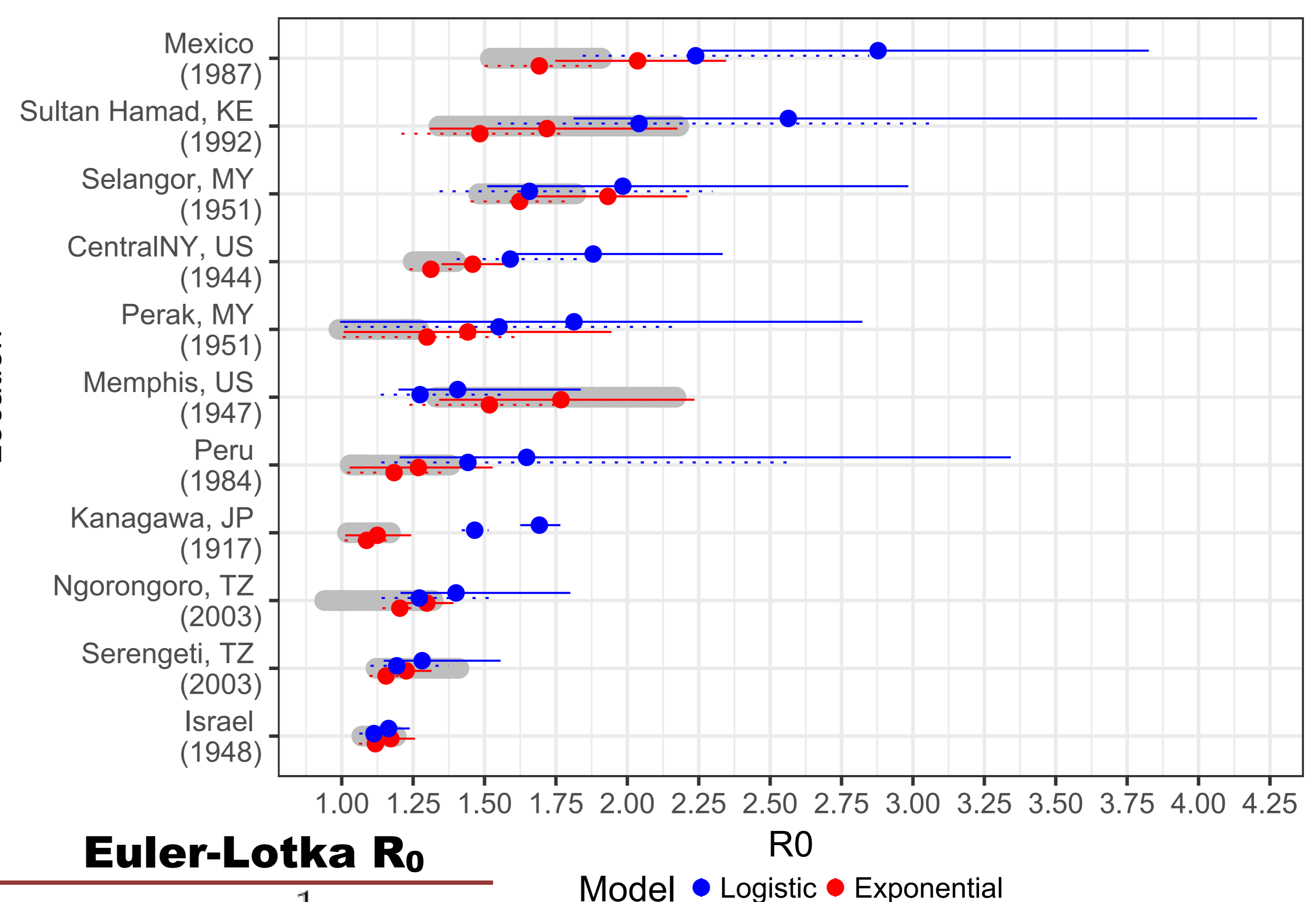


- On-going contact tracing data from Tanzania (2012-present)
- Focal dogs (biters) have longer incubation periods resulting in longer GI than SI

Initial Growth Rates (r)



Intrinsic Reproductive number R_0



$$R_0 = \frac{1}{\sum_{t=0}^{\infty} G(t)e^{-rt}}$$

- Bootstrap Euler-Lotka R_0 via resampling r and G

- Gray highlights are R_0 estimates from [1]

- Incorporating uncertainties from both time interval and r

Reference

[1] Hampson et al. "Transmission Dynamics and Prospects for the Elimination of Canine Rabies". 2009.

[2] Ma et al. "Estimating initial epidemic growth rates". 2014.

[3] Wallinga and Lipsitch. "How generation intervals shape the relationship between growth rates and reproductive numbers". 2007

Conclusions

- Using robust techniques provided larger estimates and wider confidence intervals on r and R_0 compared to previous estimates.
- Our results suggest that maybe rabies R_0 is less well known than we think.
- This finding has implications for current intervention strategies against rabies in developing countries.