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Major Article

A pilot survey of the U.S. medical waste industry to determine training needs for safely handling highly infectious waste

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Background: The recent Ebola outbreak led to the development of Ebola virus disease (EVD) best practices in clinical settings. However, after the care of EVD patients, proper medical waste management and disposal was identified as a crucial component to containing the virus. Category A waste—contaminated with EVD and other highly infectious pathogens—is strictly regulated by governmental agencies, and led to only several facilities willing to accept the waste.

Methods: A pilot survey was administered to determine if U.S. medical waste facilities are prepared to handle or transport category A waste, and to determine waste workers' current extent of training to handle highly infectious waste.

Results: Sixty-eight percent of survey respondents indicated they had not determined if their facility would accept category A waste. Of those that had acquired a special permit, 67% had yet to modify their permit since the EVD outbreak. This pilot survey underscores gaps in the medical waste industry to handle and respond to category A waste. Furthermore, this study affirms reports a limited number of processing facilities are capable or willing to accept category A waste.

Conclusions: Developing the proper management of infectious disease materials is essential to close the gaps identified so that states and governmental entities can act accordingly based on the regulations and guidance developed, and to ensure public safety.

BACKGROUND

During the 2014-2016 West Africa Ebola outbreak, the development of best practices and research surrounding Ebola virus disease (EVD) care and management were primarily focused on health care workers. However, as the U.S. medical community, and specifically high-level isolation units, began to successfully treat individuals with EVD, nonclinical aspects of EVD care were recognized as equally important in containing the virus and minimizing occupational risks. After the care of EVD patients, the Nebraska Biocontainment Unit identified proper medical waste management and disposal as a crucial component and point of consideration for U.S. health care facilities treating EVD patients.[1] An international hazard analysis of critical control points for EVD also emphasized that waste generated from the care of an EVD patient should not be disregarded as a potential transmission route.[2]

Medical waste produced through routine patient care is classified as category B or regulated medical waste per U.S. Department of Transportation (DOT) federal regulations in tandem with state medical waste regulations; therefore, medical waste processing varies

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from state to state. The DOT dictates the regulations for transport of category B infectious substances or regulated medical waste, which can be handled by most waste facilities and landfills throughout the nation so long as the waste is contained in leak-proof, properly marked packaging.[3] However, waste contaminated with EVD and some other highly infectious organisms is categorized as category A infectious substances.[4] Solids contaminated with category A infectious substances are regulated by government agencies, including the DOT, Centers for Disease Control and Prevention, U.S. Department of Labor's Occupational Safety and Health Administration, and Environmental Protection Agency, which does not typically regulate medical waste.[4] Minimum criteria are required of facilities to accept category A waste for ultimate disposal. This includes category A agents (UN2814) such as Crimean-Congo virus, *Yersinia pestis*, and EVD that must be handled and transported under stringent federal regulations and procedures dictated by the DOT Hazardous Materials Regulation (49 CFR Parts 171-180) when transported by air, rail, highway, or water.[4] The Nebraska Biocontainment Unit suggested that EVD medical waste management planning should incorporate detailed processes on how to safely handle and remove category A waste from the medical facility, including considerations for increased operational planning and financial burdens.[1]

Specifically, if category A waste contaminated with EVD is not treated via incineration or autoclaving onsite at the point of generation to inactivate or entirely remove the virus, a DOT special permit must be obtained and special category A packaging that meets the regulatory federal requirements for packaging of the DOT and Pipeline and Hazardous Materials Safety Administration must be used to transport it from the health care facility.[1,4] If off-site inactivation is required, medical facility and local government leadership, approved waste transportation and treatment facilities willing to accept the waste, state and local health departments, environmental agencies, and other units must collectively work to ensure that waste movement is compliant with inter- and intrastate regulations. The ultimate disposition of the category A waste at the off-site facility must also take into account residuals produced from inactivation.[4] Interim planning guidance has been issued as of January 2017, but there is not a mandatory nationwide industry standard established which dictates that all medical waste facilities must be ready to handle category A waste.[4]

As a result of the distinct complexity and regulatory framework for the management and disposal of medical waste contaminated with EVD, only a small number of U.S. waste processing facilities were willing to accept EVD waste.[5-8] This limited capacity not only presented logistical barriers but also raised concerns about waste worker preparedness to handle category A regulated infectious waste. Furthermore, few peer-reviewed articles specifically pertaining to the United States focus on the safe handling of category A waste or tangentially relate to highly infectious waste treatment[9-11]; those that do discuss category A waste, in Europe, do not follow the same classification system as the United States.

This pilot survey was administered to determine if medical waste facilities across the United States were currently prepared to handle or transport category A waste, to assess waste workers' extent of training pertaining to highly infectious disease (HID) mitigation and management, and to thereby suggest worker training can be supplemented or restructured to improve occupational safety and bolster worker preparedness to properly manage highly infectious waste in the future.

MATERIALS AND METHODS

This pilot survey's structure was adapted from high-level isolation unit checklists developed by the European Network for Highly Infectious Diseases[12] but modified and expanded with input from a panel of medical waste subject matter experts. We adapted a similar structure to conduct a survey in the death care sector.[13] In the fall of 2016, this medical waste gap-analysis survey was distributed via Qualtrics Software Version 2016.17 (Qualtrics, Provo, UT) (Institutional Review Board exemption Indiana University Kuali Coeus no. 1607534532). Two surveys were developed—one at the lead-supervisor-management level (lead) and the other at the worker-employee level (worker) and divided into 3 sections: (1) demographics; (2) industry-specific questions on comfortability and willingness to encounter HID scenarios, and current policies and procedures in place to address category A waste; and (3) levels of knowledge, training, resources, and personal protective equipment (PPE) to address HID scenarios. Sections 1 (9 questions) and 3 (6 questions) were identical in the lead and worker pilot surveys, with the only discrepancy being the directive pronoun. Section 2 at the lead level was 63 questions, whereas section 2 at the worker level was only 4 questions because the former asked detailed questions on organizational waste policies and procedures. Survey participants were able to select the link to which survey they felt was more appropriate—worker or lead. The survey predominantly consisted of multiple choice questions, lending the ability to provide qualitative responses where appropriate. Descriptive statistics were deliberately used given this being a pilot survey and the smaller sample size.

National medical waste organizations (Stericycle, Inc, Healthcare Waste Institute, Larson-Miller Medical Waste Disposal Service, and Republic Services) requested their waste facilities throughout the nation to disseminate the anonymous Uniform Resource Locator survey links to employees. Two follow-up e-mails were sent to solicit further participation; the survey links were closed after 105 days.

RESULTS

A total of 31 pilot surveys at the lead level and 19 at the worker level for a total of 50 were initiated and collected. All questions were voluntary, and skip patterns on questions leading to subquestions were used throughout; hence, response rates varied from 10%-78% (lead) and 5%-63% (worker), with a respective pilot survey completion rate of 58% and 47%.

Demographics

Self-reported position-titles for workers included the following: dispatcher (25%), field service administrator (17%), operator (17%), account manager (17%), and other (24%); the most common self-reported titles for leads included manager (facility, transportation, account, district operations, etc) (42%), supervisor (general, plan, or transportation) (25%), vice president (general or operations) (17%), and other (17%). Additional respondent demographics are offered to readers on request.

Lead-specific questions pertaining to industrial demographics, current operations, and existing protocols

Half of lead respondents (11/22) had transportation operations with >25 vehicles and 91% (20/22) had multistate operations. Over half of leads (52%, 12/23) indicated that their organization had a mail back program, 39% (9/23) did not, and 9% (2/23) were in the process of developing one. Of those with a mail back program, waste is sent to an owned facility (50%, 6/12), waste is sent to an owned facility but transferred to another treatment facility (33%, 4/12), and waste is sent to an entirely separate treatment facility (17%, 2/12). More than three-quarters of leads (78%, 18/23) had permitted treatment operations; 88% have an autoclave (15/17), 29% have an