Covid-19 Predictive Modeling and Public Policy

Opening the Economy

Across the world, populations are under enforced 'stay home' orders. Leaders face a critical decision: when, how and for whom should the strict stay-at-home measures be lifted and the economy opened again?

At Futurion, we developed an infectious disease model to help our clients and the public to understand how different policy choices are likely to affect health outcomes. While these are models, and not reality, they provide a way for the public to assess which policy options offer the best prospect of both health and economic recovery.

Our infectious disease model allows us to explore different 'opening' scenarios. We thus introduce the concepts of essential workers, lockdown duration and return to normal activities into the modeling structure.

We explore the public health impact of the two different strategies – which we call the Big Bang opening and the Measured approach – that we illustrate using New York state population data. We selected New York given that it is the current epicenter of the pandemic. We attempt to replicate conditions that reflect the current spread of the virus in New York state and the (fairly late) timing of its strongly enforced stay-at-home order.

The comparative results are striking and illustrate that even small differences in policies relating to re-opening the economy have significant effects on death rates, hospitalizations and time to develop and introduce a vaccine. Our results are in line with what science would dictate for an infectious disease with the characteristics of COVID-19.

Modeling Assumptions

A core assumption of the Futurcast infectious desease model is that the SARS-CoV-2 virus transmission has a natural R0 (the expected number of infections per infected person in the case of no intervention) of 3. We can reduce the effective R0 (the expected number of infections per infected person after policy intervention) by mild social distancing from the start. This would reduce the probability of transmission from 14% to 12%. We built our model on the basis of

New York's situation. Taking into account the perceived degree of spread of the virus in North America in early March, the delay in issuing enforced lockdown measures with stiff penalties, we assume total confinement for those over 70 after a total of 2,000 deaths in the state. All individuals in the model under 69 years are strictly confined after 6,000 deaths were recorded. Once confined, we estimate that the proportion of essential workers in the population varies from 10% of non infected individuals under the age of 49 years to 0% for those aged 80 and over.

In both the Measured and the Big Bang reopening models, we assume that the lockdown lasts from 30 to 60 days, depending on the age group. The lockdown period is the same in both scenarios. That is, we assume that New York state starts returning to normal after an initial 30 day lockdown period, although it will do so gradually, with the magnitude and timing of depending on age grouping.

In the Big Bang opening, we model that 90% of individuals under 49 and 20% of those between 70 and 79 return to normal starting after the 30 day locked

down period. In the Measured opening, we assume that only 60% of those sheltered between the ages 0 and 49 return to normal social activities, with this proportion reducing to 10% for those between 70 to 79 and continued confinement for those over 80.

The percent of return to normal reflects the degree of social activitities and interactions in place within the population depending on the age group. In neither cases we are assuming a 100% return to normal activities for all age groupings. In both cases, we estimate that those 80 and over would remain more or less sheltered. Travelling, attending large social gatherings, going to restaurants and bars are certainly not considered for anyone above 60.

Big Bang Scenario:

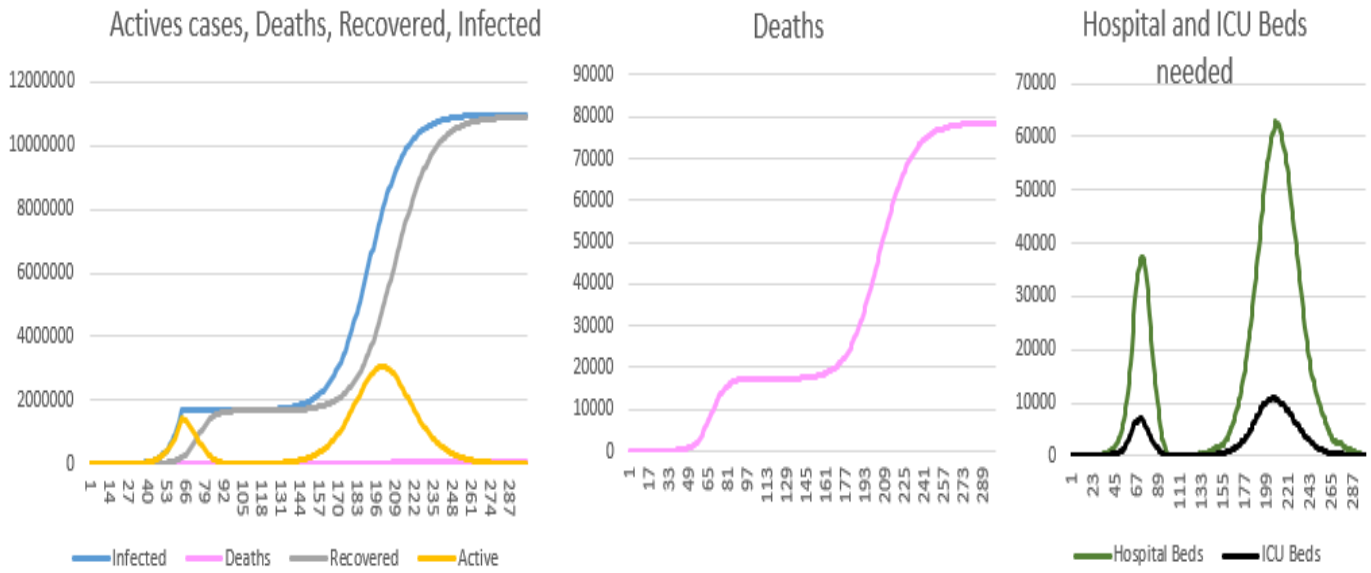
The details on shelter duration per age group, percentage of essential workers, and percentage of individuals per age group returning to normal assumed for a Big Bang scenario are given in Table 1. The table also provides the assumed percentages for each age grouping of the level of severity (I, II, III, or IV) of the illness of those infected.

Table 1. Big Bang Parameters

		Sheltered					
		☑	☑	☑	☑	☑	☑
Threshold		6000	6000	6000	6000	2000	2000
Remove Shelter (sampling)							
Shelter Duration		30	30	30	30	60	60
☐ Absolute		**0-39**	**40-49**	**50-59**	**60-69**	**70-79**	**80+**
	I	55.0%	55.0%	54.5%	56.2%	37.0%	7.0%
	II	44.8%	44.4%	40.0%	35.0%	30.0%	15.0%
	III	0.1%	0.5%	5.0%	7.0%	27.0%	60.0%
	IV	0.1%	0.1%	0.5%	1.8%	6.0%	18.0%
% of Essentials		10.0%	10.0%	5.0%	3.0%	2.0%	0.0%
% of return to normal		90.0%	90.0%	80.0%	60.0%	20.0%	10.0%

We present the predictive results obtained from the Big Bang assumptions graphically in Table 2. We first note that two waves or peaks are predicted. The first wave leads to approximately 17,000 deaths, with confinement starting at roughly day 65 (when 6,000 deaths are reached), and an ending of the lockdown, depending on age, at around day 95. With the return to normal at day 95 for practically everyone under the age of 59, we then note the virus spreads without any substantial mitigation after 50 to 60 days, thereafter leading to a total death toll for both waves of roughly 80,000 even if most seniors are still confined. The second wave is more deadly than the first as we assume that the state does not reintroduce confinement policies after the return to normal on those unconfined and already not infected.

Table 2. Big Bang Outcomes



Measured Scenario:

Table 3 provides the same level of details on the assumptions used in the Measured opening of the economy scenario.

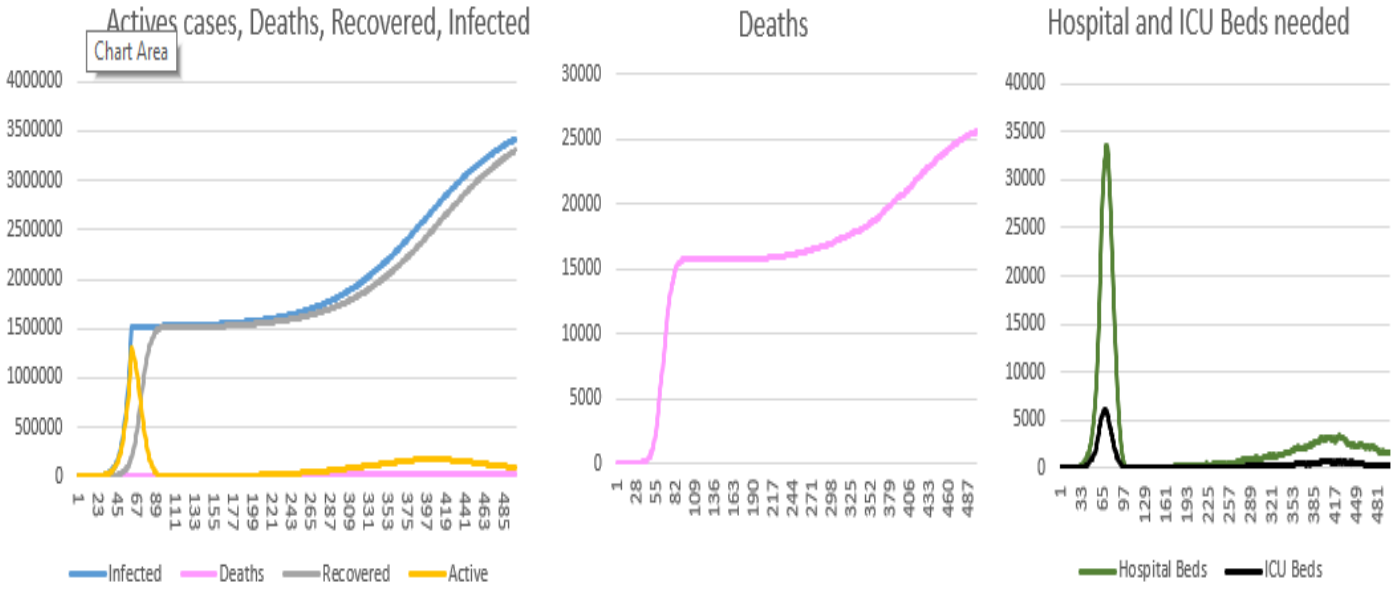
Table 3. Measured Parameters

		Sheltered					
		☑	☑	☑	☑	☑	☑
Threshold		6000	6000	6000	6000	2000	2000
Remove Shelter (sampling)							
Shelter Duration		30	30	30	30	60	60
	☐ Absolute	**0-39**	**40-49**	**50-59**	**60-69**	**70-79**	**80+**
	I	55.0%	55.0%	54.5%	56.2%	37.0%	7.0%
	II	44.8%	44.4%	40.0%	35.0%	30.0%	15.0%
	III	0.1%	0.5%	5.0%	7.0%	27.0%	60.0%
	IV	0.1%	0.1%	0.5%	1.8%	6.0%	18.0%
% of Essentials		10.0%	10.0%	5.0%	3.0%	2.0%	0.0%
% of return to normal		60.0%	60.0%	40.0%	30.0%	10.0%	5.0%

We present the predictive results obtained from the Measured scenario graphically in Table 4. We again predict two waves or peaks, but the second wave is of a much smaller magnitude than under the Big Bang approach. The first wave results in the identical death toll as in the Big Bang approach whereas the second wave adds 9,000 more. While still significant, it is an order of magnitude lower than the 63,000 deaths under the Big Bang approach. What is important to note is the time frame before the second wave starts ramping up and the speed at which it does. It does not materially start before 200 days after the end of the confinement period and peaks some 100 days thereafter.

Like the Big Bang approach, the Measured approach still involves the opening of a significant portion of the econmy and a return to normal life for close to 60% of the population under the age of 59. What is different is that, it not only markedly reduces mortality as compared to a Big Bang approach, but it also significantly reduces the stress on the healthcare system, provides the necessary time for medical science to find a successful treatment regime and to develop a vaccine that may be administered to all uninfected individuals.

Table 4. Measured Outcomes

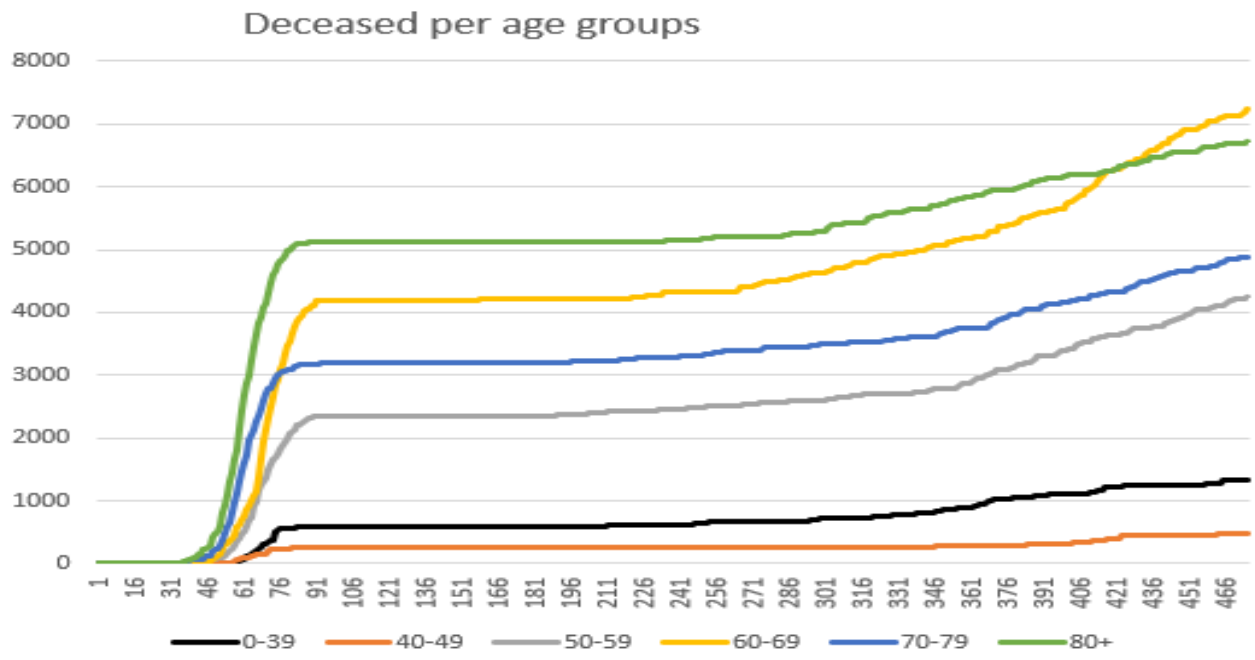


Myth or Reality

Many believe that COVID-19 only lethally affects the elderly population (over 70). Looking at the number of deceased by age group (taking the parameters drawn from the experiences of China and South Korea) presented in Figure 1 or the Measured scenario, this appears to be more a myth than a reality.

Though in the first wave those over 80 account for around 33% of the deceased, individuals in between 50 and 69 tally a significant and greater number of deaths. This is a function of the age distribution of the population and the timing of the enforced lockdown. The earlier the lockdown affecting all age groups, the lesser our model would predict a lethal impact on the younger population.

Figure 1. Deceased by Age Groups



Further Analysis

When can we return to a normal state of affairs if medical treatment and/or a vaccine are not available? Under the Measured scenario, only 17% of the total population is infected after 500 days and infection episodes would repeat over

time. Obviously, without a vaccine, the only way to return to 100% normality is when random testing produces for a number of consecutive days 0 or very few new cases.

Random testing of varying magnitude and days of no cases are elements that are included in the Futurcast COVID-19 model. We have not taken this metric into account in order to uniquely focus on the critical question in the mind of everyone today.

About Futurion

Futurion is a privately-held organisation that, since 1985, has devoted all its efforts to the development and implementation of operational and strategic forecasting technology. Its software systems are used in all industries, with a special knowledge base application for existing and pipeline pharmaceutical products.