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# The response to COVID-19

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## Discussion

### The problem

1. SARS-CoV-2 is a virus that causes the disease COVID-19. COVID-19 is a disease of the respiratory tract and may lead to fatal pneumonia.
2. There are tests available that can confirm the presence of viral RNA in an infected individual's respiratory tract, so the disease can be distinguished from other respiratory tract infections like influenza and the common cold.
3. This is a new virus and there is no vaccine against it. The only people who have immunity against it are probably those who have survived the infection. This means that practically all South Africans will get infected.
4. A situation like this is called an **epidemic**. Because the whole world is suffering from the same disease the situation is called an **pandemic**.
5. For the majority of patients COVID-19 is a minor illness and they will recover at home. A significant fraction of infected people do not develop symptoms at all and may not even notice they were infected.
6. A proportion of infected people will fall ill enough to need hospitalization.
7. Most patients who receive adequate hospital treatment recover. So far, almost all patients who have not survived have had a comorbidity.
8. The number of people who will fall ill from the infection is large.
9. Only a fraction of those people who fall ill will need to be admitted to hospital, but because a large number of people will be ill, this small fraction will be a large number of patients.
10. Because the virus is new and nobody is immune, this large number of people will fall ill simultaneously.
11. The crucial treatment for severe cases of COVID-19 is mechanical ventilation. This requires high-tech medical devices of which there are only a limited number available.
12. There are only a limited number of beds in hospitals where patients can be treated for COVID-19 pneumonia.
13. If a large number of patients all fall ill with COVID-19 simultaneously there will not be enough beds to accommodate all of them and not enough medical personnel to treat all of them. Therefore some patients will not receive any treatment, and many will receive inadequate treatment. Some of these patients will die.
14. The higher the number of patients that are ill simultaneously, the higher the fraction of those that would have survived with adequate treatment will not get adequate treatment and will die.

15. When facing such a disaster, the deeply human response is to try to limit the number of avoidable deaths.

## The solution

1. In any epidemic, the only way to reduce the number of cases is by large-scale vaccination. But a practical vaccine against SARS-CoV-2 is between 18 months and 5 years away, therefore there is no way to reduced the number of cases in the short term.
2. But it is possible to reduce the number of *simultaneous* cases.
3. If the number of simultaneous cases are reduced sufficiently, there will be enough beds to treat all the patients at any one time. The number of patients will be the same, but they will be admitted at *different times*. This is strategy of managing the epidemic is known as “flattening the curve.”
4. The number of simultaneous cases can be reduced by reducing the **rate** at which the infection spreads in the population.

## The the first thing to do

1. There is no medication that will help reduce the transmission rate.
2. The mechanism of disease transmission is clear: particles from the airway of infected individuals distribute viral particles in the environment, where uninfected individuals either
  - 2.1. inhale airborne particles, or
  - 2.2. pick up particles from a contaminated surface and transfer them to their mouth, nose, or eyes, from where they can be transported to the respiratory tract.
3. There are principally three non-pharmacological methods to prevent the transmission of the virus:
  - 3.1. Hygiene. Hygiene measures reduce transmission by destroying the virus before it can be transmitted. These include measures like surface disinfection and regular handwashing.
  - 3.2. Barriers. Barriers include isolation of infected patients and the use of personal protective equipment such as masks, gloves and gowns.
  - 3.3. Distance. Distance means physically separating infected and non-infected individuals for a long enough period to allow the immune system of an infected individual to clear the virus. These methods include quarantine, self-isolation and physical distancing.
4. To be effective, the hygiene and barrier methods require
  - 4.1. access to resources like soap and water or masks and gloves
  - 4.2. training in their effective use
  - 4.3. diligent application
5. To be effective, using distance as a method to reduce the transmission rate requires
  - 5.1. diligent application
6. The ideal way to halt the epidemic is to identify all infected individuals and to prevent them from transmitting the disease by application of all the available measures.

7. At this time there is no way to test every individual in the population. The number of tests are limited and the epidemic spreads faster than individuals can be tested.
8. Because testing everyone is impossible and everyone is liable to infection, the transmission rate can only be limited if the whole population participate in non-medical measures to limit the transmission rate.
9. It takes time to disseminate the necessary materials and training for hygiene and barrier methods among the whole population.
10. Because the contagion will spread faster than hygiene and barrier methods can be disseminated, the remaining effective measure is distancing. The government therefore first encouraged and then required the population to separate themselves physically from each other by staying at home. This is called a **lockdown**. This is in addition to measures like **contact tracing** and **quarantine** for travelers.
11. If the lockdown is effective and sustained, the epidemic will die down.

## What to do next

1. But if the epidemic dies down rapidly, then most of the population will still be liable for infection, and a re-introduction from outside will just start a new epidemic, also sometimes called a **second wave**.
2. Conditions that allow for an epidemic will exist until the greater part of the population is immune to the virus.
3. Until a vaccine is developed, the only way for an individual to become immune is to become infected with SARS-CoV-2 and survive COVID-19, should the infection progresses to disease.
4. To escape the epidemic without excess deaths we must allow a great portion of the population who are otherwise healthy to get infected, but not all at the same time.
5. The aim is therefore not to just to halt the epidemic, but to gain control over it.
6. The early imposition of a lockdown has the following benefits:
  - 6.1. It immediately disrupts the transmission of the virus.
  - 6.2. It allows time for disseminating training and materials to effectively implement hygiene and barrier methods.
  - 6.3. It allows time for expanding testing capacity.
  - 6.4. It allows time for implementing testing campaigns.
  - 6.5. It allows time for expanding hospital capacity.
  - 6.6. It allows time for the discovery of effective medical treatments.
7. Once the lockdown has brought the epidemic under control the virus can be allowed to spread at a non-epidemic rate, all the while keeping the total number of patients low enough to allow all who need hospitalization effective care.
8. The need to keep the rate of transmission low means that the lockdown will not be summarily suspended, but aspects of it will be eased over time.
9. Lockdown can be eased when:
  - 9.1. There are enough hospital beds to care for all the sick individuals.

- 9.2.** The transmission rate is below epidemic rates ( $R_0 < 1$ ).
- 9.3.** Enough testing is being done to monitor the spread of the virus.
- 10.** Once a comprehensive lockdown is no longer necessary, the lockdown can be eased in different ways:
  - 10.1.** By region: some cities or districts may be eased before others.
  - 10.2.** By activity: some activities may be permitted before others.
  - 10.3.** By business sector: Some businesses might be allowed to start operating before others.
- 11.** Lockdown will have to be tightened again if the virus starts spreading at epidemic rates.
- 12.** The effective control over the epidemic by adjusting lockdown can only be maintained by incessant testing.

## What comes after

- 1.** It will take months or years before life returns to “normal”. The epidemic will be over only when a large majority of the population is immune, either from vaccination or from exposure.
- 2.** The better hygiene, barriers, and physical distancing are implemented, the less likely society is to be disrupted by repeated lockdowns.
- 3.** Once the epidemic is under control locally, the better we coordinate with neighbouring countries and the rest of the world the sooner we can resume trade.
- 4.** The SARS-CoV-2 will not disappear, and COVID-19 will remain a disease, but it will most likely become indistinguishable from infections by other coronaviruses.
- 5.** If the technology developed and lessons learned during this pandemic are implemented consistently, this might be the last pandemic.