COVID-19 Potential Outcome Scenarios Report

June 2, 2020

Overview

The following results are based on a disease spread model developed by Metabiota for the African Risk Capacity to generate potential COVID-19 pandemic scenarios with temporal dynamics of infections, hospitalizations, and deaths. Our modeling framework consists of a stochastic metapopulation compartment model coupled with human mobility networks. The model uses reported data from official sources and current information about the epidemiological characteristics of COVID-19 from the scientific literature, and population demographic data to develop realistic scenarios of the overall impact of the pandemic. The purpose of this scenario is not to predict what will happen, but to show what could occur under a specific set of assumptions.

Brief methodology:

The model used is a modified SEIR compartment structure. The scenarios start with the current number of COVID-19 infected individuals based on the reported data and is corrected for under-reporting. Simulations are run for up to 3 years. The effective reproduction rate (Rt) at the beginning of all simulations is 2.4. We assume long-term immunity after recovery from infection.

Parameters:

Latent period: 2.3 days
Infectious period: 7.2 days
Case hospitalization ratio: 0.04
Case fatality ratio: 0.008 - 0.04

Scenario 0 - Baseline/Counterfactual:

This scenario represents the baseline or counterfactual example of the epidemic timeline under the assumption that there is no change in policy or response and no change in social distancing behavior. In this scenario we see a potential outcome of the epidemic if there is no change in transmission from a baseline Rt of 2.4 throughout the epidemic. In this scenario, the event peak is very large and varies by country based on the time of case introduction and size of the population. The population will reach herd immunity in this scenario when approximately 85-95% of the population has become infected and approximately 2% of the population dies.

Scenario 1 - Slow Containment (moderate efficacy):

This scenario represents the implementation of national preparedness and response efforts with moderate social distancing (stay at home, not a lockdown). This scenario assumes that the timeline of response is slow with moderate effectiveness in reducing transmission which is sustained. As in the other scenarios, Rt begins at 2.4, and in this scenario, we assume that transmission begins to reduce in mid-June and declines over the following 6 weeks until it

reaches 1.5. Rt then fluctuates around 1.5 for the remainder of the epidemic. Approximately 60-75% of the population has become infected and approximately 1.5% of the population dies.

Scenario 2 - Effective Containment:
This scenario represents the implementation of national preparedness and response actions as per WHO's recommendations and target levels with strict social distancing measures (stay at home with a night-time curfew or total lockdown). This scenario assumes that response happens quickly and is highly effective at reducing and maintaining reduced transmission. As in the other scenarios, Rt begins at 2.4, and in this scenario, we assume that transmission begins to reduce in early-June and declines over the following 6 weeks until it reaches 1.3. Rt then fluctuates around 1.3 for the remainder of the epidemic. Approximately 35-60% of the population has become infected and approximately 1% of the population dies.

Scenario 3 - Accelerated Containment:
This scenario is a slight modification of Scenario 2 but occurs on an accelerated timeline. In this scenario, transmission reduction begins at the end of May and declines over a 3 week period (instead of 6 weeks). Additionally, in late-July of this scenario, Rt is further reduced to 1.1 and fluctuates around this point for the remainder of the event. Approximately 5-35% of the population has become infected and approximately 0.5% of the population dies.

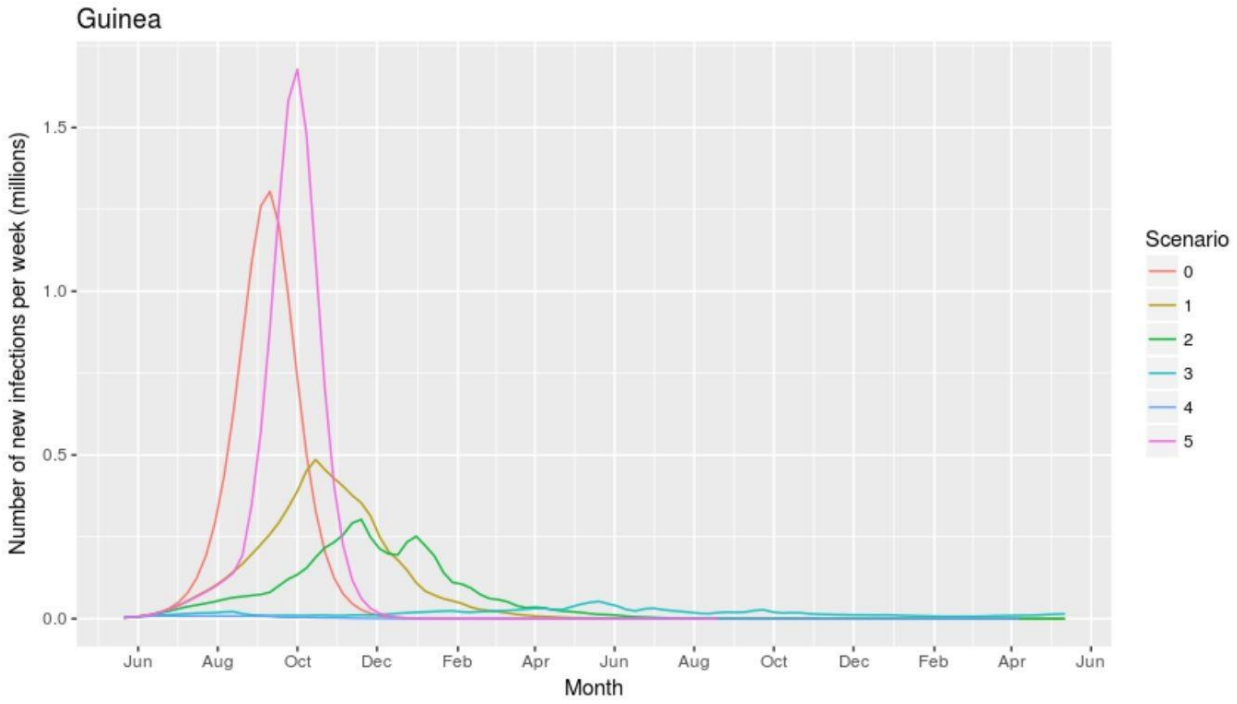
Scenario 4 - R&D Innovation:
This scenario is the most optimistic scenario and represents both accelerated effective containment and the development of a vaccine or therapeutic which is effective in reducing Rt below 1. As in the other scenarios, Rt begins at 2.4, and in this scenario, we assume that transmission begins to reduce at the end of May and declines over a 3 week period to 1.0.
Then, in late September Rt is further reduced to 0.7 which represents the introduction of a vaccine or therapeutic. Less than 10% of the population has become infected and less than 0.1% of the population dies.

Scenario 5 - Failed Containment:
This scenario represents failed containment of the epidemic. This scenario begins with the assumption that there is implementation of national preparedness and response efforts with moderate social distancing (stay at home, not a lockdown) as in Scenario 1 (slow containment). However, in this scenario we assume that these measures are not able to be maintained long term, and eventually transmission increases. As in the other scenarios, Rt begins at 2.4, and in this scenario, we assume that transmission begins to reduce in mid-June and declines over the following 6 weeks until it reaches 1.5. In early August, Rt then increases to 3 where it remains for the remainder of the event. Approximately 85 - 95% of the population has become infected and approximately 3 - 4% of the population dies.

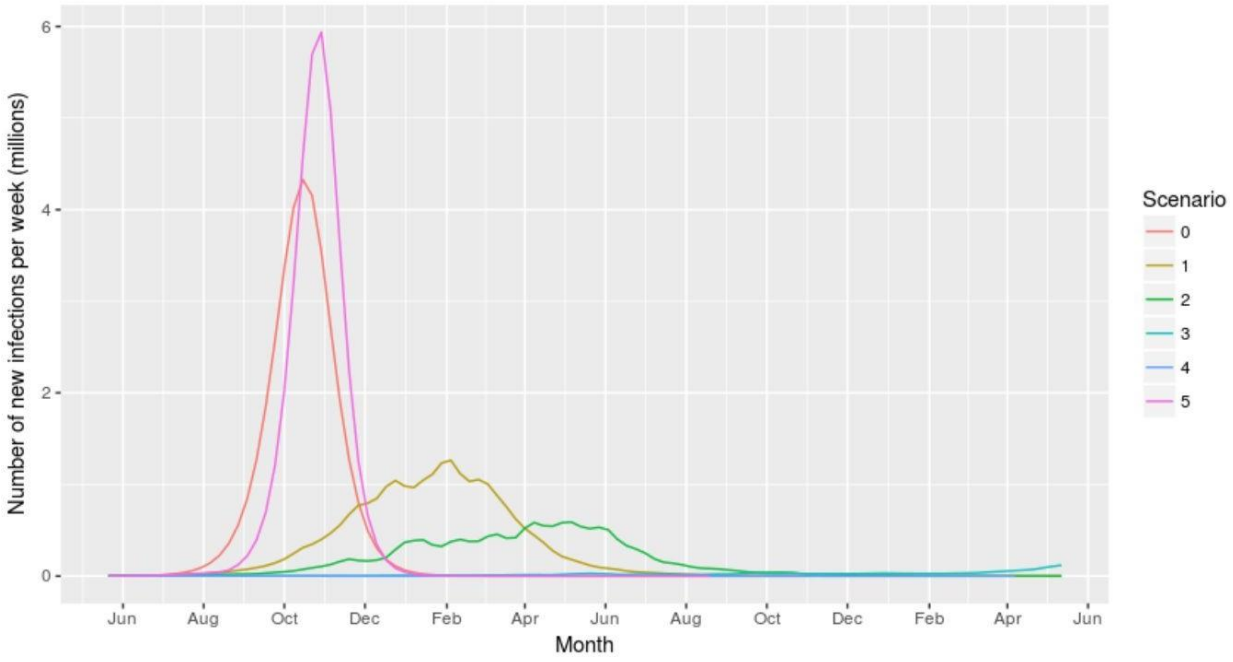
Scenario	Total cumulative infections*	Total cumulative hospitalizations*	Total cumulative deaths*	Percent of the population infected	Percent of the population dead
Guinea - Scenario 0	10,690,967	427,511	267,643	88.42	2.21
Guinea - Scenario 1	7,261,443	290,752	145,055	60.05	1.20
Guinea - Scenario 2	5,490,662	219,853	81,972	45.41	0.68
Guinea - Scenario 3	2,020,784	80,679	20,056	16.71	0.17
Guinea - Scenario 4	187,410	7,648	1,442	1.55	0.01
Guinea - Scenario 5	11,380,165	455,532	455,130	94.12	3.76
Uganda - Scenario 0	35,453,437	1,416,515	886,902	88.31	2.21
Uganda - Scenario 1	24,262,527	970,730	485,874	60.44	1.21
Uganda - Scenario 2	15,446,717	619,073	230,535	38.48	0.57
Uganda - Scenario 3	4,736,423	188,403	47,044	11.80	0.12
Uganda - Scenario 4	47,367	1,876	390	0.12	0.00
Uganda - Scenario 5	37,912,320	1,515,433	1,515,983	94.44	3.78
South Africa - Scenario 0	48,914,991	1,957,349	1,219,783	88.47	2.21
South Africa - Scenario 1	34,022,818	1,362,145	679,660	61.53	1.23
South Africa - Scenario 2	26,633,503	1,066,385	398,580	48.17	0.72
South Africa - Scenario 3	10,112,572	405,730	101,306	18.29	0.18
South Africa - Scenario 4	1,772,904	71,538	13,968	3.21	0.03
South Africa - Scenario 5	51,711,156	2,067,693	2,064,889	93.53	3.73
Ethiopia - Scenario 0	88,192,391	3,529,722	2,201,275	88.30	2.20
Ethiopia - Scenario 1	61,131,043	2,445,481	1,221,374	61.21	1.22

Ethiopia - Scenario 2	34,214,209	1,367,989	514,201	34.26	0.51
Ethiopia - Scenario 3	7,410,015	294,311	73,476	7.42	0.07
Ethiopia - Scenario 4	38,637	1,520	326	0.04	0.00
Ethiopia - Scenario 5	94,348,429	3,773,673	3,773,491	94.47	3.78
Rwanda - Scenario 0	10,272,632	410,578	256,668	88.33	2.21
Rwanda - Scenario 1	7,125,841	285,843	142,532	61.27	1.23
Rwanda - Scenario 2	3,973,579	159,446	59,557	34.17	0.51
Rwanda - Scenario 3	945,452	37,619	9,331	8.13	0.08
Rwanda - Scenario 4	6,146	235	43	0.05	0.00
Rwanda - Scenario 5	10,986,403	439,886	440,152	94.47	3.78

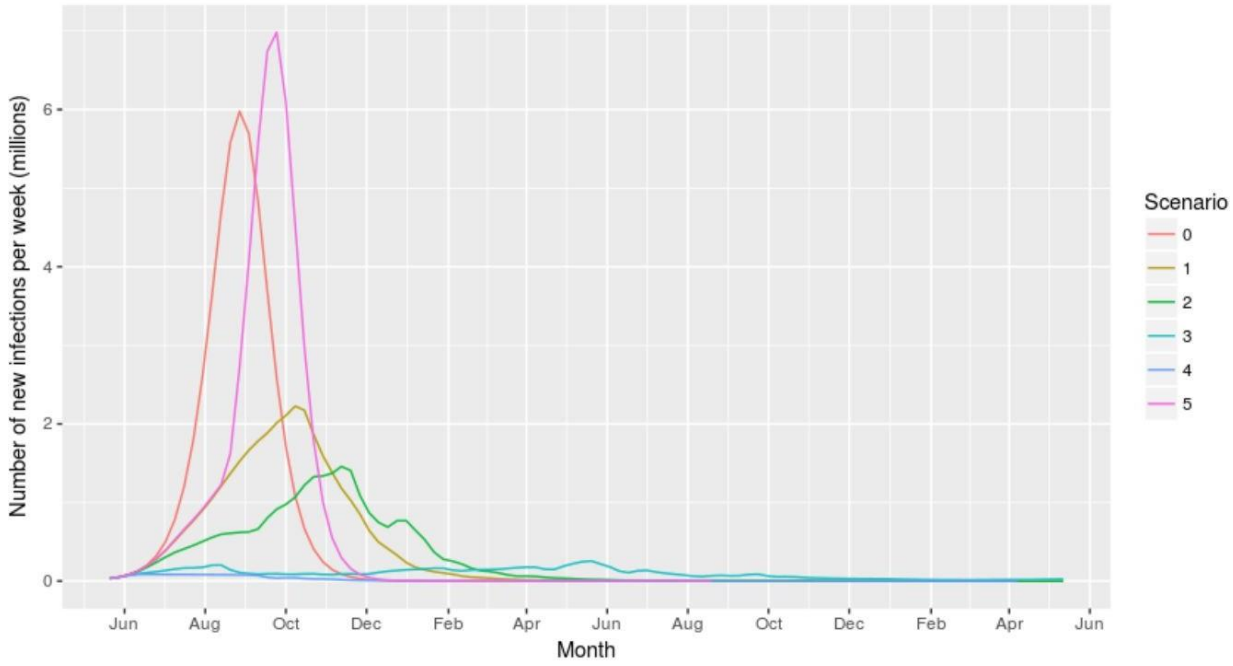
* Total cumulative infections, hospitalizations, deaths include both reported and unreported/undetected cases.

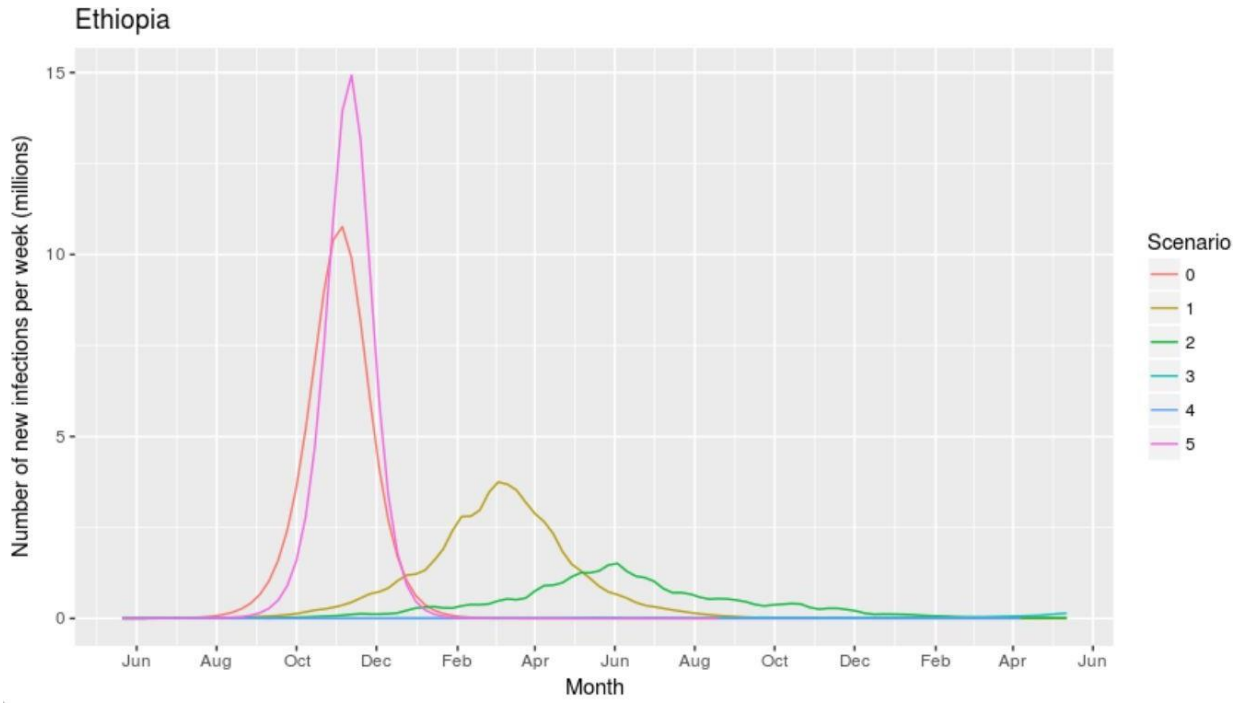


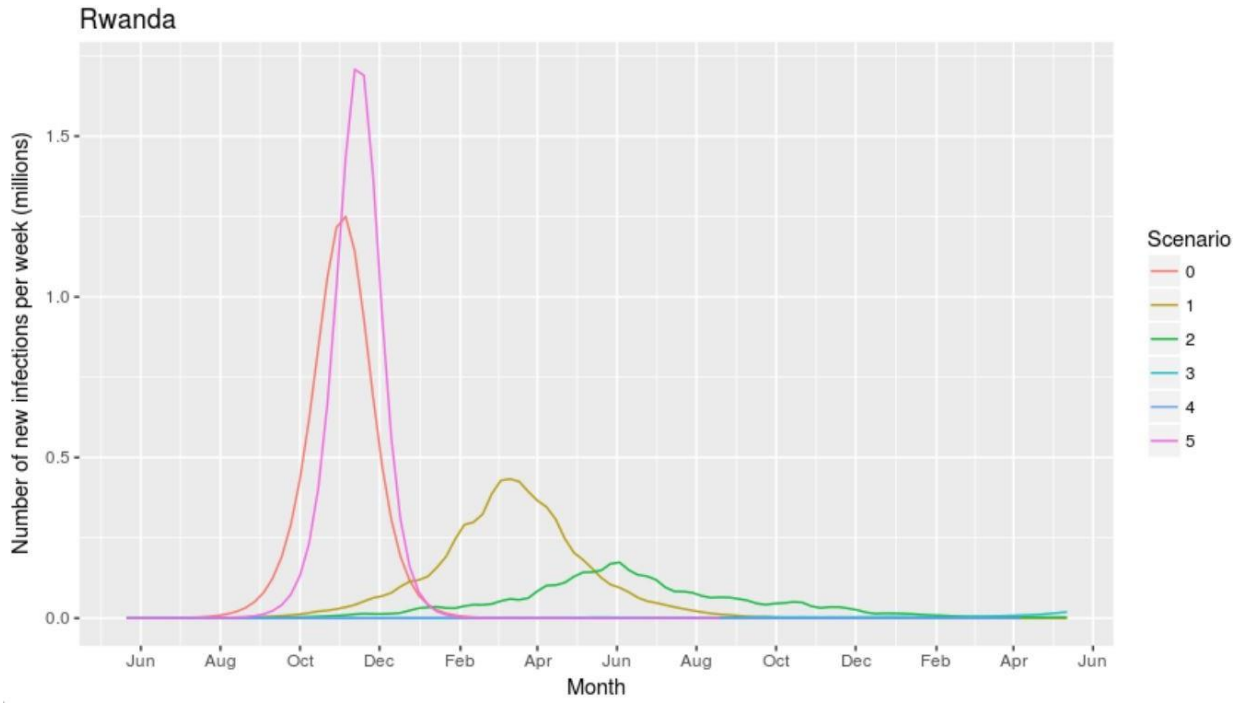
Uganda



South Africa







Model output

Complete model output has also been provided as csv files and gives the number of cumulative infections, hospitalizations, and deaths for each location by week.

Modeling assumptions and limitations

The generated model output shows the potential impact of the current outbreak under the specified assumptions. The purpose of this scenario is not to predict what will happen, but to show what could occur under a variety of conditions that remain unknown. The actual outcome that occurs may differ substantially from this scenario. This scenario is not meant to be interpreted as a prediction or forecast of the current outbreak, only one potential outcome that could occur. Please use caution when using the results for decision-making purposes.