

Feasibility of coronavirus disease 2019 eradication

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On March 11, 2020, the World Health Organization announced that the current outbreak of coronavirus disease 2019 (COVID-19) is a global pandemic.^[1] COVID-19, an acute respiratory contagious disease to which all people seem to be susceptible, is caused by 2019 novel coronavirus (2019-nCoV). The patient zero for this pandemic is unknown. Early epidemiology estimates suggest that the basic reproduction number (R0) for COVID-19 is 2.3, with a serial interval of 7.5 days.^[2] Chinese doctors and scientists issued warnings of a global pandemic at the initial phase.^[3] Unfortunately, the disease spread widely. Outbreaks and numerous new COVID-19 cases are reported daily around the world, causing public panic. To April 18, 2020, there have been more than 2,200,000 confirmed cases and 150,000 death cases reported globally.^[4]

There are two opposing courses of action by which we can respond to this outbreak. We can take action immediately, aiming to stop COVID-19 transmission, control the outbreaks, and possibly even eradicate this disease, or we can allow COVID-19 to take its natural course and simply defend passively. It is arguably better to work to stop the spread of COVID-19, because infectious disease outbreaks can be effectively controlled by contact tracing and isolation of cases, although this approach requires intensive public health effort and cooperation.^[5]

We reviewed the epidemic trajectory of COVID-19 and arbitrarily divided it into four stages, namely the pre-outbreak stage, the outbreak stage, the inflection point, and the decrement stage. A chart was made according to the daily reports of confirmed COVID-19 cases in China, from the date of the first reported case on December 8, 2019^[2] to the last reported case on March 17, 2020 [Figure 1, Supplementary Table 1, <http://links.lww.com/CM9/A249>]. We defined an 8-day duration as one serial interval unit (SIU). The pre-outbreak stage lasted 5 to 6

SIUs and was followed by the outbreak stage, which lasted for about four SIUs before reaching the inflection point. The short duration of the outbreak stage in China was possible only because a strict containment strategy was implemented. The inflection point stage lasted for about one SIU, after which the decrement stage continued for two SIUs before the number of new COVID-19 cases reached zero.

As shown in Figure 2 [Supplementary Table 2, <http://links.lww.com/CM9/A249>], the number of COVID-19 mortalities was proportional to the number of morbidities. The number of confirmed COVID-19 cases increased by the N^{th} power of two during the first SIU in the outbreak stage in Wuhan, and the associated mortality reached up to 7.28%. Hospitals inundated with so many COVID-19 cases within a short period will inevitably run out of medical resources. Such an overwhelming situation forces doctors to make choices regarding which patients to prioritize for treatment, resulting in increased mortalities. In China, the COVID-19 mortality slowly decreased until a total of 32,572 medical staff members^[6] were deployed in Wuhan to fight against the outbreak. In addition to the insufficient public health service, a shortage of personal protective equipment (PPE), lack of protective awareness, and gathering of people for various reasons all posed considerable threats to public health during this outbreak and led to a devastating loss of the global economy.

Some individuals are claiming that, given the difficulty of doing so, countries should not impose measures to prevent and control COVID-19. They argue that the population could benefit from this pandemic and become immune naturally, gaining “herd immunity.” For this to occur, about 60% to 70% of the general population would need to become infected. Based on the current estimates of the proportion of severe and critical cases (about 15%) and the death rate (about 2%, or even higher) of COVID-19

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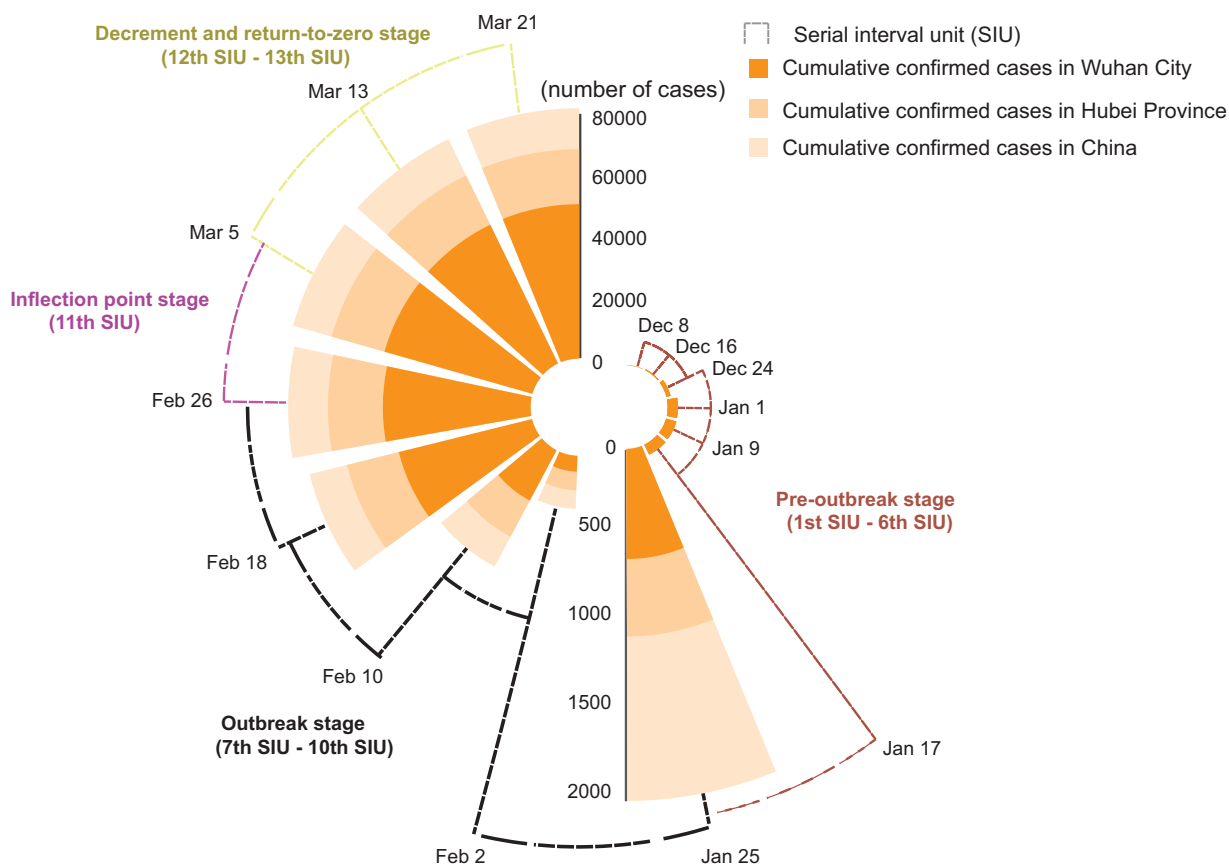


Figure 1: Trends of cumulative confirmed cases during the epidemic in Wuhan city, Hubei province, and China, respectively. We divided the duration into 13 SIUs based on 8-day intervals, ranging from December 8, 2019, to March 18, 2020. SIUs: Serial interval units.

in the general population,^[7] the amount of associated morbidity and mortality would be staggering if this “herd immunity” strategy becomes a reality; its scope would far exceed the 2009 A(H1N1)pdm09 influenza pandemic, which was characterized by highly transmissible disease with a rapid spread and is estimated to have caused 123,000 to 203,000 deaths.^[8,9] In such a scenario, COVID-19 could result in 510,000 deaths in Great Britain and 2.2 million deaths in the United States, according to a report from Imperial College.^[10]

To eradicate 2019-nCoV, lessons learned from managing the outbreak in China could be broadly applied. There have been no newly diagnosed cases of COVID-19 in Wuhan since March 18, 2020. To achieve this accomplishment, the “China Solutions” were implemented. These solutions included: (1) the four “E” strategies, that is, early detection, early diagnosis, early isolation, and early intervention; (2) centralized medical management according to disease severity, achieved via building up medical shelters for mild patients instead of allowing them to stay home, which can efficiently prevent family clusters of infection; (3) a mandatory 14-day quarantine for all close-contacts of COVID-19 cases; (4) requiring all residents to wear medical masks to abrogate human-to-human transmission; (5) canceling all unnecessary rallies and gathering activities; and (6) containment of communities with COVID-19 cases, even entire cities if necessary. The progression of the

COVID-19 outbreaks in Wuhan and outside of Hubei province strongly suggests that isolating infectious patients, curbing the transmission routes through the use of PPE, and keeping an efficient social distance are very important for preventing and controlling such outbreaks. Recommending the herd-immunity strategy is unacceptable given that: (1) senior citizens and persons with a comorbidity (eg, diabetes mellitus) are more susceptible to catching the virus and tend to have a poor prognosis; and (2) the lungs are the predominate organ that succumbs to 2019-nCoV infection, so some healthy individuals will deteriorate rapidly due to the strong responsiveness of cytokine storms or other kinds of pathogenesis.

While the COVID-19 pandemic continues around the world, the prevention and control of imported cases remains a tremendous challenge for China. Working toward this difficult goal, China customs implements a series of strategies, such as conducting a 14-day quarantine and testing either 2019-nCoV nucleic acid or its specific IgM/IgG if necessary. However, to keep the COVID-19 outbreak from resurging in China, all residents must remain vigilant, use PPE, and maintain social distance until the COVID-19 pandemic ends.

In conclusion, the success in China provides hope that COVID-19 could be the first pandemic human infectious disease to be eradicated by scientific management and

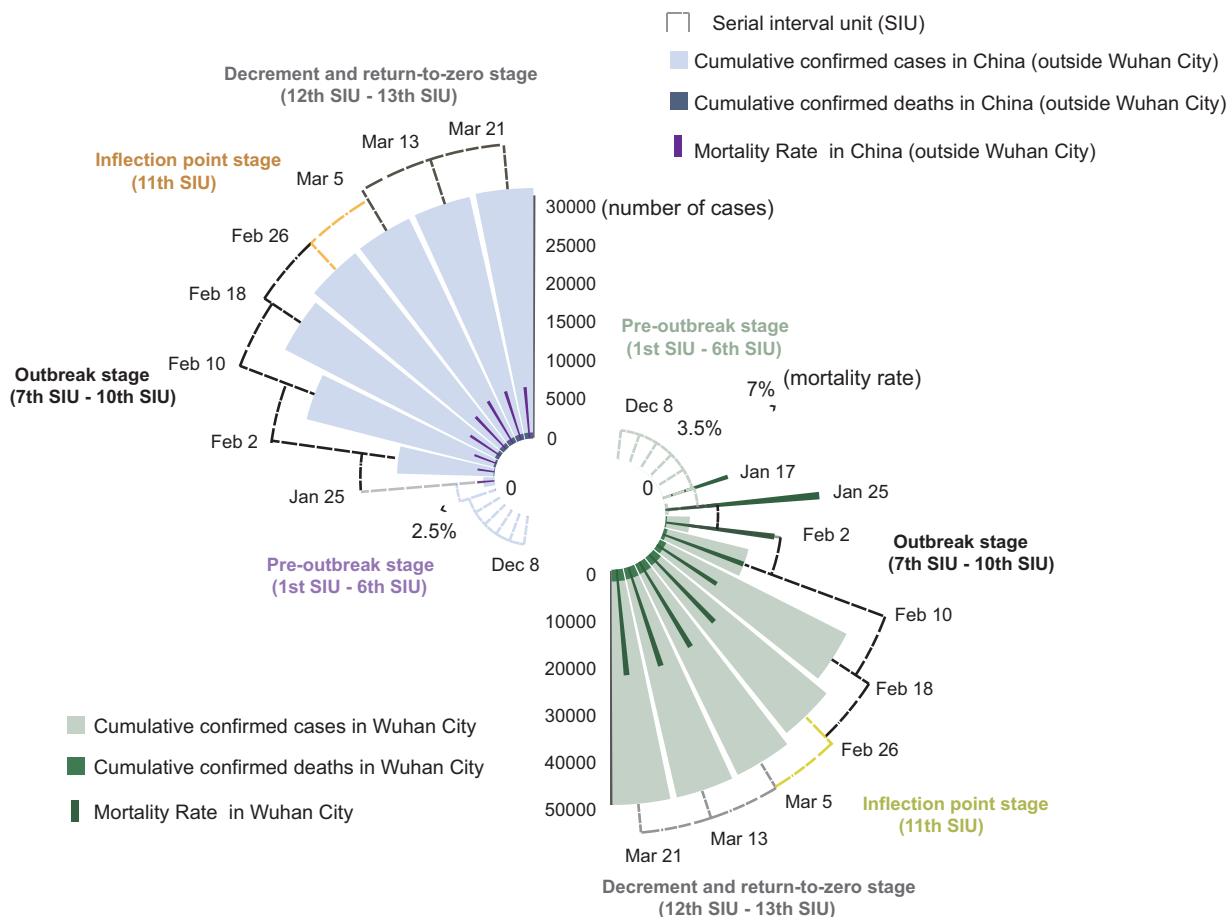


Figure 2: Trends of cumulative confirmed cases, deaths, as well as the mortality rate in Wuhan city and China (outside Wuhan city). The mortality rate in Wuhan city is significantly higher than that in China (outside Wuhan city).

effective control tactics. We strongly urge the general population to wear medical masks during the pandemic period whenever in public. This simple measure could not only help protect the wearer from becoming infected with 2019-nCoV, it will also impede the transmission route from infected individuals, thus protecting others.

Conflicts of interest

None.

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