Simulating re-opening: model settings

Columbia team

Three Policies for outputs labeled "StopAtPhase2":

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | Policy 1 | Policy 2 | Policy 3 |
| Phase 0 | now – 6/15 | now – 7/1 | now – 7/15 |
| Phase 1 | 6/15 – 8/1 | 7/1 – 8/15 | 7/15 – 9/1 |
| Phase 2 | 8/1 – 9/1 | 8/15 – 9/15 | 9/1 – 10/1 |
| Phase 2 | 9/1 – 12/31 | 9/15 – 12/31 | 10/1 – 12/31 |

Three Policies for outputs labeled "Phase1to4":

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | Policy 1 | Policy 2 | Policy 3 |
| Phase 0 | now – 6/15 | now – 7/1 | now – 7/15 |
| Phase 1 | 6/15 – 8/1 | 7/1 – 8/15 | 7/15 – 9/1 |
| Phase 2 | 8/1 – 9/1 | 8/15 – 9/15 | 9/1 – 10/1 |
| Phase 3 | 9/1 – 10/1 | 9/15 – 10/15 | 10/1 – 11/1 |
| Phase 4 | 10/1 – 12/31 | 10/15 – 12/31 | 11/1 – 12/31 |

For each policy, we simulate epidemic outcomes per the following settings:

1. Seasonality:

1. Assume same seasonality as observed for OC43 (a beta-coronavirus, in the same genus as SARS-CoV-2.
2. Assume no seasonality

2. Immunity:

1. Short-term immunity: 1 year (range: 0.5 – 1.5 years)
2. Mid-term immunity: 3 years (range: 2.5 – 3.5 years); close to estimate for human coronavirus overall (our estimate; unpublished)
3. Long-term immunity: 6 years (range: 5.5 – 6.5 years); close to estimate for OC43 (our estimate; unpublished) and reported for SARS-CoV-1 (2003 outbreak; Tang et al. 2011 *J Immunol* 186:7264-8)

3. Mobility: Estimated per categories of industries allowed to open in different phases (data from Safegraph.com)

1. Low-level increase in mobility: Assume, initially, only 50% of industries open when allowed and those allowed in the previous phase open fully in the next phase.
2. High-level increase in mobility: Assume 100% of industries open when allowed

4. Transmission rate/infectious period – representing level of infection control via precautionary measures (e.g. mask wearing, test & trace, disinfection, etc.)

1. Low-level increase in transmission rate/infectious period: 1st quartile
2. Mid-level increase in transmission rate/infectious period: 2nd quartile
3. High-level increase in transmission rate/infectious period: 3rd quartile

5. Re-introduction of infection (i.e. seeding) from outside:

1. Low-level: 1 per 60 days per uhf per age group
2. Mid-level: 1 per 30 days per uhf per age group
3. High-level: 1 per 7 days per uhf per age group

Note: to reduce number of combinations, we couple #4 with #5. For example, for simulations assuming a low-level increase in transmission rate/infectious period, the level of seeding is also assumed low.

In total: 2 x 3 x 2 x 3 = 36 scenarios for each policy

**Modeling:** An age-specific, network SEIRS (susceptible-exposed-infectious-recovered-susceptible) model was trained on case and mortality data from the week of 3/1/20 to the week of 5/17/20. From the week of 5/24/20 to the week of 12/27/20, the model was integrated stochastically using state variables estimated for the most recent week (5/17) and corresponding parameter settings under each policy and scenario. Each simulation (500 ensemble members) was repeated 10 times and aggregated for the summary.