Considerations for Safe EMS Transport of Patients Infected with Ebola Virus

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Abstract

The Nebraska Biocontainment Unit through the Nebraska Medical Center in Omaha, Nebraska, recently received patients with confirmed Ebola virus from West Africa. The Nebraska Biocontainment Unit and Omaha Fire Department's emergency medical services (EMS) coordinated patient transportation from airport to the high-level isolation unit. Transportation of these highly infectious patients capitalized on over 8 years of meticulous planning and rigorous infection control training to ensure the safety of transport personnel as well as the community during transport. Although these transports occurred with advanced notice and after confirmed Ebola virus disease (EVD) diagnosis, approaches and key lessons acquired through this effort will advance the ability of any EMS provider to safely transport a confirmed or suspected patient with EVD. Three critical areas have been identified from our experience: ambulance preparation, appropriate selection and use of personal protective equipment, and environmental decontamination. **Key words:** Ebola; EMS; transport

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Introduction

As the Ebola virus disease (EVD) outbreak infects thousands in West Africa, citizens of the United States and other aiding countries travel to endemic areas to contain viral transmission and treat patients battered by the world's deadliest Ebola epidemic to date. Unfortunately, in combating this highly infectious disease, aid workers and others have been inadvertently exposed to the virus and contracted EVD and some have been flown home for treatment – the Nebraska Biocontainment Unit being one of several receiving hospital facilities. While directing the transport of confirmed patients with EVD from airport to hospital, the Nebraska Biocontainment Unit has recognized key considerations that should be identified and addressed by hospitals and emergency medical services (EMS) providers across the United States to prepare for infectious patient transport, particularly emphasizing patients with EVD.

Infection control practices are exceptionally important during transportation, a relatively vulnerable setting for disease transmission in highly infectious patients. Throughout transport, infectious patients may transfer between multiple health-care providers and could quickly contaminate the surrounding environment. Though recommended, EMS personnel may not have first-hand experience or precise training in handling these types of highly infectious patients.[1] Unforeseen security issues might arise from terroristic threats or vehicular accidents. A patient's condition may decline during transport, requiring rapid assessment for performing riskier contamination-associated procedures in a relatively unstable environment.[2] Multiple local and national organizations must function and communicate closely throughout infectious patient transport, not to mention legality differences that must be addressed in moving infectious patients between states and countries.[1] Thus, detailed planning and effective coordination of all parties involved is essential for successful infectious patient transport.

Learning from the Nebraska Biocontainment Unit's EVD experiences and drawing from after-action discussions with the U.S. Department of State, we offer transportation recommendations on ambulance preparation, appropriate uses of personal protective equipment (PPE) for those at risk of EVD contact, transport procedures for patient care, and environmental

decontamination methods. The Nebraska Biocontainment Unit has been unique in receiving deliberate, diagnosis-confirmed EVD patients with roughly 72-hours notice, but also had the benefit of spending years training and developing the procedures as well as the relationships necessary to execute this scenario. Other hospital facilities may have no forewarning that a patient has EVD before or during emergency transport. Nevertheless, the information on safe transport procedures is valuable for EMS and hospitals to effectively prepare for potential patients with EVD. To minimize the risk and impact of receiving a patient with EVD without warning, uniform community screening procedures should be implemented by 9-1-1 dispatch, EMS providers, and clinical settings to enable activation of predetermined action plans and assets that enable immediate patient isolation and protection.[2]

AMBULANCE PREPARATION

Prior to receiving confirmed patients, the ambulance patient care compartment was stripped of all items not necessary for transport. The compartment was draped with 6-mm plastic sheeting secured with duct tape, forming an envelope of one continuous sheet of plastic to fit the back of the ambulance with adequate slack to allow emergency medical technicians (EMT) to sit on the chair and bench (Figure 1). The edges of the plastic sheet were taped to the wall, reaching the ceiling on three walls, excluding the back exit wall. In the process, the cab of the ambulance was plastic sealed to isolate the driver from the patient and to prevent environmental contamination of hard-to-clean surfaces during transport.[3] The side hatch was covered in plastic and was not to be used in any event. The paramedic chair in the back was covered with a 96-gallon biohazard bag formed to its shape. Rails and locking mechanisms necessary to secure the patient gurney protruded through the plastic, and tape was used to seal around them. Care was made to avoid placing duct tape on the flooring as this could increase the difficulty in decontamination if there were to be a fluid event on the floor. A second ambulance was draped to be ready for use in the event the primary ambulance could not be deployed or was disabled en route. Additionally, items necessary for patient care, such as oxygen and medical supplies, were placed in thin plastic bags, taped shut and placed in the patient care area of the ambulance. This allowed quick access to the items if they were needed, but protected them from contamination if unused. Following transport, the exteriors of unopened equipment bags were bleach wiped twice and interior contents were aseptically removed from the plastic bags.

PERSONAL PROTECTIVE EQUIPMENT

During transport the patient wore a Tyvek suit (DuPont, Wilmington, DE), mask, gown, and gloves. In the event of a longer transport or if patient condition so required, an ISOPOD (Immediate Response Technologies, Glenn Dale, MD) patient isolation device would have been used on the stretcher for patient fluid containment.

Ambulance personnel included an attending paramedic (administering patient care) and a medic driver, who helped load the patient onto the stretcher

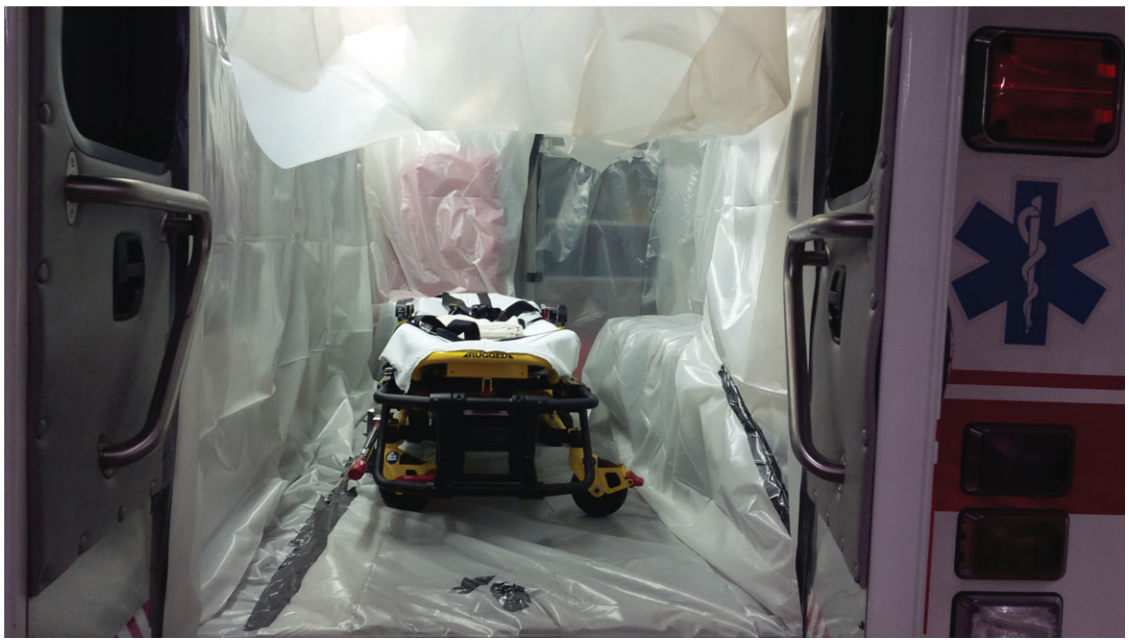

FIGURE 1. Ambulance draped with 6-mil plastic for EVD transport.

and into the ambulance, staying at the head of the stretcher in order to minimize patient contact. In the first patient's transport, a nurse from the biocontainment unit (donned in matching paramedic PPE) also rode in the back of the ambulance to support patient care. Although it is common for two paramedics to attend to patients during EMS transport, only one paramedic was used to decrease exposure risks, but two paramedics may be necessary for unstable patients.

Selection of PPE for transport personnel followed protocols that were developed over 8 years of biocontainment unit training and that align with Centers for Disease Control and Prevention (CDC) guidelines issued October 20, 2014 for PPE selection when managing patients with Ebola. All PPE was donned with assistance from a member of the biocontainment unit. All personnel wore scrubs and carried handheld radios with earpieces beneath their PPE. The attending paramedic donned a type C biological protection Tyvek suit with a powered air-purifying respirator, gloves, and boot covers (Figure 2). The medic driver wore an N-95 respirator, Tyvek suit, goggles, boot covers, and gloves, as the opening between the cab and patient compartment had been sealed with 6-mm plastic. All individuals were triple gloved per biocontainment unit procedures. The triple-glove technique consists of an inner glove that is not taped to the suit, a second long cuff glove taped to the Tyvek suit, and a third outer glove that acts as a patient-care glove. If the third glove is contaminated, this technique allows removal of the contaminated glove, bleach wiping of the second taped glove, and reapplication of a clean third patient-care glove. Procedure gloves were made available for emergency use in the driver cabin. The ambulance vent was turned on high with fresh air (not recirculated air), and the windows were cracked an inch or two to pressurize the cab, as controlled ventilation and HEPA filtration was suggested for infectious patient transport.[1]

FIGURE 2. Paramedic personal protective equipment utilized for EVD transport.

TRANSPORT

Our coalition was notified approximately 72 hours in advance of receiving each EVD case. The U.S. Department of State and Phoenix Air arranged patient transport from West Africa to Omaha. Relationships with local transportation partners had been previously established through planning, training, and exercises; partners included the Omaha Fire Department, who provided ambulances, EMS personnel, and the medical chase vehicle; the Nebraska Department of Health and Human Services; Douglas County Department of Health; and the Nebraska State Patrol, the principal law enforcement agency.

For each EBV transport a medical chase vehicle was driven by an additional paramedic with the Omaha Fire Department Medical Director, EMS Chief, a U.S. Department of State representative, and biocontainment unit personnel available with full PPE to assist as needed, including to set a cordon and begin on-site decontamination if any fluid event were to occur from the patient while outside the ambulance. The chase vehicle also carried additional PPE supplies and ISOPOD, and maintained radio contact with ambulance personnel.

The attending medic assisted with patient removal, staying at the foot of the stretcher. The stretcher entered through a designated hospital transport route rather than through the emergency department entrance. Security personnel were prepositioned at a safe distance to control the route through the hospital to the biocontainment unit.[1] Post patient delivery, the medic driver doffed PPE with assistance from biocontainment unit staff, performed hand hygiene, and

applied new PPE, awaiting further instructions for vehicle cleaning. The PPE was doffed in designated doffing areas within the biocontainment unit or ambulance decontamination site on a disposable fluid-resistant drape. The PPE and drape were then folded and placed into biohazard bags. Doffing partners followed a checklist that provided the order and key considerations for removing each piece of PPE.[4,5]

DECONTAMINATION

Following patient admission into the biocontainment unit, a biocontainment staff member donned in Tyvek suit, N-95 respirator, face shield, and gloves mopped the hospital hallway and elevator route with hospital-grade disinfectant. The elevator was wiped down with disinfectant bleach wipes. The through-hospital transportation route was held by security until cleaning was complete and four times the manufacturer recommended contact time had elapsed.

The contaminated ambulance was relocated to an isolated, controlled-access area for decontamination as recommended.[1] Decontamination was performed by two biocontainment unit staff donned in Tyvek suits, gloves, boot covers, and full-face respirators with (F)OV/AG/P95 organic vapor/acid gas cartridges. The full-face respirator was used to minimize exposure to disinfection chemicals, and to reduce the likelihood of splash exposures. The plastic sheeting covering the patient compartment was removed by folding it in onto itself, similar to how one doffs a Tyvek suit; it was contained within autoclave waste disposal bags, which were processed in a pass-through autoclave before ultimate disposal.[6] All surfaces of the ambulance (cab and patient compartment), including walls, ceiling, and floor, were thoroughly wiped with bleach solution. In a final decontamination step, the back of the ambulance was exposed to over 500 mJ/cm^2 ultraviolet germicidal irradiation. The ambulance remained out of service for 48 hours in the isolated area for decontamination.

DISCUSSION

The Nebraska Biocontainment Unit has identified key areas for consideration for EMS providers preparing for potential EVD transports that include ambulance preparation, personal protective equipment, and environmental decontamination. Given our relatively unique position as a high-level isolation unit, this extensively organized, prearranged transport would likely differ from other medical facilities lacking a containment unit and advanced notification EVD transport. Regardless, we hope sharing our first-hand transport experiences will aid any EMS providers in their preparations and abilities to safely handle any suspected or diagnosed patients with EVD.

Each transport provided lessons on improving our protocol for future transports. First, a biocontainment nurse was not present in the ambulance for the second transport, as patient care in the ambulance was minimal; a nurse would have been needed only if the patient's condition had been significantly unstable. Second, Tyvek suits can be warm and uncomfortable and are prone to goggle fogging. To ensure the health-care worker's ability to safely function, donned individuals should be well hydrated, and we found use of air-purifying respirator reduced goggle fogging and increased overall comfort. However, air-purifying respirators pose logistical contamination and cleaning challenges of their own. All the air-purifying respirators used in our transports were taken into the biocontainment unit for decontamination prior to being available for reuse. They are only useful for shifts less than 4 hours long and the equipment or suit may be easily damaged.[1] EMS personnel used for EVD transports were senior medics who volunteered for the EVD transport team. Protocols were developed to medically monitor all involved responders in transport or in direct contact with disease-contaminated materials following the transport by recording and reporting body temperatures for 21 days following transport; suggested public health actions were also recommended for personnel with "some risk" as defined by the CDC.[1,7]

Community-level coordination was a critical component of our EVD transport events and perhaps an even more important aspect of transporting suspected EVD cases presenting in the community. Preplanning that engages 9-1-1 dispatch, EMS providers, receiving hospitals, public health, and law enforcement to develop uniform screening and interagency communications plans and to align operating procedures is crucial in minimizing exposure risks and maximizing the potential to adequately identify and isolate suspected EVD patients in all phases of medical care.

CONCLUSION

EMS providers do not need to fear transporting Ebola patients if proper training, equipment, policies, and procedures are established. Safe transport of a highly infectious patient can be accomplished with preparation that includes training, equipment, and relationship development among transport partners. It is essential for EMS providers to have a close working relationship with area hospitals and infection control experts in order to address Ebola. Hospitals and infection control experts can provide the necessary information to help EMS safely transport suspected Ebola patients. As with many scenarios, stratified approaches should be developed to adequately address risk and safety while minimizing unnecessary utilization of resources. For example, the Nebraska Biocontainment Unit

utilizes a tiered PPE protocol implementing higher levels of PPE as determined by confirmed EVD patient symptoms. Similar considerations should be employed for developing EMS protocols for transporting suspected community cases that ensure adequate protection of EMS personnel, the public, and patients by employing appropriate protective measures based on patient symptoms.

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