Health Services and Infrastructure Recovery of a Major Public Hospital in Liberia During the 2014–2016 Ebola Epidemic

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ABSTRACT

During the 2014–2016 Ebola outbreak, health services in Liberia collapsed. Health care facilities could not support effective infection prevention and control (IPC) practices to prevent Ebola virus disease (EVD) transmission necessitating their closure. This report describes the process by which health services and infrastructure were recovered in the public hospital in Monrovia, Liberia. The authors conducted an assessment of the existing capacity for health care provision, including qualitative interviews with community members, record reviews in Ebola treatment units, and phone calls to health facilities. Assessment information was used to determine necessary actions to re-establish services, including building and environmental renovations, acquiring IPC supplies, changing health care practices, hiring additional staff, developing and using an EVD screening tool, and implementing psychosocial supports. On-site monitoring was continued for 2 years to assess what changes were sustained. Described in the report are 2 cases that highlight the challenge of safely re-establishing services with only a symptom-based screening tool and no laboratory tests available on-site. Despite fears among the public, health workers, and the international community, the actions taken enabled basic health care services to be provided during EVD transmission and led to sustainable improvements. This experience suggests that providing routine medical needs helps limit the morbidity and mortality during times of disease outbreak. (*Disaster Med Public Health Preparedness.* 2018;13:767–773)

Key Words: Ebola, emergency management, epidemic, epidemic response, EVD, health care facilities, patient screening, resource-poor hospitals, triage management

There have been many international publications about the response to the 2014–2016 Ebola epidemic. However, few have described the experiences of local health care facilities in West Africa, their response, and how and whether they were able to recover services. A critical element of the public health response to a disease outbreak is to maintain health services while preventing the services from spreading the epidemic.[1–3]

Long-term underinvestment in health services in Liberia resulted in health care facilities that were resource constrained. They could not support effective IPC practices to prevent EVD transmission within their doors. Health care facilities lacked personal protective equipment (PPE), isolation facilities, and even faced shortages of chlorine disinfectant.[4,5]

EVD, first seen in West Africa in December 2013 in Guinea, spread quickly in the region.[3–5] By June 2014, a nurse working in the largest public hospital in Liberia, Redemption Hospital, was diagnosed with EVD. Redemption Hospital is a secondary level health facility that cared for 15,000 patients per month before the outbreak. Within the month, 20 Redemption staff members became ill, and 12 died. Qualitative interviews by an author found that health care workers were fearful of their work environment, and community members were afraid to seek treatment. By August 2014, most health care facilities in Monrovia, Liberia's capital city, had closed, including Redemption Hospital.[6] See Figure 1 for a summary timeline.

In response to the epidemic, Liberia's Ministry of Health (MOH) and international partners opened Ebola treatment units (ETUs). The ETUs' primary purpose was to quarantine all suspected or confirmed EVD cases to reduce transmission. Despite the influx of supplies, the ETUs were not equipped to meet medical needs beyond basic EVD care. As a consequence, combined with the closure of most health care facilities, critical preventive and curative services, such as routine vaccinations, prenatal care, facility-based births, emergency care for trauma, and inpatient care for acute illness, were not available in the city.[5,6]

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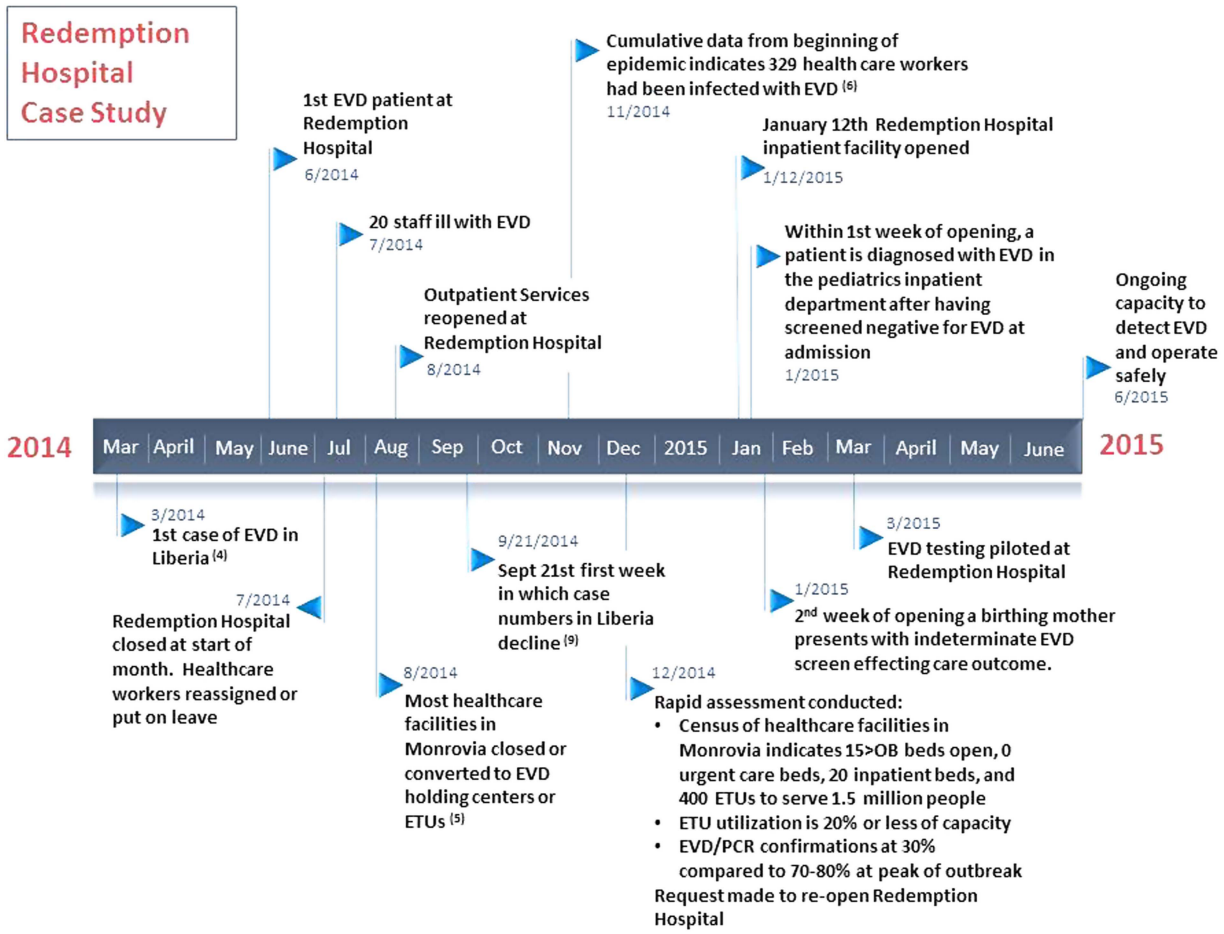
FIGURE 1

Summary Timeline of the EVD Outbreak Redemption Hospital, Liberia, 2014–2016.



METHODS

Re-Establishing Health Services

Starting the week of September 21, 2014, the number of EVD cases began to decline.[7–9] As the trend continued, there was growing concern that the unmet routine medical needs of the population were going to overshadow EVD. An environmental scan by the authors using phone interviews with those in charge with health facilities, on-site visits and record reviews at ETUs, and community focus groups and qualitative interviews was conducted in December 2014 and estimated that there were fewer than 15 obstetrical beds, no urgent care capacity, and only 20 inpatient pediatric care beds available to serve all 1.5 million people in Monrovia. ETU utilization was at 20% only or less of capacity, and a review of ETU patient records indicated EVD, confirmed by polymerase chain reaction (PCR) lab testing in only 30% of patients compared with 70%–80% at the peak of the outbreak. Psychosocial team interviews in the community revealed stories of women dying during labor and delivery and patients unsuccessfully seeking medical care at ETUs and closed health facilities. This assessment indicated an urgent need for health services and provided evidence that investments into the creation of additional ETUs were not needed. The MOH and international donors agreed to reprogram a portion of EVD response funds to reopen health facilities and re-establish health services. The Inpatient Department at Redemption Hospital was chosen as the first MOH facility to reopen.

The hospital required extensive cleanup and renovation to support new IPC guidelines.[10] An influx of supplies, additional staff, and training and support for all employees were essential as well. Table 1 summarizes the changes that were needed to reopen the facility and which of these changes were sustained 2.5 years later in July 2017. Re-establishing health services required the development of an EVD screening tool

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TABLE 1

Infrastructure and Practice Changes at Redemption Hospital During EVD Outbreak in Liberia, 2014–2016

Situation Before EVD Outbreak	Changes Made to Reopen Hospital During Outbreak	Current Level at Which Sustained, July 2017
Waste Management		
• Latrines shared by staff and patients. • No septic system – waste flowed into streets or ocean. • Placentas and all medical waste disposed into one of 3 pits behind the hospital. • Community use of area behind hospital for open defecation & dumping of refuse.	• Latrines designated for staff or patients. • Septic tank installed. • Waste pits decommissioned. • Incinerator installed. • Storm drainage improved based on community request. • Community engaged to stop leaving trash. • Accumulated trash is removed immediately.	**Fully Maintained** • All infrastructure changes sustained. **Partially Maintained** • Challenges persist with community using the area behind the hospital for open defecation and dumping refuse.
Psychosocial Supports for Staff and for Conducting Community Engagement		
• No psychosocial supports available for staff. • Community engagement limited to a few funded public health education and immunization initiatives.	• Psychosocial staff added throughout facility. • Staff Wellness Center created to provide space for counseling and for staff to decompress. • All staff trained in psychosocial first aid. • Communication between staff conducting screenings, inpatient wards, and community were established. • Community outreach conducted.	**Fully Maintained** • Wellness center with staff lounge maintained. • Counseling for staff is still available. • Ongoing communication between screening, wards, and community through meetings and data. **Partially Maintained** • Professional psychosocial staff reduced to 2. • Community outreach to improve relationship continues. A community-based participatory research project initiated to connect midwives to OBGYN nurses.
Building Entrances, Screening, and Triage		
• Eight unmonitored entrances to hospital. • No hygiene practices required at entrances. • No space, process or staff assigned to triage or screen patients. • Patients, family members, and staff entered the hospital by any one of eight entrances.	• Entry limited to 3 monitored entrances. • Separate entrances for acute care vs. wellness and prevention patient visits. • Triage area enlarged – includes barriers to keep staff 3 meters from patients. • All entering the building required to wash hands and have feet sprayed with a chlorine solution. Staff added to implement this practice. • EVD Screening tool created. (**Figure 2**) • Staff added to screen all who entered.	**Fully Maintained** • Limit of 3 entrances. • Separate entrances for acute care vs. wellness and prevention patient visits. • Handwashing at entrances. • Enlarged triage areas with barriers. **Partially Maintained** • Only symptomatic patients screened. • Considering a change to screen for more general infectious diseases risk. • IPC and screening staff reduced. **Discontinued** • Foot spraying
IPC Inside of the Hospital		
• Limited IPC policies in place. • Limited staff and staff training and supervision regarding IPC policies. • No isolation beds available. • Beds spaced to maximized number of beds. • Patients shared beds. • Stations to wash hands between patients limited. • PPE supply limited.	• "Keep Safe, Keep Serving" protocols were implemented.[9] • 40 additional IPC Staff added. Intensive training and supervision. • Isolation beds available in ER, OBGYN, and Pediatric departments. • Bed spacing increased to 4 meters between beds. • Electrical tape was used on floors to demarcate clean versus non-clean areas. • Bed sharing practices are eliminated. • Handwashing stations set up in key locations throughout the building. • PPE available to all staff with patient contact.	**Fully Maintained** • Isolation beds still available. • Bed spacing at 4 meters maintained. • No bed sharing. • Handwashing stations maintained. **Partially Maintained** • "Keep Safe, Keep Serving" protocols replaced with Universal Precautions. Hypervigilance sustained. • IPC staff reduced. Staff receive periodic training and supervision but at less intensive levels than during the outbreak peak. Training includes a focus on what signs to look for that indicate a possible outbreak, and how to report and respond to events of concern. • Patient census is back up to pre-outbreak levels. Overcrowding managed with transfers to other facilities. • PPE is available for people in key positions. Enhanced PPE used in "*wet*" situations. Long-term capacity to maintain supply is uncertain.
IPC in the Morgue and Laboratory		
• Morgue and laboratory infrastructure did not support IPC guidelines. • Morgue staff had no training on IPC protocols for dealing with dead bodies. • Laboratory staff had limited resources and training to do testing.	• Capital improvements made to both morgue and laboratory. • Investments made in equipment and supplies • Morgue staff received training and supervision. All bodies tested for EVD. • Increased capacity and training for basic testing, eventually including rapid and standard PCR testing. (3 months after reopening)	**Fully Maintained** All changes including ongoing training and supervision fully maintained. All dead bodies are still tested for EVD as part of sentinel surveillance. Rapid testing for EVD and other outbreak pathogens based on clinical picture.

EVD = Ebola virus disease; IPC = infection prevention and control; OBGYN = obstetrics and gynecology; PCR = polymerase chain reaction; and PPE = personal protective equipment.

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FIGURE 2

EVD Screening Tool Redemption Hospital, Liberia, 2014–2016.

Date ____/____/_____ **Time** ____ : ____ **am/pm** **Staff name** _____
DD/MM/YY

Redemption Hospital Triage Form

Form #: ____

Patient name _____ Age _____ Sex: M F

Living Place _____ Phone # _____
Occupation _____
Name next of kin _____ Phone # _____

Main reason for hospital visit: _____

Have you been to another health facility for this problem YES NO _____

Temperature ____ . ____ Is fever ≥38C? Yes ☐ No ☐ History of fever? Yes ☐ No ☐

Symptoms

Nausea/vomiting	Yes ☐	No ☐	Joint pain	Yes ☐	No ☐
Diarrhea	Yes ☐	No ☐	Headache	Yes ☐	No ☐
Weakness/fatigue	Yes ☐	No ☐	Cough	Yes ☐	No ☐
Loss of appetite	Yes ☐	No ☐	Difficulty Breathing	Yes ☐	No ☐
Abdominal pain	Yes ☐	No ☐	Difficulty Swallowing	Yes ☐	No ☐
Chest pain	Yes ☐	No ☐	Muscle pain	Yes ☐	No ☐
Hiccups	Yes ☐	No ☐			

Unexplained bleeding in pregnancy Yes ☐ No ☐
Other unexplained bleeding Yes ☐ No ☐ Location _____

Other Symptoms? _____

Contact History <u>in past 21 days</u>:
Did you have contact with an ill person before becoming ill? Yes ☐ No ☐
Have you attended a funeral or touched a dead body? Yes ☐ No ☐

Other reason for high level of suspicion (eg. <u>travel</u> from an EVD hotspot, occupation):
_____ Yes ☐ No ☐

Does Patient meet one of the case definitions (see EVD Flowchart) Yes ☐ No ☐

Impression: _____

_____

Plan:

Admit to Hospital	Yes ☐	No ☐	Ward _____
To OPD provider	Yes ☐	No ☐	
Home	Yes ☐	No ☐	
Referral	Yes ☐	No ☐	Where _____
Transfer to EHU/ETU	Yes ☐	No ☐	

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to assess symptoms and exposure history to keep EVD cases out of the facility (Figure 2). Suspect cases were referred to an ETU until resources were developed to isolate and test patients within the hospital.

Trust-building between the hospital and the community was critical. The epidemic shattered the community's confidence in health services. Many blamed health care facilities as the source of the epidemic and believed that the staff did not want to see patients anymore. A 2-way conversation between the hospital and the community was initiated to discuss how things would be different in the facility as it reopened. On January 12, 2015, the hospital reopened limited inpatient services.

RESULTS

Managing Risk

With the reopening, lines formed outside of the hospital entrances. Each entrance included a newly built triage space with barriers that kept patients and families 3 m away from staff that screened all for EVD using the screening tool (see Figure 2). The staff screened patients by first taking their temperature to ascertain fever using non-contact clinical thermometers. Staff then verbally inquired about an array of symptoms based on the case definition of EVD, symptoms not common to only EVD, but also malaria, liver disease, bleeding with pregnancy, parturition, gastroenteritis, and almost any viral or bacterial infection. Finally, the staff verbally inquired about EVD contact history in the past 21 days. A positive confirmation of any 2 or more of the previous factors was considered a positive screen for EVD and a "suspect" case. The national policy required that patients with a positive screen for EVD be transferred to an ETU for a laboratory test to confirm or disprove diagnosis. This policy restricting EVD lab testing to ETUs was made early on during the epidemic when prevalence was high, to encourage safe testing, accurate data collection for surveillance purposes, and to quarantine cases.

Careful monitoring and quality improvement of the infection control and screening practices were necessary. Staff re-administered the EVD screen to admitted patients to compare the information gathered at triage with their current status. In the early weeks of reopening, frequently, the rescreening revealed additional patients who met the case definition. Two patients admitted within the first 2 weeks of reopening highlight the challenges of the process. The first case involved a child admitted with fever whose family denied EVD symptoms or exposures at initial screening. This lack of honesty was frequent because families feared a transfer to an ETU. They knew that ETUs offered limited medical care and were frightened that their child might be exposed to EVD if transferred to an ETU. Interviews in the community revealed that, during these months of the outbreak, it had become commonplace to take acetaminophen/paracetamol to mask a fever before presenting to a health care facility. In this instance, after admittance to the pediatric ward, the child began to exhibit "wet" symptoms (vomiting and diarrhea). Only then did the family become more forthcoming (history of fever, vomiting, and diarrhea). The hospital transferred the patient to an ETU where EVD was laboratory confirmed. Seven hospital employees, triage and ward nurses, were placed in home quarantine for 21 days as a result of this exposure within the facility. With staff capacity strained, questions arose about the viability of keeping the doors open to serve the community. Ultimately, none of the quarantined staff were infected, but this scare led to changes to improve the quality of interviews at screening.

A week later, a woman screened negative at triage and was admitted in active labor. Hours later, when reassessed, she was believed by some staff to be a suspect EVD case. The ETU was reluctant to accept her given its limited capacity to provide obstetrical care. An exception was made to the "no testing outside of an ETU" rule, and the ETU staff came to the hospital to draw her blood for testing. Her test results were "indeterminate" for EVD, which required that she be transferred to the ETU until follow-up tests could be conducted. Hospital authorities were concerned that the entire obstetrics and gynecology staff might need to be placed on quarantine, which would necessitate closing the unit. The next day, retesting in the ETU was negative for EVD, and the patient returned to Redemption Hospital. By then, the baby died in utero from unknown causes.

These cases illustrate the challenges presented by a sensitive, but nonspecific, screening test based on subjective accounts by the patient and family and as understood by different screeners. Consequences for patients or staff could be dire in this environment of uncertainty and changing policies. Discerning EVD from other widespread conditions with overlapping symptoms like malaria and gastrointestinal illnesses was difficult. Obstetrics was particularly problematic because most patients present with bleeding, 1 of the screening signs for suspect EVD. The 24–48 hours required for a definitive EVD laboratory test from an ETU was not acceptable with the falling EVD prevalence and the need to reinstate health services. The desire to provide medical care was at odds with the fear of exposure. As such, Redemption Hospital staff, the MOH, International Rescue Committee, the World Health Organization, and the Centers for Disease Control and Prevention collaborated to expand EVD testing beyond the confines of ETUs to allow Redemption Hospital to draw samples from people with ambiguous symptom screens.

Increased access to testing was a gradual process. Laboratory testing first became available with blood draws inside of the hospital and transported to central laboratories. Then, 3 months after reopening, with proper training, supplies, and equipment, the hospital laboratory began EVD-PCR testing. The in-hospital isolation and testing of suspect cases enabled

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safe operations over the long term as intermittent cases were effectively managed during the long tail of the outbreak as flare-ups occurred.[11]

DISCUSSION

During outbreaks of severe, potentially fatal, communicable diseases, health care facilities need to maintain their core functions even when the clinical environment is full of uncertainty.[1,2] The lack of health care for common problems during a prolonged disease outbreak is associated with even higher morbidity and mortality than the outbreak itself.[3] Closure of health care facilities by plan or default creates desperation and begins to reduce the likelihood that people will cooperate with public health measures to control the epidemic, such as case detection and social distancing.[12]

The key to maintaining open doors during an outbreak is high confidence in IPC practices. To do this may require facility renovation and developing a screening process to isolate suspect cases because the availability of laboratory testing will always be delayed. In low resource settings syndromic screening, using symptom based and exposure reporting is the best first step as health facilities try to function. New IPC practices responding to the mode of transmission must be adopted, and access to IPC supplies such as bleach, gloves, and PPE is essential. Additional staff may be needed to implement the changes.

Continuous engagement of staff during an outbreak is critical to safe health services. With the loss of so many coworkers, intensive staff involvement in decision-making, training, supportive supervision, and targeted quality improvement efforts is required to restart or continue operations. The staff needs to be able to express their concerns and receive support so they can gain confidence that they can limit their risk of exposure. Exploring the idea of "safe uncertainty" and risk reduction is a useful operational approach.

It is equally important to engage the community to get feedback about the acceptability and compliance with public health measures. Community conversations to monitor rumors and assess perceptions and motivations are important. The extent to which community members feel they will get compassionate medical care and protection from exposure to a contagion can increase the odds that they will honestly report exposures and symptoms, making screening more reliable.[2,12]

False-positive screening results in the overuse of scarce resources delay treatment of the actual cause of disease and can result in patient exposure to disease when isolated with confirmed cases. False-negative screening can result in the exposure of staff and patients to the contagion, possibly necessitating the closure of services. An unshakable commitment to maintaining operations is needed to persevere in this environment.

So that proper precautions are implemented, the ability to discern risk is a critical component of IPC. Diagnostic success becomes a certainty only when accurate point-of-contact laboratory testing is available.[13] Policies that define the availability of laboratory testing must adjust to the arc of the outbreak and facilitate the provision of needed nonepidemic-related health care. Syndromic screening alone using tools based on case definitions and that are subjective is insufficient but necessary. Increasing the availability and speed of high quality, accurate, and reliable diagnostic testing within health services is needed to maintain the operations of health care facilities in times of an outbreak.[13]

Some investments during the outbreak in infrastructure improvements, training, and implementing IPC practices were sustained more than a year following the last case. These improvements may render the system more able to prevent and respond to future infectious disease events, strengthening the health system and making it more resilient.[14–16]

CONCLUSION

Keeping health care systems open is a necessity in any significant communicable disease outbreak. Despite fears about the health facility remaining open, there are ways to reduce risk and avoid amplifying the epidemic while preventing a secondary health crisis among those that no longer have access to core health services. Making sure that health workers can initiate enhanced screening, isolation, and have IPC available when an event occurs, even before the etiology is known, may prevent outbreaks from becoming epidemics. Investments in an outbreak response are not just single action events but can result in long-term improvements in prevention and preparedness.

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Conflict of Interest Statement

The authors declare no competing interests.

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