THE LANCET

Supplementary appendix

This appendix formed part of the original submission. We post it as supplied by the authors.

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Authors' translation of the Correspondence can be found on our website: www.containcovid.eu

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Methods

The following describes the methodology for calculating the estimated weekly ICU admissions per 100,000 people (an interactive sheet based on these methods can be found on www.containcovid.eu).

Immunization level. We assume for each age group *i* some immunization level r_i that could be reached in the future or had been realized in the past. This immunization level presents the fraction of immune people through vaccination or previous infection with SARS-CoV-2 (see Table 1). The table presents a relatively high immunization level that could be reached in future. The alternative scenario is "no immunization" to give another corner case, representing the situation at the beginning of the first wave. We do not consider waning immunity here.

Age group *i*	**Number of people in age group *i* *(in millions)***	**Assumed Immunization level r_i reached in future (fraction of immune through vaccination or previous infection, in %)**	**Effectiveness against severe disease course (in %)**	**ICU admission probability (in case of an infection, in %)**
80+	5.9	95	97	9.8
70+	7.5	90	97	8.4
60+	10.7	85	97	5.6
50+	13.3	80	97	1.4
40+	10.1	75	97	0.7
30+	10.9	70	97	0.28

20+	9.6	70	97	0.07
10+	7.5	10	97	0.028
0+	7.8	10	97	0.014

Table 1: Age-stratified data and assumed values used for the ICU admission estimations.The values for the age-stratified population and the ICU admission probabilities are given for Germany [1-6]. The assumed immunization presents one example calculation with age-dependent vaccination rates.

Breakthrough infection. We assume that the probability that an immunized person experiences a breakthrough infection despite immunization is given by $P_{breakthrough} = 0.25$. In other words, we assume that the likelihood of being infected is four times smaller for an immunized person than for a non-immunized person.

Fraction of immunized persons in the incidence. The fraction of immunized persons f_i in age group *i* who suffer from a breakthrough infection for any incidence is then calculated by

$$f_i = r_i \cdot P_{breakthrough} \div [r_i \cdot P_{breakthrough} + (1 - r_i)].$$

The denominator fulfills the purpose of normalization and effectively assumes that the 'breakthrough probability for non-immunized persons' is 100%, while for immunized it is 25 %. The latter combines the effect of vaccine-induced protection, and potentially higher contact rates and less personal protection by immunized people.

Number of COVID-19 infections. Using data for the number of people in age group *i* for Germany [1] (see Table 1), we can calculate the total COVID-19 cases per age group *i* per week, denoted I_i, for a given incidence.[1] In the excel sheet, everyone can adapt the incidence independently per age group.

ICU-admission probability. We need information on the age-group-dependent ICU-admission probability in case of an infection $P_{ICU,i}$, to calculate the overall ICU admission rate. We built on the probabilities $P_{ICU,i}$ from [2] for Germany. They were derived from the reported data before the Alpha variant became dominant. As there is a higher hospitalisation rate for the Alpha variant [3] than for the original one, and there appears to be an additional increase in the hospitalisation rate for the Delta variant [4], we assume that the previous ICU admission probabilities upon infection increase by 40% for the Delta variant in each age group.

Total ICU admission rate. The age-group-dependent total numbers of ICU admissions per week for non-immunized and immunized persons, respectively, are

$$N_{non-immune,i} = I_i \cdot (1 - f_i) \cdot P_{ICU,i} \quad \text{and}$$
$$N_{immune} = I_i \cdot f_i \cdot P_{ICU,i} \cdot (1 - \eta) \div P_{breakthrough},$$

where the η is the effectiveness of vaccines against a severe disease course for the Alpha variant [5] (see Table 1; assuming the BioNTech/Pfizer vaccine effectiveness). In words: The number of people admitted to ICU *without* previous immunization depends on the number of non-immune *infected* people multiplied by their ICU admission probability upon infection. For the number of people admitted to ICU *despite* previous immunization, we have to take into account that the infection probability and the hospitalization probability are both lower. Hence, we have to multiply the ICU admission probability with the probability to suffer from severe

[1] By "incidence", we mean the number of people infected and refer to the "true incidence" contrary to the reported incidence.

disease upon infection despite previous immunization. As $(1-\eta)$ describes the latter probability, but not conditional on infection, we divide this number by the breakthrough infection probability for immunized people. Therefore, the adjustment factor is $(1-\eta) \div P_{breakthrough}$.
Adding $N_{non-immune,i}$ with N_{immune} and over all age groups, we receive the total number of ICU admissions per week in Germany for the given incidence.

ICU capacity limit. We compare the ICU admission with the approximate ICU capacity limit. We estimate this limit by using the observed number of COVID-19-related ICU admissions during winter 2020/2021 in Germany, i.e. about 5 ICU admissions per 100,000 per week [6], which brought German ICUs to a capacity limit.

Supplementary references

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