



ELSEVIER

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Commentary

Nebraska Biocontainment Unit perspective on disposal of Ebola medical waste

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Q6 Clinical practices surrounding the current Ebola epidemic have been center stage in discourse concerning research and practice of care. As the medical community becomes more sophisticated in understanding the many facets of treating and containing this virus, the Nebraska Biocontainment Unit has identified Ebola medical waste disposal as a key area of concern for U.S. hospitals. The requirements for processing Ebola medical waste stand to impact most U.S. hospitals currently preparing readiness plans to receive and treat patients with suspected or confirmed Ebola virus disease (EVD).

The U.S. Centers for Disease Control and Prevention (CDC) has issued recommendations to guide health care facilities in preparing to isolate potential or confirmed EVD patients, and hospitals have established plans to isolate and care for these patients.^{1,2} The CDC's guidance includes facility and provider EVD preparedness checklists to aid the U.S. health system in preparing to prevent the spread of the virus within the United States.³ Hospitals are undertaking multiple measures to minimize the risk of EVD, including establishing EVD staffing, appropriate levels of personal protective equipment (PPE), infection prevention and control measures, environmental cleaning, laboratory procedures, public health reporting, and clinical protocols to minimize the exposure risks of health care workers (HCWs). Health care facilities and providers routinely use PPE precautions and are able to refine and implement existing protocols to effectively protect HCWs treating a suspected or confirmed patient, but waste associated with caring for an EVD patient cannot be processed as standard medical waste.

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Conflict of interest: ■■■■

Q5 Additional information: This work reflects efforts by the Nebraska Biocontainment Patient Care Unit at the Nebraska Medical Center. The Nebraska Biocontainment Patient Care unit exists as a result of significant state and institutional investments in the engineered controls, supplies, equipment, and staff training by the Nebraska Department of Health and Human Services and the University of Nebraska Medical Center.

Two high-level isolation facilities located at the University of Nebraska Medical Center and Emory University have treated EVD patients in the U.S. These units are ideally equipped for treating patients in high-level isolation because each unit is staffed with HCWs rigorously trained in donning and doffing PPE, and the facilities have been specifically engineered for high-level isolation with in-unit waste processing capability.⁴ The Nebraska Biocontainment Unit's strategy for waste management uses a pass-through autoclave to process all medical waste exiting the high-level isolation unit. Through discussions with health care entities planning for EVD patients, first-hand knowledge gained by treating EVD patients transported to the United States, and review of current guidance, we provide insight into key logistical and regulatory considerations for management of EVD medical waste in facilities without in-unit waste sterilization capabilities.

EBOLA MEDICAL WASTE

Medical waste generated through routine care is regulated by state medical waste regulations and the U.S. Department of Transportation (DOT) definitions for category B infectious substances, whereas EVD patient care waste is regulated more stringently as category A infectious substances. Category B waste is transported in leak-proof, properly marked packaging as regulated medical waste to medical waste management facilities, and state regulations define the proper treatment of these wastes.⁵

Although medical waste processing regulations vary by state, DOT regulations are preemptive for the management of these wastes in transportation and requires arranging transportation that is compliant with DOT category A infectious substance regulations. EVD medical waste is classified under DOT regulations as category A infectious substances that require stringent processes for transportation.⁶ However, EVD waste can be transported and disposed as regular medical waste if it has been autoclave sterilized prior to transportation. As such, EVD medical waste management planning should account for textiles (linens, pillows mattresses, privacy curtains) and liquid and solid waste. We review the waste processing used by the Nebraska Biocontainment Unit and key

considerations for hospitals planning to provide EVD care and process category A waste.

NEBRASKA BIOCONTAINMENT UNIT APPROACH

The Nebraska Biocontainment Unit is equipped with a pass-through autoclave allowing sterilization of all EVD solid waste being passed out of the units. Briefly, all EVD solid waste generated in the patient room and all doffed PPE is placed inside a clear autoclave bag within the room or designated doffing area. Likewise, patient linens are discarded as solid waste within the patient care room. Our experience caring for a single patient generated a total of 464.4 cu ft of solid waste weighing 1,011 lbs, which was mostly PPE. Additionally, linens (eg, HCW scrubs, towels) used as part of the exit procedure for Nebraska Biocontainment Patient Care Unit staff were placed inside green linen bags in the designated scrub doffing area, generating 4–8 bags a day. Bags were goose necked when 75% full, secured with autoclave tape, bleach wiped and transported within the unit to the pass-through autoclave by HCWs in full contact precaution PPE. After autoclave sterilization, solid EVD medical waste was retrieved from the external or clean side of the pass-through autoclave and placed in a biohazard bag lining a primary watertight receptacle and rigid outer packaging and disposed of as category B medical waste. Autoclaved HCW linens were placed into a hospital soiled linen receptacle for special processing.

Liquid waste generated by EVD patients was placed into the toilet along with hospital grade disinfectant at the appropriate manufacturer recommended ratio and held for 2.5 times the recommended contact time before flushing. This treatment of the liquid waste surpassed the CDC's guidelines, which states that the liquid waste can be flushed untreated down the toilet.³ This liquid waste approach was positively received by numerous stakeholders within the surrounding community and alleviated concerns of local plumbing and public works organizations. Hospitals considering the addition of solidifying agents to the liquid waste to enable disposal as a solid waste must first check the material compatibility of the solidifying agent with the autoclaving process prior to autoclaving. If the solidifying agent cannot be autoclaved, the solidified liquid then must be disposed of as category A waste. Our experience indicates that EVD patients may generate up to 9 L of liquid waste a day, which would then contribute to the solid waste burden.

PLANNING CONSIDERATIONS

The CDC and World Health Organization recognize onsite inactivation of microorganisms during medical waste treatment as a best practice. Health care facilities and hospitals with existing EVD preparedness plans stipulating disposal of untreated Ebola medical waste, including linens, through the regulated medical waste stream do not comply with World Health Organization and United Nations standards or the U.S. DOT's regulations governing transport and disposal of category A infectious disease.^{3,5–7} Category A infectious substances are defined as materials "known or reasonably expected to contain a pathogen, such as Ebola, that is in a form capable of causing permanent disability or life threatening or fatal disease in otherwise healthy humans based on the patient's medical history or symptoms, endemic local conditions, or professional judgment concerning the individual circumstances."⁶

Facilities not able to autoclave Ebola medical waste must coordinate with medical waste vendors to acquire a DOT category A

infectious substance special permit for transportation to an appropriate incineration facility. Requirements for a category A transportation permit include the following: (1) packages are required to be triple packaged using a primary watertight receptacle, with watertight secondary packaging, inside an approved rigid category A container; (2) containers must be labeled as United Nations number 2814 infectious substances affecting humans; (3) a transportation security plan detailing en route security; and (4) an emergency response plan that addresses spills or emergency situations of category A materials, which may also require shipment using temperature-controlled transport.^{6,8}

As such, the Nebraska Biocontainment Unit waste autoclaving capacity enables waste to be handled as regulated medical waste exempt from category A restrictions. Hospitals developing plans to autoclave waste within their facility should address safety and security risks associated with storing and internal movement of waste and environmental cleaning protocols for storage and internal transport areas. Portable autoclaves may serve as an adequate treatment option but may present a rate limiting step to the disposal of significant quantities of patient waste and will require that waste be temporarily stored. Alternative onsite treatment methods have not been broadly approved but should be explored by the CDC, DOT, U.S. Environmental Protection Agency, health care companies, and health care waste management companies to ensure effective and timely EVD waste management strategies are developed.

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