Initial Costs of Ebola Treatment Centers in the United States

John J. Lowe, University of Nebraska Medical Center
Jocelyn J. Herstein, University of Nebraska Medical Center
Paul D. Biddinger, Harvard Medical School
Colleen Kraft, Emory University
Lisa Saiman, Columbia University Medical Center
Shawn G. Gibbs, Indiana University
Philip W. Smith, University of Nebraska Medical Center
Angela L. Hewlett, University of Nebraska Medical Center

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To the Editor: The 2014–2015 outbreak of Ebola virus disease (EVD) in West Africa was unprecedented in scale and scope. During the outbreak, 11 patients with
EVD were cared for in the United States (1). Safely caring for patients with suspected EVD requires specialized protocols and training for hospital staff in the use of personal protective equipment (PPE) and isolation precautions (2,3). The care of a hospitalized patient with confirmed EVD in high-level isolation units requires large specialized teams of nurses, physicians, laboratory technologists, environmental service workers, and waste management specialists, and inpatient care may continue for weeks (3,4). The staff-to-patient ratio necessary to care for a patient with EVD in high-level isolation is much higher than that in a typical intensive care unit because of the extensive PPE used and the need for partners to assist with PPE donning and doffing.

In response to preparedness challenges in the United States, the Centers for Disease Control and Prevention recommended a multitiered framework of hospitals with advanced capabilities for Ebola care: frontline facilities, Ebola assessment hospitals, and Ebola treatment centers (ETCs) (2). Within this federal framework, 55 hospitals in the United States have been designated by their states as ETCs, which have the advanced capabilities required to provide medical care to patients with confirmed EVD throughout their illness (5). Although the cost of preparing these healthcare facilities to care for EVD patients was believed to be substantial (5–7), we aimed to directly survey the ETCs to determine the costs incurred to prepare their facilities to manage and treat EVD patients.

In April 2015, we sent a 19-question electronic survey to all 55 ETCs, including the 3 preexisting biocontainment facilities to manage and treat EVD patients. The survey was voluntary, and individual responses were confidential. The survey assessed the ETCs’ general participation and the costs incurred to establish the ETC. Of the 55 ETCs, 45 indicated interest in participating in the establishment of the United States Highly Infectious Diseases Network to establish infection control metrics and competencies for high-level patient isolation centers. The Institutional Review Board of the University of Nebraska Medical Center declared this study exempt.

Of the 55 ETCs, 47 (85.5%) responded to the survey; 45/47 provided a detailed assessment of costs. The 45 ETCs reporting total costs incurred a cumulative total of $53,909,701 (mean $1,197,993/ETC) to establish the ETCs (Table). The most costly activity was facility construction and modifications. Costs incurred to provide initial training for staff averaged $267,075 (range $10,000–$1,624,639). Each ETC spent $172,581 (mean per facility; range $3,000–$560,000) on other expenses not included in the 5 specified categories (Table). Examples of additional costs included computer hardware and software, nonmedical equipment, office supplies, and employee apparel. Costs and expenses allocated to specific purchases varied by region (online Technical Appendix Figures 1, 2).

With the exception of 3 hospitals that had preexisting biocontainment units, 52 hospitals had to undertake novel activities to prepare to care for patients with EVD, including development of plans, recruitment of facility leadership, recruitment and training of a multidisciplinary team of volunteers, and purchase of specialized supplies and equipment. The nearly $54 million in previously unbudgeted expenses was a substantial financial burden on the ETCs. Wide variations for overall expenditures and for specific types of expenditures were noted.

Because 10 ETCs did not report financial data, the overall costs reported here do not fully estimate the expenses incurred by ETCs. Furthermore, these overall costs represent only the initial start-up costs of establishing ETCs and do not include the costs of ongoing maintenance such as resupplying validation reagents for the laboratory, purchasing supplies and equipment, continual training of staff, or testing the units and programs.

This study had limitations. We could not validate self-reported data from the ETCs with information from expense reports. We also acknowledge that many additional hospitals undertook similar efforts to those of the designated ETCs but were not included in this survey (8). The costs incurred by public and private public health organizations also were not included.

In conclusion, we have described the initial preparation costs incurred by designated ETCs in the United States. The substantial start-up costs as well as ongoing maintenance costs of EVD programs underscore the need for specialized

| Table. Initial costs in US$ incurred by 45 Ebola treatment centers in the United States* |
|-------------------------------|------------------|----------------|----------------|----------------|----------------|
| Cost scale | Total costs | Construction/ facility modifications | PPE supplies | Staff training | Unit planning |
| Average | 1,197,993 | 420,502 | 213,347 | 267,075 | 176,713 |
| Median | 1,000,000 | 202,980 | 110,000 | 150,000 | 82,000 |
| High | 6,556,457 | 3,839,000 | 1,067,573 | 1,624,639 | 1,200,000 |
| Low | 51,500 | 8,500 | 10,000 | 10,000 | 10,000 |
| Sum† | 53,909,701 | 16,820,080 | 8,747,240 | 10,950,072 | 4,947,966 |

*PPE, personal protective equipment.
†Summarized data were collected through self-report by individual treatment centers through an electronically administered survey.
facilities to treat EVD (9,10). A tiered nationwide network of healthcare facilities that can rapidly identify, isolate, and treat patients with EVD has been established to improve the nation’s preparedness for EVD and can serve as a valuable resource for future outbreaks of other highly infectious diseases. Ongoing resources will be needed to sustain the readiness of such a network.

References

Address for correspondence: John J. Lowe, College of Public Health, University of Nebraska Medical Center, 984388 Nebraska Medical Center, Omaha, NE, USA 68198; email: jlowe@unmc.edu

Detection of Influenza D Virus among Swine and Cattle, Italy

Chiara Chiapponi,1 Silvia Faccini,1 Aurora De Mattia, Laura Baioni, Ilaria Barbieri, Carlo Rosignoli, Arrigo Nigrelli, Emanuela Foni

Author affiliations: Istituto Zooprofilattico Sperimentale della Lombardia ed Emilia Romagna, Brescia, Italy (C. Chiapponi, S. Faccini, A. De Mattia, L. Baioni, I. Barbieri, C. Rosignoli, A. Nigrelli, E. Foni); World Organisation for Animal Health Reference Laboratory for Swine Influenza, Parma, Italy (C. Chiapponi, L. Baioni, E. Foni)

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To the Editor: Recent studies have identified a new genus of the Orthomyxoviridae family (1–5). The virus, distant-ly related to human influenza C virus, has been provisionally designated as influenza D virus. This novel virus was identified for the first time in pigs with influenza-like illness (I), but subsequent serologic and virologic surveys have suggested cattle as a possible reservoir (2–4). Moreover, the virus was shown to infect ferrets used in laboratories as surrogates for humans when investigating influenza infection (I). In a serologic study conducted on 316 human samples, low antibody titers and a low level of positive samples (1.3%) were detected (I), suggesting that humans are a possible host to be studied in depth. To investigate the circulation of influenza D viruses among pigs and cattle in Italy, we performed bio-

molecular and virological tests on clinical samples collected from respiratory outbreaks in Po Valley, the area in Italy with the highest density of swine and cattle farms.

We screened clinical specimens from swine (n = 150) and cattle (n = 150) for influenza D virus by reverse transcrip-
tion quantitative PCR (I). Three nasal swab samples were found positive: 1 from a sow and 2 from cattle, collected from 3 farms located at linear distances ranging from 47 to 80 km. All positive samples were confirmed by partial polymerase basic 1 gene sequencing and submitted to viral isolation in cell cultures as previously described (5,6). The virus was isolated on CACO-2 and HRT18 cell cultures only from the sow sample (D/swine/Italy/199723-3/2015). Cell cultures were tested by using reverse transcription quantitative PCR. Viral RNA was isolated from clini-
cal samples or cell culture by using One-For-All Vet Kit (QIAGEN, Milan, Italy). Full-genome amplification from influenza D virus–positive samples was achieved as previ-
ously described (3). A sequencing library of the purified amplicons was prepared by using NEXTERA-XT kit and

1These authors contributed equally to this article.