



Review Article

Covid-19 Patient Transport: A Literature Review

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Abstract

The pandemic caused by the Severe Acute Respiratory Syndrome Coronavirus-2 (COVID-19) is tremendously affecting health care services worldwide due to the nature of this virus which is highly infectious with a high rate of transmission. Transmission of the COVID-19 virus quickly occurs through close contact, droplet, airborne, and faecal-oral. During the prevention and containment of the pandemic, ambulances play an important role in transporting infectious patients. Health workers working in ambulances are at high risk of contracting the COVID-19 virus considering an ambulance is a small, confined and enclosed compartment. It is necessary to find a safe way of transporting COVID-19 patients by ambulance. Methods This thesis uses a literature review method. By following the PRISMA flow diagram, research journals are gathered from the electronic database Scienccdirect and Pubmed by performing keyword searches. The results are then sorted based on predefined inclusion criteria. Nine original research journals are obtained and reviewed. Results we found a variety of control measures that can be applied in transporting COVID-19 patients safely. These control measures can be categorised using the Control Hierarchy approach which includes elimination, engineering control, administrative control and usage of personal protective equipment (PPE). Conclusion transportation of COVID-19 patients by ambulance can be carried out safely by strictly adhering to the control measures and certain protocols found in this literature review These control measures can be categorised using the Control Hierarchy approach which includes elimination, engineering control, administrative control and usage of personal protective equipment (PPE). Conclusion transportation of COVID-19 patients by ambulance can be carried out safely by strictly adhering to the control measures and certain protocols found in this literature review These control measures can be categorized using the Control Hierarchy approach which includes elimination, engineering control, administrative control and usage of personal protective equipment (PPE). Conclusion transportation of COVID-19 patients by ambulance can be carried out safely by strictly adhering to the control measures and certain protocols found in this literature review.

INTRODUCTION

The COVID-19 pandemic is still ongoing. The Extraordinary Event (KLB) of viral

pneumonia that began in early December 2019 occurred in Wuhan City, Hubei

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Province, China and was caused by the new Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). On January 30, 2020, the World Health Organization (WHO) declared this outbreak a Public Health Emergency of International Concern (PHEIC) which is the highest warning issued by WHO.¹ In its press conference on 11 February 2020, WHO named this disease as Corona Virus Disease 2019 (COVID-19).² and a month later on March 11, 2020, WHO declared this COVID-19 outbreak a pandemic.³

The ease of transmission and the high death rate from COVID-19 has caused a worldwide health crisis. As of January 26, 2020, there were 2,794 confirmed cases of COVID-19 of which 80 died.⁴ Furthermore, as of April 13, 2020, more than 1,770,000 cases have been diagnosed in 213 countries, territories or territories.⁵ In a year later, the number of confirmed cases of COVID-19 globally has reached 130,422,190 people as of April 5, 2021.⁶ Meanwhile, new confirmed cases showed an upward trend again where at its peak on December 20, 2020 there were 851,249 new cases and then on February 16, 2021 it fell to 228,734 new cases, now there is an increase again because there are 685,576 new cases as of April 3, 2021.⁷

One of the complications of COVID-19 is pneumonia where the patient will feel short of breath and there is a drastic decrease in oxygen saturation in the blood. People who are hospitalized with Covid-19, 15-30% will experience COVID-19 associated acute respiratory distress syndrome (CARDS).⁸ Where if it is not handled properly, the patient will require respiratory assistance with a ventilator later. This is a new problem because some small hospitals do not yet have ICU rooms, or the limited capacity of ICU rooms equipped with ventilators. For this reason, patients need to be referred to a larger hospital and/or a hospital that still has an ICU room with a ventilator available. COVID-19 patients who are self-isolating at home may also require transportation to the hospital in the event of

a decline in health conditions. Referring to the events above, it is necessary to transport COVID-19 patients. Ambulance vehicles are a common means of transportation used for patients who are in critical condition such as the above incident.

Ambulance originated in France in the 15th century. There are two types of ambulance, namely 'the ward type' and 'the transfer type'. 'The ward type' ambulance has resuscitation equipment and essential medicines. 'The transfer type' is used to transfer patients whose condition is stable to the hospital. Various types of ambulances appear based on variations in the patient's condition⁹. Ambulances play an important role during a pandemic. COVID-19 patients who show an increase in symptoms such as shortness of breath will be transferred to a special COVID-19 health facility by ambulance so that their condition can be monitored closely.

WHO states that COVID-19 can be transmitted through close contact, droplet particles and small particles in the air (airborne). Methods of transmission through droplets and airborne mainly occur in close contact and in rooms with poor ventilation levels.¹⁰ The above conditions strongly describe the situation when transporting Covid-19 patients in the ambulance. This is a challenge for health workers who carry out patient transfers because it includes a high risk of infection in a limited space for several hours.¹¹

Based on this, the authors are interested in raising the research topic "Literature Review: Transport of COVID-19 Patients". The general purpose of this study is to review the literature review on how to safely transport COVID-19 patients using ambulances.

METHODS

The method used to compile this literature review is done using an electronic database. Journal search method using ScienceDirect

and Pubmed. The keywords used are COVID-19 transportation and COVID-19 ambulance. The journal year is limited to 2020-2021. After the journals found were sorted according to the inclusion criteria, the authors obtained nine journals that would be used in this literature review.

RESULT

From the results of the sorting of journal articles using the PRISMA method, nine research articles related to the transportation of Covid-19 patients were obtained with the characteristics of the journal as presented in Table 1.

Table 1
Journal Characteristics and Recommendations

No	Author	Title	Research methods	Recommendation
1	Chen et al. (2021) ⁹	Analysis and influence of ambulances on containment of the spread of COVID-19 in China	Cross-sectional	The need for an ambulance equipped with a negative pressure system to contain the spread of COVID-19
2	Schwabe et al. (2020) ¹²	Long-distance aeromedical transportation for COVID patients 19 in an ambulance plane using a Portable Isolation Unit: Opportunities, Limitations and Mitigation Strategies	Retrospective review	The use of patient isolation capsules in the transportation of COVID-19 patients by airplane
3	Yang et al. (2020) ¹³	Clinical characteristics of patients with Coronavirus Disease 2019 (COVID-19) receiving emergency medical services by ambulance in King County, Washington	Retrospective group study	Screening of ambulance patients based on clinical symptoms, especially fever and respiratory problems as an initial diagnosis of suspected COVID-19 in pre-hospital situations
4	Ghazali et al. (2020) ¹⁴	Feedback for preparing an ambulance team to manage patients who contracted COVID-19: Case Study	Case study	The need for screening patients, especially those who show symptoms of respiratory, hemodynamic and neurological problems, needs to be considered as COVID-19 suspects in the context of this pandemic associated with the use of PPE.
5	Murphy et al. (2020) ¹⁵	Occupational exposure and programmed response to the COVID-19 pandemic: emergency medical ambulance service experience	Retrospective group study	The change in working methods starts from the central operator who applies COVID-19 risk scoring to patients and the results are conveyed to the ambulance staff regarding whether or not the use of PPE is necessary to reduce the risk of exposure and achieve a measurable level of PPE use.
6	Spooler et al. (2021) ¹⁶	Helicopter transport for COVID-19 critical care patients in the Netherlands: protection against COVID-19 exposure - a challenge for critical care personnel in new operations	Retrospective observational study	The use and removal of PPE and post-transport helicopter disinfection need to be carried out properly
7	Tsukahara et al. (2020) ¹⁷	Feasibility study of a portable and transparent hood made of vinyl chloride for use in ambulances during the COVID-19 pandemic	Experimental research	The use of a transparent hood over the patient's head area connected to the suction machine continuously creates

No	Author	Title	Research methods	Recommendation
8	Spangler et al. (2021) ¹⁸	Prehospital COVID-19 identification: an observational study	Retrospective observational study	negative pressure within the hood Use of the COVID-19 suspect screening protocol based on the patient's clinical condition for the central operator and ambulance staff
9	Tang et al. (2021) ¹⁹	Earlier and more extensive screening of SARS-CoV-2 is needed for first responders	<i>Cross-sectional</i>	An earlier COVID-19 screening was carried out on front-line health workers with symptoms of illness after direct contact with COVID-19 patients

DISCUSSION

In connection with the high risk of transmission during the transportation of COVID-19 patients, there are steps that need to be taken to mitigate risk and prevent exposure. According to Koehler & Rule (2020), efforts to mitigate risk and prevent exposure to COVID-19 can be carried out through the hierarchical risk control framework approach created by NIOSH.²⁰ Depicted in the inverted pyramid in Figure 1 below, the more effective controls are at the top of the pyramid, while the less effective controls are at the bottom. This risk control hierarchy consists of five levels of control efforts, namely elimination, substitution, engineering control, administrative controls, and personal protective equipment (PPE).²⁰ In the context of transporting COVID-19 patients by ambulance, exposure risk control can be structured based on the following framework:

Elimination can be done by avoiding transportation of COVID-19 patients. Patients with COVID-19 with stable conditions and without complaints means it is possible to self-isolate at home^{21,22} and there is no need to send the patient to a quarantine facility as was done by the Indonesian government at the beginning of the pandemic.

Substitution cannot be applied in the context of transporting COVID-19 patients.

Engineering controls aim to separate ambulance personnel from danger. One of the safest methods for transporting COVID-19 patients is the use of negative pressure isolation capsules as exemplified in the second research journal above using the Epishuttle PMIU.¹² or by using Rega PIU.¹¹ Ambulances with a negative pressure system as mentioned in the first journal or the use of a hood on the patient's head with negative pressure as mentioned in the seventh journal are also highly recommended for use in the transportation of COVID-19 patients because they have been shown to reduce exposure by reducing the number of virus droplets or aerosols. COVID-19 in the air.^{9,17}

If there is no separation wall between the front of the ambulance (where the driver and front passenger) and the rear compartment (where the patient is treated during the trip in the ambulance) then it is necessary to make a dividing wall to reduce exposure to the officers in front, as well as to the aircraft. the separator between the cockpit and the cabin.²³ Air recirculation in the ambulance must also be avoided by turning off the recirculation button on the ambulance air conditioning system. Try to get fresh air into the ambulance.²⁴ One literature recommends opening the ambulance windows in the driver's area whenever possible²⁵ and a guide issued by the Malaysian Ministry of Health (KKM) states that the windows in the driver's area should be lowered by 3 cm.²⁶

Administrative control for infection risk control in the transportation of COVID-19 patients is carried out from before transportation, during transportation to after transportation by implementing certain protocols. Starting from the central operator who screens the level of risk of COVID-19 using a kind of scoring system, for people who need an ambulance to determine the criteria for suspects where the results are submitted to the ambulance staff as a suggestion for determining the proper use of PPE before the ambulance comes to the patient. This is very helpful in reducing the risk of exposure to health workers as mentioned in the third, fourth and fifth journals above.¹³⁻¹⁵

The central operator in collaboration with ambulance staff is also responsible for contacting the health facility or hospital where the patient will be taken to ensure the availability of beds in the ER or isolation room or ICU room according to the patient's needs before transportation is carried out, to avoid prolonged contact between the patient and the staff. health in the ambulance which increases the risk of exposure.²⁷ Patients should also be advised to wear a surgical mask before contact with ambulance staff.¹⁴ Patients who need the help of an oxygen mask are still wearing a surgical mask over the oxygen mask.^{24,25}

During transportation, try as much as possible not to take medical actions that produce aerosols and if you do, high caution and strict mitigation are needed, for example by using a HEPA filter on an Ambu Bag or using a video intubation device to facilitate intubation or by using a Supraglottic Airway Device. such as Laryngeal Mask instead of Endo Tracheal Tube (ETT).²⁸ Protocols for the use of PPE and routine hand washing before and after transportation also need to be regulated in administrative controls.²³

As mentioned in the first and sixth journals above, after the COVID-19 patient has been transported and has been handed over to

the designated health facility, disinfection and cleaning of the ambulance must be carried out. Disinfection of ambulances and medical equipment after transportation is important to prevent exposure to both health workers and patients who will use the ambulance afterwards.^{9,16} PPE and used medical materials must be disposed of in the medical waste bin to prevent exposure.

As discussed in the ninth journal above, routine PCR examinations for health workers working in high-risk areas such as ambulances and for staff with symptoms of illness must be carried out to prevent the spread of COVID-19 in the workplace.^{19,29} Every ambulance officer needs to be vaccinated against COVID-19 if there are no contraindications because research shows that health workers who receive COVID-19 vaccination have a very low risk of contracting it.^{30,31}

Personal Protective Equipment (PPE). Although PPE is the lowest level in the risk control hierarchy, its presence is necessary and must be worn when health workers will carry out treatment or direct contact with COVID-19 patients as described in the fourth, fifth and sixth journals above. In general, the required PPE for ambulance staff in handling COVID-19 patients is at least level 2 PPE including surgical masks, non-sterile gloves, isolation gowns and eye protection (protective glasses or face shield). However, the use of level 2 PPE equipped with N95 masks is preferred. When health workers are about to take medical actions that have the potential to cause aerosols, surgical masks must be replaced with N95 masks.^{32,33} What is no less important is that training on the use of PPE and the removal of PPE must be given to health workers beforehand so that PPE can be used properly.^{14,15} The application of the Buddy Check System method where co-workers participate in ensuring that the PPE we wear is installed correctly and also ensuring that the sequence when removing PPE is followed correctly has proven to be very useful for preventing exposure.¹⁶

CONCLUSION

The transfer of COVID-19 patients using land, water or air ambulances (heli or plane) can be carried out safely as long as it is carried out in accordance with strict procedures, namely the use of negative pressure ambulances, use of personal isolation capsules, use of negative pressure hoods, use of level 2 PPE with the use of N95 masks, disinfection of ambulances after use, screening of suspected COVID-19 patients by the central operator and ambulance officers, and routine COVID-19 checks on ambulance officers. Further studies are needed as a basis for making protocols for use in the transportation of COVID-19 patients.

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CONFLICTS OF INTEREST

Ambulances play an important role during a pandemic. COVID-19 patients who show an increase in symptoms such as shortness of breath will be transferred to a special COVID-19 health facility by ambulance so that their condition can be monitored closely.

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