

## Coronavirus Pandemic

### What should we do for the safe transportation of COVID-19 patients?

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Dear Editor,

The coronavirus disease 2019 (COVID-19) pandemic is still a critical and global issue. The most serious complication of COVID-19 is pneumonia, which often requires long-term mechanical ventilation. In addition, once patient oxygenation worsens, extracorporeal membrane oxygenation (ECMO) therapy should be considered, but it is not feasible in most local hospitals. Thus, COVID-19 patients on ventilator are transported to a tertiary hospital. However, how to avoid viral transmission to the medical crew and maintain the quality of care are matters of concern during the transport.

Infections can be transmitted during patient transport. Moreover, when a patient's condition worsens during transportation, patient management becomes challenging because the transport staff are wearing personal protective equipment (PPE) within a small enclosed space. Risk of infection is also a mental health concern of the transport staff. Thus, COVID-19 patients should be transported and managed safely inside an ambulance to prevent healthcare workers from being infected [1].

Several studies reported about endotracheal intubation using a device mounted on the N95 mask or a higher-level respirator with a face shield [2,3]. However, few have reported on safety during patient transport. Based on our experience of safely transporting COVID-19 patients during emergency, we summarized the factors to consider prior to transporting a critically ill COVID-19 patient (Table 1): safety for healthcare workers, safe transport of patients to the hospital, flexible plans during transportation, a portable ventilator, and post-transport decontamination. Specifically, the staff should use coveralls with a full-face elastomeric respirator with P99 filters (Figure 1),

wear protective clothing, and don masks fitted to the face. The gap between the mask and protective clothing should be sealed with duct tape. In addition, the oxygen pipe of the mobile respiratory system in the ambulance should be checked prior to transportation.

This pandemic may be overcome by reducing the spread of infection. Critically ill COVID-19 patients admitted in local hospitals will need to be transferred to ECMO centers. We hope that our checklist assists healthcare workers in protecting themselves from infection and in safely transporting COVID-19 patients.

#### Authors' contributions

MA was responsible for patient transportation and drafting of the manuscript. YS was responsible for the preparation for transportation and revising the manuscript. WI revised the manuscript. MY was responsible for critical revision and study supervision.

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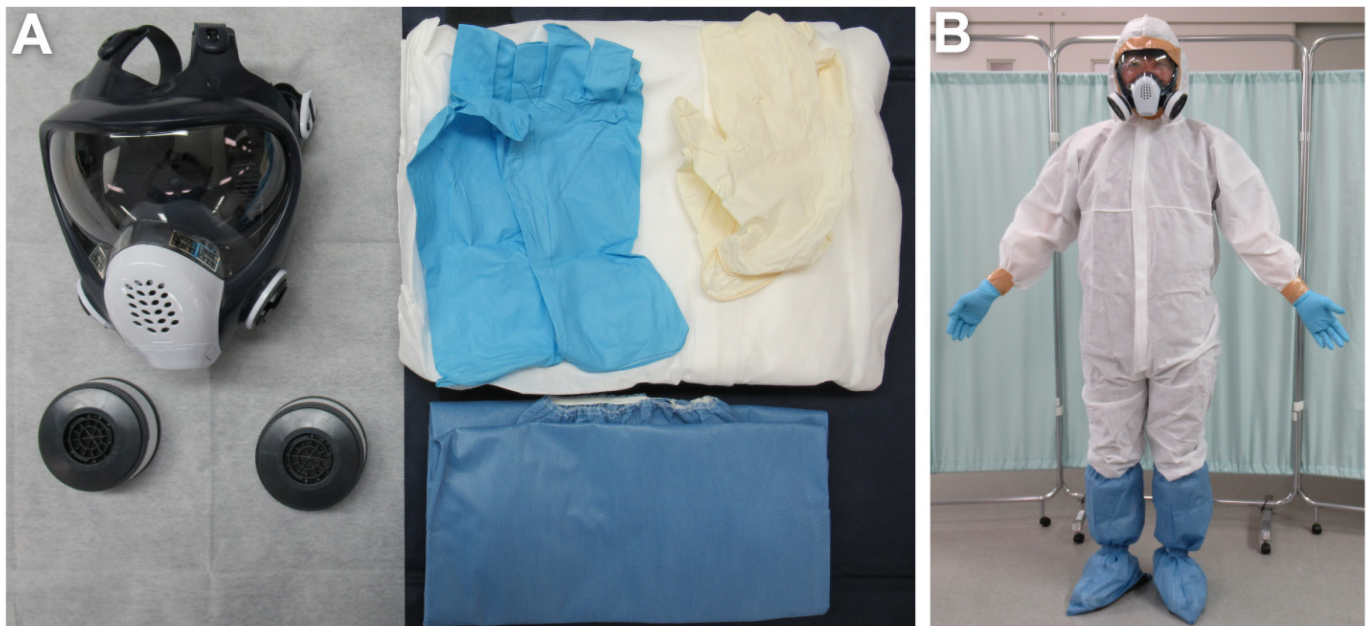
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**Table 1.** Checklist for transporting critically ill patients with COVID-19.

<b>COVID-19 Patient Transfer Checklist</b>	
<b>Healthcare worker safety</b>	<ul style="list-style-type: none"> <li>✓ Wear PPE before handling the patient                             <ul style="list-style-type: none"> <li>• Full-face elastomeric respirator with P99 filters                                     <ul style="list-style-type: none"> <li>○ If unavailable, safety goggles or a face shield for eye protection and respirator of class N95, FFP2, or FFP3 standard</li> </ul> </li> <li>• Coverall protective clothing                                     <ul style="list-style-type: none"> <li>○ If unavailable, long-sleeved gown or apron</li> </ul> </li> <li>• Double gloves (inner and outer gloves)                                     <ul style="list-style-type: none"> <li>○ Disposable nonsterile gloves</li> </ul> </li> <li>• Shoe covers</li> </ul> </li> </ul>
<b>Patient safety</b>	<ul style="list-style-type: none"> <li>✓ Cover the interior of the ambulance with a vinyl sheet</li> <li>✓ Identify patients with deteriorating conditions</li> <li>✓ Decide on transport to higher-level treatment facilities</li> <li>✓ Administer appropriate sedative and muscle relaxants</li> </ul>
<b>Flexible plans during transport</b>	<ul style="list-style-type: none"> <li>✓ Use recruitment maneuver using Jackson-Rees circuit</li> </ul>
<b>Ventilator</b>	<ul style="list-style-type: none"> <li>✓ Prepare resuscitation drugs</li> <li>✓ Check functionality of the portable ventilator                             <ul style="list-style-type: none"> <li>• Confirm connection to the oxygen outlet in the ambulance before departure</li> </ul> </li> <li>✓ Ensure remaining oxygen levels are sufficient</li> <li>✓ Check the connections between the ventilator and oxygen tubing</li> <li>✓ Monitor respiratory status</li> </ul>
<b>Post-transport decontamination</b>	<ul style="list-style-type: none"> <li>✓ Go back to the public health center in the same ambulance used for transportation while still wearing PPE</li> <li>✓ Remove the PPE at the public health center</li> <li>✓ Disinfect the interior of the ambulance by a dedicated housekeeping team</li> </ul>

PPE: personal protective equipment.

**Figure 1.** Examples of personal protective equipment.



(A) Full-face elastomeric respirator with P99 filters, coverall protective clothing, inner gloves, outer gloves, and shoe covers. (B) Total coverall with protective equipment.