Commentary

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From SARS to the Omicron variant of COVID-19: China's policy adjustments and changes to prevent and control infectious diseases

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SUMMARY The COVID-19 pandemic has been the biggest public health crisis in a century. Since it was initially reported in 2019, the duration and intensity of its impacts are still in serious question around the world, and it is about to enter its third year. The first public health revolution failed to achieve its ultimate targets, as previously contained infectious diseases seem to have returned, and new infectious diseases continue to emerge. The prevention and control of infectious diseases is still a public health priority worldwide. After SARS, China adjusted a series of its infectious disease policies. In order to ensure the effectiveness and implementation of prevention and control interventions, the government should integrate the concept of public health. Perhaps we need a global public health system at the government level to fight the potential threat of infectious disease. This system could include multifaceted strategies, not just specific prevention and control interventions, and it could also be a comprehensive system to ensure unimpeded communication and cooperation as well as sustainable development.

Keywords COVID-19, infectious disease, physical containment strategies, vaccination, global health, public health

The COVID-19 pandemic has been the biggest public health crisis in a century (Figure 1). According to the World Economic Outlook in April 2020, the International Monetary Fund ranked this crisis as the Great Lockdown. In addition to the public health crisis, this health emergency had triggered a global financial crisis, and containment measures have made stimulating aggregate activity more challenging (*1*). Worldwide, severe uncertainty about the duration and intensity of the pandemic's impacts remains in 2021, and a WHO Emergency Committee concluded that the pandemic is far from over. The Delta variant has become one of the most infectious viruses (R0:5-9·5) (*2*).

New strains pop up continuously. on Nov 26, 2021, WHO designated a new variant, Omicron. After its was first identified in southern Africa, Omicron has been found in 76 countries across the world as of Dec 14, 2021 (*3*). In the United States, 43 individuals infected with Omicron were identified from Dec. 1 to Dec. 8 (*4*); one individual was hospitalized but no deaths were reported. China has also identified 11 cases infected with Omicron until Dec. 15, 2021 (*5.6*). There is substantial uncertainty regarding Omicron's transmissibility and severity (*7*). The researchers from The University of Hong Kong found that Omicron SARS-CoV-2 infects and multiplies 70 times faster than the Delta variant and original SARS-CoV-2 in human bronchus, but the infection in the lung is significantly lower than the original SARS-CoV-2 (*8*). Given the persistent mutation of the virus, if the SARS-CoV-2 virus becomes more transmissible and it continues to exist with human beings over the long time, then presumably the disease's severity will decrease and it will become "another type of influenza."

Omicron's immune escape potential is also uncertain. Breakthrough infections are likely to occur, which means relying more on physical containment strategies. The WHO also recommends that individuals socially distance and wear masks (*7*).

1. China's experience and physical containment strategies.

During the global fight against COVID-19, China has reported only 0.05% of the total number of global cases (more than 265 million) despite its huge population base. Unlike some Western countries, China mobilized quickly and coordinated a national campaign to contain outbreaks in Hubei and related epidemics (*9.10*). In about three months, China normalized prevention and control with a focus on imported cases and related outbreaks. Since

Aug 2021, China has attempted to enter a new phase through a "dynamic zero tolerance" approach, which aims to formulate precise and differentiated strategies to prevent and control COVID-19 (Figure 2).

China's experience shows that physical containment strategies are not magic. Physical containment strategies that seek to interrupt the transmission of pathogens are effective at preventing and controlling COVID-19 and other infectious diseases (*11*). What is special is the implementation of these strategies. Traditional contact tracing and quarantine are always effective at identifying secondary cases and avoiding continued transmission. During outbreaks in Dalian (July 2020) and Guangzhou (May 2021), 74% and 65% of cases, respectively, were identified among close contacts (*9*). Implementation of social distancing and movement restrictions effectively

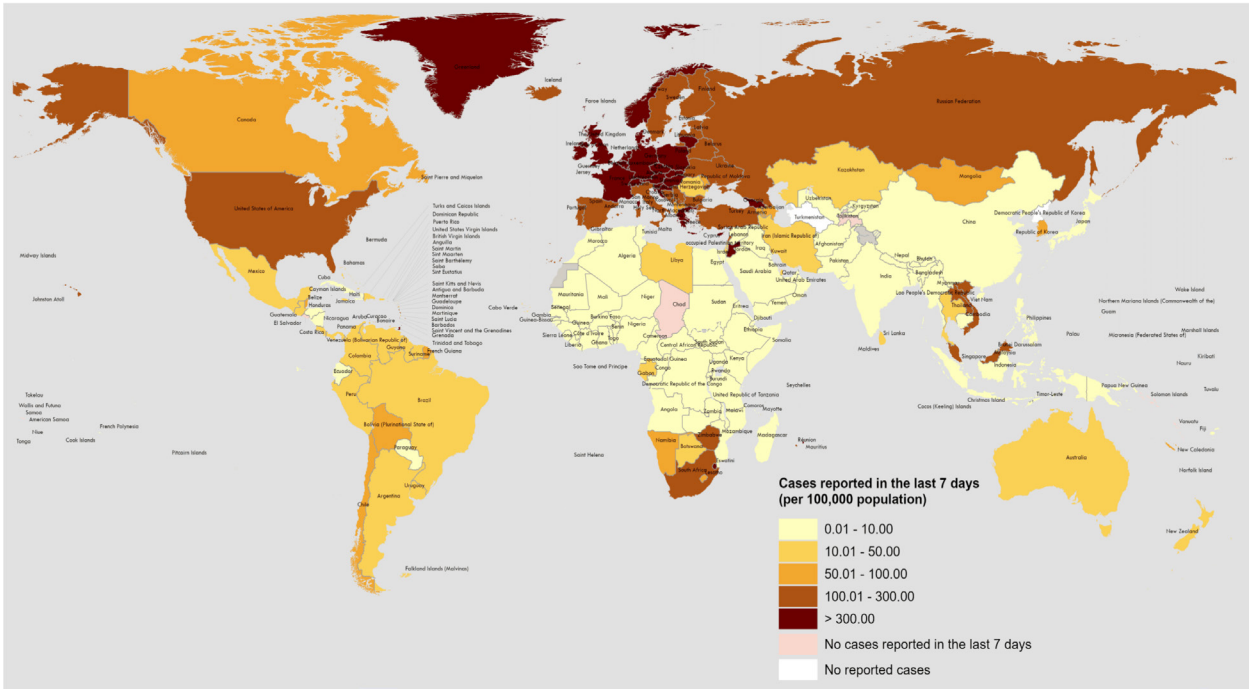

Figure 1. COVID-19 cases per 100,000 population reported by countries, territories, and areas, Dec-14 2021. Figures are from the COVID-19 Weekly Epidemiological Update. Data presented are based on official laboratory-confirmed COVID-19 cases and deaths reported to the WHO by country/territories/areas, largely based upon WHO case definitions and surveillance guidance.

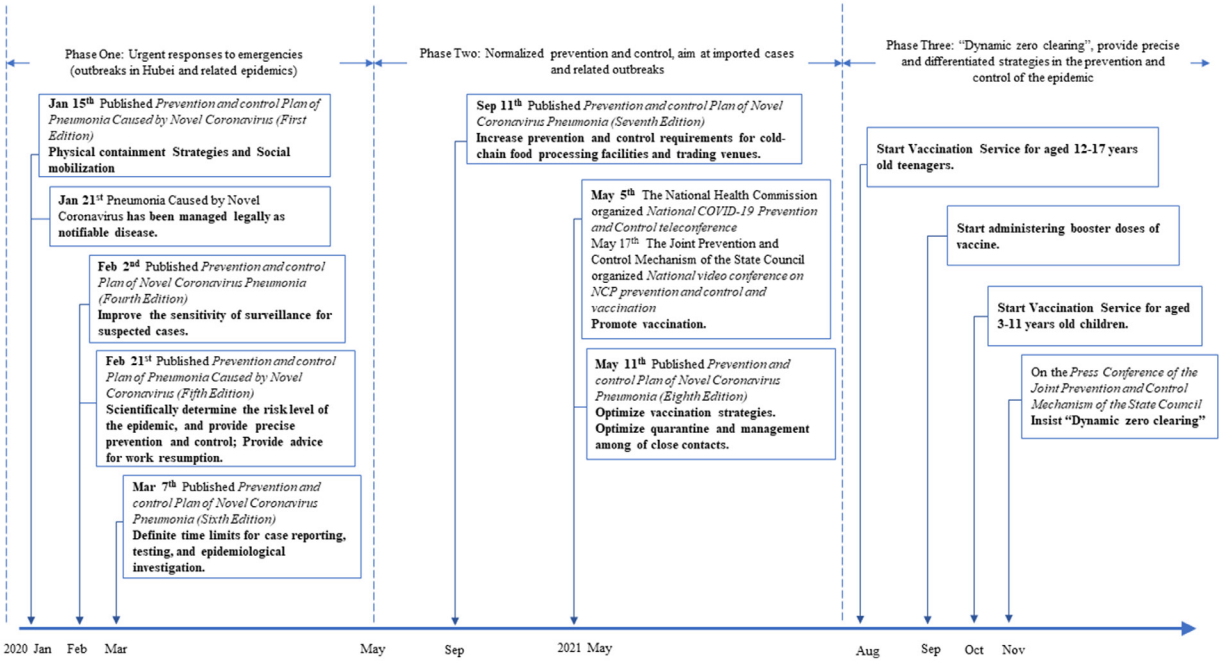

Figure 2 Prevention and control processes and strategies to combat COVID-19 in China since 2020.

reduced the secondary attack rate among household contacts. During the Wuhan outbreak (from Dec 2019 to April 2020), the household reproduction number declined by 52% among primary cases and by 63% among secondary cases (*12*).

Containment interventions also mean a certain degree of infringement upon liberty. Policy-making needs to be based on scientific evidence to assure the legality of an intervention and to balance personal privacy and public health. Government also needs to support effective public mobilization and management. Thanks to rapid and sustained containment strategies, such as the lockdown in Wuhan, China avoided a 67-fold increase in cases (interquartile range: 44-94-fold) within one month (*13*).

2. Over the long term, prevention and control of infectious diseases is the basis of public health.

The first public health revolution failed to achieve its ultimate targets, as previously contained infectious diseases seem to have returned, and new infectious diseases continue to emerge (emerging infectious diseases, or EIDs). In the late 20th century, most experts concurrently reached the conclusion that ideas on fitness and medical models should change and evolve. What causes the highest proportion of deaths has changed from acute infectious diseases to chronic diseases, and this is especially true in developed countries. However, outbreaks or pandemics of infectious diseases have presented a significant worldwide threat since 2000. These diseases include reemerging diseases, such as HIV/AIDS, malaria, tuberculosis, and West Nile virus, as well as emerging ones, such as severe acute respiratory syndrome (SARS) and COVID-19. (Table 1) There are two types of infectious diseases that represent the greatest threat to public health worldwide. One is respiratory infectious disease; the other is vector-borne diseases.

3. The concept of a global healthcare community should be integrated into all policies and regulations.

Each epidemic or pandemic is the result of a complex interplay of natural evolution and human advancement. Many EIDs appear to be caused by zoonotic pathogens and involve interaction between humans and wildlife (*14,15*). Paralleling natural evolution and human advancement, human activity seems to have expanded since mankind entered the 21st century, increasing the probability of pandemics (*14*). In addition, climate change brought about by human activity may profoundly affect the transmission of pathogens and vectors (*16,17*). Governments should once again acknowledge the actual and potential burden of infectious diseases.

Regrettably, global prevention and control efforts and awareness among the healthcare community worldwide have been far outpaced by the global spread of EIDs. Intervention strategies for infectious diseases and public health systems worldwide are not prepared for future challenges from EIDs. The WHO should expand its implementation and range of responsibilities by enhancing the "One Health" concept. A collaborative system should be created by health authorities and authorities related to wildlife and the environment. The relationship among human beings, other creatures, and diverse natural ecosystems should be fundamentally reconsidered, and the concept of global healthcare community should be devised.

Public health should be emphasized globally. In addition to development of effective vaccines in the near future, new International Health Regulations (IHR) (2022) may be modified and adopted, and a treaty or agreement with international support to fight infectious disease pandemics should also be concluded. Over the long term, political leadership at the global level is needed. The National Provider Identifier Standard (NPI) should be emphasized. Public health should be integrated into the United Nations' Sustainable Development Goals to be implemented by every member country and to facilitate global health initiatives.

Vaccines are the most crucial intervention to achieve herd immunity and prevent the spread of infectious disease. As a result of massive resources worldwide, COVID-19 vaccines have been rapidly developed in comparison to conventional vaccines. As the virus continues to mutate, research on new and highly effective vaccines should be accelerated. In the future, increased emphasis should be placed on biological research, and vaccine research and stockpiles should be improved to respond to the long-term challenges of EIDs.

To fight against potential infectious disease pandemics, training of public health personnel should be accelerated. In addition, leaders in global public health should be trained instead of relying on the CDC. There are many examples of exceptional teamwork in fighting pandemics: 1) The Epidemic Intelligence Service (EIS) of the US CDC has greatly contributed to the eradication of smallpox and many other immunization programs (*18*). 2) In 2003, Trainees from China's Field Epidemiology Training Programs helped provide scientific evidence for identification of and intervention in the SARS pandemic (*19*).

The COVID-19 pandemic has focused our attention on infectious diseases once again. We need to face the fact that the SARS-CoV-2 virus will coexist with human beings over the long term. As globalization continues, governments need to realize that the threat of infectious diseases is ever-present. We need to learn from past experience to build a global public health system to fight the potential threat of infectious diseases. This system should have multifaceted strategies and not just specific prevention and control interventions. It should also be a comprehensive system to ensure unimpeded

Table 1. Outbreaks of Emerging Infectious Diseases (EIDs) since 2000

Time of Occurrence /Duration	Sites of initial outbreaks or large outbreaks	Name of disease or virus	Events and Burden	Response of WHO	Declared a Public Health Emergency of International Concern (PHEIC)?
1999-	Perak, Malaysia	Nipah virus	1. Nipah virus was first recognized in 1999 during an outbreak in Perak, Malaysia. 2. Then in Bangladesh in 2001. 3. The disease has also been identified periodically in eastern India and other areas.	Support technical guidance 1. Use a One-Health approach. Cooperate with the agricultural sector, detect cases, and establish an animal health or wildlife surveillance system to provide an early warning to veterinary and human public health authorities. 2. Control infection in health-care settings. Implement standard infection control precautions among health-care workers.	
2002.11 -2003.07	Guangdong, China	SARS	The total number of SARS cases worldwide reached 8,437, with cases in 29 counties. Mortality from SARS is estimated to be 10-12% (*20*). SARS (R0:2.2-3.6) is more transmissible than MERS and Ebola (*2,21*).	Take effective control measures including international collaboration supported at the highest political level. Seek to apply the spirit of several regional and international efforts in fighting the SARS epidemic, including the ASEAN +31 Ministers of Health Special Meeting on Severe Acute Respiratory Syndrome (SARS) (Kuala Lumpur, 26 April 2003), the Special ASEAN-China Leaders Meeting on the Severe Acute Respiratory Syndrome (SARS) (Bangkok, 29 April 2003), and other high-level meetings (*22*).	No, WHO issued a global warning on Mar 12, 2003.
2003	From Asia to Europe and Africa	H5N1 virus	H5N1 virus has spread from Asia to Europe and Africa, and outbreaks have resulted in millions of poultry infections, several hundred human cases, and many human deaths.	1. Continuously monitor avian and other zoonotic influenza viruses closely through its Global Influenza Surveillance and Response System (GISRS). 2. Collaborate with the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization (FAO), conduct surveillance at the human-animal interface, assess the associated risks and coordinate the response to zoonotic influenza outbreaks. 3. Provide guidance and develop surveillance, preparedness, and response strategies and intervention recommendations.	
2007	The Island of Yap (Federated States of Micronesia)	Zika virus disease	1. Since 2015, outbreaks and evidence of transmission soon appeared throughout the Americas, Africa, and other regions of the world. 2. As of July 2019, a total of 87 countries and territories have reported evidence of mosquito-transmitted Zika infection (*23*).	1. Advance research in prevention, surveillance, and control of infection and associated complications. 2. Develop, strengthen, and implement integrated surveillance systems for infection and associated complications. 3. Strengthen the capacity of laboratories to test for infection worldwide. 4. Support global efforts to implement and monitor vector control strategies aimed at reducing Aedes mosquito populations. 5. Strengthen care and support of affected children and families.	Yes, on Feb 2, 2016
2009		H1N1	As of 1 August 2010, more than 214 countries and overseas territories or communities have reported laboratory-confirmed cases of pandemic influenza H1N1 2009, including over 18,449 deaths.	Raise the level of influenza pandemic alert to phase 6 in late April. Strengthen national, regional and global influenza response capacities including diagnostics, antiviral susceptibility monitoring, disease surveillance, and outbreak responses. Increase vaccine coverage among high-risk groups. In collaboration with other partners, monitor influenza activity globally through the WHO GISRS system and recommend vaccine formulations.	Yes, on April 24, 2009

Table 1. Outbreaks of Emerging Infectious Diseases (EIDs) since 2000 (Table continued)

Time of Occurrence /Duration	Sites of initial outbreaks or large outbreaks	Name of disease or virus	Events and Burden	Response of WHO	Declared a Public Health Emergency of International Concern (PHEIC)?
2010-	Endemic in more than 100 countries	Dengue	1. As of October 27, 2014, a total of 41,155 dengue cases and 6 deaths were reported in Guangdong Province, China. 2. Large dengue outbreaks, with the Region of the Americas reporting more than 2.38 million cases in 2016 (*24*). 3. The largest number of dengue cases ever reported globally was in 2019. All WHO Regions were affected, and dengue transmission was recorded in Afghanistan for the first time. 4. About 129 countries have been at risk. The America, South-East Asia, and Western Pacific regions are the most seriously affected, with Asia representing 70% of the global burden of disease (*25*).	1. Support countries in the confirmation of outbreaks through its collaborating network of laboratories. 2. Provide technical support and guidance to countries for the effective management of dengue outbreaks. 3. Support countries to improve their reporting systems and capture the true burden of the disease. 4. Provide training on clinical management, diagnosis, and vector control at the country and regional level with some of its collaborating centers. 5. Support countries in the development of dengue prevention and control strategies and adopting the Global Vector Control Response (2017-2030) 6. Review the development of new tools and publish guidelines and handbooks for surveillance, case management, diagnosis, dengue prevention, and control for Member States.	
2012.09	Saudi Arabia	MERS	1. The average MERS case fatality rate is around 35%. 2. Largest outbreaks seen in Saudi Arabia, United Arab Emirates, and the Republic of Korea.	1. Provide updated information on the situation. 2. Conduct risk assessments and joint investigations with national authorities. 3. Convene scientific meetings and develop guidance and training for health authorities and technical health agencies on interim surveillance recommendations, laboratory testing of cases, infection prevention and control, and clinical management.	
2013	China	Avian influenza A (H7N9) virus	In 2013, 139 confirmed cases were identified in 12 areas of China (*26*). As of Sep 5, 2018, a total of 1,567 laboratory-confirmed human cases, including at least 615 deaths, have been reported to the WHO.	1. Continuously monitor avian and other zoonotic influenza viruses closely through its Global Influenza Surveillance and Response System (GISRS). 2. Collaborate with the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization (FAO), conduct surveillance at the human-animal interface, assess the associated risks and coordinate the response to zoonotic influenza outbreaks. 3. Provide guidance and develop surveillance, preparedness and response strategies and intervention recommendations.	
2014-	West Africa	Ebola	The average case fatality rate is around 50%.	Prevent Ebola outbreaks by maintaining surveillance for Ebola virus disease and supporting at-risk countries to develop preparedness plans. Publish guidance and advice to prevent and control potential outbreaks. In 2015, the WHO published a list of top emerging diseases likely to cause major epidemics. The initial list of disease priorities needing urgent R&D attention comprises: Crimean Congo hemorrhagic fever, Ebola virus disease and Marburg, Lassa fever, MERS and SARS coronavirus diseases, Nipah, and Rift Valley fever. The list will be reviewed annually or when new diseases emerge.	Yes, on Aug 8, 2014 and on Jul 17, 2019.
2019	Wuhan, China	COVID-19	1. As of November 28, over 260 million confirmed cases and nearly 5.2 million deaths have been reported globally. The International Monetary Fund ranked this crisis as The Great Lockdown. 2. New strains pop up continuously. The Delta variant has even become one of the most infectious viruses (R0:5-9·5) (*2*). 3. The new Omicron variant has spread to 38 countries.	Provide support around the world to fight against this pandemic. Issue the COVID-19 Strategic Preparedness and Response Plan (SPRP) for 2021 and accompanying documents as a package aimed at guiding the coordinated action that we must take at national, regional, and global levels to overcome the ongoing challenges in the response to COVID-19.	Yes, on Jan 30, 2020.

communication and cooperation as well as sustainable development.

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