Perspective

Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak

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The novel coronavirus (2019-nCoV) that emerged in Wuhan, China in December 2019 quickly spread within Hubei province and has now reached all provinces in China and was exported to >20 countries by 30 January 2020. 2019-nCoV is thought to be primarily transmitted by respiratory droplets with a similar incubation time and generation time as SARS coronavirus (SARS-CoV).¹,² SARS was frightening at the time, maybe even more frightening compared to 2019-nCoV (now renamed COVID-19) given its much more frequent progression to severe disease and death. But the world was able to completely interrupt human-to-human transmission, halt the epidemic and SARS-CoV is now eradicated. In the absence of vaccines and antivirals, this remarkable achievement was only possible because of rigorous implementation of traditional public health measures.

We are yet again faced with a situation of an outbreak with a closely related virus for which we currently have no specific therapeutics or vaccines. Again, we need to rely on classical public health measures to curb the epidemic of this respiratory disease. The primary goal of such public health measures is to prevent person-to-person spread of disease by separating people to interrupt transmission. The tools we have at hand are isolation and quarantine, social distancing and community containment. All these tools are currently being employed at an unprecedented massive scale in China. Here we define these tools, explain how they are being used to control the novel coronavirus, and elaborate on the benefits and challenges.

‘Isolation’ is the separation of ill persons with contagious diseases from non-infected persons to protect non-infected persons, and usually occurs in hospital settings. An isolation room could also be equipped with negative pressure to reduce transmission via aerosols, but for large droplets like for SARS CoV, control was achieved without negative pressure rooms. Isolation of patients is particularly effective in interrupting transmission if early detection is possible before overt viral shedding. Given that influenza patients can already transmit before clinical symptoms set it, isolation is often too late to be sufficiently effective to halt transmission and control an influenza pandemic. However, for SARS CoV the incubation time is longer than for influenza (about 5 versus 2 days),³ and viral shedding was highest once the patient is truly sick. A longer incubation time allows for more time to identify cases and put them into isolation. The incubation time of the 2019-nCoV also has a median of 5 days,⁴ however, at this stage, it remains unknown when viral shedding and transmissibility peaks and how frequently pre-symptomatic cases result in secondary cases.

‘Quarantine’ is one of the oldest and most effective tools of controlling communicable disease outbreaks. This public health practice was used widely in fourteenth century Italy, when ships arriving at the Venice port from plague-infected ports had to anchor and wait for 40 days (in Italian: quaranta for 40) before disembarking their surviving passengers.⁵ Forty days provided ample time for the incubation time to be completed so that yet asymptomatic cases became symptomatic and could therefore be identified. Quarantine was implemented successfully as an effective measure during the SARS epidemic in 2003.⁶ It is also an important component of pandemic influenza plans. Quarantine means the movement restriction of persons who are presumed to have been exposed to a contagious disease but are not ill,
either because they did not become infected or because they are still in the incubation period. Quarantine may be applied at the individual or group level and usually involves restriction to the home or a designated facility. Quarantine may be voluntary or mandatory. During quarantine, all individuals should be monitored for the occurrence of any symptoms. If such symptoms occur, they must be immediately isolated in a designated centre familiar with treating severe respiratory illness. Quarantining is most successful in settings where detection of cases is prompt, contacts can be listed and traced within a short time frame with prompt issuance of quarantine with voluntary compliance to this issuance.

'Social distancing' is designed to reduce interactions between people in a broader community, in which individuals may be infectious but have not yet been identified hence not yet isolated. As diseases transmitted by respiratory droplets require a certain proximity of people, social distancing of persons will reduce transmission. Social distancing is particularly useful in settings where community transmission is believed to have occurred, but where the linkages between cases is unclear, and where restrictions placed only on persons known to have been exposed is considered insufficient to prevent further transmission. Examples for social distancing include closure of schools or office buildings and suspension of public markets, and cancellation of gatherings. If these measures are deemed to be insufficient, ‘community-wide containment’ may need to be implemented. Community-wide containment is an intervention applied to an entire community, city or region, designed to reduce personal interactions, except for minimal interaction to ensure vital supplies. It is a continuum to expand from social distancing to community-wide quarantine with major movement restrictions of everyone. Enforcement of community-wide containment measures is far more complex given the larger number of persons involved. Such measures are also ethically more challenging with individual human rights weighing against the public health imperative. The advent of social media is an additional challenge with individual human rights weighing against the public health imperative. The advent of social media is an additional challenge. Such measures are also ethically more challenging with individual human rights weighing against the public health imperative. The advent of social media is an additional challenge.

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There are multiple implications for travellers: national borders may be closed or they may be barred from entry into cities or provinces where community containment is being implemented. International travellers already locked into such areas will not be able to leave unless their governments charter airplanes to fly them out, and even then it may be difficult to reach the airport due to blocked roads. Indeed, most governments are now in the process of evacuating their citizens, and such passengers will be subject to 14 days quarantine upon arrival in their home country. Quarantining of those returning travellers or expats will occur at designated facilities (including islands for some countries) with medical observation. Public health measures were successful for SARS because the vast majority of SARS patients were symptomatic, and were thus identifiable and could be isolated. Viral loads peaked at 6–11 days after onset of illness for nasopharyngeal aspirates, and overall, peak viral loads were reached at 12–14 days of illness when patients were usually already in hospital care. Low or absence of viral shedding in the first few days of illness meant that early isolation measures could be effective. The incubation time allowed for timely isolation, and also for contacts to be traced and quarantined in time.

The victory of old-type public health tools over SARS provides impetus to continue such stringent measures for the novel coronavirus. Given the trajectory of this outbreak, it is now a matter of whether we are able to scale up such efforts to keep pace with the rapid increase of cases and geographical spread. Whether these rigorous measures will result in the same victory as for SARS depends on the following questions that currently remain unanswered: (i) what is the proportion of subclinical disease (asymptomatic or mildly symptomatic) that would be missed by the case definition, hence not be identified and immediately isolated, and therefore contribute to community transmission? (ii) On what day of illness is peak viral shedding, and how much viral shedding occurs before onset of symptoms? (iii) Does viral shedding occur also beyond respiratory droplets, e.g. via fomites? (iv) What is the true case fatality rate if the denominator also takes milder cases into account?
Table 1. Non-pharmaceutical public health interventions to control infectious disease outbreaks, adapted from Cetron and Simone

| Definition | Objective | Setting | Challenges | Remarks |
|------------|-----------|---------|------------|---------|
| Isolation | Separation of ill persons with contagious diseases from non-infected persons | To interrupt transmission to non-infected persons | Effective for infectious diseases with high person-to-person transmission where peak transmission occurs when patients have symptoms | Early case detection is paramount | Largely ineffective for infectious diseases where asymptomatic or pre-symptomatic infections contribute to transmission |
| Quarantine | Restriction of persons who are presumed to have been exposed to a contagious disease but are not ill, either because they did not become infected or because they are still in the incubation period | To reduce potential transmission from exposed persons before symptoms occur | Quarantining is most successful in settings where detection of cases is prompt, contacts can be traced within a short time frame with prompt issuance of quarantine | Quarantined persons will need psychological support, food and water, and household and medical supplies | Financial compensation for work days lost should be considered. Voluntary is preferred over mandatory quarantine, but law enforcement may need to be considered if quarantine violations occur frequently. Law enforcement is needed in most settings. Therefore such restrictive interventions should be limited to the actual level of risk to the community |
| Community containment | Intervention applied to an entire community, city or region, designed to reduce personal interactions and movements. Such interventions range from social distancing among (such as cancellation of public gatherings, school closures; working from home) to community-use of face masks to locking down entire cities or areas (cordon sanitaire) | To reduce intermixing of unidentified infected persons with non-infected community members. | Social distancing is particularly useful in settings where community transmission is substantial | Ethical principles and codes are needed to guide community containment practice and policy Community containment to protect the population's health potentially conflicts with individual rights of liberty and self-determination |

The answers to these questions will drive the response. Preliminary insights from clusters in Vietnam and Germany unveil that even mildly symptomatic persons may contribute to transmission.\(^{11,12}\) If this is indeed more frequent, then old-style public health measures will not be sufficient and we need to await vaccines to halt the epidemic.

The initial case fatality rate was reported to be 15%, but the initial cases were biased towards the severe end of the disease, with rapidly rising cases, it is now thought to be around 2–3%. Until we understand the full clinical spectrum of the disease, we will not know the case fatality rate. What we do know is that disease severity does not drive transmissibility. Although the case fatality rate may be far lower than that of SARS-CoV, the greatest concern could be that this novel virus behaves epidemiologically like influenza viruses, will defy all old-style public health measures, and turn into a pandemic with many more deaths than SARS.

**Conflict of interest**

None declared

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