Lockdown Maths*

Part 1: Why We Must Comply

Partha P. Majumder

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March 22nd, 2020: Janata curfew day in India. My cellphone rings at 7 am. A friend is calling. There is anger in his voice.

"Is this a way to deal with an infectious disease? They are saying that "the virus has been there for a long time", but it has suddenly become dangerous. How can a virus suddenly become dangerous?"

"We have to be indoors all day today, and now they are saying that they will do this to us for the rest of the month."

"They are saying we have to wait and watch. For how long?"

He went on and on. I stopped him.

"Ranjan, please don't be so angry. The situation is really grave. Calm down, I will call you back later and explain."

"No, you explain to me now."

Ranjan is a long-time friend. He completed his B.Com and now runs a store in Calcutta. He is aware that I am in the scientific research profession. Whenever he has a question on science, he calls me up. Like he did this morning. Except that he was also angry with the curfew and lockdown.

"Ranjan, a virus cannot survive alone. It needs a host, like us. Because it has to use the biological machinery of the host cell to survive and multiply. Therefore, any medicine aimed to kill the

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virus may also kill the host. Indeed a virus can suddenly become dangerous," I said. As this novel coronavirus has.

Many viruses are present in other animals. And mostly remain within them, without making them sick. Each virus contains a DNA or an RNA sequence. The coronavirus contains an RNA sequence. A viral sequence—DNA or RNA— is a long string of four distinct letters (alphabets). A coronavirus has a sequence of around 30,000 letters. The longest among all RNA viruses.

Ranjan betrayed his impatience: "I only wanted to know how a virus can suddenly become dangerous."

"You have heard about SARS virus, haven't you? The virus that causes severe acute respiratory syndrome."

"Yes, it had killed many people about 15 years ago."

SARS is a coronavirus. Different portions of the sequence of a virus are associated with different functions. The sequences change slightly and naturally over long periods of time; somewhat like a child making spelling mistakes.

A change in a specific portion of the sequence sometimes enables that portion to be associated with a new function. Just as a spelling error in a sentence can sometimes change the original meaning.

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Later, another virus jumped from camels to human and caused respiratory disease. The disease— Middle East Respiratory Syndrome (MERS)—was detected in 2012 and has killed about 850 people, mostly in Saudi Arabia.

SARS, MERS and the novel coronavirus (nCoV) almost certainly originated in bats. A corona virus that was found in a species of

bats is 96 per cent identical in its RNA sequence with that of nCoV.

"I have heard that bats provide a home to many viruses; but why?" Ranjan asked.

Ranjan's initial burst of anger had subsided and he was trying to understand the why and how of the nCoV infection.

"Well, Ranjan, I don't think any scientist really knows. Let me tell you that when a foreign body such as a virus enters an individual, be it a bat or a camel or a human, the individual tries to expel the virus. This is done by the body's immune system—the biological system that protects an individual against potentially harmful intruders, such as bacteria or viruses. Based on evidence, many scientists believe that bats do not exhibit as much immune response against viruses, which is why bats are home to many types of viruses. Scientists still do not understand the true reason."

Infectious agents spread from one infected individual to another by various routes. The nCoV is carried via droplets. nCoV primarily infects the respiratory tract— the lungs and other airways— resulting in cold-like symptoms, with fever. The virus is carried within droplets when an infected individual coughs or sneezes. If the droplets fall on an uninfected individual, then this individual may become infected by the virus.

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That is why maintaining a distance of about a metre is being suggested. At this distance, the droplets will fall on the ground or on another nearby surface but not on an uninfected individual. nCoV can also enter if you touch the surface on which the droplets have fallen and then pick your nose or touch your lips. That is why repeated washing of hands with soap is being recommended. Soap can destroy the virus.

In Wuhan, where nCoV first struck in a big way, appropriate precautions were not taken. By the time the Chinese government realised the magnitude of the problem, the nCoV disease (Covid-19) had bared its fangs. Travel was not restricted. People carry-

ing nCoV travelled to other places. Europe—particularly Italy—became the next epicentre.

There are two major reasons why nCoV has spread so widely and rapidly. An infected person does not show any symptoms of disease for the first three or four days. This person, therefore, is unaware of being infected and does not restrict interacting with others who are possibly uninfected. These uninfected persons then become infected.

The second reason is that we travel widely and do not like restrictions to be imposed on us. Therefore, fearing unpopularity, the governments did not impose any restrictions, such as on movement, on their citizens.

You asked how long we have to stay indoors, wait and watch for Covid-19 to disappear. No one has a perfect answer to your questions, Ranjan, but we need to understand how the spread can be curtailed".

The spread can be curtailed by social distancing, such as staying indoors. There is no medicine for Covid-19 or a vaccine to prevent infection by the novel coronavirus. Social distancing is the only way to prevent uninfected individuals from being infected.

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Therefore, the early strictures on movement and interactions that we have imposed in India are the best. Our strategy should serve as a model, now and for the future.

"Many of us, including you Ranjan, are mad that the strategy adopted by the Indian government is curbing our freedom of physical movement and social interaction," I said.

The alternative is to witness a large number of deaths, possibly much larger number than in Wuhan or northern Italy. Our population density is very high.

"Ranjan, let me explain to you how the number of infected individuals can increase rapidly unless restrictions are imposed; self-imposed restrictions are the most effective."

First, no one can get infected by nCoV unless she or he comes

in close contact with an infected individual. Contact is the only means of spreading nCoV infection; sometimes even touching a surface with the virus on it will do.

Supposing today we have 10 individuals in a given area who are infected. Suppose on an average, each of these 10 individuals comes in contact with six uninfected individuals. Not all, but a fraction (say, 50 per cent) of these 60 uninfected individuals will become infected.

Then, on the next day, there will be 30 new infected individuals. Hence, the total number of infected individuals on the next day will rise to 40 (10 old cases plus 30 new cases).

On the third day, this set of 40 people will come in contact with 240 uninfected people, and will infect half of them. In other words, the total number of infected individuals in the area will increase to 160 (120 new plus 40 old). Thus, the numbers of infected individuals rises from 10 to 40 to 160 in three days. A four-fold increase on the second day, a 16-fold increase on the third day.

This is only approximately correct because a few of the old cases will unfortunately die. The chance of death from Covid-19 is not very high; only 35 of 1,000 cases are dying on an average after a few weeks of suffering from the infection. Thus, even though 160 is an approximate number, the actual number will be close to it.

But can the increase from 10 to 40 to 160 go on forever? Certainly not. Never happened in past infections and will not happen now.

How can the increase stop? When a large number of persons is infected, the chance that an infected person will infect an uninfected person is going to be small; just because there are fewer uninfected persons left to infect. In that case, the rate of daily increase in the total number of infected individuals is going to taper off.

In the example I provided before, if each of the 10 infected persons comes in contact with only two uninfected individuals, on the next day, there will be only 10 new cases. On the second

day, the total number of cases will be 20 (10 new plus 10 old); a two-fold—instead of the previous four-fold increase.

Thus, the extent of spread of the infection will slow down. Infected persons don't keep infecting for ever. Their chance of recovery in three to four weeks is quite high. If the increase in the number of Covid-19 infected people can be slowed down by reducing their contact with those who are uninfected, a large number of infected people will recover before they can infect many others. A person who has recovered from Covid-19 is unlikely to get reinfected with nCoV. Therefore, the overall burden of Covid-19 will reduce quickly.

"Ranjan, this is precisely the strategy our government has taken. Reduce the number of contacts between uninfected persons and those with Covid-19. That will reduce the burden of infections. We should co-operate, remain indoors and adopt social distancing."

"But you still didn't tell me how long we have to wait and watch. And remain indoors," Ranjan said.

"Honestly, I do not know," I said.

The more compliant we are with social distancing, the sooner we will be able to regain our normal lives.

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