Letter to the Editor

Intra-hospital transport of mechanically-ventilated COVID-19 patients for radiological imaging—developing a protocol to prevent healthcare-associated transmission

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The 2019–2020 coronavirus pandemic is an ongoing pandemic of coronavirus diseases (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The spectrum of symptomatic infection ranges from mild to critical with respiratory complications comprising of pneumonia and acute respiratory distress syndrome. Up to 5% of patients have critical illness presenting with respiratory failure, shock or multiorgan failure requiring admission to an intensive care unit (ICU) (1). In an Italian series, 88% of critically ill patients admitted to the ICU required mechanical ventilation (2).

Advanced imaging such as computed tomography (CT) of the thorax is clinically valuable in establishing a diagnosis and for guiding triage and management of COVID-19 pneumonia and its pulmonary complications (3). Given the high cumulative incidence of thrombotic complications in critically ill ICU patients with COVID-19 such as acute pulmonary embolism, ischaemic stroke, myocardial infarction and systemic arterial embolism, other imaging modalities such as CT pulmonary angiography and magnetic resonance imaging (MRI) of the brain are essential in diagnosing these complications (4). According to researchers at the Center for Infectious Disease Research and Policy (CIDRAP), COVID-19 pandemic could last for 2 years until 2022 (5). Together with the ongoing global spread of SARS-CoV-2, a significant increase is expected in the number of imaging studies ordered for the management of COVID-19 patients. Therefore, the number of intra-hospital transport for such intubated patients is expected to increase over time.

The values of these scans have to be weighed against the potential harms and costs, such as the risk of radiation exposure to the patient, consumption of personal protective equipment (PPE) and the need for cleaning and downtime of radiology rooms during resource-constrained period. Most importantly, the risk of healthcare-associated transmission to healthcare workers and passersby during transportation for scans needs to be taken into consideration.

Aerosol and fomite transmission of SARS-CoV2 is plausible, since the virus can remain viable and infectious in aerosols for hours and on surfaces up to days (6). Notably, intra-hospital transport has been suggested as a potential risk factor for healthcare-associated transmission for the accompanying healthcare workers and surrounding passersby who might potentially be exposed to the transported patient (7). Dislodgement of endotracheal tubes or ventilator circuit tubings during the transfer may potentially aerosolise the virus contributing to airborne transmission. Similarly, transmission via the contact route may also occur through fomites in the immediate environment around the transported patient with COVID-19 during the transportation for scans.

Transport-related risks can be reduced by increased awareness and education, adequate manpower and logistics arrangement, proper choice and handling of equipment and simulation of high-risk patient transfers. The use of full PPE such as N95 masks, face shield, gowns and gloves by

the transport team cannot be overstated. The use of error-preventive tools like checklists and protocols for patient transfers could also be utilized in healthcare facilities to ensure patients and healthcare workers' safety.

In Singapore General Hospital, preventing healthcare-associated spread of COVID-19 has always been our priority to safeguard the health and safety of our patients and healthcare workers. On top of the routine isolation of suspected cases of COVID-19 using a dynamic case definition defined by the epidemiological risks (e.g., travel, positive case and cluster contact history), the relevant presenting symptoms (e.g., symptoms of acute respiratory illness and anosmia) and clinical syndromes (e.g., acute febrile respiratory illness and pneumonia), hospital-wide social distancing measures are also instituted to mitigate the risk of healthcare-associated transmission (8).

Acknowledging the potential risk of healthcare-associated transmission of COVID-19 during the transportation of intubated patients for radiological imaging and its devasting impact, we have also developed a protocol for this purpose unique to the workflow within our hospital. The principles in developing such a protocol is described in the table below (*Table 1*).

In general, such protocol integrates a multidisciplinary

Table 1 Considerations in developing a protocol for the intra-hospital transport of an intubated COVID-19 patient for radiological imaging

Stages of the transport and its issues	Considerations to be taken in the protocol
1. Pre-transport planning	
a) Indication of scan	• To confirm its indication and consider alternative (if any) which does not require the transfer of patient (e.g., ultrasound/mobile interventional radiology team)
b) Scheduling of scans	• Dedicated time slots to be made available for COVID-19 patients requiring non urgent scans to allow easier coordination, better logistics and manpower planning and minimising potential contamination of the environment
	• To coordinate timing of scans to allow adequate decontamination time
c) Manpower allocation	• An appointed coordinator to be the overall-in-charge of the transport and to follow the transport team as a point of communication for them with the rest
	• Transport team: Intensive care doctor, nurses and respiratory therapist
	• Support team: Security officers (SOs), infection preventionists (IPs) and environmental cleaning specialists (ECSs)
d) Medical equipment	• To determine equipment needed for patient's transport and monitoring
	• Use of MRI compatible ventilator for MRIs to avoid switching of ventilators
e) Infection prevention equipment	• Use of High-efficiency particulate air (HEPA) filters to endotracheal tubes
	• Use of HEPA filters to expiratory tract of the ventilators
	• PPEs to be worn by transport team and anyone in close proximity to the patient
f) Transport route	• To determine a dedicated transport route
g) Emergency resuscitation requirements	• To determine equipment, drugs and manpower needed for resuscitation
	• To determine areas along the route of transport where resuscitation can take place safely to minimise the exposure to other hospital staffs and passersby
h) Simulations of transport	• To allow the transport and supporting teams to familiarise with the transport
i) Communication	• A huddle among the ICU, transport, support and radiology teams to confirm the details of the transport and discuss the contingency plans during emergencies
2. During transport (to and from radiology suite)	
a) Patient safety	• Transport team to be with the patient at all times
	• An airway/code blue team to standby in case of emergency

Table 1 (*continued*)

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Stages of the transport and its issues	Considerations to be taken in the protocol
b) Transport team, bystanders and environmental safety	• IPs to observe for any infection control breach throughout the whole transport • SOs to station along the entire transport route for bystanders management • ECSs to decontaminate the immediate route taken by the transport team to allow the immediate re-use of the route
c) Communication	• A secured messaging platform to allow constant communication among the ICU, transport, support and radiology teams throughout the whole transport
3. In the radiology Suite	
a) SOPS for environmental setup and infection prevention measures	• Standard operating procedures (SOPS) should be unique to the setup of the radiology suites and drafted in consultation with facility management and IPs • Special attention to be observed within the radiology suite should be communicated to the transport team during the pre-transfer huddle
b) Reducing contamination	• A dedicated space for transport team to station at a waiting area during the scan
c) Patient safety	• Patient monitoring to continue during the scans
d) Ensuring scan quality	• A radiologist to review the quality of scans remotely prior patient leaving the scan room, preventing the need for re-transport for a repeat imaging
4. Post transport	
a) Decontamination	• To decontaminate the entire route/facilities used according to hospital's protocol
b) Communication	• A huddle to discuss on the areas to improve on

effort involving manpower from various medical, nursing and ancillary support teams, a precise and comprehensive plan and the utilisation of appropriate infection prevention equipment. The major stakeholders involved in such protocol should be familiarised with the transfer process and have undergone simulations before the actual transportation of the intubated COVID-19 patients. The work instructions and co-ordination need to be clear, specific and concise, as well as easy enough to be understood and complied with.

In conclusion, the demand for advanced imaging for COVID-19 is growing given the ongoing global spread and the increasing recognition of its associated complications. Hospitals need to be prepared for the increasing numbers of intra-hospital transport of such intubated patients with COVID-19. A protocol for this purpose is paramount to prevent healthcare-associated transmission. Such protocol represents the determined efforts of the hospital to safeguard the health and safety of its patients and healthcare workers. By sharing our experience of developing such a protocol, we hope that other institutions may benefit from the practical experiences we have gathered since the start of this pandemic.

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appropriately investigated and resolved.

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