

Future Trends of the COVID-19 Pandemics: What Should We Expect?

Leleu H¹, Blachier M¹
¹ PHESim, Public Health Expertise, Paris, France



BACKGROUND

The COVID-19 pandemic has been a major global health threat since 2020. In France, since March 2020, over 30 million diagnoses of COVID-19 have been made, with likely as many undiagnosed. A lot of hope had been placed on SARS-CoV-2 vaccination to control the pandemic, but the appearance of more transmissible and vaccine resistant variants have guaranteed that SARS-CoV-2 will remain circulating in the population for the foreseeable future. Indeed, despite high vaccination coverage in France, two third of the COVID-19 diagnoses were made since January 2022, and new immunity-escaping variants are appearing regularly. The future of the pandemic is thus uncertain.

METHOD

We used a previously published epidemiological model that was calibrated and validated for the French setting¹.

The model is a **stochastic agent-based model** that includes:

- A realistic synthetic population generated with demographic characteristics, comorbidities and household structure representative of the French population
- Social contacts among the individuals in the population including intrafamilial, school or work, friends or extended family members (at home or at bars and restaurants), grocery shopping, public transport and cultural activities. Evolution of social contact rates, and protective behaviors were based on Google™ Mobility data and the COVIPREV study² (Figure 1), and national restrictions
- a SARS-CoV-2 disease model, which translates the social contacts into infection probability, and simulates the patient's pathway from infection to recovery³. The risk of contamination is calibrated on the hospitalization rates observed in France (Figure 2) while the asymptomatic rate is calibrated on the seroprevalence.

Compared to the 2020 publication¹, the risk of contamination and the percentage of asymptomatic patients was updated to take into accounts seroprevalence results in France⁴. In addition, vaccination⁵ and variants⁶ were added into the model. Vaccination and natural immunity duration were based on observed data in France.

METHOD

The model was used to simulate future incidences for 2023 to 2025. Several assumptions were used: (1) variants will continue to appear at a similar rate than observed in 2021/2022. New variant will partially escape natural immunity. New variant infectiousness will be randomly changed around current level for the Omicron variants. (2) Vaccine efficacy wains in 6 month for infection, while protection for severe cases is long lived. Adults over 65 revaccinate. (3) Behaviors have returned to prepandemic levels except for telework that has stabilized at 30%.

RESULTS

The model projected repeated waves of COVID-19 infections for 2023 to 2025, with variations in the height and number of waves. These results should not be interpreted as a prediction but rather each year should be seen as future possibilities depending on variant infectiousness and moment.

Overall, the model estimated an annual incidence of over 60 millions, with symptomatic cases representing about 30% of the total incidence.

Figure 1. Assumptions regarding evolution of key social behaviors in France between 2020 and 2022

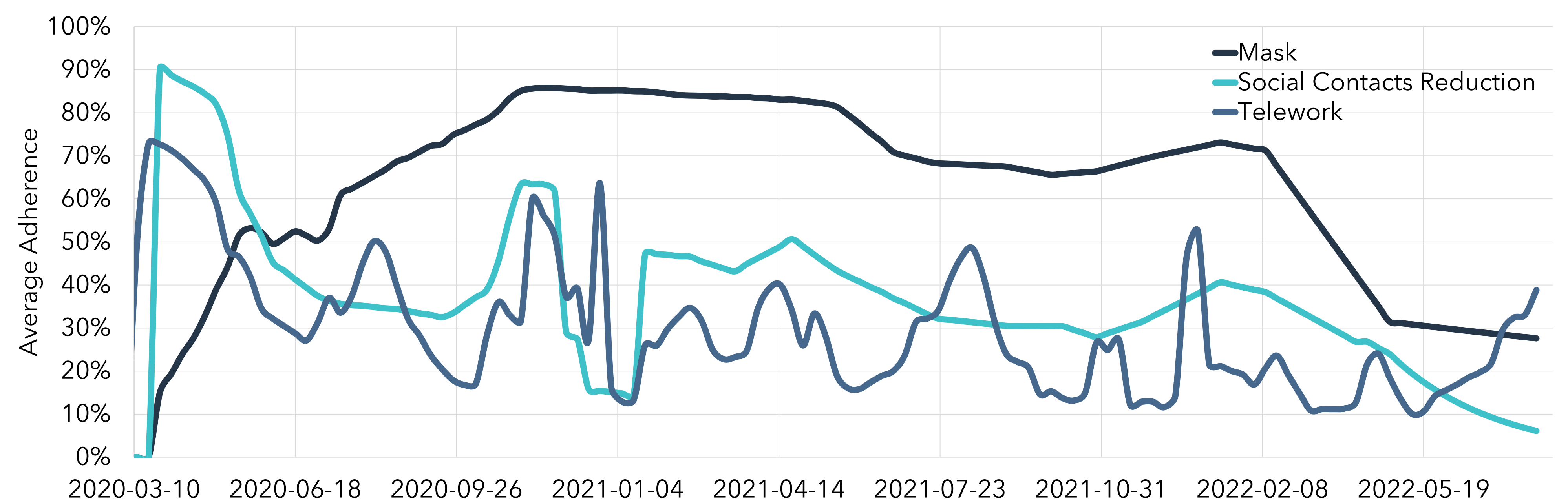


Figure 2. Comparison of the model-estimated hospitalization and the observed hospitalization in France

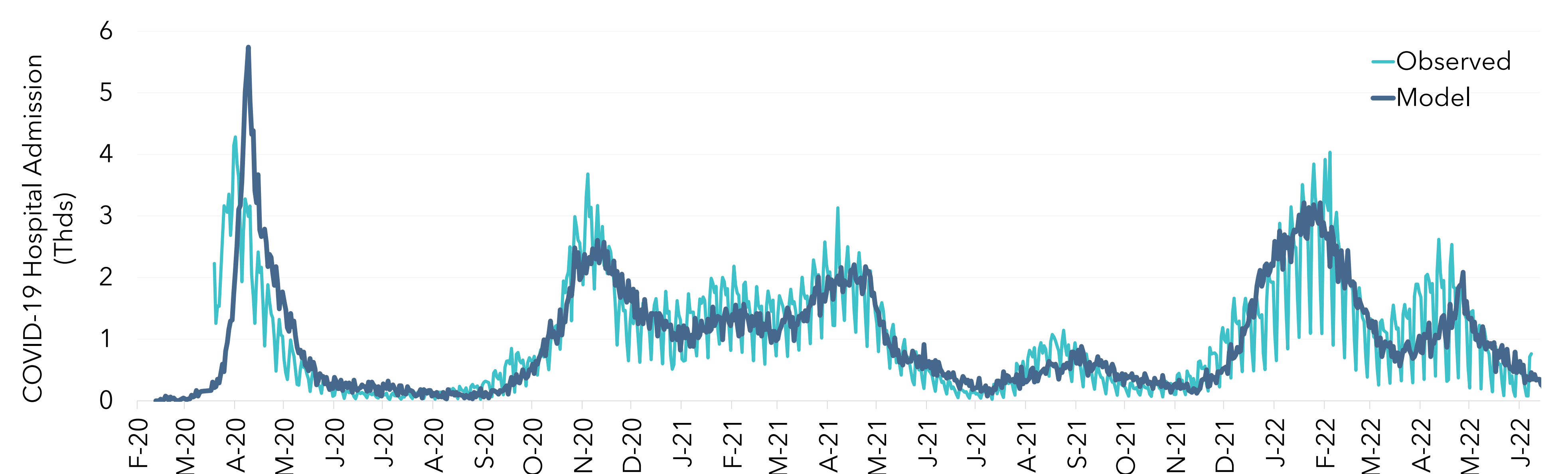
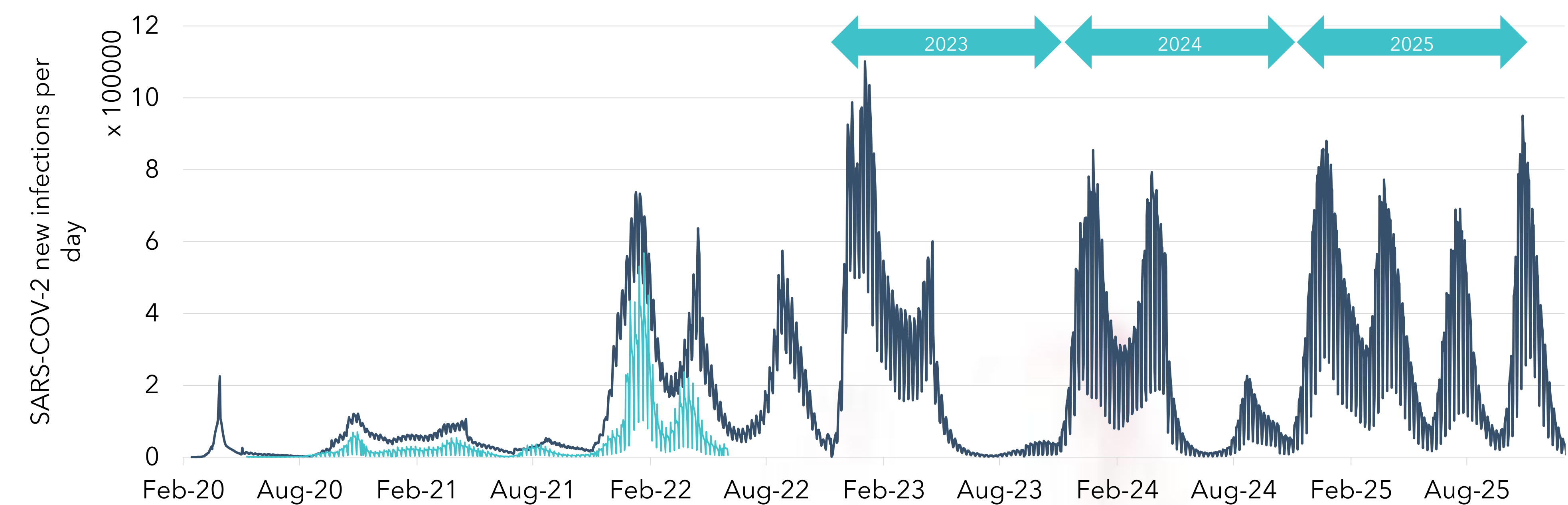


Figure 3. Comparison of the model-estimated hospitalization and the observed hospitalization in France



CONCLUSION

Based on our current knowledge, repeating COVID-19 waves are expected for the years to come. Late autumn and winter waves are the most likely as they fall within the increase transmission seasonal period. However, late winter and summer waves are possible if a more transmissible variant appears.

This has consequences for patients at very high risk, for revaccination and for treatment availability.

References

1. Hoertel, N., Blachier, M., Blanco, C. et al. A stochastic agent-based model of the SARS-CoV-2 epidemic in France. *Nat Med* 26, 1417-1421 (2020). <https://doi.org/10.1038/s41591-020-1001-6>
2. Santé Publique France. CoviPrev : une enquête pour suivre l'évolution des comportements et de la santé mentale pendant l'épidémie de COVID-19. October 2022. <https://www.santepubliquefrance.fr/etudes-et-enquetes/coviprev-une-enquete-pour-suivre-l-evolution-des-comportements-et-de-la-sante-mentale-pendant-l-epidemie-de-covid-19>
3. Salje H, Tran Kiem C, Lefrançois N, et al. Estimating the burden of SARS-CoV-2 in France. *Science*. 2020;369(6500):208-211. <https://geodes.santepubliquefrance.fr/>
4. Santé Publique France. Analyse de risque sur les variants émergents du SARS-CoV-2 réalisée conjointement par Santé publique France et le CNR des virus des infections respiratoires. 2022
5. HAS. Stratégie de vaccination contre la Covid-19. Anticipation des scénarios possibles à l'automne 2022. 2022.