Prevention of SARS-CoV-2 transmission from international arrivals: Xiaotangshan Designated Hospital, China

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Abstract
A surge in the number of international arrivals awaiting coronavirus disease 2019 (COVID-19) screening overwhelmed healthcare workers and depleted medical resources in designated hospitals in Beijing, China in March 2020. The People’s Government of Beijing Municipality therefore issued a policy which required the mandatory transfer of all asymptomatic passengers arriving from a foreign country to designated quarantine hotels, and the transfer of passengers with fever or respiratory symptoms to designated hospitals. Xiaotangshan Designated Hospital, a severe acute respiratory syndrome hospital in 2003, was rapidly renovated and put into operation with the main tasks of screening and isolating symptomatic international arrivals at Beijing Capital International Airport, providing basic medical care for mild to moderate COVID-19-positive cases, and rapidly referring severe to critical COVID-19-positive cases to higher-level hospitals. During the month-long period of its operation, 2171 passengers were screened and 53 were confirmed as having COVID-19 (six severe to critical). We describe how the use of Xiaotangshan Designated Hospital in this way enabled the efficient grouping and assessment of passengers arriving from a foreign country, the provision of optimal patient care without compromising public safety and the prioritization of critically ill patients requiring life-saving treatment. The designated hospital is a successful example of the World Health Organization’s recommendation to renovate existing medical infrastructures to improve the COVID-19 response capacity. The flexible design of Xiaotangshan Designated Hospital means that it can be repurposed and reopened at any time to respond to the changing pandemic conditions.

Introduction
The World Health Organization (WHO) declared the coronavirus disease (COVID-19) outbreak as a public health emergency of international concern on 30 January 2020. At that date, 7818 cases had been confirmed globally. In Beijing, local transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was contained by the end of February 2020, after 428 cases had been reported (Fig. 1). However, a combination of the alarming level of transmission in foreign countries and the fact that Beijing is a major hub of international aviation meant that the city faced the potential reintroduction of the virus. Screening and isolating cases arriving from a foreign country therefore became the top priority.

During March 2020, around 100,000 passengers (4000 with symptoms) arrived at Beijing Capital International Airport and required quarantine or screening, placing a huge burden on established COVID-19 designated hospitals. All screening was initially performed at Beijing Ditan Hospital, a traditional infectious disease hospital and a higher-level hospital for treating severely ill COVID-19 patients. However, in the surge in the number of arrivals requiring to be screened led to the diversion of medical resources originally allocated for the treatment of existing patients with severe COVID-19; health-care workers became overwhelmed and the supplies of medical equipment, such as nucleic acid detection tests and computed tomography scanning, were rapidly depleted.

Beijing was in urgent need of a new dedicated facility to increase its capacity to screen and isolate travellers arriving from a foreign country, and to optimize the allocation of medical resources. Xiaotangshan Hospital, located on the outskirts of Beijing adjacent to Beijing Capital International Airport and Beijing Ditan Hospital, was a severe acute respiratory syndrome (SARS) designated hospital in 2003. The first hospital rapidly built in China to tackle an outbreak of a single infectious disease, it represented a major contribution to China’s response to the public health emergency. After the outbreak of COVID-19, the original Xiaotangshan Hospital model was replicated in Wuhan when the city rapidly built a number of designated hospitals (such as Huoshenshan and Leishenshan) to ease the shortage of beds for COVID-19 patients. As part of the planning for a possible surge in COVID-19 cases, Xiaotangshan Hospital was expanded, renovated and repurposed, and renamed Xiaotangshan Designated Hospital by the People’s Government of Beijing Municipality in January 2020. The designated hospital was formally put into operation on 16 March 2020 to screen and isolate arrivals at Beijing Capital International Airport with fever or respiratory symptoms; provide basic medical care for mild to moderate confirmed COVID-19 cases; and rapidly refer severe to critical confirmed COVID-19 cases to higher-level hospitals.

On 11 March 2020, the People’s Government of Beijing Municipality issued a policy which required the mandatory transfer of all asymptomatic travellers arriving from a foreign country to designated quarantine hotels, and the transfer of passengers with fever or respiratory symptoms to designated hospitals. Although an important alternative to hospital isolation, voluntary self-isolation of travellers is unlikely to be effective in controlling transmission.
fully effective because of a general lack of adherence to the required living conditions; family members are put at risk and self-isolators can experience psychological stress. Further justification for quarantining at designated sites is that unnecessary delays are avoided for any required medical care or even rapid referral to a hospital.

Xiaotangshan Designated Hospital, together with Beijing Ditan Hospital, designated quarantine hotels and dedicated transfer vehicles, comprised the primary medical system in the prevention of virus transmission from international arrivals at Beijing Capital International Airport. We describe the structure and design of Xiaotangshan Designated Hospital, and the resources available to it. We also explain the function and operation of the designated hospital, and discuss its effectiveness and value in responding to the pandemic and preventing the transmission of the virus from overseas travellers.

Structure and resources

Xiaotangshan Designated Hospital consisted of two separate medical areas: a screening area with 750 single-bed wards, and a treatment area with nearly 150 beds. Both areas included three separate contamination-level zones: a contaminated zone where patients resided; a semi-contaminated zone where health-care workers removed personal protective equipment; and a clean zone where health-care workers received supplies, performed clerical work and rested (Fig. 2). Both areas also included two separate corridors linking the infectious disease isolation wards: one corridor for use by isolating travellers and another for health-care workers (Fig. 2).

Xiaotangshan Designated Hospital was well equipped with oxygen therapy devices, mechanical ventilators, and nucleic acid detection and computed tomography scanning equipment. To ensure efficient operation of the hospital and to maximize its screening capacity for COVID-19, it was crucial to have sufficient human resources. Beijing authorities mobilized health-care workers from 22 hospitals across the city to support Xiaotangshan Designated Hospital. This group, led by the deputy director of the Beijing Municipal Health Commission, was created to manage the hospital’s daily operations. The local government coordinated with various departments to ensure that food and medical supplies were available for both health-care workers and isolating travellers, and that basic facilities such as water, electricity and security were available. To ensure that the public understood and supported the mission of Xiaotangshan Designated Hospital, the hospital management team held several press conferences and arranged multiple interviews with officials and health-care workers to provide information about the hospital.

Function and operation

Screening

Travellers arriving at Beijing Capital International Airport with fever or respiratory symptoms were transferred to Xiaotangshan Designated Hospital, and tested for SARS-CoV-2 nucleic acid in combined nasopharyngeal and oropharyngeal swabs and serum antibodies; passengers also received chest computed tomography scans and routine blood tests. COVID-19 was confirmed if passengers tested positive for SARS-CoV-2 nucleic acid or their serum immunoglobulin M and immunoglobulin G were both positive.
ing screening, which took an average of 30 hours (from 11 hours minimum to over 5 days), all passengers were strictly subjected to single-room quarantine to avoid nosocomial infection of passengers whose symptoms were unrelated to SARS-CoV-2. As well as food and accommodation, within the screening area passengers could also access basic medical care, a disease consultant and emotional support.

COVID-19 was ruled out if both the nucleic acid test and any serum antibodies were negative, as well as no obvious abnormalities on the chest scan and in the blood test. COVID-19-negative passengers were transferred to designated quarantine hotels by dedicated transfer vehicles for a 14-day observation period. If passengers were asymptomatic and had a negative nucleic acid test on day 14, they could return to their homes by dedicated transfer vehicle. To prevent the transmission of COVID-19 with a possible incubation period of more than 14 days, self-isolation was recommended for an additional 14 days.

Anyone who developed a fever or respiratory symptoms during hotel quarantine was returned to the screening area of Xiaotangshan Designated Hospital for COVID-19 testing.

Mild and moderate cases

If mild (with symptoms including cough, sore throat, fatigue, myalgia or headache, and no signs of pneumonia on chest scan) or moderate (with symptoms also including fever and dyspnoea and pneumonia evident from the chest scan) COVID-19 was diagnosed, patients were transferred from the screening area to the treatment area of the designated hospital via a dedicated in-hospital passage for isolation and treatment. Patients received basic medical care (including antiviral, antibiotic, antipyretic and traditional Chinese medicine) as well as intravenous fluids, conventional and high-flow oxygen supplementation and respiratory rehabilitation.

Health-care workers measured the body temperature, heart rate, blood pressure, respiratory rate and oxygen saturation of patients more than four times per day to monitor the progression of the disease. Basic life support (including cardiopulmonary resuscitation, rapid defibrillation, endotracheal intubation and subsequent invasive ventilation) and close electrocardiographic monitoring were provided in two temporary single-bed intensive care units for rapidly deteriorating patients. In addition to basic food and accommodation, patients could also access the Internet as well as any required emotional support. For professional guidance, the clinical conditions of all patients were reported to a higher-level specialist group in Beijing during an online consultation every day.

Discharge conditions

Patients in the treatment area were discharged if they met all of the following criteria: (i) no fever for > 3 days; (ii) significant improvement in respiratory symptoms; (iii) obvious absorption of inflammation on chest scan; and (iv) two consecutive negative nucleic acid tests for SARS-CoV-2 with a sampling interval of more than 24 hours. Discharged patients were then transferred to a designated quarantine hotel for a 14-day period of medical observation. Self-isolation was then recommended for an additional 14 days after leaving the quarantine hotel.

Severe and critical cases

Whether during examination in the screening area or the treatment area, patients were quickly referred to a higher-level designated hospital, by dedicated transfer vehicle via a pre-established referral pathway, for intensive care if they met any of the following criteria: (i) a respiratory rate of ≥ 30/min; (ii) an oxygen saturation as measured by pulse oximetry of ≤ 93%; (iii) an arterial oxygen tension of inspired oxygen of ≤ 300 mmHg; (iv) the expansion of a pulmonary lesion in the chest scan by > 50% within 24–48 hours; or (v) the exacerbation of chronic obstructive pulmonary disease, hypertension, diabetes, coronary heart disease or any other comorbidity requiring advanced medical care.

Effectiveness and value

As a result of the diversion of international flights from Beijing to other ports
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防止境外输入人员传播新型冠状病毒：中国小汤山定点医院

在 2020 年 3 月，随着等待接受新型冠状病毒肺炎 (COVID-19) 筛查的境外输入人口激增，中国北京定点医院的医护人员感到不堪重负，且医疗资源几近枯竭。鉴于此，北京市人民政府制定了政策，要求将所有无症状的境外输入旅客转移至定点隔离酒店，并将有发烧或呼吸道症状的旅客转移至定点医院。小汤山定点医院是 2003 年治疗严重急性呼吸综合征 (非典) 的定点医院，经快速翻新后，该医院投入运营，其主要任务是筛查和隔离北京首都国际机场的有症状境外输入人员，为住院治疗的重症新型冠状病毒肺炎患者提供基础医疗服务，并将重症至危重型新型冠状病毒肺炎阳性病例迅速转诊至更高级别的医院。在其运营的一个月时间内，共对 2171 名旅客进行了筛查，并有 53 名旅客被确诊患有新型冠状病毒肺炎（6 例重症至危重病例）。我们描述了如何利用小汤山定点医院对境外输入旅客有效地分组和评估，在不损害公共安全的前提下提供最佳的患者护理，以及优先处理需要挽救生命的危重患者。该定点医院在翻新现有医疗基础设施下提高新型冠状病毒肺炎响应能力方面取得了全面成功，是世界卫生组织推荐学习的示范医院。小汤山定点医院的灵活设计意味着可以随时调整用途并重新开放，以应对不断变化的疫情状况。

Résumé

Prévenir la transmission du SARS-CoV-2 par le biais des arrivées internationales: hôpital de référence Xiaotangshan, Chine

En mars 2020, la brusque hausse du nombre d'arrivées internationales en attente de dépistage de la maladie à coronavirus 2019 (COVID-19) a submergé les professionnels de la santé et épuisé les ressources médicales dans les hôpitaux de référence à Beijing, en Chine. Le gouvernement populaire de la municipalité de Beijing a réagi en ordonnant que tous les passagers asymptomatiques en provenance d'un pays étranger soient transférés vers des hôtels de convalescence dans le but d'éviter la propagation de la maladie et de libérer des places pour les patients atteints. Le gouvernement a également ordonné que tous les passagers atteints, que ce soit en forme légère ou grave, soient transférés vers des hôpitaux de référence. L'hôpital de référence Xiaotangshan a ainsi permis de regrouper et d'isoler les passagers internationaux symptomatiques dans des hôtels de référence, et de transférer les patients atteints vers les hôpitaux de référence. En l'espace de un mois, 2171 passagers ont été testés et 53 se sont révélés positifs à la COVID-19 (6 étant dans un état grave ou critique). Nous décrivons la façon dont l'hôpital de référence Xiaotangshan a ainsi permis de regrouper et d'évaluer efficacement les arrivées de personnes atteintes de la COVID-19 et de prendre les mesures nécessaires pour les transférer vers des hôpitaux spécialisés. Cet hôpital de référence est un exemple de la façon dont les hôpitaux de référence peuvent être réutilisés et rouverts à n'importe quel moment pour réagir à un contexte pandémique en perpétuelle évolution.
Resumen

Prevención de la transmisión del SARS-CoV-2 a partir de vuelos internacionales: Hospital designado de Xiaotangshan, China

Un aumento del número de llegadas de vuelos internacionales en espera de la detección del coronavirus 2019 (COVID-19) sobrecargó al personal sanitario y agotó los recursos médicos en los hospitales designados de Pekín (China) en marzo de 2020. Para luchar contra el tsunami de pacientes asintomáticos que llegaron de un país extranjero a los hoteles de cuarentena designados, y el traslado de los pasajeros con fiebre o síntomas respiratorios a los hospitales designados. El hospital designado de Xiaotangshan, un hospital especializado en el tratamiento de pacientes con COVID-19, se puso en funcionamiento con las tareas principales de examinar y aislar a los pasajeros que llegaban del Aeropuerto Internacional de Pekín, proporcionando atención médica básica a los casos positivos de COVID-19 de leves a moderados, y derivando rápidamente los casos positivos de COVID-19 a hospitales de nivel superior. Durante el mes que duró su funcionamiento, se examinó a 2.171 pasajeros y se confirmó que 53 tenían la COVID-19 (6 de ellos con intensidad de grave a crítica). Describimos cómo el hospital designado de Xiaotangshan permitió agrupar y evaluar eficazmente a los pasajeros que llegaban de un país extranjero, prestar una atención óptima a los pacientes sin comprometer la seguridad pública y priorizar a los pacientes en estado crítico que requerían tratamiento para salvar su vida. El hospital designado es un ejemplo de éxito de la recomendación de la Organización Mundial de la Salud de renovar las infraestructuras médicas existentes para mejorar la capacidad de respuesta ante la COVID-19. El diseño flexible del hospital designado de Xiaotangshan significa que puede utilizarse y volver a adaptarse en cualquier momento para responder a las condiciones cambiantes de la pandemia.

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