

Perspective

## Centralized medical quarantine for imported COVID-19 in Shanghai, China

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The outbreak of the novel Coronavirus disease 2019 (COVID-19) that emerged in Wuhan, China, towards the end of 2019 quickly spread around the world following predicted patterns of high connectivity, with a speed that is much higher compared with other emerging infectious diseases such as Ebola or Zika.<sup>1–3</sup> Swift and decisive measures in China to contain the outbreak in Wuhan included (i) Fangcang shelter hospitals to isolate all cases, even mild cases;<sup>4</sup> (ii) lockdown;<sup>5</sup> (iii) prolonged social distancing period and extension of Lunar New Year holiday; (iv) active case finding and contact tracing and (v) effective public health messaging to change people's behaviors.<sup>6,7</sup> By mid-February, new cases were falling every day, suggesting that containment is feasible. By 13 March 2020, the number of newly imported COVID-19 cases in China exceeded the number of new indigenous cases in China for the first time. By end March, Europe was the new epicenter for the COVID-19 pandemic, followed by the USA, Brazil and Russia by end May 2020, while China did not see any new locally acquired cases for more than 50 days.

To reduce the importation for new cases into China, China implemented various strategies. From 28 March 2020, China first had temporary bans on all foreign visitors, even if they had visas or residence permits.<sup>8</sup> From 1st April, flights to a restricted number of 16 cities were introduced. The Customs authorities introduced nucleic acid testing for all overseas passengers entering China by air, sea or land, combined with quarantine. Travelers are subject to a 14-day mandatory quarantine in the first entry point city. After they complete the fortnight quarantines and test negative for the virus.<sup>8</sup>

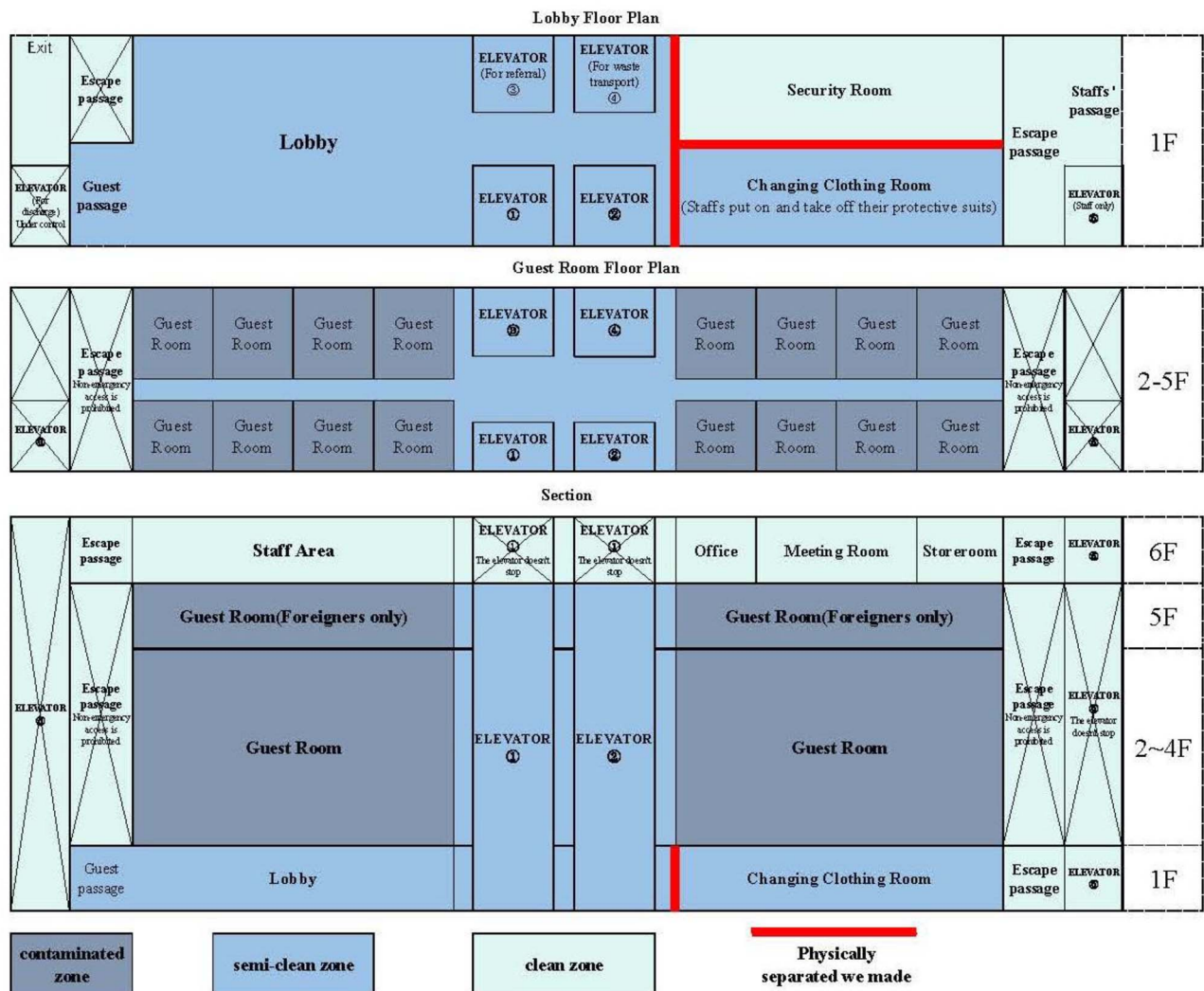
Here, we review a selection of prevention, control management strategies and experiences at the Shanghai medical quarantine centre in an effort to quarantine all imported cases in order to

interrupt any onward transmission that could potentially reignite an outbreak in China.

### Shanghai Medical Quarantine Centre for Arrivals from Overseas

The centralized medical quarantine is the main prevention and control measure in Pudong New Area, Shanghai, where the main airport for international flights is located. Forty-two quarantine sites were established, and more than 1700 health workers were dispatched to work in these centres. Centralized medical quarantine site (hereafter referred to as a 'quarantine site') requires detached buildings away from densely populated urban areas and separates sewage treatment systems. Rooms should have separate sanitary facilities, telephones and broadband Internet access, and should be separated from the kitchen, office and other auxiliary places. Central air conditioning and carpets are prohibited. [Figure 1](#) shows one example of a quarantine site with three zones and two passageways: a contaminated zone is a guest room where observers can do their masks; a semi-clean zone includes corridors, lobbies and elevators where observers are required to wear masks; changing rooms where staffs are required to put on and take off their protective suits and a clean zone for staff only; two passageways for observers and staff. Each zone is physically separated from each other. Adequate supplies of disinfectant and sterilizing equipment are provided.

Only asymptomatic travelers or returning Chinese nationals are transferred to these quarantine centers after a test was taken at the airport. Should the test taken at the airport turn positive, those persons are immediately transferred to a designated hospital. Persons with symptoms arriving at Pudong Airport,



**Figure 1.** Zones and passages in a quarantine site

Shanghai, are immediately placed in a designated hospital and tested.

These quarantine centers must be differentiated from the Fangcang shelter hospitals that China also instituted during the COVID-19 outbreak. While the centralized quarantine centers are meant for asymptomatic persons tested initially negative at airports, Fangcang shelter hospitals were designed to isolate laboratory confirmed COVID-19 patients with mild or moderate disease.<sup>4</sup>

### Setting up work teams for the Centralized Quarantine Centre in Shanghai

Supplementary Table S1 shows the team structure. The team leader is an administrative staff from a hospital, and the ratio of doctors and nurses to the total number of rooms is 1:50 and 1:100, respectively. There are two groups: the reception group and the medical treatment group.

### Measures for receiving new air passengers for observation

First, government staff received information of the time and the number of air passengers that had arrived at Shanghai airport to be transported directly from the airport. Then, the front desk medical staffs would prepare for the admission. Then, the staff would spray or wipe the surfaces of the vehicles, passageways, door handles and other objects that may be in contact with the quarantined personnel with 500 mg/L chlorine-containing disinfectant. Windows in the rooms are to be opened to enhance air flow. Before defecation and urination, disinfectant tables are being put into the toilets. The floor was mopped once a day with 500 mg/L chlorine-containing disinfectant. Disposable tableware was used, and the leftovers was collected in a leak-proof medical waste bag for centralized disposal. The sheet, duvet covers and towel were collected in the medical waste bag and sent to a special place to be washed and sterilized. Household garbage was collected in a medical waste garbage bag and sent to

the nearby medical institution for disposal as infectious medical waste.

(i) Staff protection

Details on protection measure for staff are shown in [Supplementary Table S2](#).

(ii) Quarantine measures

Quarantine involves movement restriction combined with medical observation. Persons under observation have to stay in single isolation rooms. Medical monitoring included temperature screening twice per day. When fever, dry cough, fatigue or other symptoms occur, the patient will be evaluated and transferred to the hospital if necessary. The results of virus nucleic acid test detected by the custom are closely followed. All these records are regularly filed to the CDC every day.

(iii) Providing health care and referral

In principle, these quarantine centres are not designed to provide clinical management of patients who deteriorate. If patients deteriorate, they are transferred by a designated ambulance to the corresponding medical institutions. The quarantine centers are only designed for monitoring for temperature and clinical signs of symptoms of deterioration.

## End of centralized medical quarantine

- (i) Discharge criteria: If the result of the virus nucleic acid test is negative, the 14-day quarantine is completed, provided that the person does not develop any symptoms.
- (ii) Discharge process: The quarantined persons take a shower and put on freshly washed clothes before being discharged. The person receives a forehead thermometer, a surgical mask and a 'health observation release notice' at the time of discharge.
- (iii) Environmental terminal disinfection: Rooms are treated with 1000 mg/L chlorine-containing disinfectant for spray disinfection. All textiles, including the surface of sheets, duvet covers and towels, are being sprayed until slightly wet and sent out for cleaning. Vacuum cleaner should not be used. Windows are opened for ventilation for at least 30 minutes.

## Results

During the 8-week period from 2nd March to 26th April in Shanghai, only one new local case was reported; no new confirmed or suspected local cases were reported for 55 consecutive days. Three hundred and one imported cases were reported, and one local case was reported to be related to one of the imported cases. Thus, the quarantine measures using a centralized quarantine centre were effective in interrupting onward transmission in China from imported cases.

Through the formulation of corresponding rules and regulations and the standardization of the division of staffs, 42 quarantine sites have been established in the Pudong new area of Shanghai, where the main airport for international flights is located. To illustrate: in one of these 42 quarantine sites where the author works, we received a total of 632 observers in our quarantine site during a 2-week period from 17th March

to 2nd April. Eight observers with symptoms were transferred to the hospital. Three cases of Covid-19 positive cases were screened, and 24 cases of close contact were found. A total of 416 people were released from quarantine, among whom 148 were surveyed by questionnaires. None of the staff were infected with COVID-19.

## Conclusions

Asymptomatic air passengers were reported to be as high as 5% out of all passengers on flights within Europe<sup>9</sup> and to Brunei.<sup>10</sup> Airport screening (entry and/or exit screening) alone will not be helpful as stand-alone measures to prevent the importation of cases.<sup>11</sup> Border quarantine for 14 days will be necessary to ensure that China is protected from the importation of cases that could re-ignite new outbreaks. Quarantine centres in Shanghai have been effective in containing the outbreak by interrupting onward transmission from imported cases. Only one local case occurred in relation to an imported case from overseas. Additionally, zero infections among the staff showed that disinfection and personal protection were effective.

However, there are still enormous challenges ahead. First, given the worsening of the global epidemic with more than 8 million infections by 15 June 2020, how much longer should the centralized medical quarantine continue to operate in Shanghai? With its huge consumption of manpower and resources, centralized medical quarantine may not be a sustainable long-term solution. Second, as Shanghai has fully resumed work and production, international trade and travel will become more frequent. This increasing frequency itself will be associated with an increased risk of local outbreaks notwithstanding the increasing volumes of air travelers to be tested, screened and quarantined. Third, we need to find means to mitigate socio-economic harm due to the strict measures taken. Our ultimate aim is to return to 'normalcy' by balancing economic recovery with the drastic efforts needed to contain COVID-19. To this end, we need to optimize the standardized work flow so that the work can be handed over to community health workers to relieve health care workers from the time-consuming yet medically not demanding work in the quarantine centers. Many more lessons can be learned from our quarantine centers. Qualitative studies are under way to study the impact of different cultures, age and beliefs on psychological resilience, well-being and acceptance during the 14-day quarantine period.

## Supplementary data

[Supplementary data](#) are available at *JTM* online.

## Authors' contributions

L.X. and R.Z. conceived the study; X.L. and M.L. carried out the analysis and drafted the first manuscript and Y.Z. and C.W. created the table and figure. All authors discussed the results, critically read and revised the manuscript. All authors contributed to the final manuscript and gave final approval for publication.

## Conflict of interest

All authors declare no competing interests.

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