Supplementary Information for: The impact of COVID-19 non-pharmaceutical interventions on the future dynamics of endemic infections

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Supplementary Text

RSV seasonality

RSV epidemics exhibit distinct dynamic patterns driven by local climate [1, 2]. Locations in the USA with a large seasonal variation in specific humidity tend to experience biennial RSV dynamics where a large outbreak is followed by smaller outbreak. Locations with a moderate seasonal variation in specific humidity tend to experience annual outbreaks and locations with less seasonal variation in specific humidity tend to experience more persistent RSV outbreaks. In these latter locations, such as in Florida and southern Mexico, outbreaks tend to coincide with periods of elevated rainfall. RSV epidemic dynamics exhibit a stable limit cycle structure. For a few locations, co-existing attractors are possible, with perturbations to the system driving a shift to an alternate stable limit cycle (Fig. S8) [3]. Although there are two circulating RSV strains, strain-level data were not available for the USA, so our models add across strain structure [4].

Supplementary Figures

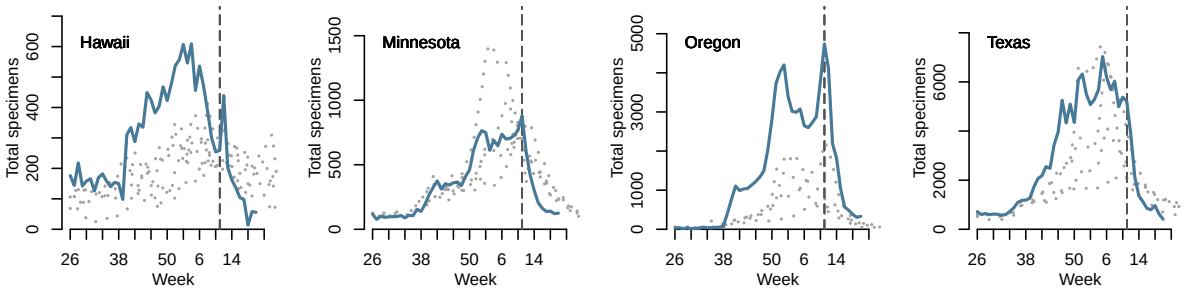

Figure S1: **Total specimens influenza**. Total number of laboratory specimens tested for influenza in four states. The highlighted line in the 2019-2020 season and the other grey lines are the previous four influenza seasons.

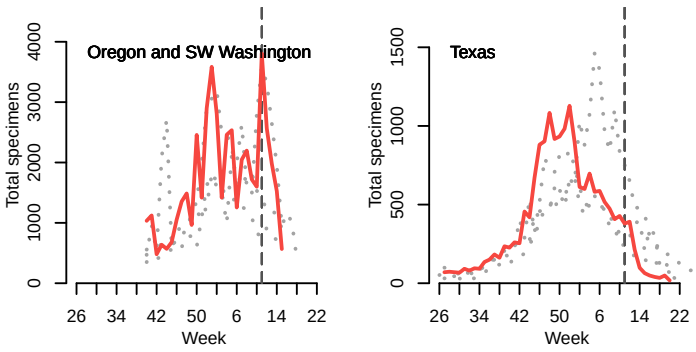

Figure S2: **Total specimens RSV**. Total number of laboratory specimens tested for RSV in two states. The highlighted line in the 2019-2020 season and the other grey lines are the previous four RSV seasons. Equivalent data were not available for Florida and Minnesota.

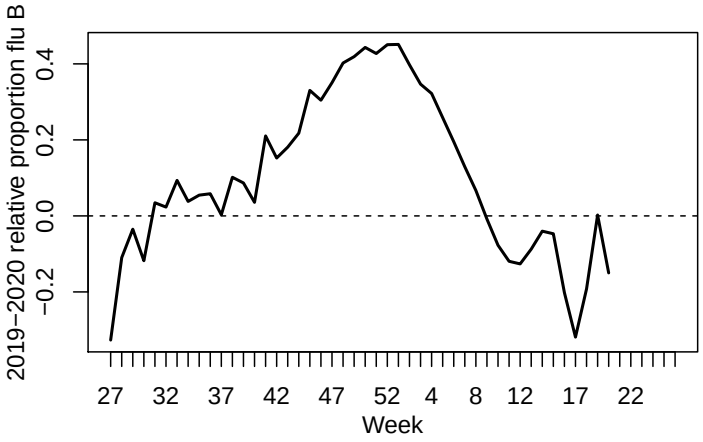

Figure S3: **2019-2020 elevated influenza B**. The average proportion influenza B circulating in 2019-2020 influenza season, over the average proportion over the preceding four years. 2019-2020 experienced elevated levels of influenza B.

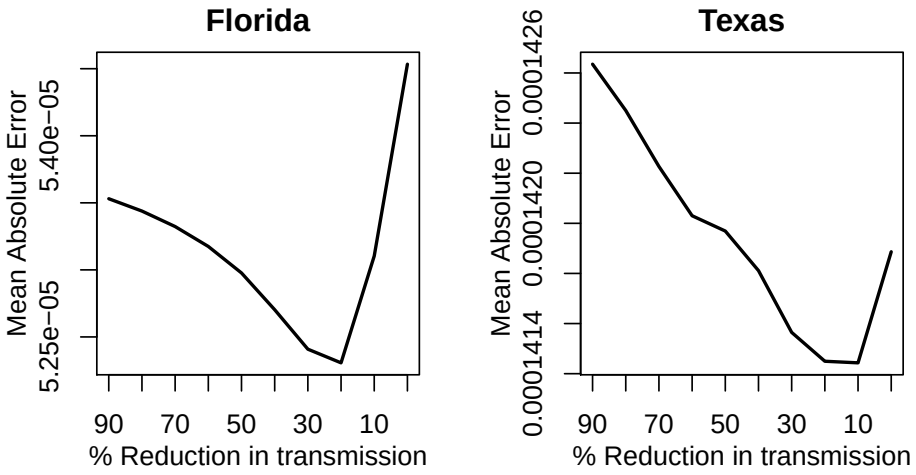

Figure S4: **Model calibration to Texas and Florida data**. Mean absolute error of simulation model fit with varying percentage transmission reductions for the control period. A 20% reduction in transmission was found to be the best joint fit for the two states.

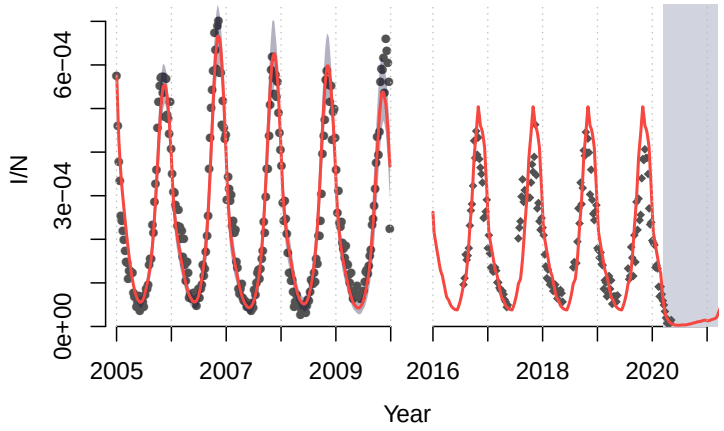

Figure S5: **Model fits of hospitalization data and surveillance data for Florida**. The TSIR model (red line) is fit to hospitalization data pre-2010 (left black circles) and then simulated forward (right hand plot), compared to scaled surveillance data (black diamonds). Different sized peaks between the two series are driven by a reduction in birth rate.

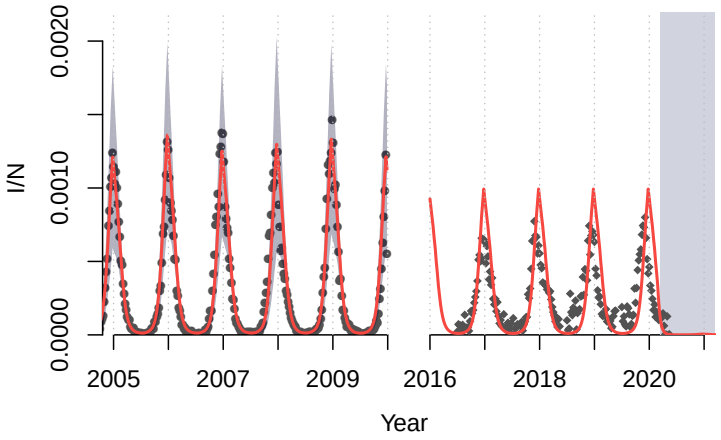

Figure S6: **Model fits of hospitalization data and surveillance data for Texas**. The TSIR model (red line) is fit to hospitalization data pre-2010 (left black circles) and then simulated forward (right hand plot), compared to scaled surveillance data (black diamonds). Different sized peaks between the two series are driven by a reduction in birth rate.

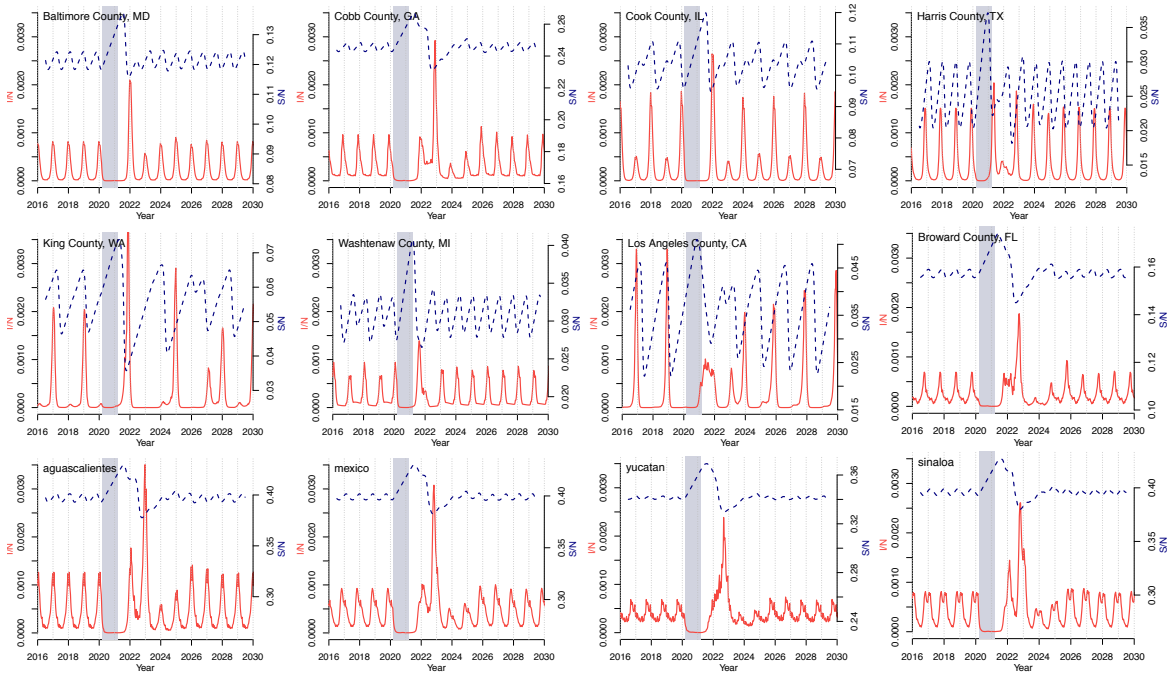

Figure S7: **Simulations for selected US counties and Mexican states in the data**. Simulations assume a 20% reduction in transmission lasting one year from Week 11 March 2020. For some locations, such as Los Angeles, and King County, WA, the model overpredicts the intensity of the biennial cycle.

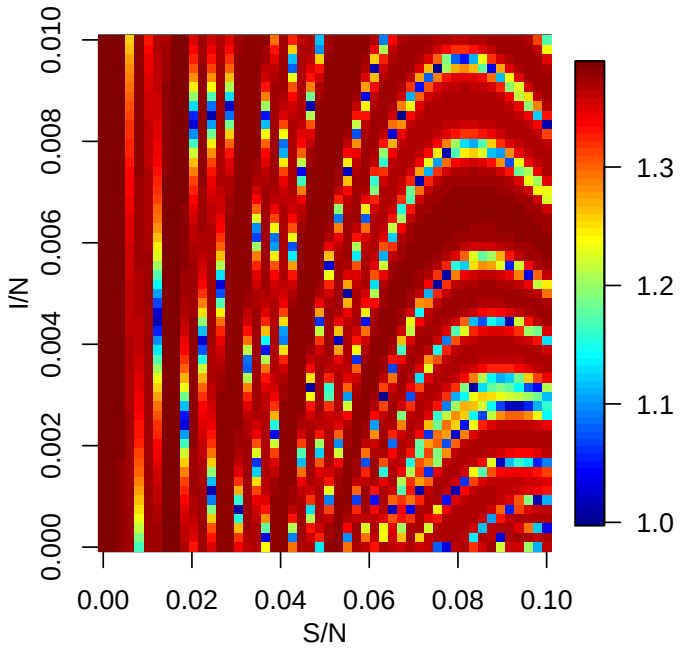

Figure S8: **Boulder county, basins of attraction** The relative size of the maximum biennial peak to the minimum biennial peak for Boulder County, given different initial susceptible and infected proportions.

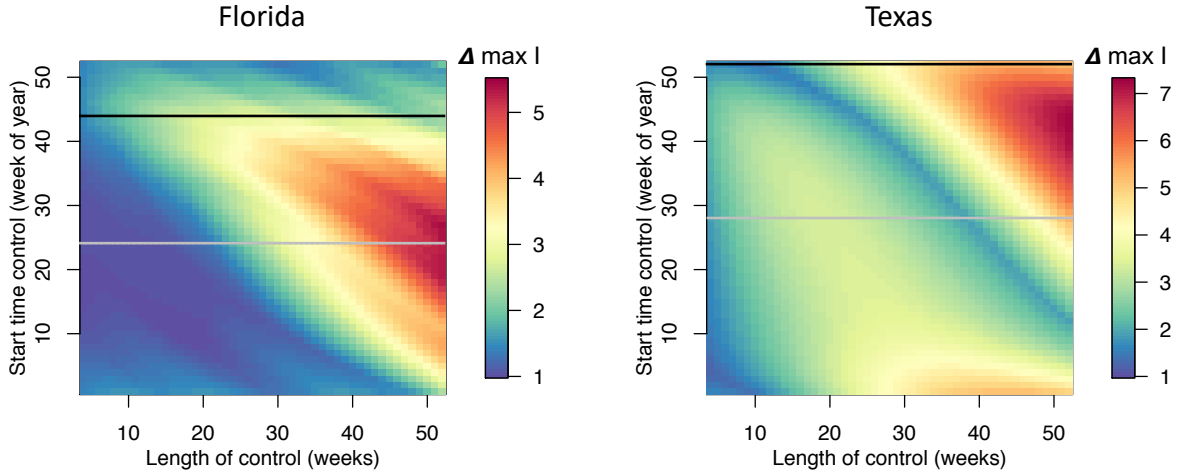

Figure S9: **Timing and length of NPIs on RSV peak proportion infected for Florida and Texas**. The effect of varying start time and length of NPI on the change of peak proportion infected relative to the pre-NPI seasonal maximum. Peak and minima timing (proportion infected) for Florida and Texas is shown with the horizontal black and grey bar respectively. The reduction in transmission due to NPIs is fixed at 20%.

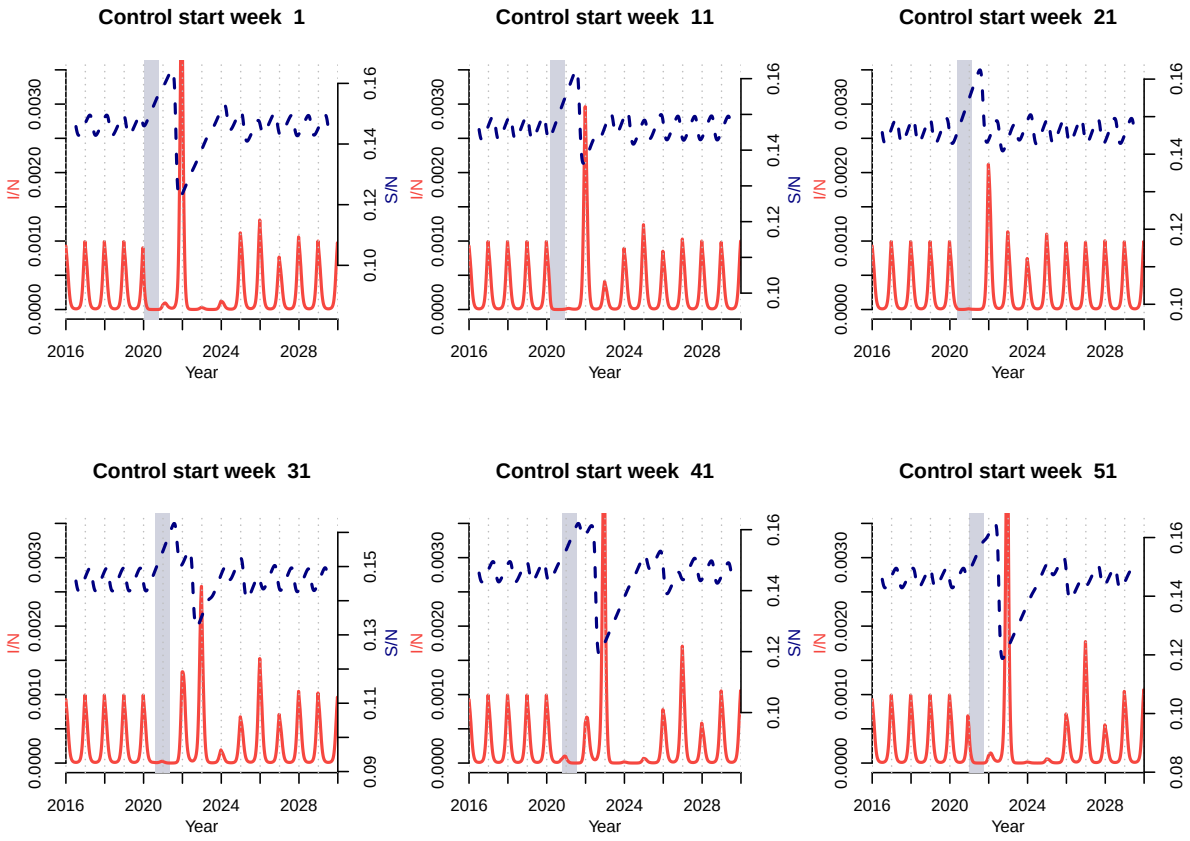

Figure S10: **Impact of start time on future RSV dynamics for Texas**. Start time of the control measure is varied at 10 week intervals from the start of 2020. The reduction in transmission is fixed at 20% and the NPIs last 40 weeks.

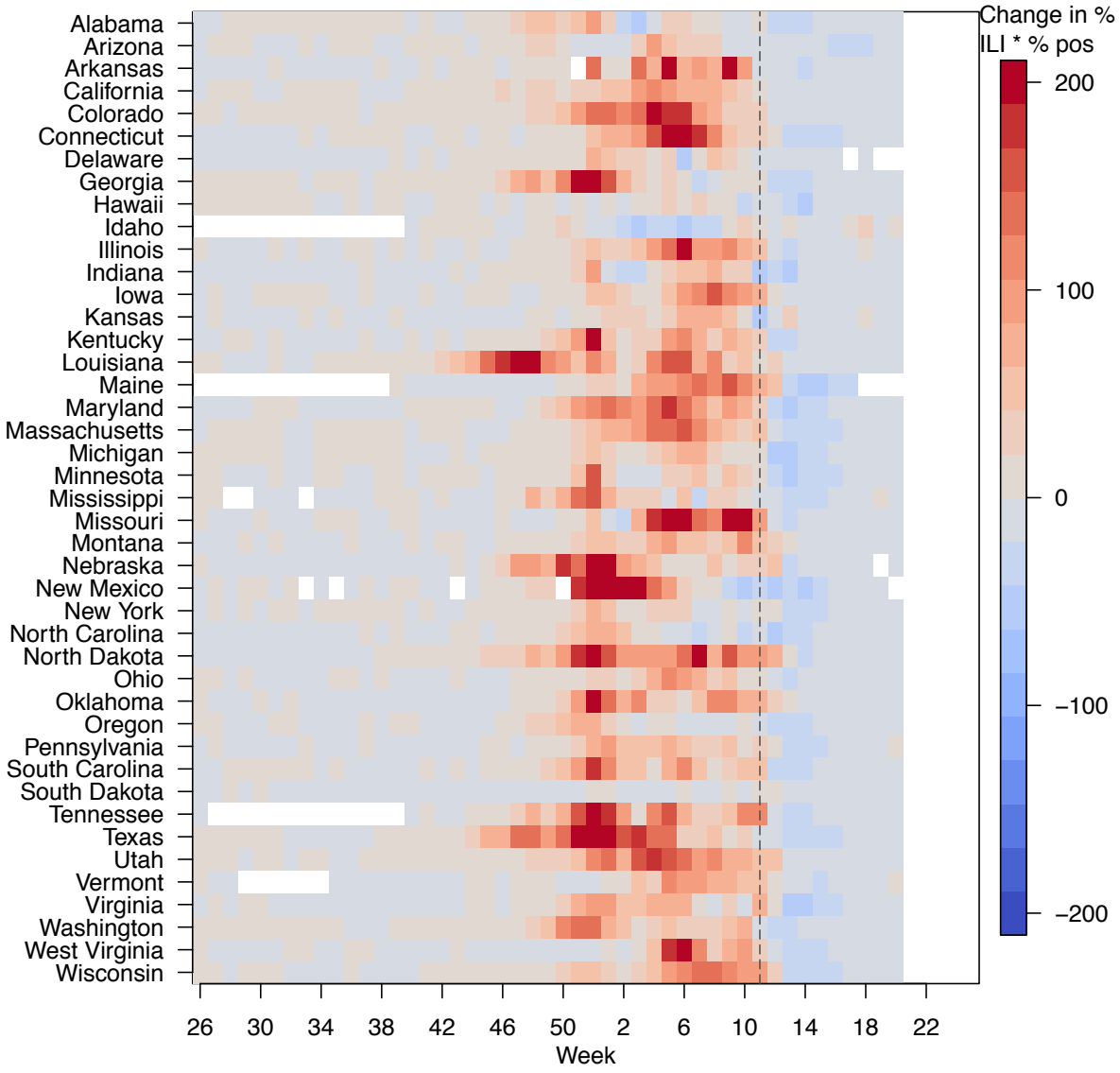

Figure S11: **2020 change in percent ILI multiplied by percent positive specimens for influenza**. Dashed lines show timing of the declaration of national emergency. States with less than 27 weeks of data are removed.

References

[1] Baker, R. E. *et al.* Epidemic dynamics of respiratory syncytial virus in current and future climates. *Nature Communications* **10**, 1–8 (2019).

[2] Pitzer, V. E. *et al.* Environmental drivers of the spatiotemporal dynamics of respiratory syncytial virus in the united states. *PLoS pathogens* **11**, e1004591 (2015).

[3] Earn, D. J., Rohani, P., Bolker, B. M. & Grenfell, B. T. A simple model for complex dynamical transitions in epidemics. *science* **287**, 667–670 (2000).

[4] White, L. *et al.* Understanding the transmission dynamics of respiratory syncytial virus using multiple time series and nested models. *Mathematical biosciences* **209**, 222–239 (2007).