A Strategy to Prevent and Control Zoonoses?

by RUIPENG LEI and RENZONG QIU

Since 1994, the world has seen eight major outbreaks caused by seven different bat-borne viruses: Hendra in 1994, Nipah virus in 1998, Marburgh in 1998 and 2004, SARS in 2002, MERS in 2012, Ebola in 2014, and SARS-CoV-2 in late 2019. At a meeting on SARS held near Beijing in the spring of 2004, participants, the majority of whom were scientists and physicians, wondered at the sudden ending of the SARS epidemic. However, only a few continued to study the virus after the epidemic ended, most notably Shi Zhengli, a research scientist working at the Wuhan Institute of Virology affiliated with the Chinese Academy of Science. Along with her colleagues in China and abroad, she spent a decade working to prove that SARS originated from a species of horseshoe bats in a cave in Yunnan Province. Since 2004, her team has also found dozens of SARS-like coronaviruses that could infect humans. It was such painstaking work that allowed them to identify, within about a week, the causative agent of Covid-19—a SARS-like virus now known as SARS-CoV-2. Thousands of coronavirus strains are waiting to be found. "We must find them before they find us," Shi said.[1]

In 2007,[2] James Childs criticized the usual defensive strategy in dealing with zoonotic epidemics, which is reactive, passive, and conservative. One of the expert teams dispatched to Wuhan by the Chinese State Health Commission to assess the disease and recommend a strategy for addressing it called for a "conservative" policy in monitoring the zoonosis: the team recommended waiting for evidence of human-to-human spread, despite the fact that there had been more than one hundred known cases of unidentified pneumonia.[3] The passive and conservative defense strategy limited the focus of decision-makers only to surveillance of human patients, ignoring the presence of disease among animals, and only to surveillance after the spread had already become an outbreak, ignoring the jump from wild animals to humans and the initial appearance of unidentified symptoms. This defensive or reactive strategy leads to failing to prevent and control the spread of the zoonosis, and the result is avoidable outbreak and pandemic.

On the contrary, an offensive strategy, which Childs called for and Shi began to carry out, is active, aggressive, and preemptive. Because of the rapid increase in the human population, the ways commercial and scientific-technological activities of urban people have expanded into the country and invaded the habitats of wild animals, and the local customs in which wild animals (sometimes raised on farms) are used for food, clothing, and medicine, in addition to the inherent biological changes of pathogens, the species barrier between humans and wild animals is becoming ever thinner. Viruses found in animals have ample opportunity to come into contact with humans.

In our opinion, the focus of prevention and control should be on the coronavirus family, given the devastating impact it has already had and can be expected to have. The first part of our suggested proactive strategy is to prevent so-called spillover of the virus from wild animals to humans. There are two transition stages required for all zoonosis emergence in humans[4]—human contact with the infectious agent and cross-species transmission of the agent—and two transition stages that are required for emergence of an epidemic and that many zoonotic pathogens do not achieve: sustained human-to-human transmission and genetic adaptation to the human host. To prevent spillover to humans, the first two of these four stages are critical. We need research into host reservoirs—the sources of the pathogens—which for SARS and possibly SARS-CoV-2 are horseshoe bats, and also into secondary or intermediate hosts in which they may live prior to reaching humans. We also have to aggressively limit the destruction of natural habitats and contact between wild animals and humans, including prohibiting wild animal trade and closing all wild animal farms except for a few necessary for research, which should be reviewed and approved.

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The second part of a proactive strategy is that when our efforts to prevent spillover fail, we have to take radical and quick steps to prevent the spillover from developing into an outbreak. The important stage here is the emergence of sustained human-to-human transmission, and this stage itself consists of three links: infection of human samplers, who are the high-risk individuals in whom the disease first appears; then the transmission from samplers to spreaders, who are individuals with high potential to spread a new virus; and third, the transmission from spreaders to the general population. It may be possible for us to prevent the emergent outbreak by controlling the transmission from a few samplers to spreaders and the transmission from spreaders to a general population. This effort requires us to implement public health interventions, such as contact tracing, social distancing, and quarantine or isolation, to prevent the virus from coming into contact with humans as early as possible, such as when there are still only dozens of cases.

A member of the second team of experts sent to Wuhan by the Chinese health department, who were there January 8 and 9, 2020, suggested that the team's conservative strategy was based on the lack of evidence of human-to-human transmission, but this expert also admitted that the spread from humans to humans could be inferred from the course of the disease.[5] We believe that putting great stock in this inference would have been valid because it was already known that all previously identified kinds of coronavirus could be transmitted from humans to humans, such as in the case of SARS and MERS. As a matter of fact, there had already been some cases in which doctors were infected with the novel coronavirus, but these cases were not reported to the expert team then.

Human-to-human transmission of SARS-CoV-2 was one of the uncertainties that decision-makers faced early on in Wuhan. Under conditions of uncertainty, we believe that a proactive strategy is better than a reactive or defensive strategy because the negative impact of the former is less than that of the latter. A proactive strategy, we think, would limit the spread of a virus and prevent it from developing into an outbreak.

1. Quoted in J. Qiu, "How China's 'Bat Woman' Hunted Down Viruses from SARS to the New Coronavirus," *Scientific American*, March 11, 2020, https://www.scientificamerican.com/article/how-chinas-bat-woman-hunted-down-viruses-from-sars-to-the-new-coronavirus1/.

2. J. Childs, "Pre-spillover Prevention of Emerging Zoonotic Diseases: What Are the Targets and What Are the Tools?," in *Wildlife and Emerging Zoonotic Diseases: The Biology, Circumstances and Consequences of Cross-Species Transmission*, ed. J. Childs, J. Mackenzie, and J. Richt (Berlin, Germany: Springer-Verlag, 2007), 389-443.

3. Q. Yu and S. Li, "An Exclusive Interview with the Second Expert Team Dispatched by State Health Commission: Why Human-to-Human Infection Was Not Found?" [in Chinese], *Journal of Finance & Economy*, February 26, 2020, http://news.sina.com.cn/c/2020-02-26/doc-iimxxstf4577244.shtml. Readers may be able to reach an English version of this article, with the main title given as "Interview with Wei Jian to Appoint the Second Batch of Experts in Wuhan," by going to http://baidu.com, using the search term "专访卫健委派武汉第二批专家：为何没发现人传人," and then selecting "English" after reaching the journal's website.

4. J. Childs, J. Richt, and J. Mackenzie, "Conceptualizing and Partitioning the Emergence Process of Zoonotic Viruses from Wildlife to Humans," introduction to *Wildlife and Emerging Zoonotic Diseases: The Biology, Circumstances and Consequences of Cross-Species Transmission*, ed. J. Childs, J. Mackenzie, and J. Richt (Berlin, Germany: Springer-Verlag, 2007), 1-31.

5. Yu and Li, "An Exclusive Interview with the Second Expert Team Dispatched by State Health Commission."