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Perspective

COVID-19 Pandemic: Non-Contact Strategies for Protecting Healthcare Workers

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The outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) has evolved into a pandemic with more than 49 million confirmed cases and almost 1,239,000 deaths globally [1]. SARS-CoV-2 infection occurs mainly via respiratory droplets from face-to-face contact and, to a lesser extent, via contaminated surfaces [2]. The virus is highly infectious and increasing evidence of hospital-based transmission has been observed [3]. In the United States, among the 156,306 COVID-19 health care workers, 789 have died [4]. The protection of health care workers is a challenge that calls for the development of effective measures.

In order to relieve the current shortage of medical resources, novel preventive and control technologies and equipment, especially those that make use of modern information technology (IT), may prove to be effective and efficient [5,6]. 3D-printed personal protective equipment (PPE) has been developed in some regions to alleviate severe shortages of masks in times of crisis [7]. A hospital has introduced a negative airway pressure respirator (NAPR), which is used in patients for bronchoscopy, to better protect health care workers from aerosols produced in the upper and lower respiratory tracts [8]. To this end, the First Affiliated Hospital of Gannan Medical University developed a new integrated IT platform comprising a series of non-contact or low-contact in-hospital screening, diagnosis, and monitoring devices for protecting health care workers from COVID-19 [9].

First, at the entrance of the hospital, patients place their identification cards against a sensor, which automatically reads their name, gender, and age, and transfers this information to the hospital information network. For triage, an automatic infrared temperature imaging and measurement system is used to determine whether the patient has a fever. Based on a series of preset questions, a designated robot automatically ascertains whether the patient had a fever or other respiratory symptoms in the past three days or a history of exposure to a SARS-CoV-2-infected individual in the last two weeks. This robot intelligently analyzes the response obtained to guide the patient into the fever clinic or outpatient clinic (Figure 1A).

Second, a non-contact television consultation system (Figure 1B) is used to interview the patient in the fever clinic. The doctor and the patient sit in different rooms, preventing direct contact. For examination, researchers employ a novel low-contact sampling and examination system, which comprises an endoscopic throat swab specimen collection system (Figure 1C), an isolated blood collection device (Figure 1D), and a two-side isolated stethoscope and electrocardiogram-acquisition system. In addition, a computed tomography room for disease screening was independently reserved for performing lung imaging examinations on patients to protect health care workers from COVID-19.

Figure 1: Non-contact in-hospital screening devices: enquiry and triage (A), non-contact television consultation (B), endoscopic throat swab specimen collection (C), and isolated blood collection (D).

Third, based on the recommendation of clinicians considering the examination results and the specific conditions of patients ascertained via the consultation, the patients are classified into three categories: non-COVID-19 patients, COVID-19suspected patients, and COVID-19 patients. It is recommended that non-COVID-19 patients be sent home for observation or special outpatient treatment. COVID-19 suspected patients should be placed in isolation for observation. COVID-19 patients are transferred to a designated hospital for treatment. Moreover, digital high-definition video cameras were installed in areas where COVID-19 suspected patients pass through in the hospital. Once the COVID-19 suspected patient is confirmed, clinicians can use digital cameras to track and intelligently analyze the patients' movements and search for contacts with high infection risk contacts. Thus, clinicians can identify individuals in intimate contact with the patient for immediate isolation and observation to further protect health care workers from COVID-19.

In addition, an intelligent infrared thermal imaging and high-definition video monitoring system is installed in emergency departments, outpatient clinics, and waiting rooms. This system is used to locate and monitor patients with fever who may have been missed. After these patients are identified, they are guided to the fever clinic for further screening and diagnosis. Finally, this system can intelligently identify individuals not wearing masks or not adhering to standard protective measures and automatically provide warnings or friendly reminders. This not only protects health care workers from COVID-19 but also increases public awareness regarding protection against respire a story infections. Between January 20 2020, and July 31, 2020, the First Affiliated Hospital of Gannan Medical University received 546,413 out patients, of which 7,933 were placed in fever clinic, and 11,098 throat swab specimens were collected by this system. Among these patients, five were diagnosed as COVID-19-positive, and none of the health care workers were infected. Overall, this integrated system minimizes direct contact between health care workers and patients, reduces the risk of infection for health care workers, and conserves medical supplies. Researchers will continue collecting feedback on relevant information throughout the application of this system and continuously improve it to developa new integrated IT platform that comprises a complete contact less COVID-19 hospital screening, diagnosis and monitoring system for the protection of health care workers from COVID-19. Given our preliminary results, this system maybe valuable to other regions and countries where the outlook of COVID-19 prevention and control is not optimistic.

Declaration of Interests

We declare no competing interests.

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