Preparing for Critical Care Services to Patients With Ebola

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As the current Zaire ebolavirus epidemic advances, infected patients may present or be transferred to medical settings with advanced management capabilities. Critical care units that may receive such patients must prepare to render such care while protecting staff from infection. Although providing supportive care to a critically ill patient with Ebola involves a pathogen more immediately lethal than others previously encountered in the United States, the risk to health care workers is manageable with infection prevention and control measures recommended by the Centers for Disease Control and Prevention (CDC) (1). We summarize the risks and protective measures included in preparation at the National Institutes of Health (NIH) and the experience gained in the clinical care of patients at Emory University hospital.

The factors that increase the risk of caring for critically ill patients with Ebola include the low infectious dose of Ebola (1 to 10 viral particles) (2), the high quantity of virus shed in the large volume of body fluids produced during illness (3), the close and extended patient contact time required of providers, the need for invasive procedures, and the absence of proven effective therapeutics.

Although compliance with infection control practices in hospitals has improved, it remains below 100% (4). The margin of error for infection is low for Ebola and the consequence of nonadherence to infection control practices potentially dire for providers and other patients. Medical facilities caring for these patients must establish and enforce fastidious infection control practices and must maintain a high level of staffing, all of whom must stringently adhere to these measures.

The appropriate level of personal protective equipment (PPE) required to safely care for patients with Ebola is a topic of debate (5, 6). Some organizations have adopted very stringent measures that exceed the recommendations of the CDC, such as those used in U.S. biosafety level-4 laboratories. These measures include covering 100% of the skin and disinfecting PPE before removal (7). Health care facilities need to address on an individual basis whether a level of protection over and above the CDC’s recommendations enhances staff safety or increases staff and community confidence that the risk for nosocomial transmission is being minimized.

Preparing critical care units for patients with Ebola introduces serious challenges. These patients frequently require invasive interventions that involve specialized equipment and mandate technical proficiency. Performing such tasks in full PPE can be difficult due to altered sensory input, diminished dexterity, and greater fatigability. Careful planning and training may mitigate these circumstances. Preintervention planning of equipment needs and how the equipment will be decontaminated requires special attention.

Critical care is a “team sport.” Effective preparation for the possibility of caring for a critically ill patient with Ebola requires the development of a multidisciplinary team that includes hospital administrators, infectious diseases specialists, hospital epidemiology, occupational medicine providers, biosafety managers, nurses, critical care physicians, respiratory therapists, laboratory staff, and housekeeping. The NIH multidisciplinary team reviewed the personnel required to provide critical care–level support for a seriously ill patient with Ebola for 1 week and derived the following minimum staffing numbers for nurses and physicians: 2 nurses per 8-hour shift (6 per day, or 12 full-time employees), 1 to 2 physicians per shift (3 to 4 per day, or 6 full-time employees), and 1 PPE adherence monitor (called the “Watsan,” 3 per day, or 6 full-time employees). Additional staff needs include respiratory therapists; isolation adherence monitors; cohort laboratory and housekeeping personnel; and administrative staff to manage logistics, supplies, waste, and public relations. Devoting such resources to patients with Ebola is likely to affect the institution’s ability to staff other services. Institutions should also determine ahead of time whether they will require staff to care for patients with Ebola or if they will rely on health care providers who volunteer (we chose volunteers).

Institutions should develop standard operating procedures for anticipated clinical interventions that maximize staff and patient safety. It is prudent to prestage equipment and supplies within the footprint of clinical space and plan for appropriate decontamination of these materials. Interventions for which standard operating procedures should be developed include performance of invasive procedures, such as intravenous line insertion and endotracheal intubation, code blue response, setup and use of renal replacement therapy, evacuation of an incapacitated or unconscious provider, and immediate occupational exposure management in a special isolation unit. Detailed standard operating procedures facilitate provision of high-quality critical care while maximizing safety.

Although each U.S. health care facility must define and implement its own processes for Ebola preparedness, we hope that our experience may help inform this planning. We have found the following 4 measures helpful: First, staff education is vital to “demystifying” Ebola and reducing anxiety. Second, posters clarifying PPE donning and doffing procedures facilitate staff understanding and compliance. Third, an ongoing, coordinated multidisci-
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**Table. Key Points for Institutions Preparing for Providing Critical Care to Patients With Ebola**

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<tr>
<th>Criteria</th>
<th>Recommendation</th>
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<tr>
<td>Identify, engage, and align with internal and external stakeholders</td>
<td>Establish primary and backup staffing plans with attention to avoiding worker fatigue</td>
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<td>hospital or corporate leadership; maintain open and regular communication to facilitate transparency</td>
<td>Provide specific training on the clinical and epidemiologic manifestations of Ebola</td>
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<td>and roles and responsibilities</td>
<td>Develop simulation-based training modules for routine and emergency care; conduct multidisciplinary training and assessment of staff proficiency</td>
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<td>Identify staff to participate in clinical care; clearly define eligibility criteria and roles and responsibilities</td>
<td>Construct feasible of performing diagnostic testing and clinical interventions that might require transport of patients to other parts of the hospital</td>
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<td>Provide specific training on the clinical and epidemiologic manifestations of Ebola</td>
<td>Standardize personal protective equipment (PPE) use and workflow issues</td>
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<td>Establish primary and backup staffing plans with attention to avoiding worker fatigue</td>
<td>Develop standard operating procedures for all clinical interventions</td>
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<td>Develop simulation-based training modules for routine and emergency care; conduct multidisciplinary training and assessment of staff proficiency</td>
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Plenary effort is required to establish standard operating procedures and staff must be trained to follow them. And finally, direct observation of clinical care enforces adherence to these procedures.

Significant institutional investment in supplies, equipment, and staff is required. Advanced planning is needed to obtain and stage supplies and equipment, including point-of-care testing devices. Careful planning for removal of large amounts of solid waste is required and should involve early engagement of outside commercial waste disposal vendors. Facility modifications directed toward biosafety and security include geographic or barrier separation of the Ebola care unit from other units, heightened security and other provisions for restricted staff entry, and on-site or local autoclave access.

The Table provides a framework for approaching the provision of critical care services to patients with Ebola.

Given the unprecedented number of cases of infection in this outbreak and the escalating global response in West Africa, that U.S. health care facilities may be faced with critically ill patients with Ebola cannot be dismissed. Adequate planning and training across U.S. health care facilities is essential. There is real hope that advanced critical care will increase patient survival and that lessons learned through providing this care will enhance patient management and improve outcomes in more resource-limited settings. The time to make such preparations is now.

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