**Response to Reviewer Panel**

**Reviewer 1**

**4 Page 18 line 307: "using data from Singapore". Can you provide a reference for this?**

To have a more relevant prior for the ascertained rate, we changed the prior for to Beta(10, 90), by a publication estimating COVID-19 under-reporting across 86 nations, including India1, rather than using the prior estimated by the cases imported to Singapore from Wuhan, China2.

1 Rahmandad, H., Lim, T. Y., & Sterman, J. (2020). Estimating COVID-19 under-reporting across 86 nations: implications for projections and control. Available at SSRN 3635047.

2 Hao, X., Cheng, S., Wu, D., Wu, T., Lin, X., & Wang, C. (2020). Reconstruction of the full transmission dynamics of COVID-19 in Wuhan. *Nature*, *584*(7821), 420-424.

**Reviewer 2\**

**7 Page 14, line 226 -start with 4 chains but end with what?**

To ensure the quality of the MCMC procedure, we fix the adaptation number at 104, thin the chain by keeping one draw from every 10 random draws to reduce autocorrelation, set a burn-in period of 105 draws under 2105 iterations for 4 parallel chains.

**9 Ensure that justification and/or references are provided for parameterizations. In fact, I think this element would be strengthened if parameter values were justified/motivated across all models in the text, before introducing each model.**

**Page 17 line 275:**

Initial states and parameter settings: We set α=0.55, assuming lower transmissibility for unascertained cases1. Compartment contains both ascertained and unascertained cases in the pre-symptomatic phase. We set the transmissibility of to be the same as unascertained cases, because it has been reported that the majority of cases are unascertained1. We assumed an incubation period of 5.2 days and a pre-symptomatic infectious period =2.3 days2,3. Thus, the latent period was =2.9 days. Because pre-symptomatic infectiousness was estimated to account for 44% of the total infections from ascertained cases2, we set the mean of total infectious period as (+)=/0.44=5.2 days, assuming constant infectiousness across the pre-symptomatic and symptomatic phases of ascertained cases4 – thus the mean symptomatic infectious period was =2.9 days. We set an isolation period of =17 days based on the study investigating the hospital stay in Karnataka, but this parameter has no effect on the model fitting procedure, or the final parameter estimates as we fit daily new cases under this method5. The duration from the onset of symptoms to isolation was estimated to be =7 days6,7. On the basis of the parameter settings above, the initial state of the model is specified on March 15. The initial number of ascertained symptomatic cases 𝐼(0) is specified as the number ascertained cases in which individuals experienced symptom onset during 12-14 March. The initial ascertainment rate is assumed to be ( = 0.10)8, and thus the initial number of unascertained cases is 𝐴(0) =(1−)𝐼(0). (0) and (0) denote the numbers of ascertained cases in which individuals experienced symptom onset during 15–16 March and 17–19 March, respectively. Then, the initial numbers of exposed and pre-symptomatic individuals are set as 𝐸(0)=(0) and 𝑃(0)=(0), respectively. The initial number of the hospitalized cases 𝐻(0) is set as half of the cumulative ascertained cases on 8 March since =7 days and there would be more severe cases among the ascertained cases in the early phase of the epidemic.

1 Li, R., Pei, S., Chen, B., Song, Y., Zhang, T., Yang, W., & Shaman, J. (2020). Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). *Science*, *368*(6490), 489-493.

2 He, X., Lau, E. H., Wu, P., Deng, X., Wang, J., Hao, X., ... & Leung, G. M. (2020). Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nature medicine*, *26*(5), 672-675.

3 Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., ... & Feng, Z. (2020). Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. *New England journal of medicine*.

4 Ferretti, L., Wymant, C., Kendall, M., Zhao, L., Nurtay, A., Abeler-Dörner, L., ... & Fraser, C. (2020). Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing. *Science*, *368*(6491).

5 Hao, X., Cheng, S., Wu, D., Wu, T., Lin, X., & Wang, C. (2020). Reconstruction of the full transmission dynamics of COVID-19 in Wuhan. *Nature*, *584*(7821), 420-424.

6 Garg S. Hospitalization rates and characteristics of patients hospitalized with laboratory-confirmed coronavirus disease 2019—COVID-NET, 14 States, March 1–30, 2020. MMWR Morbidity and mortality weekly report. 2020;69.

7 Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. Jama. 2020;323(11):1061-1069.

8 Rahmandad, H., Lim, T. Y., & Sterman, J. (2020). Estimating COVID-19 under-reporting across 86 nations: implications for projections and control. Available at SSRN 3635047.

**14 Page 17, lines 284-285 -the authors assume an isolation period of 30 days, but don't provide justification for this assumption (this seems a long period to assume). Further, the authors say that this choice has no effect on model fitting or estimates. Can the authors explain why?**

We assume the same isolation period of 30 days as what was successfully applied in the SAPHIRE modeling for Wuhan, China1 since we assumed that the hospital stay would be similar in India and in Wuhan at the early stage of pandemic and this choice has no effect on model fitting procedure and estimates. Based on a more relevant publication investigating the hospital stay in Karnataka, India2, we changed the assumed isolation period in hospital to 17 days and updated the results in the manuscript.

To explain why we stated this choice has no effect on model fitting or estimates, we fitted the daily new cases and estimated means of daily new cases for each day and assumed the observed daily cases follow a Poisson distribution with the estimated mean as its parameter. According to the schematic diagram (Figure 3) for the SAPHIRE model, the cases in hospital and deaths have no contribute to the new cases onset, therefore the estimated mean of daily new cases only depends on the 5 compartments: susceptible (S), exposed (E), pre-symptomatic infectious (P), ascertained infectious (I) and unascertained infectious (A), and all parameters except for the isolation period in hospital. Thus, we state that “this parameter has no effect on the model fitting procedure, or the final parameter estimate”.

1 Hao, X., Cheng, S., Wu, D., Wu, T., Lin, X., & Wang, C. (2020). Reconstruction of the full transmission dynamics of COVID-19 in Wuhan. *Nature*, *584*(7821), 420-424.

2 Mishra, V., Burma, A. D., Das, S. K., Parivallal, M. B., Amudhan, S., & Rao, G. N. (2020). COVID-19-hospitalized patients in Karnataka: survival and stay characteristics. *Indian journal of public health*, *64*(6), 221.

**16 Page 18, line 307 -the authors parametrize the ascertainment rate using data from Singapore. I assume that the ascertainment rate in Singapore is going to differ from India. Can the authors instead use an estimate more relevant to the Indian context considered? This links back to my earlier point about doing this analysis for a different country context --perhaps Singapore would be a good country to choose for this comparison.**

Based on a more relevant publication estimating COVID-19 under-reporting across 86 nations, including India, we changed the assumed initial ascertained rate as 0.10 and Beta(10, 90) was used as the prior of the ascertained rate estimated in the first time period. The SAPHIRE model was successfully applied in delineating the dynamics of COVID-19 in Wuhan, China1.

1 Hao, X., Cheng, S., Wu, D., Wu, T., Lin, X., & Wang, C. (2020). Reconstruction of the full transmission dynamics of COVID-19 in Wuhan. *Nature*, *584*(7821), 420-424.

**B. Each modeler can write how you did sensitivity analysis and critical parameter choices.**

**Sensitivity analysis:** We conducted the sensitivity analysis by changing the initial parameters as 20% lower or higher than the specified values in the SAPHIRE model. The estimated and ascertained rates were robust to misspecification of the duration from the onset of symptoms to isolation and of the relative transmissibility of unascertained versus ascertained cases. estimates were positively correlated with the specified latent and infectious periods, and the estimated ascertainment rates were positively correlated with the specified ascertainment rate in the initial state.

**critical parameter choices:** As described in the **Page 17 line 275** (checked the revised version above)**.**

**C. Each modeler can state how these have been used for other countries (just cite papers/MS).**

SAPHIRE model was successfully applied to delineate the dynamics of COVID-19 in Wuhan, China.

Hao, X., Cheng, S., Wu, D., Wu, T., Lin, X., & Wang, C. (2020). Reconstruction of the full transmission dynamics of COVID-19 in Wuhan. *Nature*, *584*(7821), 420-424.

**D. How are the models at picking up damped oscillations, I believe that is what we will see for India, not a huge resurgence if we believe the serosurveys and with vaccines being rolled out.**