

Foreword

Forty and Twenty Years Ago and Now — Virus Elimination Successes and New Challenges

Forty years ago, smallpox was declared eradicated by the World Health Organization (WHO). As D.A. Henderson, Director of the Smallpox Eradication Programme at the WHO quoted from the 33rd World Health Assembly (1980) (1), “...the world and all its peoples have won freedom from smallpox...a most devastating disease...since earliest time, leaving death, blindness, and disfigurement in its wake and which only a decade ago was rampant in Africa, Asia and South America.”

Twenty years ago, poliomyelitis was declared eliminated in the Western Pacific Region (WPR) by the WHO — the second of the six WHO regions to eliminate polio (2). Although maintaining polio-free status in the WPR is challenged by circulating vaccine-derived polioviruses, the WPR has remained free of wild-type polio since the declaration. Global eradication of polio will ultimately succeed through sustained effort, as eradication is scientifically feasible (3), and the political will exists to see the job through and the world to become polio-free.

To commemorate these 40- and 20-year-old successes and considering that we are in the midst of a new pandemic, I think that it is worth highlighting a few similarities and differences between smallpox, polio, and coronavirus disease 2019 (COVID-19).

Smallpox was not only devastating, it was also highly visible and readily diagnosed. Poliovirus infection, in contrast, is clinically apparent in less than 1% of infections and has required the remarkable invention of acute flaccid paralysis surveillance to render it visible to epidemiologists in near-real-time. Laboratory science advances and expertise have been essential for eliminating polio by making this invisible virus visible through diagnostic and etiological tests, molecular epidemiology, and environmental surveillance. COVID-19 is more visible than polio but not nearly as visible as was smallpox. Laboratory science, technology, and especially testing capacity have been required to “see” COVID-19 virus infections — both symptomatic and asymptomatic — to identify and stop potential chains of transmission.

Although smallpox has a basic reproduction number of about 5, implying the need of approximately 80% population immunity for transmission to die out, smallpox was eradicated with coverage short of the 80% target. This feat was facilitated by a combination of the clinical severity of smallpox, its lack of pre-symptomatic transmissibility, and an effective vaccine that made smallpox vulnerable to a surveillance and containment strategy that initially supplemented mass vaccination and then became a primary eradication tool as cases became fewer. Polio has a similar basic reproduction number to smallpox, and it occurs in outbreaks in which infections propagate rapidly and silently, requiring massive vaccination campaigns to stop.

COVID-19 is again in the middle. Despite its lower basic reproduction number, the virus propagates rapidly through community transmission and cluster events — and is transmissible from asymptomatic, pre-symptomatic, and ill individuals. In China’s remarkable and inspirational public health achievement, COVID-19 was stopped and contained through a combination of non-pharmaceutical interventions that reduce transmission risk with an incredibly effective test and trace strategy that identifies and treats in isolation infected individuals and locates their close contacts and quarantines them with testing and observation to determine whether they are infected (and therefore infectious) (4). This precision public health strategy stops chains of transmission and is similar to the smallpox surveillance and containment strategy — but unlike for smallpox, the test and trace strategy succeeded in China without use of a vaccine.

Smallpox is gone, polio is going, and COVID-19 is approaching a turning point with the emergence of safe and effective COVID-19 vaccines. Although China and other countries demonstrated that COVID-19 can be eliminated without a vaccine, the non-pharmaceutical containment effort is not only enormous and expensive, but protecting susceptible populations requires ever-vigilant virus detection and response as long as the virus circulates anywhere in the world. But unlike non-pharmaceutical interventions, which only protect indirectly through reduction or elimination of exposure, COVID-19 vaccines will have the advantage of providing direct protection to vaccinees to prevent morbidity and mortality in case they encounter the virus. Some COVID-19 vaccines — if not

all COVID-19 vaccines — will almost certainly be able to also provide indirect protection by inducing population immunity and preventing infection and transmission. Only experience with the COVID-19 vaccines will tell for sure.

Vaccines may well represent part of the pathway out of the pandemic. The challenge is how to use the COVID-19 vaccines, along with non-pharmaceutical interventions, to prevent COVID-19 morbidity and mortality and to lower and ultimately end transmission. China's situation is different from many countries because there is almost no local virus transmission here. A key question, then, is how to best use the emerging vaccines to ease and eventually eliminate the need for non-pharmaceutical interventions in China — without losing control of the coronavirus when non-pharmaceutical interventions are gradually retired. Following up China's successful pandemic containment response, which was very highly rated by the Chinese public (5), with a smooth introduction of COVID-19 vaccines will be a major challenge — but a good challenge to have.

One last point. An important similarity between smallpox, polio, and COVID-19 prevention and control is that international collaboration and cooperation was, is, and always will be a fundamental necessity for control, elimination, and ultimately eradication of infectious diseases. Countries helping each other with data, knowledge, and vaccines and other technologies will make the world a far safer and healthier place. I believe that wise and collaborative use of COVID-19 vaccines will help turn the tide of this pandemic.

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