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

A. Wilder-Smith

D. O. Freedman

Citation of published version:
Wilder-Smith, A., & Freedman, D. O. (2020). Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. In Journal of Travel Medicine (Vol. 27, Issue 2). Oxford University Press (OUP). https://doi.org/10.1093/jtm/taaa020

Journal of Travel Medicine
International Society of Travel Medicine
Established 1991
Promoting healthy travel worldwide

Journal of Travel Medicine, 2020, 1–4
doi: 10.1093/jtm/taaa020
Perspective

Perspective

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

A. Wilder-Smith MD[1,2] and D.O. Freedman MD[3]

[1]Department of Disease Control, London School of Hygiene and Tropical Medicine, Keppel St, Bloomsbury, London WC1E 7HT, UK, [2]Heidelberg Institute of Global Health, University of Heidelberg, Seminarstraße 2, 69117 Heidelberg, Germany and [3]University of Alabama, Tuscaloosa, AL 35487, USA

*To whom correspondence should be addressed.

Submitted 6 February 2020; Revised 6 February 2020; Editorial Decision 7 February 2020; Accepted 10 February 2020

Key words: SARS, MERS, coronavirus, Wuhan, pandemic preparedness, COVID-19

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.[7] 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.[8] 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 to ensure compliance. During such community-wide quarantine, it is particularly important to wisely use social media as social media provides an opportunity for communicating the reasons for quarantine, reassurance and practical advice and to pre-empt false rumours and panic. Implementation requires close partnerships and cooperation with law enforcement at the local and state level, and often involves checkpoints, and may need legal penalties if quarantine violations occur. A community-wide quarantine is currently happening in China on an order of magnitude that mankind has never witnessed before. Table 1 summarizes the different public health measures.

China has been preparing to contain future pandemics by applying lessons learnt from SARS ever since 2003.[9] We have to commend China for their swift and decisive response. Within a matter of weeks, China implemented all the tools ranging from case detection with immediate isolation, and contact tracing with quarantining and medical observation of all contacts. By 2 February 2020, 14 600 cases had been confirmed, and >20 000 cases were classified as suspect cases waiting for laboratory results, 113 579 close contacts were been tracked and 4201 people were released from medical observation. A total of 102 427 people were receiving medical observation. This is an unprecedented gigantic effort that surpasses all quarantine measures during SARS. However, the sheer magnitude of the new cases means that not all contacts can possibly be ascertained or monitored adequately. It means that many unidentified contacts are in the community. While SARS was mainly an outbreak that propagated itself within hospitals and confined communities (Hotel Metropole, Amoy Gardens etc), widespread community transmission is already evident for 2019-nCoV in Hubei Province and beyond. Hence, the most drastic of all classical public health measures was the only logical next step: community containment with social distancing, community-use of facemasks at all times and the city of Wuhan with 11 million residents was locked-in with the shutdown of the city's public transportation, including buses, trains, ferries and the airport. Prior to the lock-down in Wuhan, about 5 million (many of whom were already infected) left Wuhan thus contributing to further spread. As the community-based outbreak spread, lock-down was extended to >60 million residents in >20 cities by 30 January 2020. China has issued the largest quarantine in history.

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.[10] 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[5]

	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
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	Law enforcement is needed in most settings. Therefore such restrictive interventions should be limited to the actual level of risk to the community

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

Funding

None

References

1. Zhu N, Zhang D, Wang W *et al.* A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020; **382**:727–3.
2. Wilson ME, Chen LH. Travelers give wings to novel coronavirus (2019-nCoV). *J Travel Med* 2020.
3. Nishiura H, Mizumoto K, Ejima K, Zhong Y, Cowling B, Omori R. Incubation period as part of the case definition of severe respiratory illness caused by a novel coronavirus. *Euro Surveill* 2012; **17**.
4. Li Q, Guan X, Wu P *et al.* Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020.
5. Cetron M, Simone P. Battling 21st-century scourges with a 14th-century toolbox. *Emerg Infect Dis* 2004; **10**:2053–4.
6. Goh KT, Cutter J, Heng BH *et al.* Epidemiology and control of SARS in Singapore. *Ann Acad Med Singapore* 2006; **35**:301–16.
7. Cetron M, Landwirth J. Public health and ethical considerations in planning for quarantine. *Yale J Biol Med* 2005; **78**: 329–34.

8. Interventions for Community Containment. https://www.cdc.gov/sars/guidance/d-quarantine/app1.html accessed 14 February 2020.
9. Zhong NS, Zeng GQ. Pandemic planning in China: applying lessons from severe acute respiratory syndrome. *Respirology* 2008; **13**: S33–5.
10. Cheng PK, Wong DA, Tong LK *et al.* Viral shedding patterns of coronavirus in patients with probable severe acute respiratory syndrome. *Lancet* 2004; **363**:1699–700.
11. Phan LT, Nguyen TV, Luong QC *et al.* Importation and human-to-human transmission of a novel coronavirus in Vietnam. *N Engl J Med* 2020 doi:10.1056/NEJMc2001272.
12. Rothe C. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. *N Engl J Med* 2020 doi:10.1056/NEJMc2001468.