A Supplementary materials

A.1 Overview of model assumptions and limitations

The following assumptions were made concerning the SEIQRD dynamics:

1. All individuals experience a brief presymptomatic, infectious period.

2. All individuals, including children, are equally susceptible to SARS-CoV-2 infection. It is unlikely that lower susceptibility in children would alter the dominant role of schools in SARS-CoV-2 transmission. During model calibration, a higher effectivity of the contacts in schools (Ω_{schools}) could compensate for the lower susceptibility in children.

3. Asymptomatic and mild cases automatically lead to recovery and in no case to death.

4. Mildly infected and hospitalized individuals cannot infect susceptibles (= *quarantined*). A fraction of individuals experiencing influenza-like illness will not reduce their number of non-household contacts and will thus contribute to disease spread [52]. In our model, this behavior is not accounted for. The model cannot be used to model the effect of transmission to healthcare workers.

5. All deaths come from hospitals, meaning no patients died at home [53].

6. The modeled population is the general population of Belgium and does not explicitly take nursing homes into account. The model is unfit to make predictions on nursing home deaths.

7. Waning of antibody immunity is incorporated in the model as individuals transitioning from the recovered (R) population pool to the susceptible (S) population pool. The incorporation of antibody waning ignores the effects of cellular immunity (through T- and B-cells). More research on the exact kinetics of the immune response is necessary to finetune to the model.

The following assumptions to the hospital dynamics were made:

1. Upon arrival in the hospital, all patients immediately transfer to a cohort ward or an ICU. In real life, a patient may first spend some time in a cohort ward before going to an ICU and this is not accounted for.

2. Residence times in cohort and in ICU differ depending on the outcome of the infection (recovered or deceased).

3. All recovered ICU patients spend some additional time in cohort (recovery and observation stay).

4. Patients in nursing homes were excluded from the analysis of the clinical surveillance dataset. The model can make predictions on hospital deaths in individuals coming from the general population.

5. During the analysis of the hospital surveillance data, the data analysis was not split into several time intervals and hence the temporal changes in hospital residence times and mortalities were neglected. In spite, Faes et al. [41] have reported that the median residence time decreased after the first 2020 COVID-19 wave.

The following assumptions were made in the social contact model:

1. Prepandemic contact matrices by Willem et al. [14] are scaled with mobility reductions extracted from the GCMRs and an effectivity parameter inferred from hospitalization data using a *Markov-Chain Monte-Carlo* method to mimic pandemic social behavior.

2. The GCMRs are not age-stratified and do not correct for a potential underrepresentation of older individuals in the data collection. The GCMRs are a more coarse-grained approach as compared to social-epidemiological contact studies that estimate mixing patterns under lockdown measures [17]. However, setting up a survey-based contact study is a resource and time-intensive endeavor. The advantage of using the GCMRs in our social contact model is their rapid and public availability, making their use appropriate during the early stages of a pandemic when more accurate survey-based contact studies are being set up.

3. The effectivity of the contacts (Ω_x) are bound between zero and one. This implies that if work mobility is reduced to 40 % of its pre-pandemic value, the work contacts can account for no more than 40 % of its pre-pandemic value.

4. There is no link between the effectivity parameters and the mobility reduction. However, when relaxing measures, an increase in mobility will likely be accompanied by an increase in the effectiveness of school contacts. This is due to mentality changes upon relaxation, as measures will gradually be ignored more.

A.2 Overview of model parameters

Table 1: Overview of simulation parameters used in the extended SEIQRD metapopulation model.

Symbol	Parameter	Value	Unit	Reference
$\boldsymbol{a}$	subclinical fraction per age group	[0.98 0.98 0.88 0.69 0.59 0.39 0.13 0.07 0.01] population mean: 0.57	$(-)$	Wu et al. [37]
$\boldsymbol{h}$	fraction of mildly infected individuals requiring hospitalisation	[0.01 0.02 0.02 0.02 0.02 0.05 0.11 0.22 0.57] population mean: 0.08	$(-)$	Inferred
$\boldsymbol{c}$	fraction of hospitalisations not requiring ICU transfer	Table 4, population mean: 0.84	$(-)$	Hospital dataset
d_a	duration of subclinical infection	6.54	days	Inferred
d_m	duration of mild infection	7	days	To et al. [32]
$\boldsymbol{d}_{\text{hosp}}$	average time from symptom onset to hospitalization	Table 6, population mean: 6.4	days	Hospital dataset
$\boldsymbol{d_{C,R}}$	length of cohort stay if recovered	Table 5, population mean: 10.8	days	Hospital dataset
$\boldsymbol{d_{C,D}}$	length of cohort stay if deceased	Table 5, population mean: 11.8	days	Hospital dataset
$\boldsymbol{d}_{\text{ICU},\boldsymbol{R}}$	length of ICU stay if recovered	Table 5, population mean: 12.0	days	Hospital dataset
$\boldsymbol{d}_{\text{ICU},\boldsymbol{D}}$	length of ICU stay if deceased	Table 5, population mean: 15.2	days	Hospital dataset
$\boldsymbol{d}_{\text{ICU,rec}}$	length of recovery and observation stay in cohort after ICU stay	Table 6, population mean: 11.2	days	Hospital dataset
$\boldsymbol{m_C}$	mortality in cohort	Table 4, population mean: 0.17	$(-)$	Hospital dataset
$\boldsymbol{m_{ICU}}$	mortality in ICU	Table 4, population mean: 0.46	$(-)$	Hospital dataset
σ	length of latent period	4.5	days	Computed
ω	length of presymptomatic infectious period	0.7	days	Wei et al. [7], He et al. [29]
$\sigma + \omega$	length of incubation period	5.2	days	Liu et al. [6]
β	probability of infection upon contact with an individual capable of transmitting SARS-CoV-2 under the assumption that the infectee is 100 % susceptible to SARS-CoV-2 infection	0.032	$(-)$	Inferred
$\boldsymbol{T}_0$	total population	[1.31 1.30 1.40 1.50 1.52 1.60 1.35 0.91 0.66]$*$1e6, total population: $11.54 * 1e6$	people	StatBEL [54]
$\boldsymbol{N}_{\text{c}}$	contact matrix	9x9 matrix	days^{-1}	Willem et al. [14]

A.3 Key events

The first lockdown, which started on March 15th, 2020, and lasted until May 4th, 2020 involved the closure of schools, bars, clubs, restaurants, all non-essential shops, and closure of the border to non-essential travel (Table 2). The GCMRs show a 56 % reduction in workplace mobility (Figure 2 and Table 2). Based on surveys from the Belgian National Bank, 28.6 % of all employees were able to work from home, 29.9 % remained in the workplace and 4.4 % worked both from home and in the workplace. 32.4 % were temporary unemployed and 4.8 % were absent [55]. Public transport mobility decreased by 65 %, leisure mobility decreased by 72 %, and grocery & pharmacy mobility was reduced by 26 %. From March 15th, 2020 until May 4th, 2020, mobility remained practically constant at the aforementioned reductions. On May 4th, 2020 the lockdown was gradually lifted by re-opening all non-essential shops and lifting telework restrictions. The effect can be seen in the *Google Community Mobility Reports* (Figure 2), by the end of April, workplace and retail & recreation mobility gradually start increasing. By July 1st, 2020, almost all social measures had been lifted. During the first lockdown, schools remained fully closed until May 18th, 2020, and were only re-opened to a very limited extent before the end of the school year on July 1st, 2020. For this reason, schools are assumed to remain closed during the first COVID-19 wave. During July, there were few social restrictions, and this resulted in new, localized infection clusters. During most of August 2020, a lockdown with a curfew was imposed in Belgium's Antwerp province. We do not attempt to model the hospitalizations during July and August 2020, as modeling localized infection clusters with a nation-level epidemiological model can only be accomplished by severe ad-hoc tweaks in the social contact model. A spatial model extension was developed to better account for such localized phenomena.

During the second lockdown from October 19th, 2020 until the present day (26/02/2021), workplace mobility has been reduced by approximately 25 %. During Autumn break and Christmas holidays, workplace mobility further declined to approximately 45 %. Public transport mobility decreased by 30 % and by 50 % during holidays, leisure mobility decreased by 40-50 % and grocery & pharmacy mobility have decreased by approximately 5-10 %. Primary and secondary schools were closed between October 19th, 2020, and re-opened on November 16th, 2020. Further, schools have been closed during the Christmas holidays from December 18th, 2020 until January 4th, 2021, and were closed during spring break from February 15th, 2021 until February 21th, 2021. Universities have remained fully closed since October 19th, 2020.

During both lockdowns, increases in the categories *residential* and *parks* were observed (Figure 2). These are indicative of decreased mobility, as these suggest increased activity around the home environment. The other four categories are more indicative of general mobility as

they are related to activity around workplaces, retail outlets and use of public transportation [43]. Thus, although the mobility figures indicate people spent more time at home, this does not mean people have more contacts at home (especially under stay-at-home orders). Amplifying the fraction of household contacts under lockdown measures would increase intergenerational mixing of the population under lockdown, which is unrealistic and will lead to overestimations of the hospitalizations. The inability to accurately capture the disease spread in home *bubbles* under lockdown measures is an inherent downside of compartmental epidemiological models. We have thus not scaled the home interaction matrix ($\boldsymbol{N}_{\text{c,home}}$) with the residential mobility from the GCMRs.

Table 2: Dates of key events during the first and second lockdown in Belgium. Google mobility reduction (see Figure 2), computed as the average reduction between one key event and the next.

Date	**Key event**	**Details**	G_{work}	G_{transit}	$G_{\text{r\& r}}$	$G_{\text{g \& p}}$	H_{schools}
First COVID-19 wave (March - July 2020)							
15/03/2020	Lockdown	Closure of schools, bars, clubs and restaurants; Closure of all non-essential shops; Non-essential travel forbidden. [56]	- 56 %	-65 %	-72 %	-26 %	- 100 %
04/05/2020	Lockdown release phase Ia	Re-opening of industry and B2B services. Re-opening of non-essential retail. Merging of two *social bubbles* allowed [57].	- 44 %	-54 %	-57 %	-18 %	- 100 %
11/05/2020	Lockdown release phase Ib	Re-opening of all businesses and shops. Working at home remains the norm where possible.	- 38 %	-45 %	-46 %	-12 %	- 100 %
18/05/2020	Lockdown release phase IIa	Re-opening of businesses that involve the most human-human contact (f.i. hairdressers). Re-opening of schools for graduating classes in elementary and secondary education [58].	- 38 %	-39 %	-39 %	-8 %	- 100 %
04/06/2020	Lockdown release phase III	Re-opening of bars and restaurants. Gatherings up to 10 persons are allowed.	-22 %	-27 %	-15 %	-4 %	- 100 %
01/07/2020	Lockdown release phase IV	Closure of schools for summer holidays. Gatherings of up to 15 persons are allowed.	-32 %	-27 %	-11 %	-8 %	- 100 %
01/08/2020	Antwerp Lockdown	The number of infections starts increasing in Antwerp province, where a second lockdown with curfew is imposed [59].	-28 %	-33 %	-32 %	-6 %	- 100 %
Second COVID-19 wave (September 2020 - present)							
01/09/2020	End of summer holidays	Opening of elementary and secondary schools.	-18 %	-17 %	-14 %	-5 %	- 0 %
19/10/2020	Lockdown	Closure of bars and restaurants; Curfew; Strict social restrictions. [60]	-26 %	-31 %	-39 %	-3 %	- 0 %
02/11/2020	Lockdown	Closure of non-essential stores; Closure of all schools. [61]	-43 %	-48 %	-55 %	-13 %	- 100 %
16/11/2020	Schools reopen	Elementary and secondary schools reopen. Universities remain closed.	-27 %	-37 %	-44 %	-5 %	- 0 %
12/18/2020 - 04/01/2021	Christmas holidays	Elementary and secondary schools close. Decrease in work related mobility.	-45 %	-47 %	-42 %	-4 %	- 100 %
04/01/2021 - 15/02/2021	Period between holidays	Elementary and secondary schools reopen. British variant (501Y.V1) starts spreading [62]. Vaccination campaign in elderly homes starts [63].	-27 %	-38 %	-43 %	-6 %	- 0 %

A.4 Basic reproduction number

Since the system of differential equations (Eq. 1 - Eq. 12), is autonomous, the eigenvalues of the Jacobian matrix evaluated at its hyperbolic equilibrium point can be used to determine the nature of that equilibrium [64]. The basic reproduction number (R_0) is computed as the spectral radius of the Jacobian matrix at the disease-free equilibrium [27]. Our model has seven infected states: $E, I_{\text{presy}}, I_{\text{asy}}, Q_{\text{mild}}, Q_{\text{cohort}}, Q_{\text{ICU}}$ and $Q_{\text{ICU, rec}}$ (Figure 1). At the disease-free equillibrium, the whole population is susceptible to the infectious disease, $S_i = T_i$,

$$\boldsymbol{u}^* = (T_i, 0, 0, 0, 0, 0, 0, 0, 0). \tag{26}$$

The Jacobian $\boldsymbol{J}$ is defined as,

$$\boldsymbol{J} = \begin{bmatrix} \left.\frac{\partial f_1}{\partial x_1}\right|_{\boldsymbol{u}^*} & \cdots & \left.\frac{\partial f_1}{\partial x_n}\right|_{\boldsymbol{u}^*} \\ \vdots & \ddots & \vdots \\ \left.\frac{\partial f_m}{\partial x_1}\right|_{\boldsymbol{u}^*} & \cdots & \left.\frac{\partial f_m}{\partial x_n}\right|_{\boldsymbol{u}^*} \end{bmatrix}, \tag{27}$$

where n and m are equal to the number of infected compartments. Next, the Jacobian is decomposed in the following form,

$$\boldsymbol{J}^* = (\boldsymbol{T} + \boldsymbol{\Sigma})\boldsymbol{J} \ . \tag{28}$$

The matrix $\boldsymbol{T}$ contains all terms that lead to *transmissions* of SARS-CoV-2, while $\boldsymbol{\Sigma}$ contains all terms that lead to *transitions*. For our model,

$$\boldsymbol{T} = \begin{bmatrix} 0 & \beta \sum_{j=1}^{N} N_{c,ij} & \beta \sum_{j=1}^{N} N_{c,ij} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}, \tag{29}$$

where an entry $T_{i,j}$ is the rate at which individuals in infected state j gives rise to individuals in infected state i. And,

$$\boldsymbol{\Sigma} = \begin{bmatrix} -1/\sigma & 0 & 0 & 0 & 0 & 0 & 0 \\ 1/\sigma & -1/\omega & 0 & 0 & 0 & 0 & 0 \\ 0 & a_i/\omega & -1/d_a & 0 & 0 & 0 & 0 \\ 0 & (1-a_i)/\omega & 0 & -(\frac{1-h_i}{d_m} + \frac{h_i}{d_{\text{hosp}}}) & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{c_i h_i}{d_{\text{hosp}}} & -\left(\frac{m_{C,i}}{d_{c,D,i}} + \frac{1-m_{C,i}}{d_{c,R,i}}\right) & 0 & 0 \\ 0 & 0 & 0 & \frac{(1-c_i)h_i}{d_{\text{hosp}}} & 0 & -\left(\frac{m_{\text{ICU},i}}{d_{\text{ICU},D,i}} + \frac{1-m_{\text{ICU},i}}{d_{\text{ICU},R,i}}\right) & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{1-m_{\text{ICU},i}}{d_{\text{ICU},R,i}} & -\frac{1}{d_{\text{ICU,rec,i}}} \end{bmatrix}, \tag{30}$$

where an element $\mathbf{\Sigma}^{-1}_{i,j}$ is the expected time that an individual who presently has state j will spend in state i during its entire epidemiological *life*. The next generation matrix (NGM) is then calculated as,

$$\text{NGM} = -\boldsymbol{T}\boldsymbol{\Sigma}^{-1} \, . \tag{31}$$

The basic reproduction number R_0 is defined as the spectral radius[3] $\boldsymbol{\rho}$ of this matrix [27],

$$R_0 = \boldsymbol{\rho}(-\boldsymbol{T}\boldsymbol{\Sigma}^{-1}) \, , \tag{32}$$

which becomes for our model,

$$R_{0,i} = (a_i d_a + \omega)\beta \sum_{j=1}^{N} N_{c,ij} \, . \tag{33}$$

A linear relationship between the reproduction number and the chance of infection upon contact (β), the number of contacts ($\boldsymbol{N_c}$) and the sum of the durations of infectiousness for those compartments able to infect susceptibles makes sense.

A.5 Time-lagged cross correlation

We extracted the number of laboratory confirmed cases in youths $[0, 20[$, the working population $[20, 60[$ and the senior population $[60, \infty[$ from the *Belgian Scientific Institute of Public Health* (`https://epistat.sciensano.be/Data`) from November 2nd, 2020 to February 1st 2020. We then normalized the timeseries with the number of cases on November 21st, 2020 and visualized the result in Figure 4. Using the Python module *pandas*, the dataseries were shifted with k days and the cross correlation was computed. The procedure was performed for $k \in [-15, 5]$ days, the resulting *cross correlation function* is shown in Figure 8 and the results of the analysis are summarized in Table 3. Next, we constructed a statiscal test to check if the covariance between two series x and y, shifted with the number of days resulting in the maximum covariance, k_{max}, varied significantly from zero. Thus, the null hypothesis is,

$$H_0 : \rho_{xy}(k_{\text{max}}) = 0.0 \, . \tag{34}$$

If the cross correlation of lag k_{max} is zero, then, for a fairly large timeseries consisting of n datapoints, the covariance $\rho_{xy}(k_{\text{max}})$ will be approximately normally distributed, with mean zero and standard deviation $\sigma = \frac{1}{\sqrt{n-|k|}}$. Since approximately 95% of a normal population is within 2 standard deviations of the mean, a test will reject the hypothesis that the cross correlation of lag k equals zero when,

$$|\rho(k)| \geq \frac{2}{\sqrt{n - |k|}} \, . \tag{35}$$

The null hypothesis was rejected for all timeseries.

[3] Largest absolute eigenvalue.

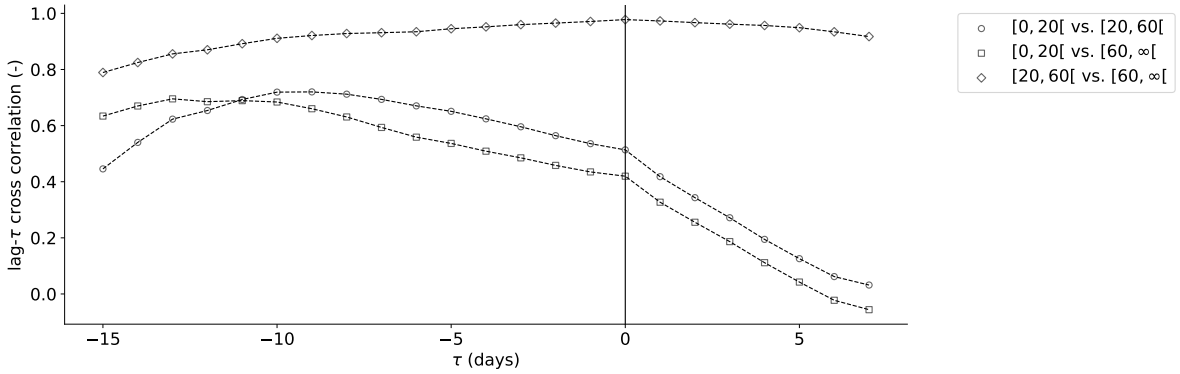

Figure 8: Cross correlation between the number of cases in Belgium in the age groups $[0-20[$, $[20-60[$ and $[60-\infty[$, from November 2nd, 2020 until February 1st 2020 in function of the number of days the timeseries are shifted relative to each other (τ). The maximum cross correlation is obtained when the series $[0-20[$ and $[20-60[$ are shifted -9 days, the maximum cross correlation is obtained when the series $[0-20[$ and $[60-\infty[$ are shifted -13 days, and the maximum cross correlation is obtained when the series $[20-60[$ and $[60-\infty[$ are not shifted.

Table 3: Results of the time-lagged cross-correlation between the number of cases in the age groups $[0-20[$, $[20-60[$ and $[60-\infty[$. Data from November 2nd, 2020 until February 1st 2020 were used in the analysis, which is equal to the daterange range shown in Figure 4.

Age group (years)	**Time-lag (days)**	**Covariance (-)**
$[0-20[$ vs. $[20-60[$	-9	0.72
$[0-20[$ vs. $[60-\infty[$	-13	0.70
$[20-60[$ vs. $[60-\infty[$	0	0.98

A.6 Supplementary data and figures

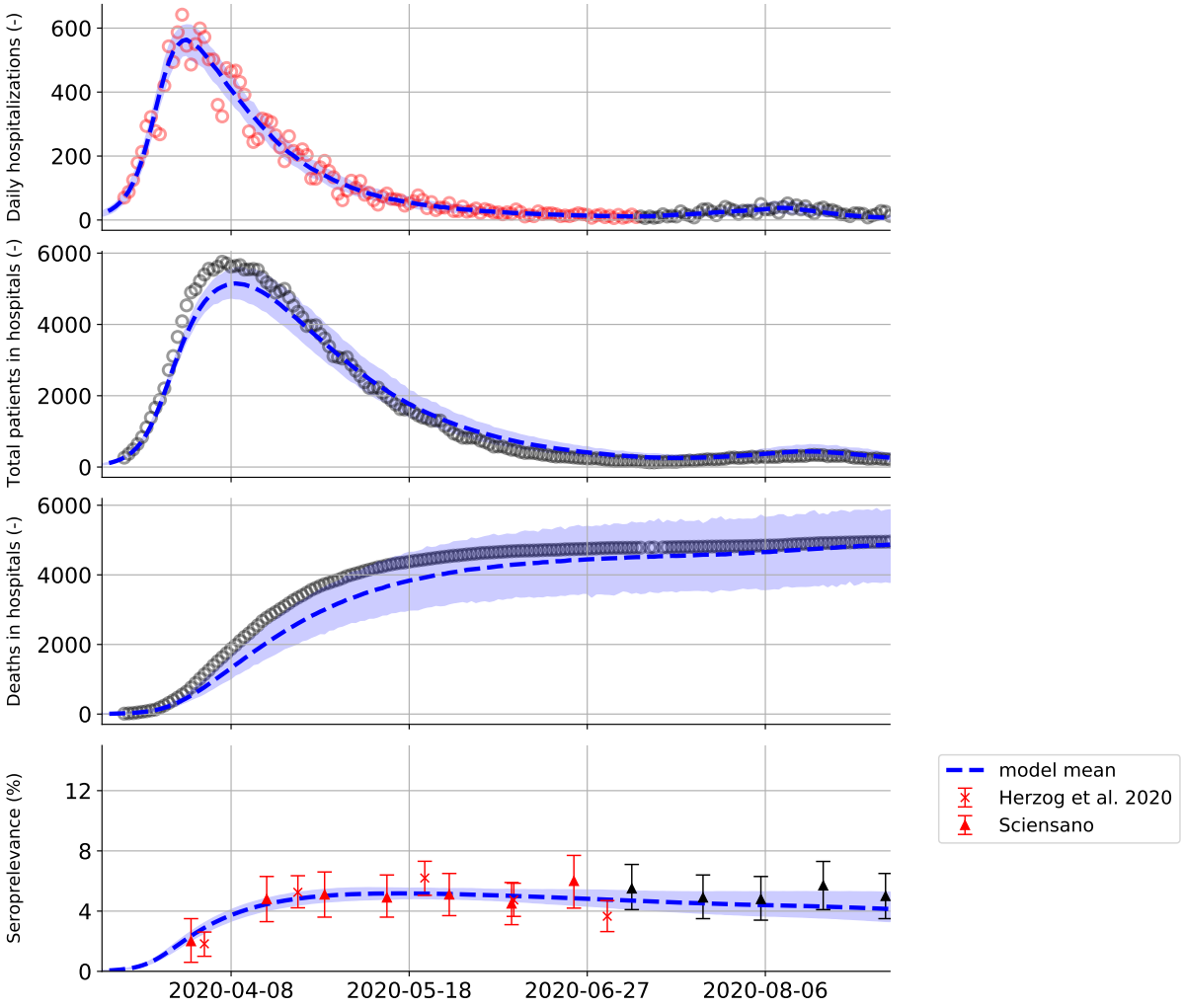

Figure 9: (top to bottom) Model predictions and data during the first COVID-19 wave in Belgium, from March 15th, 2020 until September 1st, 2020: 1) The daily Belgian hospitalizations, 2) the total number of patients in Belgium hospitals, 3) the total number of deceased patients in Belgian hospitals, 4) the seroprelevance in the Belgian population. Mean and 95 % confidence interval of 1000 model realisations. Red datapoints indicate the data was used in the model calibration, black datapoints indicate data was not used in the model calibration. The model is calibrated to the daily Belgian hospitalizations (top), the prediction for the total number of patients in Belgian hospitals and total number of deceased patients in Belgian hospitals are obtained by propagating the age-stratified mortalities ($\boldsymbol{m}_{\mathrm{C}}$ and $\boldsymbol{m}_{\mathrm{ICU}}$), age-stratified distributions between cohort and ICU ($\boldsymbol{c}$) and the residence time distributions derived from the hospital dataset in the model ($\boldsymbol{d}_{\mathrm{C,R}}$, $\boldsymbol{d}_{\mathrm{C,ICU}}$, $\boldsymbol{d}_{\mathrm{ICU,R}}$, $\boldsymbol{d}_{\mathrm{ICU,D}}$) (see Table 4 and 5).

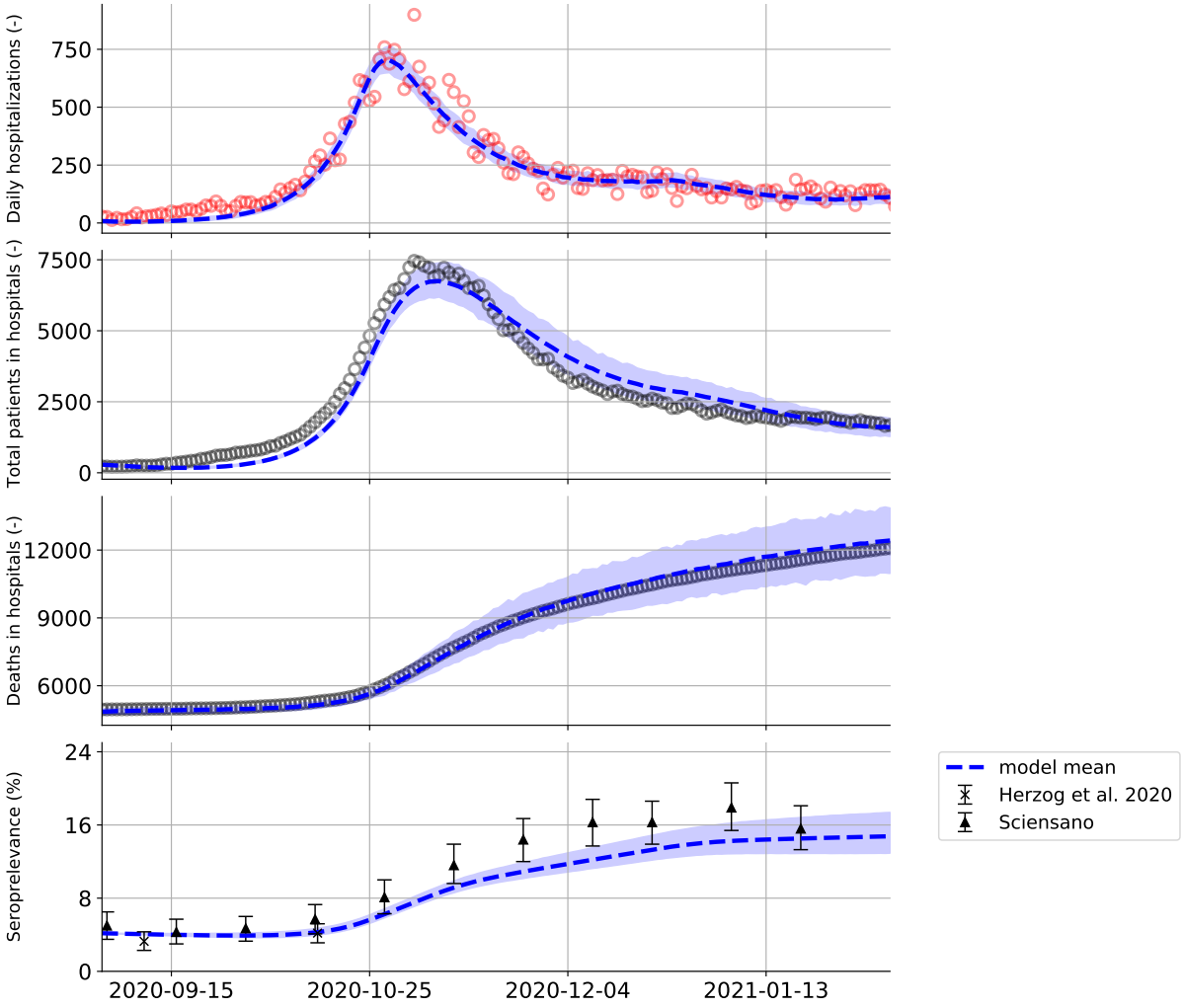

Figure 10: (top to bottom) Model predictions and data during the second COVID-19 wave in Belgium, from September 1st, 2020 until February 1st, 2021: 1) The daily Belgian hospitalizations, 2) the total number of patients in Belgium hospitals, 3) the total number of deceased patients in Belgian hospitals, 4) the seroprelevance in the Belgian population. Mean and 95 % confidence interval of 1000 model realisations. Red datapoints indicate the data was used in the model calibration, black datapoints indicate data was not used in the model calibration. The model is calibrated to the daily Belgian hospitalizations (top), the prediction for the total number of patients in Belgian hospitals and total number of deceased patients in Belgian hospitals are obtained by propagating the age-stratified mortalities ($\boldsymbol{m}_{\mathrm{C}}$ and $\boldsymbol{m}_{\mathrm{ICU}}$), age-stratified distributions between cohort and ICU ($\boldsymbol{c}$) and the residence time distributions derived from the hospital dataset in the model ($\boldsymbol{d}_{\mathrm{C,R}}$, $\boldsymbol{d}_{\mathrm{C,ICU}}$, $\boldsymbol{d}_{\mathrm{ICU,R}}$, $\boldsymbol{d}_{\mathrm{ICU,D}}$) (see Table 4 and 5).

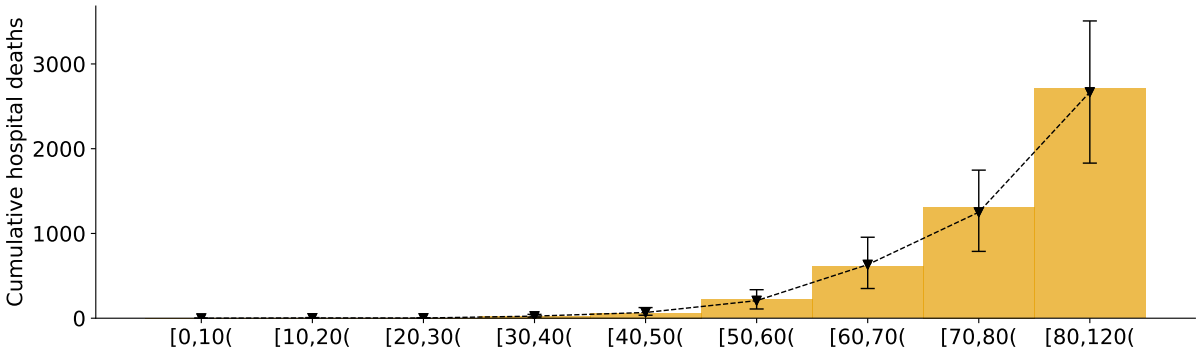

Figure 11: Cumulative deaths in Belgian hospitals per ten-year age strata. For the first Belgian 2020 COVID-19 wave, from March 1st, 2020 until September 1st, 2020. Yellow bars represent the data collected by Sciensano, inverted triangles represent the model prediction mean with 95 % confidence interval.

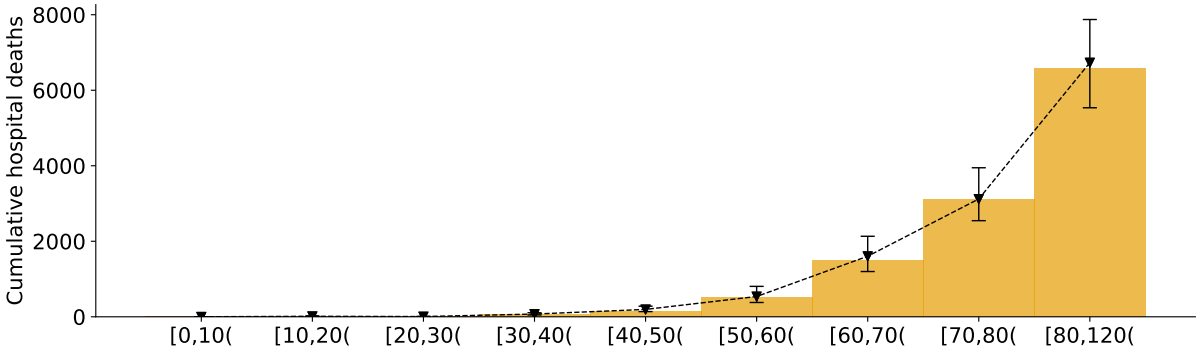

Figure 12: Cumulative deaths in Belgian hospitals per ten-year age strata. For the second Belgian 2020 COVID-19 wave, from September 1st, 2020 until February 1st, 2021. Yellow bars represent the data collected by Sciensano, inverted triangles represent the model prediction mean with 95 % confidence interval.

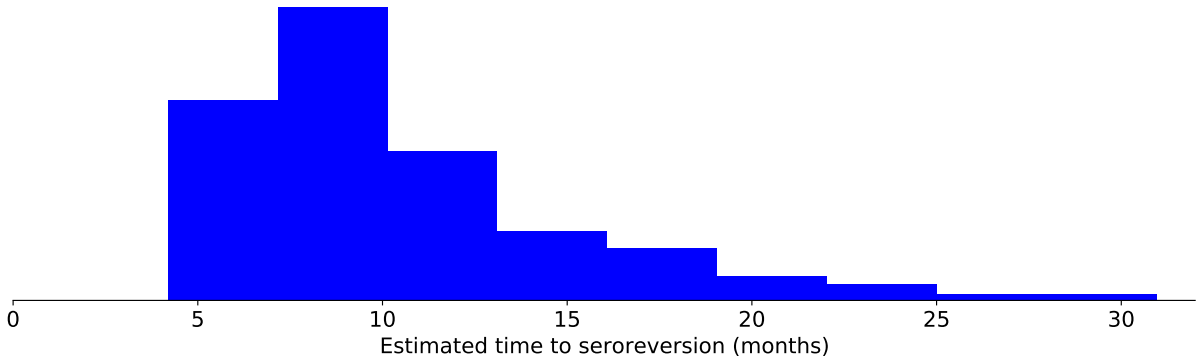

Figure 13: Estimated distribution of the time to seroreversion ($1/\zeta$). The mean time to seroreversion is 9.2 months (IQR: 7.2 months - 12.1 months).

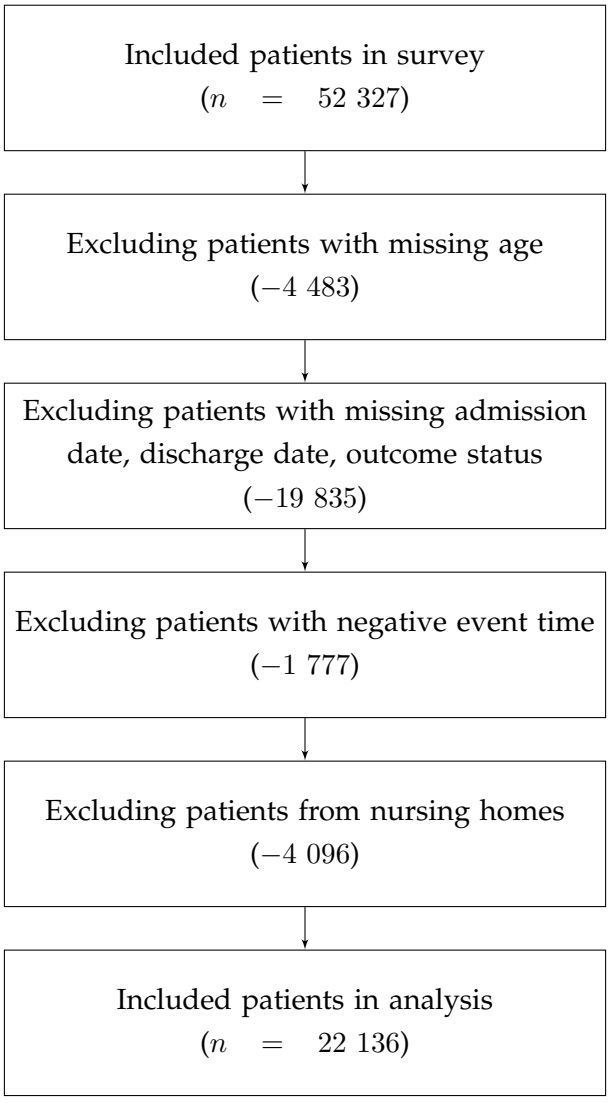

Figure 14: Flow diagram illustrating the number of patient data excluded from the survey and the reason thereof.

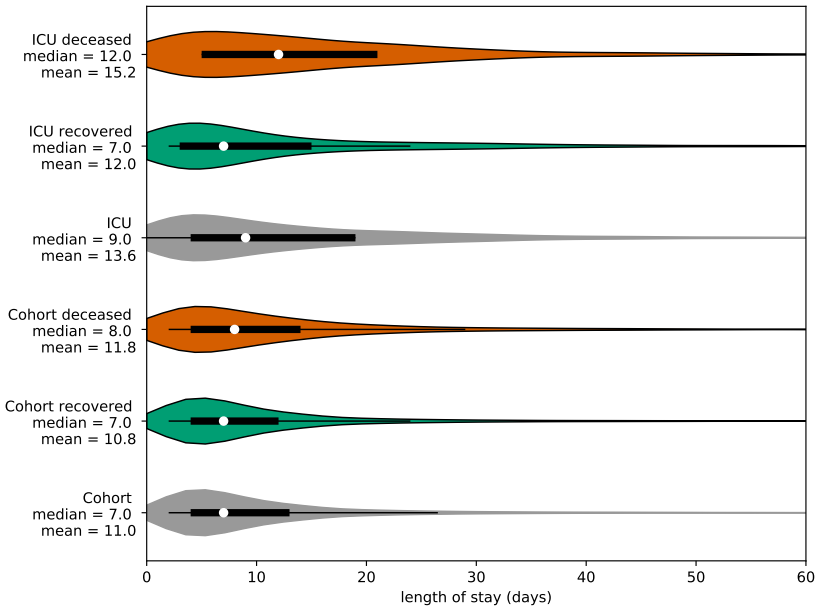

Figure 15: Observations of the length of a hospital stay for patients in cohort and ICU wards. Overall (gray), if recovered (green), if deceased (red). Residence times in cohort are shorter than residence times in ICU. In both wards, recovered patients have longer stays than deceased patients.

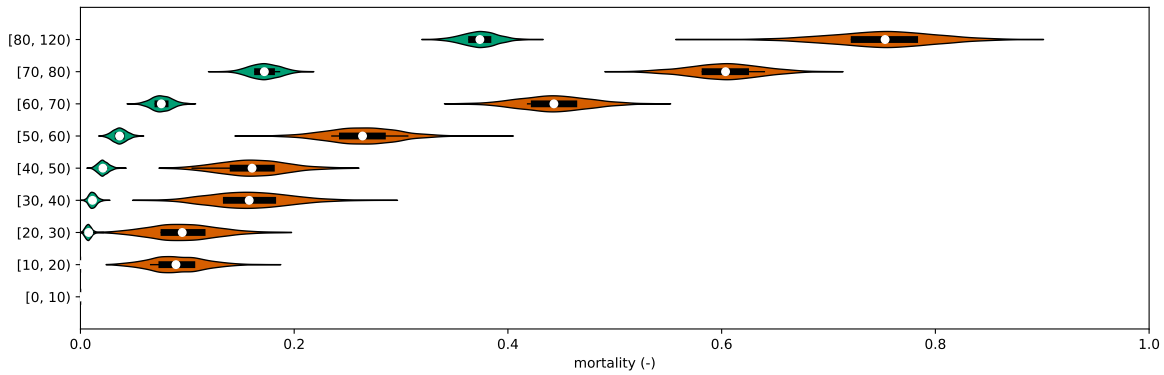

Figure 16: Mortality in cohort (m_C, green) and mortality in ICU (m_{ICU}, red) per ten-year age strata. Obtained by bootstrap resampling of the Belgian COVID-19 clincial surveillance on hospitalizations by Van Goethem et al. [40]. Mortality in both wards increases with patient age, mortality in ICU is higher than mortality in cohort.

Table 4: Computed fraction of hospitalized patients remaining in cohort and not transferring to ICU ($\boldsymbol{c}$), pooled mortality in cohort and ICU ($\boldsymbol{m}_{\text{C, ICU}}$), mortality in cohort ($\boldsymbol{m}_{\text{C}}$) and mortality in ICU ($\boldsymbol{m}_{\text{ICU}}$) per ten-year age strata. Estimates obtained by bootstrap resampling from the Belgian COVID-19 clincial surveillance on hospitalizations by Van Goethem et al. [40].

Age group	**n (-)**	$\boldsymbol{c}$ **(%)**		$\boldsymbol{m}_{\text{C, ICU}}$ **(%)**		$\boldsymbol{m}_{\text{C}}$ **(%)**		$\boldsymbol{m}_{\text{ICU}}$ **(%)**	
		mean	95% CI	mean	95% CI	mean	95% CI	mean	95% CI
$[0, 10[$	404	98.0	97.7 - 98.3	0.0	NA	0.0	NA	0.0	NA
$[10, 20[$	169	87.0	86.3 - 87.7	1.2	1.0 - 1.4	0.0	NA	8.9	7.3 - 10.7
$[20, 30[$	578	91.1	90.1 - 91.6	1.5	1.3 - 1.8	0.8	0.6 - 1.0	9.5	7.5 - 11.7
$[30, 40[$	1042	89.8	89.1 - 90.4	2.7	2.4 - 3.0	1.1	0.9 - 1.4	15.8	13.3 - 18.3
$[40, 50[$	1873	85.8	85.1 - 86.5	4.1	3.7 - 4.6	2.1	1.8 - 2.5	16.1	14.0 - 18.2
$[50, 60[$	3267	80.9	80.1 - 81.7	8.0	7.4 - 8.6	3.7	3.2 - 4.1	26.4	24.2 - 28.6
$[60, 70[$	3952	75.9	75.0 - 76.8	16.4	15.6 - 17.2	7.6	6.9 - 8.2	44.3	42.1 - 46.5
$[70, 80[$	4844	78.3	77.4 - 79.2	26.6	25.7 - 27.6	17.2	16.3 - 18.2	60.3	58.1 - 62.6
$[80, \infty[$	6007	91.8	91.2 - 92.3	40.4	39.4 - 41.5	37.4	36.3 - 38.4	75.3	72.0 - 78.4
Population	22 136	83.8	83.0 - 84.6	21.4	20.6 - 22.3	16.6	15.7 - 17.5	46.3	43.8 - 49.0

Table 5: Hospital residence time in cohort, irregardless of COVID-19 outcome (d_C), residence time in cohort, in case of recovery ($d_{C,R}$), residence time in cohort, in case of death ($d_{C,D}$). Hospital residence time in IC, irregardless of COVID-19 outcome (d_{ICU}), residence time in IC, in case of recovery ($d_{ICU,R}$), residence time in IC, in case of death ($d_{ICU,D}$) per ten-year age strata. Scale and shape parameters of Weibull distribution fitted to the residence time data. Estimates obtained by analyzing a subset of data from the Belgian COVID-19 clincial surveillance on hospitalizations by Van Goethem et al. [40].

Age group	d_{C} **(days)**				$d_{\text{C,R}}$ **(days)**				$d_{C,D}$ **(days)**			
	mean	IQR	scale	shape	mean	IQR	scale	shape	mean	IQR	scale	shape
$[0, 10[$	3.4	2.0 - 4.0	3.66	1.22	3.4	2.0 - 4.0	3.66	1.22	NA	NA	NA	NA
$[10, 20[$	6.3	2.0 - 7.0	5.64	0.85	6.3	2.0 - 7.0	5.64	0.85	NA	NA	NA	NA
$[20, 30[$	4.9	2.0 - 5.0	4.86	0.98	4.9	2.0 - 5.0	4.86	0.98	5.0	3.5 - 6.0	5.67	2.10
$[30, 40[$	5.5	3.0 - 6.0	5.77	1.12	5.5	3.0 - 6.0	5.77	1.12	6.1	2.0 - 11.0	6.38	1.13
$[40, 50[$	6.3	3.0 - 8.0	6.81	1.22	6.3	3.0 - 8.0	6.81	1.22	6.8	2.3 - 8.8	6.94	1.03
$[50, 60[$	7.6	4.0 - 9.0	8.12	1.16	7.6	4.0 - 9.0	8.07	1.17	9.1	3.0 - 10.0	9.16	1.01
$[60, 70[$	10.0	4.0 - 11.0	10.32	1.08	9.9	4.0 - 11.0	10.31	1.10	11.2	3.0 - 14.0	10.32	0.86
$[70, 80[$	12.6	5.0 - 14.0	13.11	1.10	12.6	5.0 - 14.0	13.24	1.13	12.6	4.0 - 13.0	12.42	0.97
$[80, \infty[$	15.6	6.0 - 19.0	16.37	1.13	17.8	8.0 - 22.0	19.1	1.21	11.9	4.0 - 15.0	12.21	1.06
Population	11.0	4.0 - 13.0	9.09	1.21	10.8	4.0 - 12.0	8.72	1.24	11.8	4.0 - 14.0	10.97	1.08
Age group	d_{ICU} **(days)**				$d_{\text{ICU,R}}$ **(days)**				$d_{\text{ICU,D}}$ **(days)**			
	mean	IQR	scale	shape	mean	IQR	scale	shape	mean	IQR	scale	shape
$[0, 10[$	6.0	2.0 - 8.3	6.40	1.19	6.7	2.0 - 8.5	7.37	1.37	NA	NA	NA	NA
$[10, 20[$	4.9	2.0 - 5.0	5.26	1.25	4.0	2.0 - 5.0	4.44	1.43	16.0	NA	NA	NA
$[20, 30[$	9.6	2.0 - 10.0	8.86	0.87	8.9	2.0 - 10.0	8.34	0.89	18.0	4.5 - 25.5	16.97	0.89
$[30, 40[$	10.1	2.0 - 13.3	11.08	1.00	9.4	2.0 - 11.0	8.72	0.87	14.0	5.0 - 20.0	14.86	1.20
$[40, 50[$	11.3	3.0 - 14.0	12.75	1.00	10.6	3.0 - 12.0	10.34	0.95	15.1	4.5 - 21.0	16.38	1.30
$[50, 60[$	14.1	5.0 - 19.0	1.05	1.00	11.7	4.0 - 15.8	12.02	1.08	19.7	8.5 - 27.0	20.60	1.16
$[60, 70[$	14.7	5.0 - 21.0	1.05	1.00	13.2	4.0 - 17.0	13.00	0.97	16.5	6.0 - 23.0	17.52	1.21
$[70, 80[$	15.0	5.0 - 21.0	1.05	1.00	14.6	4.0 - 21.0	14.47	0.98	15.2	6.0 - 21.0	15.83	1.12
$[80, \infty[$	10.8	3.0 - 14.0	12.58	1.00	7.9	2.0 - 9.0	7.54	0.92	11.7	3.0 - 15.0	11.25	0.92
Population	13.6	4.0 - 19.0	11.41	1.21	12.0	3.0 - 15.0	12.32	0.98	15.2	5.0 - 21.0	13.77	1.10

Table 6: Hospital residence time for a recovery stay in cohort, after a stay in ICU ($d_{\text{ICU,rec}}$), time from symptom onset to hospitalization (d_{hospital}) per ten-year age strata. Scale and shape parameters of Weibull distribution fitted to the residence time data. Estimates obtained by analyzing a subset of data from the Belgian COVID-19 clincial surveillance on hospitalizations by Van Goethem et al. [40].

Age group	$d_{\text{ICU,rec}}$ **(days)**				d_{hosp} **(days)**			
	mean	IQR	scale	shape	mean	IQR	scale	shape
$[0, 10[$	9.9	0.5 - 3.0	3.18	0.40	2.2	0.0 - 2.0	0.86	0.43
$[10, 20[$	3.4	3.0 - 4.0	2.99	0.70	5.6	2.0 - 6.0	4.69	0.73
$[20, 30[$	8.4	3.0 - 10.8	8.18	0.94	6.0	2.0 - 7.0	5.33	0.75
$[30, 40[$	6.6	2.0 - 7.0	5.88	0.80	6.7	3.0 - 9.0	6.78	1.02
$[40, 50[$	8.2	3.0 - 8.0	7.97	0.94	7.4	4.0 - 9.0	7.69	1.14
$[50, 60[$	10.1	4.0 - 11.0	10.02	0.99	7.5	4.0 - 10.0	7.73	1.08
$[60, 70[$	11.5	4.0 - 14.0	11.58	1.01	6.9	3.0 - 9.0	6.87	0.97
$[70, 80[$	15.2	6.0 - 20.0	15.29	1.02	6.6	2.0 - 8.0	5.72	0.75
$[80, \infty[$	13.3	6.0 - 16.0	14.11	1.23	5.0	1.0 - 7.0	3.62	0.59
Population	11.2	4.0 - 13.0	8.39	1.40	6.4	2.0 - 8.0	10.11	0.63

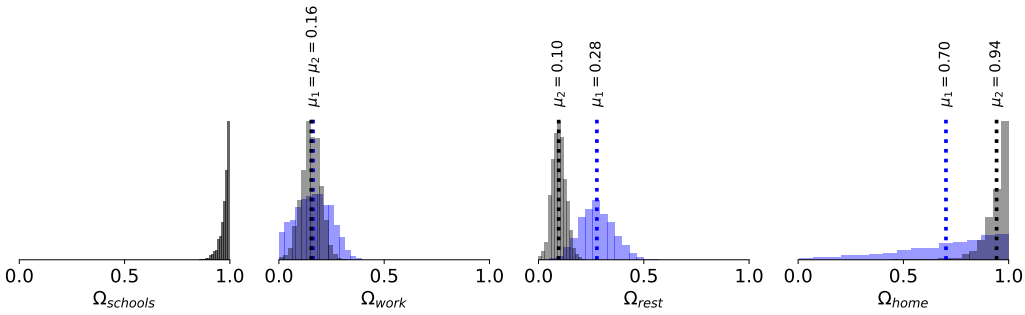

Figure 17: Inferred effectivity parameters at home (Ω_{home}), in the workplace (Ω_{work}), in schools (Ω_{schools}) and for the sum of leisure activities, other activities and public transport (Ω_{rest}), for the first COVID-19 wave (blue) and for the second COVID-19 wave (black). The effectivity of contacts in schools could not be deduced during the first COVID-19 wave because schools remained practically closed until July 1st, 2020. However, a high effectivity of contacts in schools could be deduced during the second COVID-19 wave. The effectivity of work contacts was roughly the same during both 2020 COVID-19 waves. The effectivity of leisure contacts was estimated to be lower during the second COVID-19 wave, however, leisure policies were not varied (yet) during the second COVID-19 wave, so the estimate must be taken with a grain of salt. Home contacts were deemed more effective by the model during the second COVID-19 wave.

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