

# How to Contain the Ebola Virus in the Hospital: Lessons From Nebraska

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## Nebraska Biocontainment Unit Provides Illustrated Instructions

Laura A. Stokowski, RN, MS

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### Can We Contain Ebola in Our Healthcare Facilities?

Healthcare facilities throughout the United States are scrambling to put into place Ebola preparedness plans that don't involve responding to Ebola by "making it up as we go along." Nurses are demanding to know what these plans are, how they will be trained, and how they can depend on having the supplies, equipment, staffing, and resources needed to carry them out.

A significant barrier has been an apparent lack of agreement about what should be done to protect staff and other patients from Ebola. How much and what type of personal protective equipment (PPE) is warranted? Is more PPE better? How should training take place to ensure that staff are able to put on (don) and take off (doff) PPE safely? What type of supervision should be provided during donning and doffing of PPE? What level of supervision should be in place during patient care to ensure that breaches of infection control technique and potential contamination do not occur?

Many suggestions to enhance infection control procedures have been offered, but it is up to healthcare facilities to adopt such methods as buddy systems or on-site supervision of infection control technique. As the Ebola situation evolves, guidelines and recommendations could change in response to changing levels of risk. However, experts continually claim that by isolating patients with Ebola and using proper PPE and PPE technique, it should be possible to prevent the spread of Ebola. This has been demonstrated in West Africa, but when the first patient with Ebola diagnosed in the United States entered the healthcare system, at least two nurses became infected.

Those nurses are now being cared for in special biocontainment units where patients with Ebola, transferred from West Africa, have been successfully cared for without risk to healthcare workers. Could we learn from nurses right here in the United States who are taking care of patients with Ebola, and doing a remarkably effective job at containing the virus?

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### Biocontainment Units for Patients With Ebola

The United States is fortunate in having four specialized units capable of safely providing care for patients with contagious or deadly infectious diseases. These units are located at Emory University Hospital in Atlanta, Georgia; the National Institutes of Health (NIH) in Bethesda, Maryland; St. Patrick's Hospital in Missoula, Montana; and the Biocontainment Patient Care Unit at Nebraska Medical Center in Omaha, Nebraska.

Although their approaches differ slightly, both Emory University and Nebraska Medical Center have cared for patients with Ebola during the current outbreak, and so far, no staff member from either facility has acquired Ebola virus from a patient. Dallas nurses Nina Pham and Amber Vinson, who have tested positive for Ebola, are now receiving care at NIH and Emory, respectively. Although the average hospital can't duplicate the facilities, resources, and highly specialized care possible in these biocontainment units, some of their standard operating procedures and rigorous training models could be useful lessons to those working to establish Ebola preparedness plans.

## **The Nebraska Biocontainment Unit**

The Biocontainment Unit at Nebraska Medical Center was designed as a facility for the treatment of patients affected by bioterrorism or such highly contagious and dangerous infectious diseases as Ebola, SARS, or monkeypox. Although the unit has five rooms with two beds each, Lead Nurse Kate Boulter, RN, reports that owing to the amount of autoclaving required when caring for a patient with a viral hemorrhagic disease, they can only care for two to three such patients at a time.

The facility in Nebraska has a unique arrangement. There is a separate "clean" room for clean equipment and supplies, a "dirty" staging room for collecting waste, a room with a pass-through autoclave, and an on-site satellite lab for running basic lab studies. Inside the patient room is a staff computer with Vidyo (a HIPAA-approved continuous Skype videoconferencing connection between the staff in the room and the staff outside the room), and another computer with Vidyo that allows the patient to communicate with his or her family members (who are barred from visiting in the Biocontainment Unit).

These resources are enviable, but what is really special about the Biocontainment Unit is its staff. Boulter believes in leading by example. "I never ask the nurses to do anything that I wouldn't do myself," says Boulter, who proves this by personally transporting patients with Ebola from the airport to the hospital, and by suiting up and assisting with admitting patients to the unit. The unit's 21 staff nurses (who are all based elsewhere in the hospital) choose to be part of the Biocontainment team and participate in routine education and training, including regular simulation drills on the unit. The nurses themselves developed the protocols that are followed in the Biocontainment Unit, revising and tweaking them to maximize safety.

The Biocontainment Unit also has respiratory therapists and patient care technicians. A typical day shift requires six staff members, including at least three nurses. Staff members fulfill different roles, all while suited up in full PPE. There is an autoclaver whose job is to autoclave all trash and laundry, a "doffer" who is always stationed outside the patient care area to assist staff (patient care providers and laboratory technicians) in doffing PPE, and a bedside nurse who remains in the room with the patient. Typically, nurses spend no more than four hours at a stretch in the patient's room, during which time they do not eat, drink, or use the restroom. If there is an emergency such as a code, other staff in full PPE will enter to assist, but as much as possible, actions are directed by the physician using the Vidyo conferencing system.

Whenever staff members in the patient's room make contact with the patient or items that the patient has used, they remove their outer gloves, wipe the middle-layer gloves with a bleach wipe, and then replace the outer gloves. "A lot of glove-changing goes on in that room," says Boulter. The doffer and the autoclaver perform the same process every time they touch a "dirty" item.

The attention to detail that prevents cross-contamination also extends to environmental cleanliness. Because environmental services personnel are not permitted in the biocontainment unit, the staff also cleans the unit and the patient rooms every night, using a checklist. Every surface is wiped with bleach and there are separate mop buckets for each area (nurse's station, hallway, patient room). New mop heads are used each night.

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## **The Art of Donning and Doffing PPE**

If you are the nurse involved in the care of a patient with Ebola virus infection on the Biocontainment Unit at Nebraska Medical Center, you don't wear your own scrubs, socks, or shoes at work. You don't use your own elastic tie to pull back your hair. You don't even wear your own underwear.

Wait a minute—what level of isolation is hazmat underwear? Actually, it is just one detail of the entire package of protection provided for staff members working in the Biocontainment Unit. Supplying everything down to the underwear means that staff members don't have to take home any potentially contaminated items that might transmit Ebola (or any other infectious disease) to family members.

It all makes sense when you understand how seriously protection is taken in the Biocontainment Unit. The nurse enters the unit through a locker room where she exchanges street clothes for hospital-provided underclothing, scrubs, socks, and plastic Croc-type shoes. She then dons standard precaution-level "contact" isolation gear: isolation gown, gloves, and mask, all of which are worn by everyone who enters the Biocontainment Unit, even to sit at the desk and answer the phone. If the nurse is assigned to any patient care role, additional PPE is applied in a clean staging area before entering the patient's room, according to a specific "donning" protocol. A line on the floor before the entrance to the hallway where the patient room is located reminds staff that no one crosses the line without donning full PPE (nor does anyone who is "dirty" cross the line in the other direction without following the doffing protocol.)

Assisted by a second staff member (Figure), the nurse dons the following items of PPE:

- Surgical boot covers (knee-high)
- Surgical gown (impermeable, level 4, according to Association for the Advancement of Medical Instrumentation [[AAMI](#)])
- Hood (covering the hair, ears, neck, and shoulders, tucked underneath the gown)
- Three pairs of gloves: standard (under the cuffs of the gown), purple nitrile KC500 gloves (cuffs are taped to the gown using duct tape to prevent slippage), and another pair of standard gloves over the KC500 gloves
- N95 mask (1870 white trifold style)
- Optional eye protection
- Face shield
- An apron is applied in the room if procedures are to be performed that might generate splashing or droplets (removed immediately following the procedure)



**Figure.** Alicia Parker, RN, assists Drew Molacek, RN, in donning PPE in the Nebraska Biocontainment Unit. Courtesy of the Biocontainment Unit at Nebraska Medical Center.

Tyvek suits (coveralls) and powered, air-purifying respirators are *not* worn routinely but are available if patient condition and care procedures warrant additional protection. Every staff member working in the patient room, the autoclave room, the on-site lab, or functioning as the "doffer" wears PPE as described above.

**The illustrated Nebraska Biocontainment Unit PPE Donning Protocol for Ebola Patients is available [here](#).**

Leaving the patient area is even more critical. No one simply walks out the door of the patient room, tearing off their PPE and tossing it into a red trash can. Leaving is a strictly controlled process that begins with alerting the doffer of the intent to leave, and waiting for the doffer to signal that it is safe to enter the "dirty staging area." In preparation, the doffer places a "doffing pad" on the floor that is divided into two zones, and a trash can lined with an autoclave bag into which PPE will be discarded.

Before even leaving the room, the nurse first removes the top pair of gloves and wipes the outside of her purple gloves with bleach. She then opens the door and steps onto the doffing pad. The doffer peels the duct tape from the purple gloves, which are then removed using glove-in-glove technique. The nurse turns around, and the doffer unties her gown, gently flipping it forward for the nurse to remove it carefully by gathering it and turning it inside-out into a ball. Nothing contaminated is ever allowed to touch the nurse's skin. Boot covers are removed one at a time by the doffer, and as each cover is removed, the nurse steps onto zone 2 of the doffing pad. Before removing her face shield, the nurse removes the last pair of standard patient gloves, cleans her hands with hand sanitizer, and applies a new pair of gloves. The face shield is removed, and then the hood is untied and removed carefully, along with the N95 mask. The gloves are removed and the nurse sanitizes her hands again, and applies a clean mask and gloves. Finally, the doffer uses a bleach wipe to clean the top, sides, and bottom of each of the nurse's shoes, and as each shoe is cleaned, the nurse steps off of the doffing pad with the cleaned foot.

The nurse is not finished yet. She proceeds to the sink, removes her gloves, and washes her hands with soap and water before applying another pair of gloves. She then stands at "the line" until the shower is ready, and then she showers and gets dressed in clean scrubs. Everything but her scrubs and shoes go in the trash.

**The illustrated Nebraska Biocontainment Unit PPE Doffing Protocol for Ebola Patients is available [here](#).**

It is a lot to remember, and it seems as though the doffing procedure, especially, would take a long time, but it doesn't. Although it is never rushed, the staff members have practiced it so often and become so adept at each step, that the protocol is ingrained as a habit.

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## Caring for the Caregivers

Boulter suggests that some of the lessons they have learned in the past 9 years could be useful to other hospitals, and not all of these lessons have to do with PPE. For one thing, Boulter believes in identifying the needs of nurses on the frontline of care and meeting them as much as possible, whether that means a place to rest when nurses are tired, food and drink when they take their breaks, or their preferred brand of shampoo or body wash for the shower. She does not ask nurses to spend 12 hours working in full PPE. Her staff is highly engaged in maintaining the skills and knowledge necessary to safely care for patients with infectious diseases, and the nurses take their own temperatures to monitor for possible Ebola infection. The unit also has a dedicated behavioral specialist to provide support to staff, patients, and family members.

It is noteworthy that the PPE used in the Biocontainment Unit at Nebraska Medical Center is not rare or exotic; it is available at most hospitals in the United States. Their meticulous protocol for putting on and taking off this PPE could certainly be emulated, and to assist in this, the unit's photographic donning and doffing protocols are available [online](#). The unit is also making a video to illustrate these protocols. When it is finished, it will be available on the University of Nebraska [HEROES website](#).

### Related Resources

[Nebraska Biocontainment Unit PPE Donning Protocol for Ebola Patients](#)

[Nebraska Biocontainment Unit PPE Doffing Protocol for Ebola Patients](#)

University of Nebraska Medical Center: PPE Donning and Doffing (Ebola Patients)

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