Why SARS will not return: a polemic

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Most people are convinced that the return of SARS, a zoonotic disease caused by the SARS-associated coronavirus (SARS-CoV), is inevitable this winter. I believe that this is highly unlikely given the limited infectious reservoir of SARS-CoV and the lack of transmission in the community and in the hospital setting once isolation precautions are put in place. I will examine these issues in turn.

In order for SARS to return, there must be a reservoir. Potential or known reservoirs include animals, laboratories and humans. SARS-CoV-like viruses have been isolated from Himalayan palm civets, ferrets and raccoon dogs that are sold for human consumption in live-animal markets in Guangdong Province, China.[1,2] Domestic cats living in the Amoy Garden apartment complex in Hong Kong, where more than 100 residents contracted SARS, were also found to be infected with SARS-CoV, and they were able to transmit the virus to other cats.[3] However, the cat reservoir is small in comparison with known animal reservoirs for other viruses that can cause human disease, and it has not accounted for any transmission of SARS-CoV to humans that we are aware of.

Laboratories constitute a second reservoir for SARS-CoV. Several laboratories worldwide are either working with the virus or have it stockpiled in freezers. However, this reservoir is small and carefully controlled.

Human populations are seen as another potential reservoir for SARS-CoV, but there is no evidence to support this view: there have been no SARS cases since June 15, 2003, with the exception of a case resulting from a laboratory accident in Singapore in August 2003.[4] Could SARS be spreading undetected among people in rural China or other previously infected areas? There is no reason to believe this. The experience in Canada and Hong Kong in 2003 showed that the great majority of patients with SARS are symptomatic with moderate to severe disease.[5–7] Up to 95% of patients will eventually have pulmonary infiltrates on chest radiography, and 20%–30% will require intensive care including mechanical ventilation.[7–12] When asymptomatic or mild disease does occur, such as in children, it is less likely to be transmitted to others.[4,5,13] Therefore, if SARS-CoV has continued to be spread within any human reservoir since June 15, the majority of the people who have become infected would have had moderate to severe disease requiring medical attention and hospital admission, leading to recognition of the disease.

Could patients who have recovered from an infection with SARS-CoV during the 2003 outbreak be harbouring the virus in a form that might be infectious now or might become so in the future? Although the virus can be detected by reverse-transcriptase polymerase chain reaction (RT-PCR) after the onset of the illness, it is difficult to isolate it after the third week of disease.[14,15] In addition, there has been no evidence to suggest that SARS-CoV causes chronic or relapsing disease in humans.

Even if the potential reservoirs are limited, some will argue that this does not eliminate the possibility that the virus might move beyond its reservoirs to cause another human outbreak. Important potential or proven routes of transmission of SARS-CoV include animal to human and human to human, as well as transmission through laboratory accidents. The evidence available to date suggests that SARS first emerged in southern China in November 2002 as the result of transmission of SARS-CoV from animal(s) to humans.[15] We do not know if transmission occurred only once (because of a sequence of rare events) or if it occurred more than once. More important, however, is the fact that, to the best of our knowledge, animal-to-human transmission has not occurred since that time, even though the animal markets were reopened in August 2003.[16]

The laboratory has also proven to be a recent source of transmission of SARS-CoV. The panel that reviewed the laboratory accident in Singapore in which a person contracted SARS identified many safety lapses in the laboratory. The World Health Organization (WHO) has developed laboratory guidelines to minimize the risk of such events occurring in the future.[17]

The most important means of spread of SARS-CoV has been from human to human in settings, such as hospitals, that involve close interaction between infected and uninfected people, facilitating droplet and contact transmission. After mid-January 2003, most of the people in whom SARS developed were household contacts of SARS cases or were infected in hospitals.[15] Outside of these settings, with the exception of a few unusual circumstances, SARS was not found to be highly infectious. A measure of infectiousness used in epidemiology is the basic reproduction number, R_0, which is the average number of secondary infectious cases produced by an infectious case. R_0 determines the potential for epidemic spread in a totally susceptible population in the absence of specific control measures.[18] The viruses causing influenza and measles have an R_0 of 10 and 15 respectively in the community.[19] SARS-CoV has been estimated to have an R_0 of only 4 in the hospital setting.[15] Once patients have been recognized as having SARS and isolation measures instituted, the R_0 drops to less than 1, a value that is not compatible with sustaining an outbreak, as was seen in both clusters in Toronto.[20] Outside of the hospital setting and exceptional circumstances, the R_0 of SARS-CoV has consistently proven to be less than 1, as demonstrated by the failure of this virus

to establish and maintain itself in the community.

Is SARS-CoV more effectively transmitted during the winter respiratory virus season, as some would suggest? It has been speculated that the worldwide control of SARS was aided by the arrival of warmer weather.[21] We do not know that SARS is more readily transmitted during the winter than at any other time of the year. Although it first made its appearance in the fall of 2002 in Guangdong Province, it was not until the end of the respiratory virus season in 2003 that worldwide transmission occurred.[22] Many respiratory viruses, including the human coronavirus, are more common in the winter, but this is not true for all of them.

The term "superspreading events" has been used to describe situations in which a single person has directly infected a large number of other people. In the Singapore SARS epidemic, for example, 103 of the first 201 probable cases to be reported were infected by just 5 source cases. Other superspreading events occurred in the Metropole Hotel and the Amoy Garden in Hong Kong and on an airline flight.[15,23] These examples are, however, the exception rather than the rule. There were many patients who had symptomatic infection who were cared for without precautions and who did not transmit the disease. For instance, there were airline flights with symptomatic SARS patients on board in which transmission did not occur.[23] Ten people were secondarily infected at the Metropole Hotel after exposure to the virus on the night of Feb. 21, 2003; however, only 5 infected people transmitted the virus locally upon their return home.[15] In fact, outside of China, Mongolia and the Philippines, the only areas in the world that experienced local transmission were those countries (Canada, Singapore and Vietnam) whose index case had stayed at the Metropole Hotel on Feb. 21, 2003.[24]

The dramatic spread of SARS in the late winter and spring of 2003 appeared to herald the onset of a new infectious disease that threatened to become the first pandemic of the 21st century. Four months lapsed between the recognition of the first case and the release of a global alert by the WHO on Mar. 12, 2003. Most experts agree that China has learned its lesson from the first outbreak, when authorities did not respond in a rapid and appropriate manner, allowing the virus to circumnavigate the globe. But once the Chinese authorities declared war on SARS it was quickly brought under control, as it was in other countries. The only real threat for the reintroduction of SARS-CoV to human populations is transmission from animals in markets in the south of China. However, officials in Beijing are now working closely with the WHO and have an intensive surveillance system in southern China aimed at detecting any new cases early. Early recognition and institution of control measures will prevent what we witnessed in 2002–2003.

The fact that new SARS outbreaks around the world are unlikely does not mean that vigilance is unwarranted. The SARS outbreak of 2002–2003 provides a reminder that new infectious diseases will continue to emerge and that a powerful and effective international public health community is necessary to protect us when they do.

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