Containment of critically ill patients in the emergency department during the pandemic

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To the Editor—Early measures of infection prevention and control (IPC) when patients enter a healthcare facility during a pandemic are important in avoiding nosocomial spread as well as protecting healthcare workers.[1] Severe acute respiratory coronavirus virus 2 (SARS-CoV-2), for example, is transmitted through close contact, droplets, or airborne particles formed by aerosol generation in the hospital setting. Patients with suspected or confirmed coronavirus disease 2019 (COVID-19) are frequently triaged and subsequently receive management, even resuscitation, in the emergency department (ED). Resuscitation of the critically ill patients may generate infectious aerosol during endotracheal intubation or chest compression.[2] Therefore, the critically ill patients with possibility of undergoing aerosol-generating procedures are recommended to receive treatment in negative pressure isolation rooms (NPIRs).[3]

To prevent nosocomial infections, lessons learned from the 2003 severe acute respiratory syndrome (SARS) outbreak were early cataloguing of and then isolating suspected cases.[4,5] The specific protocol adopted by our ED during the current COVID-19 pandemic for containing critically ill patients was the establishment of screening point at the corridor in front of the main ED entrance. We separated 3 distinct routes for patient diversion (Fig. 1). Based on the risk of COVID-19 and triage acuity levels, patients were categorized into 3 groups, each with a specific procedural route. We check the risks of COVID-19 according to symptoms and/or signs, as well as travel, occupation, contact, and cluster (TOCC) history at the screening point. After initial screening, patients not suspected of COVID-19 are guided to the main ED via route 1 for a regular triage process. Patients who suspected of COVID-19 with low acuity are moved to a well-ventilated tent via route 2. Critically ill patients suspected of COVID-19 are checked at the screening point and are then moved to the NPIR via route 3. A specific route for critically ill patients to be admitted to the NPIR without entering the main ED reduces the risk of nosocomial spread during management and resuscitation. A well-designed corridor in front of the main ED entrance plays an important role in infection prevention and control during pandemics.

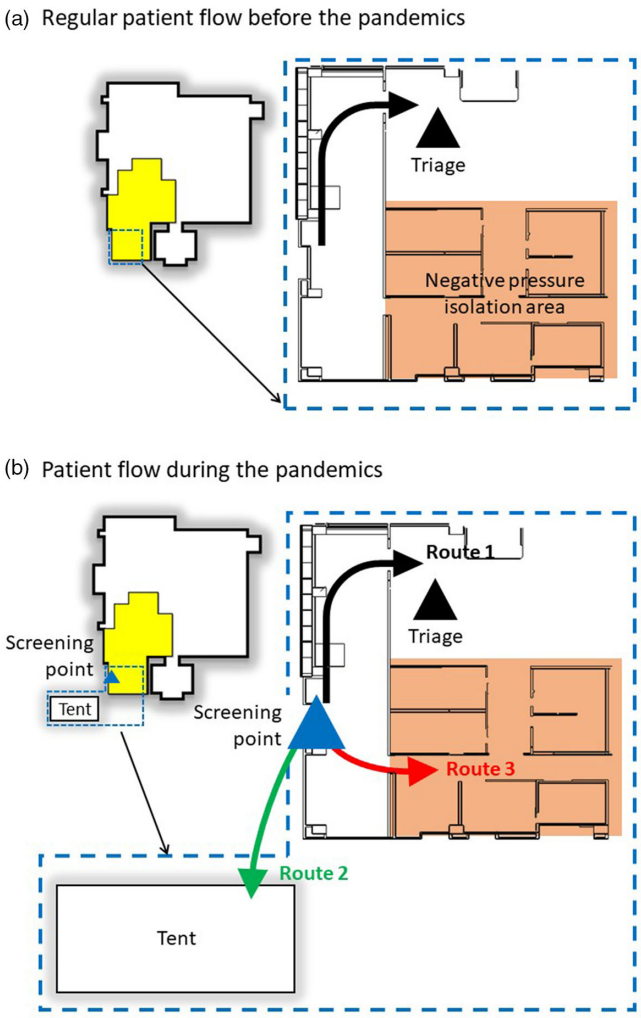

Fig. 1. (A) Regular patient flow before the pandemics. (B) Patient flow during the pandemics. The left sides of panels A and B show the first-floor plan of the hospital, and the yellow area is the emergency department (ED). The blue dotted area of the ED was amplified and shown on the right side of panel A and B. The orange area within panel A and B is the negative pressure isolation area where 2 negative-pressure isolation rooms are located. Portable radiography, sonography, electrocardiography, airway and resuscitation management equipment is available in the isolation area. In panel A, patients enter the ED through the main entrance (black arrow), and patients suspected of COVID-19 disease are triaged to the isolation area. In panel B, patients are classified as not suspected of having COVID-19, suspected of having COVID-19 with low acuity, and suspected of having COVID-19 with high acuity before allocation to route 1, route 2, and route 3, respectively.

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Airborne transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2): What is the implication of hospital infection control?

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To the Editor—Airborne transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of coronavirus disease 2019 (COVID-19), has been increasingly recognized in the indoor air environment,[1] especially in poorly ventilated premises.[2] In the recent update of a scientific brief by Centers for Disease Control and Prevention, the modes of SARS-CoV-2 transmission include inhalation of very fine respiratory droplets and aerosol particles, deposition of virus on exposed mucous membranes, and touching mucous membranes with soiled hands contaminated with virus.[3] A nosocomial outbreak of COVID-19 was possibly attributed to airborne transmission in an old-fashioned general ward with low ceiling height, despite 6 air changes per hour (ACH).[4] To establish the role of airborne transmission of SARS-CoV-2 in the healthcare setting, it is important to demonstrate the presence of SARS-CoV-2 RNA and (preferably) viable virus in the air sample. However, this requires a challenging experiment. In the previous reports of air sampling in the clinical areas, findings have been inconsistent.[5] This inconsistency is not unexpected because air samplers with different mechanisms of sample collection (eg, solid impactors, liquid impactors, filters, and other sampling methods) were used. In addition, the testing protocols were different in terms of the relative position between patients and air samplers, number of patients in the room or ward, volume of air collected per sample, and the ACH in the patient care areas. Patient factors of transmission include the severity of clinical symptoms, the presence of aerosol-generating procedure (AGP), viral load of clinical specimens, and whether the patient wore a surgical mask during sample collection. Current literature reporting the detection of SARS-CoV-2 RNA in the air in the healthcare setting is summarized in Supplementary Table 1 (online). Most of these studies do not mention the patient's viral load or whether the patient wore a surgical mask during sample collection.

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To demonstrate the SARS-CoV-2 RNA viral load correlation between air and clinical samples, we performed air sampling in the airborne infection isolation room (AIIR; 16 m^2 and 12 ACH) where a single asymptomatic COVID-19 patient was cared for from June 11 to June 17, 2021. This patient was transferred to this hospital and had SARS-CoV-2 (PANGO lineage B.1.525). No AGP was performed during air sample collection. We collected the air sample using the AerosolSense Sampler (Thermo Fisher Scientific, Waltham, MA),[6] which is ~35.5 cm in 3 dimensions and weighs 11.8 kg. It was placed 1 m from the patient's head. A single-use sampling cartridge containing 2.5 cm collection substrates was installed into the sampler. The air sample was collected through an omnidirectional inlet and was directed toward the collection substrate through an accelerating slit impactor at a flow rate of 200 L per minute. Particles were trapped on the collection substrate as the air moved around the collection area. After the sampling cycles of 2, 4, and 8 hours with patient with and without surgical masks, the sample cartridges were removed and sent to microbiology laboratory within 30 minutes. The collection substrates were then immersed into 1.5 mL viral transport medium and 250 μL medium for total nucleic acid extraction using the eMAG extraction system (bioMérieux, Marcy-l'Etoile, France) following the manufacturer's instructions. Quantification of SARS-CoV-2 RNA in the air samples was performed using the ultra-sensitive reverse-transcriptase droplet digital polymerase chain reaction (RT-ddPCR) with the QX200 Droplet Digital PCR System (Bio-Rad Life Science, Hercules, CA) as previously described.[7] The nasopharyngeal swabs were subjected to the same laboratory processing protocol. The viral loads of the air and clinical samples are summarized in Table 1.

Our findings have implications for hospital infection control. In contrast to our previous report of undetectable SARS-CoV-2 RNA in 1,000 L air samples,[8] the SARS-CoV-2 RNA was detected at a concentration of 0.009 copies/L in the room of a COVID-19 patient who was not wearing surgical mask, with a moderate level of viral load (6,828,801 copies/mL) in the nasopharyngeal swab sample when 96,000 L air was collected over 8 hours. SARS-CoV-2 RNA was also detected (0.005 copies/L) in another 8-hour air sample from the room of this COVID-19 patient who

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