Supporting Information

Epidemiological impact of prioritizing SARS-CoV-2 vaccination by antibody status: Mathematical modeling analyses

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Figure S1: Conceptual diagram illustrating the SARS-CoV-2 vaccine model. VE_S is defined as the proportional reduction in the susceptibility to infection among those vaccinated compared to those unvaccinated.[1] VE_P is defined as the proportional reduction in the proportion of individuals with severe or critical infection among those vaccinated but still acquired the infection compared to those unvaccinated.[1] In this figure, solid lines denote progression or forward movement from one population compartment to the next, while dashed lines denote backward movement from the present population compartment to the previous population compartment. Further details can be found in references.[1-4]

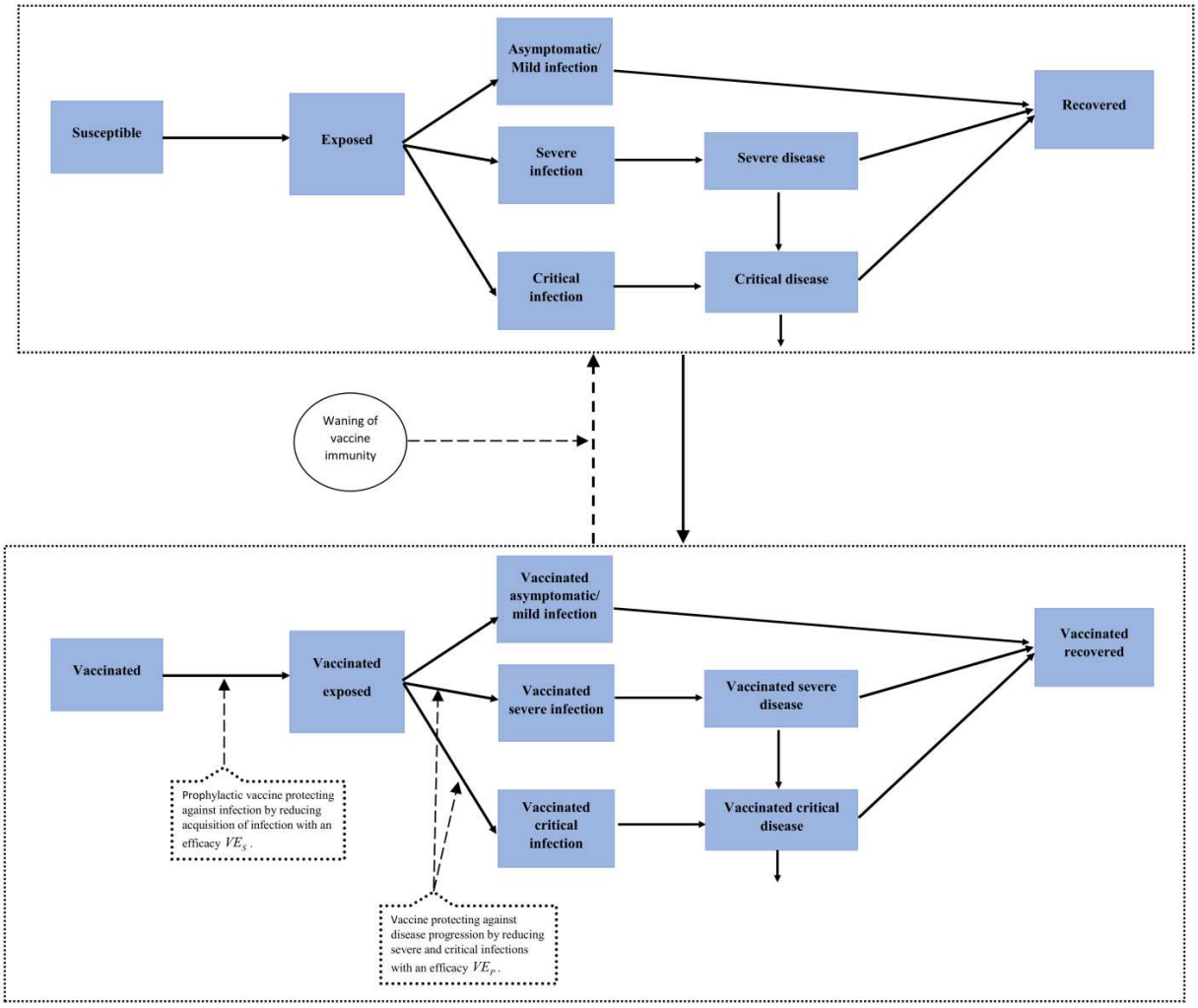


Figure S2: Model calibration. Model fits to (A) SARS-CoV-2 laboratory-confirmed cases, (B) daily hospital admissions in acute-care beds, and (C) daily hospital admissions in ICU-care beds.

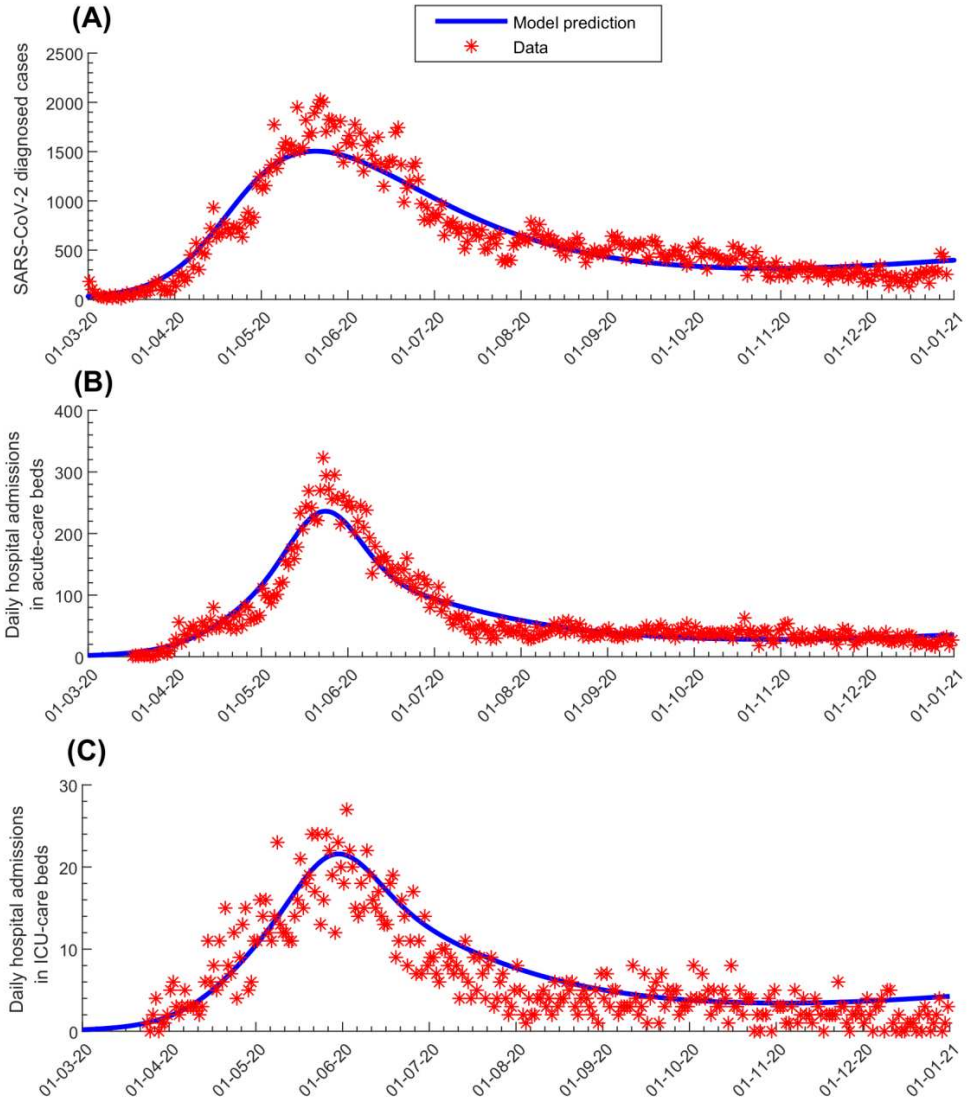


Figure S3: Impact of SARS-CoV-2 vaccination to reach 80% coverage among only the antibody-negative, or to reach 80% coverage of the whole population, for a vaccine that does not protect against infection, but protects against disease. Impact was assessed based upon A) the number of new hospital admissions in acute-care beds and ICU-care beds per day, B) the cumulative number of averted severe and critical diseases, and C) the number of vaccinations needed to prevent one severe or critical disease case. Vaccination is introduced on January 1st, 2021 and is scaled up until June 30, 2021, with concurrent gradual easing of social and physical distancing restrictions to reach an R_0 of 4 by June 30, 2021. The vaccine is assumed to have an efficacy of 95% against only disease: $VE_P = 95\%$. Duration of vaccine-induced protection is one year.

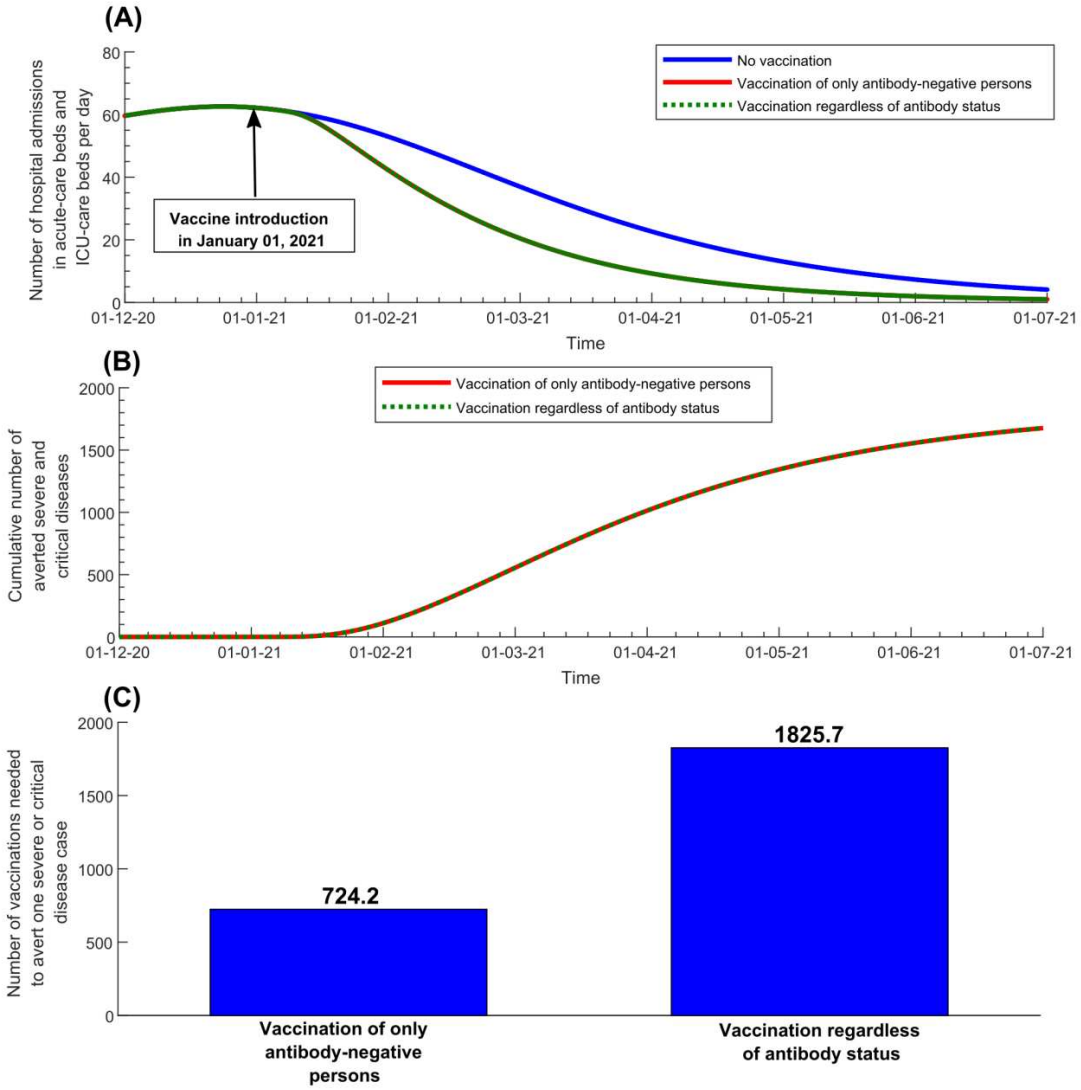


Figure S4: Effectiveness of age-group prioritization in vaccinating only antibody-negative persons. The number of vaccinations needed to prevent A) one infection, B) one severe disease case, C) one critical disease case, and D) one COVID-19 death. Vaccination is introduced on January 1st, 2021 and is scaled up until June 30, 2021, with concurrent gradual easing of social and physical distancing restrictions to reach an R_0 of 4 by June 30, 2021. The vaccine is assumed to have an efficacy of 95% against infection: $VE_S = 95\%$. Duration of vaccine-induced protection is one year.

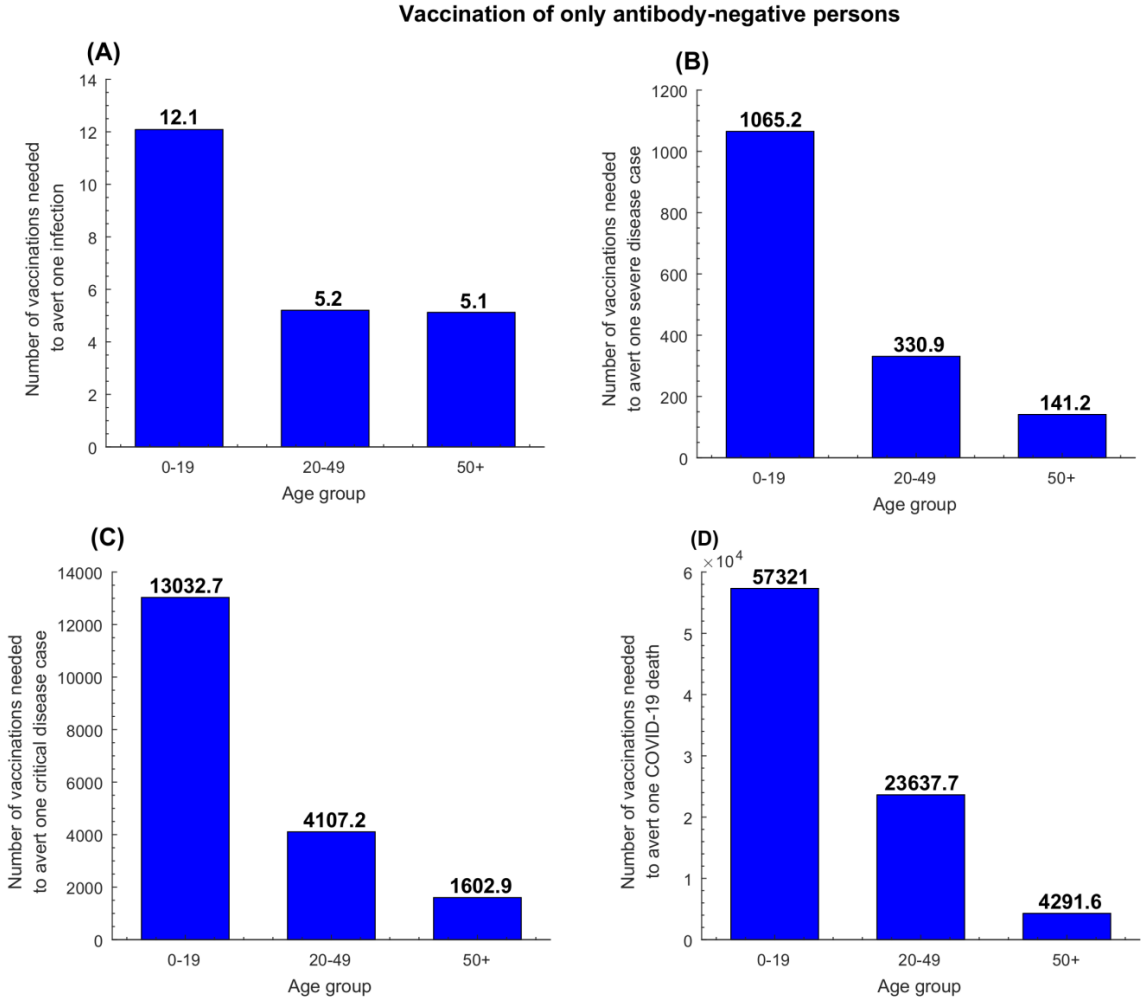


Figure S5: Effectiveness of age-group prioritization in vaccinating regardless of antibody status. The number of vaccinations needed to avert A) one infection, B) one severe disease case, C) one critical disease case, and D) one COVID-19 death. Vaccination is introduced on January 1st, 2021 and is scaled up until June 30, 2021, with concurrent gradual easing of social and physical distancing restrictions to reach an R_0 of 4 by June 30, 2021. The vaccine is assumed to have an efficacy of 95% against infection: $VE_S = 95\%$. Duration of vaccine-induced protection is one year.

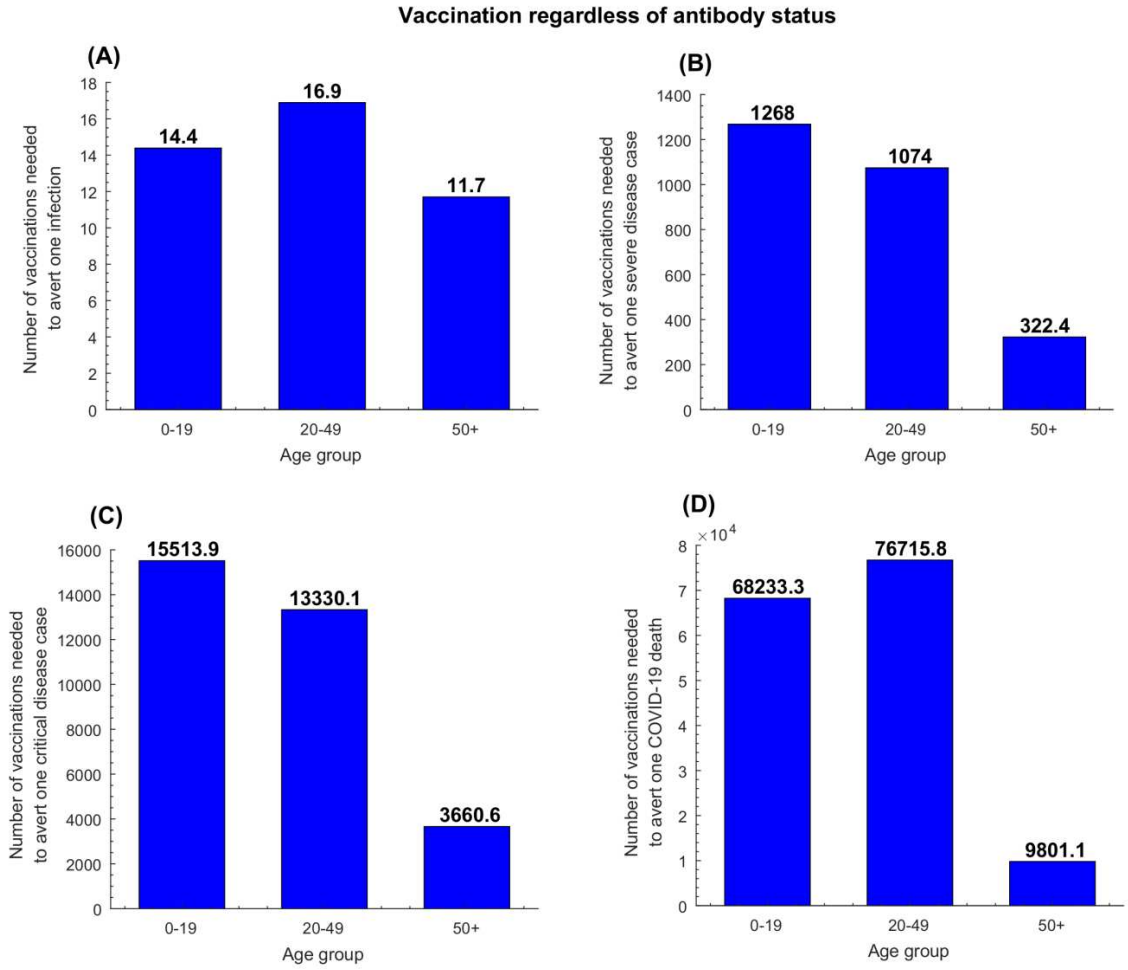


Figure S6: Uncertainty analysis. The mean and 95% uncertainty interval (UI) for the effectiveness of SARS-CoV-2 vaccination with or with no prioritization by antibody status for a vaccine that reduces infection and disease ($VE_S = 95\%$) compared to a vaccine that reduces only disease ($VE_P = 95\%$). The number of vaccinations needed to avert A) one infection A) one severe disease case, B) one critical disease case, and C) one COVID-19 death. Vaccination is introduced on January 1st, 2021 and is scaled up until June 30, 2021, with concurrent gradual easing of social and physical distancing restrictions to reach an R_0 of 4 by June 30, 2021. Duration of vaccine-induced protection is one year.

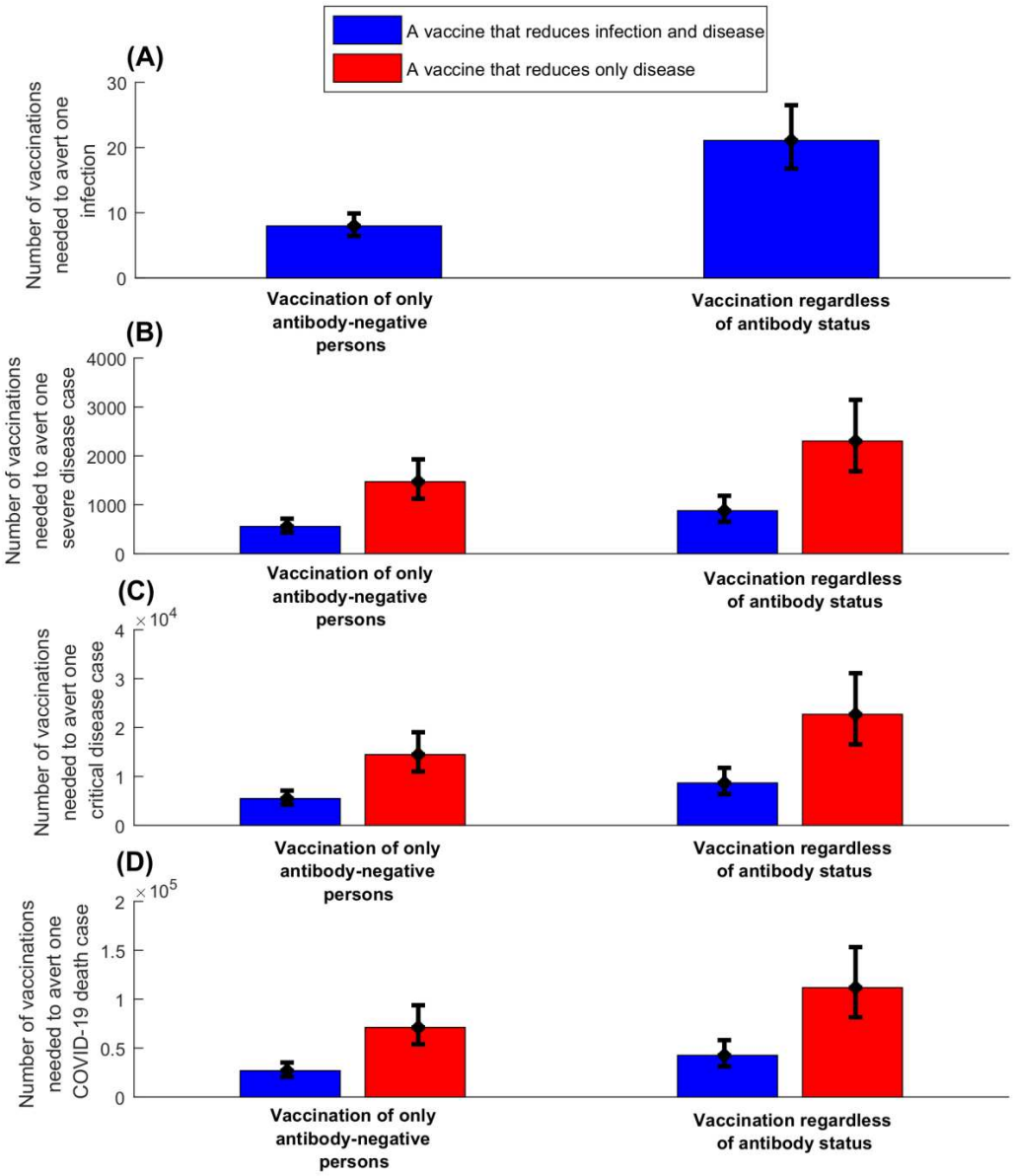


Figure S7: Sensitivity analysis assessing the effectiveness of SARS-CoV-2 vaccination to a range of vaccine efficacies. A) The number of vaccinations needed to avert one infection with or with no prioritization by antibody status for a vaccine that reduces infection and disease with efficacy (VE_S) ranging from 50% to 95%. B) The number of vaccinations needed to avert one severe or critical disease with or with no prioritization by antibody status for a vaccine that reduces only disease with efficacy (VE_P) ranging from 50% to 95%. Vaccination is introduced on January 1st, 2021 and is scaled up until June 30, 2021, with concurrent gradual easing of social and physical distancing restrictions to reach an R_0 of 4 by June 30, 2021. Duration of vaccine-induced protection is one year.

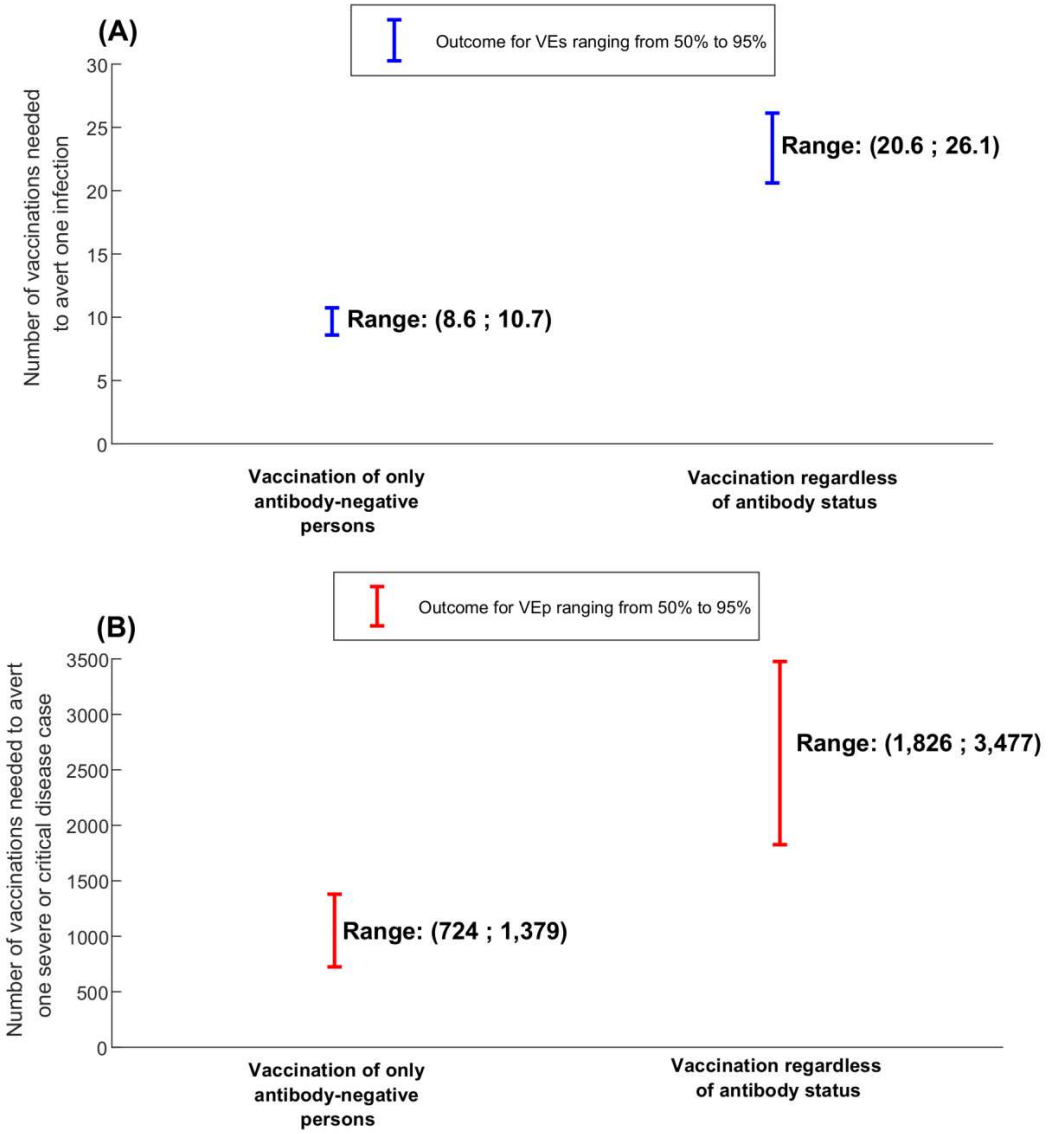
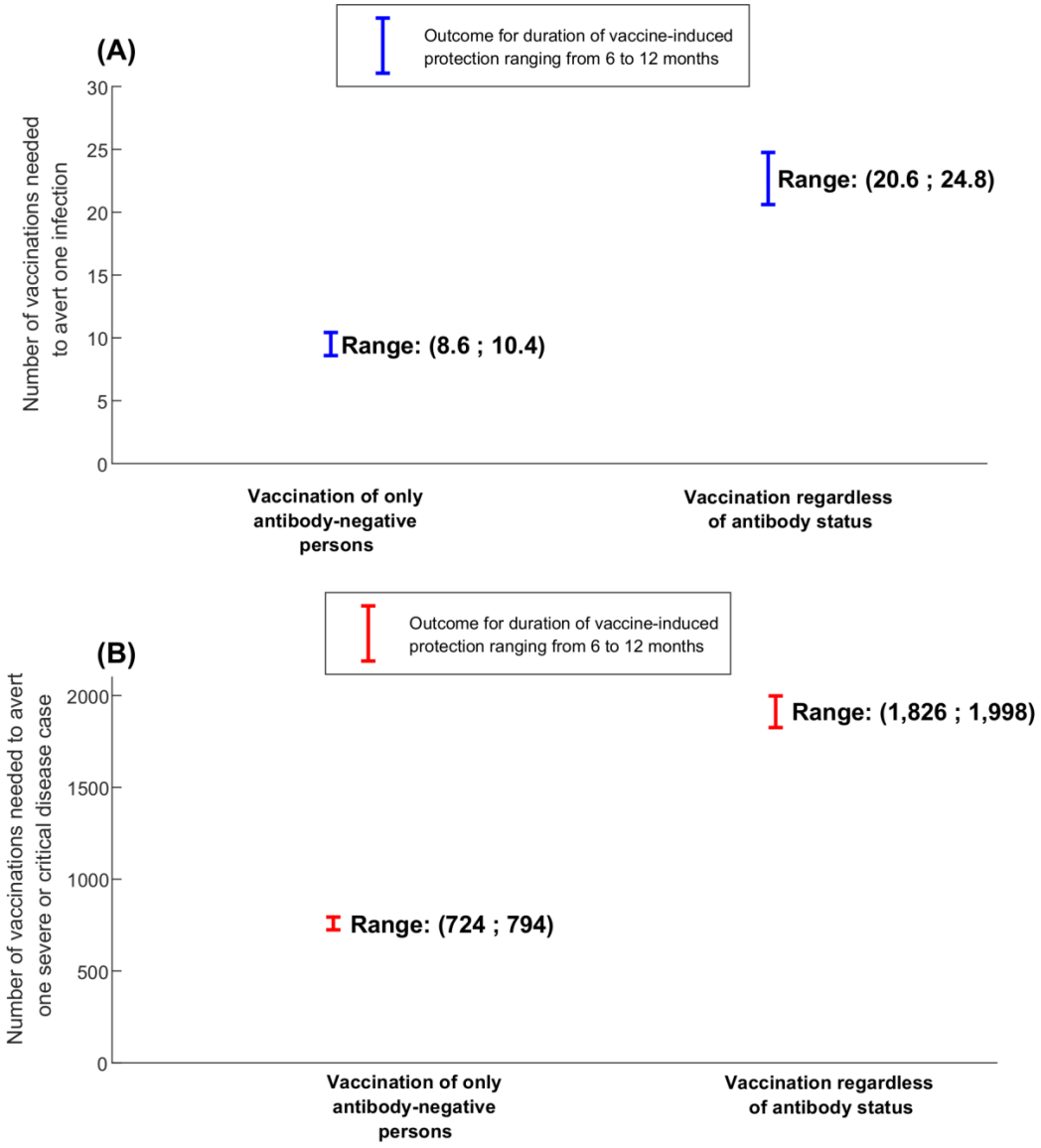


Figure S8: Sensitivity analysis assessing the effectiveness of SARS-CoV-2 vaccination to a range of vaccine-induced durations of protection. A) The number of vaccinations needed to avert one infection with or with no prioritization by antibody status for a vaccine that reduces infection and disease ($VE_S = 95\%$) at various durations of vaccine protection ranging from 6 to 12 months. B) The number of vaccinations needed to avert one infection with or with no prioritization by antibody status for a vaccine that reduces only disease ($VE_P = 95\%$) at various durations of vaccine protection ranging from 6 to 12 months. Vaccination is introduced on January 1st, 2021 and is scaled up until June 30, 2021, with concurrent gradual easing of social and physical distancing restrictions to reach an R_0 of 4 by June 30, 2021.



References

1. Makhoul M., Ayoub H.H., Chemaitelly H., et al., *Epidemiological impact of SARS-CoV-2 vaccination: Mathematical modeling analyses.* Vaccines, 2020. **8**(4).
2. Ayoub, H.H., Chemaitelly, H., Mumtaz, G.R., et al., *Characterizing key attributes of the epidemiology of COVID-19 in China: Model-based estimations.* Global Epidemiology, 2020. **100042**.
3. Ayoub, H.H., Chemaitelly, H., Seedat, S., et al., *Age could be driving variable SARS-CoV-2 epidemic trajectories worldwide.* Plos One, 2020. **15**(8).
4. Ayoub, H.H., Chemaitelly, H., Seedat, S., et al., *Mathematical modeling of the SARS-CoV-2 epidemic in Qatar and its impact on the national response to COVID-19.* Journal of Global Health, 2021. **11**.