

Forecasting the ongoing COVID-19 pandemic in Tampa Bay: impact of interplays between social interventions, vaccination, and virus variants

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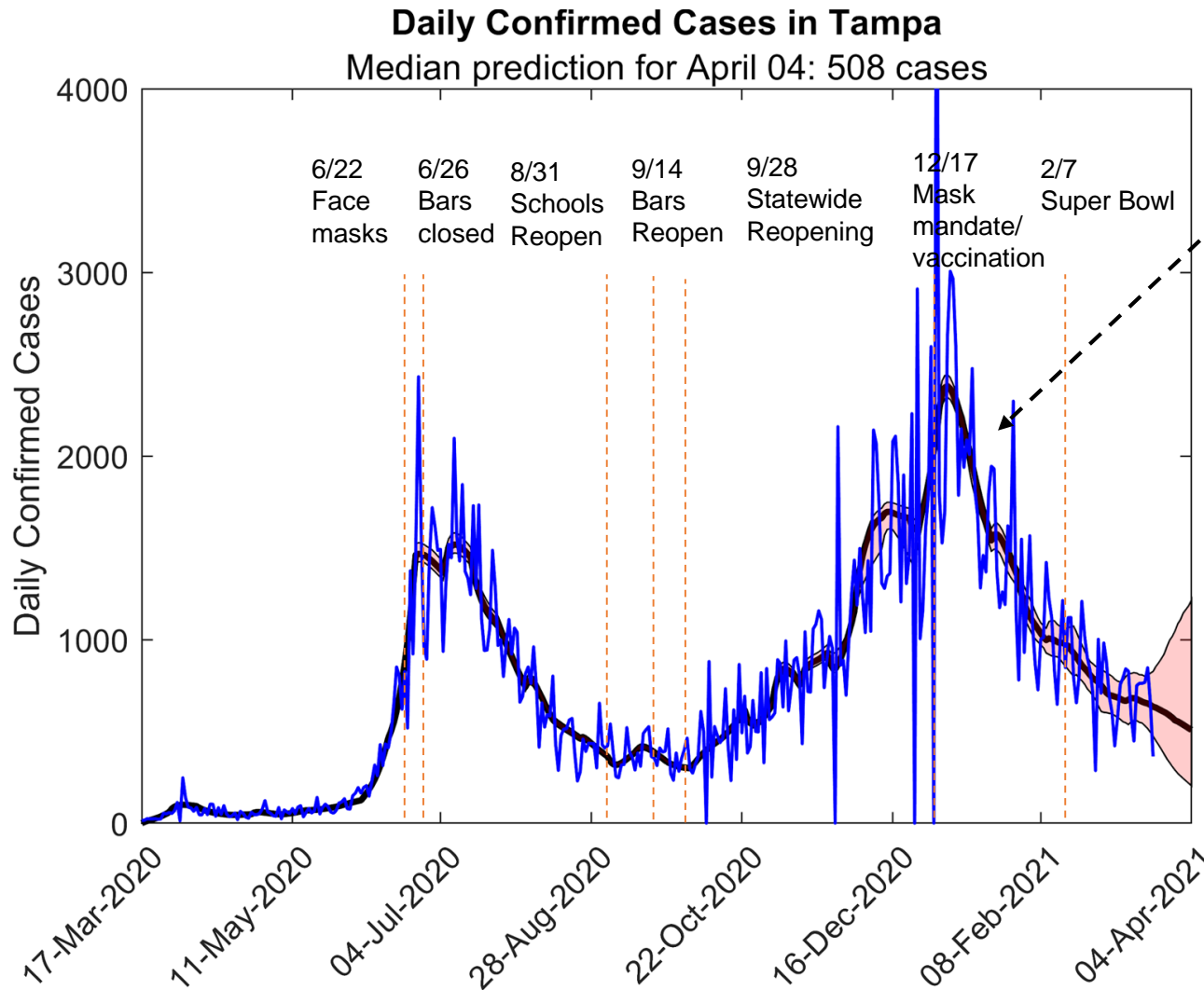
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Latest SEIRcast fit to data and near-term forecasts of daily confirmed cases for Tampa Bay to Apr 3 given current social conditions and vaccinations

- **Compartmental model** of disease transmission: spread of disease in a population is simulated by dividing the host population into various compartments and transmission is modeled through flows of hosts between compartments
- **Data-driven:** akin to hurricane models parameters are updated sequentially using newly-arriving county-level daily cases and deaths
- Forecasts are **dynamic:** change in community transmission and intervention conditions influences future predictions



- 3rd wave peak occurred 1st week of Jan following which the pandemic has been in steady decline. 2-week ahead near-term forecasts are still indicating **a gradual though a recent lessening decline** in cases. β is flatlining but not showing a major trace of the effects of new variants yet.
- Social mandates led to reduction in cases, while reopening mandates led to resurgence of the pandemic

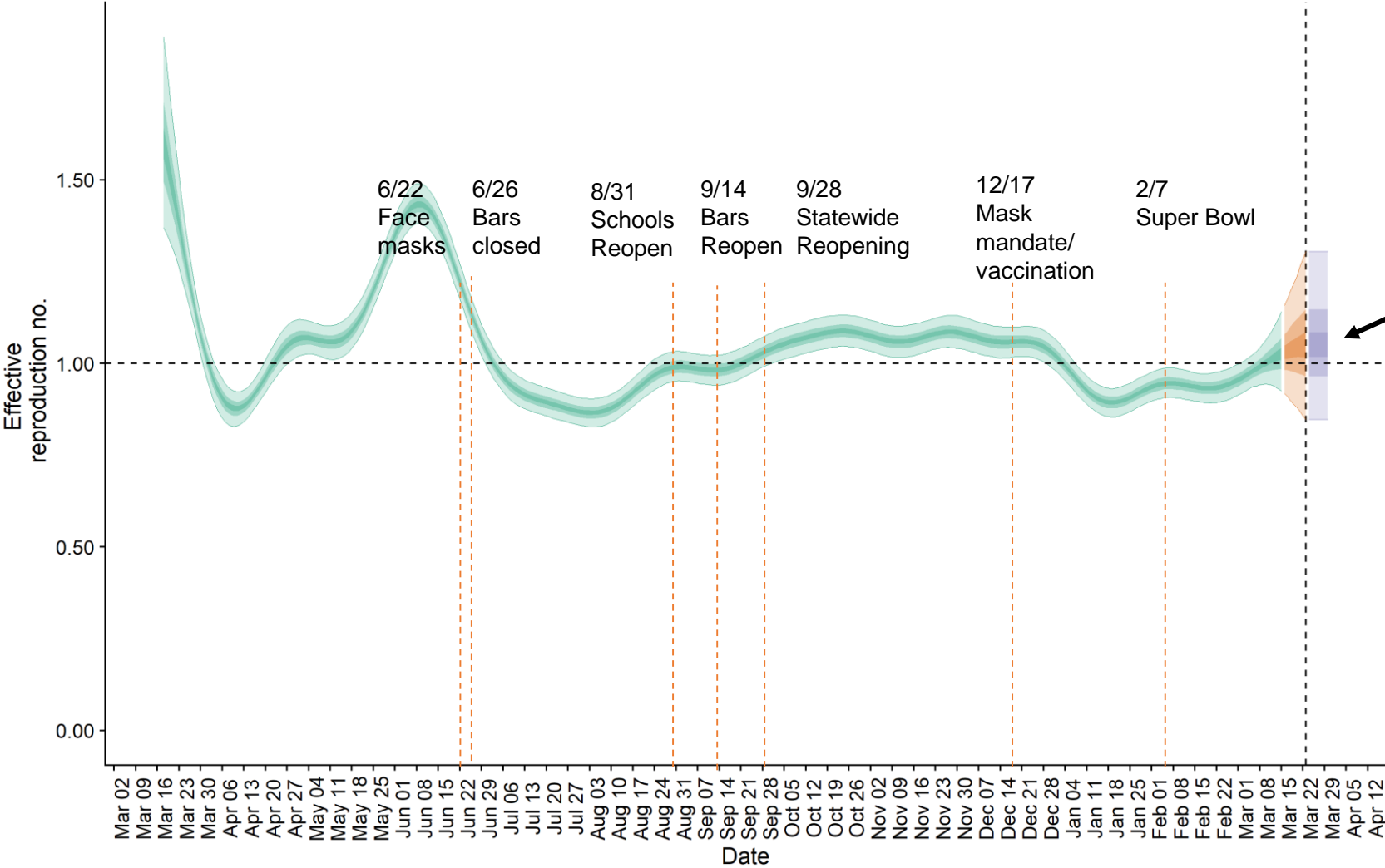
- **Update model as of 03.21.2020** (70% protection of effective susceptibles against transmission by social measures)

• Newcomb et al. (2020) Sci Rep (submitted) doi: [10.21203/rs.3.rs-96665/v1](https://doi.org/10.21203/rs.3.rs-96665/v1)

• <https://seircast.org/app/>

TIME-VARYING COVID-19 R_t (EFFECTIVE REPRODUCTIVE NUMBER) FOR THE ONGOING EPIDEMIC IN TAMPA BAY UPDATED USING DATA TO MAR 23 2021

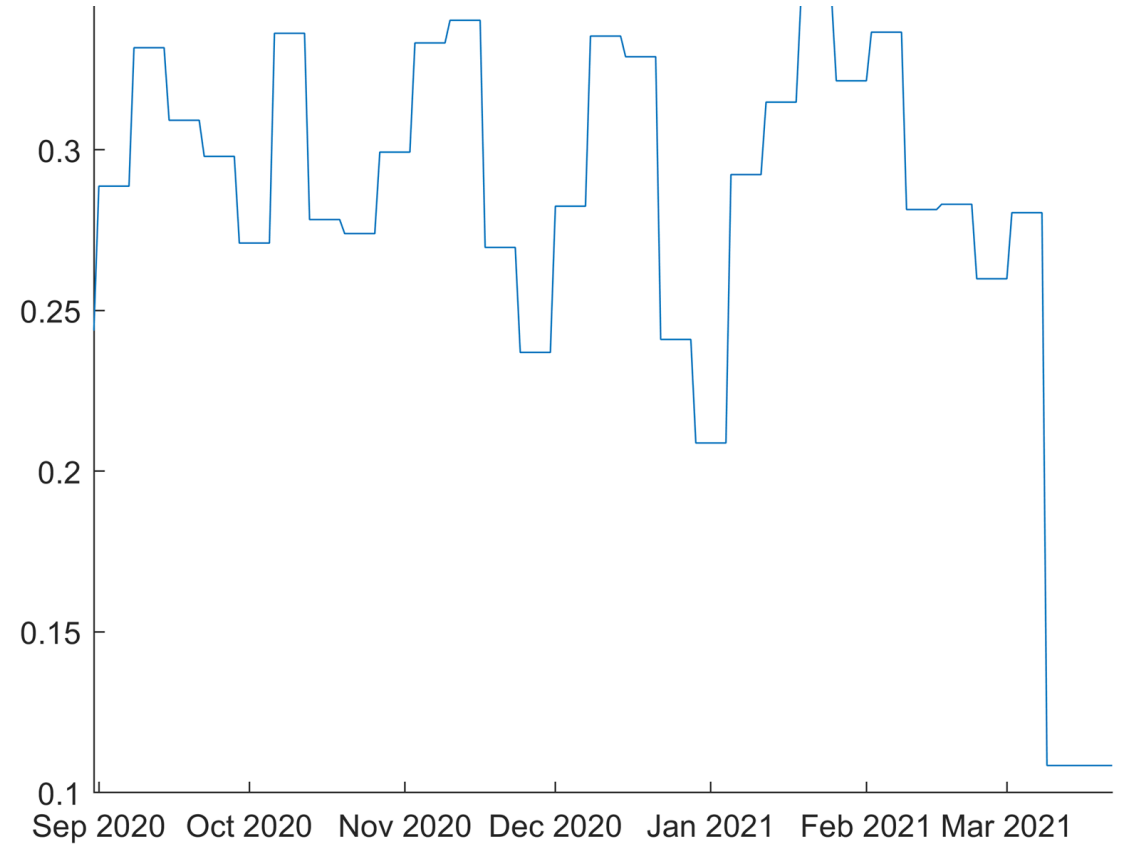
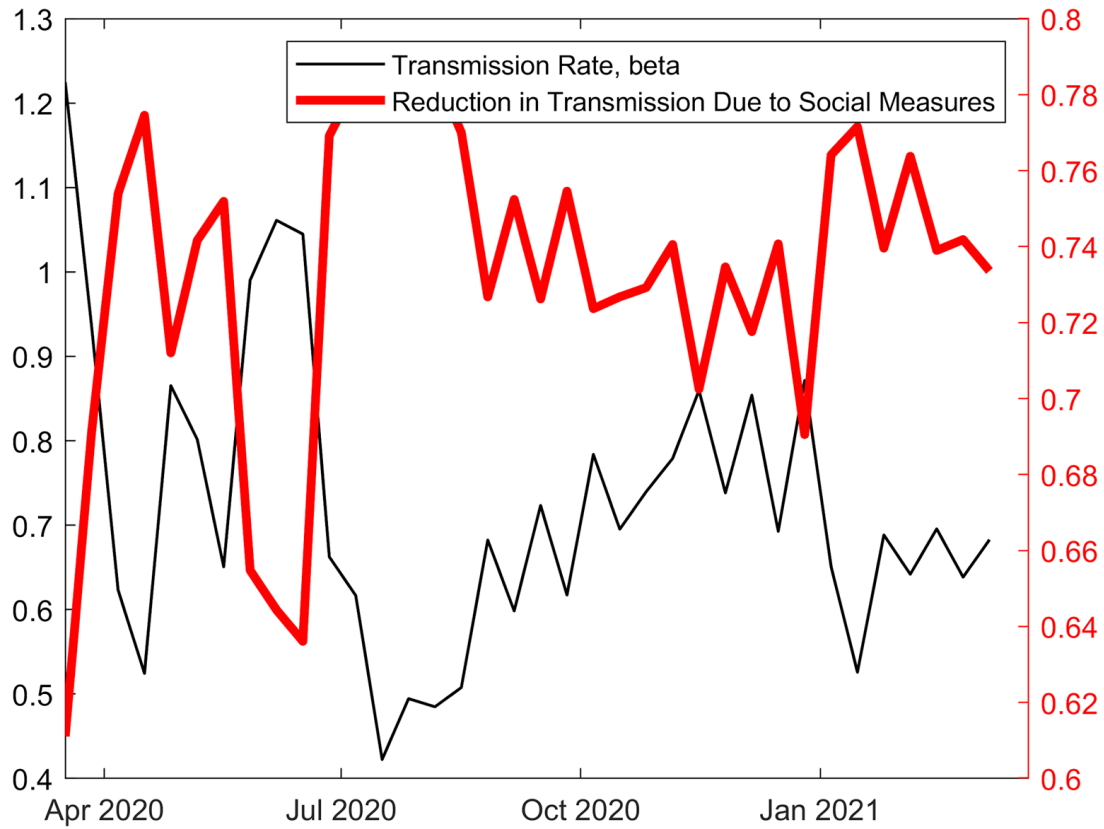
- R_t denotes how many persons on average one person can infect at any given time
- $R_t > 1.0$ denotes sustainable occurrence of active community transmission
- $R_t < 1.0$ indicates that transmission is not sustainable resulting in negative growth and if sustained eventual fade-out of the epidemic in the community



Median $R_t = 1.1$ (90% CI: 0.85 – 1.3)

- Denotes that the pandemic is beginning to grow
- Estimated using nowcasted data (corrected for report and disease incubation delays, and obs error)

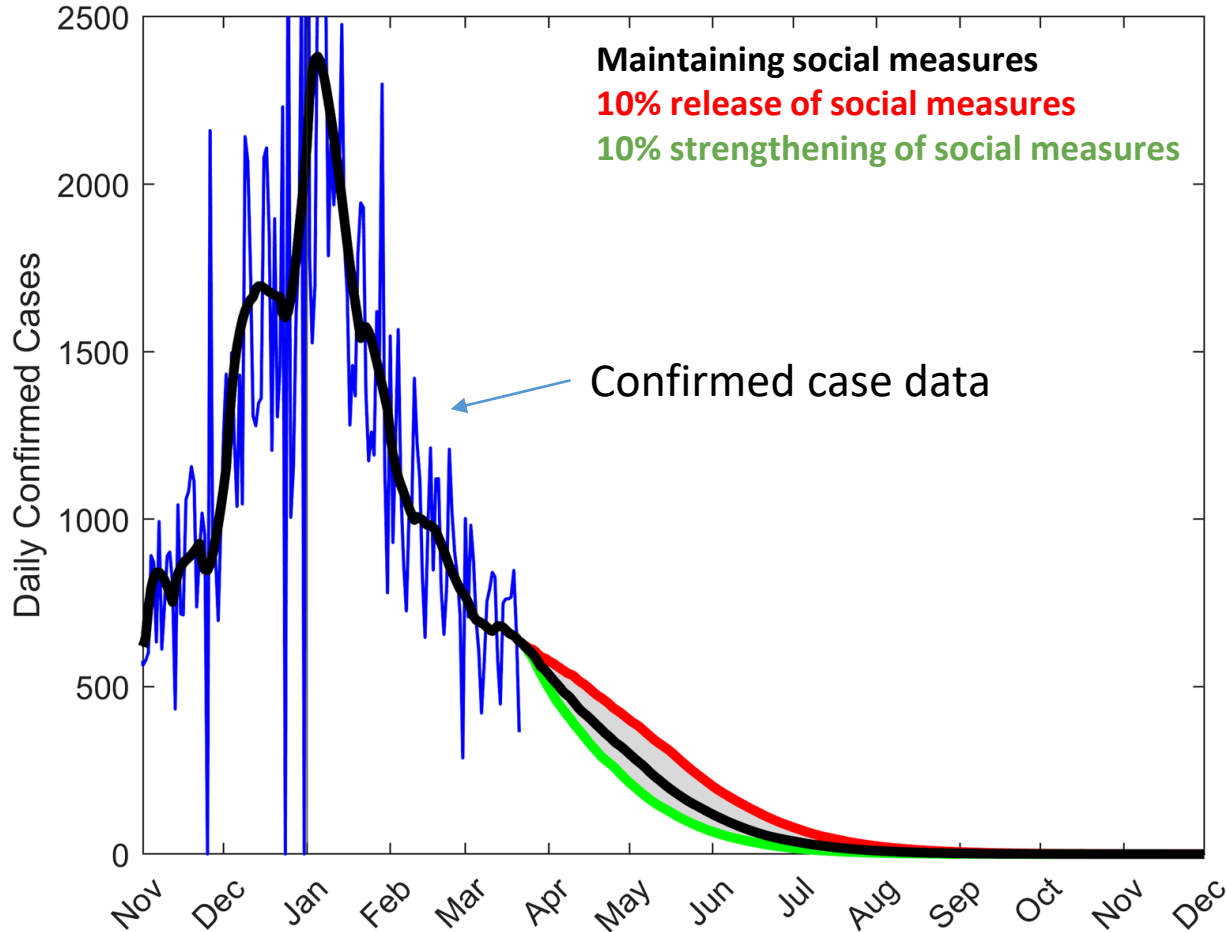
Current Estimates of Social Measures



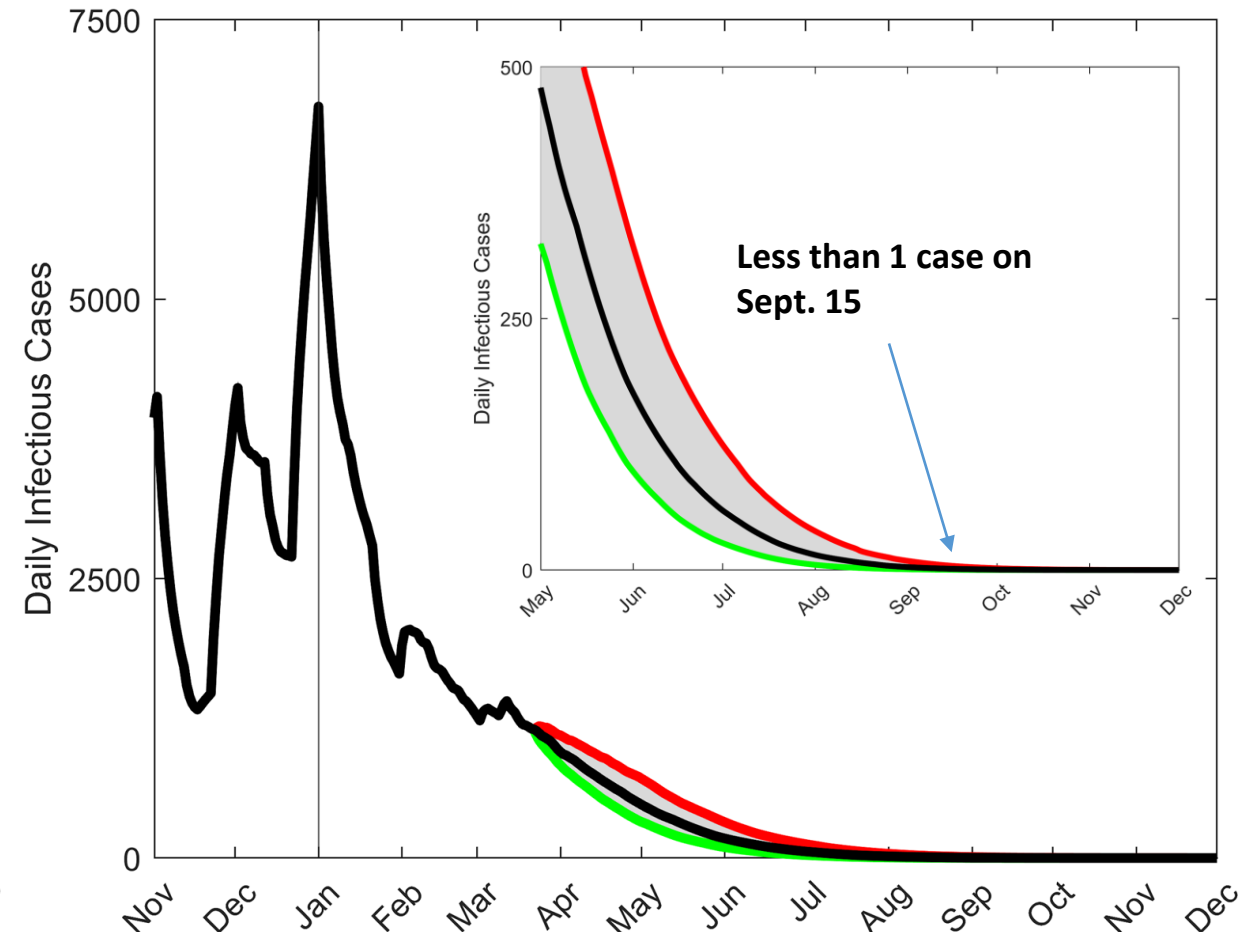
Long-term SEIRcast forecasts of daily confirmed/total infectious cases to the end of Dec 2021 given current **beta** and **vaccination** roll out rates

Assuming 65% effective vaccine, 80% effective booster

Total Daily Confirmed Cases

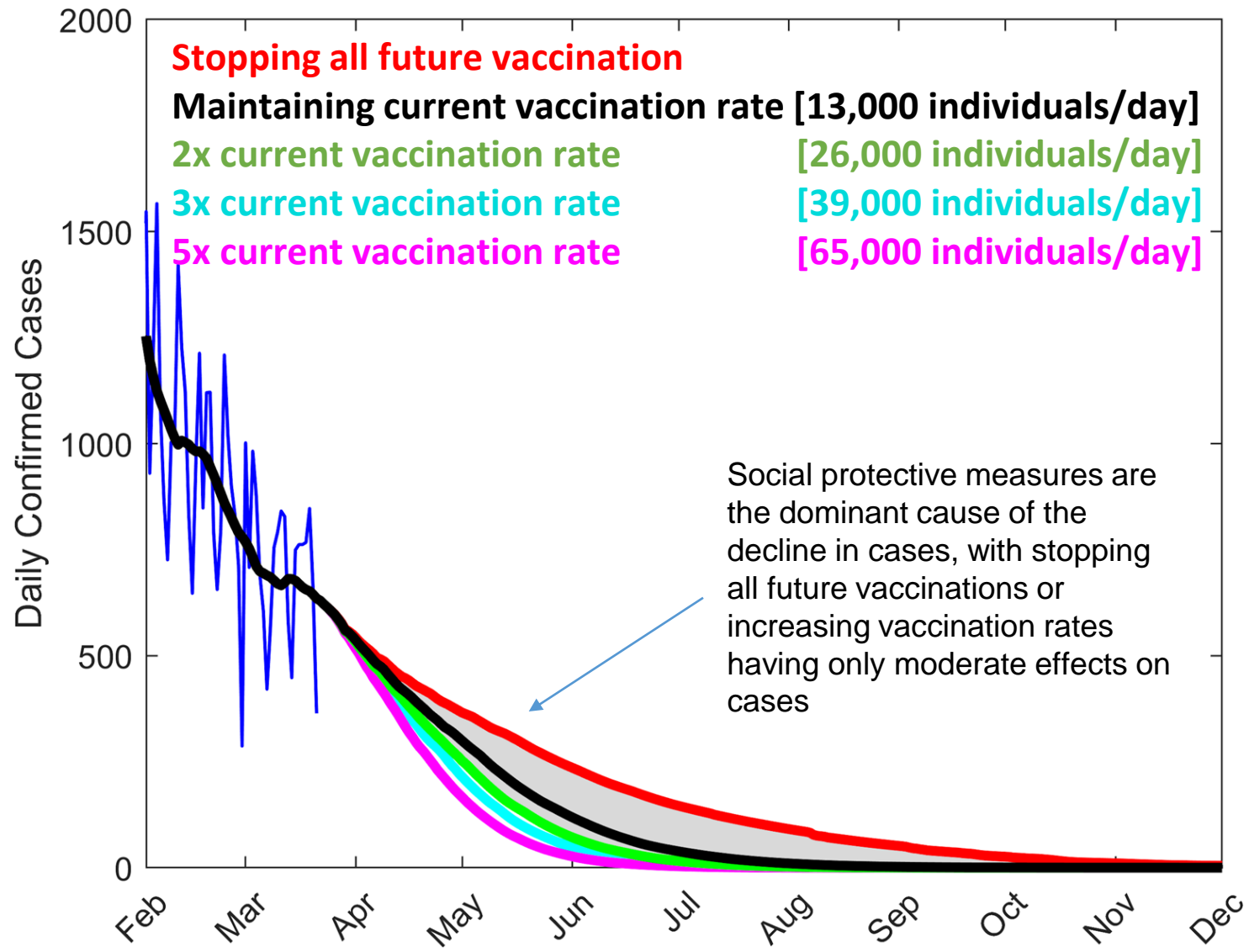


Total Daily Infectious Cases



- Note forecasts are for daily confirmed cases (left) and for total daily infectious cases (incl. asymptomatic infections) (right, which will some 2.5x confirmed cases)

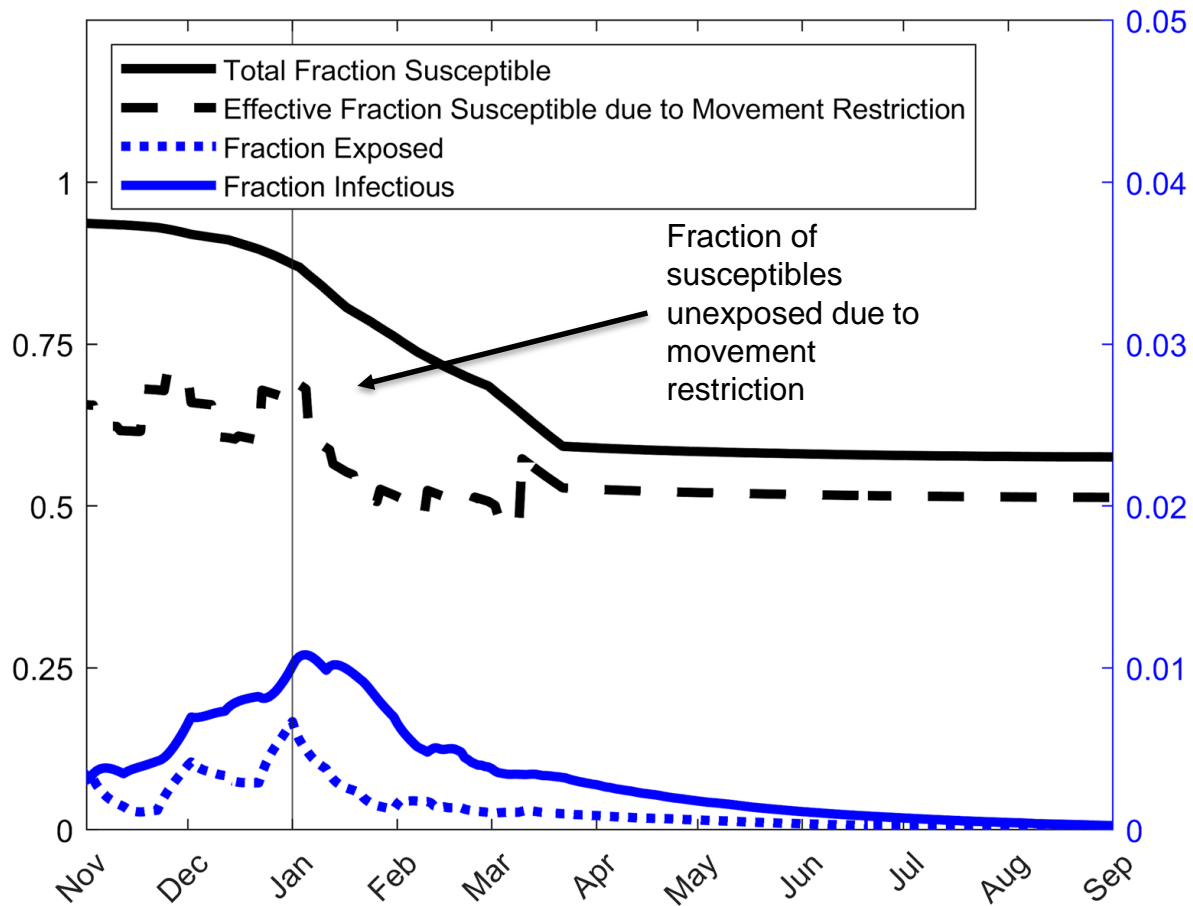
Reasons for decline: the effect of Vaccination



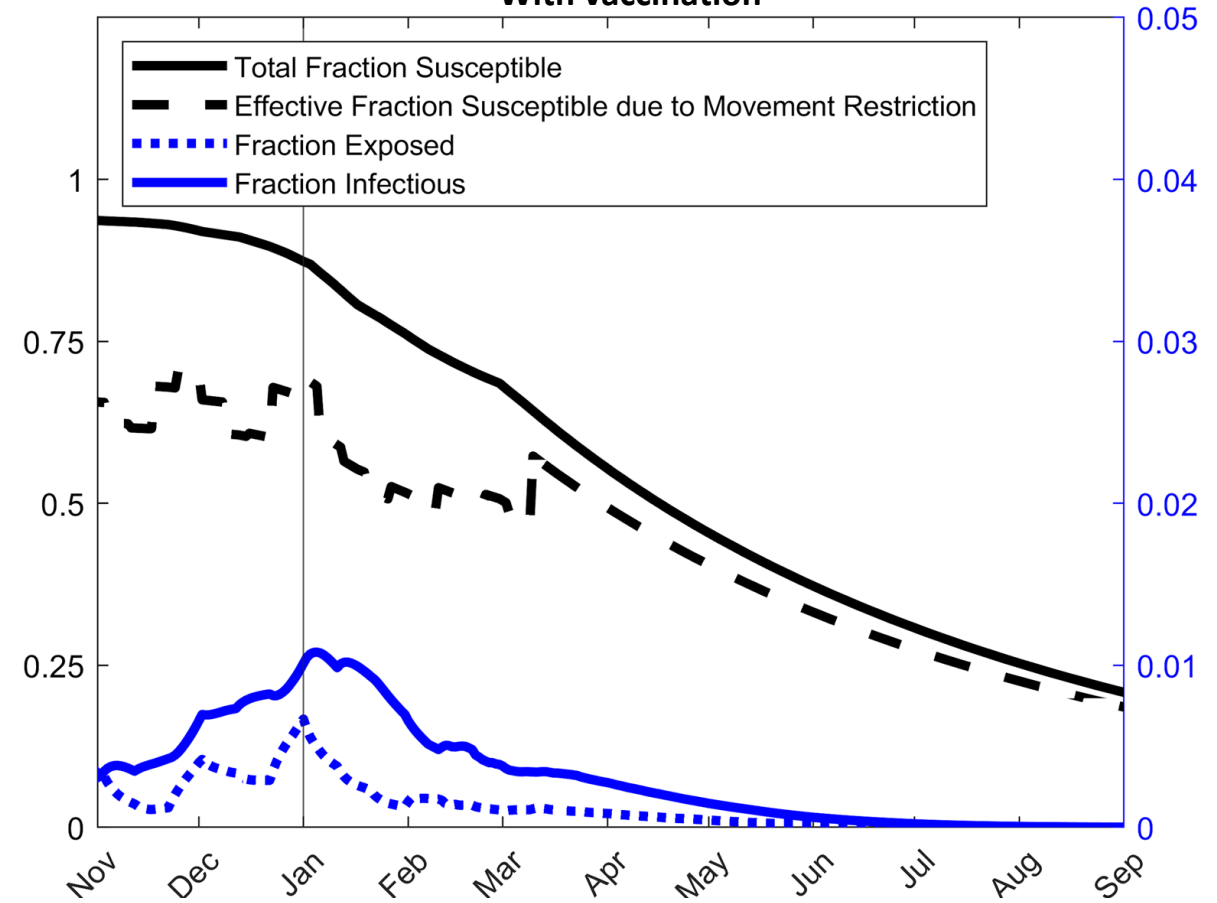
Consequence of social measures: impact on Susceptible and Effective Susceptible Populations given current **beta** and **vaccination** roll out rates

Assuming 65% effective vaccine, 80% effective booster starting from 1 Jan

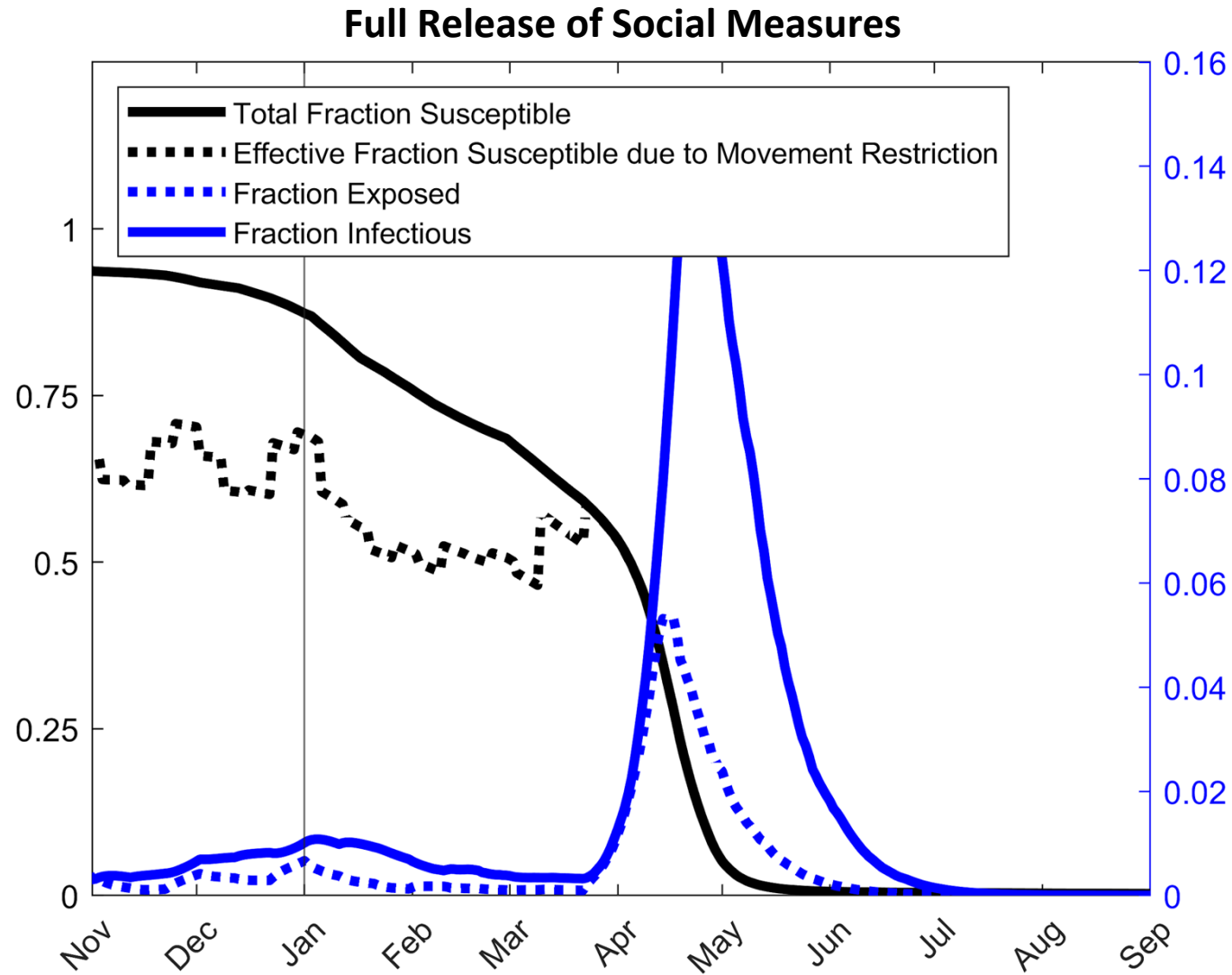
Without vaccination



With vaccination



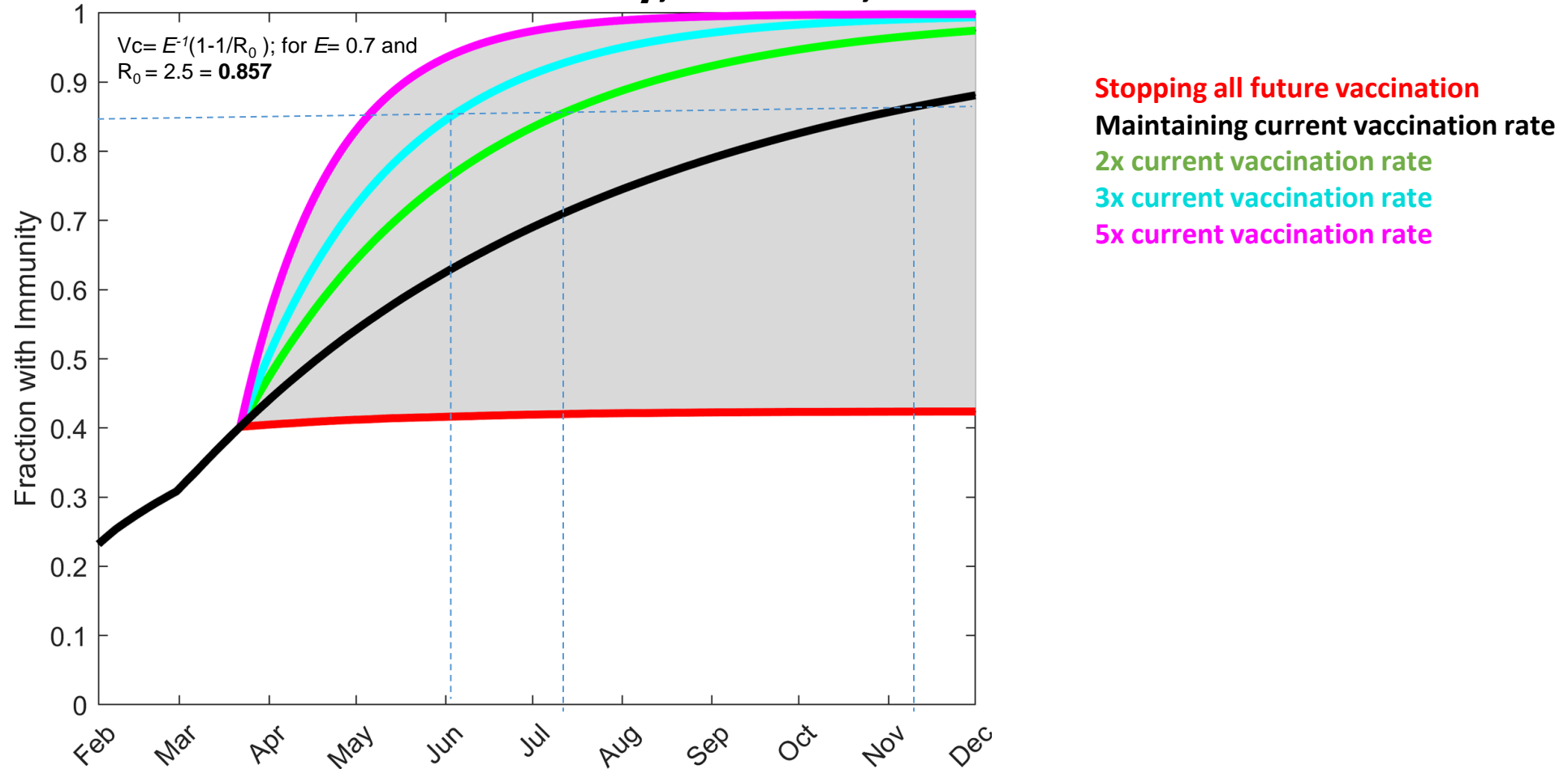
RELEASE OF SOCIAL MEASURES UNDER CURRENT VACCINATIONS BEFORE ACHIEVING HERD IMMUNITY WILL RESULT IN RESURGENCE OF INFECTION



- The disease will rapidly burn through the susceptibles upon the release of social measures, leading to a strong surge in infection

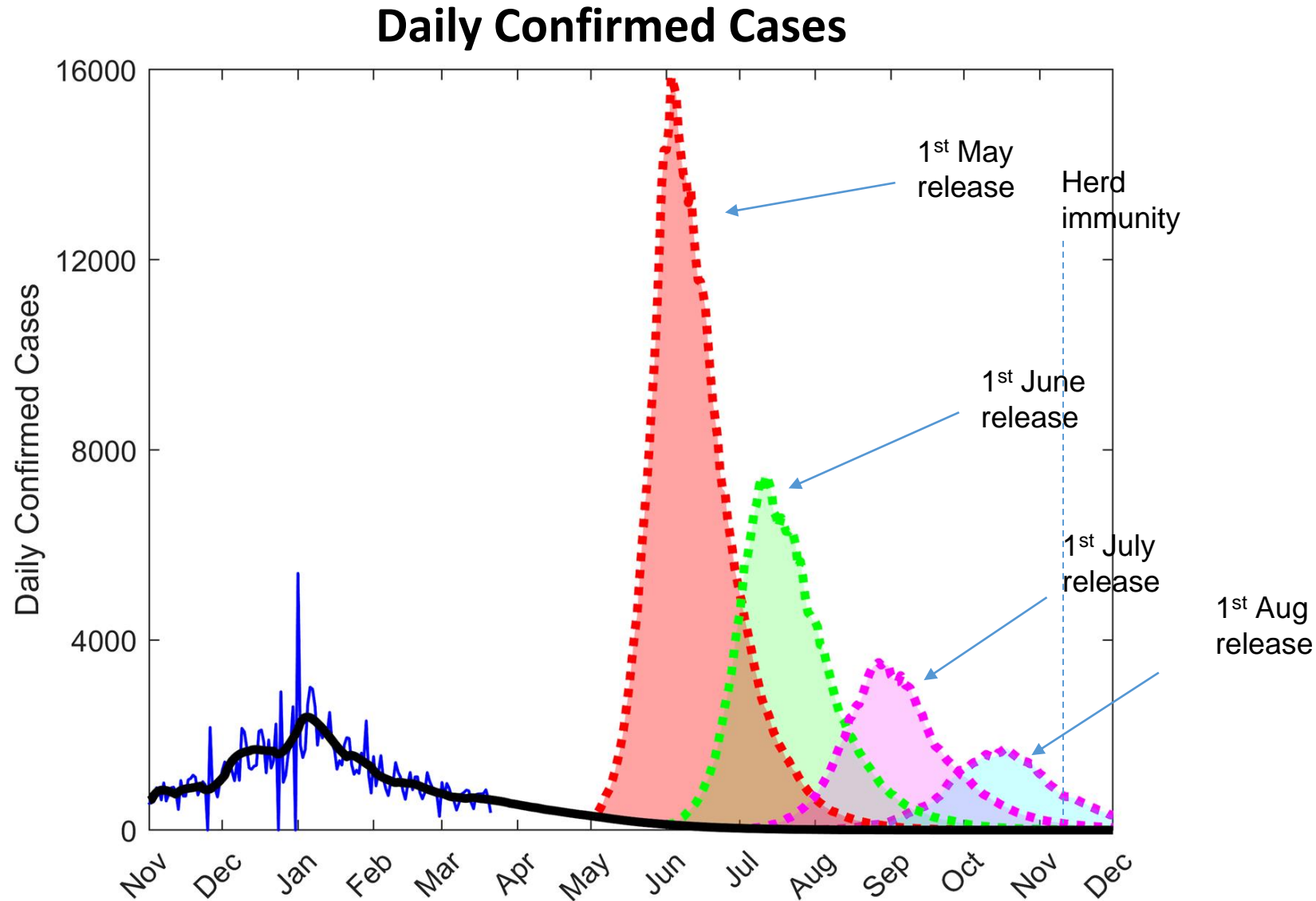
Impact of social measures and vaccination on development of herd immunity

Fraction with Natural Immunity, Vaccine, or Booster

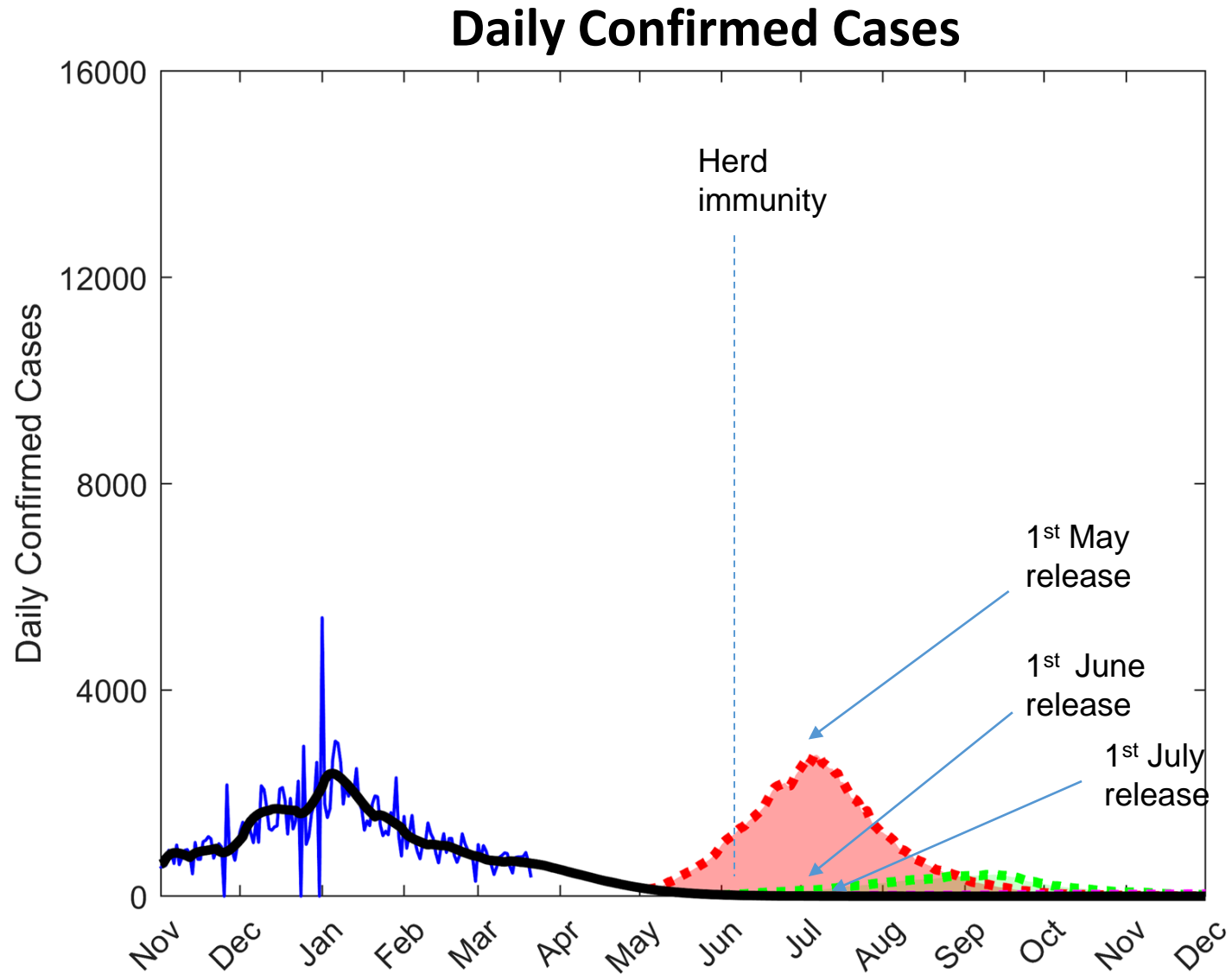


- Vaccination will be critical to developing herd immunity in the presence of social measures
- While social measures can contain spread, it will retard the development of herd immunity
- Rate of development of herd immunity will depend directly on vaccination rate

When can social measures be stopped at current vaccination and social measure rates?



What if we increase the current vaccination rate by 3x?



- Indicates that if vaccinations are increased 3x the current rate, then full release of social measures and hence re-opening of the economy could be performed safely from **1st July** or even **1st June**

Impact of SARS-Cov-2 variants (under development)

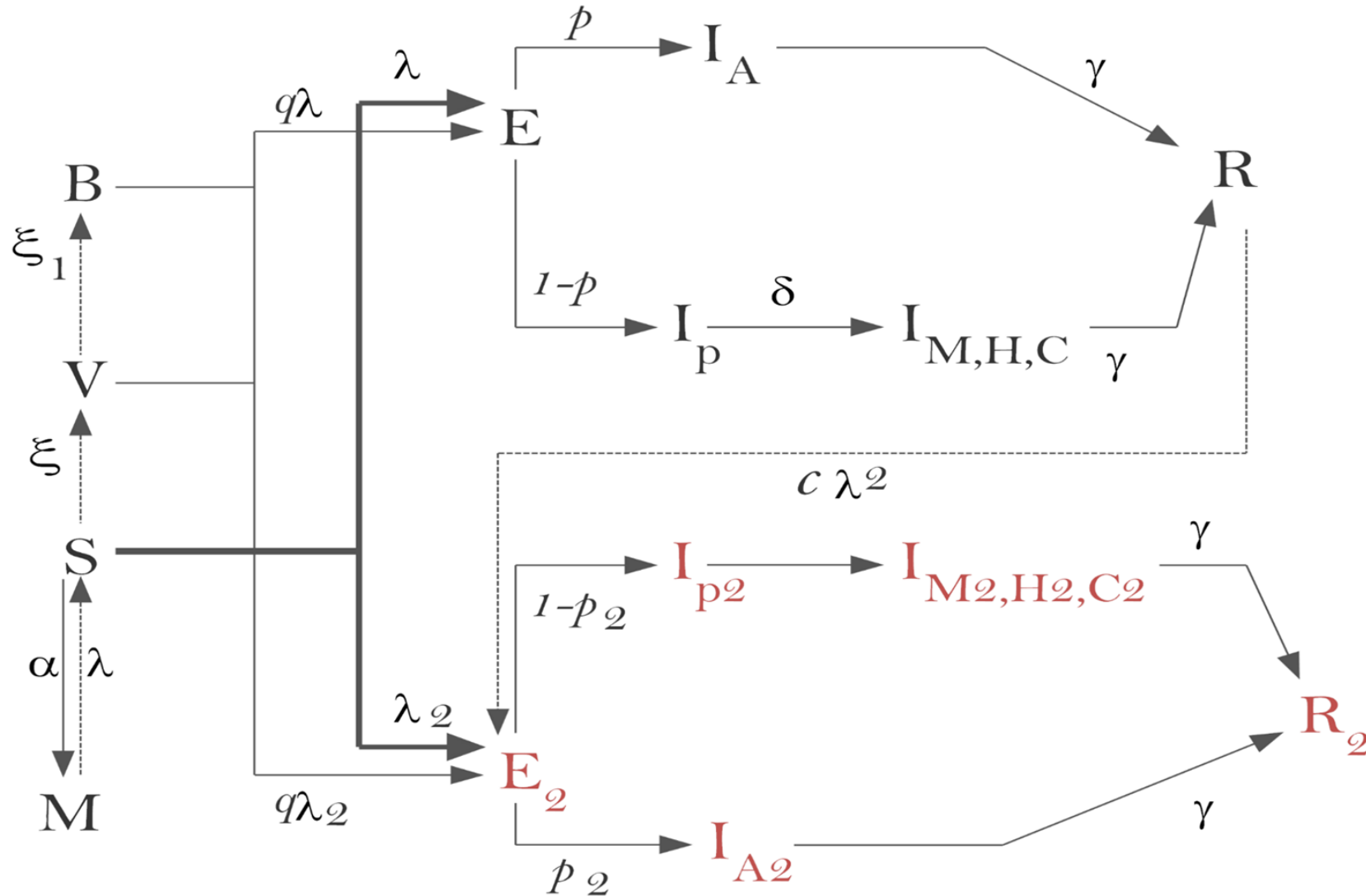
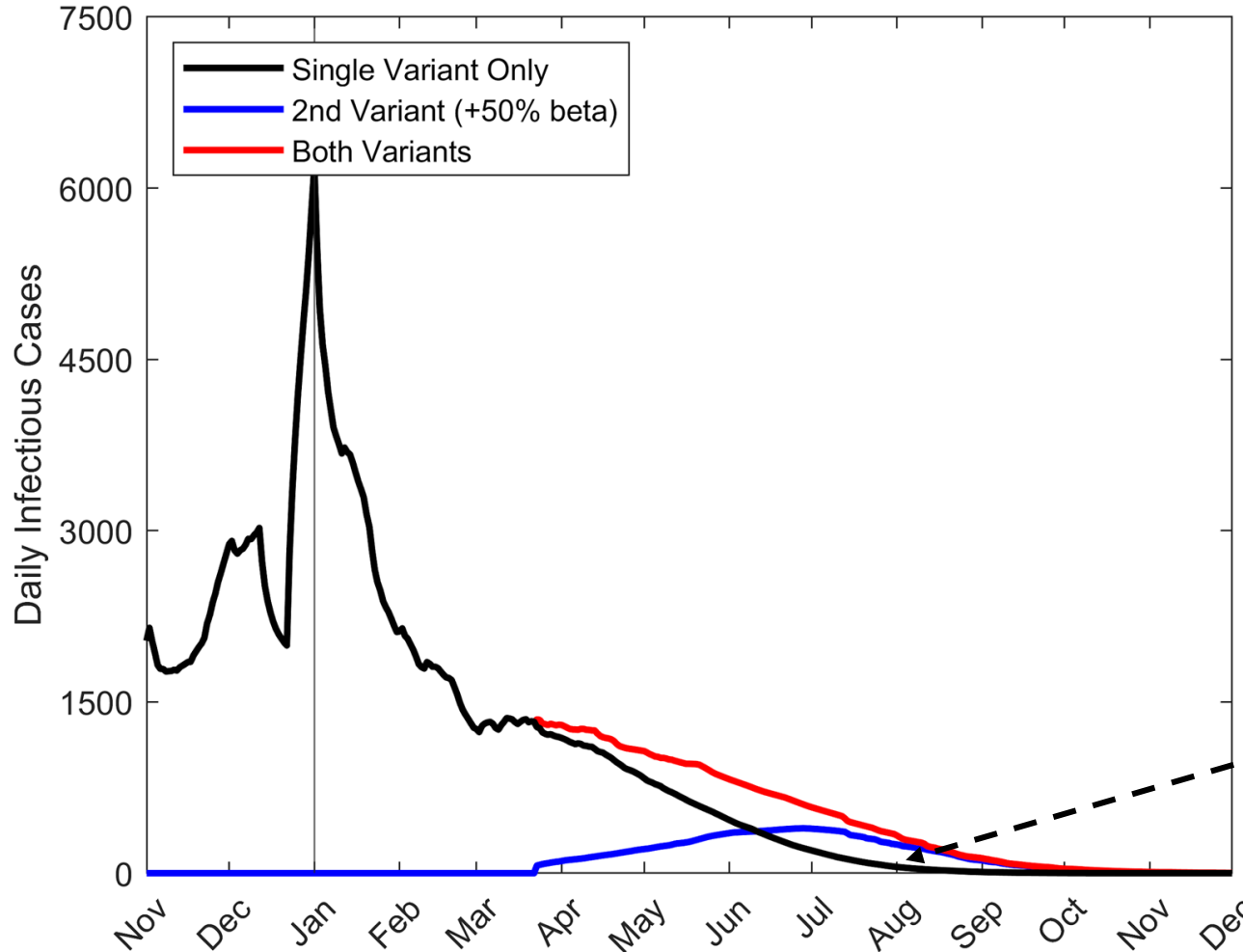


Diagram of a two-variant COVID-19 model with vaccination

Prelim 2-Variant Model Forecasts

+50% Beta



We assumed 5% of the infected population are currently carrying the B.1.1.7 variant and simulated the impact of a 50% vs 75% levels of contagiousness

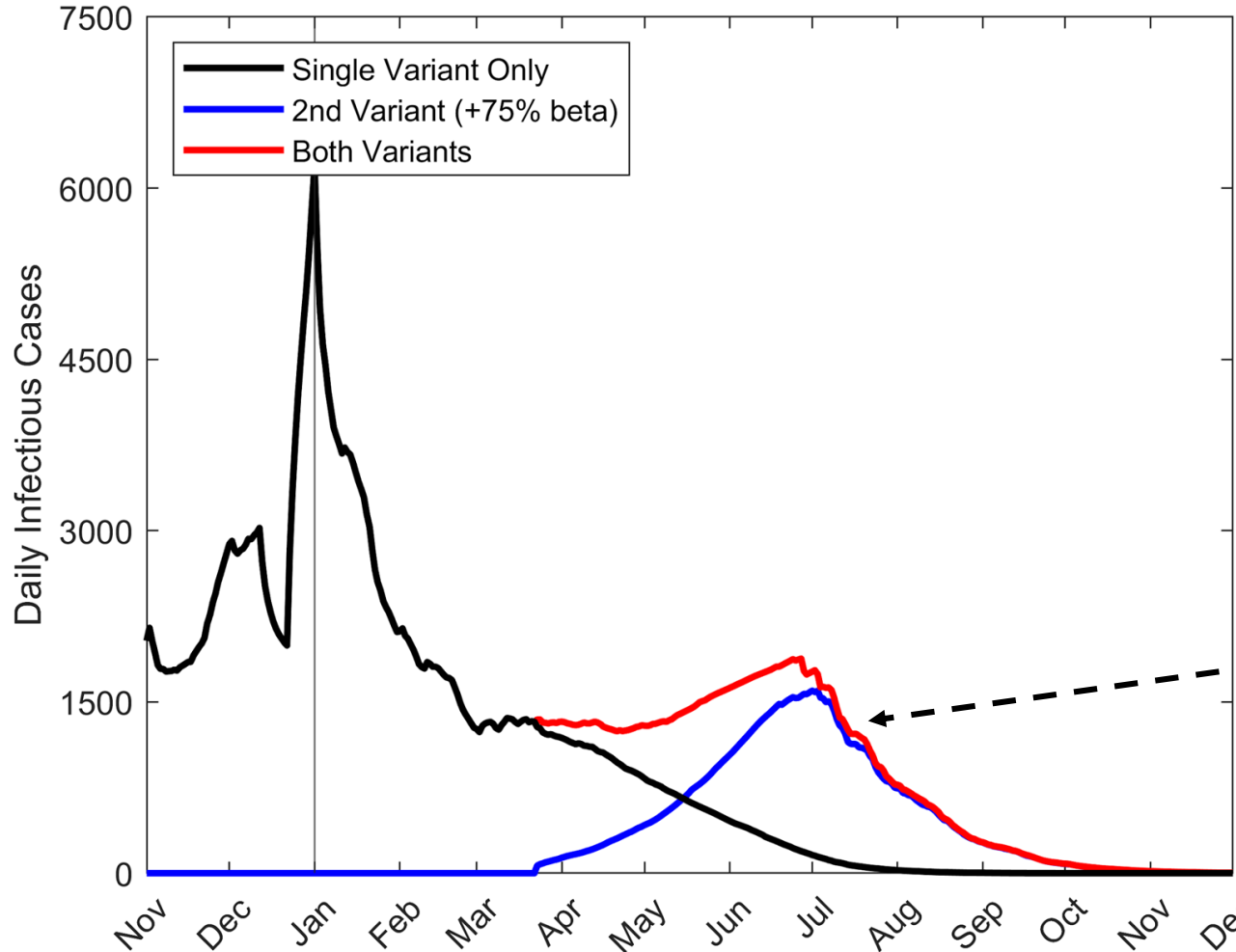
The new variant (50% transmissibility: blue curve) will spread and replace the old variant by mid June but its spread over the old variant because of continuing social measures will be moderate, although extending the end date of the pandemic

- Note results are shown for total infectious cases. Confirmed cases as reported by the DOH will be 2.5X lower than these numbers, ie need to divide these numbers by 2.5.

Simulation of cases decomposed by variants with current social measures and vaccinations

Prelim 2-Variant Model Forecasts

+75% Beta



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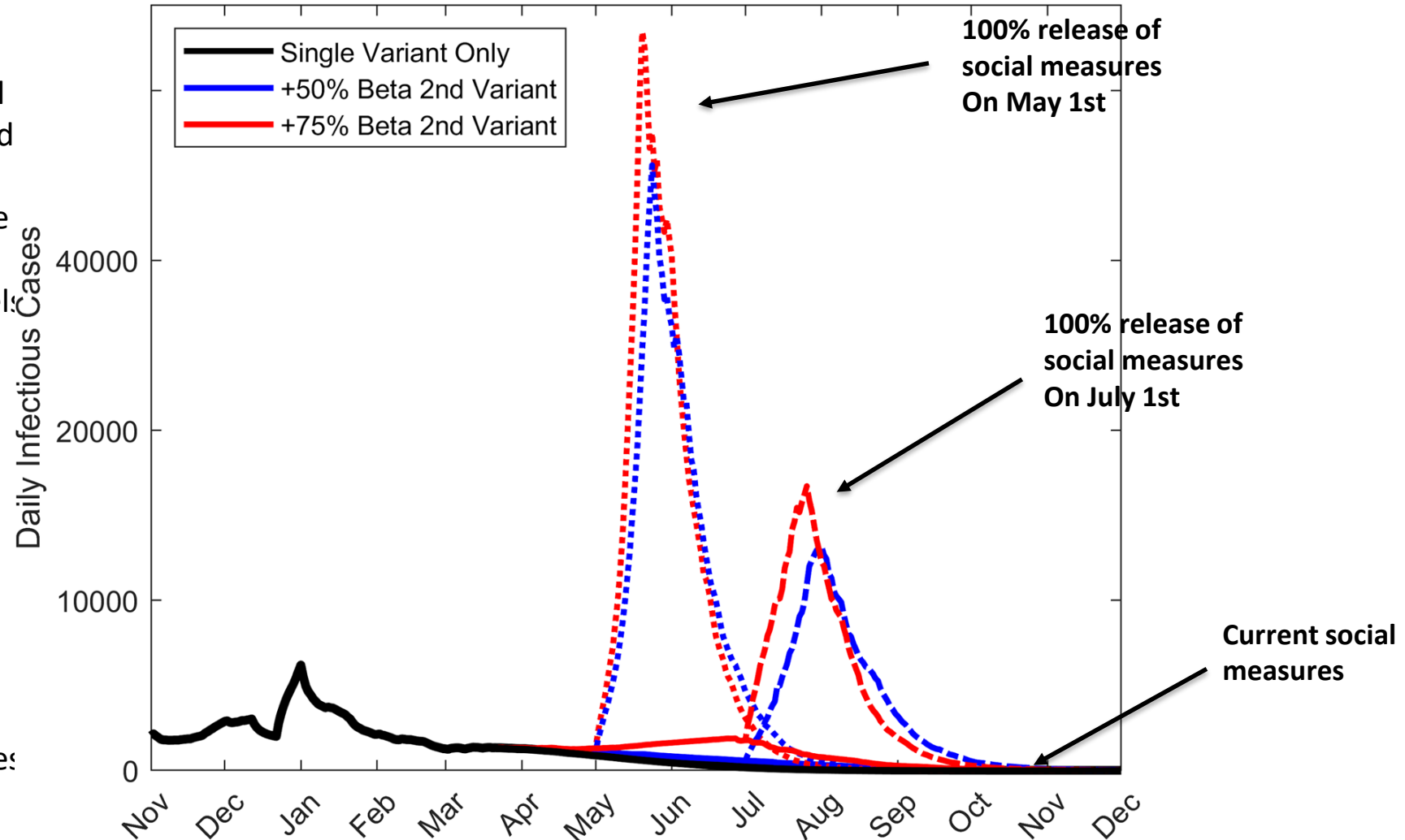
The new variant (75% transmissibility: blue curve) will spread and replace the old variant by mid May and will result in a moderate but significant spike in cases over the summer under current social measures and vaccination rate

- Note results are shown for total infectious cases. Confirmed cases as reported by the DOH will be 2.5X lower than these numbers, ie need to divide these numbers by 2.5.

Simulation of cases decomposed by variants with current social measures and vaccinations

2-Variant Model Forecasts: impact of 100% release of social measures

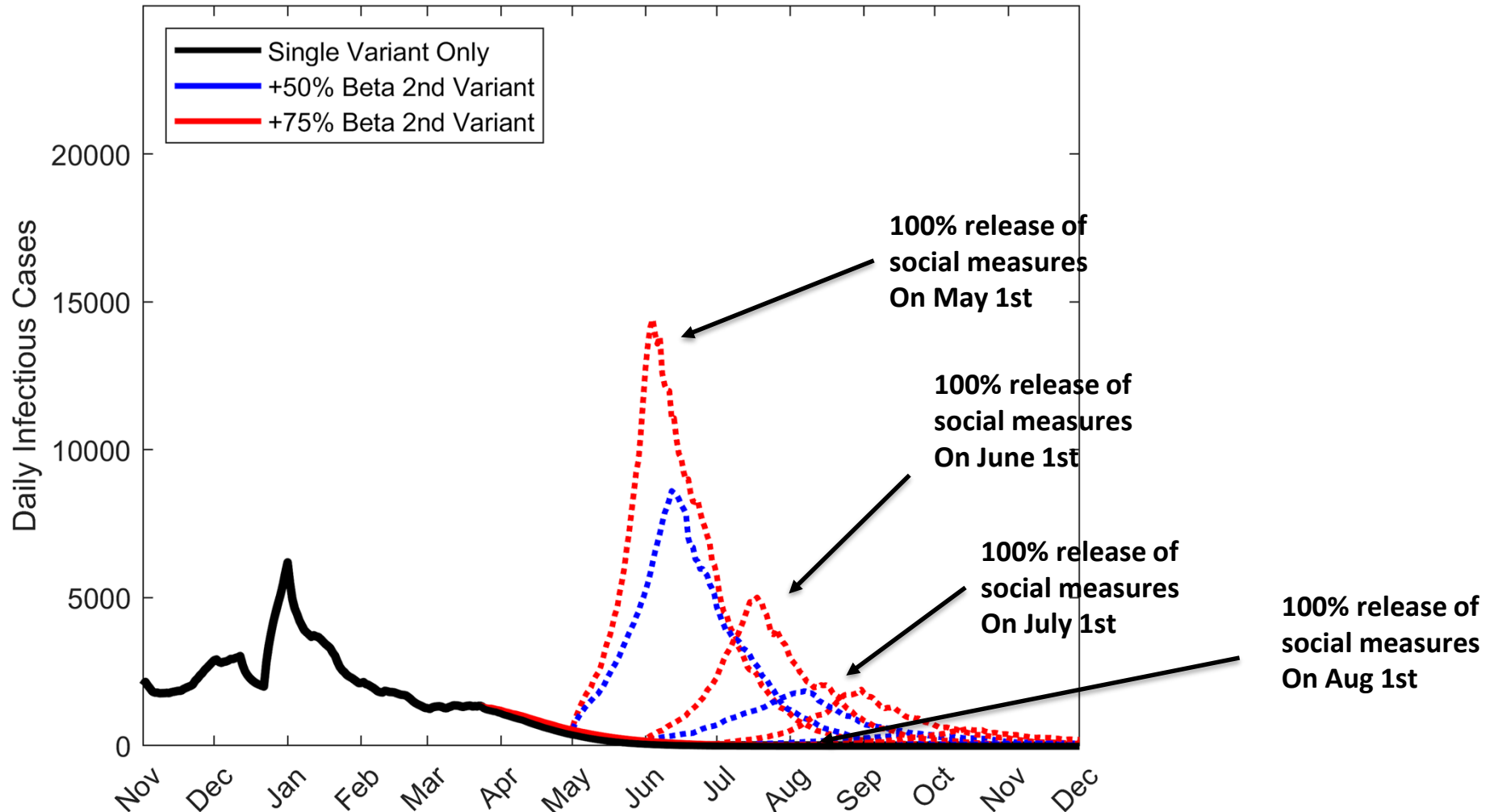
Daily Infectious Cases



- Release of the currently applied social measures will result in spikes in the spread of the 2nd variant (dashed curves) but later the release smaller the spikes owing to development of higher levels of immunity over time
- Spikes will be greater for a 75% contagiousness rate (red curves) compared to when transmissibility is lower (50% - blue curves)
- Indicates the need to ramp up vaccination before relaxation of social measures

2-Variant Model Forecasts: impact of 100% release of social measures 3x vaccination rate

Daily Infectious Cases



- Ramping up vaccination will dampen the spread of the 2nd variant owing to cross-immunity effects upon full release of social measures
- Indicates that social measures may need to be continued to end of summer at least to protect against variant spread depending on the vaccination rate

KEY TAKEAWAYS

- Latest data and both near- and long-term model forecasts indicate that the pandemic is entering a critical slowed down phase in Tampa
- If current social measures and vaccination rates are maintained, median predictions suggest that the pandemic will end by mid Sept 2021
- Social measures are highly effective in protecting against infection and is the primary reason for the current state of the pandemic
- However it retards the development of herd immunity
- Releasing current social measures before achievement of herd immunity will lead to pandemic resurgence
- Ramping up vaccination rates (5x) over the current rate will allow full release of social measures by July 1st 2021
- Virus variants are still not playing a major role in transmission
- Continuing with social measures to end of summer (Aug 2021) while vaccinations are ramped up will be vital to prevent spread of new variants