Planning Parameters for COVID-19 Outbreak Scenarios

***Date**: 2020-03-31*
***Expires**: 2020-04-09*
***POCs**: CDC COVID-19 Modeling Team: eocevent334@cdc.gov*
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How to Use this Document

This document provides parameter values for five outbreak scenarios. These scenarios are to inform planning for potential widespread transmission of COVID-19.

These scenarios are not predictions, nor are they meant to inform forecasts or estimates of the likely impact of COVID-19. Instead, the parameter values detailed below for the outbreak scenarios represent the professional and scientific judgments as values that would be appropriate to use for **planning**. Substantial scientific uncertainty remains around nearly all of these parameters.

These values have expiration dates. Given the rapidly-changing state of the science surrounding the epidemiology of COVID-19, we expect to regularly update these estimates over time. If you need updated values, please request them through one of the POCs above.

COVID-19 Outbreak Scenarios

Below are parameter values for five outbreak scenarios to model for public health response, planning and preparation for the novel coronavirus (COVID-19) outbreak. Each scenario has parameter values for the basic reproduction number (R_0), symptomatic case fatality ratio (CFR), proportion of infections that are asymptomatic, relative infectiousness of asymptomatic individuals (i.e., asymptomatic cases are 50% as infectious as symptomatic cases) and the proportion of transmission that occurs prior to symptom onset.

At this time, there is little information on the effects of age on transmission and severity. As more data become available, these scenarios can be revised to reflect age effects.

The first four scenarios were chosen to attempt to bound the likely potential outcomes. It is considered unlikely that any outbreak would be outside the range of these planning scenarios. The scenarios vary parameters related to asymptomatic transmission because these factors are judged to strongly influence the ability to identify and mitigate exposures. In this document, an asymptomatic individual should be taken to mean one who is either truly asymptomatic or else has such mild symptoms that they would not consider themselves ill. An example of the latter case is someone who retrospectively indicates that they did have mild back pain but did not think that it was indicative of illness.

Values expire 2020-04-09. Scenarios are not predictions.

The fifth planning scenario is a “best guess” of parameters based upon the current state of scientific knowledge, which is still highly uncertain. Because of the many unknowns, these values include much Subject Matter Expertise (SME) judgement and estimation. Higher asymptomatic parameters were selected because of: 1) the current state of knowledge and 2) to err on the side of caution as not over-estimate the ability of community mitigation to halt transmission.

These scenarios are visualized by their relative severity / transmissibility versus asymptomatic transmission fraction in Figure 1, below.

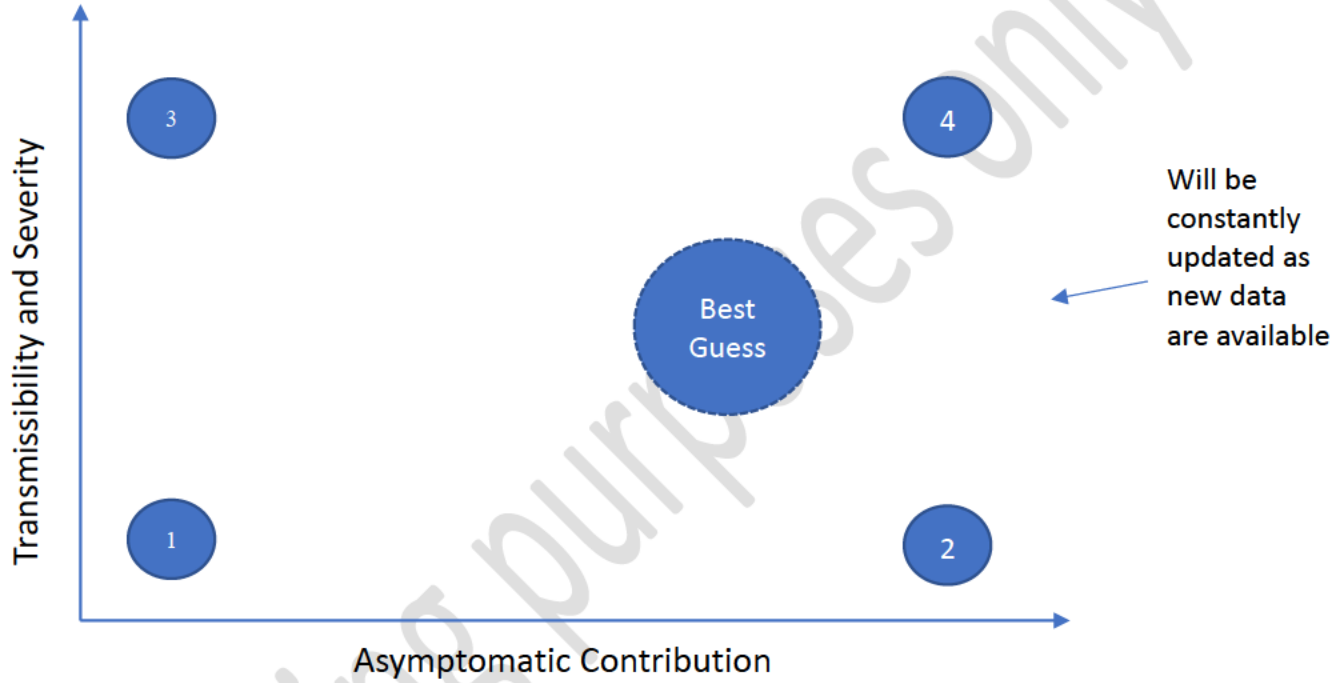

Figure 1: Visualization of Scenarios

Please note that modelers should not feel constrained by these suggested scenarios. You are free to use different parameters if you believe that they are more scientifically supported or more relevant to your particular scenario.

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Table 1. Parameters values for 5 COVID-19 outbreak scenarios. Scenarios are not predictions, can't inform estimates of likely impact, and are only appropriate to use for planning. Updates since prior version are in Red.

Parameter	Scenario 1: Moderate/high severity, low asymptomatic contribution	Scenario 2: Moderate/high severity, high asymptomatic contribution	Scenario 3: High/very high severity, low asymptomatic contribution	Scenario 4: High/Very high severity, high asymptomatic contribution	Scenario 5: "Best Guess" Source: SME Estimates
Doubling Time Source: Preliminary COVID-19 estimatess	~7 Days	~7 Days	~4.5 Days	~4.5 Days	~5.5 Days
Initial R_0 Source:COVID-19 estimates (Note that this does not necessarily correspond to serologic attack rate in a homogenous-mixing SEIR model.)	2	2	3	3	2.5
Overall Unmitigated Serologic Attack Rate Source: Model estimate from above parameters.	50%	50%	70%	70%	60%
Symptomatic Case Fatality Ratio (%) Source:COVID-19 estimates for overall; age-specific assumed to follow U.S. seasonal flu distribution Moderate estimates were chosen to match U.S. seasonal flu.	0–4: 0.006 5–17: 0.004 18–49: 0.025 50–64:0.075 65+: 1 Overall: 0.10–0.15	0–4: 0.006 5–17: 0.004 18–49: 0.025 50–64:0.075 65+: 1 Overall: 0.10–0.15	0–4: 0.04 5–17: 0.03 18–49: 0.18 50–64:0.5 65+: 7.0 Overall: 1.0	0–4: 0.04 5–17: 0.03 18–49: 0.18 50–64:0.5 65+: 7.0 Overall: 1.0	0–4: 0.01 5–17: 0.0075 18–49: 0.045 50–64:0.1 65+: 1.75 Overall: 0.25
Symptomatic Case Hospitalization Ratio (CHR) Source: Preliminary COVID-19 estimates	0–4: 0.50 5–17: 0.1 18–49: 2.0 50–64: 4.5 65+: 4.5 Overall: 4.0	0–4: 0.50 5–17: 0.1 18–49: 2.0 50–64: 4.5 65+: 4.5 Overall: 4.0	0–4: 12.0 5–17: 1.5 18–49: 6.5 50–64: 10.0 65+: 17.0 Overall: 8.0	0–4: 12.0 5–17: 1.5 18–49: 6.5 50–64: 10.0 65+: 17.0 Overall: 8.0	0–4: 4.5 5–17: 0.6 18–49: 3.5 50–64: 7.0 65+: 10 Overall: 5.5
Proportion of infections that are asymptomatic Source: Preliminary COVID-19 estimates	20%	50%	20%	50%	35%
Relative infectiousness of	50%	100%	50%	100%	100%

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asymptomatic individuals (among asymptomatic infections) Source: Assumption					
Proportion of transmission occurring prior to symptom onset (among symptomatic individuals) Source: Preliminary COVID-19 estimates	20%	40%	20%	40%	35%

Pre-existing immunity Source: Assumption	None
Time to Symptom Onset Source: COVID-19 estimates	~5 days (mean)
Average time between primary and secondary infection Source: Assumption from SARS	~7 days (mean)

Table 2. Assumptions to help anticipate resource needs for COVID-19 outbreak scenarios

Time to seek care (outpatient) Source: Survey of persons with ILI	≤2 days: 35% 3–7 days: 50% ≥8 days: 25%
Mean time from onset to hospitalization (S.D.) Source: PreliminaryCOVID-19 estimates	0–49: 5.00 (3.2) 50–64: 6.00 (3.6) ≥65: 5.0 (3.8)
Mean duration of hospitalization (S.D) Source: Preliminary COVID-19 estimates	0–49: 3.3 (3.2) 50–64: 4.0 (3.3) ≥65: 5.1 (4.0
ICU % among those hospitalized Source: Preliminary COVID-19 estimates	0–49: 10.0 50–64: 20.0 65+: 30.0
% ventilated among those in ICU Source: Preliminary COVID-19 estimates	0–49: 60.0 50–64: 75.0 65+: 75.0
Median time from symptom onset to death Source: Preliminary COVID-19 estimates	all ages: 10 days

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Table 3. Key transmissibility and severity parameters for seasonal influenza.

Parameter	Seasonal influenza
Basic Reproduction Number (R_0) Source: https://www.ncbi.nlm.nih.gov/pubmed/25186370	1.3
Approximate Symptomatic Case Fatality Ratio (%) Source: CDC seasonal influenza burden estimates	0–4: 0.006 5–17: 0.004 18–49: 0.025 50–64:0.075 65+: 1 Overall: 0.10–0.15
Approximate Symptomatic Case Hospitalization Ratio (CHR) (%) Source: CDC seasonal influenza burden estimates	0–4: 0.70 5–17: 0.25 18–49: 0.50 50–64: 1.00 65+: 9.0 Overall: 1.5

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Planning Parameters for COVID-19 Outbreak Scenarios

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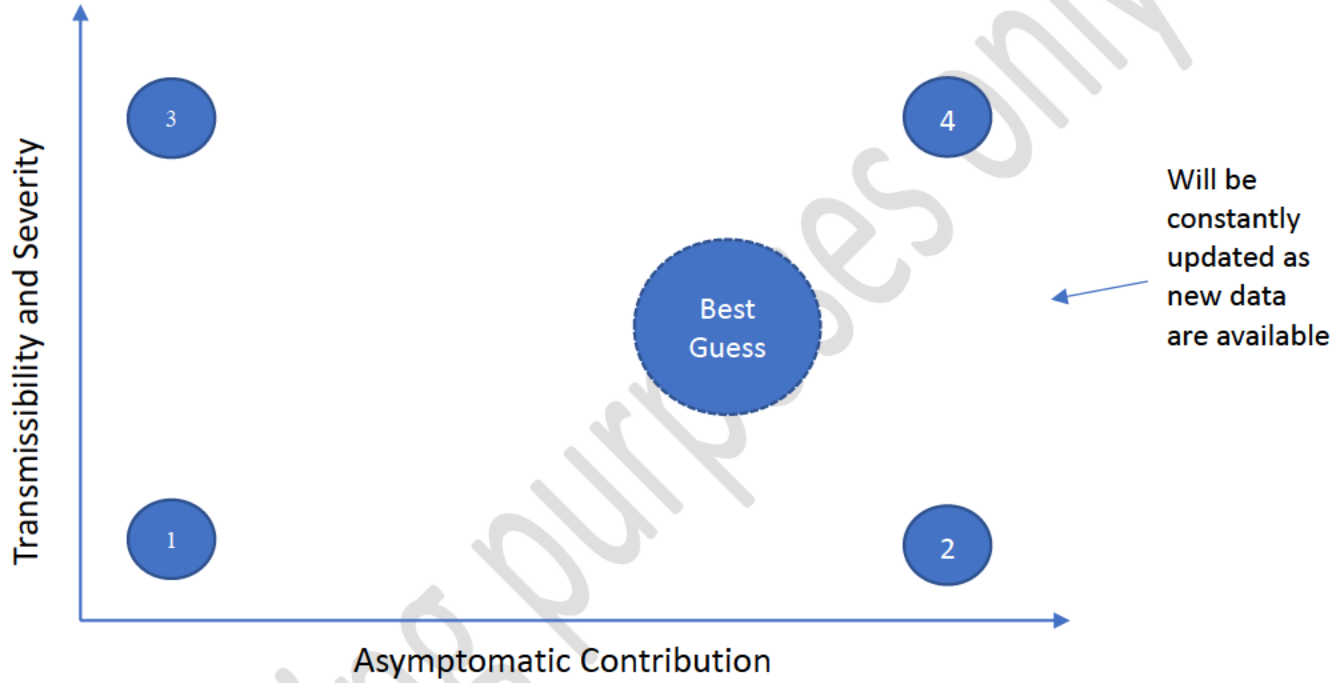

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Proportion of infections that are asymptomatic Source: Preliminary COVID-19 estimates	20%	50%	20%	50%	35%
Relative infectiousness of asymptomatic individuals (among	50%	100%	50%	100%	100%

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Mean duration of hospitalization (S.D) Source: Preliminary COVID-19 estimates	0–49: 3.1 (3.7) 50–64: 7.8 (6.3) ≥65: 6.5 (4.9)
ICU % among those hospitalized Source: Preliminary COVID-19 estimates	0–49: 10.0 50–64: 20.0 65+: 30.0
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