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# Disaster Medicine and Public Health Preparedness

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The Monrovia Medical Unit: Caring for Ebola Health Care Workers in Liberia

CAPT Paul Reed, MD; and RADM Scott Giberson

An advanced Ebola treatment facility supported by the US Government in Margibi County, Liberia, opened its doors in November 2014. The only Ebola treatment unit (ETU) of its kind in West Africa at the time of its opening, the Monrovia Medical Unit (MMU) was deployed and constructed by US Department of Defense units under the auspices of the US Department of State and the US Agency for International Development, facilitated in-country by the Office of Foreign Disaster Assistance’s Disaster Assistance Response Team. The design for modifications to the facility, doctrinally intended as a military combat surgical support hospital, was effected by the US Public Health Service (USPHS) in partnership with numerous governmental and civilian experts. The Commissioned Corps of the USPHS has continued to operationally manage the mission of the MMU, and its officers stand watch to provide direct clinical care for international and Liberian health care workers suspected of falling ill with Ebola.

Since November 2014, the MMU has admitted and cared for over 36 health care workers from 9 different nations with confirmed or suspected cases of Ebola virus disease. Over 200 officers of the USPHS Commissioned Corps of the US Department of Health and Human Services have deployed and staffed the ETU, which continues operations 24 hours a day, 7 days a week. Comments from numerous international stakeholders, including the United Nations Mission for Ebola Emergency Response (UNMEER), indicate that the presence of the MMU and its demonstrated capabilities continue to inspire and sustain confidence among the international community of responders, contributing greatly to the overall capacity of regional and global response efforts.

The photographs on the cover of this special issue depict the MMU, the USPHS Commissioned Corps officers who serve in its midst, and some of the health care workers who themselves have been cared for within the facility and have survived the Ebola epidemic. The selflessness that these health care workers have shown, in exiting the MMU and continuing to care for those impacted by the disease, defines the altruism that will ultimately lead to the resolution of this crisis. They also honor health care workers around the world who have lost their lives while providing care to others.

CAPT Paul Reed, MD
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RADM Scott Giberson
Commander
US Public Health Service Commissioned Corps Ebola Response
Teams of USPHS officers muster to formally change command of the MMU.

The first MMU patient is admitted to the facility.

Early stage of MMU development from the Air Force EMEDS system.

One of the first Ebola survivors to leave the MMU adds his handprint to the wall honoring survivors outside the facility.
At the time we prepared the editorial “Fearbola” for the December issue of the journal, there had been 15,352 cases of Ebola “officially” reported, with 5790 cumulative deaths (38% mortality) resulting from the West African epidemic. Now as of January 13, there have been a total of 21,408 cases with 8483 deaths (39.6% mortality) reported. These numbers obviously indicate that this epidemic is far from over, although the epidemiologic curves indicate a significant decrease in monthly new cases, especially in Guinea and Liberia but with a lesser positive effect for Sierra Leone. Overall, the belated but massive worldwide response to the situation is having a positive albeit slow effect on controlling and ultimately abating the epidemic.

Several months ago as the true severity of the epidemic and its global implications became apparent, we at the journal launched a novel concept for a peer-reviewed journal in which we defined an e-issue online and began to collect commentaries and articles from responders, managers, academics, and policy makers actually involved with the global response. All materials were peer reviewed and published online as expeditiously as possible. The stated intent was to provide information, data, and observations on the course of the epidemic; the effect on medical and public health interventions; and lessons learned to assist in the response and not simply as a retrospective description or analysis of events. Additionally, it was hoped that a historical record would result as the intent was to collect papers over the full course of the event.

Because of the volume of materials received, we have decided to publish the Ebola special issue collection in sections. We are most proud to introduce Section 1 in this, the February issue of 2015. When all future sections are published we will attempt to identify a sponsor or sponsors to enable us to publish a separate supplement to the journal. We are excited by the results of this project and intend to follow this process in the future for major events. From a general perspective, the impact of the Ebola issue has been extremely positive. This is dramatically demonstrated in Table 1, which shows online views of journal content. Among the most-viewed articles of the journal, 9 of these publications represent articles submitted for the Ebola special issue, with “A Primer on Ebola for Clinicians” being the most accessed article in the journal’s history.

Of course, every success comes at some cost, and for the journal as a whole, that is reflected in the dramatic increase in overall submissions, which went from 96 in 2013 to 240 in 2014. This has led to an increase in workload for a limited number of Associate Editors and increasing times to publication for authors. To address this, we will be moving to a Section Editor model under which we will have 12 or more defined sections that remain to be identified. We will be aggressively pursuing this approach and will be asking you the reader for help in identifying section types and qualified individuals to fill the Section Editor positions. There will be much to follow on this in future publications as well as discussion of such important topics as special and supplemental issues. In closing, I simply thank all of you out there for the work and support given in the past and look forward to our future together.

REFERENCES

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Ebola Virus and Public Health (Part 1)

Guest Editors

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This special section is published free online as a service to the Disaster Medicine and Public Health Community by the Society for Disaster Medicine and Public Health (sdmph.org)
The Ebola virus disease epidemic that struck West Africa throughout 2014 continues to shake the international and public health communities. Disaster Medicine and Public Health Preparedness decided to create a Special Issue focused on the Ebola crisis—an essential action for the most significant health crisis of a generation. Two important innovations make this issue of the journal unique. First is that the articles are expeditiously reviewed and published electronically so that information is made available as soon as possible to benefit policy makers and frontline clinicians. Second is that the issue is free access: the articles have been free to responders, planners, and decision makers to optimize the response, save lives, and reduce suffering to the maximum extent possible.

We are pleased to present the first set of articles focused on management of Ebola virus disease in a special print issue for wider circulation in a compact format. We expect the epidemic at some point to come to an end, largely thanks to the results of heroic public health interventions. However, unique data will continue to be important to manage Ebola and future emerging and reemerging infectious diseases (EID) on regional, national, and global levels. The fight against EID is far from over. Electronic publishing of evolving research will continue and will be used to inform evidence-based management of the epidemic. We, as guest editors for the Ebola Special Issue, are honored to have the opportunity to support those on the front lines by inspiring research and providing critical review and analysis from a scholarly perspective. Please take advantage of the knowledge we share in this special Ebola issue and apply it to reduce morbidity and mortality from Ebola virus disease and the next epidemic.

Center for Disaster and Humanitarian Assistance Medicine, Uniformed Services University of the Health Sciences, Bethesda, Maryland (Dr Beadling); Harvard Humanitarian Initiative, Harvard University, Cambridge, Massachusetts, and Woodrow Wilson International Center for Scholars, Washington, DC (Dr Burkle); Center for Disaster Medical Sciences, University of California at Irvine, Orange, California (Dr Koenig); FDA, CDER/ODG/DCR, Silver Spring, Maryland (Dr Sharp).
The Ebola Epidemic and Translational Public Health

James J. James, MD, DrPH, MHA

Several weeks ago while preparing material for the next regular issue of Disaster Medicine and Public Health Preparedness, I requested Dr. Skip Burkle to prepare a commentary from the global public health perspective on the current West African Ebola epidemic. As usual, Dr. Burkle provided a superb article that accompanies this editorial.1 Discussions of this among colleagues resulted in an outpouring of support and multiple offers to provide commentaries on different aspects of the Ebola virus and the West African epidemic. The volume of material available and promised led to the decision to electronically publish in a timely manner an open-ended special issue on Ebola that would mainly be a compilation of commentaries presented in roughly chronological order.

Drs. Skip Burkle and Charles Beadling agreed to serve as Co-Editors of this work, which from the beginning was designed to be a conduit for operational and policy level information intended to help improve both health outcomes and critical decision making. The stated goal was to provide factual, useful information without political bias and not subject to exaggeration, useless hype, or alarm. The publications would be available to all practitioners, other health workers, and policy level decision makers attempting to deliver clinical care, provide needed support services to the population, and control and contain the viral spread and would help to determine the best policies moving forward. This tragedy is like no other crisis our world has ever witnessed. Because of this, much will change in the way we look at global health security for decades to come. It is crucial that this unpredictable journey to obtaining some semblance of health security be documented for scientists and historians alike.

As an academic journal, Disaster Medicine and Public Health Preparedness has a responsibility to ensure accountability and transparency of all of its published material as well as to provide information that is evidence based, wherever and whenever possible, and has been subject to peer review. These are the journal standards and every effort will be taken to apply them as we attempt to publish a live issue on an event that is currently evolving.

This approach fulfills two long-standing goals of the journal. The first is to provide a scientifically based journal in real time that can enhance response, inform sound policy, and adapt to changes over the course of an evolving event. The second goal is to help to develop a translational framework for public health by providing a platform for improving population health outcomes through the amelioration of health determinants in the broadest sense. By necessity, this framework requires the support of and input from the many disciplines that need to be integrated to enhance all phases of the disaster cycle, e.g., prevention and mitigation, preparedness, response, and recovery and rehabilitation. Only through such an integrated multidisciplinary approach can we hope to translate disaster research and evidence-based knowledge into effective policy and approach global health security for all.

For an excellent discussion of this concept, see Ogilvie et al.2

Published online: October 7, 2014.

REFERENCES
A Primer on Ebola for Clinicians
Eric Toner, MD; Amesh Adalja, MD, FACP; Thomas Inglesby, MD

ABSTRACT
The size of the world’s largest Ebola outbreak now ongoing in West Africa makes clear that further exportation of Ebola virus disease to other parts of the world will remain a real possibility for the indefinite future. Clinicians outside of West Africa, particularly those who work in emergency medicine, critical care, infectious diseases, and infection control, should be familiar with the fundamentals of Ebola virus disease, including its diagnosis, treatment, and control. In this article we provide basic information on the Ebola virus and its epidemiology and microbiology. We also describe previous outbreaks and draw comparisons to the current outbreak with a focus on the public health measures that have controlled past outbreaks. We review the pathophysiology and clinical features of the disease, highlighting diagnosis, treatment, and hospital infection control issues that are relevant to practicing clinicians. We reference official guidance and point out where important uncertainty or controversy exists. (Disaster Med Public Health Preparedness. 2015;9:33-37)

Key Words: Ebola, epidemics, public health emergencies

In March 2014, Ebola virus (EV) was discovered to be the etiologic agent behind an outbreak of a highly lethal disease that had begun in the nation of Guinea in December 2013.1 The index patient is thought to have been a 2-year-old child.1 How he was infected is not certain. This was the first known outbreak of Ebola virus disease (EVD) in West Africa. Since that time, the outbreak has escalated to a never-before-seen scale, spreading to, and causing worse epidemics in, the bordering nations of Sierra Leone and Liberia. As the outbreak has continued, exportations of the virus to Senegal, Nigeria, and the United States have occurred.2,3 Additionally, several individuals infected with Ebola have been evacuated from the region and treated in other countries, including the United States and several European countries. As of October 12, 2014, secondary transmission to at least 2 health care workers outside the epidemic zone has occurred in Spain4 and the United States.5

Ebola outbreak control measures are relatively low-tech and have been employed with unequivocal success in the 24 preceding—and the one concurrent—Ebola outbreaks.6,7 Deploying these outbreak control measures in West Africa, however, has been complicated by several constraining factors that include the lack of local experience with EVD in West Africa, the distrust of governmental authorities by the population, the outbreak epicenter being located on a 3-border region; the level of poverty in these countries; and the inadequate health care infrastructure there.5

Another unique aspect of this outbreak is the unprecedented scale of the response and the large mobilization of resources. The World Health Organization, the US government (Centers for Disease Control and Prevention, the National Institutes of Health, the Department of Defense, and the US Agency for International Development), other governments, and many nongovernmental organizations (especially Doctors Without Borders) have been involved in this the largest outbreak response in history.9 Also, unlike in prior EVD outbreaks, in the current outbreak unlicensed novel medications, vaccinations, and diagnostics have been made available.10

HISTORY OF EBOLA VIRUS DISEASE
EVD was first described in 1976 after two nearly simultaneous outbreaks in the nations now known as South Sudan and the Democratic Republic of the Congo (DRC; formally known as Zaire). The disease and its causative agent were named for the Ebola River nearby the outbreak in the Congo. These two initial outbreaks were caused by two distinct strains of a novel filovirus that were related to the previously described Marburg virus.11 Since that time, sporadic outbreaks have occurred primarily in the nations of Gabon, Uganda, the DRC, and South Sudan. In 1989, a third strain was discovered after a shipment of monkeys from the Philippines to Reston, Virginia, was contaminated with a fatal viral infection. After investigation, a novel strain of Ebola virus was recovered (Ebola Reston) that was found to be nonpathogenic in humans despite causing subclinical infections.12 A single case with the fourth strain of Ebola, the Tai Forest strain, in the Cote d’Ivoire has been described.13 The fifth and (thus far)
final strain of Ebola, the Bundibugyo strain, was responsible for an outbreak in Uganda.\textsuperscript{14}

**EPIDEMIOLOGY AND VIRAL ECOLOGY OF EBOLA**

EBV is a zoonotic disease that spills from an assumed animal reservoir into humans. After extensive searching for the reservoir species, bats are thought to serve that function.\textsuperscript{15} Bats are the most populous mammalian species, are ubiquitous, can travel long distances, and are known to be the reservoir of several human viruses such as rabies, Nipah, SARS, Hendra, and—most significantly—the filovirus Marburg.\textsuperscript{15} However, although bats are assumed to be the reservoir, direct transmission from bats to humans has not been proven and the virus has yet to be isolated from any bat species.\textsuperscript{15} It is thought, therefore, that intermediary animals such as primates and duikers (African antelopes) may also play a role. Typically, outbreaks have been sparked when a bushmeat hunter (or someone with similar wildlife contact) contracts the illness from an intermediary host and then returns to his local village.\textsuperscript{16} Upon developing symptoms, the patient presents to a health care clinic where he may or may not be accurately diagnosed. If health care providers do not use appropriate personal protective equipment and infection control measures, transmission to health care workers may occur. Transmission is also occurring via burial practices that expose individuals to body fluids during preparation of the body.\textsuperscript{16}

Blood and other body fluids are the means by which the virus spreads between humans. Airborne spread has not been documented with any Ebola strain that is pathogenic for humans except in a laboratory setting.\textsuperscript{17} Nor has the control of any prior outbreak been hampered by lack of using airborne precautions.

In recent years, it has been shown that pigs can also be infected with Ebola viruses. In a natural setting in the Philippines, the Reston strain has been isolated from pigs.\textsuperscript{18} Experimental studies have since demonstrated that the Zaire strain can also infect pigs and produce a respiratory illness—in contrast to the human presentation, which does not typically involve respiratory symptoms.\textsuperscript{19} Dogs also exhibit evidence of asymptomatic infection with Ebola virus.\textsuperscript{20}

**MICROBIOLOGY OF EBOLA**

Ebola is a member of the viral family Filoviridae, whose name derives from the filament-like appearance of the viral particle under electron microscopy. It is a negative-sense, enveloped RNA virus with 7 genes. Enveloped viruses tend to be less hardy, unable to survive long in the environment, and are easily inactivated with ordinary detergents.\textsuperscript{17}

The surface glycoprotein encoded by the GP gene is the antigenic stimulus for human antibodies and is the target of investigative vaccines. Several genes of EV act in concert to subvert the actions of interferon, thereby allowing unchecked replication of the virus.\textsuperscript{17}

**HOW EBOLA OUTBREAKS HAVE BEEN STOPPED**

The following measures to control an EVD outbreak are based on characteristics of the virus and its clinical manifestations. It is important that all control measures be accompanied by public health messaging to explain the rationale behind each measure to the general public as well as to health care personnel.\textsuperscript{21}

**Recognition**

The first step in a response is the recognition that the virus is present. In areas in which the disease is known to occur, such as the DRC, health care providers and the public are attuned to the cardinal symptoms of the disease which, when present, prompt diagnostic testing. However, in areas in which Ebola has not been known to circulate, such as Guinea, disease recognition and public health response may be delayed. Serological studies of those who tested negative for other known pathogens can be helpful to determine whether Ebola had been circulating at low levels prior to recognition.\textsuperscript{21}

**Isolation**

Once the diagnosis of EVD has been made, steps must be undertaken to prevent further spread of the disease. Patients must be isolated in a manner that prevents exposure to their blood and body fluids (i.e., droplet/contact precautions) with health care workers using the appropriate personal protective equipment (fluid-impervious gowns, gloves, respiratory protection, and eye protection).\textsuperscript{21}

**Contact Tracing**

Once a case has been identified, individuals with whom the patient had contact while symptomatic should be determined and located. Each contact should be questioned as to their degree of exposure. Once identified, each contact should be instructed to monitor temperature periodically as well as to record the onset of any symptoms consistent with EVD. If present, such symptoms should prompt immediate isolation and treatment. This period of observation should last 21 days, corresponding to the longest known incubation period of the virus. A person who had contact with an Ebola patient prior to the onset of symptoms in that patient need not be isolated because there is no evidence that patients are contagious before the onset of symptoms.\textsuperscript{21}

**Safe Burial Practices**

A key component of diminishing an individual’s exposure to blood and body fluids includes ensuring that exposure does not occur postmortem. In historical outbreaks, traditional burial practices in which family members of the deceased bathe, embrace, and kiss the body during a funeral ritual have been linked to transmission of the virus. Instructing the population on how to modify burial rituals so as to eliminate blood and body fluid exposure has been difficult in some communities given cultural sensitivities, but this remains essential to extinguishing transmission.\textsuperscript{21}
PATHOGENESIS
Because most human cases of EVD have occurred in remote parts of Africa, there is limited direct information on the pathology of the disease in humans. Most of the available information is extrapolated from experimental work in animals including nonhuman primates. EV enters the host through mucous membranes, breaks in the skin (including microabrasions), and punctures. Experimentally, animals can also be infected by inhaled virus-laden aerosols. EV infects and replicates in a wide variety of cells. Initially, the virus targets monocytes, macrophages, and dendritic cells at the site of inoculation. From there, the virus-laden cells are transported through lymphatics to regional lymph nodes and then through the blood to the liver and spleen. From there, the infected cells disseminate throughout the host. The virus can be found in the skin and nearly all body fluids of infected individuals.22 EV, like other filoviruses, is cytotoxic and causes necrosis of many different organs through both direct cellular damage and damage to the microvasculature. Cytokines are strongly stimulated and contribute to the sepsis syndrome that characterizes the late stages of the disease. Tissue necrosis factor seems to play an import role in initiating disseminated intravascular coagulation (DIC).23

CLINICAL MANIFESTATIONS
As its classification as a viral hemorrhagic fever implies, fever occurs in the vast majority of EVD cases. On the other hand, bleeding, which is a manifestation of DIC, occurs in a minority of patients. Only 18% of patients in the current West African epidemic have had any abnormal bleeding. Gastrointestinal symptoms including pain, vomiting, and especially diarrhea are very common.24 In some patients the diarrhea can be voluminous and can rival the fluid loss seen in cholera.25 Fever and nonspecific symptoms (fatigue, weakness, malaise, anorexia, headache, hiccups, and abdominal pain) typically begin suddenly after an incubation period that averages 8 to 10 days (range, 2-21 days).26 The frequent occurrence of hiccups was one clue that prompted clinicians in Guinea to suspect EVD in the recent outbreak.27 Although sore throat can occur, other respiratory symptoms are not common.28 At this stage, the disease is often indistinguishable from many other common diseases including, for example, influenza. Some patients progress no further than this and recover. Some patients may develop an erythematous maculopapular rash in the first week. Conjunctival injection is common. Severe watery diarrhea and vomiting tend to occur after about 5 days. The cause of death in the poorly resourced countries in which outbreaks have occurred is often dehydration and electrolyte imbalance.29 This would likely be different in a setting of advanced medical care. Later in the clinical course, altered mental status, septic shock, and bleeding may occur and indicate a poor prognosis. When bleeding does occur it can manifest in many ways including petechiae, abnormal bruising, bleeding from puncture sites, or nasal, gastrointestinal, or vaginal bleeding. Fatal cases tend to progress quickly, with death occurring within 6 to 16 days.26 In Africa, case fatality rates have ranged from approximately 25% to 90%.28 This variation may be due to differences among the different Ebolavirus strains and the degree of medical care that is available. In the current West African epidemic, 7 of the first 10 patients who have been treated in the United States or Europe have survived (5 in the United States [1 died], 2 in Germany, 1 in the United Kingdom, 2 in Spain [both died]).

DIAGNOSIS
An isolated case of EVD may be very difficult to differentiate clinically from other more common diseases endemic to Africa such as malaria, typhoid fever, Lassa fever, meningitis, and cholera. In the United States, unless an epidemiological link is known (for example, by travel history), an early case may be confused with flu, a later case confused with gastroenteritis, and a very late case with sepsis of any cause. In the midst of an epidemic, clinical diagnosis becomes easier. Routine laboratory testing may show a variety of nonspecific abnormalities at various stages of the illness, including lymphopenia, leukocytosis with a left shift, thrombocytopenia, elevated transaminases, and evidence of DIC.26 The principal diagnostic test is reverse transcriptase polymerase chain reaction (RT-PCR). Ebola PCR tests are available in many state public health laboratories and at the Centers for Disease Control and Prevention (CDC). Culture of the virus is possible but is not usually clinically useful. IgG and IgM enzyme-linked immunosorbent assays (ELISAs) are also available in some laboratories.30 The IgM ELISA can provide positive results within a few days of infection but offers little benefit over PCR. Serologic assays are useful only in retrospect. It is critically important to remember that blood specimens from patients with EVD may be extremely infectious and thus must be handled accordingly.

TREATMENT
The mainstay of the treatment of EVD is good supportive care, especially fluid replacement. If the patient can drink, oral rehydration may be adequate. If not, intravenous fluid replacement is needed. The Canadian Critical Care Society recommends Ringer’s Lactate as the fluid of choice. The volume of fluid needed will depend on the degree of fluid deficit and ongoing loss. If the patient is hypotensive, an initial bolus of 20 mL/kg (repeated as needed) is recommended.31 If shock, DIC, or other organ dysfunctions are evident, they should be treated with standard critical care protocols as with any other patient with septic shock. Routine antibiotics are not indicated. Anecdotal reports suggest that the prognosis of EVD can be substantially improved with good supportive care.

There are no licensed specific medications for EVD. Several investigational drugs are just beginning early clinical trials
and have been used under compassionate use protocols for a small number of patients with EVD. These include a cocktail of 3 monoclonal antibodies produced by genetically engineered tobacco plants (ZMapp; Mapp Biopharmaceutical, San Diego, CA), a small interfering RNA (TKM-Ebola; Tekmira, Burnaby, BC, Canada), an RNA polymerase inhibitor (BCX4430; BioCryst Pharmaceuticals, Durham, NC), and an anti-sense short chain RNA (AVI 7537; Sarepta Therapeutics, Cambridge, MA). Whether these drugs are safe or effective is not yet known, because Phase 1 clinical trials have yet to be reported or, in some cases, conducted. Convalescent blood products (whole blood or plasma) from Ebola survivors have also been used in some EVD patients. Whether these therapies have been effective is not known; no controlled clinical trials have been reported.

Meticulous attention must be paid to proper specimen handling for routine care of EVD patients in hospitals. This includes guidance recommending standard contact and droplet precautions. Ebola virus is transmitted primarily by direct contact with body fluids. It is suspected that fomites can be involved as well. CDC guidelines recommend standard contact and droplet precautions for routine care of EVD patients in hospitals. This includes gloves, fluid-resistant gowns, eye protection, masks, and shoe covers. Surfaces should be disinfected. Airborne precautions (N95 respirator or Powered Air Purifying Respirator [PAPR] and negative pressure isolation) should be implemented for aerosol-generating procedures. As with other blood-borne pathogens, virus-laden body fluids aerosolized during vomiting, explosive diarrhea, or medical procedures may be able to transmit the virus as well. For this reason, some experts have advocated a higher level of routine personal protective equipment (PPE) for hospitalized Ebola patients (specifically, N-95s or PAPRs). Regardless of the type of PPE used, great care should be exercised when removing contaminated garments because it is believed that many health care workers became infected by self-contamination during the PPE removal process. Doctors Without Borders, the organization with the most experience in treating EVD patients, requires its clinical staff to work in high-risk zones to adhere to more rigorous PPE standards and infection control procedures than contained in the CDC guidelines, including taping closed all areas of exposed skin, dressing in pairs while putting PPE on to check each other, a specific protocol for doffing PPE, disinfecting PPE with sprayed bleach solutions during PPE removal, and using footbaths to disinfect shoes.

All clinical specimens from EVD patients are highly infectious. Meticulous attention must be paid to proper specimen handling and infection control procedures. Clinical laboratories must be notified in advance before any clinical specimens are sent. Recommendations for laboratory handling of specimens are available at the CDC Web site.

VACCINES

Several experimental vaccines are in various stages of clinical trials. Whether these vaccines will prove to be safe and effective is not yet known. One vaccine candidate was developed through a collaboration of researchers at the National Institutes of Health and GlaxoSmithKline. It uses an adenovirus vector into which an Ebola gene has been inserted. It is currently in Phase 1 trials. Another candidate vaccine was developed by the Public Health Agency of Canada and licensed to NewLink Genetics Corp (VSV-EBOV). This vaccine uses a vesicular stomatitis virus as a vector. It is also just entering Phase 1 clinical trials.

CONCLUSION

The size and ongoing nature of the West African outbreak makes it clear that the further importation of EVD to the United States will remain a real possibility for the indefinite future. American clinicians, particularly those who work in emergency medicine, critical care, infectious diseases, and infection control, should be familiar with the fundamentals of EVD including its diagnosis, treatment, and control.

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SPECIAL REPORT

Triage Management, Survival, and the Law in the Age of Ebola

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ABSTRACT

Liberia, Sierra Leone, and Guinea lack the public health infrastructure, economic stability, and overall governance to stem the spread of Ebola. Even with robust outside assistance, the epidemiological data have not improved. Vital resource management is haphazard and left to the discretion of individual Ebola treatment units. Only recently has the International Health Regulations (IHR) and World Health Organization (WHO) declared Ebola a Public Health Emergency of International Concern, making this crisis their fifth ongoing level 3 emergency. In particular, the WHO has been severely compromised by post-2003 severe acute respiratory syndrome (SARS) staffing, budget cuts, a weakened IHR treaty, and no unambiguous legal mandate. Population-based triage management under a central authority is indicated to control the transmission and ensure fair and decisive resource allocation across all triage categories. The shared responsibilities critical to global health solutions must be realized and the rightful attention, sustained resources, and properly placed legal authority be assured within the WHO, the IHR, and the vulnerable nations. (Disaster Med Public Health Preparedness. 2015;9:38-43)

Key Words: triage, Ebola, disaster medicine, epidemiology, public health emergencies, health law

No matter what discipline they come from, health practitioners recognize triage as an entity that exists to provide the greatest good to the greatest number of victims. Triage is common to all disasters, regardless of size. Simple triage, what most practitioners identify with in their careers, is used at the scene of a mass casualty incident to choose patients who require immediate transport to a hospital opposed to patients who can wait for help. Advanced triage portends a more extensive and serious event and refers to decisions made where severely injured should not be rationed care because they are unlikely to survive and available care is rationed to those with some hope of survival. Familiar color-coded sorting categories—expectant (black), immediate (red), observation (yellow), wait (green), and dismiss (white)—are widely recognized. Military triage in conventional warfare ensures that casualties are routed under assigned priorities to highly resourced echelons of advanced care; a major goal of triage is to treat minor injuries rapidly and return them to duty ensuring a sustainable and viable fighting force. Triage in complex humanitarian emergencies primarily focuses on civilians both from trauma and illness in environments where access and availability of health care and basic public health resources are scarce or nonexistent. A constant state of triage exists with multisectoral public health resources (water, food, health care, sanitation, shelter, fuel, and security) as vital factors in every triage decision. In large-scale communicable disease events (endemics, epidemics, and pandemics), the goal of triage becomes successfully identifying and treating primary infections and preventing secondary infections.1

The PICE (Potential Injury/Illness Creating Event) disaster nomenclature provides a method for consistency in disaster classification. With the progression from a “local, static, and controlled” disaster to an “international, dynamic, and paralytic” catastrophe, disaster and triage management (TM) become one entity.2 TM, as a process, occurs in a resource-limited, poor, or constrained environment where the demand for life-saving resources clearly exceeds supply. Individual TM decisions must “reach beyond” Ebola treatment centers (ETCs) to protect the surrounding community, the country, and the region. The decision operatives in the triage process are the likelihood of medical success and the conservation of scarce resources.1

The clinical, technical, and organizational triage processes involved in mass care infectious disease crises are complex and distinct from the triage process seen in other large-scale disaster events. Triage does not exist in isolation, but represents a complex process that balances clinical requirements with resource allocation and system management. The process, if done
appropriately, will protect and conserve numerous assets by addressing the unique factors that affect triage decisions for that particular disease. Control and containment will not be realized without attention to triage decisions. In many ways, TM keeps the crisis recovery process honest by revealing unmet or unrecognized vulnerabilities and shortfalls.

An accurate triage process is one that is sensitive, specific, and inherently influenced by the epidemiology of the infectious agents. Decisions of triage managers must show control of the transmission or reproductive rate ($R_0$) of Ebola or the ratio of primary to secondary infections. When reports indicate that “Ebola is winning,” they are referring to these data. Simply, if the $R_0 > 1$ indicates a continuance of the epidemic, a $R_0 < 1$ indicates that the disease eventually will disappear and the epidemic will be controlled. The $R_0$ averages have ranged between 1.51 and 2.53 for the 3 West African countries. While considerably higher $R_0$ values exist with more well-known infectious diseases such as measles and severe acute respiratory syndrome (SARS), the lethality of Ebola is much greater. Admittedly, while the $R_0$ is crucial in evaluating TM decisions, the available rates for those infectious and dead may be a quarter to half of what is accurate. All one can say with confidence is that those susceptible to Ebola have not fallen. Indeed, with reports from Liberia of only 17% of Ebola victims being treated in ETCs, modeling science suggests that “the epidemic will only begin to decrease and eventually end if approximately 70% of victims are in medical care facilities or ETCs.”

**TRIAGE CHALLENGES IN WEST AFRICA**

Andrew Price-Smith’s 2002 *Health of Nations* reminds us that infectious disease spread and successful containment are directly dependent on public health capacity, capability, and the strength of a nation’s governance, economy, and stability. His research and conclusions focused on infectious diseases because, to overcome epidemics and pandemics, these crises demand full capacity and capability from every sector of government. Nowhere are his theories more evident than the current severity of the Ebola virus in West Africa, as gauged by its ability to indiscriminately infect and transmit itself in a susceptible population and the inability of chronically deprived governance of nations to meet that challenge. In all 3 countries, the public health system, the economy, and governance are not capable of stemming the Ebola tide alone. An uncontrolled epidemic becomes the expected collective symptom of those failures, known to the global health community but unfortunately often not acted on or followed through in legislation and laws by world decision-makers.

Rural Ebola outbreaks in the past have been contained by early and robust public health containment and treatment skills from the World Health Organization (WHO), EpiCentre, the Centers for Disease Control and Prevention (CDC), and nongovernmental organizations (NGOs). The collection of interventional tasks, also referred to as “operational public health skill sets,” date back to the early 1970s. Indigenous and expatriate health care practitioners defined these tasks as surveillance and epidemiology, case investigation, contact tracing, case management, infection control disease containment strategies (isolation and quarantine, laboratory and treatment options), and burial interventions designed to identify and terminate the chain of human-to-human transmission of the virus, control the epidemic, and ultimately save the maximum number of lives. Today the same countries and communities suffer rapid and widespread urbanization, absence of public health infrastructure and protections, and poor health care systems that allowed the endemic in previously rural and sparse population areas to advance rapidly to dense urban conulates and a country-wide epidemic.

TM played a critical role, especially in the early stages of prior outbreaks. A major challenge facing both health care providers and policy decision-makers lies in their capacity to make that operational shift from individual-based care to population-based care and to understand the consequences of these decisions and actions. What is different in the current Ebola epidemic is that TM has already been practiced but not consistently from one county, ETC, or hospital to another. While TM is an essential step in these public health skill sets, it must be made universal in order to fully optimize diminishing resources and outcomes.

**LEGALITY**

Currently, in the 3 West African countries, triage is being managed at the local facility level primarily as “suspected versus nonsuspected of exposed/infectious” patients. Within the WHO and their clinical partner assets (e.g., indigenous clinics and hospitals, NGOs), it is the medical staff themselves, both national and international, who are performing TM. The International Health Regulations (IHR) monitoring framework and checklist for national IHR capacities refer to triage only in passing. As of this writing, WHO is updating the triage protocols for individual practitioners; however, currently there is no requirement for weekly or monthly resource reporting to a central authority. Arguably, there are no protocols for a system-wide population-based TM system nor are there clear mandates on how and by whom such a system would be implemented and under what authority. The non-legal peer review literature supports that it is an ethical and moral obligation that a triage plan make that operational shift from individual-based care to population-based care and to understand the consequences of these failures, known to the global health community but unfortunately often not acted on or followed through in legislation and laws by world decision-makers.

The importance of global health crises, including epidemics and pandemics, is reflected by the numerous treaties, mandates, regulations, guidelines, and local laws promulgating some degree of medical responsibility to those with the political means and resources. International investment in this goal was first articulated in the 1946 Constitution of the WHO, whose preamble states that “the enjoyment of the highest attainable standard of health is one of the fundamental rights of every
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human being without distinction of race, religion, political belief, economic or social condition."\textsuperscript{10} Recognition of the importance of health as a right protected under international law followed shortly thereafter when the 1948 Universal Declaration of Human Rights was unanimously proclaimed by the UN General Assembly as a common standard for all humanity.\textsuperscript{11,12} Many international, national, and regional efforts have followed that further solidify as well as expand these rights. As Alicia Yasmin states in a 2005 article describing the right of health care under international law, the rights afforded by these labors not only include the right to health care but also encapsulate a much broader concept of health. She goes on to point out that "[b]ecause rights must be realized inherently within the social sphere,...,determinants of health and ill health are not purely biological or ‘natural’ but are also factors of societal relations."\textsuperscript{12}

No plan for support of global health operational decisions, whether suggested by treaty or by law can succeed without a level of enforcement overhead. Failure to meet the responsibilities relating to health have an impact on economic and social wellness but also run the risk of noncompliance under regional, national, and international law.\textsuperscript{9,12} More than 70 national constitutions are thought to recognize the right to health with still more legislating aspects of the right to health.\textsuperscript{12} In these situations, enforcement and implementation is often left to the states themselves.\textsuperscript{9,12} When international treaty violations are thought to exist, enforcement has also been instituted by overseeing treaty organizations.\textsuperscript{9,12} Still, violations exist. Important to acknowledge, however, is that many countries that may wish to comply simply will not have the political, social, or medical infrastructure to do so. These important limitations are perhaps best reflected in that the requirement for the “highest attainable standard” of health, as stated in the preamble of the WHO Constitution, incorporates a reasonableness standard, thereby acknowledging that there are factors beyond a state’s control.\textsuperscript{12} This compromised status, within the affected West African countries, was known and acknowledged before the current Ebola outbreak.

With that backdrop, the International Covenant on Economic, Social and Cultural Rights (ICESCR) was adopted by the United Nations General Assembly in 1966. Article 12 of the ICESCR recognizes “the right of everyone to the enjoyment of the highest attainable standard of physical and mental health.”\textsuperscript{9,13} Included in the language is “[t]he prevention, treatment and control of epidemic, endemic, occupational and other diseases.”\textsuperscript{13} This “prevention, treatment and control” in fact translates operationally into a well thought out and designed triage plan and process that ensures resources be used appropriately and fairly. The methodology by which the plan occurs is called the triage process.

Laws are also important to an effective emergency response at times of crisis. As Hodge points out in a 2010 law review article on global legal triage, state-specific laws allow for the public health infrastructure through which governments can adequately detect, declare, and address emergencies.\textsuperscript{14} Legal issues are not easily resolved at the height of a public health emergency. Furthermore, Hodge reminds us that because one country’s public health legal responses may not mimic another’s, there remains the continued risk to global economic, social, and health well-being.\textsuperscript{14}

Appreciating the potential pitfalls arising from a country-led legal approach to public health emergencies, international efforts have also been undertaken. WHO revised its IHRs in 2005 following lessons learned during the 2003 SARS epidemic.\textsuperscript{15} The member states and countries under the IHR treaty are required to establish surveillance capacities and to share information relevant to public health risks.\textsuperscript{15} However, as the IHRs are meant more as a guide than a legal mandate, difficulties with enforcement may arise.\textsuperscript{14} Furthermore, national emergency and public health laws govern by default.\textsuperscript{14} Compliance with the regulations is essentially voluntary, although member states risk losing WHO status and suffering public censure with violation.\textsuperscript{14} As with so many other laws promulgating health, many nations may not possess the political or public health infrastructure to adhere to the IHR treaty.

POPULATION-BASED TRIAGE FOR INFECTIOUS DISEASES

A population-based approach in epidemics and pandemics requires a departure from the individual care role of clinicians with patients. It “does not minimize the importance of clinical tasks but rather adds the dimension of new public health and surge-capacity interventions that improve access and availability of limited health resources for the entire population.”\textsuperscript{16} Individual practitioners who only have experience with one-on-one patient-centered care may initially object or openly resist any population-based approach. Yet population-based approaches are both layered onto and intertwined within those individual patient decisions. Skill sets, especially those modified to the specific infectious agent, must be learned and practiced. A shared team approach in decision-making favors long-term success and outcomes but this may not be readily recognized by any one practitioner.

Population-based TM depends on recognition that everyone in the population falls into one of five TM categories (SEIRV):\textsuperscript{16}

\textbf{Susceptible category:} susceptible but not exposed; make up the majority of the population.

\textbf{Exposed category:} those who are infected, incubating without signs or symptoms, and not contagious.

\textbf{Infectious category:} those experiencing signs or symptoms listed in the case definition and contagious; includes those who died but whose remains are contagious.

\textbf{Removed category:} those who are no longer a source of infection, including bodily remains that are no longer
contagious and those geographically evacuated to another country with a different resource profile (e.g., United States, Spain, United Kingdom, France).

**Vaccine-protected category:** those recovered and protected either by experimental vaccination or serum antibody infusion or who have antibodies from previous epidemic recovery. They remain a crucial treatment option and must be followed as potential donors.

All categories have shared health care needs and all require some interventions. If not served, those in the susceptible category risk slippage into exposure and infection, risking preventive morbidity and mortality. The TM decisions for each category are resource and surge-capacity dependent and require unprecedented coordination and collaboration. For example, the susceptible category requires robust health information and education resources that are culturally and religiously sensitive and supported by a multidisciplinary task force that includes religious and community leaders, heads of households, anthropologists, social workers, the mental health community, and security personnel to name but a few. For the exposed, there is an inherent impetus to over-triage into this category. This can be attributed to

- The novel nature of the disease
- Absence of rapid diagnostic tests
- Lack of a vaccine
- Unusual or unclear viral shedding patterns
- Subclinical or atypical presentations
- Lack of effective treatment
- Inherent severity reflected in high case-fatality rate
- Uncertainty regarding modes of transmission and transmission potential

Much of this is true with the present Ebola epidemic. Actually, we still know very little about this virus and the disease. Suspicions about when and how patients become exposed and contagious are not necessarily clear. Mutation to aerosol spread has occurred within other primates that have had Ebola in the past, but despite more than 300 mutations so far, human-to-human passage has not been proven. The presence of US Navy laboratories will shorten the time for ETCs to learn the status of those in the exposed category, enhancing the capacity of starting treatments earlier to those infected and releasing those who are not.

For the infectious category in resource-poor areas, requirements include the uncomfortable but real determination of inclusion and exclusion criteria and minimal qualifications for survival for those who have a low probability of survival given the limited resources that are available.

- **Inclusion criteria** are the expected standards of Ebola treatment that health practitioners are trained to meet with every patient.
- **Exclusion criteria** conversely refer to situations in which expected resources are limited or lacking and care must proceed without all standards of care and equipment being met. For example, many ETCs are currently lacking intravenous fluids, antiemetics, and antibiotics for secondary infections. The lack of proper personal protective equipment, however, is a criterion for ceasing direct patient care.

- **Minimal Qualifications for Survival (MQSs)** represent a ceiling on the amount of resource expenditures that will be allocated to any one case definition, ensuring that a maximum benefit of available resources is realized to ensure a population-based best opportunity for survival. One example is ceasing advanced and resource-dependent interventions (e.g., IVs, use of sparse antibiotics, experimental vaccines) for those who will clearly not survive. In MQS situations one usually limits care to pain medication and basic non-resource-dependent nursing and comfort care. Each MQS diagnosis is always fluid and subject to change on arrival of surge-capacity resources.

A triage team approach is favored. The knowledge base for triage decisions requires multidisciplinary team guidance. Successful TM is at any one time patient, community, and organizational resource centered. Most important is that resource constraints and how they impact clinical decisions must be immediately transmitted to a central authority to mitigate the threat it exposes. Too often we are being reminded that even slight breaches in protocol will lead to transmission... the very action that proper TM is supposed to prevent.

**TRIAGE MANAGEMENT AUTHORITY**

It is imperative that greater technical and organizational leadership is required for West Africa at the regional and country levels. On August 8, 2014, the WHO Director General accepted the recommendation of the IHR Emergency Committee Regarding the 2014 Ebola Outbreak in West Africa in declaring the Ebola outbreak a Public Health Emergency of International Concern (PHEIC). This is one of 5 level 3 emergencies faced by the WHO today. Additionally, Temporary Recommendations under IHR were issued to reduce the international spread of Ebola. These include that the WHO “must coordinate daily activities of international teams (e.g., MSF, ICRC, GOARN, US-CDC, UNICEF), serve as a focal point for national and international teams” and report directly to the Ministries of Health.

Neither the WHO nor the IHR address who would have the authority and responsibility to declare the need for a country-wide or regional TM system when a government(s) or governance is incapable of providing those skills themselves. In reality, this TM state has existed almost from the outset of the epidemic in West Africa and has steadily worsened in part because of the lack of centralized control of resources and decision-making. While objectionable claims from a host country based on sovereignty is possible, it is unlikely in a steadily worsening environment where governance capacity and capability are failing. TM decisions require skills beyond
any one nation state’s capabilities. As they did during the SARS pandemic, the WHO and the IHR must assume this vital leadership role garnering renewed support from the global community (e.g., quasi-quarantine of Ontario). The central authority would enforce compliance and ensure continual data collection, analysis, and measures of effectiveness and utilize this information as the basis of daily reports and decision-making that impact practice, policy, and country-wide resource allocation among the SEIRV categories.

The SEIRV-TM methodology requires an authority that has “absolute command and control over critical care resources to ensure accountability and transparency,” similar to Emergency Operation Centers in the developed world. It must be determined whether each SEIRV category and limited resources are available and accessible to all. While this status is expected in a resource strong setting, the very definition of a resource poor or constrained environment means these resources are not present and TM must begin from the outset of the outbreak. Whether some indigenous surveillance and data collection is available or comes from outside assistance (e.g., NGOs, WHO), the very substance and boundaries of the triage categories must become clear and better defined for the caretakers. Currently, ETCs practice unsupervised TM because inclusion and exclusion criteria are overwhelmed. Health workers’ risk for transmission increases when they have never seen Ebola before or when they have seen so much of it that they are overwhelmed. This must include top-down assurance that appropriate inclusion and exclusion criteria and MQS are consistently practiced until resource acquisition cancels out those mandates country wide.

Numerous dilemma situations may confront the national and global leadership. For example, the WHO and IHR must accept governance as an essential public health infrastructure and must not allow governments to fail. All sectors of governance are crucial to success including border and internal security. United Nations may best fill those sector gaps temporarily or even assume temporary receivership. It is a major responsibility to prevent the export of Ebola from West Africa. It sets up an additional set of unknown complexities when the virus enters any new habitat, even in countries who boast of robust capacity. Other options may be necessary; as harsh as it might first appear, the central authority may decide to not permit travel outside the country until potential travelers complete an observed 21-day quarantine. If experimental vaccines become available, which may occur in a matter of months, who receives the limited resources? Health care providers have been placed high on that list, but some claim that government leaders and the military be vaccinated first, fearing a coup from within or outside their borders. Whatever the nature of the problems and the solutions, WHO/IHR leadership must have clear authority under international law to debate and decide those population-based decisions and to call on any additional global resources they require.

CONCLUSIONS

The current epidemic in West Africa has revealed multiple unmet challenges provoking apocalyptic fears in those affected countries, among the world community, and within developed countries where it has spread. Optimistic forecasts suggest that it will take an unprecedented additional 12 to 24 months to contain this crisis. Whatever the outcome, the world will not be the same. All disasters define public health vulnerabilities and expose difficult decisions like TM that demand unprecedented leadership; Ebola rapidly and ashamedly revealed grave unmet commitments that arose from the 2003 SARS pandemic. We argue here that a better understanding of the complex issues and shared responsibilities that define global health crises must be realized and the rightful attention, resources, and properly placed legal authority be assured within the WHO, the IHR, and vulnerable nations to prevent, prepare, and respond to this crisis and to those in the future.

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Operationalizing Public Health Skills to Resource Poor Settings: Is This the Achilles Heel in the Ebola Epidemic Campaign?

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ABSTRACT

Sustainable approaches to crises, especially non-trauma-related public health emergencies, are severely lacking. At present, the Ebola crisis is defining the operational public health skill sets for infectious disease epidemics that are not widely known or appreciated. Indigenous and foreign medical teams will need to adapt to build competency-based curriculum and standards of care for the future that concentrate on public health emergencies. Only by adjusting and adapting specific operational public health skill sets to resource poor environments will it be possible to provide sustainable prevention and preparedness initiatives that work well across cultures and borders. (Diaster Med Public Health Preparedness. 2015;9:44-46)

Key Words: Ebola, public health emergencies, epidemiology, disaster medicine, epidemics, resource poor settings, global health, global health security

We hear repeatedly from those in the field that the challenges of public health containment trump pure clinical responses in controlling the spread and overall outcomes in the Ebola epidemic. Outcomes, however, are only as good as the surveillance data and public health protections and infrastructure that are, we hope, sustained and unabated in both rural and urban areas. Slight shifts in the density of populations, the loss of competent nursing and other caregivers, inadequate infection control measures including the use of personal protective equipment, and how culture and local religions interpret infectious disease crises—to name but a few variables—can have immediate and devastating impact on disease transmission and outcomes.

Clinicians, including physicians, nurses, and paramedical personnel, often claim a knowledge base in public health. A direct inquiry into what exactly that experience practically entails, however, rarely follows. As an example, public health in a local or state department of health in a developed country deals primarily with disease control, health education, and statistical analyses of readily obtained epidemiologic data. All tasks are crucial, but they do not necessarily translate well into the critical skills necessary for “operationalizing public health” in a resource poor or constrained setting. In the United States, state and local directors of health, usually heavy with credentials in public health administration and policy, are vested in controlling diseases more than broad-public health preparedness. This characteristic was revealed as a crucial deficiency in the beginning days of the severe acute respiratory syndrome (SARS) and avian influenza outbreaks and launched the rush, with federal funding, to hire infectious disease specialists and epidemiologists in their health departments. A mixed bag of loss of support from resource allocators, policy makers and health leadership failed to retain their talents after federal funding ceased.1-3 Multiple barriers to retention of the vital epidemiology workforce remain today.4 Raw economic politics, at least in the United States at the local level, too often won out over preparedness and prevention leaving once again “operational responsibility unclear at the local community levels.”5 Prophetically, at the time of this writing, the CDC has already received 68 requests from hospitals or states seeking guidance or requests for blood testing on “suspected” Ebola cases.6

Yet, with a variety of emerging crises and disasters becoming more frequent, prolonged, and intense, the translation of public health principles into direct care protocols and operational skill sets needs more attention worldwide. The deficiencies in resources and skill sets among providers and multidisciplinary leadership are rarely recognized until a crisis occurs. With the emerging diversity and intensity seen in recent disasters, a sign of operational maturity is to work as a team in “trespassing professional boundaries.” These events are
solved primarily through multidisciplinary leadership. In Wessely’s *Lancet* review of Shephard’s book *Headhunters: The Search for a Scientist of the Mind*, we are reminded that while decades ago “smart, ambitious scientists could cross disciplines with greater ease than they could cross oceans. For the most modern scientists it is now the other way around.”

**THE DEMANDS OF OPERATIONAL PUBLIC HEALTH**

The demands of operational public health require close scrutiny to multiple factors, all of which could become the unsuspecting Achilles heel. Performing and writing sound survey analyses is the first tool and product of operational public health. They are essential and rightly scrutinized; they must reflect the culture, language, and understanding of invisible infectious organisms as well as the knowledge of how the outbreak is interpreted and the motives and skills of health providers and local and national decision makers. Partnering early and often with local religious and cultural leaders is fundamental. In past outbreaks of Ebola and other exceptionally lethal hemorrhagic fevers in primarily Muslim areas of Africa, one of the most crucial public health assets for success were the local imams. Through a crash course in public health, the imans convinced the families of those who died that the traditional washing, touching, dressing, and keeping vigil over the bodies could be changed without jeopardizing the guarantee that their loved ones would still receive the benefits their Muslim faith demands.

While seemingly dated, the report by Sureau and colleagues, “Containment and surveillance of an epidemic of Ebola virus infection in Yambuku, Zaire, 1976,” continues to be an excellent example of how “rapid organization of systematic active surveillance is possible” and constructed from the local level “even in areas with limited resources in skilled manpower and technology.”

Problems are resolved, providing that basic logistic, transportation, and minimal sample and shipment requirements to high security laboratories along with necessary international collaboration are also solved.

The World Health Organization and other speakers at the recent Hyogo Framework for Action meeting in Washington, DC, implored the conference audience to work for the long-term development of robust national medical teams that were specific to the region, country, and disaster. While they did not deny the importance of FMTs, which today provide both primary health and surgical specialty care, they surmised that in a perfect world it would be hopeful if they were not needed. The Ebola epidemic has tragically revealed how limited country health assets are and how long it takes to recover and rehabilitate a destroyed public health infrastructure and health system. Liberia is still recovering from a prolonged civil war fostered by former Liberian President Charles Taylor, when physicians fled and nurses had to maintain a shaky health system for many years. No one denies the current need for FMTs, but more diversity and capacity are essential to rapidly transition efficiently and effectively to the more unfamiliar and life-saving public health operational skill sets, especially among emergency medicine and primary health care providers.
In spite of initial pleas from WHO, offers of FMT assets that could immediately mimic the success and knowledge base that Médecins Sans Frontières (MSF) have accomplished were few. Both the International Committee of the Red Cross and MSF correctly appealed for supervised training in Ebola management before deployment. FMT planners knew their singular limitations, yet coordinated and collaborative order is emerging. Although initially delayed, “WHO and [United Nation] UN partner assets are now using MSF’s model and camp design in building the required logistics and safe working environments necessary to massively scale up training and suitable Ebola treatment centers for incoming FMTs” (Ian Norton, MBChB, e-mail communication August 23, 2014). These tasks are not that much different from what was accomplished in Zaire in 1976. Developed country governments are now triaging potential FMT assets for the anticipated and coordinated missions they will have. The untreated global burden of disease mortality and morbidity is expectedly severe and must be served, but Ebola treatment centers are crucial as urban illness rates soar and district hospitals suffer.

For many contributing institutions, especially WHO, UN partners, and nongovernmental organizations, where exceptional knowledge lies but resources are scant, this epidemic presents a major learning curve. Education and training courses in all contributing academic-affiliated training centers will change worldwide, and national health teams and FMTs will have to adapt and diversify as new crises demand and their needs grow. Competency-based curriculum, the foundation of the current professionalization movement in humanitarian health education and training, must concentrate on emerging public health emergencies, adjusting and adapting “operational public health skill sets” to both resource-poor environments and diseases of incomparable etiology, to provide sustainable prevention and preparedness initiatives that work well across cultures and borders. This represents a good result.

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ABSTRACT

The global rise of Ebola viral diseases in 2014 necessitates legal responses that promote effective public health responses and respect for the health and human rights of populations. Compulsory public health interventions, approval and administration of experimental drugs or vaccines, and allocation of finite resources require difficult choices in law and policy. Crafting legal decisions in real-time emergencies is neither easy nor predictable, but it is essential to controlling epidemics and saving lives. (Disaster Med Public Health Preparedness. 2015;9:47-50)

Key Words: Epidemics, Policy Making, Public Policy

A

fter decades of relative obscurity, Ebola viral disease has emerged as a major, global biothreat in 2014. Several hundred cases were previously detected before Ebola’s first appearance in Zaire and Sudan in 1976 to 2013.\(^1\) Since its reappearance in Guinea in March 2014, however, thousands—and potentially tens of thousands—of persons have been infected in 5 West African countries (Sierra Leone, Liberia, Guinea, Nigeria, and the Democratic Republic of Congo).\(^2\) Approximately 275 million people live in these 5 countries\(^3;\) 21 million reside in the dense urban environment in Nigeria’s capital, Lagos, alone. With reported mortality rates in affected areas ranging from 30% to 90% (depending on multiple factors including the availability of adequate medical personnel and facilities),\(^4\) the impact of Ebola is felt globally. Still, Médecins Sans Frontières (Doctors Without Borders) suggests that global responses are “dangerously inadequate.”\(^5\)

For only the third time since reforming its International Health Regulations in 2007, the World Health Organization (WHO) declared a public health emergency of international concern on August 8, 2014.\(^6\) While WHO’s declaration lacks the enforceability of emergency powers held by sovereign nations, it sets transnational standards for surveillance and response to the disease. Multiple West African nations have also declared their own states of emergency.\(^7\) President Ellen Johnson-Sirleaf staked “the very survival of our state and…the protection of the lives of our people” on Liberia’s state of emergency.\(^8\) Other countries or regions may follow suit by similarly declaring emergencies as the outbreak spreads.

To date, US national, state, and local governments have not declared formal states of emergency (given a lack of naturally-occurring cases in the country), but legal preparedness efforts are underway. On August 6, 2014, President Obama stated that “Ebola is controllable if you have a strong public health infrastructure in place.”\(^9\) Congress, the State Department, and the Department of Defense are closely assessing the Ebola epidemic and corresponding US policies. The US Agency for International Development has committed millions to global response efforts.\(^10\) In addition, multiple federal health agencies have sought to address legal issues centered on public health prevention; the Department of Health and Human Services supports development of the experimental drug ZMapp as a potential treatment;\(^10\) and the National Institutes of Health is accelerating human clinical trials of Ebola vaccine.\(^11\) Meanwhile, the Centers for Disease Control and Prevention (CDC) has advised Americans to avoid nonessential travel to Guinea, Liberia, and Sierra Leone, and strongly discouraged travel to affected regions of Nigeria.\(^12\) The agency also disseminated interim guidance on the safe handling of potential Ebola specimens, corpses, and fluids. The Food and Drug Administration (FDA) issued an emergency use authorization on August 5 to allow field use of a rapid Ebola diagnostic test\(^13\) and is monitoring the marketplace for fraudulent products purporting to treat Ebola.\(^14\)

The rise of Ebola necessitates legal responses that promote effective public health responses and respect for the health and human rights of local and global populations. Compulsory public health interventions, administration of experimental drugs, rapid development of vaccines, and allocation of finite resources precipitate difficult choices in law and policy. Crafting decisions in real time via legal triage is neither easy nor predictable, but it is essential to controlling the epidemic and saving lives.
GLOBAL AND DOMESTIC LEGAL RESPONSES TO EBOLA

Law is a critical underpinning and tool of international and domestic public health emergency preparedness and response to Ebola (and other emerging threats). Formal emergency declarations, for example, affect public health and medical responses by instantly altering the legal environment. Resulting legal changes vary, depending in part on the choice and type of emergency declared. In the United States, federal and many state (as well as select local) governments may declare states of “emergency,” “disaster,” or “public health emergency,” among other classifications. In conjunction with international or inter-jurisdictional declarations, these declarations empower public and private entities to address public health crises in expedited ways. Public health emergency laws (1) offer public and private sectors greater flexibility to act to protect the public’s health through testing, screening, treatment, and vaccination programs; (2) convey or impose social distancing measures designed to control the spread of infectious conditions; (3) allow temporary suspensions of regulations that may impede emergency responses; (4) encourage efforts among volunteer health providers through limits of, or protections from, claims of liability; (5) facilitate transitions to what the US Institute of Medicine defines as “crisis standards of care”; and (6) authorize alterations in medical licensing standards and scopes of practice.

Still, invoking states of emergency can be precarious. Ideally, emergency laws should clearly direct preparedness and response efforts. In actuality, they typically do not provide precise legal guidance. Framed in broad (and sometimes vague) statutory or regulatory language, emergency laws offer more of a menu of legal powers and options rather than a definitive guide for action. Providing legal flexibility when clarity is called for may seem counterintuitive, but it does make some sense. Policymakers cannot accurately predict how best to respond to emerging infectious conditions whose origin and epidemiology may be uncertain. Availing multiple legal options is central to controlling emerging infectious diseases just as medical flexibility is to determining and providing adequate treatment.

Without affirmative legal direction, however, some public and private actors may perform well outside of legal boundaries in contravention of human rights principles or individual freedoms. Alternatively, they may fail to respond because of erroneous legal advice, liability fears, or other perceived negative legal ramifications. Allegations that medical workers in Sierra Leone are abandoning Ebola patients are particularly troubling.

Illegal or unethical responses, or failures to respond, are equally unacceptable.

Through legal triage, global and national actors must prioritize legal issues and generate solutions in real time to facilitate legitimate public health efforts to limit the spread of Ebola in balance with communal and individual interests. Making sage legal choices is complex when epidemiologic facts are sketchy, resources are scarce, and communal well-being in affected jurisdictions is in jeopardy. Legal debates related to the administration of experimental drugs to Ebola patients are illustrative. Some call for rapid approval or facilitation of such drugs through emergency use authorizations by FDA. Absent a cure or even definitive medical intervention for Ebola, they argue that any drug is better than none. However, questions over the safety, availability, and efficacy of these drugs make manufacturers and medical personnel vulnerable to potential liability if unrelated harms arise in patients taking these drugs.

Unleashing a harmful experimental drug (or vaccine) on populations facing the threat of Ebola may result in a legal and ethical firestorm, even if such harms were unperceived or unintended.

POTENTIAL FOR INTERNATIONAL AND NATIONAL INFRINGEMENTS OF HUMAN RIGHTS AND FREEDOMS

Other law and policy controversies extend from the use of public health powers and authorities to control the spread of Ebola through social distancing measures. Use of isolation, quarantine, cordon sanitaire, curfews, closures, travel restrictions, and other techniques in response to emerging infectious conditions are historically and often legally prescribed. Concerning a condition such as Ebola, which can infect and kill over half its victims in relatively short periods, limiting the movement of those infected, exposed, or merely in the area may arguably be imposed as a last-ditch effort to control its spread. When such measures are used overzealously or applied too extensively, however, they may unjustifiably infringe on human rights and freedoms.

Examples and images of potential human rights violations stemming from Ebola are wide-ranging. On August 7, 2014, it was reported that the army in Sierra Leone blockaded rural areas of the country in which Ebola had spread, constraining populations’ rights to travel, whether they are infected or not. On August 18, after a medical ward was looted 2 days before, Liberian armed forces were ordered to shoot on sight anyone unlawfully entering the country from Sierra Leone under the cover of darkness. Liberia also implemented a nightly curfew on August 19 and barricaded a slum of 50,000 persons with razor wire and patrols to prevent departures. Broad-sweeping attempts to control populations not only lack efficacy to prevent the disease from spreading, they also can negatively impact communal health by denying people access to food, medicine, and other essential, life-sustaining services. Continued stigmatization of Ebola patients and survivors is patently discriminatory and a threat to their livelihood. On August 21, 2014, South Africa banned entry of all non-citizens from Sierra Leone, Liberia, and Guinea, in spite of the explicit rejection of blanket travel bans by WHO. National restrictions on flights and other travel to affected regions not only limit passage of unaffected persons, but also prevent the transport of essential supplies and personnel.
REFINING GLOBAL LEGAL APPROACHES TO COUNTER EBOLA

While at WHO, the late physician and advocate Jonathan Mann is credited for advancing the idea that protecting the public’s health and respecting human rights are synergistic not incompatible.35 Mann’s observation arose largely from international debates over appropriate treatment of persons with HIV/AIDS in the 1980s, but his message applies equally in modern outbreaks such as Ebola. To the extent that public health emergency laws and policies offer options for action, those options should be exercised consistent with basic human rights.34 Many of these rights are sufficiently flexible to allow for expedited uses of public health powers that have been empirically shown to control emerging threats. Conversely, governmental actions driven more by fear and stigmatization than efficacy are unacceptable. On international and domestic fronts, legal actions related to Ebola must (1) be grounded in public health science; (2) seek to protect patients, their families, and health care workers; and (3) respect human rights. Only then may Ebola be conquered successfully.

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COMMENTARY

Hubris: The Recurring Pandemic

Tom Koch, PhD

ABSTRACT

The 2014 Ebola outbreak has been seen by many as a “perfect storm” and an “unprecedented” public health calamity. This article attempts to place this most current of epidemics, one currently struggling for pandemic status, in an historical frame. At least since the 1600s protocols and programs for the containment of epidemic disease have been known, and mapped. And yet it was almost six months after warnings about this epidemic were first sounded that incomplete programs of control and surveillance were instituted. In effect, we have forgotten the basics of what was once common knowledge in public health. Having placed our faith in bacteriology, virology, and pharmacology, we have forgotten the lessons learned, long ago. (Disaster Med Public Health Preparedness. 2015;9:51-56)

Key Words: pandemics, epidemics, geographic mapping, Ebola

The great pandemic is neither bacterial nor viral. It is instead pride and the arrogance of the new. We have placed our faith in genetics and molecular biology, believing they are equal to any microbial challenge. Once-common public health responses are ignored because we believe modern science will solve the problem. But when new epidemics strain toward pandemic status, our science can offer only future answers, not an immediate response. The latest viral invasion is an example of this. As the Ebola epidemic matured, threatening pandemic status, popular and technical reports promised as answers DNA sequencing and untested drugs unavailable for distribution.

There was a time when epidemic recurrences and pandemic diseases ruled—a time when plague, yellow fever, and cholera were recurrent visitors. At least as early as the late 17th century, protocols were in place to restrict the spread of epidemic diseases (then typically bacterial) while caring for persons in affected areas.

Comparing those early response programs to contemporary reactions to the Ebola epidemic can teach us a great deal about the epidemics we face today and surely will face tomorrow. Here futurity is important.

We are in a period of rapid microbial evolution. Old diseases (tuberculosis, for example) once tamed are returning in new and more virulent forms. Newly evolved bacteria and viruses are simultaneously appearing with extraordinary rapidity. Recent microbial incursions include, in a partial list, an alphabet soup of challenges: HIV/AIDS, the H1N1 and H5N1 influenzas, MERS (Middle East respiratory syndrome), SARS (severe acute respiratory syndrome), and WNV (West Nile virus). Each presented an evolving health threat whose nature was at first unclear and whose unique patterns of diffusion were difficult to predict. From this perspective, Ebola is only one of a rapidly evolving class of microbial invaders.

PLAGUE

We have always lived in close relation, sometimes conflict, with members of the microbial world. Most microbes are benign and many are beneficial colonies we unthinkingly host in our bodies. But sometimes, and for a variety of reasons, bacteria and viruses become lethal, or at least toxic, sickening hosts who are hijacked as vectors for microbial advance. When that happens, the result is a local outbreak that, once firmly established, becomes a regional epidemic. From there pandemic always threatens.

The first great teacher was plague, a periodic challenge that stretched from the days of the Black Death, which helped end the Middle Ages, until the last pandemic at the end of the 19th century. Some suggest that this history provides a general model for public health reasoning and epidemic modeling. Most recent books and articles in this area, however, are primarily concerned with either identifying the genomic nature of the active plague bacillus or considering the sociology of local responses.

In the days before both bacteriology and virology, medical personnel and public officials energetically confronted plague outbreaks and epidemics. Authorities understood infectious outbreaks (including influenza and plague) as a public health problem.
By the 14th century, quarantine, which attempts to render infected persons harmless as disease carriers, was a broadly accepted form of medical prophylaxis. By the 16th century, epidemic disease was understood as a dynamic threat whose vector was trade and travelers. For example, in Hans Holbein’s 1538 Dance of Death, Plague is shown riding in the cargo holds of sailing ships when not sitting on the ox-carts of land-based travelers (Figure 1). Nobody knew what plague was, but none doubted that it spread in towns and cities by humans and through the trade that was the lifeblood of evolving nations and nation states.

Absent the advantages of modern science, the approach to disease containment was spatial and multiscalar. First, there were local quarantines of families in households diagnosed with plague. Second, regions were quarantined to either prevent the introduction of plague from areas where it was active or to keep plague from spreading outward from active areas. Medical geographer Peter Haggett calls these, respectively, “offensive” and “defensive” programs of containment. It is this kind of spatial thinking that has been degraded in recent years as a reflexive response to potential disease incursions.

### BARI, ITALY: 1690S
Both approaches were understood, and employed, at least as early as the 17th century when plague was a recurrent epidemic threat. During the plague years of 1690 to 1692, for example, Fillipo Arrieta instituted a detailed quarantine, surveillance, and support program in Bari, Italy. Using thousands of troops, his plan of attack—call it “military epidemiology”—was detailed in two maps and a text that are now housed at the library of the New York Academy of Medicine.

Arrieta understood the necessity of both defensive and offensive strategies to stop (or at least slow) the progress of plague while maintaining order in affected cities. His map shows an 80-kilometer long, defensive cordon sanitaire separating Bari, where plague was active, from neighboring provinces (Figure 2). The cordon is symbolized by a dotted line and flags, each representing the position of military posts whose soldiers prevented travel in or out of Bari Province. Along the coast, feluccas at sea similarly served the provincial quarantine program.

Within the province, Arrieta created a secondary cordon in the southeast portion of the province where plague was the most active. The walled area shown in the second map locates a dense compliment of troops (Figure 3); the density of flags reflects the strength of the action. Cities like Mola, where plague was active, were marked with a “B.” Plague-free cities were marked with a “C.” The goal was to act at both provincial and local scales to inhibit the invading microbe’s ability to gain new territory. In military terms, Arrieta sought to cut the invading microbe’s food chain by depriving it of new hosts at both local and regional scales of address.

Arrieta’s response was comprehensive. As royal auditor he was charged with ensuring the general care and welfare of the people of his province. Thus, his report describes the need for care sites where those afflicted could be treated and burial sites for those who did not survive. He was also aware that it did no good to limit plague’s reach if the persons in towns where plague was active were without food or medical support. Therefore, his report served to justify both the expense of the military campaign and simultaneously an urban program to maintain the life of townspeople whose necessities could not be ignored.

### YELLOW FEVER AND CHOLERA
In the 18th century, recurrent epidemics of yellow fever were so severe they threatened the burgeoning trade between colonial Britain and its colonies. Indeed, the epidemics threatened the very existence of the colonies. “In 1793, approximately 10 percent of Philadelphia’s population perished in an epidemic; in 1798, more than three thousand people died from the disease in a four month period in that...
In 1694, administrator Fillipo Arrieta published two maps that detailed a multi-stage containment plan designed to limit plague incursions in Bari, Italy.

In this excerpt from Arrieta's second map, troop barriers are shown along the cordons. Towns where plague had been active, was active, and had yet to arrive were distinguished by different letters.
Hubris: The Recurring Pandemic

city. The question was whether the disease was portable, transmitted by trading ships from the Caribbean, or was instead a result of the failure of public sanitation in the rapidly emerging industrial cities of America? If the disease was introduced by trade and travel, only quarantine would serve. If it was locally generated, however, trade could continue and attention could be focused on improving local sanitation.

In one of the first cases of “scientific” medicine published in a public journal, New York physician Valentine Seaman “proved” the local nature of the disease. Brilliant in its approach, his study was incorrect in its conclusions. Believing yellow fever a local, spontaneously generated disease caused by bad sanitation and resulting “bad airs,” the conclusion was that quarantine and containment need not be employed.

Similar questions about the origin and nature of a disease, and thus official responses to it, arose in the 19th century when cholera progressed from the British military encampments in India to the Middle East, Russia, and by the 1820s, to Europe. While there was little doubt that this new “Asiatic cholera” was spread by human travel and trade, British medical authors argued in The Lancet against quarantine or national programs of containment and care. Quarantine was, they insisted, a “savage” system that, in forcing a curtailment of trade, was worse than any disease it might seek to prevent. Restraint of trade could not be allowed. Public charity and general sanitation were offered instead as the nation’s palliatives. Between 1831 and 1834, over 50,000 Britons died as a result.

EBOLA

Ebola was first recognized in Sudan and Zaire in 1976 as one of a class of hemorrhagic fevers. Repeated local outbreaks received little international attention in subsequent decades. As late as 2012 they appeared to be rare, isolated events without general consequence. International officials paid little attention in March 2014 when increasing deaths were reported in Guinea. It was not until August 2014, when localized outbreaks matured into a full-blown epidemic affecting Liberia, Sierra Leone, Nigeria, and Uganda, that the world took notice but not action.

The World Health Organization continually monitored the progress of Ebola, reporting increasing mortality and new outbreaks on a regular basis. Effective responses were left to affected regions financially and politically unable to cope with the epidemic’s progression and severity. Aid was received in affected areas principally from international, nongovernmental organizations like Médecins Sans Frontières (Doctors without Borders). By September 2014 they, too, were overwhelmed by the spread of the disease.

Into September 2014 there were neither national nor international attempts to create a coordinated response similar to Arrieta’s, to both isolate regions of viral activity (offensively or defensively) while assuring care in areas where Ebola was active. In August 2014 international airlines began to voluntarily halt flights into affected areas. This informal program of offensive containment had the effect of reducing the supply of voluntary medical workers and necessary supplies to affected regions, thus exacerbating the crisis. In affected cities, local quarantines largely failed because they lacked the support those in affected areas required.

Why was there no concerted effort to contain Ebola in its early stages, to treat those affected in isolated outbreaks, or to mount an international effort at care and containment as the epidemic expanded and deaths increased? Why was there no plan, like Arrieta’s in Italy in 1694, to aggressively meet the microbial event head-on, and early?

DISCUSSION

By September 2014 commentators who themselves had been unconcerned with earlier outbreaks were insisting the Ebola epidemic was the result of if not racism, then a general disregard for the health of African peoples. They castigated wealthy nations for not aggressively supporting health interventions in affected countries and thus for the “perfect epidemiological storm” that resulted. But richer nations generally ignore isolated outbreaks of disease, even new diseases, in their own countries as well. There was no outcry, for example, when a new and virulent strain of tuberculosis evolved in the Skid Row slums of Los Angeles. Nor are Americans, or others, generally concerned with the incursion of a host of tropical diseases spreading across areas of poverty in the southern United States. Simply, we have assumed these localized outbreaks of evolving microbes will remain treatable by one or another modern drug. Where they are not, we pay little attention because they are isolated, localized, and thus the sole responsibility of local authorities.

This is hubris, perhaps, but not racism. It resides instead in the assumption—false but ingrained—that modern microbial scientists can defeat any public health threat as soon as it appears. Thus, we have come to assume the epidemic curve (an 18th century observation) of an evolving disease will be truncated simply by interventions at a local level. Microbial threats will remain a local phenomenon, not the springboard for an epidemic or pandemic threat. And yet, the progress of Ebola in 2014, local outbreaks that became regional and national epidemics, follows a well-understood pattern of infection that Arrieta well understood. Our faith in modern science and its advanced pharmacologies has lulled us into thinking the old, activist model of an Arrieta is not needed. Alas, while experimental drugs show promise in combating current Ebola strains (evolving as they are), even if effective they will not be available for widespread distribution until the peak of the current epidemic curve in affected regions is well past. Whether they can be deployed will depend upon their cost. The pricing of new drugs
patented by pharmaceutical companies is, today, the sole provenance of for-profit manufacturers.

Finally, the current epidemic emphasizes what was once well understood by the 18th and 19th century “sanitarians” like Valentine Seaman. Sporadic disease events become general disasters when societies fail to provide the basic necessities of public health: adequate housing, good nutrition, and health care. Containment may restrict the diffusion of this or that disease, but as sanitarians from Valentine Seaman to Edmund Chadwick insisted, disease and ill health are at the least “predisposing causes” bred within local communities and economies. Ebola results, as do most infectious diseases, at the intersection of ecology and economy.

The conclusion, I believe, is clear. Disastrous medical situations result when once accepted basics of public health—economic and social—are ignored. Modern public health protocols have neglected, in the main, the social focus and political oversight that once dominated traditional responses to public health threats. Put another way, when facing the potential of epidemic disease, social epidemiology is public health. Early interventions to prevent outbreaks require not merely containment but attention to the social realities that promote disease generally.

Bacterial and viral evolutions are always encouraged by a well-understood set of conditions. These include urbanization in a context of accompanying deforestation that disturbs traditional ecologies. With urbanization typically comes poverty and income inequality, the result of which is the aggregation of vast groups of immune-suppressed persons in densely settled but poorly maintained cities. These in turn provide an ideal environment for the evolution of microbes displaced by urbanization, deforestation, and changes in traditional patterns of agricultural production. All of this occurs in the context of local, regional, and national travel and trade that ensure new vectors for evolving microbial strains.

From the perspective of the history of public health, Ebola is nothing new. It is instead the newest in a long line of microbial events responding to environmental changes and pressures induced by humans who are the principal vectors for their dissemination.

Disaster medicine results when the general necessities of public health (housing, nutrition, and medical care) are ignored in environments where traditional ecologies have been disturbed and human migration is active. The best of science will not be effective against a rapidly evolving bacterium or virus. To inhibit their evolution and their spread will demand that public health again be, as it once was, a socially active constituent of both medical science and political will. To ignore this activist perspective is to assume evolving microbial threats will remain safely distant from us and that the lives of those affected are, somehow, of little consequence. The history of epidemics insists the first is a faint hope, rarely answered. Philosophy insists the second is a perspective that civilized persons cannot embrace.

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COMMENTARY


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ABSTRACT

During public health emergencies of international concern such as the 2014 Ebola event, health care leaders need to educate clinicians on the front lines to make uncomfortable, but real triage decisions that focus on optimization of population health outcomes over individual care. Health care workers must consider their own protection first before direct contact with potentially contagious patients. In an era of globalization and emerging infectious disease, routine triage including evaluation of the standard vital signs must shift to include public health considerations with immediate consequences. A new “vital sign zero” should be taken at the time of initial patient evaluation to assess for risk and exposure to potentially contagious infectious diseases. (Disaster Med Public Health Preparedness. 2015;9:57-58)

Key Words: Ebola, triage, public health, infectious disease medicine, public health emergency

PROTECTION OF HEALTH CARE WORKERS AND PUBLIC HEALTH DURING INITIAL ASSESSMENT: SCENE SAFETY AND TRIAGE VITAL SIGNS

Health care providers are familiar with the classic four vital signs of pulse, blood pressure, respiratory rate, and temperature as typically measured during initial hospital triage. A fifth vital sign of pain has also been proposed. Yet, as the Ebola outbreak has illustrated, it may be unsafe to approach a patient to perform a triage assessment and collect initial vital signs if potential hazards are present. These hazards can include direct threats to first responders and other health care providers and indirect threats to the public health if a chain of disease spread inadvertently ignites.

Every EMS responder knows that “scene safety” trumps patient assessment; if you become the victim, you can no longer be the provider of patient care. Unlike a standard hazmat situation, however, with a bioagent, you cannot see a cloud of smoke or hear an explosion or smell a noxious agent or readily detect a chemical or radiological agent. While traditional teaching has been that intact skin provides adequate protection for biological weapons other than mycotoxins, Ebola is different.1-3 Secondary contamination or exposure may be possible—in fact, the bodily fluids of an infected Ebola patient can be transmitted in much the same way as a chemical agent. Furthermore, decontamination, eg, of personal protective equipment and transport vehicles, may be necessary.

Classically, we consider transmission of a biological agent with short-term lethality to health care providers to be by airborne routes (such as illustrated by World Health Organization modeling for aerosolized release of other Category A bioterrorism agents), rather than by direct contact with blood and bodily fluids.2,3 Ebola has caused us to rethink this strategy for protection of health care workers.

Advanced Trauma Life Support teaches us to assess not only ABCs in our primary survey, but also D and E, with E indicating “exposure.” Should we not also primarily assess for the risk of “exposure” to a contagious infectious disease for frontline health care providers?

GOAL OF TRIAGE

We must also understand the goal of triage and how to apply triage in different settings. Under standard operations in a hospital setting with sufficient resources, triage is performed to sort through and rapidly identify the sickest patients first. These patients would then be the first to receive treatment. In the prehospital setting with a mass casualty incident where there are sufficient resources and intact communications and transportation infrastructures, the goal of triage may be to identify which patients have the highest priority for transport to definitive care. The key decision would be which patients need the quickest access to resources available in the hospital that are not available in the field (eg, surgery for uncontrolled internal hemorrhage).

In a scarce resource environment, the goal of triage shifts from optimizing individual outcomes to maximizing population outcomes.4 When does disaster triage...

become daily triage? Sometimes it is difficult to have situational awareness that provides an accurate real-time assessment of the adequacy of resources and the extent of the population needs. Cone and Koenig discuss triage in the case of a biological agent as part of the model they developed for the chemical, biological, radiological, or nuclear (CBRN) environment. This situation can be challenging because incubation period and degree of contagiousness vary by agent. In addition, unlike Ebola according to the current state of the science, some biological agents can be transmitted from person to person before patients display signs or symptoms.

A useful triage methodology for conceptualizing a bioevent is Burkle’s SEIRV model. According to this construct, the population is categorized as susceptible, exposed, infectious, removed, or vaccinated (leading to the acronym SEIRV). It is possible that patients can present with combined conditions (eg, Ebola plus malaria, a traumatic injury, or a myocardial infarction); hence, it is important to perform an initial screening on all patients. Health care workers and the public health must be protected, yet delays in treating other emergency conditions must be avoided. Just as we must not be too focused on radiation as attention to traumatic injuries is the priority in patients exposed to a radiological dispersion device, we must be cautious to strike the appropriate balance when treating people who may have a risk of spreading Ebola. We must not let patients die from trauma or myocardial infarction while we are screening for a travel history and exposure.

PROPOSAL FOR A NEW “VITAL SIGN ZERO”

By adding a new “vital sign zero” at the beginning of triage, we can increase the likelihood of early identification of at-risk populations and provide appropriate levels of personal protective equipment to health care workers. This concept extends far beyond the current situation with Ebola and would increase our preparedness to tackle other existing emerging infectious diseases (such as Middle East respiratory syndrome coronavirus) and the, as yet unnamed, next big thing.

To protect individual health care providers and the public, vital sign zero must be taken before the others. Routine triage becomes similar to triage in a scarce resource environment where we must “do the most good for the most people,” which, at times, might not be the best for the individual patient. We should also involve palliative care experts in discussions about what to do in futile cases when risk to providers and public health may far outweigh any remote chance of benefit to the patient.

If vital sign zero is abnormal, the alarm must sound immediately. We need 24/7 access to public health (including infection control) and law enforcement authorities, whether in an out-of-hospital or health care facility setting. In addition, there is no time to change policy on the fly. Therefore, we must be proactive in developing all-hazard policies and procedures. This extends to regulation and legislation. For example, the Pandemic and All-Hazards Preparedness Act (PAHPA, P.L.109-417) legislation should be amended to include generic, descriptive language that encompasses any contagious infectious disease so that it does not have to be amended for every emerging infectious disease, as was the case when severe acute respiratory syndrome had to be added by executive order. We need to focus on managing emerging events rather than reacting to rapidly evolving, yet anticipated, situations.

Population triage is a new concept with important public health implications in today’s globalized world. We ask everyone about tetanus, but why are we not routinely screening for serious contagious infectious diseases? Let’s consider public health as the new vital sign zero!

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Journalists and Public Health Professionals: Challenges of a Symbiotic Relationship

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ABSTRACT

Journalists and health professionals share a symbiotic relationship during a disease outbreak as both professions play an important role in informing the public’s perceptions and the decisions of policy makers. Although critics in the United States have focused on US reporters and media outlets whose coverage has been sensationalist and alarmist, the discussion in this article is based on the ideal—gold standard—for US journalists. Journalists perform three primary functions during times of health crises: disseminating accurate information to the public, medical professionals, and policy makers; acting as the go-between for the public and decision makers and health and science experts; and monitoring the performance of institutions responsible for the public health response. A journalist’s goal is to responsibly inform the public in order to optimize the public health goals of prevention while minimizing panic. The struggle to strike a balance between humanizing a story and protecting the dignity of patients while also capturing the severity of an epidemic is harder in the era of the 24-7 news cycle. Journalists grapple with dueling pressures: confirming that their information is correct while meeting the demand for rapid updates. Just as health care professionals triage patients, journalists triage information. The challenge going forward will be how to get ahead of the story from the onset, racing against the pace of digital dissemination of misinformation by continuing to refine the media-science relationship. (Disaster Med Public Health Preparedness. 2015;9:59-63)

Key Words: epidemics, health communication, vulnerable populations, Ebola

Reporting about the Ebola outbreak in West Africa has presented a host of challenges and ethical dilemmas for journalists just as the epidemic has presented a host of challenges for health care professionals facing local resource shortages, rapid transmission, shifting protocols, and ethical decisions. In covering a disease outbreak media professionals have a symbiotic relationship with health care professionals as both professions play an important role in informing the public’s decisions and perceptions as well as those of policy makers.

Although critics have focused on US reporters and media outlets whose coverage has been sensationalist and alarmist, the discussion in this article is based on a potential ideal—gold standard—for US journalists. These writers and photographers would likely concur with the perspective of Wilkins1 that journalists share public health’s mission of prevention and mitigation and that they perform 3 primary functions during times of health crises: disseminating accurate information to the public, medical professionals, and policy makers; acting as the go-between for the public and decision makers and health and science experts; and monitoring the performance of institutions responsible for the public health response.1

In disseminating information, journalists covering the Ebola outbreak follow the same protocol as when covering many crises, such as natural disasters, epidemics, or even armed conflict. Their primary goal is to responsibly inform the public so that they can optimize prevention and safety while minimizing panic. This means getting as close to primary sources of information as possible and confirming that information with a second source. Just as health care professionals triage patients, journalists triage information. The 24-7 news cycle has made this process more difficult as journalists grapple with dueling pressures: confirming that their information is correct while meeting the demand for rapid updates.

Responsible media professionals understand their job is to proceed with balance and caution. Reporters should be asking themselves some important questions in the process. They need to consider whether reporting too much detail about the science of the disease will overwhelm a public that really only wants to know how they will be impacted personally. On the other hand, reporters might consider whether declining to present all of the science in order to report on a level that the greatest number of people will comprehend will simplify the health problem so
that it misleads the public or reinforces superstitions about the disease’s causal chain and biological pathway.

Journalists also face an ethical dilemma when deciding whether to identify by name a patient who has contracted the disease in question. On the one hand, identifying patients by name humanizes a story, but on the other hand, doing so risks the loss of patient privacy. These are risks that the patient may not understand when giving consent. The concept of informed consent, which is standard policy in health care, is not fully developed in journalism. Although the Health Insurance Portability and Accountability Act of 1996 (HIPAA) does not apply to reporters,7 reporters need to appreciate the consequences of identifying those who have the disease, especially when there is stigma attached to the condition. For their part, health care professionals—who were customarily reticent about revealing a patient’s personal details to journalists long before the passage of HIPAA—need to appreciate that putting a human face on a crisis is a prime way to grab the public’s attention and may facilitate the wider dissemination of important information.

In the United States and other Western nations, media professionals might wonder if their coverage should narrowly focus on their own nations or communities or if, in the case of Ebola, their reporting should focus more on the West African nations where the suffering is greatest. Why only tell the personal stories of Ebola patients in the West? Why not humanize the thousands of victims in Guinea, Sierra Leone, and Liberia? Perhaps if Western media had been more attentive to Ebola’s tragic toll in West Africa, the rush to find treatments and vaccines might have begun sooner. On the other hand, journalists might also consider if focusing on West Africa engenders xenophobia and plays into existing prejudices or creates new ones. Such responses are reflected in the calls for a blanket ban of all flights carrying passengers from Ebola-affected countries. Also, one might today speculate whether the current tendency to dismiss scientific information—as exemplified by the climate science debate—would have been mitigated had the media faced earlier the ongoing consequences of a US Congress unwilling to acknowledge the expertise of scientists who, according to Favaro,3 themselves “must be impartial arbiters of data, not political agents.”

Photojournalists play a unique role in covering a disease outbreak. They strive to balance literally putting a human face on the story with protecting the dignity and privacy of those most bearing the disease’s burden. Photojournalists who have returned recently from their reporting trips in Liberia have described their ethical dilemma in covering the Ebola story with humanity and compassion while at the same time portraying the grim reality of those suffering from the disease.4,5 Just as health care professionals grapple with prevention protocols, photojournalists have struggled to respond to mixed messages as to what precautions are necessary to protect themselves, because their work requires close proximity to Ebola patients.6,7

Journalists who embrace their role as a go-between for the public and decision makers or experts are hampered by the fact that they likely have no more than basic knowledge about health. The media industry has contracted in the face of economic losses and few news outlets have staff reporters who specialize in health coverage. The writers or photojournalists who are often dispatched to cover health crises—especially when the epicenter is in a developing country—are more likely to be those who have worked in rugged conditions such as war zones or scenes of natural disasters rather than health reporters who have a science background. Thus, a vital part of a functional symbiotic relationship between health care professionals and journalists is for the former to be mindful of the imperative to communicate clearly and forthrightly so as to facilitate comprehension of an epidemic’s science by journalists whose message will likely be the public’s primary source of information. As do journalists, researchers and epidemiologists must consider the audience they are trying to reach and communicate in a language that the broadest range of people will comprehend.

For the most part journalists provide the primary conduit for health officials’ messages to the public. Thus, it is in the interest of public health officials to do their part in providing the information that reporters deem necessary, not just the information that health professionals deem appropriate. The key to the symbiotic relationship is that members of both professions respect one another’s judgment of what they require in order to perform their respective roles. Moreover, despite frustrations with public misperceptions about Ebola—some of which have been fostered by irresponsible media coverage and some of which are the product of Internet rumors—it is the responsibility of public health representatives and medical personnel to be forthright and accessible in order to facilitate education of the public and counteract the misinformation. This is the best way for public health experts to stay on top of the story and to be out in front of any panic.

UNINTENDED CONSEQUENCES
In their determination to fulfill their role in disseminating information to the public, media outlets might seriously consider if the material they print or broadcast may have unintended consequences such as poor mental health outcomes. A growing body of research has found adverse psychological outcomes associated with high exposure to media coverage of crises.8,9 On the other hand, concern about this consequence should be weighed against the possibility that too little coverage endangers the public by minimizing the need for precaution. In the case of Ebola, the media has a serious responsibility to inform but not inflame, motivate but not induce panic, and create empathy while
not exploiting the victims. With new or unfamiliar crises these journalistic tasks become even more complex and politically risky.

THE “ATTENTION CYCLE”: JOURNALISM, EPIDEMICS, AND PANDEMICS

Downs\textsuperscript{10} labels journalistic coverage trends “the attention cycle.” He identifies five stages. The first is the “pre-problem stage” when experts are aware of an adverse condition but the public has not yet caught on. This is followed by the “alarmed discovery and euphoric enthusiasm” stage when the public is not only cognizant of a problem but also agitated. The advent of the third stage, “realizing the cost of significant progress,” arrives when the public realizes the economic, technological, or social costs of resolving a crisis. The “gradual decline of intense public interest” is after a discouraged public learns not to expect a quick cure. The final “post-problem stage” is when a problem has persisted long enough that it is no longer a focal point and “moves into a prolonged limbo.”

The “attention cycle” for coverage of epidemics and pandemics closely fits the model Downs describes. In coverage of health issues, the cycle’s stages are correlated with how close to home the disease seems to hit. For example, in the early days of the HIV/AIDS pandemic, media response in the United States was initially slow when the disease appeared to be confined to high-risk groups such as homosexuals and intravenous drug users. At that time there was little interest by journalists except for those who worked in cities with large homosexual populations such as San Francisco. Thus, the wider public had not yet caught on to the outbreak. However, when there was found to be a risk to the general population—starting with the infection of hemophilia patient Ryan White who contracted HIV from a blood transfusion—media coverage intensified and the public was alarmed about the risk of contracting the disease.\textsuperscript{11} Moreover, much of that early coverage, which characterized the behavior of the at-risk populations as aberrant, contributed more to the disease’s stigma than it did to understanding HIV’s transmission. Media coverage was most constructive when attention turned to precautions and behavioral changes for the public, most notably the use of condoms, and we arrived at the point when “safe sex” became a part of the lexicon.

Polling results found that at one time 75% of the public relied on news media for their information about HIV/AIDS.\textsuperscript{12} This figure is salient when considering the roles and responsibilities of journalists in covering the Ebola outbreak. But the imperative for accuracy and balance is even greater than it was for HIV/AIDS when we take into account that an increasing percentage of the public relies not on traditional news platforms for information but turns to Internet sources that may or may not be reliable. A Pew Research Center poll in 2013 found that 50% of Americans rely on the Internet for news, which is still fewer than rely on television, and the percentage that rely on the Internet among people ages 18 to 29 years is 71%.\textsuperscript{13} Thus, rumor can turn to accepted fact at the speed of broadband.

As with HIV/AIDS the intensity of Ebola coverage by Western journalists has correlated with what population is most impacted. Global reporting about Ebola has intensified with the spread of the disease to the West, despite the fact that the toll of the disease is far greater in West Africa and that the outbreak began in early 2014.\textsuperscript{14} Unlike the coverage of HIV/AIDS, the Ebola story has intensified in the United States to a disproportionate level using words such as “crisis” or “panic” to describe the disease’s status even though there have been only 3 confirmed cases in the United States plus 2 others in people who were first symptomatic while still overseas.\textsuperscript{15} Most important, if coverage of both diseases had begun at the onset of their respective outbreaks—regardless of the victims—prevention would likely have been better served.

COLLABORATION

The role that health care professionals play in media coverage of epidemics cannot be overstated and their role in any confusion about the risks and severity of the health concern in question cannot be minimized. Wilkins (p 252) discusses this in the case of the SARS outbreak in 2002:

Media coverage of SARS also makes visible an important fulcrum to leverage stronger media coverage: co-operation from the other institutions in society. While SARS focuses attention on the necessity for government cooperation, other institutions in society, particularly the scientific and medical community, are equally implicated. Journalism can be only as good as the quality of information journalists have to work with...\textsuperscript{16}

As Garrett\textsuperscript{16} points out, “If you assume the media will behave abominably, they probably will. If in contrast there is a level of mutual professional respect in play...events will unfold more smoothly for all concerned.” During the 1947 smallpox outbreak editors and health officials met and designed a mutually agreed upon strategy for persuading the population to support a vaccination campaign.\textsuperscript{16} In 2014 this story may sound quaint, but a version of this collaborative scenario is certainly a worthy goal. Skype or other electronic forms of communication have replaced the conference room as the venue for discussion; but for journalists the motivation—a desire for a seat at the table—remains the same. This seat at the table comes with the need to trespass professional boundaries for the common good. It did the mission of global health little good when, for example, Margaret Chan, the Director-General of the World Health Organization declined to meet with journalists at the World Health Assembly in Geneva, Switzerland, earlier this year.\textsuperscript{17}

It is important to understand that responsible journalists are not an impediment to the mission of public health...
professionals. They can even be an extension of that work, but only if they not only are supplied with high-quality information but also sense that nothing is being withheld. It is the withholding of information by health officials rationing information on the basis of what they think the public deserves to know that sends journalists down a path in search of details they suspect are missing. Nothing motivates writers or photographers more than the suspicion that they are being kept out of the loop. If this happens early in the outbreak, misinformation takes on a life of its own. Like any pathogen it may be difficult to contain and the transmission may be hard to stop even if we understand the pathways.

CONCLUSIONS
The Ebola outbreak illustrates well the dynamics and challenges of the symbiotic relationship of journalists and health care professionals and scientists, especially in the era of the rush of the 24-7 news cycle. While the ideal described in this commentary is far from fully realized, the importance of transforming the gold standard practice to the observed practice cannot be minimized. Going from the theoretical to the applied is critical for public health.

Some commentators have said that in the United States there is not an outbreak of Ebola but rather there is an outbreak of panic, the source of which is largely that portion of the media that, in the rush to beat their competitors, hyps every bit of information beyond its significance. However, once we wade through the fog of the 24-7 news cycle and sift through the hyperbole that has plagued the coverage of the Ebola crisis in the United States, there are key roles and responsibilities journalists possess that public health professionals can embrace. Journalists can be more cognizant of the information they report—despite the pressures of the digital era—and health experts need to work together to convey consistent clear messages and respect the role that journalists serve as their conduit to the public. Too often scientists and medical personnel utter the word “media” as if it is an expletive.

For journalists meeting the responsibilities of informing rather than inflaming requires vigilance regarding use of language in headlines and story content. For example, a newspaper story about a company that manufactures personal protective equipment said that “hospitals across the country brace for potential new cases of Ebola, which has already killed more than 4,500 people....” There was no sentence clarifying that 4500 people had died on the other side of the globe at that point and not in the United States, even though by the time this was published this should have been common knowledge. Furthermore, there was “potential” for new cases but if ever a qualifying sentence was appropriate, this was an instance. We have seen headlines such as “Man with Ebola-like symptoms taken to Boston hospital” accompanied by a sub-headline reading “Not likely patient has Ebola, hospital says.” These kind of headlines amplified the public’s nervousness. At one point a pregnant passenger from Mali, a West African country far from Sierra Leone or Liberia, who fainted on a jet-bridge was eventually removed by first responders wearing hazmat suits. Meanwhile, elsewhere a headline read, “This is how you get Ebola, as explained by science.” The latter serves the public and public health far more than do the others, but unfortunately headlines such as the latter were initially scarce, although they have become more common.

The challenge going forward will be to get ahead of the story from the onset racing against the pace of digital dissemination of misinformation. Refining the dynamics of the media-science relationship is essential to containing the outbreak of misinformation and mistrust—just as when we work to contain any other contagion.

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REFERENCES
The Ebola Threat: China’s Response to the West African Epidemic and National Development of Prevention and Control Policies and Infrastructure

Hao-Jun Fan, MD; Hong-Wei Gao, MD; Hui Ding, MD; Bi-Ke Zhang, MD; Shi-Ke Hou, MD

ABSTRACT

There is growing concern in West Africa about the spread of the Ebola hemorrhagic fever virus. With the increasing global public health risk, a coordinated international response is necessary. The Chinese government is prepared to work in collaboration with West African countries to assist in the containment and control of the epidemic through the contribution of medical expertise and mobile laboratory testing teams. Nationally, China is implementing prevention programs in major cities and provinces, the distribution of Ebola test kits, and the deployment of a new national Ebola research laboratory. (Disaster Med Public Health Preparedness. 2015;9:64-65)

Keywords: epidemics, emergency responders, infection control

Ebola virus disease (EVD), formerly known as Ebola hemorrhagic fever, is a severe and often fatal illness and one of the world's most virulent diseases. It is transmitted by direct contact with the blood, body fluids, and tissues of infected animals or people.

Repeated efforts to find a natural reservoir of the virus have produced unclear results, but the fruit bat is suspected to be a reservoir. The virus first emerged near the Ebola river in Zaire (now the Democratic Republic of the Congo) in 1976 and reappeared in South Sudan in 1979. Since then, there have been several outbreaks in rural Africa, but none has approached the magnitude of the current outbreak or have occurred in dense urban populations.

Cases in 6 African countries represent the largest EVD outbreak ever recorded. In response, a number of unaffected countries have made a range of travel-related advisories or recommendations. Experts from the World Health Organization (WHO) have declared the Ebola outbreak in West Africa an "extraordinary event" and announced a global public health risk of international spread on August 8, 2014, emphasizing that a coordinated international response is necessary.

PUBLIC HEALTH RESPONSE OF THE CHINESE GOVERNMENT

As of this writing, no one has been infected in China. However, China closely collaborates with West Africa in labor, business, and overseas education and also routinely sends medical aid and health teams to the region. Thus, the risk of importing the disease cannot be ignored. Chinese governmental cooperation with African countries is actively involved in the fight against Ebola. During the annual meeting of the Summer Davos forum in Tianjin, September 10, 2014, Premier Li Keqiang stated that China is prepared to "fight side by side" with West African countries to combat the Ebola epidemic.

CHINESE RESPONSE TO WEST AFRICA

Medical Expertise

On August 10–11, 2014, China deployed disease control expert teams as well as medical supplies into Guinea, Liberia, and Sierra Leone to provide technical assistance to local health authorities.

Economic Assistance

China has deployed 3 teams of experts and supplies by chartered air to Guinea, Liberia, and Sierra Leone. The supplies, worth 30 million yuan ($4.9 million), included medical protective clothes, disinfectants, thermo-detectors, and medicines. An additional 200 million yuan ($32.54 million) package of humanitarian aid, including food, supplies for disease control, emergency treatment facilities, and capital support are scheduled for shipment to countries as well as to international aid organizations.

Mobile Laboratory Teams

To further support Sierra Leone and to respond to the United Nations and WHO appeal, China sent a
mobile laboratory testing team, equipped with 59 medical experts who specialize in laboratory testing, epidemiology, clinical medicine, and nursing to Sierra Leone on September 16. China has additionally dispatched 115 medical experts to Liberia and Guinea. Chinese medical staff in West African countries has reached 174 in total.

INTERNAL CHINESE PREVENTION PROGRAMS

The Chinese National Health and Family Planning Commission has distributed a protocol for diagnosis, treatment, and rapid response of Ebola cases to 31 provincial health departments. Because China is involved in considerable economic and tourism travel with many countries, especially in Africa, Dong Xiaoping, a research fellow with the Institute of Virus of the Chinese Center for Disease Control and Prevention (China CDC), has warned that the virus has a risk of entering China through previously undetected individual human cases. Detection can be strengthened with individual checks at customs, although the possibility of an Ebola outbreak in China remains extremely low.

Six major governmental departments (the National Health and Family Planning Commission; the Ministry of Public Security; the General Ministration of Customs; the General Administration of Quality Supervision, Inspection and Quarantine; and the State Administration of Traditional Chinese Medicine) have set up 5 supervision groups be located in Beijing, Shanghai, and the provinces of Jiangsu, Zhejiang, and Guangdong. These groups will focus on entry and exit ports, designated hospitals, and disease control and prevention institutions to educate, train, and supervise on inspection and quarantine, as well as provide requirements and advice for prevention protocols.

Ebola Test Kits

Until now there has been no preventive vaccination or effective medications. A test kit for the Ebola virus, developed by China’s Academy of Military Medical Sciences, has received approval for mass production in Shenzhen, Guangdong province.

National Ebola Research Lab

Chinese health officials have confirmed the establishment of a high-level safety standards laboratory expected to be completed by 2015 to focus research on the Ebola virus with the intent to develop a vaccine. China CDC has expressed that “Based on the evaluation by our experts from the China CDC, we may not prevent Ebola from entering China. However, as long as it lasts in Africa, it is more likely to be brought here. We are confident that our control and prevention mechanism is able to curb its spread.”

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COMMENTARY

Mapping Medical Disasters: Ebola Makes Old Lessons, New

Tom Koch, PhD

ABSTRACT

Disaster medicine is characterized by shortages of everything but patients. There are never enough beds, equipment, personnel, or supplies. In the 2014 Ebola epidemic, another scarcity was maps. The need for maps of the affected areas, and the ways the maps were used, serve to emphasize the way maps have always served in both disaster medicine and public health preparedness. Those lessons are reviewed here in the context of the Ebola epidemic. (Disaster Med Public Health Preparedness. 2015;9:66-73)

Key Words: disaster medicine, disaster planning, disease outbreaks, medical cartography, spatial epidemiology

For researchers, what is now officially known as the West African Ebola virus disease epidemic has been something of a boon. “It’s a very serious epidemic, but everything has a silver lining,” the Director of Development Research for the African Development Bank told reporters.1 In response to the epidemic, millions of dollars of research-related dollars have flowed into the region. And, too, popular and professional attention was focused on countries that are too often ignored. For medical and public health professionals, however, it is difficult to see the epidemic as anything but a human disaster. For personnel in the field and for those who support them, the real issue is what can be learned to prevent future disasters and to ensure that future infectious disease outbreaks can be better contained and, where containment is impossible, more effectively managed.

There are lessons to be learned. For example, in the best of conditions and with fulsome international effort, it will take at least 12 to 18 months before a vaccine can be designed, tested, and approved for general use. Even if a vaccine or prophylactic treatment is available, it will require months before contracts are signed for ramped-up production of medicines that must then be distributed to regional centers for eventual delivery to patients living in far-flung, isolated regions.

In the interim, older disaster medicine and public health protocols must be enacted. This article reviews the utility of medical mapping as one of those areas of traditional response. The argument will be that field mapping as a surveillance system, and more generally as a tool of field medicine and public health, is a critical instrument in the identification, investigation, and treatment of isolated outbreaks threatening epidemic expansion.

MEDICAL MAPPING

Since the late 17th century, mapping has been a critical tool used by physicians and public health officials confronting local outbreaks, regional epidemics, and broad pandemic events.2 Since the late 18th century, mapping has also served as a fundamental medium for the presentation and testing of theories of disease incidence and transmission.3 In the early 20th century, disease mapping was widely taught as a principal technique in “sanitary science,” the forerunner of modern epidemiology and public health.4 Its prominence continued through most of the century.

In recent years, however, medical mapping has been assumed by some to serve illustratively but not substantially in disease management and study. It has been used primarily as at best a pictorial summation of the analytic calculations underlying a primarily statistical “spatial epidemiology.”5 Much of that work has focused on a general consideration of disease incidence on global and regional scales.6,7 Other studies have used mapping as an investigatory medium for the analysis of specific disease ecologies.8 Whatever their scale or specific subject, all maps perform two critical functions, one existential and the other geographic.9 All maps argue the existence of something in a place. “This (cholera, Ebola, tuberculosis) is here (this street, town, county, country).” Second, individual cases (the rows in a dataset) are
presented as similarly symbolized members of a single event class. This transforms a set of distinct occurrences into parts of a single thing (The Epidemic).

The central thesis of medical mapping is that disease events have a spatial structure based upon the locational incidence of mortality and morbidity in an environment whose individual constituents promote or retard the progress of a specific disease. By defining different events as members of a single class, and positioning them in relation to other event classes, a set of dynamic relational structures with explanatory and prescriptive potential is enacted.

It is not simply the commonality of events of a similar nature but the relations between them (usually based upon density and distance) that is important. For example, maps of cholera incidence typically will include a second event class of local water sources, one or more of which is the suspected source of an outbreak. In public health mapping, classes of disease incidence are mapped with classes of available clinic and hospital resources if it is a question of resource availability and allocation.

### Ebola Mapping

Perhaps the earliest map of Ebola was included in a March 24 report issued by the Republic of Guinea’s Health Ministry. The map identified 4 adjacent prefectures, distinguished by red hatching, in which Ebola had been confirmed: Guéckédou, where the majority of deaths had occurred; Macenta; Kissidougou; and N’Zérékoré. In the map the names of neighboring countries (Liberia, Mali, Senegal, and Sierra Leone) were lettered but otherwise not distinguished. The map thus argued a limited outbreak in 4 provinces of 1 country. The potential for disease diffusion to neighboring countries was implicitly denied in this manner. The map conformed to the assumption that, like previous outbreaks beginning in the 1970s, this one would be spatially contained in non-metropolitan, interior areas.

In its March 27, 2014, report, the World Health Organization (WHO) similarly mapped all national prefectural boundaries, coloring red those reporting active Ebola cases (Figure 1). That map included the coastal prefecture of Conakry and its port city of the same name where 4 cases were confirmed and a fifth was suspected. That brought the total number of confirmed Ebola cases to 103. The possibility of other new infections was being investigated, at that time, in only 2 adjacent provinces, which were colored pink.

For a medical geographer, the WHO map, but not the Ministry of Health’s map, would have raised a warning flag. A slow diffusion from Guéckédou to neighboring districts would be expected and could potentially be managed with local containment and treatment programs. But a hotspot on the nation’s capital, Conakry, promised the likelihood of an expansive epidemic. Localized in central provinces with sparse populations, the Ebola outbreak would, presumably, be containable and short lived. But an outbreak in Conakry, the nation’s capital with an estimated population of nearly 2 million persons, was something else. Here was the possibility of a large outbreak in an urban population in a city with maritime and other connections to cities in the region and the world.

The questions the first Conakry cases raised were thus exigent. Were they an independent, unrelated outbreak or was the source the Guéckédou outbreak? If the latter, as seemed likely, were the Conakry cases the result of person-to-person transmission or something else (perhaps a food source)? If the outbreak in Conakry was expansive rather than independent, if Ebola was traveling, where else might it soon appear?

If, in retrospect, the epidemic that resulted was an “avoidable crisis,” as some have argued, here was where it might have been stopped. Early symptoms of epidemic expansion posted in national prefectural maps were ignored, or at the least, not sufficiently credited. Experts assumed reasonably, but in the end inaccurately, what the March WHO map denied: Ebola was always a highly localized, short-term, typically rural event. A complex of factors ranging from regional poverty, a minimal health infrastructure, poor communication between attending agencies, and an environment conducive to viral expansion all contributed to the outbreak. But the failure to see in this and subsequent early disease maps the epidemiological signs of expansion delayed a series of potentially effective interventions.

### Epidemic Expansion

As the epidemic matured, the scale of the maps expanded beyond the Republic of Guinea to permit inclusion of cases confirmed in adjacent countries. By the summer of 2014, the resolution of these maps increased to permit the mapping of relative incidence in various cities in the region (Figure 2). In these “dot maps” the size of the circle was based on the number of reported cases. In some maps, pie charts were used to distinguish between “confirmed,” “probable,” and “suspected” cases in a city or town. In official reports by the WHO and others, graphs of the increasing epidemic curve—in cities and across the region—were included based on the same data as the maps. Eventually, maps of the regional epidemic included a third event class in which hospitals and medical facilities were included. These did not, however, include institutional capacity (number of beds, doctors, and nurses, etc) and patient loads. Had those data been included, the inadequacy of existing medical resources—local and international—would have been immediately evident.

These dot maps, which were widely reproduced in international newspapers, served as evidence of a serious, expansive epidemic.
Expansion into Conakry and Freetown (Sierra Leone) and Monrovia (Liberia)—larger port cities—signaled potential pandemic expansion. The maps argued, simply, “this (epidemic) is here and it might soon be everywhere.” Increasingly, maps of potential pandemic occurrence, and then international cases involving former health workers, were published.

**Local Mapping**

When the first cases of Ebola hemorrhagic fever were reported in March 2014, Swiss-based Médicine sans Frontières (MSF) quickly dispatched an epidemiological team to Guéckédou, Guinea, the epicenter of what was to become a regional epidemic. The MSF team included a geographic information systems (GIS) specialist who, over an 8-week period, created 109 maps of local roads, landmarks, and villages, in Guéckédou prefecture. In a region without existing maps of affected towns and villages, this was critical. Without these maps, tracking the incidence of Ebola across the villages and towns of a region was difficult. Approximately 60% of the GIS specialist’s time therefore was spent on producing way-finding maps of the roads and villages in the region; the remainder
was used to create maps that addressed public health concerns over the location of water, hygiene, and sanitation teams. Only a few maps were made to serve epidemiological investigations.

In recent decades, mapping has been transformed from a manual to a digital skill with the use of computer-based GIS programs. Before the MSF team’s departure, a general map of the Guéckédou region was traced based on satellite images of the region. In this process, a satellite image of the target area is displayed in a program permitting streets, buildings (homes, hospitals, schools, etc.), and biogeographic elements (lakes, streams, etc) to be constructed as separate digital event classes. The result is at once spatially precise and easily modified when new data become available (for example, patient location). These satellite-based computer maps are typically composed of lines (for streets), points (precise locations), and polygons (biogeographic and political boundaries) and can be easily printed or digitally distributed.

The resulting way-finding maps were critical for foreign field workers unfamiliar with the region. Without them, getting from medical sites to local villages would have been impossible. Also, the maps permitted a picture of the spatial

FIGURE 2


By August, maps were describing a regional outbreak with varying mortality in various cities across West Africa.  
http://apps.who.int/iris/bitstream/10665/131974/1/roadmapsitrep1_eng.pdf?ua=1.15
spread of the epidemic to be ascertained. Within the target prefecture, for example, 14 separate villages were named “Bendou.” Identifying which Bendou was the home of a specific patient was potentially critical to those tracing the chain of disease transmission and to others attempting to understand the general structure of the district epidemic.  

“The challenge is good information, because information helps tell us where the disease is, how it’s spreading and where we need to target our resources,” a United Nations emergency response official told reporters in October 2014.  

Unfortunately, we don’t have good data from a lot of areas. We don’t know exactly what is happening.” Mapping was a critical medium in which data on “what is happening” could be collected, organized, analyzed, and presented. Because local and foreign workers often spoke different languages, maps served as a lingua franca promoting shared knowledge among those who otherwise had difficulty communicating.

**HOT Mapping**

As the epidemic expanded, detailed and accurate maps of newly infected towns and villages across the infected territory were similarly unavailable. Innovatively, MSF and Red Cross International decided to crowdsourc the task of mapping these newly infected, previously unmapped towns and villages.  

The idea had been tried before but never at this scale. Hundreds of international volunteers were invited to join the “missing maps” project organized by Humanitarian OpenStreetmap (HOT). Participants registered, logged in online, and were directed to satellite maps of towns or villages where maps were urgently required by ground personnel. In some countries, “HOT parties” were organized for volunteers.

“Firstly,” the website of the program instructed, “we need to trace the features of the target location. Using aerial photographs as a backdrop, we can literally trace road networks, buildings and landmarks to build a line drawing of the area.”  

Once a contributor’s work was saved to the website, it was integrated automatically into the cooperatively constructed evolving map. Local personnel then added the names of buildings, neighborhoods, lakes, roads, etc, to the digital construct. Those were then uploaded to volunteers who entered them into the map’s final version. As a result, what otherwise would have taken weeks of individual labor required only a few days per map.

**Epidemic Mapping**

Inclusion of a GIS expert resulted from an earlier MSF study describing epidemiology as “the domain where GIS can bring the most positive evolution.” Yet, the potential contribution of mapping to the medical effort was hampered by ignorance...
about the uses of maps in an epidemic environment. “Most MSF staff know very little about GIS in general, let alone how a GIS officer could support them.” As a result, the GIS team member spent relatively little time contributing to epidemiological studies.

That MSF team members knew little about the use of maps in epidemic studies and public health initiatives was unfortunate. Beginning with the mapping of yellow fever in late 18th century cities, maps have served as a vehicle through which an infectious chain of transmission can be traced in an effort to uncover the source of an outbreak. Figure 3 is a typical illustration of this kind of mapping by W. H. Frost, a US epidemiologist investigating a poliomyelitis outbreak in Mason City, Iowa, in 1912. The mapped approach was based on techniques developed for single-source, bacterial disease outbreaks such as cholera and typhoid fever in the 19th century.

In the current Ebola outbreak, transmission mapping at the beginning of the outbreak might have alerted field medical personnel that the outbreak that they thought was contained in May was in fact expanding. Mapping of affected persons and their travels during the period of disease incubation almost certainly would have described what was only later recognized. Citizens of Meliandou, where the epidemic’s 2013 index case was eventually located, and Guéckédou in Guinea lived in a porous border region across which Kissi-speaking persons regularly traveled into Liberia and Sierra Leone. The effort to contain the disease in Guinea was therefore doomed without a cooperative effort by all 3 countries to contain an outbreak in a shared region. “The most tragically missed opportunities stemmed from the poor flow of information about who was infected and whom they might have exposed.” That failure of information was more geographic than medical, and thus potentially reportable via mapping of local travel patterns.

FIGURE 4

The extent of the map is roughly congruent with the area most affected by the virus. 

http://elifesciences.org/content/early/2014/09/05/eLife.04395.
Investigatory Mapping

Medical mapping has served as a means to both develop and test theories about the environmental origins of infectious disease outbreaks. In this case, increasing attention was paid to the possibility that the outbreak was promoted not only by person-to-person transmission but also through the food chain in which wild animals ("bush meat") served as a local protein source.\(^{22}\) Of special interest was the prevalence of fruit bats, a primary protein source in local diets.\(^{23}\) Bats have been previously implicated in the transmission of several diseases, including Ebola, MERS, SARS, and Marburg hemorrhagic fever.\(^{24}\) Thus, by the autumn of 2014 some disease ecologists were mapping the natural territory of bats both as a way of considering their engagement in this epidemic and in a first assessment of the potential of the Ebola virus to spread to other areas in Africa with robust, shared bat populations.

Figure 4 by Pigot et al\(^{23}\) is one of a series of maps of bat species suspected as potential West African Ebola reservoirs. The dots on the map locate observation points used to identify the species' spatial range. Coloration, yellow to green, describes the relative probability of the presence of the target species, in this case the little colored fruit bat (Myonycteris torquata).

Public Health Preparedness

Epidemics and pandemics are composed of a set of localized outbreaks in which scarcity typically reigns. There is never enough equipment: beds, medicines, or ventilators are in short supply; doctors and nurses are overwhelmed by patient volumes. In localized events, those shortages typically are quickly relieved through the support of neighboring health districts or federal assistance. This was the case in the United States, for example, following Hurricane Katrina.\(^{25}\) That becomes less possible, however, in a disease event affecting a broad geography when shortages of equipment and personnel become regional rather than local. This was especially true during the West African Ebola epidemic where existing health infrastructures were, at the start, at best minimal.\(^{26}\)

Mapping provides an essential medium in which at-risk populations can be first estimated and then matched with probable care needs early in an outbreak. Algorithms exist for the estimation of disease transmission rates, incubation periods, and the reproduction number of specific viruses, including Ebola.\(^{27}\) Other algorithms permit rapid population estimates based on the density of buildings and, if available, housing density in specific communities. Knowing where existing cases are, and the extent of public health resources available for their treatment, permits public health responders to not only provide more efficiently what is needed but estimate what likely will be needed in different disease scenarios.

DISCUSSION

It is easy to look back and see what, during a crisis, was unclear. None of this is to be taken as criticism of the extraordinary efforts of MSF, Red Cross, or WHO personnel. Nor is it meant as criticism of the efforts of medical or public health officials in the affected countries. Rather it is to suggest that lessons may be learned to limit potential epidemics in the future and to better care for both those affected and the personnel who care for them.

A signal lesson of local, national, and international responses to the 2014 Ebola epidemic was the failure to immediately recognize the dynamic and expansive nature of the event. Some blamed the WHO and the budget cuts that had decimated its roster of experienced personnel.\(^{28}\) Others blamed systemic regional poverty, the effects of deforestation, and a history of conflicts.\(^{29}\) These were critical and their importance is not to be underestimated.

Instead, I argue here that the failure to contain the outbreak at its onset resulted in part from its expansion being unnoticed, unseen. Workers on the ground warned of an emerging epidemic, but without detailed and shared maps, those warnings apparently were discounted. The paucity of maps appears to have contributed to a failure by both local authorities and the international community to “connect the dots” and then react aggressively and proactively to dynamic outbreaks in various locales with, in retrospect, obvious epidemic potential.

Among the lessons of the Ebola outbreak, therefore, is the need for rigorous medical mapping as soon as the presence of potentially contagious outbreaks is noted. Accompanying these incidence maps can and should be others describing medical resources, populations, and, at another scale, proximity to neighboring, potentially at-risk populations. Those data would serve to create a better early warning system of outbreaks threatening epidemic status. With that early warning, localized interventions can be planned.

This will require the engagement of persons trained in mapping the epidemiology of disease events and the public health issues surrounding them. It will require those persons’ knowledgeable participation in systems of international, regional, and local disease planning and surveillance. Doing this work in map-poor environments with few clinical resources and a range of cultures and languages presents specific challenges. A future article will detail the nature and potential of field mapping in such environments as a practical adjunct to medical care and public health initiatives.

If Ebola taught us nothing else, it served as a reminder—if one is truly needed—that local and regional health crises are always potentially international in nature. Yesterday’s outbreak “there” may become ours tomorrow “here.” Communicable and infectious diseases spread across the globe in predictable ways and, in the map, the necessity for cooperative responses to disease events can be seen, assessed, and collectively confronted.
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BRIEF REPORT

Ebola Virus Disease: Preparedness in Japan

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ABSTRACT

The current outbreak of Ebola virus disease (EVD) is due to a lack of resources, untrained medical personnel, and the specific contact-mediated type of infection of this virus. In Japan’s history, education and mass vaccination of the native Ainu people successfully eradicated epidemics of smallpox. Even though a zoonotic virus is hard to control, appropriate precautions and personal protection, as well as anti-symptomatic treatment, will control the outbreak of EVD. Ebola virus utilizes the antibody-dependent enhancement of infection to seed the cells of various organs. The pathogenesis of EVD is due to the cytokine storm of pro-inflammatory cytokines and the lack of antiviral interferon-α2. Matricellular proteins of galectin-9 and osteopontin might also be involved in the edema and abnormality of the coagulation system in EVD. Anti-fibrinolytic treatment will be effective. In the era of globalization, interviews of travelers with fever within 3 weeks of departure from the affected areas will be necessary. Not only the hospitals designated for specific biohazards but every hospital should be aware of the biology of biohazards and establish measures to protect both patients and the community. (Disaster Med Public Health Preparedness. 2015;9:74-78)

Key Words: zoonoses, disaster medicine, infectious disease medicine, Ebola, infection control

One of the factors in the loss against the current outbreak of Ebola virus (EBOV) is cultural disparity. In the ancient days of Japan, when knowledge of modern medicine was lacking, people would pray to the gods against infectious disease, and many historical shrine activities arose from such diseases. Historical descriptions of smallpox eradication may help to overcome differences in civilization.

The history of smallpox vaccination dates to 1796, when Edward Jenner demonstrated the resistance of inoculated individuals to smallpox. Description of smallpox was found from AD 735 at Kyushu in Japan, and even the emperor suffered from the disease. Masamune Date Tohoku Shogun (1567-1634) also suffered from smallpox and lost his left eye. Japan closed the door to the rest of the world from 1639 and prohibited trading with any foreign countries except China and Holland. The isolation brought peace for 300 years, except that syphilis had already entered Japan around 1520 and was endemic in large cities. The national isolation, however, delayed nationwide Jennerian vaccination until 1849 when a German doctor, Dr. Otto Mohnike, successfully vaccinated one child in Nagasaki, Japan.1 In 1854 Japan concluded a commercial treaty with the United States, and modern civilization including knowledge of medical science proceeded as a result of the Meiji revolution. The Compulsory Vaccination Act was passed in 1886 in Japan.

The first compulsory mass vaccination was performed in 1857 among the Ainu people in Hokkaido, who are regarded as descendants of the pre-agriculture native population of northern Japan, because they had suffered periodically from serious epidemics of smallpox. More than 6000 Ainu people were successfully vaccinated, and the ongoing population decrease of the Ainu was terminated.2,3 This event was painted as a memorial representing successful vaccination and was given to the local government 150 years ago. The description attached reads that the Ainu people feared vaccination and some fled into the mountains. Therefore, the government gave rice, clothes, and money to encourage acceptance of the vaccination, as shown in the picture (Figure 1). The picture also shows two doctors performing vaccinations by using lancets. This picture also implies that any intervention against microorganisms should be conducted carefully for human security, even though great beneficial effects can be anticipated for society.1

Through similar such efforts, the World Health Organization declared the eradication of smallpox worldwide in 1980, 1 year before the human
immunodeficiency virus (HIV) endemic started. Coincidentally, the Ainu people’s infection with human T cell leukemia virus (HTLV)-1 was also known. This extraordinary achievement was accomplished through the collaboration of countries around the world. The success is partly because smallpox infection is not a zoonosis. EBOV is a zoonotic pathogen carried by various species of fruit bats and monkeys that are present throughout central and sub-Saharan Africa. We should also prevent the infection of EBOV to animals in our country from imported cases.

PATHOGENESIS OF EBOV AND OTHER HEMORRHAGIC VIRUSES
Because disease containment during outbreaks is the first priority, it has been difficult to study the pathogenesis of
human EBOV infection. In a study of EBOV-infected monkeys, an increase in d-dimer was observed after 24 hours and 2 days later, while activation of protein C was decreased. This phenomenon is due to a reduction in coagulation proteins associated with liver failure caused by viral infection. The platelets did not decrease until 3 to 4 days. To quickly determine a patient’s disease state, it is important to monitor changes in the coagulation system. Such reactions can also occur in other infections. However, the severe symptoms of Ebola virus disease (EVD) are presumably due to the specific mechanism of the infection. According to a study by Takada et al in Hokkaido University, the mechanism in many organs of the body is the presence of antibodies to EBOV surface glycoprotein, which enhances the infectivity of the virus by crosslinking cells and glycoproteins via the Fc receptor or the complement component C1q/C1q receptor complex on the cell surface. This mechanism is a new concept of an antibody-dependent infection enhancement.

A few studies using Luminex have been reported, and the first report showed a “cytokine storm,” with hypersecretion of numerous pro-inflammatory cytokines, chemokines, and growth factors and the noteworthy absence of antiviral interferon (IFN)-α/β. Immunosuppression was characterized by very low levels of circulating cytokines produced by T lymphocytes and by massive loss of peripheral CD4 and CD8 lymphocytes, probably through Fas/FasL-mediated apoptosis. In contrast, another study showed low levels of pro-inflammatory cytokines and high levels of immunosuppressive cytokines like interleukin (IL)-10.

Molecular pathogenesis in similar symptoms caused by other viruses could give a clue to the pathogenesis of EVD. In the infection of dengue virus (DENV), another hemorrhagic virus, IL-10 followed by IFNγ-induced protein-10 (IP-10), IL-18, and Galectin-9 (Gal-9), a matricellular protein (MCP) were remarkably enhanced. Gal-9 is reported to be produced by both T and endothelial cells and is recognized as a bidirectional immunoregulator. We also reported a marked elevation of Gal-9 in acute HIV infection and a rapid decrease after anti-retroviral therapy. Gal-9 could be a potential danger signal biomarker of acute virus infection.

In an animal model of EBOV infection, immunosuppression, increased vascular permeability, and impaired coagulation have been identified as hallmarks of the disease. Gal-9 is also known to induce apoptosis of Th1 cells and may contribute to the apoptosis of T cells in EVD.

We believe MCPs may play a primary recovery function of virus infection because all infection and inflammation are associated with edema, in which the accumulated fluid is rich in MCPs. In addition to Gal-9, we have examined if another MCP, osteopontin (OPN), is involved in acute virus infection. Proteolytic cleavage of OPN by thrombin (between Arg168 and Ser169) generates a functional fragment of N-terminal OPN (trOPN). In DENV infection, plasma leakage associated with mild thrombocytopenia is frequently observed in dengue shock syndrome under fatal conditions. The levels of OPN, trOPN, d-dimer, thrombin-antithrombin complex (TAT) protein, and thrombomodulin (TM) are significantly elevated in the critical phase in both dengue fever (DF) and dengue hemorrhagic fever (DHF) patients as compared to healthy individuals. During the recovery phase, OPN levels declined whereas trOPN levels further increased dramatically in both DF and DHF. The OPN level was found to directly correlate with d-dimer and ferritin levels, whereas the generation of trOPN was positively associated with the TAT level, platelet count, and viral RNA load. These findings indicate that OPN and trOPN could reflect immunocoagulation cross talk and high trOPN levels could reflect recovery. Studies of the roles of MCPs in inflammation and coagulation abnormalities in DENV or HIV infection would help to elucidate the pathogenesis of EVD.

**INFECTION PREVENTION AND INFECTION ROUTE**

The source of infection of EBOV is direct contact with blood, saliva, sweat, secretions, or excretions from patients with symptoms. Patients with symptoms that have disappeared and patients who have died can still transmit infection. Because EBOV is only transmitted by contact with body fluids, further infection is suppressed by thorough precautions such as wearing gloves and gowns when touching the infected person. For infection control, the following are important in preventing transmission:

1. Hand hygiene, 2. Use of personal protective equipment (PPE; e.g., gloves, gowns, masks), 3. Safe injection practices, 4. Handling of potentially contaminated equipment or surfaces in the patient environment, and 5. Respiratory hygiene/cough etiquette.

**HANDLEING OF PATIENTS IN JAPAN**

There has been time to carefully consider the response in Japan, which lies 14,000 kilometers from West Africa and has no direct flights from the affected area and no EBOV generation in neighboring countries. However, in this era of global transportation, we must establish a system that can handle suspicious travelers with fever from endemic countries who passed the first check at the international port or airports. In the Japanese Act Regarding Infectious Disease, EBOV is classified as a type 1 infectious disease (http://www.mhlw.go.jp/english/wp/wp-hw3/dl/2-083.pdf). As of April 2014, there are 44 hospitals (84 beds) throughout Japan that have designated beds for class 1 infectious diseases.

Correct diagnostic processes and appropriate precaution and isolation to prevent outbreak are vital. Interviews with patients with fevers >38 °C are critical. We first ask immigrants and returnees whether more than 21 days have passed since they left the countries where EVD is prevalent (Guinea, Liberia, Sierra Leone, Nigeria, Democratic Republic of the Congo, Uganda, Sudan, Gabon, Cote d’Ivoire,
Republic of Congo, and Senegal). If only fever is present, they are observed as an inpatient or outpatient. The differential diagnosis includes malaria, typhoid fever, shigellosis, cholera, leptospirosis, plague, rickettsial disease, relapsing fever, meningitis, hepatitis, and other viral hemorrhagic fevers. In the case of continued fever, intense weakness, muscle pain, headache, sore throat, vomiting, diarrhea, rash, kidney failure, liver dysfunction, external or internal bleeding with a decrease in white blood cells and platelets, or an elevation of liver enzymes, we proceed to the next step.

Patients are transported to medical institutions designated for class I or class II infectious diseases as suspect cases designated EVD. Class I and class II infectious diseases are defined in the Prevention of Infectious Diseases and Medical Care for Infectious Patients Act. Class I corresponds to Centers for Disease Control and Prevention category A and includes pathogens that have a “very serious” influence on the health and life of people (matching). Class II includes pathogens that have a “serious” impact on the health and life of people. Samples of blood or tissue from patients should be sent to the National Institute of Infectious Diseases for a definitive diagnosis. Samples are an extreme biohazard risk; laboratory testing on non-inactivated samples should be conducted under maximum biological containment conditions. Similar measures are taken with a person who is in contact with the body fluids of a person or animal diagnosed with EVD or suspected to have EVD.

After in-hospital diagnosis of temporarily suspected cases, sending the patient to the medical institution designated for class I is virtually impossible because transportation of the patient increases the probability of spread of the infection. Patients will be placed in isolation and medically treated at the hospital that performed the first medical examination even if it is not a designated hospital. Thus, in all hospitals, it is always necessary to conduct measures to control communicable diseases. It is necessary to determine the hospital policy for handling patients suspected of having class I or class II infectious diseases. For proper medical treatment, the instruments for biochemical and coagulation tests are required in the patient’s room, which must properly handle drainage for class I infection, and a designated X-ray machine in the hospital ward is also necessary. Standard and contact precautions and appropriate sterilization of the instruments will sufficiently prevent nosocomial infection and outbreak.

**TREATMENT**

Patients are given only symptomatic treatment without antiviral agents, because we do not have any effective antiviral medicine at present. The three classifications of disseminated intravascular coagulation (DIC) that must be attended to in EVD are fibrinolytic system suppression, fibrinolysis balance, and hyperfibrinolysis. EVD is presumed to target the hyperfibrinolysis type. For coagulation therapy, the serine protease inhibitor and antithrombin III is preferred over other forms of anticoagulant therapy. If necessary, a transfusion of platelet concentrate or fresh frozen plasma may be considered. Recombinant thrombomodulin (TM) forms a thrombin-TM complex and suppresses thrombin. Protein C (APC) is activated by a thrombin-TM complex and inhibits thrombin generation under protein S. APC also promotes the activation of thrombin-activatable fibrinolysis inhibitor (TAFI) and exerts anti-fibrolytic activity. APC exerts anti-inflammatory effects by binding to protease-activated receptor (PAR)-1. A thrombin-TM complex suppresses inflammation directly by adsorbing high mobility group box (HMBG)-1 released from necrotic cells, activated by macrophages. It is important to know that bleeding and DIC in EVD can be controlled by using these medicines.

The product ZMapp is a combination of three different monoclonal antibodies that bind to the protein of EBOV. It is too early to conclude whether ZMapp is safe and effective because it is still in the experimental stage and has not yet been tested in humans as a clinical trial. The establishment of careful outcome-based evidence is required.

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Ebola Virus Disease: Preparedness in Japan

Favipiravir (Avigan) is a new antiviral medication developed by Fuji Film Company and Toyama Chemical with effectiveness against viral infectious diseases such as Ebola virus,\(^1,2\) 2009 pandemic influenza H1N1 virus,\(^3\) Lassa fever, and Argentine hemorrhagic fever.\(^4\) Favipiravir, which is also known as T-705, is an experimental antiviral drug with activity against many RNA viruses. Similar to other experimental antiviral drugs (eg, T-1105 and T-1106), it is a pyrazinecarboxamide derivative. Favipiravir is active against influenza viruses, West Nile virus, yellow fever virus, foot-and-mouth disease virus, and other flaviviruses, including arenaviruses, bunyaviruses, and alphaviruses.\(^1,2\) Favipiravir does not inhibit the RNA involved in DNA synthesis in mammalian cells and is therefore not toxic to the host.\(^1\)

Several laboratory studies have shown the effectiveness of favipiravir against Ebola virus. Oesterreich et al. showed that favipiravir administration to mice infected with Zaire ebolavirus on day 6 after infection induced rapid viral clearance, reduced biochemical parameters of disease severity, and prevented a lethal outcome in 100% of the animals.\(^5\) The United Kingdom Ministry of Defense showed that favipiravir gave 100% protection against aerosolized Ebola virus infection, and protection was shown in immune-deficient mice after 14 days of twice-daily administration.\(^1\) These studies suggested that favipiravir might be useful for the treatment of Ebola virus disease, including pandemic outbreaks, although no clinical trial has yet been performed.

**CURRENT STATUS OF EBOLA VIRUS INFECTION**

Ebola virus disease (EVD or simply Ebola) is a severe, often fatal disease in humans. Several outbreaks of EDV have been identified as occurring before 2014.\(^5\) The first known outbreak of EVD was identified between June and November 1976 in South Sudan, and the second major outbreak occurred in 1995 in the Democratic Republic of Congo.

The World Health Organization recently updated the global situation of EVD to include 4555 fatalities among 9216 patients as of October 17, 2014. The details are listed in Table 1, by country.\(^6\) The center of the outbreak is in West Africa, and the first case was suspected to have occurred in Guinea in December 2013.

EVD, formerly known as Ebola hemorrhagic fever, is introduced into the human population through close contact with the blood, secretions, organs, or other bodily fluids of infected animals. Ebola then spreads in the community through human-to-human transmission, with infection resulting from direct contact (through broken skin or mucous membranes) with the blood, secretions, organs, or other bodily fluids of infected people and indirect contact with environments contaminated with such fluids. Burial ceremonies in which
mourners have direct contact with the body of the deceased person can also play a role in the transmission of Ebola. Although local and international health agencies have made maximum efforts to control the outbreak, EVD continues to spread globally. On August 8, 2014, the World Health Organization declared the Ebola outbreak an international public health emergency.

One of the major issues surrounding EVD is the fact that many health workers are at risk of infection and potentially death. On July 29, Sierra Leone’s top Ebola doctor, Sheik Umar Khan, died of complications of EVD. Two US citizens, Dr. Kent Brantly, who was working with an aid organization in Liberia, and Nancy Writebol, a Christian missionary in Liberia, were transferred to Emory University Hospital in Atlanta, Georgia, for the treatment of complications from Ebola virus infection. Before their evacuation from Africa, ZMapp, an experimental biopharmaceutical comprising three humanized monoclonal antibodies under development as a treatment for Ebola virus disease, was administered. The condition of both patients improved, and both Brantly and Writebol were released from the hospital later. Miguel Pajares, a Roman Catholic priest, was transferred from Monrovia, Liberia, to Spain on August 7 after being infected with Ebola. He was also given ZMapp. Two days after receiving the drug, he died on August 12. Since August 14, ZMapp has been used to treat patients in Liberia, although supplies of ZMapp may be inadequate.

### OFFICIAL APPROVAL OF FAVIPIRAVIR IN JAPAN

In March 2011, an application was made to the Ministry of Health, Welfare and Labor, Pharmaceutical and Food Safety Bureau, Evaluation and Licensing Division (the agency that regulates and approves new drugs and medical devices in Japan), to approve favipiravir as a new antiviral medication for influenza type A and B. A Phase I/II clinical trial was conducted in the United States, which showed that compared with placebo, patients treated on protocol with a dose of 1800 mg twice a day during the first day and 800 mg twice a day for the second through fifth days showed significant reduction of the 6 main influenza symptoms including cough, sore throat, headache, nasal symptoms, muscle pain, and general fatigue (Gehan-Wilcoxon test: p = 0.01). However, patients treated using a protocol including 2400 mg for the first dose and 600 mg for the second and third doses on the first day, followed by 600 mg 3 times a day for the second through fifth days, did not have significant improvement (Gehan-Wilcoxon test: p = 0.414). While favipiravir showed clinical effectiveness against influenza type A and B infections, the results were not consistent and depended on the treatment protocol.

The combination of peramivir and favipiravir was proposed to be effective for the treatment of the 2009 pandemic of oseltamivir-resistant influenza A (H1N1) infection and was tested in mice. However, favipiravir has teratogenicity and embryotoxicity. Fetal death during early embryogenesis was observed in rats. Use of typical doses of favipiravir in mice, rats, rabbits, and monkeys demonstrated teratogenicity including external anomalies, internal anomalies, and skeletal anomalies. Favipiravir is excreted in human breast milk and semen. It is therefore contraindicated during pregnancy, and contraception is required at the conclusion of treatment in women of childbearing age.

On March 26, 2014, the Ministry of Health, Welfare and Labor, Pharmaceutical and Food Safety Bureau, Evaluation and Licensing Division, approved favipiravir in consideration of the situation that antiviral medication-resistant influenza will emerge. However, strict requirements accompanied this approval. First, the findings for clinical effectiveness in humans are limited and include only trials in influenza infections. Second, because of teratogenicity and embryotoxicity, favipiravir will be administered to patients only when the Japanese government makes the decision to use the medication during an outbreak of antiviral medication-resistant influenza. Without the permission of the Minister of Health, Welfare and Labor, favipiravir cannot be manufactured or stocked in Japan.

Strict requirements are not practical for Fuji Film Company and Toyama Chemical for drug production. In addition, several international agencies have shown strong interest in the possibility of developing favipiravir. Both Fuji Film Company and Toyama Chemical would like to contribute to patient welfare in Japan.

### PREPARING FOR AN OUTBREAK OF EBOLA

On August 15, 2014, the Minister of Health, Welfare and Labor of Japan, Mr. Tamura, stated during a media conference that using favipiravir in Japanese patients during emergencies such as an outbreak of EVD or pandemic Influenza is not against the Pharmaceutical Affairs Law and administration of this medication is permitted on the basis of a physician’s judgment. This can be interpreted as allowing favipiravir to be one of the candidates for use during an outbreak of new viral infectious diseases in Japan.

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**TABLE 1**

Global Status of Ebola Virus Disease as of October 17, 2014, According to the World Health Organization

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea</td>
<td>1519</td>
<td>862</td>
</tr>
<tr>
<td>Liberia</td>
<td>4262</td>
<td>2484</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>3410</td>
<td>1200</td>
</tr>
<tr>
<td>Nigeria</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Senegal</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Spain</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>United States</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>9216</td>
<td>4555</td>
</tr>
</tbody>
</table>

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*Disaster Medicine and Public Health Preparedness*
On August 25, 2014, the Chief Cabinet Secretary, Yoshihide Suga, mentioned in a media conference that the Japanese government is willing to provide support in collaboration with pharmaceutical companies, especially when there is a formal request from the World Health Organization.9

On September 19, a Frenchwoman who became infected with EVD in Liberia began taking favipiravir with other medications, because the French National Agency for Medicines and Health Safety asked Fuji Film Company and Toyama Chemical for assistance. This woman fully recovered and was discharged from the hospital on October 4. The French and Guinea governments are planning to conduct a clinical trial of favipiravir in November 2014.10

In October 2015, the World Medical Association (WMA), declared the WMA Resolution on Unproven Therapy and the Ebola Virus11 and strongly supported the intention of paragraph 37 of the 2013 revision of the Declaration of Helsinki, which reads: “In the treatment of an individual patient, where proven interventions do not exist or other known interventions have been ineffective, the physician, after seeking expert advice, with informed consent from the patient or a legally authorised representative, may use an unproven intervention if in the physician’s judgment it offers hope of saving life, re-establishing health or alleviating suffering. This intervention should subsequently be made the object of research, designed to evaluate its safety and efficacy. In all cases, new information must be recorded and, where appropriate, made publicly available.”

DISCUSSION
There are several concerns about the use of favipiravir during an EVD outbreak. Phase I/II trials to establish clinical efficacy against influenza have been completed in Japan and the United States. However, data showing efficacy against Ebola in humans are not yet available. Second, as shown in experimental trials, favipiravir has a risk for teratogenicity and embryotoxicity in humans. Therefore, if favipiravir is used against EVD, we must be careful to protect the patients being treated with a medication with only limited data regarding efficacy and side effects.

As of October 21, 2014, there are no effective medications for the treatment of EVD. Since this represents an international crisis, using a new medication such as favipiravir for EVD is acceptable if the intention of paragraph 37 of the 2013 revision of the Declaration of Helsinki is respected along with other emergency WMA resolutions for EVD. The importance of a speedy approval process and less stringent regulations for the use of experimental drugs such as favipiravir in emergencies is important.

The authors sincerely hope that the international community will overcome the difficulties of EVD in the world.

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Ebola Outbreak Response: The Role of Information Resources and the National Library of Medicine

Cynthia B. Love, MLS; Stacey J. Arnesen, MS; Steven J. Phillips, MD

ABSTRACT

The US National Library of Medicine (NLM) offers Internet-based, no-cost resources useful for responding to the 2014 West Africa Ebola outbreak. Resources for health professionals, planners, responders, and researchers include PubMed, Disaster Lit, the Web page “Ebola Outbreak 2014: Information Resources,” and the Virus Variation database of sequences for *Ebolavirus*. In cooperation with participating publishers, NLM offers free access to full-text articles from over 650 biomedical journals and 4000 online reference books through the Emergency Access Initiative. At the start of a prolonged disaster event or disease outbreak, the documents and information of most immediate use may not be in the peer-reviewed biomedical journal literature. To maintain current awareness may require using any of the following: news outlets; social media; preliminary online data, maps, and situation reports; and documents published by nongovernmental organizations, international associations, and government agencies. Similar to the pattern of interest shown in the news and social media, use of NLM Ebola-related resources is also increasing since the start of the outbreak was first reported in March 2014 (*Disaster Med Public Health Preparedness*. 2015;9:82-85)

Key Words: disease outbreaks, crowdsourcing, social media, mass media, Internet

Information plays a vital role in every disaster incident or public health emergency. The 2014 West Africa Ebola outbreak has engaged the world’s attention as an unprecedented outbreak of the disease. This outbreak has grown dramatically and across a wider geographic region than previously experienced. Because it is a grim disease, has a high mortality rate, sickens health care providers, and threatens the public health and civil infrastructure of regions, Ebola commands media attention and compels public interest and response.

There is no question that interest in Ebola is reflected in available measures of public online discourse. The US Department of Health and Human Services (HHS) NowTrending Web site documents an incidence of tweets about Ebola ranging from thousands to tens of thousands per hour. NowTrending.HHS.gov analyzes Twitter data for selected health topics and displays the frequency of tweet topics on a world map. Such data can indicate emerging health issues and where they are occurring, as well as measure public interest in tweeting about a topic. Of the 27 disaster and public health emergency conditions tracked by NowTrending, “Ebola” and “natural disasters” were equally ranked as the highest topics, each representing 23% of the tweets in the NowTrending database for August 30 to September 19, 2014 (data based on 7,339,468 tweets during this time period matching at least one of the 234 terms currently tracked across 27 conditions).

Google News searches on “Ebola” (as tracked in Google Trends) increased from the lowest value (1) to the highest (100) between July and August 2014 and dropped in September to 50% of the August peak. Google Trends shows that the countries with the highest search volume on “Ebola” are (in order) Liberia, Sierra Leone, Nigeria, Ghana, Zambia, Côte d’Ivoire, Senegal, Guinea, Canada, and South Africa. News outlets globally have published or broadcast story after story.

As the world’s largest aggregator of biomedical literature, the US National Library of Medicine (NLM) is responding to the increased interest in Ebola by developing new resources and enhancing existing ones to meet the needs of health professionals and the general public. Responders, planners, policy makers, researchers, disaster managers, government decision makers, health care providers, and humanitarian workers all need the best and most current medical and public health information so they can act safely and effectively in managing the outbreak.
PubMed, the NLM index of biomedical journals, added 212 publications on Ebola or Ebolavirus during the almost 6-month period from March 1 to September 19, 2014. In comparison, during the previous 10 years, an average of 98 articles per year on Ebola were added to PubMed. In the same time period, an average of 671 articles per year about all viral hemorrhagic fevers were added to PubMed. As one might expect, the number of articles continues to grow as the outbreak progresses.

Of the 212 publications in PubMed, 60% (127) are clearly related to the current outbreak. Journals with multiple articles on the subject page “Ebola Outbreak 2014: Information Resources.”4 Whereas individual organizations, such as the World Health Organization and the US Centers for Disease Control and Prevention, focus on writing and publishing their own guidelines and updates, DIMRC pulls those sources together in one Web guide and continuously monitors key agencies and organizations for new information to keep the page up-to-date. The guide identifies key social media sources of information, online maps, Web sites of international and US agencies, and links to documents and journal articles on Ebola.

Previous studies5 and experience6 show that much of the key medical and public health information on disasters and emergencies is not found in the published biomedical journal literature, especially during and immediately following unprecedented events. Key government and nongovernmental organization reports, assessments, and training materials, as well as new treatment and prevention guidelines, are not included in well-known databases such as PubMed. These materials (often described as grey literature) are indexed in Disaster Lit: the Resource Guide for Disaster Medicine and Public Health. Disaster Lit has added 111 reports, guidelines, factsheets, US Congress reports and hearings, training webinars, and Web sites on Ebola since March through September 19, 2014. In the month ending September 18, Disaster Lit was searched for ‘Ebola’ over 22,000 times, easily the number one topic of interest. Of the 111 reports, 60% are categorized as guidelines, 13% are fact sheets, 10% are Web pages, and 17% are categorized as other.

These materials are primarily from the United States, the United Kingdom, and the countries hosting headquarters of international agencies; the materials are primarily not from the affected countries. The most frequent sources of documents are the US Centers for Disease Control and Prevention, the US Food and Drug Administration, the National Institute of Allergy and Infectious Diseases, the US National Institutes of Health, the US Agency for International Development, the World Health Organization, the World Health Organization Regional Office for Africa, and the European Centre for Disease Prevention and Control.

Ebolavirus (the cause of Ebola hemorrhagic fever) is also the subject of intense study. The NLM National Center for Biotechnology Information (NCBI) released a resource page on Ebolavirus on September 19, 2014.7 The page aggregates links to virus data at NCBI as well as links to information on the current outbreak. The Virus Variation database for Ebolavirus allows searching for nucleotide and protein sequences by a variety of criteria including host, sequence patterns, region or country of isolation, and collection or release dates. Sequences can be downloaded in many formats or used to find links to sequences in NCBI databases such as PubMed.

The NLM Emergency Access Initiative (EAI) was activated for the Ebola outbreak in August 2014. EAI is a collaboration...
Ebola Outbreak Response: Information Resources

between NLM and a number of publishers of medical literature to provide free access to medical information during catastrophic events. As a result of the devastation of medical libraries in Hurricane Katrina, NLM and the publishers developed a mechanism to provide temporary access to materials usually available only by subscription. EAI was first activated in 2010 following the major earthquake in Haiti. Use of EAI is intended for those affected by a specific incident and for those providing assistance to the affected population. EAI provides free access to full-text articles from over 650 biomedical journals, over 4000 online reference books, and several databases.

At the recent request of the World Health Organization and others, NLM and the publishers activated EAI for the Ebola outbreak.8 EAI is expected to benefit medical and public health workers in West Africa as well as those deploying from outside the region to provide humanitarian assistance. Between August 12 and September 23, EAI has been visited over 2500 times, with half of those visits from the United States. The most heavily used materials have been medical textbooks on virology, epidemiology, and infectious diseases, along with some use of medical journals. The top textbook titles accessed through the EAI in August through September 2014 were as follows: Red Book: 2012 Report of the Committee on Infectious Diseases, 29th edition (most frequently used); Human Virology (4th edition); Epidemiology: Principles and Practical Guidelines; Handbook of Epidemiology; and An Introduction to Epidemiology for Health Professionals. Of the journals available through EAI, BMJ was the most accessed, followed by the Journal of Infectious Diseases. Enhanced access to and display of resources on mobile devices and the expansion of cellular telephone and Wi-Fi service across the globe has made it possible for the latest information to be more accessible than ever.

The resources described above, Ebola Outbreak 2014: Information Resources, EAI, PubMed, Disaster Lit, and Virus Variation: Ebolavirus, primarily contain information for health professionals. NLM is also committed to providing information for the general public through the MedlinePlus.gov Web site. In response to the growing interest and concern over the outbreak, MedlinePlus released topic pages (one in English, one in Spanish) on Ebola on August 13, 2014. The English page was viewed by nearly 3000 in its first 3 weeks. In a dramatic increase, the MedlinePlus Encyclopedia entry on Ebola was visited about 5000 times in June and 86,000 times in August by a predominantly US audience.

Ensuring that health care workers and the public are aware of and use these authoritative and up-to-date NLM resources is always a challenge. Through extensive contacts with response organizations, the DIMRC attempts to reach a wide range of responders in the United States and internationally. The DIMRC also encourages use of these resources by the librarians and information specialists who may be handling information queries from their own communities and institutions. Information about NLM disaster and emergency resources is distributed primarily through e-mail and Twitter. Lists and e-newsletters from both NLM and other agencies distribute NLM messages to at least 50,000 subscribers. The Twitter account, @NLM_DIMRC, has over 2700 followers, and those followers pass along (retweet) the messages that DIMRC sends. A Twitter message about the “Ebola Outbreak 2014: Information Resource” Web page resulted in 2100 visits to the page in the month ending September 19, 2014.

This unprecedented Ebola outbreak is being matched with an outpouring of information from many sources, ranging from peer-reviewed journal articles to the latest Twitter traffic. NLM is collecting and organizing information from these many streams to make it easier to follow and learn from this unfolding event. To stay current on Ebola (and other disaster or public health emergency) information resources, subscribe to the e-mail list, DISASTR-OUTREACH-LIB, at http://disasterinfo.nlm.nih.gov/dimrc/dimrclistserv.html.

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CONCEPTS in Disaster Medicine


Kristi L. Koenig, MD, FACEP, FIFEM

ABSTRACT

During an evolving public health emergency, a simple algorithm for initial patient identification and management is essential for providers on the front lines. This article recommends a 3-pronged system of Identify, Isolate, Inform to describe the actions necessary in the first few minutes of encountering a potential Ebola patient. Application of the “vital sign zero” triage concept of early recognition of potential threats coupled with this novel algorithm will optimize protection of health care workers and the public health while concurrently providing a safe method for individual patient care. (Disaster Med Public Health Preparedness. 2015;9:86-87)

Key Words: Ebola, emerging infectious disease, public health emergency, infectious disease medicine

The 2014 Ebola outbreak is a dramatic illustration of the need to apply public health principles in daily emergency care situations. There is no room for error in early identification of patients needing investigation for Ebola infection. A missed case has obvious implications for not only the individual patient, but also for the exposed health care workers and the population at large. Accordingly, identification is the first guiding principle of the algorithm. Prior to any assessment or intervention that requires physical contact with a patient (or potential contact with a patient’s blood or other bodily fluids), first responders and other health care workers must identify whether the patient is potentially infected. An assessment of epidemiologic risk factors prior to performing a standard triage exam is essential during a public health emergency.1 In the case of Ebola, if the patient has not traveled to one of the outbreak countries within the last 21 days nor had contact with a known Ebola patient, further assessment can be performed. Appropriate precautions must still be taken due to the potential for other contagious infectious disease, e.g., Middle East respiratory syndrome coronavirus, tuberculosis, or measles.

Although used in some airports and health care facilities, fever screening alone is inadequate. Patients with Ebola may not initially present with fever, and symptoms can be very mild early in the disease course. In addition, it is difficult to determine the denominator for the number of patients at risk; this will be larger in some communities than others. Particularly during influenza season, many patients will present with fever and some communities may have a nontrivial number of travelers from the affected regions of West Africa. Aside from health care resources, it could be very frightening for the individual patient who is already sick enough to seek emergency care to be whisked off into isolation by people in moon suits! The bottom line is that fever screening is limited by both false negatives and false positives, with both situations being problematic.

If a potential Ebola patient is identified via epidemiologic screening and has suggestive signs and symptoms, the second step in the algorithm is to isolate. We must be prepared to isolate patients in every setting where they are identified. This could include the prehospital setting, a clinic or doctor’s office, or a hospital. Exposure to other patients must be avoided. This can be accomplished in many ways, including moving the patient to an alternate care site (such as a tent outside the hospital) or directly to an isolation unit without exposing others.

The final action in the 3-step approach is to inform. Depending on the site of patient identification, this would include informing the health department, the hospital infection control, supervisors, and law enforcement. Health care workers must have protocols for who and how to report and 24/7 access to these authorities. Backup systems must be in place for rapid notifications in case appropriate authorities are not immediately available via standard communications methods.

Use of the “vital sign zero” concept,1 ie, assessing for hazards before approaching a patient, is the first step.
in protecting health care providers and the public health. Following this, the 3-pronged algorithm of Identify, Isolate, Inform is an easy-to-remember, commonsense approach that puts public health first and foremost on the minds of frontline health care providers. This methodology will assist health care providers to resist the temptation to leap in and perform resuscitation in an unsafe setting.

Identify, Isolate, Inform provides the initial template for an organized approach to a potentially contagious patient, including those who are highly infectious. Multiple essential subgroup steps and responsibilities follow; however, omitting these critical initial public health actions would be analogous to failing to defibrillate a patient in cardiac arrest and expecting subsequent protocols to produce a good outcome. Likewise, failing to don appropriate protective equipment and decontaminate a patient after an organophosphate exposure would risk health care workers becoming patients. With globalization of health care, this public health paradigm shift is critical if we are to keep the world population safe. The 3 I’s are the ABCs of Ebola management.

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REFERENCE
The international community has been asked to mobilize urgently to fight the current Ebola virus disease outbreak in West Africa. The World Health Organization (WHO) has declared that the “single most important” problem slowing relief efforts is “not having enough people on the ground,” and that several thousand health care workers are needed to contain the outbreak. More Ebola Treatment Centers (ETCs) are needed to stem the disease; however, at press time, only 2 international aid agencies have supported ETCs along with national ministries of health and the WHO. Nongovernmental organizations, governments, and the WHO are mobilizing rapidly. In the coming weeks and months, a surge of physicians, nurses, and other health care volunteers will deploy to West Africa at considerable personal risk to provide clinical care and to support disease control efforts. To date, 301 health care workers have become infected with Ebola, half of whom have died.

Organizations participating in the Ebola response must carefully plan to carry out their responsibility to ensure the safety and security of responders. At the same time, individual health care volunteers and their employers must evaluate the ability of an aid organization to protect its workers in the complex environment of an unheralded Ebola outbreak. We present a minimum set of operational standards developed by a consortium of Boston-based hospitals that a professional organization should have in place to ensure the health, safety, and security of its staff in response to the Ebola virus disease outbreak. (Disaster Med Public Health Preparedness. 2015;9:88-89)

Key Words: voluntary workers, disease outbreaks, disaster medicine, emergency responders
of the personal protective equipment (PPE) that is universally required prior to providing clinical care or other supportive activity.

Fourth, robust and reliable supply chains should be in place to ensure adequate medicine, supplies, and other support for complex medical field operations. In particular, the supply chain must guarantee an adequate supply of PPE as recommended by the WHO, the CDC, and Doctors Without Borders: disposable gloves, long-sleeve impermeable gowns, medical masks, eye protection with goggles or face shield, and closed puncture- and fluid-resistant shoes. Additional PPE, such as waterproof aprons, disposable shoe and leg coverings, heavy-duty rubber gloves, and particulate (N95) respirators, may be required depending on the task and risk.

Fifth, the organization should have clear contingency plans for medical evacuation or treatment of sick or injured staff. Because commercial medical evacuation insurance often does not cover active Ebola cases, organizations must be able to arrange and fund adequate care for staff who contract Ebola virus disease. Contingency plans should also include the management of security threats such as civil unrest, natural disasters, or other large-scale outbreaks. Plans to monitor security situations and either shelter in place or evacuate staff via predetermined overland and air routes should be redundant, written, and readily available to staff.

Finally, organizations should have a clear plan for the return of volunteers to their clinical duties back home that complies with CDC, state, and local guidelines. For example, if individuals are required to remain on 21-day home personal isolation after deployment, organizations must consider who will be responsible for the volunteers' and their families' needs (food, water, medicine, mental health), isolation compliance, and return-to-work considerations.

These represent the minimum set of operational standards that a professional organization must have in place to ensure the health and security of its staff in response to the Ebola virus disease outbreak.

Individuals who plan to volunteer with an international aid organization during an Ebola epidemic should not make the decision lightly. Individuals must carefully assess their own skills, experience, knowledge, family circumstances, and personal health. Only those clinicians with the highest level of readiness—personal, mental, and professional—should consider deployment. Trainees, medical students, residents, and fellows must be strongly discouraged from volunteering. A considerable body of knowledge highlights the negative impact of untrained response workers—even though they are trained clinicians—in providing assistance during outbreaks or in the aftermath of natural disasters. Organizations with current experience in managing ETCs have provided important guidance for organizations and individuals who intend to deploy.

Individual volunteers must consider the need for personal preparation and proper equipment. Volunteering will likely require a significant time commitment. Given the scale of the outbreak and the cost of sending individuals, a 2-week deployment is wholly insufficient. Volunteers should be prepared for longer deployments and to be highly self-sufficient. The CDC has issued the primer “Advice for Humanitarian Aid Workers Traveling to Guinea, Liberia, Nigeria, or Sierra Leone during the Ebola Outbreak” for potential volunteers. As indicated in the CDC checklist, individuals must review their health insurance, medical evacuation insurance, accidental death and disability insurance, and even life insurance coverage in light of their personal and family circumstances.

From our own research into these issues, we know that medical assistance and, if necessary, medical evacuation for even non-Ebola illness or injury can be extremely challenging to carry out from affected countries. For Ebola-related exposure or infection of a health care worker, the likelihood of evacuation is remote, if not impossible, despite the several cases widely reported by the media.

The current Ebola outbreak is a global emergency, and our global health care community must and will rise to serve those affected. But each of us must invest in fully understanding the capabilities and limitations of the organization with which we deploy and serve.

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Letter to the

Editor

Operationalizing Public Health Skills to Resource Poor Settings

Sim Sai Tin, MD; Viroj Wiwanitkit, MD, FRFM

We would like to comment on the recent publication “Operationalizing Public Health Skills to Resource Poor Settings.” Burkle noted that “adjusting and adapting specific operational public health skill sets to resource poor environments” is a main point to consider during the 2014 Ebola virus outbreak. In fact, as noted by Burkle, the modification of operationalizing public health skills for each specific setting is an important factor determining the success of the public health manipulation. Nevertheless, for the control of epidemics, including the present 2014 Ebola crisis, consideration of international collaboration is not any less important. International collaboration, based on cross-cultural agreement, to screen and control the disease is a vital process in the present-day crisis. In some situations, a local public health agency might have to deal with possible importation from other countries. This can be problematic if there is not adequate knowledge of the virus. For example, it is a potential problem in pilgrimage activities such as the Hajj.

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Letter to the

Reply to Tin and Wiwanitkit

Frederick M. Burkle, Jr, MD, MPH, DTM

Your comments are most welcome and I agree, multiple issues arise in control and containment that clinicians and decision-makers have little experience with. For all practitioners, those public health skills are fundamental. They must be equally translatable to every patient as well as to decisions made by the broad international community. Collaboration and cooperation is essential. One reason Ebola has spread so easily in Liberia is the rapid urbanization and density of the population from Monrovia to the northern counties. The Hajj is another timely example because the population density has increased every year with more attendees from around the world. The decision to prevent attendees from West Africa this year is a correct one that is unavoidable in the larger triage system necessary in epidemics and pandemics.

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Letter to the Editor

Ebola and the Limited Effectiveness of Travel Restrictions

Morenike Folayan, FWACS; Brandon Brown, PhD, MPH

The current Ebola virus disease (EVD) outbreak in West Africa is the worst epidemic of Ebola since the first case was officially reported in 1976. The “traveling” of the infection from Guinea and Liberia to other parts of West Africa, Europe, and America has caused anxiety and panic. To control exportation and importation of EVD, the World Health Organization recommends exit screening in Guinea, Liberia, and Sierra Leone for unexplained febrile illness consistent with potential Ebola infection.1 Where entry screening is required, management systems must be in place to care for travelers and suspected cases in compliance with International Health Regulations requirements.1 By November 17, 2014, over 50 countries around the world had issued travel restrictions to and from Ebola-affected countries.2 The Centers for Disease Control and Prevention also recommends that US citizens avoid nonessential travel to Guinea, Liberia, and Sierra Leone and take precautions when traveling to Mali.3

Index patients with EVD outside Africa have been healthy at the time of arrival into the subsequent country, illustrating the difficulties provided by the incubation period of Ebola infection. Most cases of EVD managed outside of West Africa were citizens flown to their home countries for EVD care. Three were nurses exposed to EVD while managing patients. Three others were West Africans flown to Germany for management.

The implications of travel restrictions are vast. Travel restrictions make it harder to tackle the disease because the movement of supplies, equipment, and humanitarian aid to affected areas becomes difficult. Eba4 highlighted the human rights violations resulting from efforts to contain the epidemic and the limited success achieved from such measures. Similar to HIV, the current call to issue travel restrictions and to quarantine health care workers who return to their home country from affected countries in West Africa is rooted in fear. Such actions interfere with the rights of affected individuals and propagate stigma with far-reaching implications. Where suspected travelers from West Africa have symptoms suggestive of Ebola infection and quarantine is applicable, isolation facilities must be optimal with physical, social, and psychological support provided for all those quarantined and quality personal protective equipment provided for health care providers.5 Effective personal protective equipment is a beneficial disaster management strategy for Ebola. Travel restrictions are not the solution to containing Ebola.

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