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Original Research

A Critical Care Transport Program's Innovative Approach to Safety During the Coronavirus Disease 2019 Pandemic

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A B S T R A C T

Objective: The coronavirus disease 2019 (COVID-19) pandemic has resulted in the frequent transfer of critically ill patients, yet there is little information available to assist critical care transport programs in protecting their clinicians from disease exposure in this unique environment. The Lifeline Critical Care Transport Program has implemented several novel interventions to reduce the risk of staff exposure.
Methods: Several safety interventions were implemented at the beginning of the COVID-19 pandemic. These initiatives included the deployment of a transport safety officer, a receiving clean team for select interfacility transports, and modifications in personal protective equipment.
Results: From February 29, 2020, to August 29, 2020, there were 1,041 transports of persons under investigation, 660 (63.4%) of whom were ultimately found to be COVID-19 positive. Approximately one third were ground transports, 11 (1.1%) were by air, and the remainder were intrahospital transports. There were 0 documented staff exposures or illnesses during the study period.
Conclusion: The adaptation of these safety measures resulted in 0 staff exposures or illnesses while maintaining a high-volume, high-acuity critical care transport program. These interventions are the first of their kind to be implemented during the COVID-19 pandemic and offer a framework for other organizations and future disease outbreaks.

The treatment of patients with coronavirus disease 2019 (COVID-19) is fraught with risks to health care clinicians.[1,2] This risk is magnified when transporting patients from one location to another because of the proximity of clinicians to the patient in a confined space for extended periods of time. Both hospital and out-of-hospital organizations have recommended different strategies to reduce the risk of disease transmission to clinicians in their respective settings.[3,4] An environment that melds characteristics of both hospital and prehospital medicine, critical care transport requires its own unique strategies for hazard mitigation. These strategies must allow the care providers to implement recommended infection control practices while maintaining a high level of care in a mobile and confined environment with limited maneuverability.

Respiratory failure in this population is common, frequently requiring support in the form of high-flow nasal cannula, noninvasive positive-pressure ventilation, or mechanical ventilation. Although the specifics of COVID-19 transmission are still unresolved,[5] it is generally accepted that critically ill patients receiving respiratory support or undergoing aerosol-generating procedures present a high risk to clinicians.[6]

As the COVID-19 pandemic continues to surge so will the interfacility transfer of COVID-19 patients via ambulance and helicopter.[7] The objective of this article is to describe the implementation of several hazard mitigation strategies used by the Lifeline Critical Care Transport Team (Lifeline) to ensure the safety of staff during the transport of COVID-19 patients and persons under investigation (PUIs). During the study period, there were no staff exposed[8] to COVID-19 in over 1,000 transports of high-risk patients.

Methods

This is a descriptive study of the multiple safety interventions implemented by Lifeline during the COVID-19 pandemic. These

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included the use of a transport safety officer (TSO), a receiving clean team for select interfacility transports, and modifications in personal protective equipment (PPE). The study period was February 29, 2020, to August 29, 2020, and was approved by the institutional review board.

Study Site

Since its inception 28 years ago, Lifeline has provided care for patients within the Johns Hopkins Hospital and Health System. The team has a multifaceted transport mission, including movement of critically ill patients within the Johns Hopkins Hospital, emergency response in the hospital and around the medical campus, and the interfacility ground and air transport of patients referred into the Johns Hopkins Hospital and throughout the health care system. The team is involved in approximately 22,000 air, ground, and in-hospital patient transports each year. The Johns Hopkins Hospital is a 1,154-bed quaternary care hospital and 1 of 10 regional emerging special pathogens treatment centers designated by the assistant secretary for preparedness and response.[9]

The TSO

The primary responsibility of the TSO is to ensure staff and bystander safety during the transport of patients with suspected or confirmed COVID-19 (Table 1). There is no patient care responsibility associated with this position, a purposeful decision to ensure focus is maintained on the sole objective—safety. Training to become a TSO is available to all Lifeline staff. A half-day course consisting of didactic and hands-on training was followed by an observed evaluation.

The TSO's first objective is to ensure the proper donning of PPE. The TSO observes vigilantly for best practice deviations during the donning process using a checklist to confirm all PPE is being appropriately worn and that the teams' respirators have proper fit and function. The TSO remains outside the patient room while maintaining full visibility of the treatment team members. The TSO is empowered to pause patient care and movement operations for actions that could lead to a breach in infection control practices. Real-time feedback and relevant education are provided to health care staff to reduce future occurrences and improve safety.

Once the patient is ready for transport, a transport safety checklist is again reviewed by the TSO that includes ensuring a surgical mask is placed on the patient, PPE is being appropriately worn, and high-efficiency particulate air filters are in the proper location within the ventilator circuit should the patient require noninvasive support or ventilator management.

Because hospital staff, bystanders, and other patients are at risk of exposure once the patient leaves their isolation room, the TSO also plays a crucial role in mitigating the risk to these individuals. Tight corridors and small elevators do not allow for physical distancing and represent a potential opportunity for exposure. Throughout the transport, the TSO walks ahead of the stretcher and clears hallways of bystanders to reduce any risk. Doors are opened, and buttons are pushed for the crew to avoid potential contamination of the hospital and transport environments. If a crewmember accidentally touches a door handle or other surface, the TSO is equipped with cleaning wipes to disinfect the area.

During ambulance transport, the TSO sits in the passenger seat of the cab, which has been partitioned off from the patient care compartment to minimize pathogen transmission. The crewmembers providing direct patient care are equipped with a 2-way radio worn under their PPE, which allows for easy communication to the TSO. To limit the risk of breaching PPE and to decrease contaminating surfaces in the ambulance, the TSO relays messages from the crew to the communications center or the medical control physician when online consultation is required. Similarly, when patient transport occurs via air, the TSO occupies the copilot seat of the helicopter. Upon hospital arrival, the TSO is responsible for ensuring that hand hygiene is completed upon exiting the transport vehicle and that the transport route is clear. During flight operations, the TSO assists the flight crew as they remove their flight helmets and don their face shield.

Once patient care has been transferred, the crew doffs their PPE under the supervision of the TSO. Doffing is a high-risk procedure; a previous study of health care workers caring for potential Ebola virus patients identified 103 ways that the doffing process could fail and result in exposure.[10] The TSO is responsible for mitigating this risk by monitoring and assisting crews in the removal and disposal of their PPE. A best practice checklist is used to ensure that all steps are followed. Finally, equipment is decontaminated to be ready for the next call.

A Receiving Clean Team

Additional risk mitigation is achieved by assigning a separate Lifeline clinical team to receive interfacility transport patients on hospital arrival. This team assumes patient care on hospital arrival and transports the patient to the receiving unit. The intent of the secondary "clean team" is to decrease the risk of potential contamination to the hospital environment from high-risk ground transports, such as extended transports beyond 60 minutes or those that require aerosol-generating procedures. This handoff of care limits the introduction of bioburden from PPE and relieves the transport team who are often mentally and/or physically fatigued as a result of providing ongoing resuscitation during long transports while in PPE. The TSO remains with the new clean team to ensure a consistent member of the initial team was present upon handoff to hospital staff. There have been no reports of errors in omission or commission of patient information during the handoff to hospital staff.

PPE and Transport Modifications

Standard isolation gowns were found to be impractical for both ground and air transport. The constant movement that occurred during transport resulted in ripping and tearing of the gowns. Given these concerns, the use of surgical gowns was implemented because of their increased durability and flexibility. As an increased transport safety measure, the junction between the surgical gown and gloves is secured with polyethylene-coated, nonpermeable adhesive tape (duct tape). Because of repetitive movement, the wrist cuffs of the surgical gowns often migrated up the arm, creating a gap of exposed skin between the cuff and the glove; taping the wrists prevents this gap and potential exposure. When team configuration permits, the emergency vehicle operator is responsible for starting the transport vehicle and ensuring that the air conditioner in the patient care compartment is activated. This is done to reduce ambient air temperature for patient and team comfort. A rechargeable cooling vest is available

Table 1
Responsibilities of the Transport Safety Officer

General responsibilities
Ensure staff and bystander safety
Halt operations if there is a hazard risk
Before transport
Assist with proper donning
Ensure patient is properly prepared for transport, including applying a surgical mask
Gross decontamination of the bed after patient is transferred to stretcher
During transport
Monitor for infection control breaches and quickly remedy any that occur
Clear traffic from hallway
Open doors and press elevator buttons
Responsible for radio and cellular communications
After transport
Observe and assist with proper doffing
Gross decontamination of equipment

Table 2
Transports During the 6-Month Study Period

Modality	Number of PUIs, n (%)	Number of COVID-19–Positive Cases, n (%)	Total Number of Patients Transported, n (%)
Intrahospital	294 (43.3)	384 (56.6)	678 (65.1)
Ground	81 (23.1)	271 (77.0)	352 (33.8)
Air	6 (54.5)	5 (45.5)	11 (1.1)
Total	381 (36.6)	660 (63.4)	1,041 (100)

to staff as an additional comfort measure for extended ground and air transports.

Additional considerations and modifications were necessary to ensure the same high-level compliance and safety of staff involved in helicopter emergency medical services transport. As expected, powered air-purifying respirators were not feasible because of flight helmets. Instead, a fit-tested Draeger or N95 respirator was worn underneath the helmet. Once off the aircraft, the clinicians remove their helmet and replace it with a face shield. Because of the modifications in the doffing steps to accommodate the flight helmet, all flight team members including TSOs were validated in PPE donning and doffing specific to flight operations. The pilot remains in the helicopter, removed from the patient care team, to decrease the need to sanitize the front of the aircraft and prevent exposure.

Results

Between February 29, 2020, and August 29, 2020, Lifeline completed 1,041 transports, 381 (36.6%) of which were PUIs and 660 (63.4%) were COVID-19 positive (Table 2). Of the 352 (33.8%) patients transported by ambulance, 271 (77.0%) were COVID-19 positive. The remaining 11 (1.1%) interfacility transports were by helicopter, 5 (45.5%) of which were COVID-19 positive. At the apex, Lifeline completed 21 PUI and COVID-19–positive transports in 1 day. There were no known or reported staff exposures[9] or COVID-19 illness.

Discussion

The provision of prehospital care can be high risk for the transmission of highly infectious diseases. Increased COVID-19 infection rates have been reported among prehospital responders.[1] Patients transported by critical care teams are typically very ill and often require constant resuscitation, including aerosol-generating procedures, which further increases disease exposure.[5]

There is limited information to guide critical care transport programs in establishing mitigation strategies during the COVID-19 pandemic. The adaptations implemented by Lifeline were critical to maintaining a 0 exposure and disease transmission rate throughout the first 6 months of the pandemic.

The addition of an extra staff member on transports was a substantial personnel and PPE commitment. Resilience was created within staffing by cross-training personnel resulting in their ability to fulfill multiple roles (clinical vs. TSO); however, the additional staffing needs resulted in payroll costs in the form of overtime. Costs associated with PPE use were also increased because of the addition of the TSO and clean receiving team. It is our belief that the cost incurred by these program modifications is outweighed by the benefits, most notably no staff exposures or work-related illness. This prevented work-related quarantine or isolation and thus avoided the cost of overtime pay to backfill positions.

These interventions are the first of their kind to be implemented during the COVID-19 pandemic and offer a framework for other institutions and transport programs, including for future disease outbreaks. Notable limitations include the use of data from a single system, the absence of scene transports, and the use of paramedic/nurse crew configuration.

Conclusion

Lifeline mitigated staff risk by modifying and developing strategies specific to COVID-19. Through the use of a TSO, a receiving clean team for select interfacility transports, and modifications to PPE, the result was 0 staff exposures during the first 6 months of the COVID-19 pandemic at a high-volume and high-acuity critical care transport program.

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