

Report from the Field

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Preparation Work and On-Site Management of Large-Scale COVID-19 Nucleic Acid Testing: Report From the Field

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Abstract

Routine coronavirus disease 2019 (COVID-19) screening found 1 asymptomatic COVID-19 patient. An emergency sampling team was organized consisting of 1200 health-care workers, and a total of 3.2228 million COVID-19 samples had been collected and detected. This study summarizes the on-site management experience in large-scale COVID-19 nucleic acid testing from various aspects: staff preparation, materials preparation, site layout, logistics support, and information system support. Suggestions are put forward for the deficiencies and parts needing improvement. Such deficiencies included some sampling sites were not properly chosen, different areas were unclearly marked off from each other, and some site moving lines were confounding; how to communicate with the street service workers who had little professional knowledge on the epidemic spread or the working principles of the workflow and site layout; and the way to resolve conflicts on site.

On May 21, 2021, routine coronavirus disease 2019 (COVID-19) screening among staff boarding the international freighters in Yantian District, Shenzhen, found 1 asymptomatic COVID-19 patient.¹ On May 25, our hospital group sent 53 health-care workers to the Longgang District. By the evening on the same day, 13,000 samples had been collected.

According to the epidemic prevention and control situation and the deployment plan, our hospital group quickly mobilized a COVID-19 nucleic acid testing team on May 25 for the large-scale emergency COVID-19 screening in Luohu District to arrest the spread of COVID-19. The emergency sampling team, consisting of 1200 health-care workers, was not only responsible for the normal operation of the hospitals but also for the COVID-19 nucleic acid sample collection and testing at 119 sampling sites in Luohu District. By June 23, 2021, 3.2228 million samples had been collected and tested among the residents under the jurisdiction of the Luohu District.

We had already accumulated a great deal of experience in large-scale COVID-19 nucleic acid sample collection and testing after several rounds of such testing.^{2–4} We were quick to react in the face of newly reported COVID-19 cases, sending personnel and materials fast to the sites where they were urgently needed. The personnel performed large-scale nucleic acid sample collection and testing and presented the reports at an incredibly high speed. Below, we will describe our experience of on-site nucleic acid sample collection and testing for diagnosing COVID-19.

Methods

Ethics

This study is a summary of experience. Clinical trials are not involved. All experts participating in semi-structured interviews have signed informed consent.

Study Design

Selection and Description of Participants

Semi-structured interview was used in this study. Twenty staff members were involved in site management.

Technical Information

The following questions were asked in the interview draft:

- What do you think is necessary to prepare for large-scale COVID-19 nucleic acid testing?
- What do you recommend for site layout?
- What do you recommend for division of the large-scale COVID-19 nucleic acid testing site?
- Do you have any suggestions on the layout and division of personnel on the sampling site?

- E. What logistical support do you need?
- F. What good experiences do you think we can spread?
- G. What deficiencies do you think we have?
- H. What else do you suggest?

The final interview subjects are coded. Interviews are transcribed verbatim into written material and then reviewed. Colaizzi's 7-step phenomenological data analysis method was used for data analysis.

Management of the Large-Scale COVID-19 Nucleic Acid Testing Sites

After the interview, we introduced the on-site management experience in large-scale COVID-19 nucleic acid testing from various aspects: staff preparation, materials preparation, site layout, logistics support, and information system support. The detail is shown in the Supplementary file.

Results

Smooth Communication Channel

Rapid transmission of commands from the top to the bottom level was a key reason behind the high efficiency of this round of large-scale nucleic acid sample collection and testing in the Luohu District. The site/group leaders uploaded, from the sampling sites, the number of samples already collected. The hospital decision-makers, street service workers, and personnel at the disease control and prevention center at the second-line could check this information in real-time. Hence, the decisions could be adjusted flexibly, depending on the statistics and pictures of the sampling sites shot and uploaded by the medical staff.

Close Cooperation Between the Street Service Workers and the Hospitals

The street service workers were responsible for population count, and responsible for the layout of the sampling sites and maintaining the order of the sampling sites. The medical staffs were responsible for nucleic acid sample collection, medical waste disposal after the sampling, and sample preprocessing. The street service workers and the medical staff performed their respective roles and collaborated closely with each other, dealing with issues of concern for each other to ensure the high efficiency of the district-wide COVID-19 screening.

Collaboration Between the Health-Care Workers and Residents

A smooth workflow could minimize the waiting time for the testees on-site, improving the efficiency of nucleic acid testing. The medical staff, testees, and other working staff on site were required to do the following to achieve the above goals:

1. The residents scheduled for the testing were informed of the workflow, precautions;
2. At the entrance of the sampling site, several bulletin boards illustrating the workflow were placed apart.
3. The testees were guided by the working staff on-site and presented their QR codes for scanning. They were told to wait in line. Each waiting group consisted of 1 person, 5 people, or 10 people.

4. At the exit was a reference desk for answering the doubts of the testees. The common questions and answers could also be published in the bulletin board.

Remuneration and Pay for the Health-Care Workers and Labor Force Allocation

The primary concern was how to mobilize the enthusiasm of the medical staff fully. The hospitals set up a subsidy system for the district-wide COVID-19 screening. This temporary subsidy system had greatly motivated the medical staff.

Logistics Support System of the Hospital

The timely availability of epidemic prevention and control supplies was of special importance for district-wide COVID-19 screening. In addition, special personnel were deployed at the logistics and distribution center every day to track the information provided by the site leaders in the WeChat group. The temporary redeployment and immediate replenishment of the materials were made possible based on the feedback from the site leaders.

Information System Support Consisting of "Internet+Nucleic Acid Testing System"

A powerful information system is necessary for large-scale COVID-19 screening, on-site order maintenance, and shortening the time to get the test results. The information department of our hospital had developed "mobile sample collection system-Luohu Mode (version 3.0)". This information system has the following advantages:

- (1) High efficiency, convenience, and fastness. With this new sampling system, only a personal digital assistant (PDA) or mobile phone was needed on-site for the input of the nucleic acid sampling data. The information of approximately 1000 testees could be input every hour by QR code (quick response code) scanning.
- (2) Easy data sharing for the convenience of the testees. This sampling system achieved real-time epidemic prevention and control data sharing and business collaboration across the provinces, cities, districts, and medical institutions. The test results could be queried by means of many hospital and government platforms.
- (3) Simple operation. Under the system, the personal information was bound to the tube barcode using a mobile device. All business data (personnel information and tube barcodes) were uploaded to the backstage database asynchronously.
- (4) Backstage data capture for the convenience of management. The real-time monitoring interface and heat map display were available backstage, enabling the real-time inspection of the test data and the densely populated areas to guide staff assignment and sampling sites set up.

Discussion

The health-care workers from Shenzhen Luohu Hospital Group had completed 2 rounds of large-scale COVID-19 nucleic acid testing. However, some problems were identified during on-site quality inspection and control as follows:

Insufficient Awareness of COVID-19 Prevention and Control Among the Health-Care Workers

At some sampling sites, the clean areas and contaminated areas were poorly separated from each other. Some working staff, other than the assigned health-care workers, had poor self-protection awareness. They entered and left the clean areas wearing isolation gowns that were already contaminated or touched sterile materials with undisinfected hands.

Lack of Homogenization of Operations Among the Health-Care Workers

All personnel had received training on the “seven-step hand washing method,” “method of wearing and taking off the protective equipment,” “method of wearing and taking off the isolation gown,” and the “method of collecting nasal and throat swabs.” However, as there were too many personnel to be trained, “one-to-one” training was hardly possible. During the on-site quality inspection, a lack of homogenization of operations among the health-care workers was a significant issue.

Communication Barriers at the Sampling Sites

During the on-site quality inspection, we also found that some sampling sites were not properly chosen, different areas were unclearly marked off from each other, and some site moving lines were confounding. The street service workers can be better informed of the requirements for site layout through illustrations in the print version or graphics.

Conclusions

During the second round of district-wide COVID-19 nucleic acid testing, the sampling lasted from 6 AM on June 19 to 7 PM on June 23. A total of 1,289,439 samples were collected, and the sampling rate was 101.04%. The test results were already available for 1,207,483, accounting for 93.64%. We have confidence that by clarifying the details of the sampling and screening procedures, optimizing the workflow, and rectifying the quality, the hospital group will be quicker in response to such public emergencies. All these

measures will lay a solid foundation for ensuring the safety and health of the residents.

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Author contributions. The manuscript has been read and approved by all the authors. Han Zhao: manuscript preparation, manuscript editing, manuscript review, on-site management of large-scale COVID-19 nucleic acid testing. Junhui Yan: takes responsibility for the integrity of the work as a whole from inception to published article. Xiuming Zhang: on-site management, laboratory testing, manuscript review. Lisha Huang: data acquisition, data analysis. Xiaoping Lei: literature search. Xiaowei Wei: on-site management of large-scale COVID-19 nucleic acid testing. Hui Xing: on-site management of large-scale COVID-19 nucleic acid testing. Xiaoli Ye: literature search.

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