# Transport and Management of Patients With Confirmed or Suspected Ebola Virus Disease

Alexander Isakov, MD, MPH*; Wade Miles, NRP; Shawn Gibbs, PhD, MBA; John Lowe, PhD; Aaron Jamison, NRP; Raymond Swansiger, PA-C, MPAS

*Corresponding Author. E-mail: aisakov@emory.edu.

The foundation of safe care for patients with confirmed or suspected Ebola virus disease is effective infection control practice, which requires implementation of appropriate administrative policies, work practices, and environmental controls, accompanied by focused education, training, and supervision. In 2002, Emory University partnered with the Centers for Disease Control and Prevention to develop a capability for the evaluation and management of individuals with serious communicable disease. In 2005, the University of Nebraska developed a similar isolation capability. In each case, the hospitals partnered with emergency medical services (EMS) professionals to ensure safe out-of-hospital transport and management of their patients. The objectives of these hospital and out-of-hospital collaborations were to close education, training, and practice gaps to best facilitate the care for patients with serious communicable disease while ensuring the safety of the medics and the general public through meticulous implementation of infection control practices as recommended by Centers for Disease Control and Prevention. The description of practices implemented by EMS teams in these communities for the transport of patients with confirmed Ebola virus disease is shared so that others might more readily implement these practices, policies, and procedures as applicable to their mission requirements and system design. Transport of patients with relevant travel history and development of illness (persons under investigation) is also included. [Ann Emerg Med. 2015;66:297-305.]

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## INTRODUCTION

Emergency medical services (EMS) professionals respond daily to victims of serious illness or injury. They often encounter patients infected with dangerous communicable diseases, including methicillin-resistant *Staphylococcus aureus*, *Clostridium difficile*, *Neisseria meningitis*, hepatitis B and C, HIV, and multidrug-resistant tuberculosis. To be prepared to safely manage such patients, paramedics and emergency medical technicians are trained, as part of their core curriculum, to implement standard and transmission-based precautions to prevent exposure to themselves or others. Across the United States, EMS transports of such patients occur regularly. However, the transport of the first patient with confirmed Ebola virus disease to the United States (Atlanta, GA), the transport of the first US-diagnosed Ebola virus disease case (Dallas, TX), and the first transmission of Ebola virus disease to health care workers in the United States understandably raised anxiety in the EMS community about the appropriate education and training, policies, and procedures, as well as supervision required, to be best prepared for transporting patients with serious communicable disease in the United States.

EMS and other US health care professionals lack familiarity with Ebola virus disease,[1] which is understandable. Although sporadic human outbreaks of Ebola virus disease have occurred since the illness was first recorded in 1976, the disease has been limited to the geographic area of its animal host, in rural parts of Africa. Although there have been reported cases of similar viral hemorrhagic fevers exported to other countries,[2,3] the occurrences have been few.

Lapses in standard and transmission-based infection control practice, an essential foundation for the safe transport and management of patients with Ebola virus disease, are well documented.[4-8] EMS crews do not consistently comply with such basic infection control practices as hand hygiene.[4] More broadly, the compliance of EMS providers with standard infection control precautions and equipment disinfection has been described as suboptimal.[5] Unannounced collections of environmental samples from ambulances have grown methicillin-resistant *S aureus* and other multidrug-resistant organisms.[6-8]

In 2002, Emory University partnered with the Centers for Disease Control and Prevention to develop a capability for the evaluation and management of individuals with

- Introduction and overview of transport of patients with serious communicable disease
  - Education and training
  - Equipment
  - Concept of operations
- Tenets of infection control
  - Standard precautions
    - Hand hygiene
    - PPE
    - Patient care equipment
    - Environmental controls
    - Injury prevention
  - Transmission-based precautions (contact, droplet, aerosol)
    - PPE
    - Patient care equipment
    - Patient placement
    - Categorization of common pathogens
- Education about serious communicable pathogens
  - Epidemiology of illness
  - Microbiology of pathogen
  - Methods of acquisition/transmission
  - Natural disease course
    - Incubation
    - Signs and symptoms
    - Transmission
    - Recovery
  - Preventing transmission/infection control
  - Treatment
  - Vaccine/prophylaxis
- Operational planning and procedures
  - Clinical care guidelines
  - Crew composition and roles
  - Vehicle preparation
  - Special equipment
  - PPE
    - Selection
    - Donning
    - Doffing
  - Decontamination and disinfection procedures
  - Waste management
  - Partnership with receiving facilities
  - Postmission surveillance

**Figure 1.** Education and training. *PPE*, Personal protective equipment.

serious communicable disease. This partnership included Grady EMS for the development of a team with the requisite competencies necessary to transport and manage these patients in the out-of-hospital setting. In 2005, the University of Nebraska developed isolation capability for serious communicable diseases and initiated partnerships with EMS professionals to provide safe transport and management of patients admitted to the facility. The objectives of these hospital and out-of-hospital collaborations were to close education, training, and practice gaps to best facilitate the care for patients with serious communicable disease while ensuring the safety of the medics and the general public through meticulous implementation of infection control practices as recommended by CDC. The description of practices implemented by EMS teams in these communities for the transport of patients with confirmed Ebola virus disease is shared so that others might more readily implement these practices, policies, and procedures as applicable to their mission requirements and system design. A discussion about evaluation and transport of patients with relevant travel history and development of illness is also included.

## EDUCATION AND TRAINING

Team medics are provided education about serious communicable pathogens, their modes of transmission, the availability of vaccines, pre- and postexposure prophylaxis and treatment. The education most importantly emphasizes strict adherence to standard and transmission-based infection control practices (Figure 1). We believe that it is important for paramedics to not only understand what to do but also why. Understanding the nature of the illnesses they confront helps providers overcome apprehension and fear so they can render safe and effective care.

After initial instruction, team medics complete competency-based training, with special attention to the proper donning and doffing of a variety of personal protective equipment in the presence of a trained observer. Careful attention is paid to compliance because a seemingly minor lapse in technique can put health care workers at risk for infecting themselves or spreading dangerous pathogens to others. For example, a cluster of severe acute respiratory syndrome cases among protected health care workers in 2003 raised questions about health care worker familiarity with how best to remove personal protective equipment (PPE) without

No environmental package shall have recirculating air selected

Ventilation system in driver compartment will be turned on, with fan on high

Exhaust vent in patient compartment will be turned on

Driver compartment will be sealed from patient compartment

The litter stanchions will be removed before draping

Patient compartment will be draped in disposable barriers

Stretcher will be protected with impervious barrier

Litter stanchions will be replaced and taped to seal

Medical gear will be stowed in patient compartment behind disposable barriers

Medical equipment can be stowed in patient compartment, sealed inside a clear plastic bag for easy access

Oxygen delivery kit should be stowed in patient compartment and sealed inside a clear plastic bag for easy access

**Figure 2.** Ambulance preparation.

contaminating themselves.[9] Developing and maintaining a high level of competency with the use of PPE is vital for workforce safety.[10]

## VEHICLE PREPARATION

Team medics learn to prepare the ambulance in advance to facilitate decontamination and disinfection after patient contact (Figure 2). They do this by separating the driver compartment from the passenger compartment such that the driver compartment is always considered clean. Medics who have made patient contact do not return to the driver compartment. The ventilation system in the driver compartment is turned on, with the fan set on high and in such a way as to not allow recirculation of air. The intent is to create a positive-pressure environment in the driver compartment to guard against aerosol. Although Ebola is known to be transmitted by direct contact with blood or infectious bodily fluids or droplets and not by aerosol, this simple technique is implemented as an extra measure of caution should an aerosol-producing procedure be required in the patient compartment. CDC has previously recommended this technique for the ground transportation of patients who pose a risk of disease transmission by aerosol.[11]

Medics also envelop the interior of the patient compartment with impervious barriers to prevent contamination of surfaces difficult to clean and disinfect. This is especially important for patients who pose a high risk for sharing infectious bodily fluid through active bleeding, vomiting, or diarrhea. The stretcher is similarly protected with an impervious sheet (Figures 3 and 4).

A full complement of medical gear is available but protected behind the impervious drapes. Medical gear can be made more readily accessible by sealing in a clear plastic bag within the patient compartment to facilitate rapid access if required. This gear may include a bag-valve-mask device, airway adjuncts, and equipment to facilitate intravenous access and volume resuscitation. A leakproof container should be available for collection of emesis.

## PATIENT PREPARATION

Patients who can cooperate may be asked to wear an impervious suit to prevent exposure to sites of cutaneous bleeding, or an undergarment capable of collecting large

**Figure 3.** Grady EMS draping technique using One Tuff disposable impermeable sheeting 4′×15′.

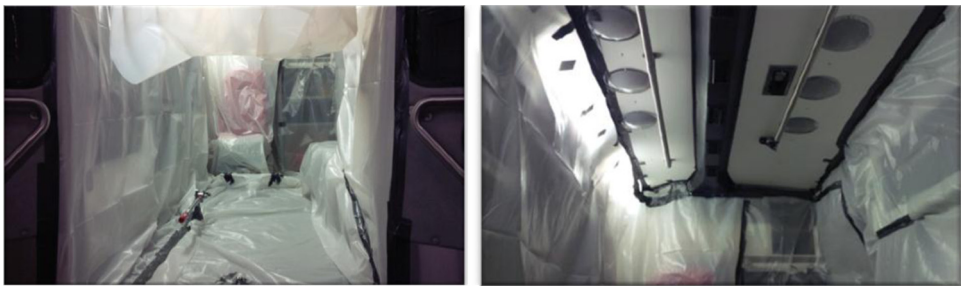

**Figure 4.** UNMC draping technique using 6-mil impermeable plastic.

volumes of diarrhea. Should the patient not be able to don an impervious suit, an impervious covering may be used for the same purpose: to limit contamination of environmental surfaces and minimize the potential for paramedic exposure. To limit spread of droplets to environmental surfaces inside and outside the ambulance, patients are asked to wear a surgical mask if tolerated (Figures 5 and 6). If a patient is vomiting and cannot tolerate a surgical mask, a leakproof container should be provided for the patient to assist in the collection of emesis and to limit contamination of environmental surfaces.

## HEALTH CARE WORKER PPE

Personal protective equipment must be donned, in the presence of a trained observer, to protect the medic from exposure to blood or infectious bodily fluid. CDC recommends contact and droplet precautions, to include aerosol protection should an aerosol-producing procedure be required. The transport team met the CDC's standard by wearing a footed Tyvek (DuPont, Wilmington, DE) suit, gloves, and a hooded, powered, air-purifying respirator for eye and mucous membrane protection. We recognized that goggles and a surgical mask technically meet the requirement for mucous membrane protection from droplets and that the hooded, powered, air-purifying respirator was not strictly required. During years of operational experience in our work environment, however, the team found the hooded, powered, air-purifying respirator cooler and more comfortable to use, especially on an extended mission. The device also averted any issues with eyewear fogging and protected health care providers from inadvertent touching of the face. The Tyvek suit and hooded, powered, air-purifying respirator also afford excellent splash protection, a very important consideration when managing a patient in an ambulance compartment where vomit, diarrhea, and blood pose a serious risk of exposure. Our patients were all several days into the course of their Ebola virus disease illness, a time when episodic emesis and profound diarrhea are reported.[12] And should the patient suddenly require an aerosol-producing procedure, such as open suctioning to prevent aspiration or emergency intubation, the medic is already afforded the appropriate respiratory protection. A properly fitted air-purifying respirator has also been successfully used. Other PPE ensembles that prevent exposure to skin and mucous membranes will also be effective if used properly. Selection of PPE should be in accordance with CDC guidelines and accommodate the condition of the patient, the anticipated mission requirements, and the work environment and be in concert with the requisite competencies to properly use the equipment.

**Figure 5.** Patient enveloped in impervious sheet.

If patient is ambulatory, he or she will be asked to wear impervious suit, surgical mask, and gloves if tolerated.

If patient is having large volumes of diarrhea, he or she will be asked to wear an adult undergarment.

If patient is nonambulatory, he or she will be shrouded in impervious sheet as tolerated, and surgical mask will be applied.

**Figure 6.** Patient preparation.

- Transport team consists of 4 members: 2 primary health care workers (paramedic or critical care nurse), team leader, and EMS physician
  - HCW 1
    - Dons hands-free radio; footed impervious suit; hooded, powered, air-purifying respirator system; double gloves
    - Provides assessment and care for patient in the ambulance
    - Responsible for patient record
  - HCW 2
    - Don radio with hands-free communications, footed impervious suit, N-95 mask, eye protection, double gloves
    - Designated to drive the ambulance
    - If patient is nonambulatory, will don PPE ensemble that matches that of HCW 1 and assists with patient loading and care
  - Team leader
    - Operates the supervisory vehicle
    - Coordinates with supporting agencies
    - Serves as safety officer
    - Will don same PPE ensemble as HCW 2 and serve as ambulance operator if HCW 2 is needed for patient care
    - Standard uniform, radio and cell telephone communications, ready to don higher-level PPE if needed
  - EMS physician
    - Provides oversight of patient care
    - Manages clinical communications between transport teams and receiving facility
    - Provides contemporaneous clinical decisionmaking and direct medical control as necessary
    - May operate the supervisory vehicle if the team leader is redirected to drive the ambulance
    - Standard uniform, radio and cell telephone communications, ready to don higher-level PPE if needed

**Figure 7.** Personnel roles and protective posture. *HCW,* Health care worker.

## WORK PRACTICES

Policies and procedures are implemented to prevent exposure to blood and infectious bodily fluids (Figure 7).

The transport team consists of 2 trained medics, a team leader, and an EMS physician. Patient contact is limited to the least number of persons required to provide care for the patient. If a patient is ambulatory, it may be possible for only 1 medic to make patient contact, leaving the second medic free to provide support and drive the ambulance. If the patient is nonambulatory or in need of more active management, both medics will make patient contact, and the supervisor will don PPE and move to drive the ambulance, with the EMS physician following. The team leader and EMS physician support the mission by managing communications and logistics with involved agencies (which may include law enforcement, airport operations, public health, and emergency management), managing safety, and providing clinical decisionmaking and direct medical control when required. This frees the treating medic to focus on patient assessment and adherence to sound infection control practice. Communications are facilitated by hands-free push-to-talk radios, which are worn inside the impervious suit, to protect against exposure to blood and bodily fluids. When communications are not encrypted, the transport team is careful to protect privileged health information.

Standard clinical care guidelines are modified to enhance safety by avoiding aerosol-producing procedures when possible and prohibiting sharps in a moving vehicle. The care team is capable of providing advanced life support and will administer supportive therapy as indicated by the patient's condition and as guided by the EMS physician. Every precaution will be taken to provide for the safety of the care team, which may include stopping the vehicle if needed to ensure no breach in infection control processes. Although written guidelines are helpful, direct medical control, provided by the EMS physician or medical director on scene, can provide decision support.

Transition of the patient to the care of the isolation unit team is a function of robust planning and exercise. Patients with confirmed Ebola virus disease are brought directly into the isolation unit. A patient report and expected time of arrival are provided in advance for the waiting care team. Routes to the isolation unit are selected to be most direct and to limit any risk of exposure to environmental surfaces. Ambulatory patients may be walked into the isolation unit to facilitate the most direct route. Nonambulatory patients are conveyed by stretcher, using the most direct route available. Selected routes are secured to prevent unintended contact with unprotected staff, patients, or visitors. The isolation unit care team is waiting to receive the patient in the PPE ensemble appropriate for the patient's condition.

A location must be identified where decontamination and disinfection of the ambulance can proceed without distraction. A well-ventilated area is desirable, given possible use of bleach for decontamination and disinfection.

The 2 primary care health care workers are mainly responsible for decontamination and disinfection of the ambulance. They will be in full PPE for initial decontamination procedures.

The team leader and EMS physician will observe/supervise the process; standard precautions only unless they have need to make physical contact.

Stretcher, stretcher stanchions, and any other equipment will be removed from the patient compartment for decontamination if visibly soiled and disinfected.

Any gross contamination (blood or bodily fluid spills) of equipment or protective barrier drapes will be treated for 90 seconds with a fresh household bleach solution (1:10 mix ratio) 0.5% hypochlorite concentration before soaking up of the fluid with absorbent materials. These absorbent materials should be placed in a leakproof container for disposal with the infectious waste.

Equipment will be disinfected with an EPA-registered hospital-grade disinfectant or a fresh household bleach solution (1:100 mix ratio) 0.05% hypochlorite concentration, with attention to proper contact time.

Barrier drapes will be carefully removed from the patient compartment and placed in biohazard bags for disposal. Any full bags will be closed with a gooseneck technique (twist the open end and then fold it over into a gooseneck, sealing over the neck using a twist-tie or tape) and the outer surface disinfected with an EPA-registered disinfectant or 0.05% hypochlorite solution.

Health care workers proceed with supervised doffing of PPE (as described in Figure 9).

Health care worker again dons PPE, to include at a minimum a footed impervious suit, surgical mask, eye protection, and double gloves for protection while commencing terminal disinfection.

All surfaces of the patient compartment will be disinfected with an EPA-registered hospital-grade disinfectant or a fresh household bleach solution (1:100 mix ratio) 0.05% hypochlorite concentration with attention to proper contact time. Stretcher and medical equipment are also disinfected a second time. All biohazard bags are closed and exterior surfaces disinfected.

On completion of terminal disinfection, health care worker proceeds with supervised doffing of PPE into final biohazard bag, which is closed and disinfected.

All waste is double bagged and exterior surfaces are disinfected.

Biohazard bags are inserted into autoclave bag provided by the isolation unit.

Waste is transferred to the hospital isolation unit.

Further guidance about environmental infection control is available at http://www.cdc.gov/vhf/ebola/hcp/environmental-infection-control-in-hospitals.html.

**Figure 8.** Decontamination and disinfection of ambulance.

Hospital environmental services personnel are trained to disinfect environmental surfaces in the transit area that may have become contaminated.

## DECONTAMINATION, DISINFECTION OF THE AMBULANCE, AND DOFFING OF PPE

Isolating the driver compartment and the application of impermeable barriers to keep interior surfaces of the ambulance clean facilitate decontamination and disinfection of the ambulance. All waste is double bagged and clearly marked a biohazard. The interior of the ambulance, the stretcher, any exposed equipment, and all exterior surfaces of the waste bags are disinfected with an Environmental Protection Agency-registered hospital-grade disinfectant appropriate for the suspected or known pathogen.[13] A disinfectant effective against nonenveloped viruses, such as norovirus, will be effective against Ebola. Surfaces are disinfected by wiping; sprays are not used to avoid inadvertent splash or droplet generation and to prevent uncontrolled running of fluid into crevices. Special attention is given to ensuring the appropriate contact time for the selected disinfectant agent. To limit creation of multiple waste streams, all waste produced by the transport is managed by the hospital isolation unit (Figure 8).

The team leader and EMS physician observe and supervise the proper disinfection of the ambulance, the collection of infectious waste, and the doffing of PPE to facilitate safety and ensure no violation of technique or

All doffing of PPE will be observed/supervised by personnel who have been similarly trained and have demonstrated competency in the procedure.

Any person physically assisting with doffing will be required to wear at a minimum footed impervious suit, surgical mask, eye protection, and double gloves.

If health care provider is in hooded, powered, air-purifying respirator and full impervious suit, assistant will wipe down all surfaces of the PPE ensemble with an EPA-registered hospital disinfectant, including external gloves.

Remove any stay-down tape.

Remove external gloves and discard.

Disinfect gloves with EPA-registered hospital disinfectant.

Remove protective suit, careful to not come in contact with any exterior surfaces.

Disinfect gloves with EPA-registered hospital disinfectant.

Remove eye and respiratory protection.

Disinfect gloves with EPA-registered hospital disinfectant.

Remove gloves and disinfect hands with an alcohol-based hand disinfectant.

**Figure 9.** Doffing of PPE.

breach in protocol. The doffing process may include wiping the exterior of the impermeable suit and hood with disinfectant wipes before removal to limit the likelihood of inadvertent exposure to infectious fluid. Any member of the team who is physically assisting with the removal of PPE is also, at a minimum, in protective garments that protect exposure of skin, clothing, and mucous membranes (Figure 9). Any breach of infection control procedure is immediately managed in accordance with CDC guidance. Any exposed skin is immediately washed with cleansing or antiseptic solution, mucous membranes are copiously irrigated, and supervisor and public health authority are immediately notified to facilitate rapid evaluation, consideration of postexposure prophylaxis options, and monitoring. Even in the absence of a recognized exposure, the transport team is monitored for subjective illness and fever for the duration of the incubation period (21 days in the case of Ebola) to ensure that any developing illness is recognized and swiftly evaluated.

The transport of patients with confirmed Ebola virus disease to isolation units at Emory University Hospital and University of Nebraska Medical Center was guided by years of training and exercise. In our view, a team with the requisite competencies is best suited for scheduled transport of patients with confirmed or high risk of having Ebola virus disease. This is particularly relevant, given the active screening of travelers returning from Ebola-affected countries who may develop signs and symptoms of disease, necessitating their transportation for further evaluation and management.

The procedures we describe are applicable to transport of patients with confirmed Ebola virus disease or considered at high risk of having the disease. This does not describe every traveler returning from an Ebola-affected country who develops signs of illness.

## TRANSPORT OF PATIENTS UNDER INVESTIGATION FOR HAVING EBOLA VIRUS DISEASE

A person under investigation is an individual who develops signs and symptoms of illness and also has some epidemiologic risk of exposure to Ebola virus disease in the preceding 21 days. The authors also have experience transporting patients who meet criteria for persons under investigation, and in these cases, a patient evaluation assists in selecting the appropriate procedures and PPE ensemble to provide for the safety of the transport team. With the assistance of public health officials, a history is obtained to determine what risk the patient has for exposure to Ebola virus disease.[14] The risk may be high, as in the case of a needle stick from a needle contaminated with the blood of a confirmed Ebola patient, or low, as in the case of a patient who has traveled in a country with widespread Ebola activity, but without a known exposure. This epidemiologic assessment is then complemented by an assessment of the patient's clinical condition and the risk that the health care worker could be exposed to bodily fluids. If the patient simply has fever, has no evidence of vomiting or diarrhea, and is lucid and conversational (the "dry" patient), the medic is considered to be at less risk for exposure to bodily fluids. In contrast, the patient with active vomiting and diarrhea (the "wet" patient) poses a greater risk of transmission to the medic simply because there is greater risk of exposure to infectious bodily fluid. For patients who pose a limited risk for exposure to bodily fluids, the selected PPE is less onerous. Medics apply 2 pairs of gloves, an impermeable gown, and a face shield or surgical mask and goggles for protection of mucous membranes. For patients posing a greater risk of exposure, a more protective PPE ensemble, as previously described, is recommended.[15] The selection of PPE for the transporting EMS team is

Persons exposed to Ebola virus disease but remaining asymptomatic are not contagious.[19]

Transmission of the Ebola virus requires direct contact with infected blood or bodily fluids. The virus enters the body through breaks in the skin or through the mucous membranes.[20]

Patients with Ebola virus disease become more contagious as the course of their disease progresses.[12] Patients in the later phase of disease in which vomiting, diarrhea, and bleeding are present are more likely to transmit the disease than those with fever alone early in the course of the disease.[16]

PPE should be selected according to known routes of transmission, condition of the patient, and operational requirements; for example, the PPE selected for protection against blood and bodily fluid exposure for a patient with fever only will likely be different than what is selected for the patient with uncontrolled vomiting and diarrhea.[15,21]

Travelers from Ebola-affected countries who develop generalized signs of illness are still more likely to have malaria, acute diarrheal illness, or other infectious disease than they are to have Ebola virus disease.[17]

Supervised/observed decontamination, disinfection, and doffing of PPE may help avoid breaches in infection control practice.

**Figure 10.** Considerations when managing a patient with suspected or confirmed Ebola virus disease.

determined by assessment of patient condition and risk of exposure to bodily fluids.

For the transport of patients with suspected Ebola virus disease, it may also be useful to recognize that those with the disease become more contagious as the course of their disease progresses.[12] The patient in the later phase of disease, in which vomiting, diarrhea, and bleeding are present, is more likely to transmit the disease than the patient with fever alone early in the course of the illness (see Figure 10 for relevant considerations).[16]

The direction of travel of individuals from Ebola-affected countries to designated ports of entry in the United States and the active monitoring of returned travelers by public health officials has greatly eased the challenges faced by EMS personnel for management of persons under investigation. Fever and other signs of illness in recently returned travelers can now be quickly recognized and patients quickly referred to appropriate health centers by appropriate conveyance for evaluation of their illness. It may further reassure medics to know that travelers from Ebola-affected countries who develop generalized signs of illness are still more likely to have malaria, acute diarrheal illness, or other infectious disease than they are to have Ebola virus disease.[17] While this indicates a need for timely patient evaluation, it should also put in context the risk posed to EMS by these patients. To date, more than 1,000 travelers returned from Ebola-affected countries have been monitored in Georgia, with fewer than 30 requiring evaluation as persons under investigation. No cases of Ebola virus disease have been diagnosed in this cohort.[18]

## CONCLUSION

EMS responders in every community must be prepared to respond to a caller with fever and a relevant travel history. Education and training are essential for implementation of effective standard and transmission-based infection control practice. They are also essential for EMS professionals to have the confidence to be comfortable in their work environment. Guidance for effective screening of patient contacts by 911 public safety answering points and EMS providers, as well as measures to facilitate appropriate infection control, continues to evolve.[15]

The foundation of safe care for patients with confirmed or suspected serious communicable disease is effective infection control practice. This is not achieved by simply donning a particular PPE ensemble. It requires implementation of appropriate administrative policies, work practices, and environmental controls, accompanied by focused education, training, and supervision. CDC publishes guidelines to assist agencies with this task, but it inevitably evolves as risk points are identified and best practices emerge about the management of Ebola virus disease and other serious communicable diseases in the US health system. Although formal guidance may change, recognition of these accepted principles may help guide the EMS community to be best prepared to meet this ever-present challenge.

*Supervising editor:* Gregory J. Moran, MD

*Author affiliations:* From the Section of Prehospital and Disaster Medicine, Department of Emergency Medicine, Emory University School of Medicine, Atlanta, GA (Isakov); Grady Emergency Medical Services, Grady Health System, Atlanta, GA (Miles, Jamison); University of Nebraska Medical Center, Omaha, NE (Gibbs, Lowe); and Operational Medicine, Office of Medical Services, US Department of State, Washington, DC (Swansiger).

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## REFERENCES


1. Kortepeter M, Smith P, Hewlett A, et al. Caring for patients with Ebola: a challenge in any care facility. *Ann Intern Med*. 2015;162:68-69.
2. Timen A, Koopmans M, Vossen A, et al. Response to imported case of Marburg hemorrhagic fever, the Netherlands. *Emerg Infect Dis*. 2009;15:1171-1175.
3. Centers for Disease Control and Prevention. Imported case of Marburg hemorrhagic fever—Colorado, 2008. *MMWR Morb Mortal Wkly Rep*. 2009;58:1377-1381.
4. Ho JD, Ansari RK, Page D. Hand sanitization rates in an urban emergency medical services system. *J Emerg Med*. 2014;47:163-168.
5. Bledsoe BE, Sweeney RJ, Berkeley RP, et al. EMS provider compliance with infection control recommendations is suboptimal. *Prehosp Emerg Care*. 2014;18:290-294.
6. Alves DW, Bissel RA. Bacterial pathogens in ambulances: results of unannounced sample collection. *Prehosp Emerg Care*. 2008;12:218-224.
7. Brown R, Minnon J, Schneider S, et al. Prevalence of methicillin-resistant *Staphylococcus aureus* in ambulances in southern Maine. *Prehosp Emerg Care*. 2010;14:176-181.
8. Merlin M, Wong M, Pryor P. Prevalence of methicillin-resistant *Staphylococcus aureus* on the stethoscopes of emergency medical services providers. *Prehosp Emerg Care*. 2009;13:71-74.
9. Centers for Disease Control and Prevention (CDC). Cluster of severe acute respiratory syndrome cases among protected health-care workers—Toronto, Canada, April 2003. *MMWR Morb Mortal Wkly Rep*. 2003;52:433-436.
10. Fischer II WA, Hynes NA, Perl TM. Protecting health-care workers from Ebola: personal protective equipment is critical but not enough. *Ann Intern Med*. 2014;161:753-754.
11. Centers for Disease Control and Prevention. IV. Infection control for prehospital emergency medical services (EMS). Available at: http://www.cdc.gov/sars/guidance/i-infection/prehospital.html. Accessed March 25, 2015.
12. Chertow D, Kleine C, Edwards J, et al. Ebola virus disease in West Africa—clinical manifestations and management. *N Engl J Med*. 2014;371:2054-2057.
13. Centers for Disease Control and Prevention. Interim guidance for environmental infection control in hospitals for Ebola virus. Available at: http://www.cdc.gov/vhf/ebola/hcp/environmental-infection-control-in-hospitals.html. Accessed November 10, 2014.
14. Centers for Disease Control and Prevention. Epidemiologic risk factors to consider when evaluating a person for exposure to Ebola virus. Available at: http://www.cdc.gov/vhf/ebola/exposure/risk-factors-when-evaluating-person-for-exposure.html. Accessed March 25, 2015.
15. Centers for Disease Control and Prevention. Identify, isolate, inform: emergency medical services (EMS) systems and 9-1-1 public safety answering points (PSAPs) for management of patients who present with possible Ebola virus disease (Ebola) in the United States. Available at: http://www.cdc.gov/vhf/ebola/pdf/ems-911-patients-with-possible-ebola.pdf. Accessed March 25, 2015.
16. Yamin D, Gertler S, Ndeffo-Mbah M. Effect of Ebola progression on transmission and control in Liberia. *Ann Intern Med*. 2015;162:11-17.
17. Wu H, Fairley J, Steinberg J, et al. The potential Ebola virus–infected patient in the ambulatory care setting: preparing for the worst without compromising care. *Ann Intern Med*. 2015;162:66-67.
18. Parham M, Edison L, Soetebier K, et al. Ebola active monitoring system for travelers returning from west Africa – Georgia, 2014-2015. *MMWR Morb Mortal Wkly Rep*. 2015;64:347-350.
19. Drazen J, Kanapathipillai R, Campion E, et al. Ebola and quarantine. *N Engl J Med*. 2014;371:2029-2030.
20. Centers for Disease Control and Prevention. Transmission—Ebola virus disease. December 8, 2014. Available at: http://www.cdc.gov/vhf/ebola/transmission/index.html. Accessed December 17, 2014.
21. Interagency Board for Equipment Standardization and Interoperability. Recommendations on selection and use of personal protective equipment for first responders against Ebola exposure hazards. V1–5, October 24, 2014. Available at: https://iab.gov/Uploads/IAB%20Ebola%20PPE%20Recommendations_10%2024%2014.pdf. Accessed November 25, 2014.