**Functional Testing for BackToSchool Model**

The model code implementing the structural checks and tracking variables discussed below is provided in abm\_code.R, model output can be generated using the test\_runs.R script, and the Table 1 checks listed below can be replicated with the table1\_checks.R script.

**Table 1 Checks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Target Value** | **Observed Value** | **Relative Difference** | **Approach to tracking** |
| Baseline Attack Rate | 0.070 | 0.070 | <1% | The model code tracks the total number of contacts for each type of interaction between infected and susceptible individuals (e.g., at-home contact between an asymptomatic adult and child) and the total number of infections resulting from those contacts.  In order to recover an estimate for each attack rate multiplier from these trackers, we used a three-step process. First, for all types of interactions that involved a particular multiplier (e.g., at-home attack rate multiplier), we calculated the number of infections that we would expect to see in the absence of that multiplier by multiplying the tracked number of contacts for those interactions by all the other relevant multipliers (e.g., for at-home interaction between an asymptomatic adult and child, multiply total number of contacts by the baseline attack rate, asymptomatic adult infectiousness multiplier, and child susceptibility multiplier, but not the at-home multiplier); we calculated the total number of expected infections across all types of interactions involving the particular multiplier. Second, we calculated the total number of tracked actual infections across those interactions. Third, we divided this total number of actual infections by the total number of infections we would expect in the absence of the multiplier (calculated in the first step). If the model code has implemented the multiplier correctly, this quotient will equal (in the limit) the particular multiplier parameter we want to recover.  *Tracker names (in abm\_code.R):*  person.days.at.risk.home.parents, etc. (for number of contacts per interaction type) and the location, source, adult, and source\_symp variables (for number of infections from each interaction type). These trackers are summarized., respectively, at the end of the model run in the risk\_ct\_sympA\_A\_home, etc. and inf\_ct\_sympA\_A\_home, etc. variables. |
| At-school mitigation multiplier | 0.500 | 0.501 | <1% |
| At-school mitigation multiplier | 1.000 | 1.002 | <1% |
| At-home attack rate multiplier | 2.000 | 2.015 | <1% |
| Brief contact multiplier | 0.125 | 0.125 | <1% |
| Staff-staff contact multiplier | 2.000 | 1.996 | <1% |
| Child care contact multiplier | 1.000 | 1.000 | <1% |
| Child infectiousness multiplier | 0.500 | 0.501 | <1% |
| Asymptomatic adult infectiousness multiplier | 0.500 | 0.497 | <1% |
| Symptomatic child at-home infectiousness multiplier | 2.000 | 2.020 | <1% |
| Child susceptibility multiplier | 0.500 | 0.500 | <1% |
| Latent Period (days) | 3.046 | 3.045 | <1% | Each day in the model, it is checked who is infected but not infectious (latent), infected but not symptomatic (incubation), or infectious at home. For people who meet the criteria, 1 is added to a tracker for the latent, incubation, or infectious period. Individuals infected in the broader community are not included in this tracker, because they can become infected in the “start-up” period in the model.  The infectious period at home is tracked instead of other infectious period metrics (e.g., infectious days at school), since the other metrics are impacted by policies like testing and quarantine. The code for these policies is tested using the “structural checks” described below.  *Tracker names (in abm\_code.R):*  exposed\_not.inf\_days, exposed\_not.symp\_days, and inf\_home\_days, to track latent, incubation, and infectious periods, respectively. |
| Incubation Period (days) | 5.010 | 5.012 | <1% |
| Infectious Period (days) | 5.051 | 5.051 | <1% |
| Probability of asymptomatic infection (child) | 0.400 | 0.398 | <1% | Total number of infected individuals who are not flagged as symptomatic divided by total number of infected individuals.  *Tracker names (in abm\_code.R):*  symp |
| Probability of asymptomatic infection (adult) | 0.200 | 0.200 | <1% |
| Probability of subclinical infection (child) | 0.800 | 0.795 | <1% | Total number of infected individuals who are flagged as subclinical divided by total number of infected individuals.  *Tracker names (in abm\_code.R):*  sub\_clin |
| Probability of subclinical infection (adult) | 0.400 | 0.400 | <1% |
| Screening Test Sensitivity | 0.900 | 0.900 | <1% | Total number of true positive tests divided by total number of tests conducted.  *Tracker names (in abm\_code.R):*  pcr\_tp\_count for number of true positive tests and test\_ct for total number of tests conducted. |
| Screening Test Uptake | 0.900 | 0.900 | <1% | Total number of tests conducted divided by total number of times individuals were eligible (i.e., in-school on a screening day).  *Tracker names (in abm\_code.R):*  test\_ct for total number of tests conducted and test\_regular\_eligible for number of times individuals were eligible. |
| Hospitalization Rate (unvaccinated child) | 0.001000 | 0.000999 | <1% | First, the total number of infections tracked in the model was multiplied by the fraction of the susceptible population (i.e., unvaccinated or “non-effective” vaccination) that is unvaccinated. Then, the total number of hospitalized individuals was divided by this number of infections in unvaccinated individuals to recover the hospitalization rate.  *Tracker names (in abm\_code.R):*  children for total number of children infected, adult for total number of teachers infected, family for total number of adult family members infected, hosp\_child for total number of children hospitalized, and hosp\_adult for the total number of adults hospitalized. |
| Hospitalization Rate (unvaccinated adult) | 0.024000 | 0.023996 | <1% |
| Vaccine uptake (student) | 0.250 | 0.250 | <1% | The total number of individuals flagged as vaccinated was divided by the total number of individuals.  *Tracker names (in abm\_code.R):*  vacc |
| Vaccine uptake (teacher) | 0.700 | 0.700 | <1% |
| Vaccine uptake (family) | 0.700 | 0.700 | <1% |
| Vaccine effectiveness | 0.700 | 0.700 | <1% | The total number of individuals flagged as “not susceptible” was divided by the total number of individuals flagged as vaccinated.  *Tracker names (in abm\_code.R):*  susp for susceptible individuals and vacc for vaccinated individuals. |
| Local Incidence Rate (cases per residents per day) | 0.000150 | 0.000150 | <1% | The total number of individuals infected in the wider community was divided by the product of the total number of days run and the total number of individuals in the model.  When an individual was infected within the model (e.g., at school, not in the wider community), the number of days remaining in the model run after their infection was subtracted from the denominator of this fraction.  *Tracker names (in abm\_code.R):*  child.start.count and adult.start.count for total number of individuals infected in the wider community, and child.community.risk.days and adult.community risk days for the number of days individuals were at risk of infection from the wider community. |
| Local Incidence Rate (cases per residents per day) | 0.000750 | 0.000749 | <1% |
| Local Incidence Rate (cases per residents per day) | 0.001500 | 0.001497 | <1% |

**Structural Checks**

*Household Contact Structure*

Model run stopped if the household members contacted by each infected individual do not match the list of all uninfected and susceptible individuals in that household (line 403 in abm\_code.R).

Model run stopped if an infected individual does not contact anyone in their household, but there are uninfected individuals in that household (line 412 in abm\_code.R).

Model run is stopped if an infected individual who was not infected in the wider community does not contact any household members (line 1286 in abm\_code.R).

Model run is stopped if an individual infected in the wider community infects an individual in their household (line 1311 in abm\_code.R).

*In-School Transmissions*

Model run is stopped if an infectious individual is at school on a weekend day (line 1326 in abm\_code.R).

Model run is stopped if individuals infected at school were not supposed to be present at school on that day (lines 1345-1364 in abm\_code.R). The list of individuals present in school on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 807-866 in abm\_code.R).

*Classroom Contact Structure*

Model run stopped if the classroom members contacted by each infected individual do not match the uninfected and susceptible individuals in their classroom present in school on a given day (lines 441-457 in abm\_code.R). The list of individuals present in school on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 807-866 in abm\_code.R).

Model run is stopped if an infected individual does not contact anyone in their classroom when they are at school (lines 485-490 in abm\_code.R).

*Random In-School Contact Structure*

Model run is stopped if the number of individuals randomly contacted by an infected individual at school during the day does not equal the number of contacts prescribed by the model parameter n\_contacts (line 516 in abm\_code.R).

Model run is stopped if the individuals randomly contacted by an infected individual at school are not supposed to be present at school on that day (line 524 in abm\_code.R). The list of individuals present in school on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 807-866 in abm\_code.R).

*Random In-School Staff-Staff Contact Structure*

Model run is stopped if the number of staff members randomly contacted by an infected staff member at school during the day does not equal the number of contacts prescribed by the model parameter n\_staff\_contact (when there are enough staff members present to have that number of contacts) (lines 553-555 in abm\_code.R).

Model run is stopped if the staff members randomly contacted by an infected staff member at school are not supposed to be present at school on that day (line 568 in abm\_code.R). The list of individuals present in school on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 807-866 in abm\_code.R).

*Specials In-School Contact Structure*

Model run is stopped if the teachers contacted by an infected individual in a specials class are not supposed to be present at school on that day (line 755 in abm\_code.R). The list of individuals present in school on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 807-866 in abm\_code.R).

Model run is stopped if the students contacted by an infected teacher in a specials class are not supposed to be present at school on that day (line 770 in abm\_code.R). The list of individuals present in school on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 807-866 in abm\_code.R).

Model run is stopped if an infected individual has a specials class scheduled for the day, but has not contacted anyone in that class (lines 774 in abm\_code.R).

Model run is stopped if the number of specials classes assigned to each specials teacher does not equal 4 (line 1337 in abm\_code.R).

Model run is stopped if at least one infection occurs in a specials classes, but specials classes are turned off with the model parameter run\_specials\_now (line 1796 in abm\_code.R).

*Childcare Contact Structure*

Model run is stopped if there is more than one group of households sharing care that has a size less than the household group size prescribed by the model parameter n\_HH (lines 604-609 in abm\_code.R).

Model run is stopped if the number of adults at each childcare contact is not equal to the number of adults present prescribed by the model parameter num\_adults, and this cannot be explained by the small size of the household group (lines 610-612 in abm\_code.R).

Model run is stopped if the individuals contacted by an infected individual within childcare contacts does not match the list of uninfected, susceptible individuals who are supposed to be present at childcare that day (line 620 in abm\_code.R). The list of individuals present at childcare on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 868-926 in abm\_code.R).

Model run is stopped if individuals infected at childcare were not supposed to be present at childcare on that day (lines 1458-1475 in abm\_code.R). The list of individuals present at childcare on each given day is determined by a separate testing function that takes into account the quarantine, isolation, and testing policy structure in the model (lines 868-926 in abm\_code.R).

*Other Checks*

Model run is stopped if individuals infected on the previous day are not marked as infected the next day (lines 1125-1127 in abm\_code.R).

Model run is stopped if screening testing takes place on any day but a Monday (line 1223 in abm\_code.R).

Model run is stopped if at least one individual is marked as both not susceptible to infection and unvaccinated (line 1962 in abm\_code.R).