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SARS-CoV-2 variants and vaccination: Analysis for Brussels Capital Region, Belgium

Modelling results by the SIMID consortium

This document contains model estimates of hospital admissions and ICU load using observational data up to August 20th, 2021, by a stochastic dynamic transmission model for the Brussels Capital Region, Belgium. This analysis is a continuation of our recent modeling work for Belgium, hence we refer to our "Technical Note v20210818" for the details and limitations of the dynamic model. We focus here on the model refinements that we considered to capture the incidence of hospitalizations in the Brussels Capital Region and our latest results. Previous reports are available via simid.be and the covid-en-wetenschap blog.

Preliminary conclusions

- Social mixing and thus risk behaviour still drives the projected burden of disease. An increase of +50% of the behaviour we estimate for August 2021, shows hospital admission levels in line with the projections using the "September 2020" behaviour which would result in a high pressure on hospital capacity (in the Brussels Capital Region).

Model input and assumptions

1. The transmission model we developed for Belgium has been re-calibrated for the Brussels Capital Region on August 20th, 2021, using regional population details and reported hospital admissions. The time-specific Belgian age distribution of hospital admissions is adopted for the regional model. The number of initial cases in 2020 and the introductions of Alpha en Delta VOC are down-scaled in relation to the regional population. The temporal transmission dynamics are re-calibrated from September 2020 onward. General model details and limitations are provided in our Technical Note v20210818.

2. We designed three **social mixing scenarios** to explore the impact of behavioral changes in the coming weeks and months by re-using estimated transmission dynamics from previous stages in the COVID-19 epidemic. This approach aims to re-capture social contact and risk behaviour that originates from adaptive behaviour and measures that were previously in place. The scenarios are not intended as justification to return to or re-introduce a specific set of measures and circumstances from the past. All scenarios start from the social mixing and transmission behaviour we estimated up to August 20th and have a simulation horizon up until December 2021. None of the scenarios include the effect of the introduction of infected cases as a result of international travel.

    - **Scenario A:** We assume no changes in risk behaviour after August 20th, 2021.
    - **Scenario B:** We assume a behavioral shift on September 1st, 2021, in line with an increased risk of +50% with respect to the estimates for August 2021. This behavior is assumed to be maintained until the end of the simulation.
    - **Scenario C:** We assume a behavioral shift on September 1st, 2021, in line with the dynamics we estimated for September, 2020. This behavior is assumed to be maintained until the end of the simulation.

3. **Vaccine uptake** in the model is based on the reported uptake for the Brussels Capital Region by Sciensano, derived from Epistat on August 11th, 2021. For the model projections, we extrapolate the vaccine uptake according to the vaccination rate related to mRNA vaccines in the last 2 weeks for individuals between 12-29y until a 55% 1st dose coverage is reached. For the projected vaccine uptake, the time between 2 mRNA doses is assumed to be 5 weeks. For all individuals of 30 years and older, we fixed the current 1st dose uptake. The vaccine uptake by age group is presented in Figure 2.

Limitations

- **This transmission model is suited for scenario analyses to investigate possible future paths, it is not a prediction model.**
- The (weekly) age distribution of hospitalized patients is derived from the Belgian hospital survey in which patients are only included at hospital discharge. This implies a considerable delay in the availability of up to date information concerning the age distribution of hospitalizations. In addition, we do not account for potential regional differences in the age distribution of hospital admissions.
- We attribute the growth advantage of the VOCs completely to transmissibility, and as such, ignore the potential effect of immune escape.
- This model does not explicitly account for importation by returning travelers which could have a large impact on the evolution of the epidemic. Further work related to this is ongoing. Importantly, an implicit attribution of such cases to local transmission is used instead. Therefore results need to be interpreted with caution.
- We present our modelling results by the mean and pointwise 95% credible interval based on 20 model realizations, which capture stochastic effects and parametric uncertainty. The interplay between these two actors and the presentation of modelling uncertainty is subject of future research.
- This modeling exercise is based on applying a stochastic age-discretized compartmental model to the regional incidence data as mentioned above. However, the model is not spatially explicit, hence, disease transmission does not accommodate (social) interactions/mobility between Belgian regions nor between the region under study and other countries (see previous bullet). Consequently, all (regional) infections are assumed to result from local transmission.
- Modeling of the aforementioned regional incidence data assumes that all hospitalized cases are *home-grown*, i.e. no hospitalized patients are coming from other Belgian regions. However, during the epidemic and especially during the second COVID-19 wave, patients were referred to hospitals outside the region were they reside.

Model results and discussion

Figure 1 present the results of our scenario analyses with respect to social mixing. All projections show large credible intervals and should be interpreted with great caution.

- The quantitative outcomes of the mixing scenarios are highly dependent of the situation on September 1st. If the dynamic model underestimates the transmission in August, the projected peaks are likely an underestimation, and vice versa.
- Qualitatively, we found that the estimated risk behaviour for "September 2020" causes an increase in hospital admissions up to an average of 160 per day. Although the peak height might be similar to October, 2020, this peak would be reached without additional behavioural changes/restrictions, such as in October, 2020. Hence, the result of population immunity is apparent, though challenged by the increased transmissibility and severity of the Delta VOC.
- Social mixing and thus risk behaviour still drives the projected hospital admissions. An increase of +50% of the behaviour we estimate for August, 2021 (Scenario B), is in line with the projections with "September 2020" behaviour. It goes without saying that an increase larger than +50%, e.g. pre-pandemic contact behaviour, would result in even more hospitalisations (admissions and load; ICU and non-ICU).

Contributors to this report **(alphabetically)**

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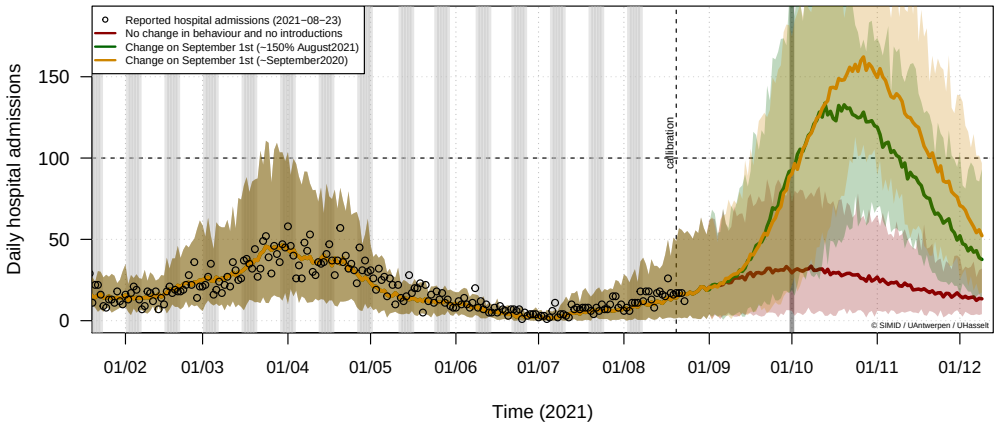
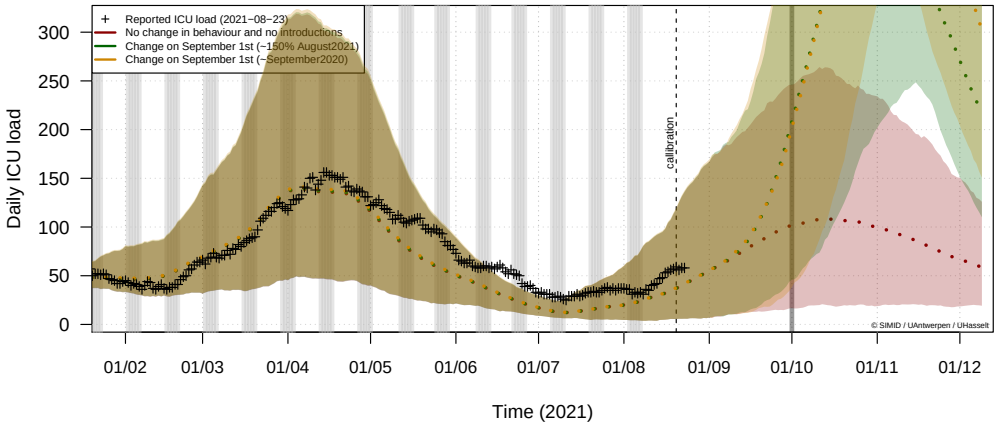
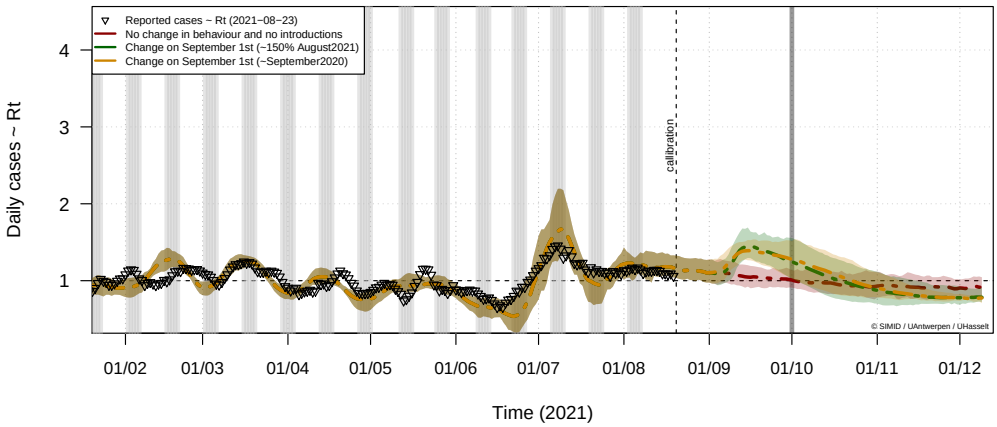


(a) Daily hospital admissions



(b) ICU occupancy



(c) Reproduction number over time (Rt)

Figure 1: Model projections on daily hospital admissions, ICU occupancy and reproduction number for different assumptions on social contact behavior from September 1st, 2021. The results are summarised by the mean (line) and 95% point-wise credible intervals (shaded area) of 20 model runs.

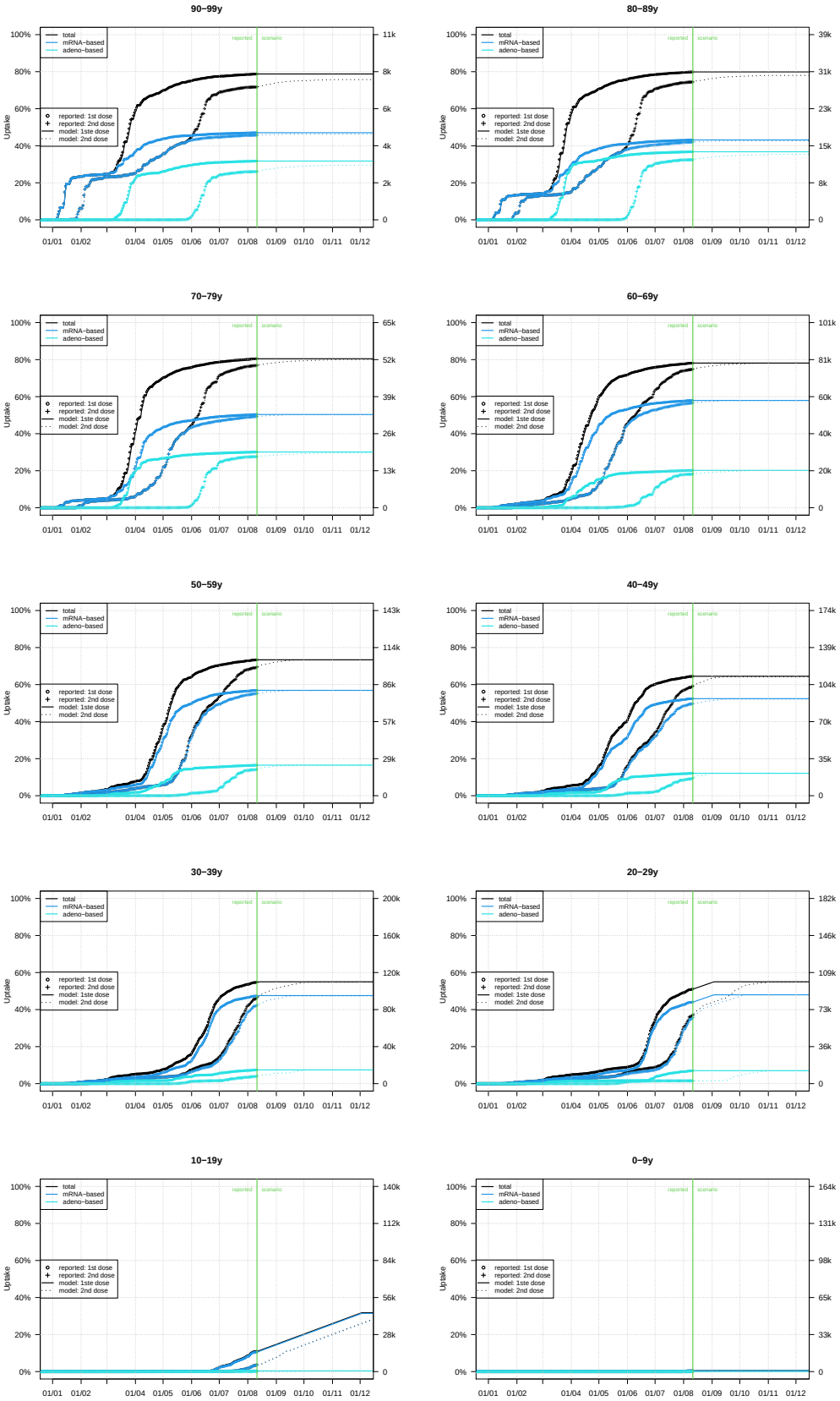


Figure 2: Vaccine uptake by age based on the reported uptake for Brussels on August 11th, 2021.