The potential impact of delta variant of SARS-CoV-2 in the context of limited vaccination coverage and increasing social mixing in Bogotá, Colombia

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Abstract

Background: More than 122,000 COVID-19 associated deaths have been reported in Colombia and about 27,000 in the city of Bogotá by the first week of August, with vaccination coverage in the city at 30% for complete schemes and at 37% for partial vaccination. As the incidence of cases currently decreases, questions remain about the potential impact of the delta variant already present in the city.

Methods: We used an agent-based model calibrated to data on age-structured deaths and dominance of variants in Bogotá. We used efficacy data for the portfolio of vaccines available, including known changes for SARS-CoV-2 variants. We modelled scenarios of early and delayed introduction of the delta variant in the city along with changes in mobility and social contact, and vaccine strategies over the next months.

Findings: We estimate that by mid July, vaccination may have already prevented 17,800 (95% CrI: 16,000 - 19,000) deaths in Bogotá. The delta variant could become dominant and lead to a fourth wave later in the year, but its timing will depend on the date of introduction, social mixing patterns, and vaccination strategy. In all scenarios, higher social mixing is associated with a fourth wave of considerable magnitude. If an early delta introduction occurred (dominance by mid July), a new wave may occur in August/September and in such case, age prioritization of vaccination and second dose not postponed are more important. However, if introduction occurred one or two months later (dominance by mid August/September) the age-prioritization is less relevant but maintaining the dose scheme without postponement is more important. In all scenarios we found that increasing the vaccination rate from the current average of 50,000/day to 100,000/day reduces the impact of a fourth wave due to the delta variant.

Conclusions: In Bogotá, the delta variant could still lead to a fourth wave, whose magnitude would depend on its introduction time and the level of social mixing. Its impact can be mitigated by increasing vaccination rates to achieve high coverage quickly, with non-delayed second doses. We found that, at this point, suspending the age prioritization to achieve higher coverage with first doses does not seem to have a major effect on deaths and ICU demand. But, delaying the second dose may not be beneficial and may even increase the incidence of severe outcomes.
Introduction

In Colombia, by the beginning of August 2021, 4.8 million COVID-19 cases and 122,000 deaths due to COVID-19 had been reported [1]. Bogotá contributes to close to 30% of the cases in the country, with 1.4 million reported by the first week of August [2]. The third wave of the epidemic in the country surpassed the magnitude of the previous two, and overwhelmed the capacity of the health system.

Vaccination against COVID-19 initiated in the country on February 17, 2021 with various vaccines introduced progressively (CoronaVac/Sinovac, Pfizer-BioNTech BNT162b2, Oxford/AstraZeneca (AZD1222), Janssen (J&J) Ad26.COV2.S, and more recently Moderna mRNA-1273). The Ministry of Health defined a prioritization strategy that started with health care workers, and then in the general population beginning with the older age groups and those with comorbidities [3]. By the beginning of August, 32% of the total population of Colombia had received at least one dose and about 25% had a complete scheme [3,4]. In Bogotá, 5.3 million doses have been administered, with 38% of the population having received at least one dose, and close to 30% a completed vaccination scheme. Under the age-prioritization strategy, the country has started to vaccinate those above 25 years [5].

Various SARS-CoV-2 variants have been reported in Colombia. The alpha variant (B.1.1.7) was first reported on April 16, 2021, and the gamma variant (P.1) on January 29, 2021. In addition, several regions in Colombia have reported since the beginning of January the B.1.621 variant, which then became dominant during the third wave of COVID-19 [6]. The delta variant (B.1.716.2) was reported on July 26, 2021. This VOC has overtaken as dominant in various countries in Latinamerica such as Brazil, Mexico, and Costa Rica [7]. Delta has been described in the United Kingdom as 1.5 times more transmissible than alpha, with increased severity, and able to partially escape the effect of vaccines [8,9]. Given the characteristics of delta, it is important to quantify its potential impact if it becomes the dominant variant in Bogotá.

We used a detailed agent-based model of the epidemic in Bogotá to explore the impact of multiple circulating variants, including delta. We also studied the impact of changing social mixing patterns in the city and different vaccination strategies.
Results

Model calibration until third wave

The model was calibrated to daily reported deaths and seroprevalence data in Bogotá. Using preliminary data on variants dominance in the city, observed mobility, and vaccination coverage, we reproduced the daily trends of deaths, as well as the effective reproduction number and daily intensive care unit (ICU) beds demand in the city (Fig 1, Fig S4). Although the third wave has been the largest in the city, and the model shows an attack rate over 80% in the city by July, our simulations show that the vaccination program already had a large impact on the peak and total number of deaths. Up to mid July, 2021, we estimate a total of 17,800 (95% CrI: 16,000 - 19,000) deaths averted by vaccination (Fig 1).

The model results suggest that the third wave of infections was caused mainly by the B.1.621 followed by the gamma variant (Fig S3). We estimated that the B.1.621 variant is likely to be 1.2 (1.2 -1.98) times more transmissible and able to evade immunity from previous infections at 37% (19% - 48%), compared to the original lineages. We estimated the potential early introduction of the alpha variant in Bogotá to be around November 2020, followed by the introduction of gamma early in January, 2021 (Fig S2), whereas the appearance of B.1.621 may have occurred later in the month [6]. Based on this framework, our baseline scenario assumed that importations from the delta variant may have started in Bogotá since May, 2021 (Fig S2), but in such a case, delta would not become dominant before August (Fig S3). Calibrated parameters are listed in Table S1.
Fig 1. Model calibration and validation until third SARS-CoV-2 wave in Bogotá, Colombia. Panel A shows the daily number of deaths in the city, panel B shows the estimated infection attack rate, panel C shows the effective reproductive number, and panel D shows the daily demand for intensive care unit beds (ICU) due to COVID-19. In all panels, black lines show the calibrated model and red color the data. The gray lines show the dynamics of an alternative scenario without vaccines.

Model future projections

The baseline model assumes that the delta variant has already been introduced in the city but it is still not dominant. Projections show a fourth wave of COVID-19 in the city due to the delta variant, however its magnitude may depend on the date of introduction of delta, the social mixing patterns, and the vaccination coverage achieved at the time of dominance (Fig 2).

Our model results show a magnitude of a fourth wave of COVID-19 in Bogotá would depend on the intensity of social mixing over the coming months. The current level of social mixing assumes a moderate-high level of mobility with a moderate level of contacts, while the scenario of higher social mixing assumes an increase in the number of contacts per person, in the community overall, in addition to high levels of mobility. In all scenarios, higher social mixing increased the projected number of deaths and ICU demand in the context of a dominant delta...
variant (Fig 2). With high social mixing, an early introduction of delta would result in a peak of 189 (95% CrI: 160-245) daily deaths, whereas a late introduction would cause a peak of 130 (95% CrI: 116 - 180). In both scenarios of the timing of delta, reduced social mixing resulted in a smaller peak. With moderate social mixing, an early introduction of delta would result in a peak of 104 (95% CrI: 77-150) daily deaths, compared to 59 (95% CrI: 47-136) daily deaths in the scenario of late introduction of delta.

Another driver of the potential magnitude of the fourth wave is the vaccination coverage achieved by the time delta is dominant. In scenarios of an early introduction of delta (dominance in August), our simulations showed that a new wave may occur in August/September, and in such case, changes in the vaccination strategies would have a small effect in the dynamics of the fourth wave. Nonetheless, increasing the vaccination rate to 100,000 vaccines/day could slightly reduce the impact on deaths and ICU demand if age continues to be prioritized and intervals between doses are not postponed to 84 days. Postponing the dose interval to 84 days resulted in an increased number of deaths in this scenario, even with higher vaccination rates (Fig 3 & S5, left column). In the scenario in which delta introduction occurs two months later (dominance in October), the age-prioritization for adults is less relevant but maintaining the dose scheme without postponement is more important. In this scenario, we found that increasing the vaccination rate to 100,000/day (the maximum possible according to health authorities) could have a larger impact in reducing the burden of a fourth wave due to the delta variant. These findings remain similar even if assuming that efficacy against infection is 100% of the efficacy against symptoms (Figs S6 & S7).
Fig 2. Projections of potential impact of delta variant on a fourth SARS-CoV wave in Bogotá, according to timing of delta introduction and social mixing patterns. Columns show the timing of delta introduction, defined as early (calibrated), 30+ delta (delayed 30 days), and 60+ delta (delayed 60 days). Panels A-C show the daily number of deaths, panels D-F show the daily demand for ICU beds, panels G-I show the cumulative number of deaths from August to November, and panels J-L show the cumulative number of ICU beds in the city from August to November. Dark blue lines show a scenario of high mobility and high contacts, and light blue lines indicate the current estimated levels of mobility and contacts in the city. The red lines (right axis) represent the coverage of vaccination in proportion to the total population.
Fig 3. Projections of potential impact of delta variant on a fourth SARS-CoV-2 wave in Bogotá, according to timing of delta introduction, level of social mixing, and vaccination strategies. Columns show the timing of delta introduction, defined as early (calibrated), 30+ delta (delayed 30 days), and 60+ delta (delayed 60 days). Panels A-C show the daily number of deaths under a scenario of high social mixing, panels D-F show the daily number of deaths under a scenario of moderate social mixing, panels G-J show the difference in the cumulative number of deaths between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with high social mixing, and panels J-L show the difference in the cumulative number of deaths between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with moderate social mixing. Black line shows the baseline scenario of mobility and current vaccination strategy. Dashed lines show the impact of increasing the interval between Pfizer vaccine doses to 84 days. Blue colors show the impact of increased vaccination rates (100,000/day) without age priority. Green colors show the impact of increased vaccination rates (100,000/day) with age priority. Gray colors show the impact of baseline vaccination rates without age priority.
Discussion

We simulated the impact of the introduction of the delta variant with an agent-based model that includes a detailed representation of the population of Bogotá by age, geographic location, and main social activities and mobility patterns (schools, universities, workplaces, long-term care facilities, households, and neighborhoods). This model has been previously validated to COVID-19 dynamics in various places [10,11]. We found that the increased number of cases and deaths during the third wave of COVID-19 in the city could be explained by a combination of higher mobility and social contacts, along with the presence of variants of concern or interest, in particular gamma may explain the first part, and B.1.621 the second part of the third wave. B.1.621 may have overcome the gamma variant as dominant despite being potentially introduced at similar times. Interestingly, we found that the alpha variant was not a driver of the third wave. Despite an estimated high infection attack rate in the city, our model suggests that there is still a risk of an additional fourth wave produced by the delta variant, whose amplitude would depend on the timing of introduction of delta, the vaccination coverage and strategy, and the level of social mixing over the next months.

We evaluated the potential impact of postponing the second dose on the potential future dynamics of COVID-19 in the city. We found that in our context this may not contribute to reducing the impact of a fourth wave, in contrast to previous modeling analyses that have shown benefits at the population level [12,13]. However, those studies have been evaluated for non-delta variants. Also, the benefits of second dose postponement is still under debate [14,15]. Furthermore, some studies have suggested that postponing the second dose may be related with more stronger and durable immune protection [16,17]. However, even if this holds, postponement of second dose would result in less protection at the individual level for those with incomplete vaccination scheme under the imminence of the presence of delta variant that may result in higher impact at the population level. Indeed, recent studies indicate that the effectiveness of the first dose of the Pfizer-BioNTech BNT162b2 and the Oxford/AstraZeneca (AZD1222) vaccines considerably decreases for the delta variant (being around 33%) [8].
We also evaluated the impact of different vaccination roll-out strategies. We found that even if vaccination rates are doubled, under a scenario of early introduction of delta, there might not be enough time to mitigate the impact of a fourth wave. However, if the introduction of delta is delayed or social mixing remains moderate, increasing the vaccination rates may result in a milder fourth wave. Our results suggest that in the context of a delayed presence of delta, a preferred strategy for the city is maintaining moderate levels of social mixing combined with a rapid increase in vaccination rates (even without age prioritization) and administering a second dose without postponement.

Based on vaccination coverage data available and vaccine hesitancy for adults being estimated in population-based surveys at 12.8% [18], our model assumes that about 10% of the target population remains not vaccinated, despite already being eligible. This means that for each target group of the vaccination campaign roll-out plan there is a remaining high-risk population that has not been vaccinated (due to hesitancy or access barriers). Although we did not model strategies to reach these populations, reaching these groups will have the highest impact in reducing severe disease outcomes in a future wave of COVID-19.

**Limitations and strengths**

Our model relies on data to adjust current dynamics and to project hypothetical scenarios of future transmission. Currently, there is scarce data corresponding to dominance of SARS-CoV-2 variants in the city, which may affect our estimates of dominance of variants. Also, our projections rely on our ability to project future social mixing patterns, which has proved challenging. For these reasons, we have considered scenarios of moderate and high social mixing levels over the coming months. Our model also relies on available data on vaccination efficacy or effectiveness against multiple variants. However, for some of them, there is still considerable uncertainty. These include, for instance, the effectiveness of CoronaVac/Sinovac vaccine against the delta variant, and of all the vaccines against the B.1.621 variant. Moreover, our model has not considered data on waning immunity over time. Further work may also include estimates of the potential impact of boosters, particularly in high-risk populations. Also, we did not include the potential effect of milder disease in breakthrough infections and reinfections due to T-cell response.
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Methods

Data

Time-varying trends of cases and deaths were obtained from public data sources [19]. We used the daily number of deaths reported in Bogotá as of mid-July 2021, population based seroprevalence data as of Nov, 2020 (based on anti-SARS CoV-2 IgG) [20], and available prevalence data on variants over the third wave in Bogotá based on 120 samples from the epidemiological weeks 12 to 22 [21] to calibrate the model parameters. To represent changes in mobility, we used Google Mobility Reports [22] and Grandata project [23], both freely available online. Data on vaccination were obtained from datasets available online from the Ministry of Health [24](Fig S1). We obtained daily ICU bed demand from the Secretary of Health of Bogotá. Other data sources to create the synthetic population were obtained from official population projections by age for 2021[25], IPUMS-International [26] and the Secretary of Education of Bogotá.

Model

We extended a previous version of our SARS-CoV-2 Bogotá model [10] to include the potential effect of vaccination and variants. Our agent-based model simulates transmission of SARS-CoV-2 based on daily activity patterns of a synthetic population, representing demographic and geographic characteristics of the total population of Bogotá. Social mixing was considered in the
model assuming two ways to increase contacts: mobility and average number of contacts.

Mobility in the model represents the proportion of people who leave their household to participate in other activities, such as school or work. Community contacts are included in the model as an average number of contacts that an individual has in the community, given that the individual leaves the household. For instance, both mobility and community contacts may increase in holidays.

We calibrated the model in a two-step fashion. First, we fitted parameters related to transmission of the original lineage of the virus by contrasting the model outputs to daily incidence of deaths reported from March 2020 to December 2021. Then, drawing from this calibrated distribution of parameters, we fitted parameters related to the transmissibility, immunity escape, and introduction of the alpha, gamma, and B.1621 variants. In this step, we calibrated the model parameters to the daily incidence of deaths and the preliminary dominance data obtained from samples for weeks 12 to 22. Finally, the model was validated against the only available population based seroprevalence study (as of Nov 2020 [20]) and daily ICU requests provided by the city’s Secretary of Health. Parameters of the delta variant were assumed as the median value of estimates from other studies [27].

Variants’ parameters and importation

To calibrate the parameters related to transmission and immunity escape for the different variants, we used the ranges reported in the literature (Table 1). The date of introduction of variants was estimated using reported cases from international travelers and the prevalence of variants in their countries of origin [28], as well as the presence of the emerging B.1.621 variant in the country of origin [6]. Hence, the total number of imported infections from variant ‘v’ can be estimated as

\[ N_v(t) = f_v \times N(t) \times (\sum_c D_v(c, t) \times P_c), \]

where \( N(t) \) is the total imports detected in the city for time ‘t’; \( D_v(c, t) \) is the dominance of variant ‘v’ in country ‘c’ at time ‘t’ as reported at [21] as of June 30th, 2021; \( P_c \) is the overall
proportion of importations detected in the city from country ‘c’; and $f_p$ is a scaling factor estimated using daily deaths and dominance data from sequenced samples.

Table 1. Parameter bounds for characteristics of variants included in the calibration.

| Variant       | Transmission | Escape   | Date first reported | Source |
|---------------|--------------|----------|---------------------|--------|
| Alpha (B.1.1.7) | 1.5          | 0.00 - 0.05 | 2021-03-10          | [29]   |
| Gamma (P.1)   | 1.7 - 2.4    | 0.21 - 0.46 | 2021-03-24          | [30]   |
| Delta (B.1.617.2) | 2.10 - 2.46 | 0.10 - 0.55 | 2021-07-26          | [27]   |
| B.1621        | 1.0 - 2.0    | 0.0 - 0.5  | 2021-03-14          | Used for estimation |

Vaccination

Vaccination parameters
We included four vaccines currently used in Colombia, namely, Oxford/AstraZeneca (AZD1222), Pfizer-BioNTech BNT162b2, CoronaVac/Sinovac, and Janssen (J&J) Ad26.COV2.S. We used vaccine efficacy as reported from the clinical trials, except when the trial had not enough power to report efficacy (i.e. severe disease, death) or estimates were not available, in which case, results from observational studies were used. The point estimate and confidence intervals for the protection against symptomatic, and severe disease are listed in Table S1.

We considered that the protective effect of vaccines starts after a period that can vary between 7 and 15 days after the first or second dose according to what is reported for each vaccine (Refs in Table S1). We assumed that vaccines have some level of protection against infection. Given the uncertainty in this regard, in our main analyses we assumed that protection against infection is 50% of that reported for symptomatic disease. We also considered an alternative scenario of efficacy against infection being 100% of the efficacy against symptomatic disease. The arrival of each type of vaccine and the maximum number of vaccines delivered each day were determined by the vaccination delivery reports by the country’s Ministry of Health [24], as shown in Fig S1.
To project the future delivery of vaccines, we assumed constant availability with the proportion of vaccine types determined by the current one. In terms of the daily capacity of vaccine administration, we assumed that the current daily vaccination rates would remain until the target population is completely vaccinated. We also assume a probability of vaccine uptake of 90%.

**Simulation scenarios**

We assessed the potential impact of delta variant introduction in the city by calibrating the transmission model to current patterns and projecting the number of deaths and the demand for ICU beds, from August to November 2021. The baseline scenario used the calibrated parameters for alpha, gamma, and B.1.621. For delta, we assumed the median value of studies reported in the literature [29,30]. The scaling factor of imports of delta was assumed to be a middle point similar to values calibrated to the alpha and gamma variants.

We simulated a set of scenarios to calculate the impact of mobility and the timing of the introduction of the delta variant. To evaluate the potential impact of mobility and contacts on the future dynamics of COVID-19 due to the delta variant, we simulated two different scenarios of mobility and contacts. The baseline scenario assumed the current levels of mobility and moderate contacts. We also considered a scenario of high mobility and high contacts, which assumed that contacts increased to the levels observed during December 2020. We evaluated two additional scenarios for the timing of the introduction of the delta variant: 30 or 60 days later than our baseline estimates.

We simulated alternative scenarios of vaccination considering: the increase in the vaccination capacity to 100,000 vaccines per day, a delivery with no age-based prioritization for future administration in contrast with the current age-prioritized strategy, and the postponing of the second dose of the Pfizer BioNTech’s BNT162b2 mRNA vaccine (from 21 to 84 days). We calculated the effect of these administration strategies on the cumulative number of deaths and ICU beds required from August 1st to November 1st, 2021, and the differences with the baseline scenario.
## Supplementary material

### Table S1. Parameter values for vaccine efficacy

| Variant       | Vaccine                      | Efficacy against Symptomatic Disease | Efficacy against Severe Disease | Ref            |
|---------------|------------------------------|--------------------------------------|---------------------------------|----------------|
|               |                              | One dose | Two doses | One dose | Two doses |                        |
| Pre-delta     | Oxford/AstraZeneca (AZD1222) | No data | 0.78 (0.68, 0.85) | No data | 0.9 | [31] |
| variants      | CoronaVac/Sinovac            | 0.58 (0.46,0.67) | 0.51 (0.36,0.62) | 0.43 (0.37,0.48) | 0.89 (0.84,0.92) | [32],[33] |
|               | Pfizer-BioNTech BNT162b2     | 0.71 (0.69,0.73) | 0.91 (0.89,0.93) | 0.8 | 0.9 | [31] [34,35] |
|               | Moderna mRNA-1273            | 0.73 (0.70,0.76) | 0.94 (0.89,0.97) | 0.8 | 0.9 | [31] [36] |
|               | Janssen (J&J) Ad26.COV2.S    | 0.67 (0.59,0.73) | - | 0.93 (0.73,0.99) | - | [37] |
| Delta variant | Oxford/AstraZeneca (AZD1222) | 0.3 (0.24, 0.35) | 0.67 (0.61,0.72) | 0.71 (0.51,0.83) | 0.92 (0.75-0.97) | [8] [38] |
|               | CoronaVac/Sinovac            | 0.46 (0.37-0.54) | 0.41 (0.21,0.50) | 0.43 (0.37,0.48) | 0.89 * (0.84,0.92) | Inferred from [39] and [40] |
|               | Pfizer-BioNTech BNT162b2     | 0.36 (0.23-0.46) | 0.88 (0.85-0.90) | 0.94 (0.46-0.99) | 0.96 (0.86-0.99) | [8] [38] |
|               | Moderna mRNA-1273            | 0.36 (0.23-0.46) | 0.88 (0.85-0.90) | 0.94 (0.46-0.99) | 0.96 (0.86-0.99) | Assumed from [8] [38] |
| Janssen (J&J) Ad26.COV2.S | 0.60 (0.51, 0.63) | - | 0.93 (0.73, 0.99) | - | Inferred from [39] and [40] |

*Situations where there is no clinical trial and so effectiveness data was used

** Situations where either efficacy or effectiveness data are not available and so values were inferred based on model by [39] and [40]
Table S2. Calibrated parameters.

| Parameter                                           | Value                      | Source  |
|-----------------------------------------------------|----------------------------|---------|
| Transmissibility                                    | 0.37                       | Calibrated |
| Alpha transmissibility compared to original         | 1.5                        | [29]    |
| Gamma transmissibility compared to original lineages| 2.0 (95% CrI: 1.1 - 2.2)    | Calibrated |
| B.1.621 transmissibility compared to original lineages| 1.23                       | Calibrated |
| Delta transmissibility compared to original         | 2.1                        | Assumed |
| Alpha immunity escape                               | 0.089 (95% CrI: 0.086 - 0.094) | Calibrated |
| Gamma immunity escape                               | 0.27 (95% CrI: 0.26 - 0.29)  | Calibrated |
| B.1.621                                             | 0.45 (95% CrI: 0.19 - 0.45)  | Calibrated |
| Delta immunity escape                               | 0.3                        | Assumed |
| Alpha importations scaling factor                   | 5.9 (95% CrI: 2.9-8)        | Calibrated |
| Gamma importations scaling factor                   | 6 (95% CrI: 5.9 - 9.35)     | Calibrated |
| B.1.621 Bogotá importation day                      | 2021/01/24 (2021/01/04 - 2021/02/17) | Calibrated |
| Delta importations scaling factor                   | 5                          | Assumed |
| Facemask adherence                                  | 0.71                       | Calibrated |
**Fig S1. Vaccine stock and coverage in Bogotá.** Panel A shows the arrival of vaccines by date and type of vaccine. Panel shows the coverage of fully vaccinated individuals divided by the total population of the city. Panel C shows daily vaccines administered in the model (gray) and data (red).
Fig S2. Importation of SARS-CoV-2 infections to Bogotá by variants and country of origin. Panel A shows the proportion of countries of origin from detected importations in the city of Bogotá, panel B shows a smoothed line of the trend of imports in the city, panel C shows the baseline estimated imports for each variant in the city, and panel D shows the proportion of the imports from each variant, according to prevalence in each country of origin.
Fig S3. Model fit to dominance of variants. Panel A shows the dominance of different variants in the city for the scenario of early introduction of delta, panel B shows the dominance of variants for the scenario of delta 30+ (30 days delayed), and panel C shows the dominance of variants for the scenario of delta 60+ (60 days delayed). Each line shows the dominance of each variant as estimated by the model. Diamonds show the data on dominance from these variants. Date of sample collection calculated as 7 days after infection.
**Fig S4. Model fit to age-specific deaths.** Black lines show the model daily number of deaths, and red dots and lines show the reported daily deaths for each age group.
Fig S5. Projections of potential impact on ICU beds of delta variant on a fourth SARS-CoV-2 wave in Bogotá, according to timing of delta introduction, level of social mixing, and vaccination strategies. Columns show the timing of delta introduction, defined as early (calibrated), 30+ delta (delayed 30 days), and 60+ delta (delayed 60 days). Panels A-C show the daily number of ICU demand under a scenario of high social mixing, panels D-F show the daily number of ICU demand under a scenario of moderate social mixing, panels G-I show the difference in the cumulative number of ICU beds between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with high social mixing, and panels J-L show the difference in the cumulative number of ICU beds between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with moderate social mixing. Black line shows the baseline scenario of mobility and current vaccination strategy. Dashed lines show the impact of increasing the interval between doses to 84 days for the Pfizer vaccine. Blue colors show the impact of increased vaccination rates (100,000/day) without age priority. Green colors show the impact of increased vaccination rates (100,000/day) with age priority. Gray colors show the impact of baseline vaccination rates without age priority.
Fig S6. Projections of potential impact of delta variant on a fourth SARS-CoV-2 wave in Bogotá, according to timing of delta introduction, level of social mixing, and vaccination strategies, under an alternative scenario of VE against infection (100% of VE against symptomatic disease). Columns show the timing of delta introduction, defined as early (calibrated), 30+ delta (delayed 30 days), and 60+ delta (delayed 60 days). Panels A-C show the daily number of deaths under a scenario of high social mixing, panels D-F show the daily number of deaths under a scenario of moderate social mixing, panels G-I show the difference in the cumulative number of deaths between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with high social mixing, and panels J-L show the difference in the cumulative number of deaths between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with moderate social mixing. Black line shows the baseline scenario of mobility and current vaccination strategy. Dashed lines show the impact of increasing the interval between doses to 84 days for the Pfizer vaccine. Blue colors show the impact of increased vaccination rates (100,000/day) without age priority. Green colors show...
the impact of increased vaccination rates (100,000/day) with age priority. Gray colors show the impact of baseline vaccination rates without age priority.

**Fig S7.** Projections of potential impact on ICU beds of delta variant on a fourth SARS-CoV-2 wave in Bogotá, according to timing of delta introduction, level of social mixing, and vaccination strategies, under an alternative scenario of VE against infection (100% of VE against symptoms). Columns show the timing of delta introduction, defined as early (calibrated), 30+ delta (delayed 30 days), and 60+ delta (delayed 60 days). Panels A-C show the daily number of ICU demand under a scenario of high social mixing, panels D-F show the daily number of ICU demand under a scenario of moderate social mixing, panels G-I show the difference in the cumulative number of ICU beds between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with high social mixing, and panels J-L show the difference in the cumulative number of ICU beds between alternative vaccination strategies and the baseline scenario (50 thousand vaccines/day with age prioritization and non-postponed second dose) with moderate social mixing. Black line shows the baseline scenario of mobility and current vaccination strategy. Dashed lines show the impact of increasing the
interval between doses to 84 days for the Pfizer vaccine. Blue colors show the impact of increased vaccination rates (100,000/day) without age priority. Green colors show the impact of increased vaccination rates (100,000/day) with age priority. Gray colors show the impact of baseline vaccination rates without age priority.
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