Public Health Measures to Slow Community Spread of Coronavirus Disease 2019

Benjamin J. Cowling¹ and Allison E. Aiello²

¹World Health Organization Collaborating Centre for Infectious Disease Epidemiology and Control, School of Public Health, University of Hong Kong, Hong Kong, ²Department of Epidemiology, Carolina Population Center, Gillings School of Global Public Health, University of North Carolina, Chapel Hill, North Carolina, USA

Coronavirus disease 2019 (COVID-19) was initially identified in an outbreak of viral pneumonia in Wuhan, People’s Republic of China, in December 2019, and it has now been recognized in 77 countries with over 90 000 laboratory-confirmed cases and over 3000 deaths as of March 3, 2020 [1]. The epidemiology of COVID-19 has recently become clearer as incident cases continue to rise and researchers refine estimates of the severity, transmissibility, and populations affected. Based on available data, COVID-19 is efficiently transmitted in the community, and the proportion of infections leading to severe illness is particularly high among adults ≥50 years of age and among individuals with comorbid health conditions. Although rare, severe cases have also been reported among younger individuals. Thus far, the estimated basic reproductive number of COVID-19 is higher than that of influenza [2], as is the case fatality risk for adults and older individuals.

An estimated 80% of COVID-19 cases are mild [1]. This is not a glass-half-full statistic, because 20% of infections result in clinically severe cases that have the potential to overwhelm already overburdened health facilities. Given the lack of vaccines and effective antivirals, nonpharmaceutical interventions (NPIs) are the most effective available interventions for local and global control and mitigation of COVID-19. To date, measures aimed at slowing introduction of infection globally have included travel restrictions, isolation of confirmed cases, and quarantine of exposed persons. In the United States, NPIs have reduced the number of infected persons entering the community, but recent outbreaks in multiple US states make it clear that these measures have delayed but not prevented community transmission. In 2009, NPIs were able to delay large epidemic waves of pandemic influenza A(H1N1)pdm09 in some locations until after the summer, because influenza transmission tends to be reduced by higher temperatures and humidity. It is unclear whether COVID-19 transmission will be heavily affected by seasonal weather variation, given that transmission is now occurring in multiple tropical and subtropical locations.

Given the many uncertainties regarding the potential for widespread community transmission of COVID-19, community mitigation measures to curb local transmission must be carefully considered and applied where possible. In the 1918/1919 influenza pandemic, timely and sustained use of a broad set of NPIs including school closures, banning of mass gatherings, mandatory wearing of masks, isolation of ill persons, and appropriate disinfection and/or hygiene measures reduced mortality in several US cities [3]. These measures decreased transmission, spread the epidemic over a longer period of time, reduced the height of the epidemic peak, and reduced the overall number of infected persons and overall health impact. In this study, we discuss NPIs that may be most effective given our current understanding of COVID-19 epidemiology (Table 1).

PERSONAL PROTECTIVE MEASURES AND ENVIRONMENTAL MEASURES

Personal protective measures such as hand hygiene and face mask use are included in public health guidelines for pandemic preparedness. Hand hygiene effectively reduces the transmission of respiratory infections through indirect contact in the community setting, and it should be practiced by ill individuals, their contacts, and the larger population to limit the risk of transmission through fomites [4]. Most coronaviruses, including severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), are inactivated by alcohol-based hand sanitizers and disinfectants such as bleach. Environmental disinfection with appropriate sanitizers is also recommended [4].

Because hand hygiene does not affect direct transmission of COVID-19 by respiratory droplets or aerosols, face masks have been widely deployed by at-risk populations in China and some other locations in Asia, for example, in Hong Kong and Taiwan. The efficacy of face masks among healthy individuals is unclear, but masks may protect others, particularly healthcare workers, from actively symptomatic individuals with COVID-19. However, the combination of masks and hand hygiene has been shown
to reduce transmission of respiratory viruses and serves to highlight that layering of NPIs is more effective at reducing disease transmission than any NPI alone [4]. Mask use could be recommended for ease transmission than any NPI alone. Combination of NPIs is more effective at reducing disease transmission and serves to highlight that layering of NPIs is more effective at reducing disease transmission than any NPI alone.

In most locations, containment efforts are likely to be ineffective in preventing close contacts being carefully traced and quarantined at home or in designated quarantine facilities. This requires intense laboratory surveillance to pick up COVID-19 cases in the community, including cases with mild illness. To date (March 13, 2020), these containment measures appear to have been able to prevent sustained local transmission in Hong Kong, Singapore, and Taiwan.

Medical isolation of cases has been feasible in outbreaks of SARS and Middle East respiratory syndrome (MERS) because infections are generally severe and of a limited number, but similar practices are less useful in influenza epidemics because of the huge number of cases and difficulties in identifying mild infections [5]. Quarantine of asymptomatic exposed persons has also been used to contain SARS and MERS outbreaks, but it will not be feasible in designated quarantine facilities if there is widespread community transmission of COVID-19. Moreover, quarantine measures can be costly, challenging to enforce, and introduce location-specific ethical and legal challenges that may hamper control efforts. Perhaps the most important NPIs in this domain are strong, coordinated public health messaging to self-isolate when ill. Previous work has demonstrated that the speed with which infected populations are quarantined, through a combination of hospital-based isolation and self-quarantining, accelerates during epidemics of emerging disease such as COVID-19 [6]. Public health messaging to leverage and augment this natural acceleration of isolation and quarantine practices may be critical in the context of widespread community transmission. Expanding access to surveillance and diagnostic testing is also critical to identify transmission clusters where isolation is most important.

### COMMUNITY MITIGATION MEASURES

In most locations, containment efforts are likely to be ineffective in preventing...
epidemics, and public health measures will be needed to mitigate the pandemic impact at a local level [7]. As local epidemics progress towards a peak in incidence, there will be a surge in healthcare demand, and particularly the demand for intensive care, to a level that is likely to overwhelm the healthcare system. The aim of mitigation is to reduce this surge as much as possible. Community mitigation measures generally promote social distancing to reduce transmission, but they can be extremely disruptive and have population-specific economic consequences [5]. Similar to influenza pandemics, mitigation measures that could be considered for COVID-19 include the temporary closure of schools and workplaces and cancellation of mass gatherings for a period of time to flatten the epidemic peak. Voluntary avoidance measures, where people choose to stay at home more often, will also contribute to social distancing.

Careful consideration of the positive and negative effects of school closures in the United States is critical, because prolonged closures disproportionately affect low-income families and must include contingency plans for providing free meals and other programming to families that rely on school-based learning and economic support. Currently, it appears that children can be infected as easily as adults; however, the risk of severe disease is very low in this group. Given that children can be infected, it is reasonable to believe that they would also be contagious, although the importance of children in community transmission of COVID-19 has not yet been quantified. Closure of workplaces introduces similar ethical concerns, because low-income workers often have limited ability to work from home without loss of pay and other benefits. Careful evaluation should be given to the timing and duration of community mitigation measures to maximize the beneficial epidemiologic effects while minimizing social and economic harm.

CONCLUSIONS
Given the evolving picture of the COVID-19 pandemic, the application of layered, multifaceted, location- and population-specific NPIs will need to be considered and initiated quickly to curb widespread transmission. When NPIs are “reactive” to widespread transmission, instead of “proactive” to the potential for transmission, they often fail to reduce rates of illness. The types of proactive measures we describe here were successful in mitigating the 1918/19 influenza pandemic and may be just as valuable almost a century later.

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