Impact of January 2021 social distancing measures on SARS-CoV-2 B.1.1.7 circulation in France

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Abstract

Facing B.1.1.7 variant, social distancing was strengthened in France in January 2021. Using a 2-strain mathematical model calibrated on genomic surveillance, we estimated that social distancing allowed hospitalizations to plateau, by decreasing transmission of the historical strain while B.1.1.7 continued to grow. Variant dominance is expected by the end of February-early March in France, with large geographical heterogeneity. Without strengthened social distancing, a rapid surge of hospitalizations is expected in the next weeks.
The new SARS-CoV-2 B.1.1.7 variant (20I/501Y.V1, also called variant of concern VOC 202012/01 or ‘UK variant’) initially detected in the UK\(^1\)\(^2\) is rapidly expanding its geographical range to European countries\(^3\). To assess its penetration in France, a large-scale genome sequencing initiative was conducted in the country in early January\(^4\) (Flash1 survey). It analyzed through Thermo Fisher 11,916 PCR positive samples out of 183,363 samples collected on January 7-8 by participating laboratories. 298 samples were confirmed B.1.1.7 variant, corresponding to 70% of analyzed S-gene dropouts, leading to an estimated 3.3% of new cases on January 7-8 due to SARS-CoV-2 B.1.1.7 variant in France.

Given the concern for the new variants and the high incidence levels, progressively strengthened social distancing measures were implemented in 2021. With a nationwide 8pm-curfew since mid-December, curfew was anticipated at 6pm in several departments at different dates in early January, due to deteriorating indicators. To further limit SARS-CoV-2 spread, French authorities extended the 6pm-curfew nationwide on January 16, with renewed recommendations for telework and the use of preventive measures. On January 31, these measures were further strengthened through heightened controls and closure of commercial centers.

The presence of B.1.1.7 variant on the territory, however, poses critical additional challenges to epidemic control. Its higher transmissibility represents a strong selective advantage to rapidly become the dominant strain\(^5\)\(^6\), as already seen in the UK\(^1\)\(^2\) and other European countries\(^3\). Social distancing will have a differential impact on the variant and the historical strain. Most importantly, its effect is not identifiable in regular surveillance data in France, not distinguishing between the two strains besides specific-date surveys.

Using a 2-strain age-stratified transmission model\(^7\) integrating mobility data, fitted to hospital admissions, and calibrated to the estimated B.1.1.7 prevalence, we evaluated the impact of January 2021 social distancing measures on the two strains, and provide projections for B.1.1.7 dominance. Our results are validated independently with the preliminary estimates of the Flash2 survey conducted on January 27\(^9\).

**Modeling SARS-CoV-2 2-strain transmission dynamics**

We extended a previously developed age-stratified transmission model that was used to assess the impact of interventions against COVID-19 pandemic in 2020 in France\(^8\)\(^9\)\(^10\). The model is discrete, stochastic and integrates demography, age profile, social contacts, mobility data over time to account for social distancing measures\(^7\). Fitted to hospital admission data through a maximum likelihood approach, the model was validated against three serological studies’ estimates\(^7\). Details are provided in Ref.\(^7\) and the Supporting Information (SI).

The model was extended to describe the circulation of two SARS-CoV-2 variants – the historical strain and B.1.1.7. Variant circulation was initialized on Flash1 survey estimates\(^4\). Complete cross-immunity and 50% transmissibility increase (range: 40-60%) were considered based on available knowledge\(^1\)\(^2\).

We fitted the model to three geographical areas, characterized by different variant circulation: mainland France (3.3%); Île-de-France region, reporting the highest penetration (6.9%); Nouvelle Aquitaine region, reporting one of the lowest penetration (1.7%). Preliminary estimates from the Flash2 survey were used for validation (see the SI for details).

We considered projections based on the fit to daily hospital admission data up to w05, alongside a scenario assuming a relaxation of social distancing (10% increase in the effective reproductive number) and one assuming a strengthening of the measures (10% decrease). We estimated the time at which hospitalizations reach November peak levels (second lockdown), when conditions were close to hospital capacity in a number of regions.

**Estimated impact of social distancing measures and resulting B.1.1.7 trajectories**

Hospital admission data show that after an increase from December (average 6,700 weekly hospitalizations) to early January (about 9,000 in w02), the epidemic plateaued in the second half of the month, after the implementation of the first measures (**Figure 1**). Similar trends were reported in the three areas, with Nouvelle Aquitaine experiencing a more marked increase at the start of 2021.
Based on the estimated B.1.1.7 prevalence in early January, the model predicted that the observed plateau results from the counterbalance between two opposing dynamics: a decreasing circulation of the historical strain (with effective reproductive numbers $R_{e}^{FR} = 0.95 (0.94-0.96)$, $R_{e}^{IDF} = 0.95 (0.93-0.97)$, $R_{e}^{NAQ} = 0.88 (0.81-0.94)$) opposed to the exponential increase of the variant.

Under the conditions estimated at w05, hospitalization levels compatible with November peak would be reached around w11 in France, w9 in Île-de-France, and after w12 in Nouvelle Aquitaine (Table 1). A partial relaxation of social distancing, corresponding to the estimated situation in early January before stricter measures were implemented, would anticipate these estimates of 1-2 weeks. Stronger social distancing, compatible with the situation of the last weeks of the second lockdown, would gain additional time, especially in those regions with lower variant prevalence (Nouvelle Aquitaine). Planned vaccination rollout would have limited impact on these trajectories until March, assuming efficacy against symptomatic forms only (see SI).

**Figure 1.** Projected weekly hospitalizations due to SARS-CoV-2 historical strain and B.1.1.7 variant in France and in the two regions under study. From left to right: scenario assuming a strengthening of social distancing (SD) measures from w06, compatible with the situation experienced in the last weeks of the second lockdown; scenario based on estimates up to w05 and assuming no additional changes; scenario assuming a relaxation of social distancing measures from w06, compatible with the situation in early January. Dots correspond to weekly hospitalization data used for fitting the model. The solid black curve refers to the overall trajectory, due to the concurrent circulation of the historical strain (dashed green curve) and B.1.1.7 variant (solid green curve), assuming 50% increase in transmissibility (40% and 60% increases are shown for sensitivity in the SI). The shaded area around the curve corresponds to the 95% confidence interval; it is not shown for the single strains, for the sake of visualization. The second wave is shown for reference, together with indications of the timing of social distancing measures.
Table 1. Estimated week at which hospitalizations exceed the peak value of the second wave in France and in the two regions under study. Projections consider the scenario based on estimates up to w05 and assuming no additional changes (central column), a scenario assuming a strengthening of social distancing (SD) measures from w06 (left column), and one assuming a relaxation of social distancing measures from w06 (right column). Results correspond to a 50% increase of transmissibility of the variant (40% and 60% increases are shown for sensitivity in the SI).

| Region          | Peak weekly hospitalizations of second wave | Strengthening of SD measures | Estimated | Relaxation of SD measures |
|-----------------|--------------------------------------------|-----------------------------|-----------|--------------------------|
| France          | 17,000 weekly hospitalizations             | after week 12               | week 11 (9-12) | week 9 (8-11)           |
| Île-de-France   | 3,000 weekly hospitalizations              | week 11 (10-14)            | week 9 (8-12) | week 8 (8-11)          |
| Nouvelle Aquitaine | 800 weekly hospitalizations               | after week 12               | after week 12 | week 11 (10-12)         |

Estimated B.1.1.7 prevalence and dominance date

The rapid increase of B.1.1.7 prevalence over time estimated by the model is in agreement with the preliminary estimates resulting from the Flash2 survey (Figure 2). Biases affecting Flash survey data due to reinforced tracing around suspected or confirmed variants may explain the discrepancy observed in Nouvelle Aquitaine, as they would be more relevant in small-size epidemic.

The model predicts that the variant would become dominant in week 9 (8-9) in France, 7 in Île-de-France, and 10 (9-11) in Nouvelle Aquitaine. Changes in social distancing would negligibly affect the estimated dominance date, as the measures would have a concurrent effect on both strains. Estimated variations are larger for changes in the assumed increase in variant transmissibility.
Figure 2. B.1.1.7 projected prevalence over time and estimated dominance week in France and in the two regions under study. Top, bottom left: estimated percentage of B.1.1.7 cases over time, assuming 50% (range 40-60%) increase in transmissibility for the variant. Points represent the consolidated estimates from Flash1 survey; point-lines represent the preliminary estimates from the Flash2 survey. We considered S-gene target failure percentages of positive tests for each territory and estimated the proportion of B.1.1.7 between 70% (Flash1 survey’s proportion) and 100% (indicated with the point): 9.8-14% in France; 13.7-19.5% in Île-de-France; 9.4-13.4% in Nouvelle Aquitaine. Bottom right: estimated week of B.1.1.7 dominance, assuming 50% (range 40-60%) increase in transmissibility for the variant, and considering the estimated scenario (middle point) and the scenarios with strengthening (lighter color, left point) and relaxation (darker color, right) of social distancing measures.

Discussion

We estimated that social distancing implemented in January 2021 was able to bring the effective reproductive number of the historical strain below 1, leading to its decline while B.1.1.7 cases exponentially increased. This result was consistently found in the analysis of national data and of two regions, reporting the highest and among the lowest variant penetration, and validated independently by the preliminary estimates of the second genomic survey.

Social distancing was the combined effect of imposed restrictions11 and individual response to renewed recommendations on telework and risk reduction. Telework, estimated from mobility data7,12, was maintained at the levels reached before releasing the second lockdown. Measures, however, were not enough to lead to a decline in the variant spread due to its more efficient transmission. B.1.1.7 is predicted to rapidly increase and become dominant in France by the end of February-early March, with large geographical heterogeneity depending on variant penetration4 and efficacy of social distancing13,14.

Strengthening social distancing measures show clear advantages in gaining time to extend the plateau before the expected resurgence of cases. The scenario proposed here, with a 10% reduction in current $R_e$, is less efficient than the early phase of the November mild lockdown, with schools open. It corresponds to the situation estimated in the later phase, when relaxation emerged, mobility increased and telework progressively reduced. The additional measures taken on January 31, a possible slowdown induced by winter school holidays, as well as a strengthening of the test-trace-isolate strategy6 may provide a short-term relief. In absence of more rigorous and intensified social distancing, B.1.1.7 will drive a rapid growth in the next weeks, with an earlier timing in those regions reporting a large presence of the variant (e.g. Île-de-France). Increasing vaccination coverage is key15, but
its mitigating impact is expected to become visible starting April, according to estimated rollout plans and assuming efficacy only against symptomatic forms of infection.

Our study has limitations. It considered the strengthening of social distancing, but not stronger measures as a lockdown. Increased transmissibility was assumed from prior estimates in the UK\textsuperscript{1,2,16}, compatible with those from other countries\textsuperscript{6}. Similar estimates from French data will help update projections, however validation with the second genomic survey already suggests a good agreement with assumptions. We did not consider additional differences between the variant and the historical strain, such as increased severity. Other variants were not considered here, as estimated at a lower penetration, but their circulation will concur to the expected case surge.

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Conflict of interest

None declared.

Authors’ contribution

VC conceived and designed the analysis. LDD, CES, GP performed the analysis. LDD, CES, GP, DLB, VC interpreted the results. VC wrote the manuscript. LDD, CES, GP, DLB, VC critically revised the manuscript and approved its final version.

References

1. Davies, N. G. \textit{et al.} Estimated transmissibility and severity of novel SARS-CoV-2 Variant of Concern 202012/01 in England. \textit{medRxiv} (2020) doi:10.1101/2020.12.24.20248822.

2. Volz, E. \textit{et al.} Transmission of SARS-CoV-2 Lineage B.1.1.7 in England: Insights from linking epidemiological and genetic data. \textit{medRxiv} 2020.12.30.20249034 (2021) doi:10.1101/2020.12.30.20249034.

3. ECDC. Risk Assessment: Risk related to spread of new SARS-CoV-2 variants of concern in the EU/EEA. \textit{European Centre for Disease Prevention and Control} https://www.ecdc.europa.eu/en/publications-data/covid-19-risk-assessment-spread-new-sars-cov-2-variants-eueea (2020).

4. Santé publique France. COVID-19 : point épidémiologique du 28 janvier 2021. https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-et-infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-point-epidemiologique-du-28-janvier-2021.

5. Sabbatini, C. E., Domenico, L. D., Pullano, G. & Colizza, V. Estimated date of dominance of VOC-202012/01 strain in France and projected scenarios. https://www.epicx-lab.com/uploads/9/6/9/4/9694133/inserm_covid-19-voc_dominance-20210116.pdf.

6. Christian L. Althaus et al. Transmission of SARS-CoV-2 variants in Switzerland. https://ispmbern.github.io/covid-19/variants/index.pdf.

7. Pullano, G. \textit{et al.} Underdetection of cases of COVID-19 in France threatens epidemic control. \textit{Nature} 590, 134–139 (2021).
8. Santé publique France. COVID-19 : point épidémiologique du 4 février 2021. /maladies-et-traumatismes/maladies-et-infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-point-epidemiologique-du-4-fevrier-2021.

9. Di Domenico, L., Pullano, G., Sabbatini, C. E., Boëlle, P.-Y. & Colizza, V. Impact of lockdown on COVID-19 epidemic in Île-de-France and possible exit strategies. *BMC Med.* **18**, 240 (2020).

10. Di Domenico, L., Pullano, G., Sabbatini, C. E., Boëlle, P.-Y. & Colizza, V. Modelling safe protocols for reopening schools during the COVID-19 pandemic in France. *Nat. Commun.* (2021) doi:10.1101/2020.05.08.20095521.

11. Spaccaferri, G. *et al*. Early assessment of the impact of mitigation measures to control COVID-19 in 22 French metropolitan areas, October to November 2020. *Eurosurveillance* **25**, 2001974 (2020).

12. Google. COVID-19 Community Mobility Report. *COVID-19 Community Mobility Report* https://www.google.com/covid19/mobility?hl=en.

13. Cauchemez, S., Kiem, C. T., Paireau, J., Rolland, P. & Fontanet, A. Lockdown impact on COVID-19 epidemics in regions across metropolitan France. *The Lancet* **396**, 1068–1069 (2020).

14. Pullano, G., Valdano, E., Scarpa, N., Rubrichi, S. & Colizza, V. Population mobility reductions during COVID-19 epidemic in France under lockdown. *Lancet Digit. Health* 2020.05.29.20097097 (2020) doi:10.1101/2020.05.29.20097097.

15. European Centre for Disease Prevention and Control. Integrated COVID-19 response in the vaccination era. https://www.ecdc.europa.eu/en/publications-data/integrated-covid-19-response-vaccination-era (2021).

16. Leung, K., Shum, M. H., Leung, G. M., Lam, T. T. & Wu, J. T. Early transmissibility assessment of the N501Y mutant strains of SARS-CoV-2 in the United Kingdom, October to November 2020. *Eurosurveillance* **26**, 2002106 (2021).
1. SARS-CoV-2 B.1.1.7 variant estimated circulation in France

Two large-scale genome sequencing initiatives (called Flash surveys) were conducted in France to estimate the variant circulation in the country and at regional level at different moments in time. Flash 1 survey\(^1\) was conducted on January 7-8 and its consolidated results are described in the main text. Here we present the results of the Flash 2 survey\(^2\), conducted on January 27, for which preliminary estimates are available at this time. 7,657 PCR positive samples were analyzed out of 95,306 samples collected on January 27 by participating laboratories. S-gene target failure was identified in 428 cases out of 3,065 positive cases analyzed through Thermo Fisher, leading to an estimated 14% of S-gene target failure in France, 19.5% in Île-de-France and 13.4% in Nouvelle-Aquitaine. As genome sequencing is still undergoing, we use these data and estimate B.1.1.7 penetration as a 70% to 100% proportion of S-gene target failure percentages of positive tests, given that 70% was the proportion estimated in the Flash 1 survey. Estimated ranges are: 9.8-14% in France; 13.7-19.5% in Île-de-France; 9.4-13.4% in Nouvelle Aquitaine.

2. SARS-CoV-2 two-strain transmission model

We use a stochastic discrete age-stratified transmission model, integrating demographic, age profile, social contact data, mobility data, data on adoption of preventive measures, to account for age-specific behaviors over time and role in COVID-19 transmission. Four age classes are considered: [0-11], [11-19], [19-65], and 65+ years old (children, adolescents, adults, seniors). Transmission dynamics follows a compartmental scheme specific for COVID-19 (Figure 1) where individuals are divided into susceptible, exposed, infectious, hospitalized and recovered. The infectious phase is divided into two steps: a prodromic phase (\(I_p\)) and a phase where individuals may remain either asymptomatic (\(I_{m}\), with probability \(p_\text{asym}=40\%\)) or develop symptoms. In the latter case, we distinguished between different degrees of severity of symptoms (paucisymptomatic (\(I_{ps}\)), individuals with mild (\(I_{m}\)) or severe (\(I_{s}\)) symptoms\(^{14}\)). Prodromic, asymptomatic and paucisymptomatic individuals have a reduced transmissibility\(^7\). A reduced susceptibility was considered for children and adolescents, along with a reduced relative transmissibility of children\(^{8-13}\). We assume that infectious individuals with severe symptoms reduce of 75% their number of contacts because of the illness they experience\(^{14}\). Additional details and parameter values can be found in Ref.\(^{13}\).

Complete cross-immunity and 50% increased transmissibility (range 40%-60%)\(^{16,17}\) were assumed for the B.1.1.7 variant compared to the historical strain. We did not consider further differences between the two strains.

Social mixing was informed from behavioral data and was modeled through the parametrization of contact matrices. In particular we considered attendance at school\(^{18}\), percentage of telework\(^{19}\), and adoption of physical distancing over time\(^20\). Contacts at school were considered according to the school calendar. In France all schools are in session with 100% physical presence since the start of the school calendar in September. In the period of May-July, after the first lockdown, schools were open but attendance was on a voluntary basis\(^21\). Social contacts at work were modified to account for the percentage of workers not going to their place of work over time, following the variation of presence at workplaces based on Google Mobility Trends\(^{19}\) (Figure S2). To account for individuals’
risk protection behavior over time, we parametrized contact matrices with the percentage of population avoiding physical contacts from the results of regular large-scale surveys conducted by Santé Publique France (CoviPrev\textsuperscript{20}). From these data, we also estimated that seniors have a higher risk aversion behavior compared to other age classes, leading to an average additional 30% reduction of their physical contacts\textsuperscript{15}.

The contacts in leisure and non-essential activities were informed based on implemented restrictions and mobility data in community settings (see e.g. use of transport and visits to retail in Figure S3).

![Diagram of compartmental scheme](image)

**Figure S1.** Two-strains compartmental scheme. Compartments with continuous line (top) account for the diffusion of historical strain, compartments with dashed line (bottom) account for the diffusion of B.1.1.7 variant. S=Susceptible, E=Exposed, I\textsubscript{p}=Infectious in the prodromic phase, I\textsubscript{as}=Asymptomatic Infectious, I\textsubscript{ps}=Paucysymptomatic Infectious, I\textsubscript{ms}=Symptomatic Infectious with mild symptoms, I\textsubscript{ss}=Symptomatic Infectious with severe symptoms, H=severe case admitted to the hospital, R=recovered.

![Graphs showing change in workplace locations](image)

**Figure S2.** Estimated change in presence at workplace locations over time and by region based on Google location history data\textsuperscript{19}.
Figure S3. Estimated change in the number of people visiting places of retail (top) and in the movement to transit stations (bottom) over time and by region based on Google location history data. 
3. Sensitivity analysis

3.1 Projected weekly hospitalizations due to SARS-CoV-2 historical strain and B.1.1.7 variant for the 40%-60% range of increased transmissibility

Figure S4. Impact of 40% transmissibility increase on the projected weekly hospitalizations due to SARS-CoV-2 historical strain and B.1.1.7 variant. From top to bottom: mainland France, Île-de-France region and Nouvelle Aquitaine region. From left to right: scenario assuming a strengthening of social distancing (SD) measures from w06; scenario based on estimates up to w05 and assuming no additional changes; scenario assuming a relaxation of social distancing measures from w06. Dots correspond to weekly hospitalization data used for fitting the model. The solid black curve refers to the overall trajectory, due to the concurrent circulation of the historical strain (dashed green curve) and of the B.1.1.7 variant (solid green curve), assuming 40% increase in transmissibility. The shaded area around the curve corresponds to the 95% confidence interval; it is not shown for the single strains, for the sake of visualization. The second wave is shown for reference, together with indications of the timing of social distancing measures.
Figure S5. Impact of 60% transmissibility increase on the projected weekly hospitalizations due to SARS-CoV-2 historical strain and B.1.1.7 variant. From top to bottom: mainland France, Île-de-France region and Nouvelle Aquitaine region. From left to right: scenario assuming a strengthening of social distancing (SD) measures from w06; scenario based on estimates up to w05 and assuming no additional changes; scenario assuming a relaxation of social distancing measures from w06. Dots correspond to weekly hospitalization data used for fitting the model. The solid black curve refers to the overall trajectory, due to the concurrent circulation of the historical strain (dashed green curve) and of the B.1.1.7 variant (solid green curve), assuming 60% increase in transmissibility. The shaded area around the curve corresponds to the 95% confidence interval; it is not shown for the single strains, for the sake of visualization. The second wave is shown for reference, together with indications of the timing of social distancing measures.
Table S1. Impact of 40% transmissibility increase on the estimated week at which hospitalizations exceed the peak values of the second wave in France and in the two regions under study. Projections consider the scenario based on estimates up to w05 and assuming no additional changes (central column), a scenario assuming a strengthening of SD measures from w06 (left column), and one assuming a relaxation of social distancing (SD) measures from w06 (right column). Results correspond to a 40% increase of transmissibility of the variant.

| Peak weekly hospitalizations of second wave | Strengthening of SD measures | Estimated | Relaxation of SD measures |
|-------------------------------------------|-----------------------------|-----------|---------------------------|
| France                                    | 17,000 weekly hospitalizations | after week 12 | week 12 (10-13) | week 10 (8-12) |
| Île-de-France                             | 3,000 weekly hospitalizations | after week 12 | week 10 (10-13) | week 9 (9-12) |
| Nouvelle Aquitaine                        | 800 weekly hospitalizations  | after week 12 | after week 12 | after week 12 |

Table S2. Impact of 60% transmissibility increase on the estimated week at which hospitalizations exceed the peak values of the second wave in France and in the two regions under study. Projections consider the scenario based on estimates up to w05 and assuming no additional changes (central column), a scenario assuming a strengthening of SD measures from w06 (left column), and one assuming a relaxation of social distancing (SD) measures from w06 (right column). Results correspond to a 60% increase of transmissibility of the variant.

| Peak weekly hospitalizations of second wave | Strengthening of SD measures | Estimated | Relaxation of SD measures |
|-------------------------------------------|-----------------------------|-----------|---------------------------|
| France                                    | 17,000 weekly hospitalizations | week 11 (9-12) | week 9 (8-11) | week 9 (8-10) |
| Île-de-France                             | 3,000 weekly hospitalizations | week 9 (8-12) | week 8 (8-11) | week 8 (7-10) |
| Nouvelle Aquitaine                        | 800 weekly hospitalizations  | after week 12 | week 11 (10-12) | week 10 (09-11) |

3.2 B.1.1.7 projected prevalence over time for the scenarios with relaxation or strengthening of social distancing measures

Figure S6. Impact of strengthening and relaxation of SD measures on the B.1.1.7 projected prevalence over time. Estimated percentage of B.1.1.7 cases over time, assuming 50% (range 40-60%) increase in transmissibility for the variant. From left to right: mainland France, Île-de-France region and Nouvelle Aquitaine region. Points represent the consolidated estimates from Flash1 survey; point-lines represent the preliminary estimates from the Flash2 survey. We considered S-gene target failure percentages of positive tests for each territory and...
estimated the proportion of B.1.1.7 between 70% (Flash1 survey’s proportion) and 100% (point). Colors indicate increase in transmissibility (green for 40%, red for 50%, blue for 60%). Color shade refers to the estimated scenario (intermediate color) and the scenarios with strengthening (lighter color) and relaxation (darker color) of social distancing measures. Results show that social distancing measures of this intensity do not have a significant impact on the prevalence of B.1.1.7 over time, as they concurrently act on both strains.

4. Impact of vaccination

Here we show model projections considering the introduction of vaccines on the estimated scenario for France with 50% increase in transmissibility of the B.1.1.7 variant (top central panel of Figure 1 of the main paper). Following estimated plans for rolling out the vaccination campaign, we simulate the administration of 100,000 or 200,000 doses per day in France, prioritized to the older age class. We consider that this rhythm of vaccination is in place from week 4. We assume 90% vaccine efficacy in preventing symptoms following the administration of the second dose, 2 weeks after the first. We consider a conservative assumption of no efficacy on transmission, in lack of estimates. Even with the higher daily rhythm (200,000 doses administered per day), vaccination has a minimal effect in reducing the number of hospitalizations in the timeframe under study (Figure S7). This result may be conservative for two reasons. First, we do not consider an efficacy in transmission or protection from infection. Second, priority is given to 65+ whereas vaccination is currently being rolled out in the 75+ age class in the timeframe under study, characterized by a higher hospitalization rate. As our model does not break down further age classes above 65 years of age, vaccination cannot account for the higher advantage in targeting older age classes.

![Figure S7](image)

**Figure S7.** Impact of vaccination on the projected weekly hospitalizations due to SARS-CoV-2 historical strain and B.1.1.7 variant. Solid line refers to the estimated scenario for France with 50% increase in transmissibility of the B.1.1.7 variant, without vaccination (as in first row, central panel of Figure 1). Dotted line refers to the same scenario, with the introduction of vaccines. Rhythm of vaccination from w04 is 100,000 doses administered per day (left) and 200,000 doses administered per day (right). Dots correspond to weekly hospitalization data used for fitting the model. The shaded area around the curve corresponds to the 95% confidence interval; it is shown only for the scenario without vaccination, for the sake of visualization.

5. References

1. Santé publique France. COVID-19 : point épidémiologique du 28 janvier 2021. https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-et-infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-point-epidemiologique-du-28-janvier-2021.

2. Santé publique France. COVID-19 : point épidémiologique du 4 février 2021. https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-et-infections-respiratoires/infection-a-coronavirus/documents/bulletin-national/covid-19-point-epidemiologique-du-4-fevrier-2021.

3. Lavezzo, E. et al. Suppression of a SARS-CoV-2 outbreak in the Italian municipality of Vo’. *Nature* **584**, 425–429 (2020).
4. Riccardo, F. et al. Epidemiological characteristics of COVID-19 cases and estimates of the reproductive numbers 1 month into the epidemic, Italy, 28 January to 31 March 2020. Eurosurveillance 25, 2000790 (2020).
5. Salje, H. et al. Estimating the burden of SARS-CoV-2 in France. Science 369, 208–211 (2020).
6. Verity, R. et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. Lancet Infect. Dis. 20, 669–677 (2020).
7. Li, R. et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). Science 368, 489 (2020).
8. Zhang, J. et al. Changes in contact patterns shape the dynamics of the COVID-19 outbreak in China. Science 368, 1481–1486 (2020).
9. Davies, N. G. et al. Age-dependent effects in the transmission and control of COVID-19 epidemics. Nat. Med. 26, 1205–1211 (2020).
10. Zimmermann, P. & Curtis, N. Coronavirus Infections in Children Including COVID-19: An Overview of the Epidemiology, Clinical Features, Diagnosis, Treatment and Prevention Options in Children. Pediatr. Infect. Dis. J. 39, 355–368 (2020).
11. Jiehao, C. et al. A Case Series of children with 2019 novel coronavirus infection: clinical and epidemiological features. Clin. Infect. Dis. 71, 1547–1551 (2020).
12. Fontanet, A. et al. SARS-CoV-2 infection in primary schools in northern France: A retrospective cohort study in an area of high transmission. medRxiv http://medrxiv.org/lookup/doi/10.1101/2020.06.25.20140178 (2020).
13. Fontanet, A. et al. Cluster of COVID-19 in northern France: A retrospective closed cohort study. medRxiv https://www.medrxiv.org/content/10.1101/2020.04.18.20071134v1 (2020).
14. Van Kerckhove, K., Hens, N., Edmunds, W. J. & Eames, K. T. D. The impact of illness on social networks: implications for transmission and control of influenza. Am. J. Epidemiol. 178, 1655–1662 (2013).
15. Pullano, G. et al. Underdetection of cases of COVID-19 in France threatens epidemic control. Nature 590, 134–139 (2021).
16. Davies, N. G. et al. Estimated transmissibility and severity of novel SARS-CoV-2 Variant of Concern 202012/01 in England. medRxiv (2020) doi:10.1101/2020.12.24.20248822.
17. Volz, E. et al. Transmission of SARS-CoV-2 Lineage B.1.1.7 in England: Insights from linking epidemiological and genetic data. medRxiv 2020.12.30.20249034 (2021) doi:10.1101/2020.12.30.20249034.
18. Ministère de l’Éducation Nationale de la Jeunesse et des Sports. Déconfinement phase 2 : point de situation au 28 mai. Ministère de l’Éducation Nationale et de la Jeunesse https://www.education.gouv.fr/deconfinement-phase-2-point-de-situation-au-28-mai-303813.
19. Google.com. COVID-19 Community Mobility Report. COVID-19 Community Mobility Report https://www.google.com/covid19/mobility?hl=fr.
20. Santé publique France. COVID-19: une enquête pour suivre l’évolution des comportements et de la santé mentale pendant l’épidémie. https://www.santepubliquefrance.fr/etudes-et-enquetes/covid-19-une-enquete-pour-suivre-l-evolution-des-comportements-et-de-la-sante-mentale-pendant-l-epidemie.
21. Di Domenico, L., Pullano, G., Sabbatini, C. E., Boëlle, P.-Y. & Colizza, V. Modelling safe protocols for reopening schools during the COVID-19 pandemic in France. Nat. Commun. (2021) doi:10.1101/2020.05.08.20095521.