Short Communication

The Smart Safeguard System for COVID-19 to prevent cluster-infection in workplaces

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ABSTRACT

The ongoing Coronavirus Disease 2019 (COVID-19) broke out in China since December 2019, and rapidly spread worldwide. To contain the disease, unessential businesses had been shut down in several countries to a varying extent. Nowadays, the enterprises are resuming productions and businesses. While the resumption of production is crucial to social development, it elevates the risk of cluster-infections at the workplaces. Guangdong Second Provincial General Hospital therefore set up the Smart Safeguard System for COVID-19, aiming to provide rapid screening and consistent protection to assist the local enterprises with resumption. The system has received positive feedback as being helpful and practical. It has the potential to be widely used to prevent the cluster-infection of COVID-19 at workplaces during the pandemic.

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Coronavirus Disease 2019 (COVID-19) has been spreading across worldwide since 2019 [1]. To curb the spreading of the disease, unessential businesses had been shut down in several countries to a varying extent. Nowadays, to guarantee residents' livelihood and restore economic progress, the government encouraged some of the enterprises in resuming production and business in many countries [2,3]. While the resumption of production is crucial to social development, it elevates the risk of cluster-infections at the workplaces. For example, multiple cluster-infection cases in workplaces have been reported across China [4].

The World Health Organization (WHO) and Chinese Centre for Disease Control and Prevention have published recommendations and suggestions on occupational health management against COVID-19 [5,6]. In addition, several guidelines have been published in the US and Europe [7,8]. However, there are few practical and ready-to-use protocols for enterprises on how to get prepared for resumption and to protect their employees while working during the epidemic. As a provincial emergency hospital with extensive experience in combating infectious diseases, Guangdong Second Provincial General Hospital (GD2H), located in Guangzhou City,

China, developed **the Smart Safeguard System for COVID-19** on the demands of local enterprises (Fig. 1). Enterprises sought for help from GD2H on their own initiative and used the system voluntarily. The system aims to provide rapid screening and consistent protection to assist the enterprises with resumption. The system was generated by experts whose specialization was infectious diseases, clinical laboratory science and epidemiology. It is now being trialed in several constructive companies in Guangzhou, with positive feedback consistently received [9]. The system consists of two stages. First, the screening tests detect existing suspected cases of COVID-19 before resumption and prevent them from entering the workplaces. The subsequent protective service monitors newly suspected cases and ensures the full safety of the employees while working.

The rapid screening includes two steps in sequence. First, all the employees are tested for serum Immunoglobulin M (IgM) and Immunoglobulin G (IgG) antibodies, in addition with investigation for epidemiological history (whether travelled to high-risk areas, got close to wild animals, or had contact with COVID-19 patients or suspected cases within the recent 14 days) and symptoms related to COVID-19 (fever, non-productive cough, chest tightness, chest pain and diarrhea, to mention a few). Employees with elevated IgM/IgG levels, any suspicious epidemiological history or symptom are isolated and selected for nucleic acid tests, while others are allowed enter workplaces immediately. Subsequently, oropharyngeal swab

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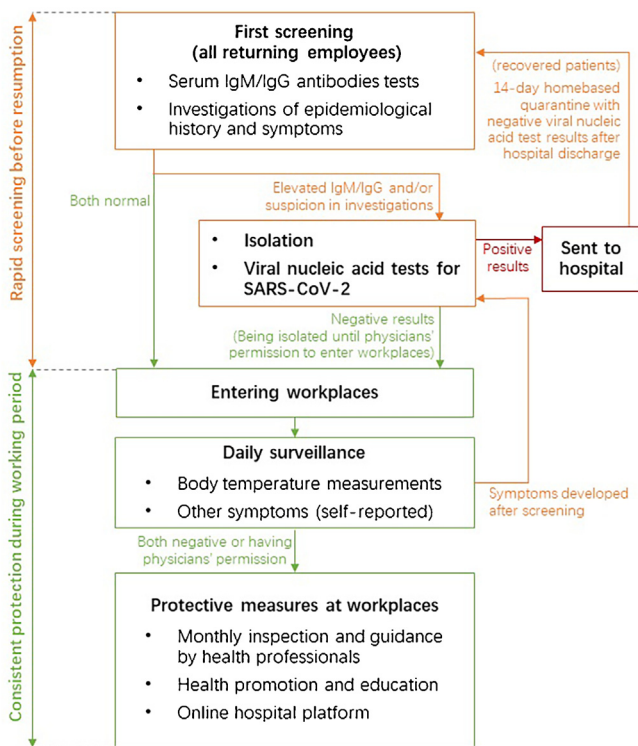
Fig. 1. The ***Smart Safeguard System for COVID-19*** developed by Guangdong Second Provincial General Hospital.

specimens are collected from the selected employees for Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2) by the specific test kits. There were cases that patients recovered from COVID-19 had positive PCR results again after discharged form hospitals [10]. This could be because of the patients' long duration of viral shedding after recovery, false negative PCR results before discharging, or re-infection. Although no clear evidence showed viral shedding was associated with infectivity, patients discharged with false-negative PCR results and those re-infected could be potentially transmissible. Besides, positive antibody tests could be found in those potential transmissible individuals [11,12]. Therefore, we perform PCR tests for all individuals with positive antibody tests, regardless of their previous infections.

Employees who are tested positive in viral nucleic acid tests are sent to hospital for further examinations and treatments, while the others with negative results continue to be isolated or enter workplaces at physicians' discretion. Those with positive viral nucleic acid test results and hospital admission will receive healthcare professionals' careful decisions on whether to be quarantined alone or in combination with appropriate therapies. Nevertheless, once those with positive test results are admitted to hospital, they will be exited from our algorithm for workplaces.

Of note, according to *Guidelines for the Diagnosis and Treatment of Novel Coronavirus Infection (Trial Version 8)* [13] by the National Health Commission, individuals recovered from COVID-19 are allowed to re-enter the system and repeat the algorithm when they complete the 14-day homebased quarantine with negative viral nucleic acid test results after hospital discharge.

Besides screening, consistent protection is provided during the working period including the following four aspects:

- A smart-phone application is used for daily surveillance. The application was developed by GD2H and had already been widely used in Guangdong province for the control of COVID-19. The employees are asked to document whether they have related

symptoms once a day. The occupational health managers of the enterprises take the temperature for each employee two times a day and report the data via the application. Healthcare professionals from the hospital provide daily risk report for each enterprise based on their uploaded information. Employees with any newly developed symptoms will be admitted to isolation units immediately. Physicians will be dispatched from the hospital to give them viral nucleic acid tests and further discretion.
- Professionals of infectious disease management are dispatched monthly to the workplaces to give on-site inspections and guidance.
- The enterprises carry out regular health promotion and education sessions on COVID-19 for their employees to enhance their self-protection, including wearing masks while working, frequent and thorough hand-washing, and regular disinfection of the workplaces.
- The employees can use the online hospital platform whenever needed medical advice and mental consulting [14].

The abovementioned screening protocol is an innovation proposed by GD2H. Generally, the entire staff of the enterprises is required to undertake viral nucleic acid tests as recommended. Nevertheless, the exclusive viral test is expensive and time consuming, and may expose employees to potential risks of infection. It is thus ineffective and impracticable, especially for enterprises that have large staff and urgent needs of immediate resumption. Moreover, it may result in unnecessary waste of healthcare resources and unduly heavy burden to the enterprises. Therefore, a system with triage is needed to prioritize the use of screening tests. The Smart Safeguard System uses serum IgM and IgG levels as indicators of infections for the first screening. IgM and IgG levels can be tested much more rapidly, and are highly sensitive to recent and past infections, respectively. However, the accuracy of antibody test is relatively low due to its incapability to reflect the pathogens. Therefore, investigations on epidemiological history and relevant symptoms are introduced for further screening to identify those with high suspicion of SARS-CoV-2 infection. It should be noted that due to the development of technology, overall serum IgM and IgG tests can be updated to specific serum antibodies against SARS-Cov-2, which may improve the specificity of the screening. After these two steps, the remaining number of suspected cases to undergo viral nucleic acid tests is largely reduced, making the whole screening protocol be more efficient.

There are some unique characteristics of the system that may impact its generalizability. First, COVID-19 is relatively well-controlled in China, therefore the positive cases are expected to be small. Guangdong is one of the developed provinces in China, in which the medical resource is relatively sufficient. Moreover, the majority of enterprises that piloted our system are constructive companies. Their constructive workplaces are high-risk environments due to sizable population density. We follow a relatively conservative standard in our system, trying to minimize the risk of COVID-19 infection in workplaces. However, we suggest that when the system is to be implemented in other countries, the criteria of quarantine may be reconsidered taking account of the availability of medical resources and the actual risks of the working environment. Moreover, data from pilot studies should be carefully analyzed to confirm the benefit, safety and cost-effectiveness of the system before it can be broadly recommended.

The Smart Safeguard System for COVID-19, consisting of rapid screening and consistent protection, offers comprehensive assistance for enterprises during the epidemic of COVID-19. The system has received multiple positive feedback from the public, enterprises, government and media, reflecting its popularity and practicality. The system is anticipated to help prevent the cluster-infection of COVID-19 at workplaces, and has the potential to be

widely used in other public places in the routine practices during the epidemic.

Competing interests

None declared.

Ethical approval

Not required.

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