Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.
eMethods. Bayesian Inference Method to Estimate Age-Varying Susceptibility to SARS-CoV-2

**Bayesian Inference**

**A. Overview**

In a Susceptible-Exposed-Infectious-Recovered (SEIR) model, the force of infection \( \lambda \), the rate at which susceptible individuals are infected (i.e., exposed), is a crucial factor. The age-specific force of infection \( \lambda_i \) in age group \( i \) at discrete time \( t \) could be written as:

\[
\lambda_i = \mu(t|q_i) = \frac{q_i \sum_{j=1}^A \phi_{ij}(t) \left( I_{\text{presym}}^j(t-1) + I_{\text{sym}}^j(t-1) + 0.5I_{\text{asym}}^j(t-1) \right)}{n_i}
\]

where \( q_i \) is the probability that a contact between a susceptible in age group \( i \) and infectious person leads to infection, \( \phi(t) = \phi_{ij}(t) \) means contact matrix at discrete time \( t \) (\( \phi_{ij}(t) \) is the number of contacts an individual of age group \( j \) makes with those of age group \( i \) per unit time at discrete time \( t \)), \( n_i \) is the number of individuals in age group \( i \). \( I_{\text{presym}}^j \) is the number of individuals who become infectious before the symptom onset; \( I_{\text{sym}} \) is the number of individuals who are both symptomatic and infectious; \( I_{\text{asym}} \) is the number of individuals who are infectious but never developed any symptoms. We suppose that the relative infectiousness of the \( I_{\text{asym}} \) is half of \( I_{\text{presym}} \) or \( I_{\text{sym}} \). Here \( i \) is in age group \( A = \{1, 2, \cdots, A\} \).

We try to estimate \( q_i \) during the third and fourth waves in South Korea and denote it as \( \theta_i \) hereafter. If we could observe the number of exposed individuals at time \( t \) for age group \( i \) and the number of total infectious individuals, the likelihood of the parameters could be easily derived. However what we could observe is only the number of diagnosed (i.e, quarantined) individuals for age group \( i \in A \) at time \( t \). In addition, asymptomatic infection which is the notable feature of COVID-19 should also be reflected in the model. To resolve these difficulties, we use a Bayesian approach. In particular, we develop an efficient MCMC (Markov Chain Monte Carlo) algorithm in which the exposed date, symptom onset date and transmission onset date for all quarantined individuals are imputed with an assumption that there are 16% asymptomatic individuals. We explain the details of our Bayesian method in the following three subsections.

**B. Data, Model and Posterior**

The data we used in the analysis is daily numbers of quarantined individuals for each age group from 15 October to 22 December 2020 (3rd wave) and from 27 June to 21 August 2021 (4th wave).

To estimate \( \theta_i \), we are going to impute the exposed dates, symptom onset dates and transmission onset dates of all quarantined individuals conditional on given quarantined dates. For this purpose, we need a probability model which relates the exposed dates, symptom onset dates and transmission onset dates to the quarantined dates.

| Symptomatic cases | Asymptomatic cases |
|-------------------|--------------------|
| **Symbol** | **Definition** | **Symbol** | **Definition** |
| \( E \) | Exposed date of an individual | \( E \) | Exposed date of an individual |
| \( Y \) | Incubation period | \( L \) | Latent period |
| \( I \) | Transmission onset time relative to the symptom onset | \( C \) | Infectious period suspended by quarantine |
| \( D \) | Diagnostic delay (i.e, Quarantined) from the symptom onset | \( R \) | Infectious period |

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For each symptomatic individual, the quarantined date is sum of the exposed date (E), the incubation period (Y) and the period for symptom onset to diagnostic delay (D). In addition, these individuals start infecting other susceptibles from the transmission onset date (E + Y + I)

For each asymptomatic individual, the quarantined date is sum of exposed date (E), latent period (L) and period for transmission onset to quarantined date (C). We assume that the latent period distribution of asymptomatic individuals is same as that of symptomatic individuals. Also the quarantined time distribution of C(f_c) of asymptomatic individuals is set to be the exponential distribution with mean 1/1.7, which satisfies P(C > R) = 0.01 where E + L + R is defined as the recovered date.

Finally, the quarantined date T is defined as

$$T = (E + Y + D)I(\Delta = 0) + (E + L + C)I(\Delta = 1)$$ (S2)

where \(\Delta\) is equal to 0 when the individual is symptomatic and 1 when asymptomatic. We set \(P(\Delta = 1) = 0.16\).

For individual k, let \(W_k = (E_k, Y_k, I_k, L_k, C_k, D_k)\) and \(V_k = (Y_k, I_k, L_k, C_k, D_k)\). Let \(\mathcal{D}\) be the observed data which consist of the daily numbers of quarantined individuals. Our strategy to estimate \(\theta_i\) is to generate \(W_k\) and \(\theta\) iteratively from their conditional posterior distributions \(P(\theta_i|W, \mathcal{D})\) and \(P(W_k|W(-k), \theta, \mathcal{D})\) respectively, where \(W = \{W_k\}\) and \(W(-k)\) denotes \(W\) except \(W_k\).

We could describe as,

$$P(W_k|W(-k), \theta_{i_k}, D) = P(W_k|W(-k), \theta_{i_k}, D)I(\Delta_k = 0) + P(W_k|W(-k), \theta_{i_k}, D)I(\Delta_k = 1)$$ (S3)

$$= P(E_k|V(1:N), \theta_{i_k}, D)(f_Y(Y_k)f_I(I_k)f_D(D_k)I(\Delta_k = 0) + f_L(L_k)f_C(C_k)I(\Delta_k = 1))$$ (S4)

C. Generating \(\theta\) and \(W\) from their conditional posterior distributions

C.1. Generating \(\theta\)

For the prior distribution of \(\theta_i\), we use a diffuse gamma distribution \(\text{Gamma}(0.001, 0.001)\) for all \(i\). Then

$$p(\theta_i|W^{(i)}_k \mathcal{D}) \propto p(\theta_i)p(W^{(i)}_k \mathcal{D} | \theta_i), \quad i \in \mathcal{A}$$ (S5)

when \(W^{(i)}_k = \{W_k |\text{The age group of } k \text{ is } i\}\), \(n_i\) is the population for age group \(i\).

In turn, \(P(W^{(i)}_1, \ldots, W^{(i)}_{n_i} \mathcal{D} | \theta_i)\) can be expressed as

$$P(W^{(i)}_1, \ldots, W^{(i)}_{n_i} \mathcal{D} | \theta_i) = P(E^{(i)}_1, \ldots, E^{(i)}_{n^{(i)}_i} | V(1:N), \theta_i)P(V(1:N)) = \prod_{k=1}^{n_i} P(E^{(i)}_k | V(1:N), \theta_i)P(V(1:N))$$ (S6)

$$P(E^{(i)}_k | V(1:N), \theta_i) = P(E^{(i)}_k | I_{total}(t), t < E^{(i)}_k, \theta_i) = P(E^{(i)}_k | \theta_{i_k})\prod_{t=1}^{E^{(i)}_k - 1}(1 - p(t | \theta_{i_k}))$$ (S7)

Since \(p(E^{(i)}_k | V(1:N), \theta_i)\) is the probability of an individual \(k\) to be infected at discrete time \(E^{(i)}_k\) (implying the individual \(k\) has not been infected before).

$$P(V(1:N)) = \prod_{\Delta_k = 0}^{\Delta_k} 0.84 f_Y(Y_k)f_I(I_k)f_D(D_k) \prod_{\Delta_k = 1}^{\Delta_k} 0.16 f_L(L_k)f_C(C_k)$$ (S8)

where \(N = \sum_i n_i\) (Total population size), \(V_k = (Y_k, I_k, L_k, C_k, D_k)\) and \(i_k\) is the age group of individual \(k\). By applying the following approximation,

$$P(E^{(i)}_k | V(1:N), \theta_{i_k}) = P(E^{(i)}_k | I_{total}(t), t < E^{(i)}_k, \theta_{i_k}) = p(E^{(i)}_k | \theta_{i_k})\prod_{t=1}^{E^{(i)}_k - 1}(1 - p(t | \theta_{i_k}))$$

$$\approx p(E^{(i)}_k | \theta_{i_k})e^{-\sum_{t=1}^{E^{(i)}_k - 1} p(t | \theta_{i_k})}$$ (S9)

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we have

\[ \theta_i | W, D \sim \text{Gamma} \left( 0.001 + |E_i|, 0.001 + \sum_{k \in E_i} \phi_j(t) I_{total}(t - 1) \frac{n_i}{n_i} + \sum_{k \in S \cup E_j \cup E_0} \phi_j(t) I_{total}(t - 1) \right) \quad (S10) \]

where \( E_i \) is set of individuals in the age group \( i \) exposed during the 3rd wave \([t_1, t_2]\) (or 4th wave).

### C.2 Generating \( W \)

We generate \( W \) by generating \( W_k \) from \( P(W_k | W_{(-k)}, \theta, D) \) iteratively, and generate \( W_k \) through the Metropolis-Hasting (MH) algorithm. To sample from the posterior \( P(W_k | W_{(-k)}, \theta, D) \) by the MH algorithm, we use the following proposal distribution:

\[
Q(E_k, V_k) = Q(E_k | V_k)Q(V_k) \\
Q(V_k) = p(V_k | D) \\
Q(E_k | V_k) = \delta(T_k - Y_k - D_k)I(\Delta_k = 0) + \delta(T_k - L_k - C_k)I(\Delta_k = 1) \quad (S13)
\]

Putting the above together, the sampling procedure of \( W_k \) is summarized in Algorithm S1.

**Algorithm S1. Bayesian Inference**

Input : \( W_k^{(0)} \) for \( k = 1, 2, \ldots, N \)

1. Sample \( \theta^{(0)} = (\theta_i^{(0)}) \) from prior.

2. for \( m = 1: M \) (number of iteration) do

   → **Gibbs sampling**

3. for \( k = 1: N \) do

   → **MCMC**

4. Sample \( W_k^{(m)} \) from \( Q(E_k, V_k) \)

5. \[ \alpha \leftarrow \frac{P(E_k^{(m)}, V_k^{(m-1)} | \theta^{(m-1)}, D)Q(V_k^{(m-1)})}{P(E_k^{(m)}, V_k^{(m-1)} | \theta^{(m-1)}, D)Q(V_k^{(m-1)})} \]

   → **Acceptance ratio**

6. \[
W_k^{(m)} \leftarrow \begin{cases} 
W_k^{(m)} & \text{if } \alpha \geq 1 \\
W_k^{(m-1)} & \text{else}
\end{cases}
\]

7. Sample \( \theta_i^{(m)} \) for \( i = 1, 2, \ldots, A \) from \( p(\theta_i | W^{(m)}) \)

The acceptance ratio \( \alpha \) can be obtained as follows, where \( W_k^{(m)} \) and \( W_k^{(m-1)} \) are denoted by \( W_k^{(\text{new})} \) and \( W_k^{(\text{old})} \), respectively.

For \( I_{sym} \), let \( m_k^{(lm)} = (T_k - D_k^{(\text{new})} + I_k^{(\text{new})}) \land \left( T_k - D_k^{(\text{old})} + I_k^{(\text{old})} \right) \), \( M_k^{(lm)} = (T_k - D_k^{(\text{new})} + I_k^{(\text{new})}) \lor (T_k - D_k^{(\text{old})} + I_k^{(\text{old})}) \).

For \( I_{asym} \), let \( m_k^{(lm)} = (T_k - C_k^{(\text{new})}) \land \left( T_k - C_k^{(\text{old})} \right) \), \( M_k^{(lm)} = (T_k - C_k^{(\text{new})}) \lor (T_k - C_k^{(\text{old})}) \). Here \( T - D + I \) and \( T - C \) are transmission onset date and \( a \land b = \min(a, b), a \lor b = \max(a, b) \).
\[
\beta(t) = \begin{cases} 
    p_i(t) & \text{if } t \notin \left[ m_k^l, M_k^l \right] \cdots (s) \\
    \phi_{i,t}(t_{\text{total}}(t) - 1) + \sum_{t \in k} \phi_{i,t}(t_{\text{total}}(t) - 1) - p_i(t) & \text{if not (s), } T_k - p_i^{(\text{new})} + p_i^{(\text{old})} < T_k - p_i^{(\text{old})} + p_i^{(\text{old})} \\
    \phi_{i,t}(t_{\text{total}}(t) - 1) + \sum_{t \in k} \phi_{i,t}(t_{\text{total}}(t) - 1) - p_i(t) & \text{if not (s), } T_k - p_i^{(\text{new})} + p_i^{(\text{old})} > T_k - p_i^{(\text{old})} + p_i^{(\text{old})} 
\end{cases} 
\]

\[
\alpha = \begin{cases} 
    \frac{p_i^{(\text{old})}}{p_i^{(\text{new})}} e^{-\sum_{k \in A} p_i^{(\text{old})}} \left( \prod_{k \in A} \frac{p_i^{(\text{old})}}{p_i^{(\text{new})}} \left( e^{x_{k,\text{total}} - p_i^{(\text{old})}} \right) \right) \prod_{k \in A} \left( e^{x_{k,\text{total}} - p_i^{(\text{old})}} \right) & E_k^{(\text{new})} > E_k^{(\text{old})} \\
    \frac{p_i^{(\text{old})}}{p_i^{(\text{new})}} e^{-\sum_{k \in A} p_i^{(\text{old})}} \left( \prod_{k \in A} \frac{p_i^{(\text{old})}}{p_i^{(\text{new})}} \left( e^{x_{k,\text{total}} - p_i^{(\text{old})}} \right) \right) \prod_{k \in A} \left( e^{x_{k,\text{total}} - p_i^{(\text{old})}} \right) & E_k^{(\text{new})} = E_k^{(\text{old})} \\
    \frac{p_i^{(\text{old})}}{p_i^{(\text{new})}} e^{-\sum_{k \in A} p_i^{(\text{old})}} \left( \prod_{k \in A} \frac{p_i^{(\text{old})}}{p_i^{(\text{new})}} \left( e^{x_{k,\text{total}} - p_i^{(\text{old})}} \right) \right) \prod_{k \in A} \left( e^{x_{k,\text{total}} - p_i^{(\text{old})}} \right) & E_k^{(\text{new})} < E_k^{(\text{old})} 
\end{cases} 
\]

D. Reproducibility

Code and data to reproduce the analyses are available at https://github.com/Hwichang/Age-varying-susceptibility-to-the-Delta-variant-of-SARS-CoV-2.
### eTable 1. School Attendance Ratio During Fourth Wave

| Attendance ratio (%) | 2021-09-29 | 2021-09-28 | 2021-09-23 | 2021-09-15 | 2021-09-13 | 2021-09-09 | 2021-09-06 | 2021-09-01 | 2021-08-31 |
|----------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Kindergarten         | 91.6       | 90.9       | 89.8       | 93.2       | 91.3       | 92.3       | 90.3       | 88.9       | 82.3       |
| Primary school       | 79.7       | 78.7       | 75.6       | 79.3       | 77.9       | 77.7       | 76.4       | 55.7       | 48.6       |
| Middle school        | 80.5       | 80.3       | 76.5       | 75.6       | 79.7       | 76.9       | 74       | 45       | 56.2       |
| High school          | 81.4       | 81.7       | 72.9       | 81         | 80.9       | 80.9       | 81         | 73.5       | 74.2       |

| Attendance ratio (%) | 2021-08-26 | 2021-08-24 | 2021-08-19 | 2021-08-13 | 2021-08-11 | 2021-08-09 | 2021-08-04 | 2021-08-02 | 2021-07-28 |
|----------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Kindergarten         | 74.4       | 66.5       | 55.7       | 27.5       | 20.4       | 15.2       | 1.9        | 1.6        | 11.7       |
| Primary school       | 36.7       | 20.6       | 4.1        | 0.4        | 0.2        | 0.1        | 0          | 0          | 0.7        |
| Middle school        | 55.7       | 50.7       | 27.7       | 2.1        | 0.9        | 0.6        | 0.2        | 0.1        | 0          |
| High school          | 73.1       | 70.1       | 55.9       | 6.5        | 5.2        | 4.2        | 1.1        | 0.9        | 0.4        |

| Attendance ratio (%) | 2021-07-26 | 2021-07-21 | 2021-07-16 | 2021-07-14 | 2021-07-12 | 2021-07-07 | 2021-06-30 | 2021-06-23 | 2021-06-16 |
|----------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Kindergarten         | 20.2       | 42.8       | 45.8       | 56.7       | 78         | 94.3       | 94.3       | 95.2       | 94.4       |
| Primary school       | 3.2        | 24.5       | 31.5       | 46.9       | 58.6       | 80.2       | 79.9       | 80.2       | 79.3       |
| Middle school        | 0.4        | 4.2        | 10.3       | 45.3       | 50.5       | 77.6       | 76.6       | 76.3       | 76         |
| High school          | 0.8        | 3.4        | 10         | 47.3       | 57.6       | 79.4       | 85.6       | 76.2       | 75.7       |
### Table 2. Vaccine Coverage Data First Half of 2021

| Age  | Type | 2021-05-29 | 2021-06-05 | 2021-06-12 | 2021-06-19 |
|------|------|------------|------------|------------|------------|
| 18~29| AZ   | 1st        | 135,692    | 135,784    | 135,839    | 135,901    |
|      |      | 2nd        | 85,495     | 109,495    | 119,623    | 126,856    |
|      | P    | 1st        | 27,641     | 29,436     | 178,863    | 416,390    |
|      |      | 2nd        | 25,208     | 25,475     | 25,895     | 27,395     |
|      | JJ   | 1st        |            |            |            | 7          |

| 30~49 | AZ | 1st | 847,219 | 1,025,861 | 1,246,444 | 1,408,453 |
|       |    | 2nd | 189,256 | 231,801   | 250,360   | 263,501   |
|       | P  | 1st | 48,627  | 49,791    | 51,888    | 54,848    |
|       |    | 2nd | 45,135  | 45,627    | 46,420    | 48,307    |
|       | JJ | 1st |         |           | 528,740   | 993,216   |

| 50~74 | AZ | 1st | 2,085,973 | 3,585,248 | 6,383,358 | 8,608,663 |
|       |    | 2nd | 224,463   | 258,346   | 297,104   | 335,204   |
|       | P  | 1st | 61,363    | 63,194    | 65,844    | 67,835    |
|       |    | 2nd | 55,806    | 56,547    | 57,570    | 61,124    |
|       | JJ | 1st |          |           | 38,053    | 121,808   |

| ≥75  | AZ | 1st | 199,117  | 201,748   | 208,756   | 219,906   |
|      |    | 2nd | 4,926    | 10,446    | 44,541    | 99,090    |
|      | P  | 1st | 1,993,383 | 2,504,010 | 2,964,448 | 2,985,116 |
|      |    | 2nd | 1,513,004 | 1,541,859 | 1,583,769 | 1,969,791 |
|      | JJ | 1st |          |           | 54         | 312       |

AZ; ChAdOx1 nCoV-19 (AZD1222, Oxford–AstraZeneca), P; BNT162b2 (tozinameran, Pfizer–BioNTech), JJ; Ad26.COV2.S (Johnson & Johnson), M; mRNA-1273 (elasomeran, Moderna)

Reference: [https://ncv.kdca.go.kr/](https://ncv.kdca.go.kr/)
### eTable 3. Vaccine Coverage Data Second Half of 2021

| Age | Type | 2021-06-28 | 2021-07-05 | 2021-07-12 | 2021-07-19 | 2021-07-26 | 2021-08-02 | 2021-08-09 | 2021-08-16 | 2021-08-23 | 2021-08-30 | 2021-09-06 | 2021-09-13 | 2021-09-20 |
|-----|------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| AZ  | 1st  | 135,946    | 135,960    | 135,967    | 136,081    | 136,388    | 137,332    | 137,784    | 138,118    | 138,312    | 138,441    | 138,525    | 138,561    | 138,561    |
|     | 2nd  | 131,100    | 131,693    | 131,701    | 131,729    | 131,758    | 131,766    | 131,864    | 132,141    | 133,002    | 133,431    | 133,800    | 134,001    | 134,215    |
|     | 2nd P* | 70     | 433        | 828        | 1,102      | 1,251      | 1,430      | 1,628      | 1,811      | 1,942      | 2,031      | 2,315      |            |            |
| P   | 1st  | 623,290    | 626,570    | 695,296    | 759,478    | 1,208,724  | 1,502,771  | 1,715,833  | 1,964,306  | 2,185,802  | 2,697,092  | 3,142,071  | 4,003,302  | 4,618,031  |
|     | 2nd  | 29,047     | 178,201    | 405,053    | 608,844    | 622,353    | 688,277    | 750,851    | 1,190,221  | 1,255,330  | 1,274,463  | 1,382,183  | 1,655,660  | 1,938,605  |
| JJ  | 1st  | 10         | 17         | 18         | 18         | 18         | 18         | 18         | 22         | 43         | 66         | 3,141      |            |            |
|     | 2nd  | 238        | 13,408     | 33,018     | 54,038     | 55,041     | 55,149     | 56,043     | 65,832     | 119,032    | 141,432    |            |            |            |
| AZ  | 1st  | 533,056    | 533,620    | 533,673    | 533,904    | 534,502    | 535,751    | 536,330    | 537,524    | 555,572    | 579,203    | 589,942    | 592,690    | 592,690    |
|     | 2nd  | 128,494    | 136,891    | 136,891    | 136,918    | 137,087    | 137,177    | 137,416    | 137,954    | 139,285    | 140,822    | 142,421    | 142,892    | 143,403    |
|     | 2nd P* | 21,590    | 108,118    | 170,524    | 187,106    | 190,264    | 217,370    | 259,206    | 317,043    | 382,761    | 387,079    | 388,308    |            |            |
| P   | 1st  | 28,184     | 29,578     | 37,728     | 37,829     | 221,883    | 454,070    | 639,936    | 768,405    | 941,218    | 1,240,986  | 1,518,671  | 2,214,956  | 2,687,480  |
|     | 2nd  | 24,546     | 25,257     | 26,102     | 27,000     | 27,851     | 35,236     | 126,569    | 212,461    | 222,234    | 234,213    | 375,123    | 550,202    | 750,133    |
| JJ  | 1st  | 802,334    | 802,874    | 802,951    | 802,956    | 802,983    | 802,983    | 802,987    | 802,987    | 824,599    | 860,571    | 887,563    | 910,527    |            |
|     | 2nd  | 1,270      | 3,156      | 4,887      | 5,030      | 5,058      | 43,053     | 46,592     | 51,287     | 99,452     | 104,850    | 121,918    | 217,364    | 593,717    |
| M   | 1st  |            |            |            |            |            |            |            |            |            |            |            |            |            |
|     | 2nd  | 1,379      | 2,978      | 4,807      | 4,992      | 5,045      | 5,327      | 10,502     | 43,163     | 56,991     |            |            |            |            |
| AZ  | 1st  | 880,407    | 881,151    | 881,269    | 881,650    | 882,513    | 883,871    | 884,663    | 887,289    | 927,882    | 985,751    | 1,009,579  | 1,014,709  | 1,014,709  |
|     | 2nd  | 144,437    | 155,994    | 155,994    | 156,074    | 156,270    | 156,390    | 156,777    | 157,651    | 159,449    | 162,330    | 164,165    | 164,805    | 165,532    |
|     | 2nd P* | 43,974    | 180,789    | 252,570    | 270,534    | 277,512    | 347,791    | 482,002    | 627,500    | 710,976    | 715,286    | 717,390    |            |            |
| P   | 1st  | 29,595     | 31,515     | 40,017     | 218,287    | 335,390    | 682,788    | 936,781    | 1,103,408  | 1,353,604  | 1,752,595  | 2,121,406  | 3,218,448  | 3,898,027  |

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| Age Group | 1st | 2nd |
|-----------|-----|-----|
| 50~59     | 39,484 | 34,364 |
| AZ        | 944,250 | 5,855,390 |
| P         | 196,587 | 196,521 |
| JJ        | 1,084,344 | 1,084,096 |
| M         | 337,429 | 337,429 |
| 60~69     | 21,875 | 20,699 |
| AZ        | 5,855,390 | 139,603 |
| P         | 5,857,335 | 60,138 |
| JJ        | 1,891,830 | 1,857,309 |
| M         | 178,316 | 178,316 |
| 70~79     | 21,583 | 21,583 |
| AZ        | 47,791 | 47,791 |
| P         | 48,076 | 48,076 |
| JJ        | 1,861,424 | 1,861,424 |
| M         | 60,393 | 60,393 |

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|       | 2nd P* | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    | 1st    |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| P     |        | 14,585 | 24,000 | 29,143 | 29,320 | 29,336 | 29,403 | 29,637 | 30,040 | 30,430 | 30,555 | 30,627 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 1st   | 1,424,636 | 1,432,143 | 1,453,719 | 1,469,104 | 1,473,470 | 1,487,688 | 1,502,379 | 1,511,870 | 1,518,376 | 1,524,082 | 1,528,847 | 1,532,960 | 1,536,611 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 2nd   | 1,115,520 | 1,392,073 | 1,405,112 | 1,414,527 | 1,422,426 | 1,443,725 | 1,458,942 | 1,463,773 | 1,464,458 | 1,465,530 | 1,468,857 | 1,482,547 | 1,500,325 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| JJ    |        | 8,216 | 8,270 | 8,272 | 8,274 | 8,277 | 8,276 | 8,277 | 8,278 | 8,461 | 9,060 | 9,616 | 10,483 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| M     |        | 2     | 9     | 17    | 17    | 17    | 9,347 | 9,863 | 10,224 | 12,931 | 13,357 | 14,235 | 15,405 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 2nd   |        | 2     | 2     | 17    | 17    | 19    | 57    | 548   | 9,123 | 9,930 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| ≥80   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| AZ    |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| P     |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 1st   | 185,863 | 187,493 | 188,398 | 188,827 | 189,188 | 189,447 | 191,547 | 198,708 | 204,109 | 208,934 | 211,177 | 212,076 | 212,355 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 2nd   | 114,222 | 130,211 | 140,851 | 146,420 | 148,891 | 150,096 | 152,194 | 157,234 | 161,096 | 166,697 | 172,254 | 174,991 | 176,234 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 2nd P* |        | 70    | 188    | 295    | 301    | 301    | 301    | 301    | 301    | 303    | 304    | 305    |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| JJ    |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| M     |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 1st   | 273    | 320    | 320    | 320    | 320    | 321    | 321    | 321    | 321    | 357    | 1,134  | 1,486  | 2,159  |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 2nd   |        | 1     | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 4      | 125    | 169    |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

* Since mid-July 2021, a mixed combination of ChAdOx1 nCoV-19 (AZD1222, Oxford–AstraZeneca) first and BNT162b2 (tozinameran, Pfizer–BioNTech) second was used.
eFigure 1. Result of Sensitivity Analysis: Baseline

### A. Age-varying susceptibility to the SARS-CoV-2

![Graph showing age-varying susceptibility to SARS-CoV-2](chart)

### B. Fold-rise in susceptibility to the Delta/pre-Delta

![Graph showing fold-rise in susceptibility to Delta/pre-Delta](chart)

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|----------------------|------------------|-----------|
|           | 2.50% 50% 97.50%     | 2.50% 50% 97.50% | 2.50% 50% 97.50% |
| [0,5)     | 0.02829 0.030807 0.033569 | 0.043465 0.045887 0.048048 | 1.536416 1.489504 1.431315 |
| [5,10)    | 0.023685 0.025646 0.027586 | 0.043276 0.045437 0.047555 | 1.82717 1.771664 1.723862 |
| [10,15)   | 0.027847 0.02998 0.032231 | 0.055012 0.057505 0.059875 | 1.975501 1.918102 1.857688 |
| [15,20)   | 0.023795 0.02538 0.027121 | 0.039571 0.041149 0.042844 | 1.66301 1.621304 1.579741 |
| [20,25)   | 0.046352 0.048611 0.051073 | 0.077432 0.079681 0.082327 | 1.670517 1.639143 1.611961 |
| [25,30)   | 0.04139 0.043289 0.045337 | 0.07181 0.073878 0.076013 | 1.734952 1.706649 1.676628 |

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| Interval | Lower | Upper | Lower | Upper | Lower | Upper | Lower | Upper | Lower | Upper |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| [30,35)  | 0.037224  | 0.039097  | 0.040973  | 0.051992  | 0.05386  | 0.055663  | 1.396753  | 1.377602  | 1.358515  |       |
| [35,40)  | 0.040271  | 0.04238  | 0.044537  | 0.057469  | 0.05928  | 0.061105  | 1.427043  | 1.398781  | 1.372018  |       |
| [40,45)  | 0.036144  | 0.037729  | 0.039539  | 0.04292  | 0.04438  | 0.045879  | 1.187476  | 1.176285  | 1.160361  |       |
| [45,50)  | 0.043949  | 0.045958  | 0.047976  | 0.053215  | 0.055067  | 0.05688  | 1.21083  | 1.198201  | 1.185606  |       |
| [50,55)  | 0.04641  | 0.048158  | 0.050051  | 0.046457  | 0.048016  | 0.049475  | 1.001017  | 0.997043  | 0.9885  |       |
| [55,60)  | 0.047279  | 0.049315  | 0.051147  | 0.049173  | 0.050767  | 0.052315  | 1.040061  | 1.029443  | 1.022836  |       |
| [60,65)  | 0.049461  | 0.051628  | 0.053608  | 0.052036  | 0.054286  | 0.056405  | 1.052075  | 1.051481  | 1.052176  |       |
| [65,70)  | 0.050556  | 0.053013  | 0.055442  | 0.052981  | 0.055411  | 0.058047  | 1.047972  | 1.045232  | 1.046975  |       |
| [70,75)  | 0.043144  | 0.045885  | 0.048753  | 0.02862  | 0.030949  | 0.033265  | 0.663372  | 0.674497  | 0.682317  |       |
| [75,+)  | 0.140352  | 0.145997  | 0.151866  | 0.155416  | 0.164431  | 0.17482  | 1.107328  | 1.126262  | 1.151142  |       |
**Figure 2.** Result of Sensitivity Analysis: 4% Asymptomatic Infections

### A. Age-varying susceptibility to the SARS-CoV-2

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|-----------------------|------------------|-----------|
|          | 2.50%  | 50%  | 97.50% | 2.50%  | 50%  | 97.50% | 2.50%  | 50%  | 97.50% |
| [0,5)     | 0.025865 | 0.028017 | 0.030438 | 0.038677 | 0.040748 | 0.042897 | 1.495301 | 1.454397 | 1.409292 |
| [5,10)    | 0.021731 | 0.023424 | 0.025279 | 0.038392 | 0.040384 | 0.042498 | 1.766694 | 1.724016 | 1.681141 |
| [10,15)   | 0.02539  | 0.027179 | 0.02937  | 0.049117 | 0.051339 | 0.053558 | 1.934465 | 1.888909 | 1.823548 |
| [15,20)   | 0.02161  | 0.023147 | 0.024622 | 0.035323 | 0.036825 | 0.038282 | 1.634593 | 1.590928 | 1.554769 |
| [20,25)   | 0.042101 | 0.044197 | 0.04613  | 0.068304 | 0.070392 | 0.072277 | 1.622399 | 1.592698 | 1.566813 |
| [25,30)   | 0.037596 | 0.039434 | 0.041197 | 0.063482 | 0.065195 | 0.06693 | 1.688559 | 1.653254 | 1.624614 |

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| Age Group | Percentage | Standard Deviation | Mean | Standard Error | 95% CI Low | 95% CI High |
|-----------|------------|--------------------|------|---------------|------------|-------------|
| [30,35)   | 0.034108   | 0.035655           | 0.037418 | 0.046105 | 0.047775 | 0.049403 | 1.351759 | 1.339918 | 1.320308 |
| [35,40)   | 0.037044   | 0.038699           | 0.040471 | 0.051488 | 0.052922 | 0.054541 | 1.389914 | 1.367557 | 1.347647 |
| [40,45)   | 0.032887   | 0.034472           | 0.03609  | 0.038329 | 0.039628 | 0.04086  | 1.165477 | 1.149573 | 1.132147 |
| [45,50)   | 0.040258   | 0.041917           | 0.043616 | 0.047524 | 0.048936 | 0.050434 | 1.180501 | 1.167439 | 1.156317 |
| [50,55)   | 0.042134   | 0.043743           | 0.045571 | 0.041578 | 0.04286  | 0.044193 | 0.986791 | 0.979801 | 0.969764 |
| [55,60)   | 0.04309    | 0.044721           | 0.046526 | 0.043962 | 0.045336 | 0.046846 | 1.020235 | 1.013743 | 1.006878 |
| [60,65)   | 0.044889   | 0.046779           | 0.048583 | 0.046622 | 0.048595 | 0.050571 | 1.038604 | 1.038817 | 1.040915 |
| [65,70)   | 0.045654   | 0.047994           | 0.050251 | 0.047142 | 0.049538 | 0.05194  | 1.032579 | 1.032169 | 1.033613 |
| [70,75)   | 0.039149   | 0.041289           | 0.04376  | 0.02599  | 0.027916 | 0.029953 | 0.663877 | 0.676113 | 0.684477 |
| [75+]     | 0.126492   | 0.13185            | 0.136889 | 0.140551 | 0.148336 | 0.15708  | 1.11114  | 1.125044 | 1.147502 |

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**eFigure 3.** Result of Sensitivity Analysis: 40% Asymptomatic Infections

### A. Age-varying susceptibility to the SARS-CoV-2

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|----------------------|------------------|-----------|
| [0,5)     | 2.50% 0.034055       | 50% 0.037556     | 97.50%    |
|           | 97.50% 0.040725      | 50% 0.055123     | 97.50%    |
| [5,10)    | 2.50% 0.028982       | 50% 0.031427     | 97.50%    |
|           | 97.50% 0.034079      | 50% 0.054844     | 97.50%    |
| [10,15)   | 2.50% 0.034077       | 50% 0.036518     | 97.50%    |
|           | 97.50% 0.039336      | 50% 0.069659     | 97.50%    |
| [15,20)   | 2.50% 0.028991       | 50% 0.031139     | 97.50%    |
|           | 97.50% 0.033173      | 50% 0.049922     | 97.50%    |
| [20,25)   | 2.50% 0.056732       | 50% 0.059505     | 97.50%    |
|           | 97.50% 0.062333      | 50% 0.09836      | 97.50%    |

### B. Fold-rise in susceptibility to the Delta/pre-Delta
| Age Group | Mean | 95% CI | Median | 95% CI | Minimum | 95% CI | Maximum | 95% CI |
|-----------|------|--------|--------|--------|---------|--------|---------|--------|
| [25,30)   | 0.050627 | 0.05319 | 0.055891 | 0.090664 | 0.093327 | 0.095974 | 1.790827 | 1.754605 | 1.717169 |
| [30,35)   | 0.045527 | 0.047774 | 0.050278 | 0.065976 | 0.068175 | 0.070729 | 1.449169 | 1.427031 | 1.406752 |
| [35,40)   | 0.049432 | 0.051736 | 0.05418 | 0.072658 | 0.074838 | 0.077252 | 1.469865 | 1.446546 | 1.425849 |
| [40,45)   | 0.043944 | 0.046094 | 0.048272 | 0.054637 | 0.056456 | 0.058322 | 1.243351 | 1.22481 | 1.208191 |
| [45,50)   | 0.05373 | 0.055979 | 0.058476 | 0.067795 | 0.070014 | 0.072315 | 1.261771 | 1.250725 | 1.236643 |
| [50,55)   | 0.05656 | 0.058938 | 0.061415 | 0.059183 | 0.061022 | 0.063009 | 1.046363 | 1.035359 | 1.025942 |
| [55,60)   | 0.058006 | 0.060313 | 0.062604 | 0.06214 | 0.064275 | 0.066431 | 1.071269 | 1.06569 | 1.061132 |
| [60,65)   | 0.060278 | 0.062956 | 0.065515 | 0.065896 | 0.068645 | 0.071397 | 1.093203 | 1.090351 | 1.089767 |
| [65,70)   | 0.061658 | 0.064603 | 0.067678 | 0.066379 | 0.069972 | 0.073606 | 1.076568 | 1.08311 | 1.087595 |
| [70,75)   | 0.053366 | 0.056472 | 0.05983 | 0.036458 | 0.039311 | 0.042402 | 0.683174 | 0.696119 | 0.708713 |
| [75+]     | 0.172041 | 0.17943 | 0.186494 | 0.196831 | 0.209439 | 0.222033 | 1.144092 | 1.167244 | 1.190564 |
**eFigure 4.** Result of Sensitivity Analysis: Age-Varying Asymptomatic Proportions

52%, 50%, 45%, and 12% among individuals aged 0–4 years, 5–11 years, 12–17 years, and 18 years or older, respectively.

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|----------------------|------------------|----------|
| [0,5)     | 0.028675 0.031236 0.034147 | 0.046062 0.048522 0.051124 | 1.606377 1.553394 1.497158 |
| [5,10)    | 0.024929 0.027085 0.02924 | 0.048033 0.050374 0.052918 | 1.926812 1.859873 1.809756 |
| [10,15)   | 0.030225 0.032527 0.035035 | 0.063673 0.066354 0.069409 | 2.106616 2.039944 1.9811  |
| [15,20)   | 0.024597 0.026322 0.028241 | 0.043749 0.045612 0.047407 | 1.778615 1.732831 1.678682 |
| [20,25)   | 0.045476 0.047701 0.049893 | 0.078916 0.08111 0.083646 | 1.735338 1.700378 1.676491 |
| Age Group | Mean Age | Mean BMI | Mean SBP | Mean DBP | Mean Glucose | Mean HbA1c |
|-----------|---------|---------|---------|---------|-------------|------------|
| [25,30)   | 0.040659| 0.042504| 0.044425| 0.072461| 0.074412    | 0.076394   | 1.782155   | 1.750735   | 1.71961     |
| [30,35)   | 0.036702| 0.03864 | 0.040541| 0.053069| 0.054924    | 0.056863   | 1.445929   | 1.421442   | 1.402599    |
| [35,40)   | 0.040364| 0.042229| 0.044234| 0.059069| 0.060969    | 0.062992   | 1.463404   | 1.443775   | 1.424069    |
| [40,45)   | 0.03561 | 0.037418| 0.039101| 0.044228| 0.045647    | 0.047333   | 1.241996   | 1.219929   | 1.210533    |
| [45,50)   | 0.043488| 0.045388| 0.047337| 0.054772| 0.056564    | 0.058474   | 1.259462   | 1.246234   | 1.235264    |
| [50,55)   | 0.045404| 0.047335| 0.049215| 0.047592| 0.049037    | 0.050564   | 1.048204   | 1.035964   | 1.027417    |
| [55,60)   | 0.0467  | 0.048647| 0.050525| 0.050252| 0.051929    | 0.053586   | 1.076046   | 1.067476   | 1.060567    |
| [60,65)   | 0.049185| 0.051086| 0.053098| 0.053996| 0.056111    | 0.058203   | 1.097813   | 1.098358   | 1.096151    |
| [65,70)   | 0.050295| 0.052801| 0.055437| 0.05528 | 0.058034    | 0.060712   | 1.099109   | 1.09911    | 1.09515     |
| [70,75)   | 0.043293| 0.045813| 0.048555| 0.030568| 0.032808    | 0.03522    | 0.706058   | 0.71612    | 0.725355    |
| [75+)     | 0.140277| 0.146151| 0.152142| 0.166294| 0.175837    | 0.186653   | 1.185464   | 1.203116   | 1.226837    |
**eFigure 5.** Result of Sensitivity Analysis: Age-Varying Ascertainment Ratio

1.2 times more cases than reported among those aged < 20 years

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|----------------------|------------------|-----------|
| [0,5)     | 0.032687             | 0.035518         | 0.038205  |
| [5,10)    | 0.026812             | 0.028739         | 0.030869  |
| [10,15)   | 0.030212             | 0.032356         | 0.034665  |
| [15,20)   | 0.025982             | 0.027553         | 0.029247  |
| [20,25)   | 0.04537              | 0.047496         | 0.049729  |

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| Age Group | Mean 25th | Mean 50th | Mean 75th | Median 25th | Median 50th | Median 75th |
|-----------|-----------|-----------|-----------|-------------|-------------|-------------|
| [25,30)   | 0.041124  | 0.043114  | 0.045105  | 0.070931    | 0.072849    | 0.074815    | 1.724805    | 1.689702    | 1.658671    |
| [30,35)   | 0.0369    | 0.038797  | 0.040823  | 0.05115     | 0.052882    | 0.054547    | 1.386189    | 1.363025    | 1.336186    |
| [35,40)   | 0.040016  | 0.04178   | 0.043692  | 0.055866    | 0.0577      | 0.059538    | 1.396104    | 1.381051    | 1.362693    |
| [40,45)   | 0.035528  | 0.037248  | 0.038774  | 0.041749    | 0.043099    | 0.044956    | 1.175115    | 1.157078    | 1.151718    |
| [45,50)   | 0.043224  | 0.045076  | 0.047013  | 0.052023    | 0.053554    | 0.055167    | 1.203584    | 1.18808     | 1.173448    |
| [50,55)   | 0.04551   | 0.047388  | 0.049275  | 0.045532    | 0.046975    | 0.048462    | 1.000494    | 0.991285    | 0.983507    |
| [55,60)   | 0.046831  | 0.048549  | 0.050566  | 0.048173    | 0.049679    | 0.051223    | 1.028655    | 1.023283    | 1.013       |
| [60,65)   | 0.04882   | 0.05092   | 0.052965  | 0.0506      | 0.052817    | 0.055149    | 1.036474    | 1.037249    | 1.041235    |
| [65,70)   | 0.049538  | 0.051932  | 0.054468  | 0.05116     | 0.053685    | 0.056191    | 1.032756    | 1.033754    | 1.031622    |
| [70,75)   | 0.042217  | 0.04471   | 0.04735   | 0.0275      | 0.029682    | 0.031877    | 0.651389    | 0.663883    | 0.673226    |
| [75+]     | 0.135969  | 0.141575  | 0.147052  | 0.148358    | 0.157357    | 0.167277    | 1.091117    | 1.111471    | 1.137537    |
eFigure 6. Result of Sensitivity Analysis: 25% Relative Infectiousness of Asymptomatic Infections
| Age Group | Median 30% | Median 50% | Median 95% | Mean 30% | Mean 50% | Mean 95% |
|-----------|------------|------------|------------|----------|----------|----------|
| [30,35)   | 0.035677   | 0.053432   | 0.057217   | 1.497655 | 1.474604 | 1.450124 |
| [35,40)   | 0.038673   | 0.059027   | 0.062797   | 1.526304 | 1.506096 | 1.484609 |
| [40,45)   | 0.034369   | 0.044081   | 0.047142   | 1.282586 | 1.26617  | 1.257626 |
| [45,50)   | 0.041781   | 0.054659   | 0.058439   | 1.308251 | 1.296741 | 1.284913 |
| [50,55)   | 0.044086   | 0.047721   | 0.050825   | 1.082466 | 1.074755 | 1.065669 |
| [55,60)   | 0.045281   | 0.050505   | 0.053749   | 1.115371 | 1.109077 | 1.099277 |
| [60,65)   | 0.047255   | 0.053417   | 0.057919   | 1.130397 | 1.131802 | 1.130756 |
| [65,70)   | 0.047923   | 0.054386   | 0.059626   | 1.134864 | 1.131146 | 1.132421 |
| [70,75)   | 0.041021   | 0.029371   | 0.034138   | 0.716015 | 0.731784 | 0.742637 |
| [75+]     | 0.131881   | 0.159522   | 0.179414   | 1.209595 | 1.22891  | 1.25716  |
eFigure 7. Result of Sensitivity Analysis: 75% Relative Infectiousness of Asymptomatic Infections

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|----------------------|------------------|-----------|
| [0,5)     | 0.033943 0.03685 0.039607 | 0.042358 0.044708 0.046822 | 1.247914 1.213264 1.182169 |
| [5,10)    | 0.027768 0.029841 0.032123 | 0.042186 0.044286 0.046344 | 1.51926 1.484061 1.442694 |
| [10,15)   | 0.031355 0.033613 0.035893 | 0.053688 0.056145 0.058397 | 1.712256 1.670328 1.62697 |
| [15,20)   | 0.02704 0.028668 0.030446 | 0.038613 0.040154 0.041802 | 1.428026 1.400642 1.373003 |
| [20,25)   | 0.047153 0.049349 0.051717 | 0.075459 0.077653 0.080205 | 1.600281 1.573546 1.55085 |
| [25,30)   | 0.042717 0.044706 0.046839 | 0.069965 0.071956 0.07403 | 1.637871 1.609528 1.580525 |

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| Age Group | Mean 1 | Mean 2 | Mean 3 | Mean 4 | Mean 5 | Mean 6 |
|-----------|--------|--------|--------|--------|--------|--------|
| [30,35)   | 0.038287 | 0.040287 | 0.042332 | 0.05065 | 0.052459 | 0.054214 |
| [35,40)   | 0.041554 | 0.043426 | 0.045446 | 0.055986 | 0.057748 | 0.059534 |
| [40,45)   | 0.036977 | 0.038701 | 0.040315 | 0.041815 | 0.043246 | 0.044698 |
| [45,50)   | 0.044915 | 0.046807 | 0.048784 | 0.051849 | 0.053657 | 0.055428 |
| [50,55)   | 0.047258 | 0.049217 | 0.051192 | 0.045287 | 0.046786 | 0.048225 |
| [55,60)   | 0.048446 | 0.050282 | 0.052327 | 0.047945 | 0.049476 | 0.050964 |
| [60,65)   | 0.050478 | 0.052637 | 0.054713 | 0.050753 | 0.052908 | 0.054973 |
| [65,70)   | 0.051162 | 0.053621 | 0.056201 | 0.051658 | 0.054016 | 0.056598 |
| [70,75)   | 0.043436 | 0.045993 | 0.048739 | 0.027921 | 0.030186 | 0.032433 |
| [75+)     | 0.139854 | 0.145725 | 0.151337 | 0.151564 | 0.16041 | 0.170559 |
**eFigure 8.** Result of Sensitivity Analysis: Vaccine Efficacy at Lower Bound of 95% CI

A. Age-varying susceptibility to the SARS-CoV-2

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|----------------------|------------------|-----------|
| [0,5)     | 0.02829 0.030807 0.033569 | 0.04305 0.045447 0.047569 | 1.521747 1.475223 1.417061 |
| [5,10)    | 0.023685 0.025646 0.027586 | 0.042912 0.045041 0.047124 | 1.811787 1.756235 1.708248 |
| [10,15)   | 0.027847 0.02998 0.032231 | 0.05455 0.057028 0.059332 | 1.9589 1.902171 1.840861 |
| [15,20)   | 0.023795 0.02538 0.027121 | 0.039022 0.040582 0.042266 | 1.639939 1.598983 1.558444 |
| [20,25)   | 0.046352 0.048611 0.051073 | 0.075683 0.077911 0.080492 | 1.632785 1.602738 1.576042 |
| [25,30)   | 0.04139 0.043289 0.045337 | 0.070158 0.072175 0.074224 | 1.695051 1.667291 1.637171 |

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| Age Group | Median BP (mmHg) |
|-----------|-----------------|
| [30,35)   | 0.037224 0.039097 0.040973 | 0.050789 0.052562 0.054296 | 1.364424 1.344406 1.325173 |
| [35,40)   | 0.040271 0.04238 0.044537 | 0.056114 0.057846 0.059658 | 1.393392 1.364952 1.339525 |
| [40,45)   | 0.036144 0.037729 0.039539 | 0.041805 0.043217 0.044662 | 1.156616 1.145471 1.129577 |
| [45,50)   | 0.043949 0.045958 0.047976 | 0.051843 0.053621 0.055395 | 1.179614 1.166747 1.154652 |
| [50,55)   | 0.04641 0.048158 0.050051 | 0.044658 0.046113 0.047532 | 0.962257 0.95753 0.949682 |
| [55,60)   | 0.047279 0.049315 0.051147 | 0.047246 0.04877 0.050242 | 0.99931 0.988937 0.982299 |
| [60,65)   | 0.049461 0.051628 0.053608 | 0.042538 0.044387 0.04612 | 0.860038 0.859746 0.860319 |
| [65,70)   | 0.050556 0.053013 0.055442 | 0.043347 0.0453 0.047449 | 0.857407 0.854512 0.855822 |
| [70,75)   | 0.043144 0.045885 0.048753 | 0.023427 0.025309 0.027174 | 0.543006 0.551571 0.557375 |
| [75+]     | 0.140352 0.145997 0.151866 | 0.13443 0.142278 0.151246 | 0.957808 0.974527 0.995918 |
**eFigure 9.** Result of Sensitivity Analysis: Vaccine Efficacy at Upper Bound of 95% CI

### A. Age-varying susceptibility to the SARS-CoV-2

| Age group | 3rd wave (Pre-Delta) | 4th wave (Delta) | Fold-rise |
|-----------|----------------------|------------------|-----------|
| [0,5)     | 0.02829 | 0.030807 | 0.033569 | 0.043874 | 0.046316 | 0.048479 | 1.550885 | 1.503437 | 1.444158 |
| [5,10)    | 0.023685 | 0.025646 | 0.027586 | 0.043672 | 0.045865 | 0.047947 | 1.843859 | 1.788349 | 1.738085 |
| [10,15)   | 0.027847 | 0.02998 | 0.032231 | 0.055443 | 0.058013 | 0.060346 | 1.990975 | 1.935038 | 1.8723 |
| [15,20)   | 0.023795 | 0.02538 | 0.027121 | 0.040133 | 0.0471 | 0.043431 | 1.68664 | 1.64365 | 1.601381 |
| [20,25)   | 0.046352 | 0.048611 | 0.051073 | 0.079176 | 0.081483 | 0.084143 | 1.708148 | 1.676218 | 1.647519 |
| [25,30)   | 0.04139 | 0.043289 | 0.045337 | 0.073459 | 0.075573 | 0.077757 | 1.77479 | 1.7458 | 1.715109 |

### B. Fold-rise in susceptibility to the Delta/pre-Delta

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| [30,35) | 0.037224 0.039097 0.040973 | 0.053203 0.055076 0.056962 | 1.429278 1.408711 1.390225 |
| [35,40) | 0.040271 0.042380 0.044537 | 0.058771 0.060590 0.062526 | 1.459369 1.429697 1.403918 |
| [40,45) | 0.036144 0.037729 0.039539 | 0.043967 0.045451 0.047015 | 1.216428 1.204667 1.189095 |
| [45,50) | 0.043949 0.045958 0.047976 | 0.054495 0.056396 0.058266 | 1.239962 1.227123 1.214449 |
| [50,55) | 0.046410 0.048158 0.050051 | 0.048101 0.049720 0.051260 | 1.036442 1.032429 1.024154 |
| [55,60) | 0.047279 0.049315 0.051147 | 0.050928 0.052564 0.054145 | 1.077189 1.065872 1.058608 |
| [60,65) | 0.049461 0.051628 0.053608 | 0.063546 0.066306 0.068849 | 1.284776 1.284310 1.284310 |
| [65,70) | 0.050556 0.053013 0.055442 | 0.064663 0.067643 0.070902 | 1.279042 1.275959 1.278847 |
| [70,75) | 0.043144 0.045885 0.048753 | 0.034943 0.037807 0.040606 | 0.809932 0.823943 0.832892 |
| [75+)  | 0.140352 0.145997 0.151866 | 0.182573 0.193139 0.205337 | 1.300821 1.322901 1.352092 |