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## Coronavirus and Sars: How China and S'pore have improved in disease management

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While information flow and response capabilities are better now than during Sars in 2003, the evidence so far shows that the coronavirus originating from Wuhan is a formidable foe. Things will get worse before getting better.

The public is usually quite familiar with what many clinical specialists such as surgeons, cardiologists and anaesthetists do.

But many are not familiar with what a public health specialist does. A public health physician's core competencies include epidemiology, and coordinating and planning the fight against communicable diseases, among others.

Since the onset of the epidemic from its epicentre in Wuhan, China, 2019 novel coronavirus (2019-nCoV) infections have spread to many countries around the world at an alarming rate. Many friends and colleagues have asked how I see this epidemic panning out as a public health physician.

How is one to start assessing the seriousness of an outbreak? A few metrics are critical.

### REPRODUCTIVE RATIO

First, the key performance indicator in controlling an outbreak is the reproduction number (also known as reproductive ratio), commonly known as  $R_0$ .

$R_0$  basically denotes the number of additional cases each case is thought or expected to generate in the course of a case of the disease being infectious.

If the  $R_0$  value of disease X is 2.2, then each case of disease X is expected to generate an average of 2.2 cases, which means the epidemic is growing.

Indeed, in a recent study published in the authoritative New England Journal of Medicine (NEJM) on Jan 29, the  $R_0$  value of the coronavirus that originated in Wuhan is 2.2, after the paper's authors analysed 425 cases from the onset of the outbreak till Jan 21.

Despite the Herculean efforts put in by the Chinese government and other affected countries, the epidemic is growing because  $R_0$  remains greater than one.

The various interventions and measures that have been put in place are targeted to bring  $R_0$  to less than one. Only when  $R_0 < 1$  can we safely say the epidemic has stopped growing.



People at a Residents' Committee centre collecting packs of face masks for their households last Saturday. The general public does not need to wear a mask when there is no local transmission, but in the case of local transmission, we may well need to. ST PHOTO: LIM YAOHUI

## DOUBLING TIME

Another metric is the epidemic doubling time, which the NEJM paper stated was 7.4 days. This means the number of infected people doubles every 7.4 days.

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In fact, if we look at World Health Organisation data, which publishes the number of infections in China and the world daily, the most recent doubling time is about three to four days, at the point at which this commentary was written.

The number of infections in China has roughly doubled from 9,720 on Jan 31 to 20,438 on Feb 4, while the number of deaths also doubled from 213 to 425 over the same period of four days.

This is a sobering statistic, although the rapid increase in numbers may be partly due to other factors, such as clearing a backlog of cases due to lack of diagnostic test kits or increasing awareness.

Given how the numbers of infections and deaths in China have grown at an increasing pace in the last few days, one can conclude that the epidemic there is not yet at its peak. Which means that things are likely to get worse before they get better there.

## PRINCIPLES OF CONTROL

The principles of controlling a communicable disease outbreak or even an epidemic are well known, and have not changed for decades: Identify the pathogen (the organism causing the disease) and destroy or eliminate the source of the pathogen; break the chain of transmission and treat the infected and, where possible, protect those who are highly susceptible to the infection through vaccination.

A simple example is a food poisoning outbreak in a restaurant: Remove the contaminated food, isolate and treat those who are infected, vaccinate the food handlers against certain food-borne communicable diseases, and thoroughly clean up the food establishment.

In vector-borne diseases, we also try to destroy the vector, such as the Aedes mosquito in dengue.

But in an epidemic of this magnitude, and with the very incomplete information available about the coronavirus, the challenges healthcare workers and policymakers are facing are indeed daunting.

## **MORE THAN JUST CASE-FATALITY RATE**

Many commentators have remarked that this coronavirus is a lot less threatening than Sars in 2003.

They cite a statistic called the case-fatality (CF) rate and say that the CF rate of the 2019 novel coronavirus is only about 2 per cent, while that of Sars is 10 per cent to 11 per cent.

This means that one in 10 Sars patients died, while the corresponding number for 2019-nCoV is one in 50. So there is a lot less to worry about 2019-nCoV than Sars, goes the argument.

I think we need to look at the differences in CF rate with a healthy dose of caution.

A rate matters little to the general population as opposed to actual numbers of deaths and infections around them. Given the speed of transmission of the disease, the size of this epidemic has already surpassed Sars. The number of deaths will probably also surpass the number of deaths from Sars, which was about 800 worldwide.

In any case, at 2 per cent, 2019-nCoV is 20 times more deadly than the influenza virus, which has a CF rate of about 0.1 per cent.

Several characteristics render this disease more dangerous than Sars and what its lowly CF rate might suggest. These are:

- The ability of the virus to be transmitted even during the incubation period.
- The infection does not have very reliable and apparent signs, such as fever. Only 83 per cent of patients had fever (in a study involving 99 patients published in The Lancet on Jan 30).
- An infection offers only short-term immunity, and a patient may get reinfected with 2019-nCoV, according to some infectious diseases experts in China with direct experience in treating the disease.

The CF rate depends on the ability to accurately diagnose two things: death and the disease. It is not easy to diagnose a new disease or the cause of death.

In the case of Sars, there was probably a lot of under-diagnosis of the deaths and more so the disease because we did not have the ability or the capacity to diagnose Sars quickly and accurately in 2003.

**It is thus paramount that the authorities keep giving clear explanations and updated information, and drive home the truth that in this evolving situation, different solutions will be needed at different stages of the outbreak. So policy tweaks, reversals or modifications are to be expected, and must not be misconstrued as examples of incompetence.**

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Sars diagnostic tests only came along a few months into the outbreak; in contrast, today, tests for 2019-nCoV were available a few weeks after patients were diagnosed with this new disease.

A low CF rate may also be an indication of better treatments today than in 2003 with Sars.

While there is no definitive treatment for the novel coronavirus, supportive treatments such as oxygen therapy, antibiotics for secondary bacterial infection, mechanical ventilation, extracorporeal membrane oxygenation and continuous renal replacement therapy are more readily available now in China and elsewhere than in 2003, which helps to reduce fatalities.

Whatever the case may be, it is obvious that 2019-nCoV causes considerable morbidity (sickness) and mortality (deaths), especially when compared to influenza, which means that treating it will demand enormous healthcare and, in particular, hospital resources.

Some data suggests that about 20 per cent of confirmed cases require aggressive or intensive supportive treatment in hospitals.

It is apparent that even if the CF rate of 2 per cent seems low, this has come about at the enormous cost of nationwide and medical resources deployed in this fight.

This is quite unsustainable in the long term, because it is at the expense of suspending much normal, peacetime healthcare services. Such a suspension in itself has huge knock-down negative effects.

## **2003 AND NOW: CAUTIOUS OPTIMISM**

However, amid the gloom and doom, there is room for cautious optimism.

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Simply put, China in 2019/2020 is very different from the China of 2003. Yes, there are reports of bureaucrats and the police clamping down on early discussion and reports of the outbreak, which led to a significant delay in public health measures being instituted to control the spread of the disease - but there has also been a dramatic change in how China manages an outbreak and engages the world now, compared to the Sars crisis.

First, the capacity and speed of the Chinese medical and scientific community to sequence the viral genome of 2019-nCoV and develop diagnostic tests was simply breathtaking: It was reported that the Chinese National Health Commission was notified of the possibility of a new disease outbreak on Dec 31 last year.

The virus was quickly isolated on Jan 7, and by Jan 10, the Chinese government had published online the first genome sequence of 2019-nCoV, enabling laboratories around the world to synthesise diagnostic tests just a few days later.

Second, Chinese doctors and scientists are now actively publishing research papers on the epidemic in leading international medical journals such as the NEJM and The Lancet. By doing so, they are sharing information and experience with the international healthcare community quickly.

This is a stark difference from what happened in 2003, when the Chinese medical and research community did not publish much at all, and if they did, it was only when the Sars epidemic was long over.

In Singapore, things are also very different from 2003 during the Sars outbreak. We have an experienced team of public health officials and senior hospital clinicians who have gone through Sars, and we are better prepared.

One may ask: "Just exactly how better prepared are we?"

I will give you a few examples.

I was the chief operating officer of Singapore General Hospital (SGH) when the Sars outbreak occurred. I was also the only doctor in SGH then who was equipped with a public health postgraduate degree. I had the dual responsibility of ensuring that the facilities and supplies in SGH were adequate to meet the challenge of fighting Sars and to undertake other public health responsibilities.

When Sars entered SGH through a patient discharged from Tan Tock Seng Hospital, it was my responsibility to investigate the outbreak, identify the index case and put in place measures to contain the outbreak in SGH, otherwise known as the SGH cluster.

During the Sars outbreak, SGH had to increase isolation-room capacity, because the existing capacity was manifestly inadequate.

The SGH operations team, working through the night, converted dozens of rooms over a weekend into negative-pressure rooms with nothing more than modified industrial fans and pieces of plywood. (In negative-pressure rooms, the ventilation system removes more exhaust air from the room than air is allowed into the room.)

As the SGH cluster evolved, hospital policies and procedures had to be developed and put in place on the fly.

Simple but effective practices such as triaging of patients, and the limiting and registration of visitors, were introduced while the Sars outbreak evolved.

We also had to hastily assemble a field epidemiology team to investigate the SGH cluster and develop field epidemiology practices from scratch, including contact mapping, tracing and surveillance.

That was the situation in 2003: understaffed, under-equipped and inexperienced.

Since Sars, we have built another three large general hospitals: Khoo Teck Puat, Ng Teng Fong and Sengkang, which have greatly increased capacity within the public healthcare system.

And the spanking new National Centre for Infectious Diseases (NCID) next to Tan Tock Seng Hospital was officially opened just last September.

NCID boasts isolation and treatment facilities that we could only dream of in 2003.

Now, practically all public general hospitals have public health doctors and well-established plans, policies and procedures in place, as well as exercises carried out to test these plans and the readiness of our hospitals and clinics to respond to communicable disease outbreaks.

Of course, no two diseases are the same, and plans have to be modified according to the epidemiology of the new disease, but at least no one is working from scratch.

## **LOGISTICS, COMMUNICATIONS AND WHOLE-OF-GOVERNMENT APPROACH**

Aside from getting the fundamentals right in our healthcare system, three other aspects of the fight against the coronavirus epidemic deserve our attention.

First, in any war against a communicable disease with no definitive treatment, managing the logistics of personal protection equipment (PPE) is paramount.

PPE includes things like surgical face masks, N95 masks, gloves, goggles and isolation gowns. Ensuring an adequate supply of PPE is like ensuring that soldiers have enough ammunition to fight in a war. Just as we don't want our soldiers to run out of ammo, we don't want our healthcare workers to run out of PPE.

After experiencing the difficulties faced during Sars, we now have a local producer of N95 masks. When this outbreak is over, it may be good for the authorities to explore having a local producer of the humble three-ply surgical mask and other PPE as well.

Another aspect is that of mass psychology and communications.

There was hardly any social media in 2003 to speak of, but social media now plays an important role in ensuring timely information flow.

But as we all know, the Internet and social media are a two-edged sword. There is as much fake news and misinformation about the coronavirus epidemic as there is useful and accurate information.

An inherently difficult feature of communicating information about a novel disease is that our knowledge of the disease is incomplete, and hence, the information communicated may necessarily change frequently, leading to much confusion on the ground.

For example, the average incubation period for the coronavirus was originally thought to be about seven to 10 days. It has since been shortened to 5.2 days.

The general public does not need to wear a mask when there is no local transmission, but in the case of local transmission, we may well need to.

Case definitions of the disease and quarantine criteria in Singapore may also change because of the rapidly changing situation in China.

But the layman, or even doctors at the front line, may be left wondering why there are bewildering changes from one day to the next, which may in turn lead some to question if the authorities know what they are doing. If doctors or medical personnel start to feel this way, confidence in the whole system may be undermined.

It is thus paramount that the authorities keep giving clear explanations and updated information, and drive home the truth that in this evolving situation, different solutions will be needed at different stages of the outbreak.

So policy tweaks, reversals or modifications are to be expected, and must not be misconstrued as examples of incompetence.

But the third aspect is perhaps the most important. And that is the necessity of taking a whole-of-government approach.

This is a contrast to Sars when, in the early days of the outbreak, efforts to contain it were largely left to the Ministry of Health and the public healthcare system. It was rather late in the day when the private healthcare sector and other ministries were roped in to fight the outbreak. To be fair, once all hands came on deck, the Government was able to harness a whole-of-nation response.

To conclude: China is responding better than it had with Sars, and research on the virus is stepping up quickly. Indeed, the race for definitive treatments and a vaccine is already heating up.

In Singapore, the authorities, the healthcare system and the general populace are more ready to battle this disease than the one in 2003.

However, while we are largely on the right track and have reason to be cautiously confident that we will win this fight, the unique epidemiological features of 2019-nCoV - especially its ability to spread without detection - mean we must not let our guard down or be complacent.

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