

COVID-19: another infectious disease emerging at the animal-human interface

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The ongoing novel coronavirus outbreak is an example of yet another infectious disease emerging at the animal-human interface, causing considerable concern and disruption as it spreads across international borders. It is remarkable to think that we didn't know about this new coronavirus a few weeks ago, yet it now dominates news headlines globally, has caused major disruptions to travel and trade, and over 200 publications on the outbreak are already listed on PubMed this year. In New Zealand, temporary entry restrictions into the country have been placed on foreign nationals travelling from or through mainland China, New Zealand residents recently arrived from China are asked to self-isolate for two weeks, and specific diagnostic testing for the newly discovered virus is now available in at least three diagnostic laboratories. The country's tourism industry and tertiary institutions are already counting the economic cost.

We also have some new names. The novel coronavirus has been named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses,¹ while the disease associated with it is now referred to as COVID-19. Plenty of opportunity for confusion there.

Much of what we have been witnessing is a result of the rapid sharing of information, possibly more than with any other outbreak. The early messaging to the world about the initial stages of the outbreak contrasts with the delayed sharing of information that characterised the start of the SARS epidemic in 2002–2003. Indeed, within days of the first reports in December 2019 of a mystery cluster of pneumonia cases in Wuhan we heard about the discovery of a new presumptive aetiological agent,

shortly followed by the freely available genome sequence of the virus.² China has been rightly commended for this excellent investigative work and transparency. Dissemination of the genome sequence data led to the rapid development of diagnostic tests and has already prompted early efforts to develop an effective vaccine. The successful culture of SARS-CoV-2 in a Melbourne laboratory was quickly followed by the sharing of extracted nucleic acid from the virus for use as diagnostic test positive controls (including to New Zealand). We have also seen unprecedented sharing of near real-time data on case numbers, deaths and geographic spread. Medical journals are scrambling for papers on COVID-19 and, equally, health professionals and academics are scrambling to publish early findings. A well-publicised error in an early report³ (claiming, with incorrect evidence, that SARS-CoV-2 can be transmitted by people without symptoms) reminds us that key quality checks should not be circumvented in the effort towards timely dissemination of sound information to the scientific and health communities.

While the pace of activity may have caught out many, the background to the situation we are facing is of no surprise. This sort of outbreak has been anticipated for some time and it will happen again. Indeed, although there are still many unknowns, the unfolding scenario is predictable in many ways, largely because we have seen similar situations before. This is not the first time we have encountered a previously unknown or new strain of a virus emerge in human populations who have close contact with wildlife and other animals, whose spread is accelerated by modern human transportation pathways and crowded urban environments, and with notable health-care-associated transmission. The SARS

epidemic in 2002–2003,⁴ the 2009 H1N1 influenza pandemic,⁵ the emergence of MERS coronavirus in 2012⁴ and the 2014–2016 West African Ebola outbreak⁶ are the obvious recent examples associated with spread across international boundaries and appreciable morbidity and/or mortality in humans. All have been associated with considerable global anxiety and disruption. So, we have some familiarity with the broader context, but are now trying to better understand key details in order to inform the public health response to this new infectious disease.

Based on available information, the current picture of COVID-19 is of a disease that ranges clinically from a mild respiratory syndrome to life-threatening pneumonia affecting both lungs, with severe disease associated with increasing age and comorbidity.^{7,8} We are still learning about disease severity, transmissibility, controllability and the identification of a presumed animal reservoir. Latest case fatality rate estimates for COVID-19 are ~2%, more than in the influenza H1N1 2009 pandemic (<1%), but less than with SARS (10%) and MERS (40%). It is important to bear in mind that the denominator in these calculations may be underestimated due to failure to account for mild cases of the disease, and that most of the case series published to date are on patients with disease severe enough to warrant hospitalisation. Metrics, such as the basic reproduction number (R_0), indicate that transmissibility of SARS-CoV-2 is similar to influenza, but much less than measles. We have little information on the prevalence of asymptomatic infection and whether there is appreciable transmission from asymptomatic cases, important pieces of information for infection control purposes. There has also been little information on COVID-19 in children, raising questions about whether severe disease is less common in this age group. Some of the early cases series from China reported a relatively high prevalence of apparent transmission within the healthcare environment. All these characteristics will be refined as more information comes to hand.

China has made huge efforts to contain the outbreak through rigid enforcement of infection control measures, including widespread use of isolation and the curtailing

of social gatherings. In doing so they have effectively created the largest quarantine in human history. Even though COVID-19 has spread to many other countries, the vast majority of cases are still within mainland China, and ongoing transmission outside China has been limited so far. The world is watching eagerly to see whether the containment efforts in China, together with border control measures implemented by other countries, will be effective in minimising further spread. Even the most optimistic would regard more widespread transmission as likely, but the hope is that the pace and extent can be limited. There are also real concerns about ongoing transmission becoming established in low-income countries with less developed health systems, the consequences of which could be devastating.

The precise origin of the COVID-19 virus is yet to be determined, but epidemiological evidence indicates that several zoonotic transmission events occurred in December 2019 at Wuhan's Huanan Seafood Wholesale Market, a live animal and seafood market where wild animals were traded. Molecular evidence showed the virus to be most closely related to a coronavirus isolated from a horseshoe bat from Yunnan Province. Horseshoe bats are understood to be maintenance hosts for SARS-related coronaviruses and COVID-19 may have emerged in a similar way to SARS—from sequential recombination events between the precursors of bat SARS-related coronaviruses, prior to spill-over to an intermediate host and then zoonotic transmission.

Public health authorities have a tough job at times like these. They are tasked with making major decisions in the face of key knowledge gaps, while dealing with rapidly changing information and conflicting pressures and opinions coming from many directions. Given the uncertainties and the potential serious consequences of the outbreak, they can justify taking a precautionary approach as we learn more about the disease. We have seen this in many jurisdictions. The decision by New Zealand to place temporary entry restrictions on foreign nationals travelling from or through mainland China was a brave one and is unprecedented. However, it is in line with the actions of other countries and was, in

part, justified by authorities on the basis of New Zealand's isolated island geography (making it easier to prevent border incursions) and position as a major gateway to many small South Pacific nations.

How prepared is New Zealand for this sort of outbreak? We will only really know in its aftermath (and if it arrives), but there have been considerable efforts by the country's health system to prepare as best it can. At this stage, while there are no cases in New Zealand, the focus has been on keeping COVID-19 out of the country. The likelihood of maintaining this status is low, and now is the time to be preparing for an anticipated upsurge in respiratory disease in the community and increased pneumonia hospitalisations. The New Zealand Influenza Pandemic Action Plan has been in existence since 2002,⁹ with several subsequent revisions, and provides a framework for pandemic responsiveness. While focused on influenza, it contains many principles that should apply to the current COVID-19 epidemic. There is also a chance that transmission of SARS-CoV-2 may coincide with our next seasonal epidemic of influenza, creating additional pressure on the health system.

Pathogens spread through populations by various pathways and means of contact. Understanding the complex systems that drive occurrence is essential for informing strategies to tackle emerging and re-emerging infectious diseases, and this usually requires responses from multiple

disciplines and an awareness of what is happening globally. Consequently, professionals and researchers from a wide range of disciplines must work together and with communities to prevent and control infectious disease impacts through actions at all levels. "One Health" is the longest running of a number of approaches that aim to break down the artificial barriers between human, animal and ecosystem health researchers, so that they work together to attain optimal health for people, animals and the environment.¹⁰ This approach makes particular sense in New Zealand given the country's relatively isolated island ecosystem vulnerable to introduced pest and pathogens, economic dependency on agriculture and the physical environment, well-connected scientific community and an existing indigenous Māori world view and knowledge system that emphasises holism and interconnectivity between humans, animals and the environment.¹¹ Indeed, New Zealand has the opportunity to be a global leader here, and considerable efforts are already underway in the effort to establish this transdisciplinary approach.¹¹

Episodes of zoonotic spill-over leading to sustained transmission of new infectious diseases in humans appear to be increasing in frequency. As a consequence, pandemic preparedness must be a priority for the global health agenda and for New Zealand. This is the time for coordinated action. As always, this outbreak will provide numerous learnings for us all.

Competing interests:

Nil.

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