FEATURE

Ebola in the United States: Education, Training, and Interventions

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Closing the gaps in education and training can ease anxiety about Ebola virus disease (EVD) and help health care workers be more comfortable and better prepared when faced with a patient suspected to have the disease.

In a session devoted to EVD, Alexander Isakov, MD, MPH, Emory University School of Medicine, Atlanta, Georgia, USA, focused on prehospital evaluation and management of patients with serious communicable disease. David C. Pigott, MD, University of Alabama at Birmingham, Birmingham, Alabama, USA, provided up-to-date information on the pathogenesis of EVD.

Dr Isakov focused on the need for health care workers to understand and implement strict infectious control measures to screen, identify, and manage patients with EVD, emphasizing the following key points when dealing with individuals who have returned from one of the affected West African countries:

- Asymptomatic patients are not contagious
- Risk of transmission increases with the severity of illness
- Infection control revolves around preventing exposure to blood and infectious bodily fluid
- Personal protective equipment (PPE) should reflect the condition of the patient and operating environment
- Special supervision is advised when during decontamination and disinfection procedures and when health care workers doff PPE.

Peer-Reviewed Highlights From the

American College of Emergency Physicians Scientific Assembly

October 27–30, 2014
Chicago, Illinois

Dr Pigott explained that the Ebola virus typically enters the host through a break in the skin or via mucous membranes. The virus spreads through the lymphatic system to regional lymph nodes, liver, and spleen, infecting and replicating in a variety of cells and causing cytotoxic tissue damage, endothelial injury, increased vascular permeability, and loss of vascular tone [Toner E et al. *Disaster Med Public Health Prep*. 2014].

Although EVD is very infectious and requires only a few particles (estimates as low as 1-10 virions) to cause infection, Dr Pigott emphasized that transmission requires direct contact with infected body fluids. Vomit, feces, and blood are most infectious, whereas other fluids, such as sweat and saliva, carry lower risk of transmission. Patients with more advanced disease are more highly viremic, and their body fluids contain higher levels of virus. There is risk of transmission via contact with contaminated surfaces. In Dr Pigott's opinion, speculation that EVD could mutate to an airborne form is unsubstantiated. Table 1 lists the risk level by type of exposure to infected patient.

To educate and train health care workers on EVD, Dr Isakov drew on the experiences and evolving policies developed more than 10 years ago at Emory University Hospital's Serious Communicable Disease Unit. A joint venture between Emory University Hospital and the

Table 1. Risk Level by Type of Exposure to Infected Patient

High risk	Needlestick or mucous membrane exposure to blood or bodily fluids
	Direct skin contact with or exposure to blood or bodily fluids in patient without appropriate PPE
	Processing blood or bodily fluids of patient without PPE or biosafety precautions
Low risk	Household contact
	Other close contact

PPE, personal protective equipment.

Table 2. Experimental Interventions for EVD

Type of Therapy	Description	Evidence to Date
Convalescent	Plasma or whole-blood transfusions from patients who have recovered from Ebola	Primate studies indicate no benefit [Jahrling PB et al. *J Infect Dis.* 2007]
	Antivirals	
ZMapp	Composed of 3 monoclonal antibodies	100% effective in primate study [Qiu X et al. *Nature.* 2014]
TKM-Ebola	Combination of small interfering RNAs targeting EVD proteins	Phase I clinical trials in humans completed in May 2014; currently on hold by FDA but available for use under IND application
Brincidofovir	Prodrug of oral form of cidofovir	IND approval from FDA against Ebola virus; so far given to 3 patients
BCX4430	Adenosine analog	Protects primates against Ebola up to 48 h after exposure [Warren TK et al. *Nature.* 2014]
	Vaccines	
VSV-EBOV	Recombinant vector vaccine derived from vesicular stomatitis virus	100% effective in primate studies; phase I human trials beginning
ChAd3	Recombinant vector vaccine derived from ChAd3	Phase I human trials began in September 2014 in the United Kingdom and United States; manufacturer is preparing to stockpile 10 000 doses

ChAd3, chimpanzee adenovirus type 3; EVD, Ebola virus disease; FDA, Food and Drug Administration; IND, investigational new drug; VSV-EBOV, Vesicular Stomatitis Virus–Ebola Virus.

Centers for Disease Control and Prevention (CDC), this unit is one of the 4 health care facilities identified in the United States that had special provisions in place to care for patients with serious communicable diseases, like Ebola.

Dr Isakov reviewed the algorithm provided by the CDC to screen suspected EVD patients with at the point of entry [*Identify, Isolate, Inform: Emergency Department Evaluation and Management of Patients With Possible Ebola Virus Disease*. CDC. 2014].

Establishing exposure history is the critical first step that informs the rest of the screening. If a patient has traveled in the previous 3 weeks to one of the 3 West African countries with epidemic EVD (Guinea, Liberia, and Sierra Leone) and has signs or symptoms of illness (fever, severe headache, muscle pain, weakness, fatigue, diarrhea, vomiting, abdominal pain, unexplained hemorrhage), he or she is put in a private room.

Dr Isakov also emphasized the importance of the CDC's recommendation to stratify patients based on their degree of signs and symptoms. For example, when caring for patients with copious diarrhea and vomiting, health care workers need more protection than for patients presenting simply with fever.

PROTECTING HEALTH CARE WORKERS FROM EXPOSURE

Health care workers should avoid contact with any of the patient's vomit or diarrhea or other bodily fluids, which requires adequate PPE. It is critical for health care workers caring for patients to receive training on the proper way to don and doff PPE, whether managing a patient in-hospital or transporting them via ambulance or other forms of transport.

For patients who arrive in ambulances or other forms of transport, decontamination and disinfection of the ambulance or transport are also necessary. Procedures also implemented to facilitate vehicle disinfection include isolating the driver compartment from the patient compartment, and protecting the patient compartment environmental surfaces with impervious barrier drapes.

For all of these measures, Dr Isakov emphasized the need for supervision of the process to ensure no lapse in procedure that could inadvertently expose a health care worker to infectious fluids [Isakov et al. *Ann Intern Med.* 2014].

Currently, the only established treatment for EVD is supportive care: symptom control, hydration, electrolyte repletion. However, Dr Pigott provided a brief overview of investigational treatment options for EVD and the evidence to date (Table 2).

Dr Pigott concluded by highlighting the CDC's 3 major strategies to address the current EVD outbreak: prevention (reducing disease outbreaks), detection (identifying cases and contacts), and response (establishing training and treatment centers) [*N Engl J Med.* 2014].