**System requirements**

* + Operating System Linux/FreeBSD based
  + Intel x86 Cpu
  + clang version 11.0.0 (clang-1100.0.33.17)
* GSL - GNU Scientific Library

**Versions the software has been tested on**

* MacOS Catalina (version 10.15.5)
* GSL (version 2.6)

**Compile code**

Launch script

*src/compile.sh*

**Demo**

* Demo vaccination: launch script

*src/run\_demo\_vax.sh*

* Demo no vaccination: launch script

*src/run\_demo\_novax.sh*

**Example of launch script:**

./gen ../exp -w *CHI* -s *0* -selReff 1.3 -ni 40 -selVAXEFF 80 -selIMM 0 -is 1 -cov 70 -capacity 3000000 -interv 1 -omega\_1 0.04761905-omega\_2 0.07142857 -waning\_rate 0 -tstartvax 15 -tstartinf 0 -pdetected 1 -vax\_only\_susc 1 -vax\_prevent 0

**Table 1:** Command line arguments

|  |  |  |  |
| --- | --- | --- | --- |
| Argument | Type | Description | Baseline values |
| argv[1] | string | Path to output directory | ../exp |
| -w | string | Specifier of region/state | CHI |
| -s | int | Random seed | [0,Inf) |
| -selReff | double | Selector of transmissibility (used to read corresponding input vector of attenuated scale factors for transmission betas) | 1.1;1.3;1.5; 2.5 |
| -selVAXEFF | int | Selector for vaccine efficacy file, indicates vaccine efficacy achieved after the 2nd dose in people aged 20-59y (used to read corresponding matrix of vaccine efficacy by age in the different vaccination compartments) | 0 (corresponds to scenario without vaccination); 80 |
| -selIMM | Int | Identifier of scenario considered for initial immunity (“0” corresponds to 0% of immune in each age group). | 0 |
| -is | int | Susceptibility to infection | 1 (age-specific) |
| -cov | Int | Vaccination coverage (used to select input file of number of doses administered over time) | 70 |
| -capacity | Int | System capacity - daily number of first doses the system is capable to administer (used to select input file of number of doses administered over time) | 3mln |
| -interv | int | Identifier of population priority (used to select input file of number of doses administered over time) | 1 |
| -ni | double | Initial number of infections | 40 |
| -omega\_1 | double | Rate of transition between V0 and V1 (1/interval between 1st and 2nd dose). | 0.04761905 |
| -omega\_2 | double | Rate of transition between V1 and V2 (1/time needed by 2nd dose to become effective) | 0.07142857 |
| -waning\_rate | double | Rate of transition between V2 and W | 0 |
| -tstartvax | int | Time at which vaccination starts (days) | 15 |
| -tstartinf | int | Time at which epidemic is seeded (days) | 0 |
| -pdetected | double | Percentage of symptomatic cases detected | 1 |
| -vax\_only\_susc | Int | Parameter identifying to who vaccination is administered | 1 (vaccinate susceptible only, i.e. all symptomatic/asymptomatic infections are detected) |
| -vax\_prevent | Int | Identifier of type of vaccine, either preventing SARS-CoV-2 infection or symptoms only | 0 (vaccine prevents infection) |

Table: Description of input and output files. Symbols in brackets (e.g. *{-w}* ) in file name represent the value of the specified command line parameter.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| File name | Path from  common\_input folder | Dimension  (rows x columns)a | Type | Sep | Description |
| INPUT | | | | | | |
| parameters | ./ | 4x2 | *gamma*: double  *ZETA*: int  *Nit*: int  *Tmax*: int | Tab | Column 1: parameter name  *gamma*: recovery rate  *ZETA:* time steps per day  *Nit, Tmax:* see note **a**  Column 2: parameter value |
| age\_structure\_*{-w}\_u* | ./age\_structure/ | Ax3 | Int | Tab | Column 1: lower age limit  Column 2: upper age limit  Column 3: population with underlying conditions in age group |
| age\_structure\_*{-w}\_nu* | ./age\_structure/ | Ax3 | Int | Tab | Column 1: lower age limit  Column 2: upper age limit  Column 3: population without underlying conditions in age group |
| beta\_*{-w}*\_SUSC\_*{-is}\_Reff\_{-selReff}* | ./betas/{-w}/{-selIMM} | Nx1 | double | - | Scaling factor shaping the transmissibility (*N* stochastic samples **b**) |
| relative\_susceptibility\_matrix\_susc\_*{-is}* | ./ | AxN | double | Tab | Age-specific relative susceptibility (*N* stochastic samples **b**) |
| * ac\_h\_ext\_\* * ac\_s\_ext\_\* * ac\_w\_ext\_\* * ac\_r\_ext\_\*   \* runs from 1 to *Nit* a | ./contact\_matrices/{-w} | AxA | double | Tab | Average number of contacts of an individual of age group (row) with individuals of age group (column).   * ac\_h\_ext\_\*: household contacts * ac\_s\_ext\_\*: school contacts * ac\_w\_ ext\_\*: contacts at work * ac\_r\_ ext\_\*: community contacts |
| initial\_immunity\_*{-selIMM}* | ./initial\_immunity/{-w} | AxN | double | Tab | Age-specific proportion of immune individuals at the beginning of simulations (assumed to be the same for individuals with/without underlying conditions) |
| psym | ./ | 1xA | Double | Tab | Age-specific probability of developing symptoms |
| vaccine\_efficacy\_{-selVAXEFF} | ./vaccination/vaccine\_efficacy | Ax3\*  \*3=number of vaccination compartments (fixed) | double | Tab | Age-specific vaccine efficacy in the different ramp-up stages (V0,V1,V2) |
| u\_ndoses\_CHI\_capacity\_*{-capacity}\_*cov\_*{-cov}* | ./vaccination/ndoses/{-w}/{-priority} | (TxZETA)xA | int | Tab | Age-specific number of doses to be administered in each time step to individuals with underlying conditions |
| nu\_ndoses\_CHI\_capacity\_*{-capacity}\_*cov\_*{-cov}* | ./vaccination/ndoses/{-w}/{-priority} | (TxZETA)xA | int | Tab | Age-specific number of doses to be administered in each time step to individuals without underlying conditions |
| OUTPUT | | | | | | |
| resA\_{-w}\_ phi{-selReff}\_vaxeff{-selVAXEFF}\_susc{-is}\_interv{-interv}\_iscen{-selIMM}\_capacity{-capacity}\_cov{-cov}\_sim\_$.tsv | {argv[1]}/{-w}/ interv\_{-interv} | Tx(Ax2) | int | Tab | Number of new infections in age group at time . The first A columns correspond to individuals with underlying conditions, the second A columns corresponds to the population without **b** |
| resB\_{-w}\_ phi{-selReff}\_vaxeff{-selVAXEFF}\_susc{-is}\_interv{-interv}\_iscen{-selIMM}\_capacity{-capacity}\_cov{-cov}\_sim\_$.tsv | {argv[1]}/{-w}/ interv\_{-interv} | Tx(Ax2) | int | Tab | Number of new infections in age among individuals in age group in compartment V2 at time. The first A columns correspond to individuals with underlying conditions, the second A columns corresponds to the population without **b** |

**a**: A: number of age groups (18); N: number of stochastic simulations (equal to *Nit*, set to *2*00); T: number of simulation days (equal to *Tmax*).

**b**: Each execution of the code runs *Nit* model simulations and prints the corresponding output file (identified by $\in{1,2,3,…,Nit})