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Ebola Virus Disease Surveillance in Sierra Leone:
Port Loko and Kambia District Ebola Response in the West Africa EVD Epidemic

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ABSTRACT

The West Africa Ebola Virus Disease (EVD) Epidemic is the worst outbreak of EVD in recorded history. While much has been published regarding the international and national-level EVD responses, there is a dearth of literature on more local structures, successes, and failures. This paper therefore seeks to understand how the EVD response unfolded in the Port Loko and Kambia Districts of Sierra Leone. 43 District Surveillance Officers, the epidemic's frontline responders, were surveyed. From this, it was found that political deference to the World Health Organization and their focus on technical epidemiology over logistical and operational needs had a strong and negative impact on the efficacy of both district's EVD response. A number of policy recommendations follow: most significant is the need to establish an Integrated Disease Surveillance and Response network in conjunction with the improvement of Sierra Leone's existing District Health Information Systems 2 architecture. Doing so will empower Sierra Leone's government to take the lead in future outbreak responses.

In memory and dedication to Peter Lamin, Idrissa Turay, Morlai Dumbuya, Augustine Baker, and the hundreds of response workers who made the ultimate sacrifice for their country and their people during the 2013-2016 West Africa Ebola Epidemic. Your actions saved lives – ours could not save yours.

May you rest in peace, and may God bless you all.

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ACRONYMS

AAR	After Action Review	ACF	Action Contre La Faim
AU	African Union	BritMil	British Armed Forces
C2	Command and Control	CCT	Community Contact Tracer
CDC	Centers for Disease Control and Prevention	CEBS	Community Event Based Surveillance
CEO	Chief Executive Officer	CFR	Case Fatality Rate
CHC	Community Health Clinic	CHO	Community Health Officer
CHP	Community Health Post	CHS	Community Health Sciences
CHW	Community Health Worker	CIF	Case Investigation Form
CivMil	Civilian-Military	CLO	Chiefdom Liaison Officer
CSO	Chiefdom Surveillance Officer	CT	Contact Tracing
CTS	Contact Tracing Supervisor	DC	District Coordinator
DCC	District Council Chairman	DEERF	DFID Emergency Ebola Response Fund
DERC	District Ebola Response Center	DFID	Department for International Development
DHIS2	District Health Information Systems 2	DHMT	District Health Management Team
DLO	District Liaison or Logistics Officer	DMO	District Medical Officer
DMS	District Medical Store	DO	District Officer
DSO	District Surveillance Officer	EOC	Emergency Operations Center
ERC	Ebola Response Consortium	ERW	Ebola Response Worker
ETC	Ebola Treatment Center	EVD	Ebola Virus Disease

FAO	Food and Agriculture Organization	GIS	Geographic Information Systems
HIS	Health Information Systems	HRH	Human Resources for Health
HIV	Human Immunodeficiency Virus	IDP	Internally Displaced Person
IDSR	Integrated Disease Surveillance Response	IFRC	International Federation of the Red Cross and Red Crescent
IMC	International Medical Corps	IO	International Organization
IOM	International Organization for Migration	IPC	Infection Prevention and Control
IRC	International Rescue Committee	JIATF	Joint Inter-Agency Task Force
KCAP	Kambia Community Action Plan	KGH	Kambia Government Hospital
KPI	Key Performance Indicator	LGH	Lungi Government Hospital
LO	Liaison or Logistics Officer	LSHTM	London School of Hygiene and Tropical Medicine
MCD	Meets Case Definition	MCHP	Maternal and Child Health Post
MoD	Ministry of Defense	MoHS	Ministry of Health and Sanitation
MoSW	Ministry of Social Welfare	MoU	Memorandum of Understanding
MS	Medical Superintendent	MSI	Marie Stopes International
NERC	National Ebola Response Center	NGO	Non-governmental Organization
OEZ	Operation Enduring Zero	OFDA	Office of Foreign Disaster Assistance
ONP	Operation Northern Push	PHE	Public Health England
PHEIC	Public Health Emergency of International Concern	PHU	Peripheral Health Unit
PIH	Partners in Health	PLGH	Port Loko Government Hospital
PPE	Personal Protective Equipment	QIP	Quick Impact Project

RSLAF	Republic of Sierra Leone Armed Forces	RUF	Revolutionary United Front
S/CRS	Office of the Coordinator for Reconstruction and Stabilization	SDO	Senior District Officer
SLL	Sierra Leonean Leone	SLP	Sierra Leone Police
SMAC	Social Mobilization Action Consortium	SocMob	Social Mobilization
SOP	Standard Operating Procedure	SU	Stabilization Unit
TL	Team Leader	U5	Under-five
UN	United Nations	UNDP	United Nations Development Program
UNFPA	United Nations Population Fund	UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Emergency Fund	UNMEER	United Nations Mission for Ebola Emergency Response
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs	USAID	United States Agency for International Development
USG	United States Government	VHF	Viral Hemorrhagic Fever
VHF	Viral Hemorrhagic Fever (Epidemiology software)	VQF	Voluntary Quarantine Facility
WASH	Water, Sanitation and Hygiene	WHO	World Health Organization
WFP	World Food Program	XB	Cross-border

**Ebola Virus Disease Surveillance in Sierra Leone:
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INTRODUCTION

The ongoing West Africa Ebola Virus Disease (EVD) Epidemic is the worst outbreak of EVD in recorded history, with cases in ten countries and continued transmission in Guinea and Liberia.¹ As of April 26, 2016, the Centers for Disease Control and Prevention (CDC) reports that 11,325 people have died from this aggressive hemorrhagic fever, with 11,310 of those deaths attributed to Guinea, Liberia, and Sierra Leone.² Due to incomplete data and reporting this number likely captures less than half, and potentially as little as 30 percent, of case fatalities.³

Despite these human costs, the outbreak is significantly less devastating than original worst-case projections: in September 2014, with cases of EVD rising exponentially in Guinea, Liberia, and Sierra Leone, the CDC projected that there could be anywhere between 537,000 and 1.4 million cases by January 20, 2015, four short months later (Figure 1).⁴ The dramatic difference – the outbreak’s 28,652 suspect, probable, and confirmed cases amount to just over two percent of the worst-case projection⁵ – can be attributed to concerted response and intervention efforts by the people of the affected countries and the wider international

¹ As of April 26, 2016.

² “2014 Ebola Outbreak in West Africa – Case Counts,” last modified April 26, 2016, <http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/case-counts.html>.

³ Donald G. Mcneil Jr, “Fewer Ebola Cases Go Unreported Than Thought, Study Finds,” *The New York Times*, December 16, 2014, <http://www.nytimes.com/2014/12/16/science/fewer-ebola-cases-go-unreported-than-thought-study-finds-.html>.

⁴ Denise Grady, “Ebola Cases Could Reach 1.4 Million Within Four Months, C.D.C. Estimates,” *The New York Times*, September 23, 2014, <http://www.nytimes.com/2014/09/24/health/ebola-cases-could-reach-14-million-in-4-months-cdc-estimates.html>; the elves, *Ebola in West Africa since June 4, 2014*, 2014, TitusONENine, accessed January 09, 2016, http://www.kendallharmon.net/t19/images/Ebola_since_June_2014.jpg; Somini Sengupta, “New Ebola Cases May Soon Reach 10,000 a Week, Officials Predict,” *The New York Times*, October 14, 2014, <http://www.nytimes.com/2014/10/15/world/africa/ebola-epidemic-who-west-africa.html>.

⁵ “2014 Ebola Outbreak in West Africa – Case Counts.” According to the CDC, 15,261 cases have been laboratory confirmed – a further 13,391 cases were not laboratory confirmed, but considered suspect or probable cases. These cases include individuals with lost records, and those who died and were buried in the community without sampling, among others.

community. Over the course of the outbreak the international community poured in billions of dollars of support and thousands of outbreak response specialists,⁶ the vast majority of which began to arrive shortly after the CDC’s dire September 2014 projections.

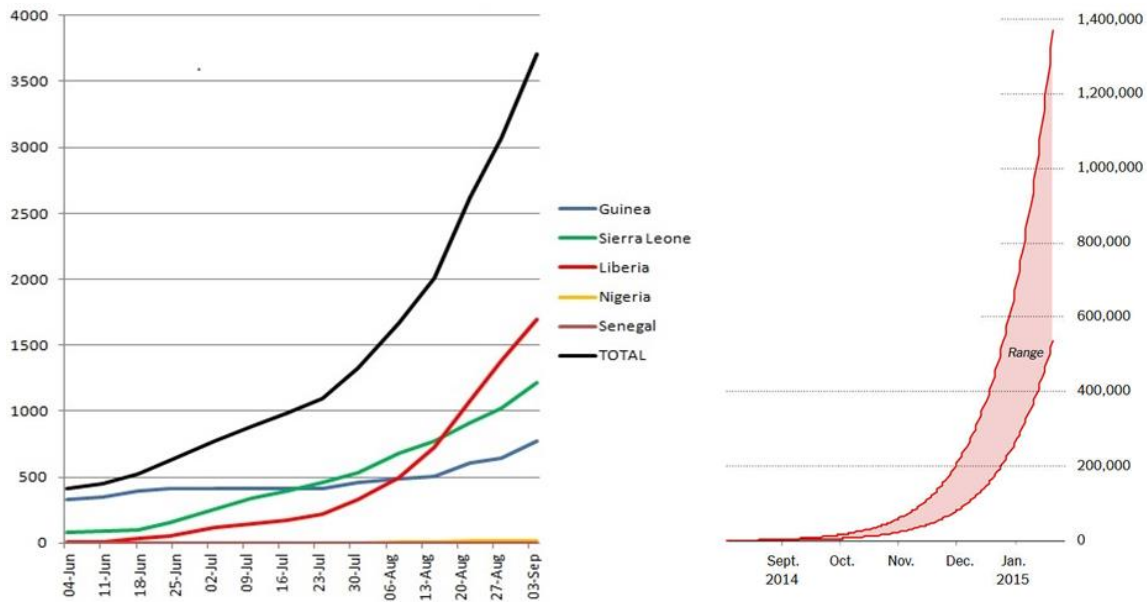


Figure 1: Cumulative cases, 6/14 – 8/14 (left) and Projected cases, 9/14 – 1/15 (right)

Despite this incredible success, a November 2015 report by a Harvard-London School of Hygiene & Tropical Medicine (LSHTM) panel found the epidemic “exposed deep inadequacies in the national and international institutions responsible for protecting the public from far-reaching human, social, economic, and political consequences of infectious disease outbreaks.”⁷ The Director of LSHTM and report co-author Dr. Peter Piot further stated that “major reforms of national and global systems to respond to epidemics are not only feasible, but also essential [to

⁶ For example, the United States committed \$5.4 billion to the response in 2015. Britain, another major funder, contributed over \$600 million. Respectively; “Consolidated and Further Continuing Appropriations Act, 2015.” *U.S. Congress*, December 9, 2014; and “Defeating Ebola in Sierra Leone: UK aid update 06/11/15.” *Department for International Development*, November 6, 2015. Accessed January 27, 2016.

⁷ Suerie Moon, Devi Sridhar, Muhammad A Pate, Ashish K Jha, Chelsea Clinton, Sophie Delaunay, Valnora Edwin, Masoka Fallah, David P Fidler, Laurie Garrett, Eric Goosby, Lawrence O Gostin, David L Heymann, Kelley Lee, Gabriel M Leung, J Stephen Morrison, Jorge Saavedra, Marcel Tanner, Jennifer A Leigh, Benjamin Hawkins, Liana R Woskie, and Peter Piot, “Will Ebola Change the Game? Ten Essential Reforms before the next Pandemic. The Report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola,” *The Lancet* 386 (2015): 1.

prevent such inadequacies] in future epidemics.”⁸ In short, while the response ensured the CDC’s worst-case projections were never realized, it nonetheless exposed (and in many ways created) huge inefficiencies. The end result of these inefficiencies should not be caged in political euphemism – human lives were unnecessarily lost. The people of Guinea, Liberia, and Sierra Leone had to face the profound human, social, economic, and political consequences of avoidable tragedy.

Using EVD disease surveillance between January and September of 2015 in the Port Loko and Kambia Districts of Sierra Leone as a case study, I intend to contextualize and provide insight to these inadequacies within the EVD response structure at the district level of Sierra Leone. Disease surveillance (hereafter ‘surveillance’) is fundamental to the control of any infectious disease epidemic. Within the context of EVD in Sierra Leone, surveillance’s most rudimentary functions are to:

- Identify the *index case* for any new EVD event. The *index case* is the source case for a specific *transmission tree*, a diagram of all related cases. The index case is the EVD event’s *first wave* of transmission – cases resulting from contact with the index case are considered among the *second wave* transmission, followed by the *third wave*, and so on.
- Identify all contacts of the index case for the duration of time that the index case was symptomatic, not limited to people who directly touched the index case. This can also include people who shared a mattress or latrine with the index case, among others.
- Quarantine some or all contacts of the index case. To facilitate straightforward monitoring, as well as to prevent further transmission elsewhere, some or all contacts of the index case may be quarantined at their respective homes for the duration of EVD’s

⁸ “Independent panel of global experts calls for critical reforms to prevent future pandemics,” last modified November 23, 2015, http://www.lshtm.ac.uk/newsevents/news/2015/ebola_report.html.

incubation period, 21 days. Later in the outbreak (early summer of 2015), some “voluntary quarantine facilities” (VQFs) were established so that high risk contacts could receive enhanced monitoring, and avoid the possibility of transmitting EVD to their family at home. Some low risk contacts may not be quarantined, but are nonetheless required to submit to health monitoring for 21 days.

- Monitor contacts of the index case for 21 days. This involves assessing all case contacts twice daily and asking them if they are experiencing any symptoms of EVD. In Port Loko District, this also included taking body temperatures – fever being a symptom of EVD – with an infrared thermometer.
- Evacuate any contact who meets case definition (MCD) to an Ebola Treatment Center (ETC) for treatment and testing.
- If the sick individual is EVD positive, start again: identify their contacts, quarantine as necessary (if the new case came from within a quarantined household, add 21 days to the quarantine), and monitor.

Comprehensive disease surveillance can also include activities such as the investigation of all sickness or death in a population, regardless of a known or suspected EVD link, the systematic laboratory sampling of all corpses prior to burial, the creation of movement restrictions and monitoring checkpoints to capture sick travelers, and so on. In short, it is the process of understanding where cases are coming from, and then using that knowledge to control further infection through the implementation of various public health measures in an educated and informed manner.

In the Global North, surveillance also includes very technical epidemiological analysis, as there is a wealth of intelligence that is immediately available. For example, hospitals and other

care centers in the United States systematically report anonymized morbidity and mortality data to state and federal public health departments. As such, a huge amount of population health intelligence already exists in aggregate. Trawling such digital data for signs of disease outbreak or a *significant event* is undeniably complex.⁹ However, any response to a suspected outbreak in such an environment also presupposes existing infrastructure for the strong and systematic collection of reliable, accessible and comprehensive disease-related intelligence.

This reality is starkly contrasted by that of Port Loko and Kambia Districts of Sierra Leone (Figure 2),¹⁰ as it is by the country and region more generally. While a Health Information System (HIS) does exist in Sierra Leone, it is paper based, and therefore useless in an outbreak where significant event response time is measured in hours, not weeks. Response staff in both districts must also conduct surveillance in almost-inaccessible riverine areas due to heavy rains and poor roads; work in a social environment with a systemic lack of trust in authority and Ebola Response Workers (ERWs) that occasionally results in physical violence; promote facility-based healthcare at ETCs in a region where a considerable population of undocumented and informal traditional healers ply their trade; and operate within large swaths of geographic area with no cellular network or usable telecommunications. These are some of many social, logistical, and operational challenges faced by ERWs in Port Loko and Kambia Districts.

Port Loko and Kambia Districts (hereafter ‘Port Loko’ and ‘Kambia’) not only faced great logistical and operational challenges, but were also uniquely affected by EVD.¹¹ Port Loko

⁹ A *significant event* can be understood as any rate of new infection that occurs above the expected threshold. It can also include any other event that is abnormal and cause for concern. For example, a particular geographic area can expect to have up to N new cases of human immunodeficiency virus (HIV) in a month. If in any month there were greater than N new cases of HIV in this area, this would constitute a significant event and require the attention of epidemiologists and surveillance officers. In the case of EVD, any new case is considered a significant event, as the expected threshold for EVD transmission is zero.

¹⁰ Map adapted from “Sierra Leone / Republic of Sierra Leone”, d-maps.com, accessed January 09, 2016, <http://d-maps.com/m/africa/sierra/sierra36.gif>.

¹¹ To avoid confusion, I will refer to the eponymous capital towns as Port Loko Town and Kambia Town.

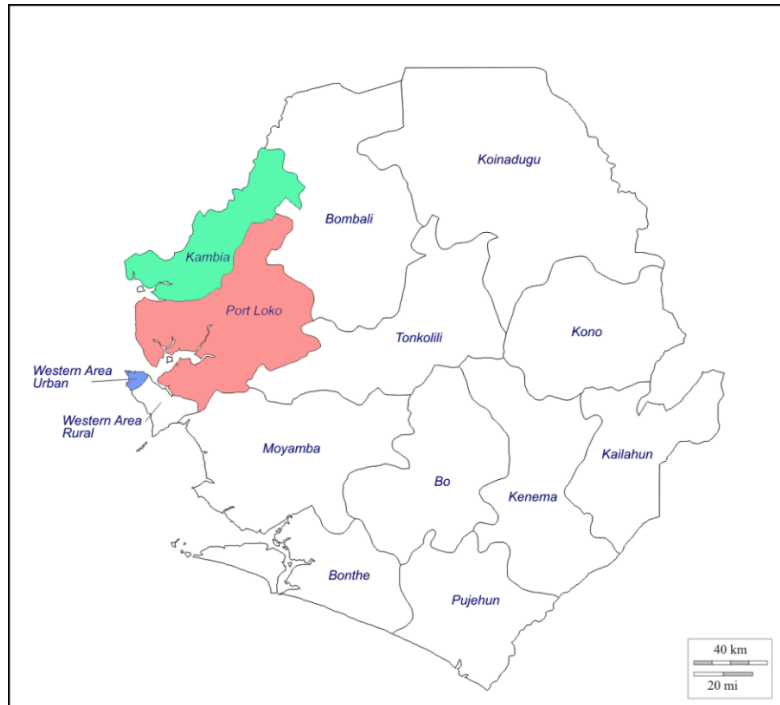


Figure 2: Sierra Leone and its 14 districts, including Port Loko, Kambia, and Western Area Urban (Image source: Author)

was long the epicenter of EVD in Sierra Leone and experienced more EVD-related deaths than any other geographic region in the country outside the capital Freetown. Kambia, with a significantly lower population than Port Loko, had fewer cases, but the eradication of cases that did occur was unusually protracted, and the aforementioned logistical and operational challenges were particularly acute. As the Conakry to Freetown highway cuts through it, the district is also an important and largely unmonitored transportation hub for travelers between Sierra Leone and Guinea.¹² As two distinct but epidemiologically important districts in Sierra Leone's EVD outbreak, Port Loko and Kambia provide an ideal case study for understanding how the EVD response was organized at the district level, how it was operationalized, and through this, to establish what were and were not effective solutions to the incredible challenges facing these two districts. While national-level response structure and timeliness has been critiqued previously

¹² High quality maps of Port Loko, Kambia, and Western Area can be found in Appendix D.

(including the aforementioned Harvard-LSHTM panel criticisms), little research has been published regarding such district level analysis.¹³

This paper is not intended to point fingers for the sake of pointing fingers. It is also in no way intended to disparage the concept, importance, and potential of International Organizations (IOs), and the central role they should play in responding to international crises. The EVD outbreak in West Africa was totally unprecedented and wildly complicated, and few appreciated how challenging the response would become. Rather, by conducting this analysis and writing this paper, the hope is to allow future outbreak responses to be politically and operationally designed in a way that engages all partners in conversation and problem solving more conducive to an effective and sustainable response. Given the nature of the work, human lives really are at stake.

To conduct this analysis, I will draw upon nine months of qualitative, participatory observations undertaken between January and September 2015 while supporting EVD surveillance in Port Loko and Kambia with the non-governmental organization (NGO) GOAL Global (hereafter ‘GOAL’).¹⁴ Qualitative observations are corroborated by analyses of various unpublished standard operating procedures (SOPs) and surveillance policies, as well as an organizational analysis of the Port Loko and Kambia District Ebola Response Centers (DERCs). Qualitative observations are also corroborated by a survey of Port Loko and Kambia District Surveillance Officers (DSOs).¹⁵

DSOs are the backbone of not only surveillance but the entire EVD response – these frontline workers are responsible for generating almost all epidemiological information, for

¹³ Laura Miller, Emmanuel d’Harcourt, Anna Kim, Megan Coffee, “The Ebola Lessons Reader: What’s being said, what’s missing and why it matters,” *The International Rescue Committee*, March 2016, http://www.rescue.org/sites/default/files/resource-file/The%20Ebola%20Lessons%20Reader_Final.pdf.

¹⁴ The typical CDC deployment was 4 weeks, and the typical WHO deployment was 6 weeks.

¹⁵ See Appendix A.

investigating and tracking down new cases, and for helping monitor case contacts. As such, their work is foundational to all other work: for example, technical epidemiology from the World Health Organization (WHO) relies on information and intelligence generated by DSOs. On this basis, understanding DSO challenges is crucial to understanding what happened during the EVD outbreak, with particular regard to what could have been done differently, and transitively, what should be changed in the future. Furthermore, to date, no formal survey of DSOs to this end has been completed. A March 2016 report by the International Rescue Committee (IRC) found that a “weakness of the reflections [on the EVD response to date] is a focus on the upper tier” of the response, while there is “almost no attention given to practices [or voices] throughout”.¹⁶ As such, the opinions of DSOs in Sierra Leone are not only invaluable, but also as-of-yet unheard.

When qualitative observations are attached to surveillance SOP and policy analyses, DERC organizational analysis, and a survey of DSOs, it becomes clear that the focus on technical epidemiology over logistical and operational realities, and more broadly, overall political deference to the WHO, had a strong negative impact on the efficiency and efficacy of Port Loko and Kambia’s EVD responses. Survey analysis indicates top DSO challenges included lack of sufficient and timely salaries, atrocious road conditions, and work fatigue. The WHO – an organization that self-proclaims its technical and advisory strengths – was terribly placed to resolve these operational and logistical concerns. The WHO Director-General’s Special Representative for the Ebola Response Dr. Bruce Aylward put it plainly: the WHO is “an organization that was not designed to be an operational field-based organization... play[ing] such a role.”¹⁷ In spite of this retrospective acuity, the WHO nonetheless demanded and was awarded

¹⁶ “The Ebola Lessons Reader: What’s being said, what’s missing and why it matters”.

¹⁷ “Ebola: Responses to a public health emergency. Second Report of Session 2015-16,” British House of Commons International Development Committee, January 12, 2016: 17. <http://www.publications.parliament.uk/pa/cm201516/cmselect/cmintdev/338/338.pdf>.

political authority over operational and logistical decision making in Port Loko and Kambia, to the significant detriment of the districts' DSOs and EVD responses more generally.

In this paper I will first provide an overview of EVD and the West Africa Ebola Epidemic, followed by an overview of Port Loko and Kambia, including their community structures and demographics, their health systems, each district's EVD epidemiology, and a timeline of significant events. I will then provide an organizational analysis of the DERC, including its design and management structure. This will be followed by an analysis of EVD surveillance in Port Loko and Kambia, including pre-intervention realities, operationalization post-intervention, the difficulties that were faced therein, and the solutions put forth to resolve these difficulties. I will then discuss the survey methodology and present the survey data, followed by an analysis of the latter. Combining the DERC organizational analysis, Port Loko and Kambia EVD surveillance analysis, and DSO survey analysis, I will discuss findings and implications, namely the negative consequences of delegating operational and logistical decision making to the WHO, and the ways in which doing so resulted in response inefficiencies and avoidable tragedy. This analysis will be followed by a number of policy recommendations, the most significant of which is the need to establish an Integrated Disease Surveillance and Response (IDSR) network in conjunction with the improvement of Sierra Leone's existing District Health Information Systems 2 (DHIS2) architecture. Doing so will not only empower Sierra Leone's government to take the lead in future outbreak responses, EVD or otherwise, but also help prevent disease outbreaks from becoming epidemics in the first place.

OVERVIEW

In this section, I will first present a brief history of EVD. The purpose of this subsection is to contextualize the limited significance of historical outbreaks, which resulted in the delayed and initially inadequate response to the West Africa EVD Epidemic. This is followed by a brief history and presentation of the unprecedented nature of the West Africa EVD Epidemic, including how the international community was thus unprepared. This has implications for the creation and efficacy of surveillance response structures discussed later in this paper, in particular the operationalization of surveillance by the WHO rather than more appropriate alternatives. The third and last subsection discusses future implications of the West Africa EVD Epidemic, namely, that despite the almost-total success in eradicating EVD transmission from the region to date, existing surveillance structures must be strengthened rather than dismantled due to the possibility of EVD arising from dormant reservoirs.

Brief history of Ebola Virus Disease

EVD was first identified in 1976 by a team of scientists, including Dr. Peter Piot, at the Institute of Tropical Medicine in Antwerp, Belgium. A blue thermos flask had arrived in the mail from Yambuku village in then-Zaire, with three blood samples from a dying Belgian nun. Two of the three sample tubes had shattered. Dr. Piot and his team had no idea that the remaining sample tube – and the soup of icy water, glass, and blood around it – contained the second deadliest virus ever discovered.¹⁸

The scientists diligently worked to isolate the unknown virus. Upon increasingly harrowing reports of violent, bloody deaths from Yambuku, the team was ordered by the WHO

¹⁸ Peter Piot, *No Time to Lose: A life in pursuit of deadly viruses* (New York: W.W. Norton & Company, 2012), 3-4. EVD has a case fatality rate second only to rabies. David Quammen, *Ebola: The Natural and Human History of a Deadly Virus* (New York: W.W. Norton & Company, 2014), 23.

to transfer all samples to the Army High Security Laboratory in Porton Down, England, one of only three labs outside the Soviet Union capable of handling such dangerous material.¹⁹ The Belgian team complied, in part: they kept one sample, and rushed to identify what was causing such devastation in Yambuku.²⁰

Under electron microscopy, the team found what they were looking for: a previously unknown worm-like virus was unmistakable on the microscope's photographs. A few days later, the CDC 'Hot Lab' in Atlanta, to whom the samples sent to Porton Down had been forwarded, confirmed the deadly hemorrhagic virus was previously unknown to science. Dr. Piot and his Belgian team, as well as teams from France, Canada, South Africa, Zaire, and the United States, formed a collective investigative group called the International Commission and rushed to Yambuku to investigate.²¹

The International Commission arrived at Yambuku in an American C-130, the only method of accessing the incredibly rural and forested area.²² On their arrival, they found communities wracked by recent deaths, and a number of people dying of terrible complications, including the most widely associated and egregious symptom of EVD, prolific bleeding from bodily orifices and secretions, including vomit (Figure 3).²³

The researchers named the terrible new virus after the nearby Ebola River, which translated to "Black River" in the local Lingala language. The team considered it a "suitably

¹⁹ The two others were the CDC 'Hot Lab' in Atlanta and the US military lab at Fort Detrick, Maryland. *No Time to Lose*, 12.

²⁰ *Ibid*, 14.

²¹ *No Time to Lose*, 16; *Ebola: The Natural and Human History of a Deadly Virus*, 22.

²² *No Time to Lose*, 30.

²³ *Ibid*, 45. In the West Africa Ebola Epidemic, fever *plus* three other symptoms was considered to MCD for EVD, *if* the patient had no known contact with the virus. If the patient had known contact, fever plus one other symptom was considered to MCD. Case definition was changed a number of times throughout the outbreak, and there was significant disagreement between the WHO and CDC as to what should be the accepted standard. The aforementioned definition was the most widely accepted definition.

Read each one aloud and mark an answer for every symptom occurred during this illness (not only right now):

Fever	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Headache	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Vomiting/nausea	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Difficulty breathing	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Diarrhea	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Difficulty swallowing	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Conjunctivitis (red eyes)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Skin rash	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Intense fatigue/weakness	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Hiccups	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Anorexia/loss of appetite	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Unexplained bleeding	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Abdominal pain	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	If yes, please specify: _____			
Muscle pain	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Other symptoms:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Joint pain	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	If yes, please specify: _____			

Figure 3: EVD symptoms, as listed on a Case Investigation Form (CIF) from the West Africa Ebola Epidemic

ominous” name.²⁴ They understood the newly-named EVD was zoonotic, meaning a virus with an animal reservoir. The International Commission investigated bed bugs, rats, mice, squirrels, mosquitoes, duikers, dogs, bats, and monkeys. None had traces of the epidemic devastating the community around them.²⁵

Without managing to establish the source, the teams were nonetheless able to bring the Yambuku outbreak to a halt using basic Infection Prevention and Control (IPC) measures: contrary to popular belief, EVD is an incredibly ineffective virus. It is only transmissible when a patient is symptomatic; the virus is not airborne, so transmission requires direct contact with bodily fluids; and the virus is killed by chlorine, hand sanitizer, and regular soap. In response to public concern over the West Africa EVD Epidemic, Dr. Piot said he “wouldn’t be worried to sit next to someone with Ebola virus on the [subway] as long as they don’t vomit on you or something.”²⁶ This is not to say that basic IPC measures are entirely effective. Indeed, in Yambuku, the International Commission’s success in stopping the outbreak was partly due to the virus’ high mortality rate, which tore its way through the small and isolated population of Yambuku so quickly that it could not reproduce as fast as it destroyed its own host.²⁷

²⁴ *Ibid*, 57.

²⁵ *The Natural and Human History of a Deadly Virus*, 24.

²⁶ Lydia Smith, “Ebola Discoverer Peter Piot: ‘I would Sit Next to an Infected Person on the Train,’” *International Business Times*, July 31, 2014, accessed February 7, 2016, <http://www.ibtimes.co.uk/ebola-discoverer-peter-piot-i-would-sit-next-infected-person-tube-1459154>.

²⁷ The CFR was 92.5 percent in the Yambuku outbreak. *No Time to Lose*, 59.

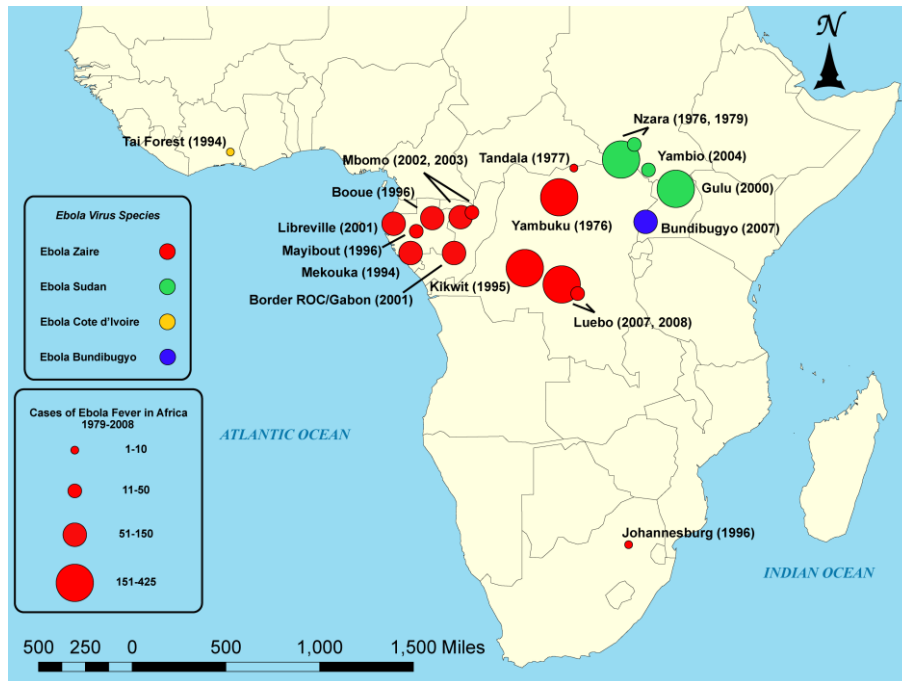


Figure 4: EVD outbreaks, 1976 - 2008

Further study continued to prove elusive: outbreaks following the Yambuku epidemic were similarly short, intense, and geographically dispersed, making investigation highly complex. Unlike other illnesses such as malaria, tuberculosis, and diarrheal diseases that cause millions of deaths each year, neither the Yambuku outbreak nor the 22 other outbreaks prior to the West Africa EVD Epidemic resulted in significant caseloads. Collectively, these 23 outbreaks resulted in 1,580 known deaths.²⁸ All were contained within the African continent (Figure 4),²⁹ and in no way appeared to place populations in Europe and the United States at risk. Research dollars and international interest were subsequently limited.³⁰ Scientists were and continue to be unsure about the virus' animal reservoir (though antibodies have been found in chimps and fruit bats and are thus the primary suspects), still do not know the biological

²⁸ *The Natural and Human History of a Deadly Virus*, 45.

²⁹ Zach Orecchio, *Distribution of Ebola Virus Outbreaks 1979 – 2008*, 2011, University of Southern Florida Geography Department, accessed January 09, 2016, <https://upload.wikimedia.org/wikipedia/commons/thumb/8/87/EbolaSubmit2.png/1280px-EbolaSubmit2.png>.

³⁰ *The Natural and Human History of a Deadly Virus*, 110.

mechanism by which EVD causes death, and until 2015, were unable to produce a viable vaccine for this devastating disease.³¹

Brief history of the West Africa EVD Epidemic

With the West Africa EVD Epidemic, the calculus changed, and a previously insignificant virus became the center of international attention and concern. The outbreak is believed to have started in the small Guinean village of Meliandou in December 2013 (red pin, Figure 5), close to international borders with Sierra Leone and Liberia.³² After playing around a tree frequented by a large Angolan free-tailed bat population, a one-year-old boy named Emile fell sick, infecting his mother.³³ His death and her burial, at which many family and community members ceremonially washed her infectious body, sparked the beginning of the deadliest outbreak of EVD ever recorded.³⁴



Figure 5: Meliandou, Guinea (red pin), the location of the first EVD case in the West Africa EVD Epidemic

³¹ *Ibid*, 48, 81; “Ebola vaccines, therapies, and diagnostics,” last modified October 6, 2015, http://www.who.int/medicines/emp Ebola_q_as/en/.

³² Adapted from OpenStreetMap, OpenStreetMap Contributors, and the Humanitarian OpenStreetMap Team, 2015, accessed January 09, 2016, <https://www.openstreetmap.org/#map=7/7.787/-11.536&layers=H>.

³³ Sylvain Blain et al, “Emergence of Zaire Ebola Virus Disease in Guinea,” *The New England Journal of Medicine* 371 (2014): 1418-1425.

³⁴ *Ibid*, 1418-1425.

In the first months of 2014, the virus rapidly spread throughout the West Africa region (Figure 6), in particular Liberia and Sierra Leone, where, alongside Guinea, the virus would take its largest toll.

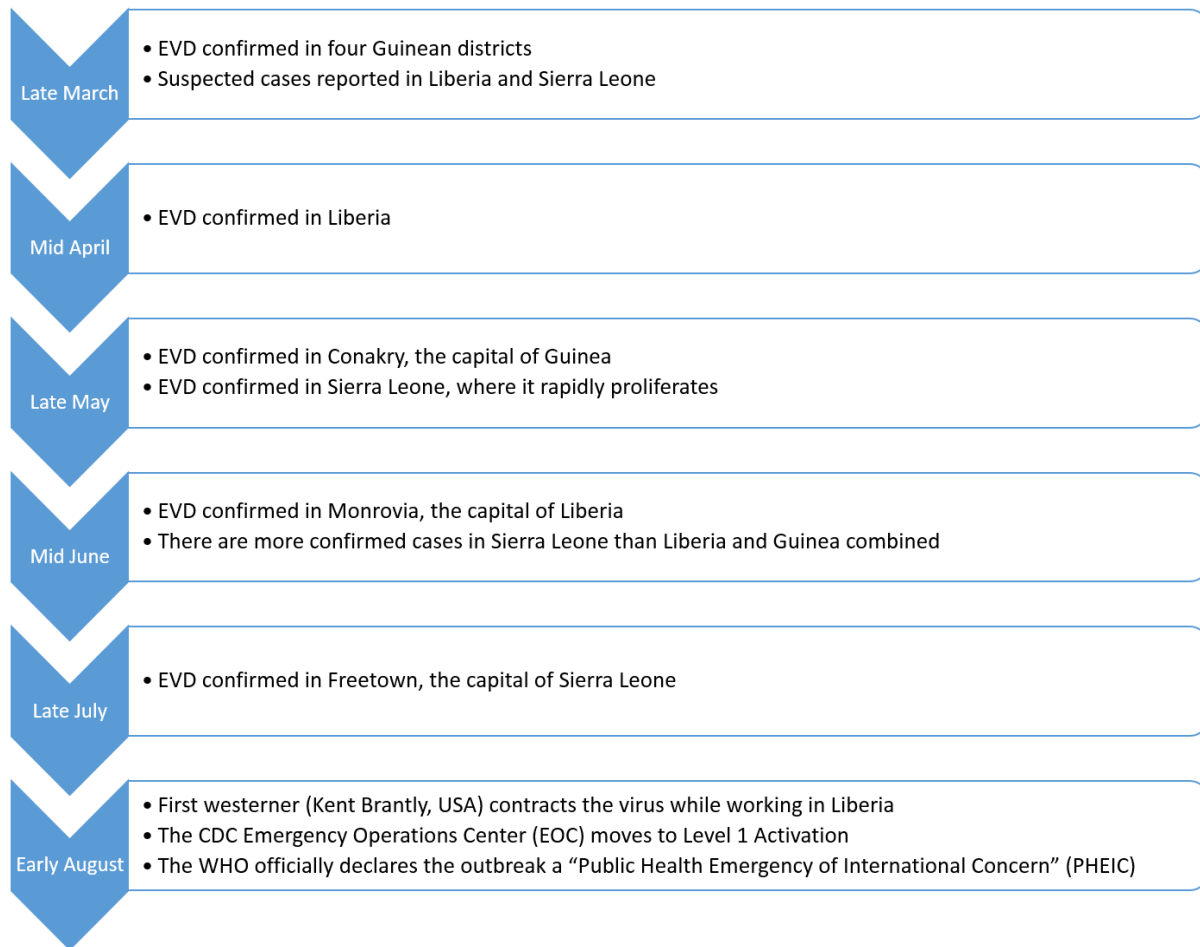


Figure 6: Rapid escalation of EVD in West Africa in the first months of 2014 (Image source: Author)

With this rapid escalation,³⁵ and exponential transmission between the beginning of June and end of August 2014, the CDC projected as many as 1.4 million people could contract the virus by January 2015 if no concerted international effort was made to stem the outbreak (Figure 1).³⁶

³⁵ "Previous Updates: 2014 West Africa Outbreak," last modified December 30, 2015, <http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/previous-updates.html>; "Seven die in Monrovia Ebola outbreak," June 17, 2014, <http://www.bbc.co.uk/news/world-africa-27888363>; "US Ebola patient Kent Brantly 'thrilled to be alive,'" August 21, 2014, <http://www.bbc.com/news/world-us-canada-28885753>; "Statement on the 1st meeting of the IHR Emergency Committee on the 2014 Ebola outbreak in West Africa," August 8, 2014, <http://www.who.int/mediacentre/news/statements/2014/ebola-20140808/en/>.

³⁶ "Ebola Cases Could Reach 1.4 Million Within Four Months, C.D.C. Estimates".

Thankfully, following the CDC’s terrifying projection, their Emergency Operations Center (EOC) Level 1 Activation, and the WHO’s Public Health Emergency of International Concern (PHEIC) declaration, such a response was mounted. Whereas almost no support had been pledged at the time of the CDC’s projections in early September, by the end of October, 2014, almost \$2.4 billion had been committed.³⁷ Support generally followed colonial ties: the United States predominantly supported Liberia, the United Kingdom predominantly supported Sierra Leone, and France predominantly supported Guinea.

Despite travel restrictions and the shutdown of most civilian air service, by the end of the year thousands of infection specialists and humanitarian workers poured into West Africa.³⁸ Burial teams were established to safely bury the highly infectious corpses of EVD victims.³⁹ ETCs and labs were built and staffed across the region, allowing for patient treatment and testing, and the removal of highly infectious patients from their community.⁴⁰ In Sierra Leone (as roughly mirrored by Guinea and Liberia), a national call center was established so people could report sickness and deaths in their community, as was a National Ebola Response Center (NERC) and District Ebola Response Centers (DERCs) across the country’s 14 districts to coordinate EVD response activity. The scale of the response did not abate for some time: in 2015, the United States alone spent \$5.4 billion on the outbreak response.⁴¹

As a result of profound international support for hard working but resource strapped national response staff, only two percent of the CDC’s September 2014 projection has been realized: over the course of the outbreak, from December 2013 to date, 11,325 people are known

³⁷ “How Much Is Actually Being Spent on Ebola?” October 27, 2014, <http://www.cgdev.org/blog/how-much-actually-being-spent-ebola>.

³⁸ “Defeating Ebola in Sierra Leone: UK aid update 06/11/15”.

³⁹ “Ebola: A day with the burial team,” January 7, 2015, <http://www.bbc.co.uk/news/health-30712162>.

⁴⁰ Among many examples: “Our Ebola Treatment Centre: Greening to Open GOAL Ebola Treatment Centre in Sierra Leone,” December 15, 2015, <https://www.goalglobal.org/stories/post/our-ebola-treatment-centre>.

⁴¹ “Consolidated and Further Continuing Appropriations Act, 2015”.

to have died from EVD, predominantly in Guinea (3,358), Liberia (3,163), and Sierra Leone (8,706) (Figure 7).⁴² Seven other countries were nominally affected, with 34 confirmed cases between Nigeria, Senegal, Mali, Spain, Italy, the United Kingdom, and the United States. A very informative animation of the outbreak’s geographic intensity over time in Guinea, Liberia, and Sierra Leone has been created by the WHO, and can be found on their website.⁴³ The map in Figure 7 (below) is adapted from the animation’s last frame.

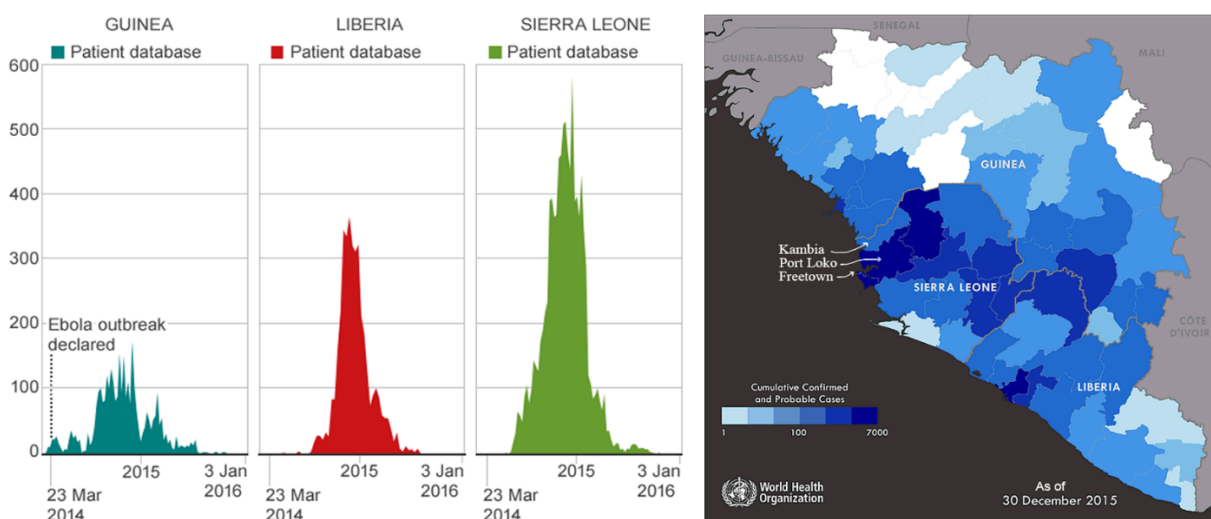


Figure 7: Weekly EVD cases by country (left) and cumulative by country and district (right)

The West Africa EVD Epidemic: Moving forward

As can be seen in Figure 7, the outbreak is close to being declared over. Indeed, all countries affected by EVD have been declared EVD-transmission free by the WHO at least once over the course of the outbreak, following requisite back-to-back 21 day EVD incubation periods (the time it takes from acquiring an infection to when it manifests with symptoms) with no

⁴² Total deaths attributed to EVD (26,638) is probably between 30 and 50 percent of what actually transpired. “Fewer Ebola Cases Go Unreported Than Thought, Study Finds”.

⁴³ Adapted from the World Health Organization’s *How the Ebola outbreak and WHO’s response unfolded*, February 1, 2016, The World Health Organization, accessed February 07, 2016, <http://www.who.int/csr/disease/ebola/en/>; the British Broadcasting Company’s *Ebola: Mapping the Outbreak*, January 14, 2016, the BBC, accessed January 18, 2016, <http://www.bbc.com/news/world-africa-28755033>.

known transmission.⁴⁴ A timeline of the region’s EVD-transmission free status – and the unexpected cases that reversed these declarations – can be found below (Figure 8).

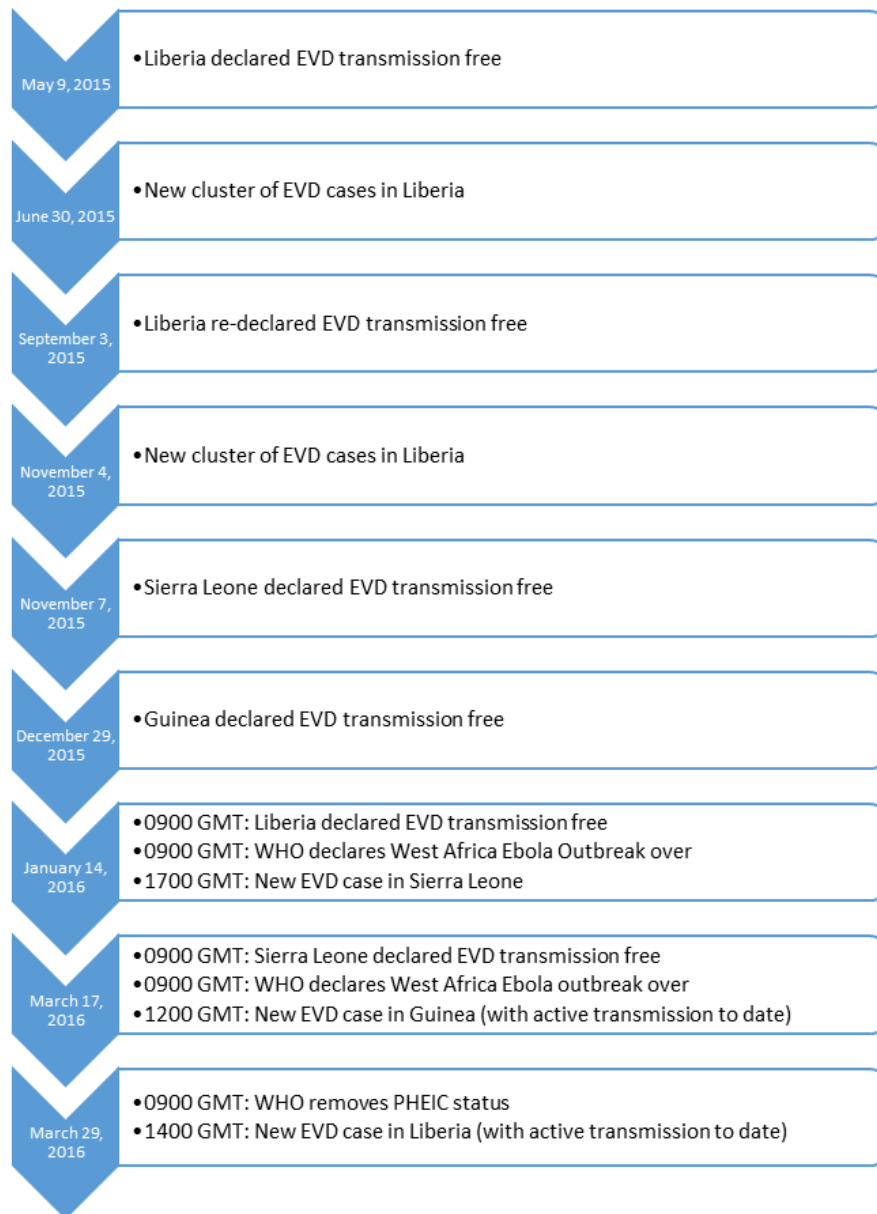


Figure 8: Declaration and rescindment of EVD-transmission free status (Image source: Author)

It is important to note the difference between being EVD transmission free, like the WHO declarations noted above, and EVD free, which will come much later: the terms are

⁴⁴ “2014 Ebola Outbreak in West Africa – Case Counts”; “WHO downgrades Ebola health risk”, March 29, 2016, <http://www.bbc.com/news/health-35921161>; “Ebola in Liberia: Woman dies months after epidemic declared over”, April 1, 2016, <http://www.bbc.com/news/world-africa-35944163>.

regularly conflated by media outlets.⁴⁵ The difference between them has significant implications for the approaching but elusive end of the West Africa EVD Epidemic, and transitively for surveillance over the coming months and years.

When a person is considered to have survived EVD, they have successfully cleared the virus from their blood stream. Laboratory blood tests can find EVD antibodies, but no EVD virus. As such, the survivor will no longer experience symptoms of the virus, and can no longer communicate the virus to others under normal conditions. However, the virus can exist for up to a year, and potentially longer, in immunoprotected bodily fluids like semen and breast milk, as well as brain, spinal, intraocular, and amniotic fluid.⁴⁶ In rare instances, EVD can be sexually transmitted from male survivors' semen to female partners, female survivors' breast milk to breastfeeding infants, or pregnant females' amniotic fluid to newborns.⁴⁷ In exceptionally rare circumstances, immunosuppressed individuals can re-infect themselves, a process whereby active virus in immunoprotected fluids crosses back into the blood stream, making the survivor sick and infectious once again. A high-profile example is found in the re-emergence of EVD in British nurse Pauline Cafferkey.⁴⁸

Therefore, when a country is declared *EVD transmission free*, it does not imply the country is *EVD free*, as it is possible for the virus to re-enter the human population. Transitively, the removal of *EVD transmission free* status does not necessarily imply the discovery of previously unknown transmission and therefore a surveillance failure: indeed, for all of the

⁴⁵ For one example, see Lisa O'Carroll and Umaru Fofana's "WHO officially declares Sierra Leone Ebola-free," *The Guardian*, November 7, 2015, accessed February 7, 2016, <http://www.theguardian.com/world/2015/nov/07/world-health-organisation-sierra-leone-ebola-free>.

⁴⁶ Gibrilla F. Deen et al, "Ebola RNA Persistence in Semen of Ebola Virus Disease Survivors – Preliminary Report," *The New England Journal of Medicine* (2015): 1-7, accessed February 7, 2016, doi: 10.1056/NEJMoa1511410.

⁴⁷ "Persistent virus in people recovering from Ebola virus disease", last modified January 2016, accessed February 7, 2016, <http://www.who.int/csr/disease/ebola/virus-persistence/en/>.

⁴⁸ "Ebola nurse Pauline Cafferkey 'has made full recovery'," November 12, 2015, <http://www.bbc.com/news/uk-scotland-34791692>.

unexpected cases that reversed the EVD transmission free status in West Africa for which a source can be ascertained, sexual transmission has been the cause. On this basis, despite the dramatic reduction in caseload and transmission, West Africa and the IOs supporting surveillance in Guinea, Liberia, and Sierra Leone must remain well-funded, vigilant, and prepared: while the region will be *EVD transmission free* on May 8th, 2016 assuming there are no further cases in Sierra Leone, Liberia, and Guinea, *EVD free* status will take at least a further calendar year.

PORT LOKO AND KAMBIA DISTRICTS

In this section, I will first present the geography and demographics of Port Loko and Kambia. The purpose of this subsection is to present geographic and demographic complexities and realities that have implications for EVD surveillance in the West Africa EVD Epidemic. An analysis and discussion of these implications can be found on pages 77-89. This is followed by a discussion of community and political structures in Port Loko and Kambia, including a brief overview of the hierarchy of community and political structures. Similarly, each have implications for EVD surveillance in the West Africa EVD Epidemic, an analysis and discussion of which can be found on page 97. This is followed by a subsection on health service delivery in Port Loko and Kambia. The purpose of this subsection is to present the structure and quality of Port Loko and Kambia's existing health infrastructure, and the way that citizens of each district access care. This, in turn, has implications for EVD surveillance, a discussion of which can be found on pages 82-83 and 86-88. This section concludes with an epidemiological overview, the purpose of which is to present Port Loko- and Kambia-specific EVD epidemiology, which will later be used to contextualize various analyses.

Geography and demographics

Port Loko and Kambia are two of Sierra Leone's 14 districts, located in the country's northwest (Figures 9 and 10, respectively).⁴⁹ They are the primary focus of this paper.

Port Loko has a population of about 550,000 between its 11 chiefdoms.⁵⁰ Port Loko shares a long northern border with Kambia. Port Loko is home to Sierra Leone's traditional

⁴⁹ "Sierra Leone: Port Loko District Profile (29 December 2015)," *The United Nations Office for the Coordination of Humanitarian Affairs*, December 29, 2015, <http://reliefweb.int/report/sierra-leone/sierra-leone-port-loko-district-profile-29-december-2015>; "Sierra Leone: Kambia District Profile (29 December 2015)," *The United Nations Office for the Coordination of Humanitarian Affairs*, December 29, 2015, <http://reliefweb.int/report/sierra-leone/sierra-leone-kambia-district-profile-29-december-2015>.

⁵⁰ "2004 Population and Housing Census of Sierra Leone: Population Profile of Sierra Leone", 8-9.

healer network.⁵¹ The Temne ethnic group is the district’s largest.⁵² 80% of the district’s population rely on agriculture as their primary livelihood; trade and mining are the next largest industries. Port Loko is considered relatively affluent due to its mineral wealth, though mining revenues are often generated and owned by Chinese companies.⁵³



Figure 9: Port Loko and its eleven chiefdoms

Kambia is smaller, with a population of about 350,000 among its seven chiefdoms.⁵⁴ Like Port Loko, it borders the Atlantic Ocean to the east and Bombali District to the west. Almost its entire southern border is shared with Port Loko. Its northern border with Guinea, the pervasive epicenter of Guinea’s EVD outbreak, is highly porous, with 48 recognized crossings.⁵⁵

With proximity to Guinea and convenient road links to both Conakry and Freetown, Kambia is also home to large markets that serve people from throughout Sierra Leone and

⁵¹ Indrias G Kassaye, “Traditional healers – friends or foes in the fight against Ebola?,” September 28, 2015, <https://blogs.unicef.org/blog/traditional-healers-friends-or-foes-in-the-fight-against-ebola/>.

⁵² “Sierra Leone: Port Loko District Profile (29 December 2015)”.

⁵³ 2004 Population and Housing Census of Sierra Leone; *Sierra Leone: Port Loko District Profile*.

⁵⁴ “Sierra Leone Demographic and Health Survey 2013,” Statistics Sierra Leone (SSL) and ICF International (Freetown: SSL and ICF International, 2014): 8; “Sierra Leone: Kambia District Profile (29 December 2015)”.

⁵⁵ Moustapha Diallo, “Guinea: Enhanced community engagement to bring the Ebola outbreak to an end,” May 14, 2015, accessed February 7, 2015, <http://www.ifrc.org/en/news-and-media/news-stories/africa/guinea/guinea-enhanced-community-engagement-to-bring-the-ebola-outbreak-to-an-end-68602/>.

Guinea.⁵⁶ Kambia is ethnically diverse, and has the country's largest population of Susu (primarily a Guinean people).⁵⁷ Like Port Loko, 80% of the population rely on agriculture for their primary livelihood.⁵⁸ However, unlike Port Loko, Kambia does not have an active mining industry, and is therefore relatively less affluent. Less than half of Kambia's population has received any education whatsoever.



Figure 10: Kambia and its seven chiefdoms

Kambia also has a unique history in the Sierra Leone Civil War (1991-2002). In the first years of the war, hundreds of thousands of refugees passed through Kambia on their way to Guinea or settled in the then-calm district as internally displaced peoples (IDPs). However, the district was not immune to the war's atrocities for long: in 1995, the rebel Revolutionary United Front (RUF) abducted a large number of children, many of whom became child soldiers.⁵⁹ By 1999, the RUF had achieved a number of military victories in Kambia and occupied every major town.⁶⁰ Despite military campaigns by both Guinea and Sierra Leone, the RUF held Kambia

⁵⁶ *Sierra Leone: Kambia District Profile*.

⁵⁷ *Ibid.*

⁵⁸ *Ibid.*

⁵⁹ "Human Rights Abuses in a War Against Civilians," *Amnesty International*, September 13, 1995, <http://www.refworld.org/docid/3ae6a98e10.html>.

⁶⁰ *Ibid.*

until disarmament in 2001. The United Nations High Council for Refugees (UNHCR) called the district “one of the poorest and most devastated areas [in] Sierra Leone’s decade-long civil war.”⁶¹ The effects are still felt today: large scale movement of people continues in the district, as refugees and IDPs return home or permanently settle.⁶² Given Kambia’s particularly complicated relationship with the war, ongoing population movement, and the large number of returning child abductees and soldiers, reintegration efforts in the district have been particularly troublesome.

Despite these differences, Port Loko and Kambia share many demographic similarities, as presented in Figure 11.⁶³ The districts’ significant Muslim population, as well as the districts’ poverty and reliance on agriculture, have implications for surveillance and EVD-eradication efforts as discussed on pages 87-89.

Item	P. Loko	Kambia
% Islam as primary religion	80	80
% Urban dwelling	17	20
Life expectancy (years) at birth	49	51
% Food insecure	70	71
% Chronically malnourished	35	38
% Poverty	60	60
% Agriculture as primary livelihood	81	80
% Literacy	32	32

Figure 11: Demographic similarities between Port Loko and Kambia (Image source: Author)

The districts also share two key geographic similarities with surveillance implications (pages 77-81 and 88): the Conakry-Freetown highway, and the districts’ riverine areas.

The Conakry-Freetown highway begins in Conakry and travels south through Guinea to the country’s primary border crossing with Sierra Leone in Kambia. Depending on one’s

⁶¹ “UNHCR donates ambulance to help recovery of Sierra Leonean town”, August 10, 2004, accessed February 7, 2016, <http://www.unhcr.org/4118d6cc4.html>.

⁶² *Sierra Leone: Kambia District Profile*.

⁶³ All information taken from the *Sierra Leone Demographic and Health Survey* and district profiles.

direction of travel, Kambia Town is either the first or last port of call in Sierra Leone, and is therefore a significant center of movement and trade. The highway continues south through Kambia into Port Loko. In Port Loko, one can follow the road through to Freetown, or branch to Sierra Leone's other districts. Travelers and trade from Conakry and Freetown must pass through this junction to access all other districts in Sierra Leone. As such, both Port Loko and Kambia experience a large amount of international and inter-district trade and travel.

The Atlantic coastline of both districts is a moderately populated riverine area (Figure 12 shows its most northern boundaries).⁶⁴ This contrasts significantly with much of the rest of the country. South of Port Loko, Sierra Leone is known for its pristine beaches. In Port Loko and Kambia, however, the coast is riddled with swamplands and is largely inaccessible by land. Despite this, marine trade and travel is prolific in the region, including across the Sierra Leone-Guinea border.



Figure 12: Kambia's riverine region

⁶⁴ Adapted from OpenStreetMap, OpenStreetMap Contributors, and the Humanitarian OpenStreetMap Team, 2015, accessed January 09, 2016, <https://www.openstreetmap.org/#map=12/8.9268/-13.3254&layers=H>.

Community and political structure

Sierra Leone's district-level community and political structure is a complex, imbricating history of pre-colonial and colonial organization. Rather than disregard the precolonial chieftaincy structure in favor of direct rule, British colonists chose to emphasize it. Doing so was politically exigent: it greatly facilitated the collection of taxes and the assertion of British interests across the political and ethnic divisions of Sierra Leone.⁶⁵

Upon independence from Great Britain in 1961 (a relatively amicable process for both countries), Sierra Leone adopted a democratic parliamentary governance structure.⁶⁶ Like the British, the new nation did not dismantle the chieftaincy structure. It was too entrenched:⁶⁷ the status of many of the country's political elites was due to their chieftaincy heritage. The structure also continued to serve the needs of Sierra Leone's ethnically and politically disparate nature, proving the only effective institution of local governance.⁶⁸ The World Bank did sponsor the creation of elected local councils in 2004, but this new political division has had little effect.⁶⁹ As such, it is not noted in the following diagram of Sierra Leonean political authority (Figure 13).

As such, today Sierra Leone has two parallel and interweaving political structures, one democratically elected, the other hereditary, an unelected vestige of precolonial political organization. Both share responsibility for governing the people of Sierra Leone's districts. Unelected chiefs have seats in parliament, can raise taxes, control the judicial system, and allocate land, an incredibly important resource due to the population's reliance on agriculture.⁷⁰ In the words of political historian David Harris, the country is at once "a version of democracy...

⁶⁵ David Harris, *Sierra Leone: A Political History* (London: Hurst & Company, 2013), 165-166.

⁶⁶ *Ibid*, 165-167.

⁶⁷ *Ibid*, 166.

⁶⁸ *Ibid*, 165-167.

⁶⁹ Tristan Reed, James Robinson, "The Chiefdoms of Sierra Leone" (working paper, Harvard University, 2013), 2.

⁷⁰ *Ibid*, 166; Daron Acemoglu, Tristan Reed, and James Robinson, "Chiefs: Economic Development and Elite Control of Civil Society in Sierra Leone" (working paper, Stanford University, 2013), 1.

where the electorate is enthusiastic and knowledgeable” and “also a version underpinned by fragile institutions and firmly entrenched in patronage, chieftaincy, and ethno-regionalism which show only slight perturbations over time.”⁷¹

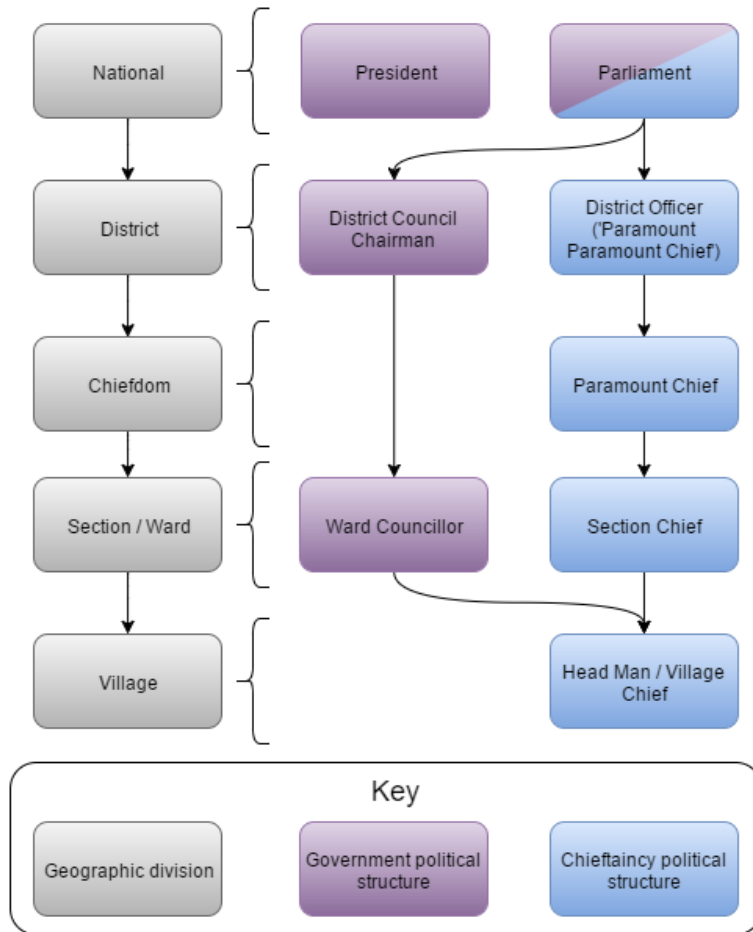


Figure 13: Political structure in Sierra Leone (Image source: Author)

Geographic political boundaries follow a muddle of both the government and chieftaincy political structures (Figure 13). The nation is divided into fourteen districts.⁷² Each district has a District Council Chairman (DCC), the elected government representative at the district level. Each district also has a ‘chief of chiefs’, whose title changes district to district. In Port Loko, this

⁷¹ *Sierra Leone: A Political History*, 180.

⁷² Between national and district division there is a layer of geographic political division that is irrelevant to this paper. The country is split into three provinces (Northern, Southern, and Eastern) and one area (Western Area). This is not noted in Figure 11 as it is not relevant to this paper, but would fall between the national and district division.

individual is known as the Senior District Officer (SDO). In Kambia, this individual is known as the District Officer (DO). Each district is then broken into constituent chiefdoms – eleven in Port Loko, and seven in Kambia. Each chiefdom has a Paramount Chief, who reports to the SDO/DO. There is no elected chiefdom-level government official.

Below the chiefdom level, there are two further divisions, ward and section. Ostensibly, wards are the lowest division of elected government. However, this is little more than formal. Wards are not used by Sierra Leoneans, and are useful only for Sierra Leone’s decennial census.⁷³ Sections, on the other hand, each have an identified Section Chief, responsible for several adjacent villages, and are thus important geographic divisions. Each village has a Head Man. Lastly, each household within a village has an identified Head of Household.

In short, to the average Sierra Leonean in Port Loko and Kambia, political authority is generally understood as follows. At home, there is a Head of Household. In the village, there is a Head Man or Village Chief. In a Section, a collection of villages, there is a Section Chief. In a chiefdom, a collection of sections, there is a Paramount Chief. At the district level, a collection of chiefdoms and wards, there is both a chieftaincy representative (SDO/DO) and an elected representative (DCC). Ultimately, both systems and every division of governance, from the household to district level, was required to effectively conduct surveillance, a discussion of which can be found on page 61 and 97.

Health service delivery

Sierra Leone’s health system (both non-EVD and EVD specific) has many components. For the purposes of this paper, only a selection is presented here (Figure 14). All presented in Figure 14 are officially recognized by the Government of Sierra Leone.

⁷³ “The Chiefdoms of Sierra Leone”, 2.

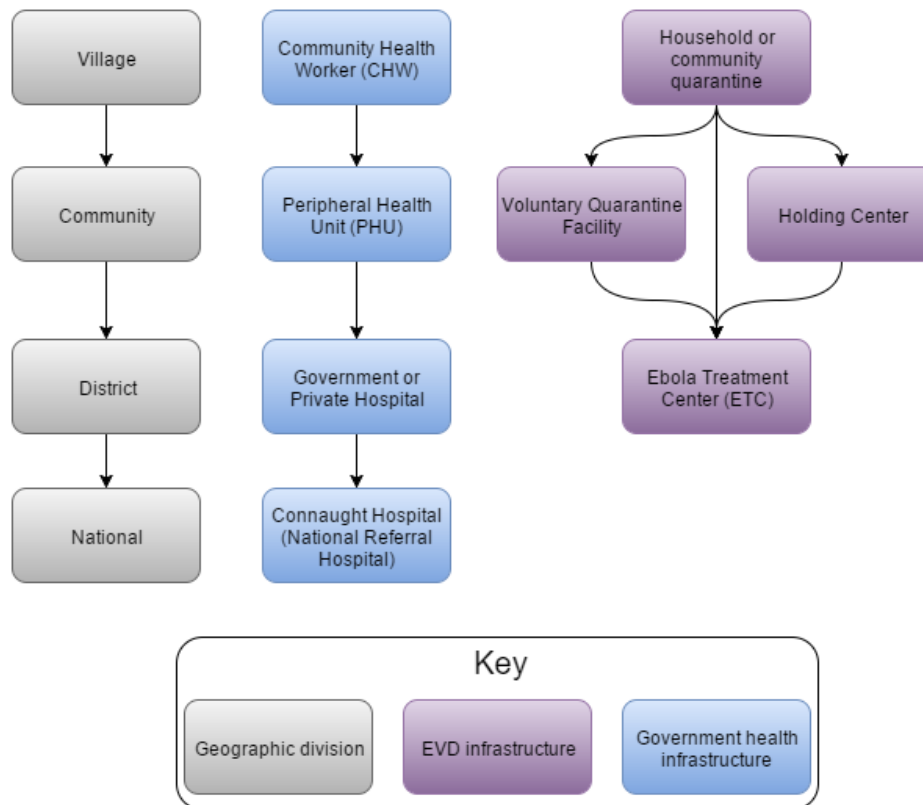


Figure 14: Sierra Leone's official health system (non-EVD and EVD) (Image source: Author)

With only .02 physicians per 1,000 citizens, Sierra Leone has a severe dearth of trained doctors, even relative to other African nations.⁷⁴ Kenya and South Africa have, respectively, 10 and 40 times the density of physicians; in the United States, far from the leading nation by this metric, the factor is 125.⁷⁵ It is important to note that these statistics were taken between 2007 and 2013, prior to the West Africa EVD Epidemic, in which many Sierra Leonean physicians died, and medical schools were closed. It is therefore likely these already dire statistics overestimate the country's human resources for health (HRH).

As such, Sierra Leone relies heavily on resource-efficient Community Health Workers (CHWs) to deliver home-to-home community care to the country's 6 million citizens. The CHW

⁷⁴ "World Health Statistics, 2015," *World Health Organization* (Geneva: World Health Organization Press, 2015), 120.

⁷⁵ *Ibid*, 117, 120.

program is not without fault: the Ministry of Health and Sanitation (MoHS) said it was created in “the absence of specific policy stipulations... [that] resulted in uncoordinated implementation, duplication of efforts, and [an] inability to systematically... scale.”⁷⁶ Due to such disorganization, it is not possible to ascertain precisely how many CHWs exist. An MoHS overview document contains no such statistics.⁷⁷

Despite this disorganization and lack of accurate data, the program is undeniably prolific. There is generally one or more CHW per village: as such, Port Loko and Kambia each have somewhere between several hundred and several thousand CHWs.⁷⁸ While these individuals are unpaid and have no formal medical training, they must complete a CHW training.⁷⁹ They are responsible for the provision of basic care and medicines, coordinating water and sanitation healthcare (WASH), and for recognizing when someone might need institutionalized care, among other basic tasks.⁸⁰

If and when a CHW decides to refer a patient, they will do so to the area’s Peripheral Health Unit (PHU). All CHWs are assigned to a specific PHU and work within that PHU’s catchment area. Sierra Leone has 1,228 PHUs – there are 106 in Port Loko and 67 in Kambia.⁸¹ PHUs can provide general care, as Community Health Posts (CHPs) or Community Health Centers (CHCs), or specialized care, such as Maternal and Child Health Posts (MCHPs). They are generally staffed by a Community Health Officer (CHO), who has completed a three-year

⁷⁶ “Policy for Community Health Workers in Sierra Leone, June 2012”, *Government of Sierra Leone Ministry of Health and Sanitation* (2012), 1.

⁷⁷ *Ibid.*

⁷⁸ *Ibid.*, 10; this rough number was also corroborated in district CHW meetings I attended between January and September of 2015. At any one meeting, it was not unusual for several hundred CHWs to materialize.

⁷⁹ The content and duration of the training can vary wildly, from several days of rudimentary basics to several months of fairly complicated medical interventions, like birth attendance. *Ibid.*, 5, 1, 10, 21.

⁸⁰ *Ibid.*, 11.

⁸¹ Nadia Minclier Cobb, “Sierra Leone’s Community Health Officers,” January 20, 2015, accessed February 8, 2016, <http://whoeducationguidelines.org/content/sierra-leone%E2%80%99s-community-health-officers>; numbers for Port Loko and Kambia were established by GOAL Global staff in June, 2015.

Bachelor of Science degree in Community Health Sciences (CHS). Sierra Leone has around 500 trained CHOs.⁸² Given their training, these practitioners can provide more sophisticated care than a CHW, including very minor surgeries and basic diagnostics. However, as PHUs are poorly resourced (it is not unusual for a PHU to lack running water and electricity, for example), CHO work is primarily preventative.⁸³ As such, they are also responsible for patient up-referral to the nearest District Hospital.⁸⁴

District Hospitals provide the most significant care available at the district level. Kambia has one District Hospital, the Kambia Government Hospital (KGH). Port Loko has a number of private hospitals, and two government hospitals; Port Loko Government Hospital (PLGH), and Lungi Government Hospital (LGH). These hospitals are staffed by trained nurses and usually at least one physician. They generally have an operating theater, medical store, laboratory, morgue, incinerator, condition- and gender-specific wards, and other basic hospital infrastructure. HRH and other resources are still few and far between: reliable running water and electricity remain the exception, not the rule. If care is required that cannot be provided at a District Hospital, patients may be referred to Freetown's Connaught Hospital, the national referral hospital.

It should be noted that health infrastructure was largely damaged or destroyed in the 1991-2002 Sierra Leone Civil War. Sierra Leonean Dr. Muctarr Amadu Sheriff Jalloh described the war's impact in an interview with the International Federation of Red Cross and Crescent Societies (IFRC):⁸⁵

The civil war brought all the health and economic infrastructures down to zero during the ten years. Many clinics that had been established by the government

⁸² *Ibid.*

⁸³ *Ibid.*

⁸⁴ *Ibid.*

⁸⁵ "Sierra Leone's long recovery from the scars of war," *Bulletin of the World Health Organization*, Vol. 88 No. 10 (October 2010): 717.

were completely demolished... A lot of [the country's] health professionals left the country because of fear.

KGH, for example, was completely destroyed.⁸⁶

Health infrastructure was chronically underfunded before, during, and since. A 2009 survey of ten government hospitals, published in the *Journal of the American Medical Association*, put it bluntly:⁸⁷

There was a paucity of electricity, running water, oxygen, and fuel at the government hospitals in Sierra Leone. There were only 10 Sierra Leonean surgeons practicing in the surveyed government hospitals... There were few supplies at any of the hospitals, forcing patients to provide their own... The government hospitals were decimated during the civil war, but they form the backbone of... care for most of the country's population... There are severe shortages in all aspects of infrastructure, personnel, and supplies.

Given its dilapidated infrastructure and totally inadequate human and physical resources, Sierra Leone was woefully unprepared for the West Africa EVD Epidemic. Hospitals with no running water were hardly the place to care for highly infectious patients, but by Summer 2014 they were overflowing with EVD patients nonetheless. Bed spaces were constantly full, and many patients were left to die on the ground outside hospital gates. More than half of all PHUs closed during the outbreak due to staff being either quarantined or seconded to the EVD response.⁸⁸

To fill this urgent need for infection control and bed space, the international community (generally American and British military engineers) rapidly built a number of ETCs and converted some schools and PHUs into VQFs and Holding Centers.⁸⁹ ETCs were designed for

⁸⁶ *UNHCR donates ambulance to help recovery of Sierra Leonean town.*

⁸⁷ T. Peter Kingham et al, "Quantifying Surgical Capacity in Sierra Leone: A Guide for Improving Surgical Care," *JAMA Surgery* 144(2) (2009): 122-127.

⁸⁸ "Sierra Leone Health Facility Survey 2014: Assessing the impact of the EVD outbreak on health systems in Sierra Leone," *UNICEF* (December 3, 2014): 18.

⁸⁹ VQFs were facilities with heightened monitoring where EVD contacts could elect to wait out their 21-day quarantine. Removing these potentially sick individuals from their home prevented onward transmission to their families. Holding Centers were built before ETCs could take escalating caseloads – sick patients were brought to an

maximal IPC, and integrated IPC measures into their physical structure (Appendix H). By January 2015, three ETCs had been built and staffed in Port Loko and Kambia, with a further ETC built and staffed in June of that year.

There is a third, unofficial system for health service delivery in Port Loko and Kambia: receiving care from one of the estimated 45,000 traditional healers in Sierra Leone.⁹⁰ It is not accurate to conflate traditional healers with witch doctors, though many traditional healers employ folk, spiritual, and herbal remedies.⁹¹ Traditional healers may also prescribe over-the-counter pharmaceuticals, and have established referral protocols to nearby PHUs or hospitals. The term is broad, and essentially includes all people practicing unregistered and unlicensed medicine, outside the formal health service delivery mechanisms outlined above.

Traditional healing is incredibly popular for a number of reasons. First and foremost, it is incredibly cheap – patients must often pay a user fee, travel costs, and drug costs to receive care at government facilities.⁹² Traditional healers charge a small fraction of this cost, or allow for payment in kind.⁹³ In addition, some traditional healers purport to cure ailments untreatable in hospitals, such as bad love, economic insecurity, and even biomedical conditions like blindness, cancer, and EVD.⁹⁴ The latter made traditional healers very attractive to the large number of Sierra Leoneans who do not trust officially recognized health systems to provide quality EVD

ETC directly bed space permitting, but were otherwise taken to a Holding Center while their blood was tested for EVD. If the patient was EVD positive, they were transferred to an ETC. If the patient was negative, they were returned to their local PHU or hospital, depending on their medical needs.

⁹⁰ Dariusz Dziewanski, “How traditional healers helped defeat Ebola,” *Al Jazeera*, November 5, 2015, accessed February 8, 2016, <http://www.aljazeera.com/indepth/features/2015/10/traditional-healers-helped-defeat-ebola-151028114811599.html>.

⁹¹ Katherine Mueller, “Turning to traditional healers to help stop the Ebola outbreak in Sierra Leone,” *The International Federation of Red Cross and Red Crescent Societies*, July 31, 2014, <http://www.ifrc.org/en/news-and-media/news-stories/africa/sierra-leone/turning-to-traditional-healers-to-help-stop-the-ebola-outbreak-in-sierra-leone-66529/>.

⁹² Lisa Denney, and Richard Mallett, “Mapping Sierra Leone’s plural health system and how people navigate it”, *Secure Livelihoods Research Consortium* (London: Overseas Development Institute, September 2014), 2.

⁹³ *Ibid*, 3.

⁹⁴ *Turning to traditional healers to help stop the Ebola outbreak in Sierra Leone*.

treatment and care.⁹⁵ Furthermore, traditional healers allow patients to receive care when and where they want – while the average distance from a rural village to PHU is 18 kilometers, “there is no village in Sierra Leone that doesn’t have a traditional healer.”⁹⁶ This saves a patient both time and travel costs. Particularly renowned traditional healers may even have a traveling circuit, providing care at a patient’s home.⁹⁷

As they are unlicensed and unregistered, the number of traditional healers in any one district is impossible to ascertain, though the number is certainly in the thousands. Kambia, therefore, has a significant network of traditional healers, as well as many who travel into the district from neighboring Guinea. Port Loko’s numbers are presumed to be uniquely significant, as it is considered West Africa’s center for traditional healing.⁹⁸ People travel from across Sierra Leone, Liberia, and Guinea to access traditional healing in the district.⁹⁹ Traditional healers had a significant negative impact on surveillance during the West Africa EVD Epidemic, a discussion of which can be found on pages 82-83 and 86-88.

Epidemiological overview

Port Loko and Kambia EVD caseloads were dramatically different for much of the West Africa EVD Epidemic. The first confirmed case of EVD in Port Loko was in May, 2014, months before cases were confirmed in neighboring Kambia in September that year (Figures 15, 16, and

⁹⁵ *How traditional healers helped defeat Ebola.*

⁹⁶ *Ibid.*

⁹⁷ A number of EVD cases were caused by such traditional healer travel, including a Port Loko case in June 2015 that re-sparked the outbreak in the district.

⁹⁸ Hassan Bruz, “NERC Boss Tours Ebola Hot Spots in Northern Sierra Leone”, April 3, 2015, <http://www.voice-of-binkongoh.info/nerc-boss-tours-ebola-hot-spots-in-northern-sierra-leone/>.

⁹⁹ “Sierra Leone: a traditional healer and a funeral: Ebola at 6 months” *World Health Organization*, n.d., accessed February 8, 2016, <http://www.who.int/csr/disease/ebola/ebola-6-months/sierra-leone/en/>; “National Ebola Response Centre District Brief – Kambia and Port Loko – Operation Northern Push Executive Summary”, *National Ebola Response Center*, July 1, 2015, <http://nerc.sl/sites/default/files/docs/HE%20Brief%20-%20ONP.pdf>, 5.

17).¹⁰⁰ That same month, Port Loko had become the outbreak’s epicenter, and was experiencing close to one hundred laboratory confirmed cases per month. As previously mentioned (page 9), this probably captured less than half of cases actually occurring within the district. After September’s precipitous increase in EVD cases (around epi week 38), Port Loko continued to experience high caseloads until the end of December 2014 and beginning of January 2015 (epi weeks 52 through 3), when caseloads dropped just as quickly as they had risen the previous autumn.

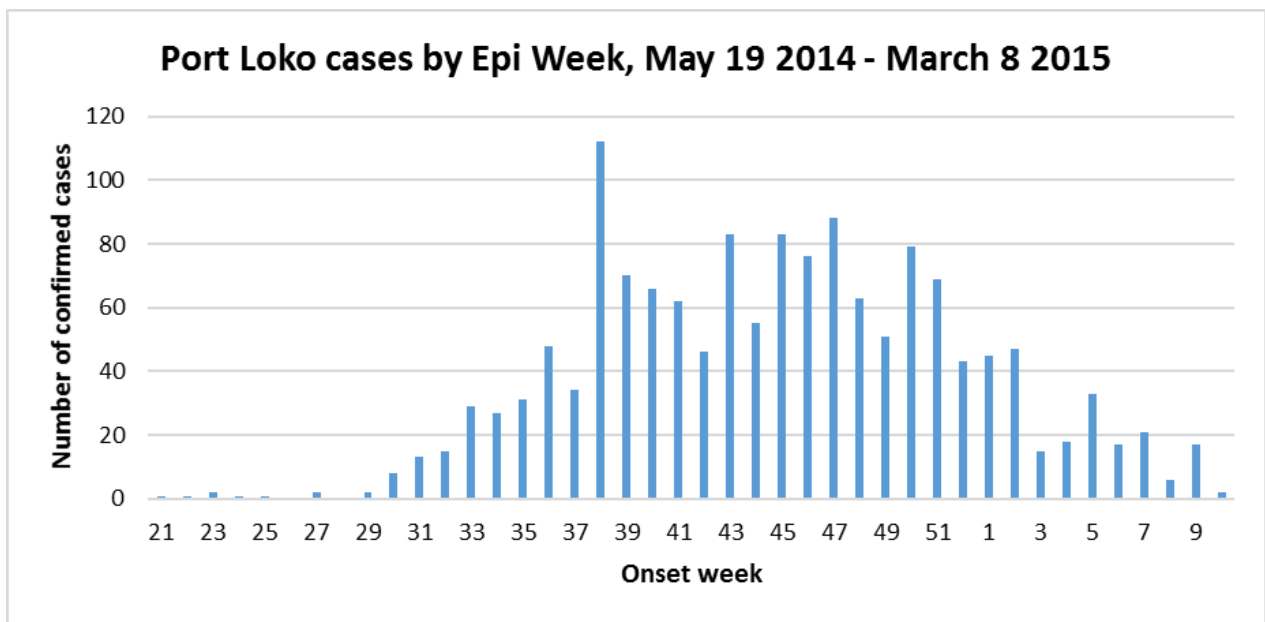


Figure 15: Laboratory confirmed EVD in Port Loko, May 19, 2014 - March 8, 2015 (Image source: Author)

Kambia, on the other hand, never experienced caseloads anywhere near as high as Port Loko’s. However, once there, cases stubbornly persisted (Figure 16).

Despite these two different beginnings (one dramatic but short-lived, the other calm but protracted),¹⁰¹ by the June of 2015 both districts were the center of EVD eradication efforts in

¹⁰⁰ Figure 15 and Figure 16 are adapted from an unpublished WHO Port Loko situation report in March, 2015 and an unpublished CDC Kambia situation report in May, 2015, respectively.

¹⁰¹ By mid-April, Port Loko had consecutive weeks without cases, despite surveillance improving significantly. Kambia could not claim the same until mid-July.

Sierra Leone. Kambia’s transmission did not abate, and eventually a case slipped through the cracks: a woman evaded quarantine in Kambia and traveled to the densely populated town of Lungi, Port Loko. On June 16, 2015, the government announced “Operation Northern Push” (ONP) (see page 96), a no-holds-barred carte blanche to do whatever necessary to eradicate EVD from the two districts, and transitively, the country.

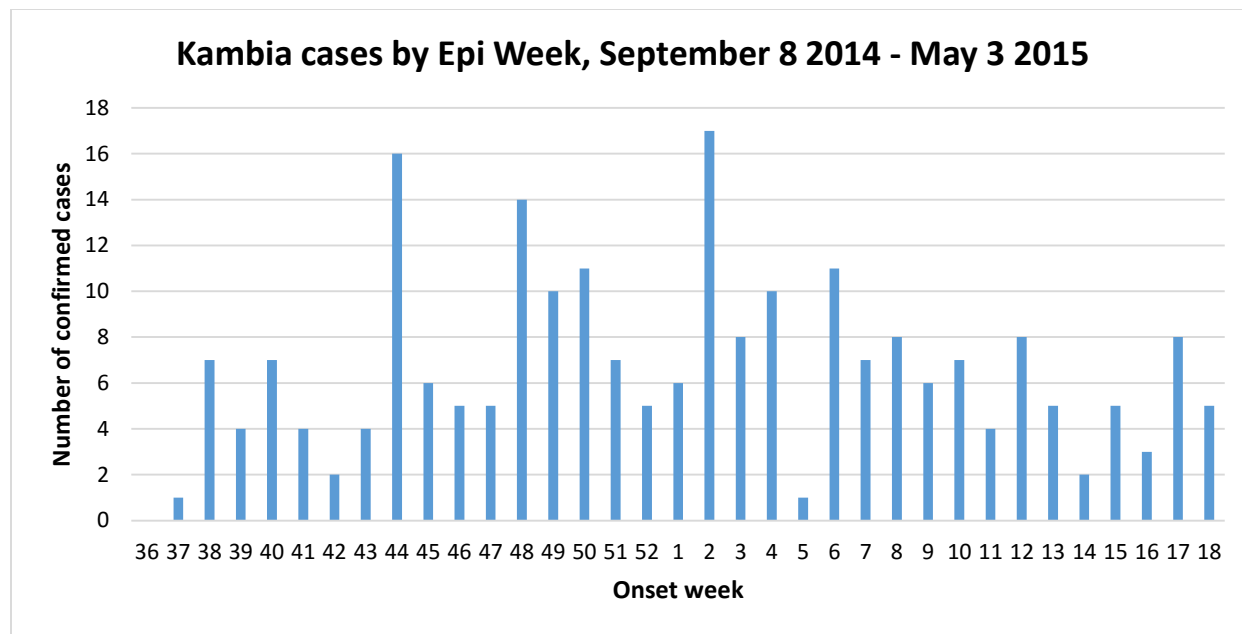


Figure 16: Laboratory confirmed EVD in Kambia, September 8, 2014 – May 3, 2015 (Image source: Author)

While ONP did not experience success within the operation’s initial window of 21 days (indeed, it was extended indefinitely and technically continues to date), EVD cases did abate in both districts. Kambia’s transmission was finally brought under control, and cases dropped to almost zero. On July 13, 2015, Port Loko experienced its last case of EVD in the West Africa EVD Epidemic. A new cluster of cases in Kambia did arise in late August 2015, but less than two weeks later this was once again contained. Kambia experienced its last case of EVD in the West Africa EVD Epidemic on September 7, 2015. A timeline of these and other significant events for the EVD outbreak and surveillance in Port Loko and Kambia can be found below (Figure 17).

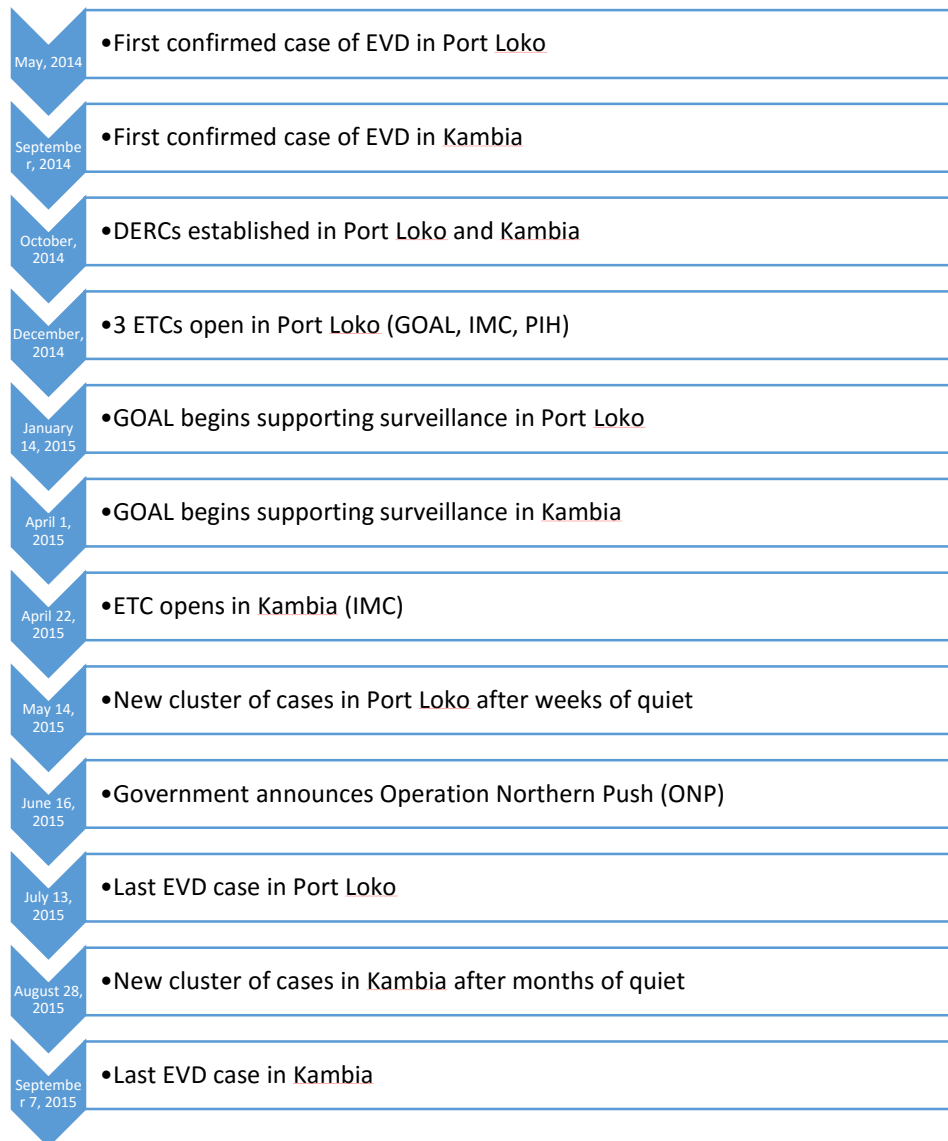


Figure 17: Port Loko and Kambia significant events timeline (Image source: Author)

ORGANIZATION OF THE DISTRICT EBOLA RESPONSE CENTER

The purpose of this section is to present the background and management structure of the DERC, the core organizational body of district-level EVD response, as well as its operational divisions under the ‘pillar system’. Given the DERC is ultimately responsible for surveillance at the district level, the ramifications of its creation and the consequences of its management structure have enormous implications for surveillance in Port Loko and Kambia, which are discussed at length on pages 89-97.

Background

Prior to the creation of DERCs,¹⁰³ district-level EVD response operations were coordinated by District Health Management Teams (DHMTs) under the authority of the MoHS. However, HRH and physical resources were lacking (pages 36-42), as was strong operational coordination. It is on this basis that the Sierra Leonean government established the NERC, a breakaway of the Ministry of Defense (MoD), to coordinate the national EVD response. The NERC Chief Executive Officer (CEO), Paolo Conteh, is also the country’s Minister of Defense. While the NERC superseded the MoHS’ authority over EVD response policy, the NERC was not tasked with operational management, and as such did little to resolve district-level coordination needs. An alternative to the DHMT was required.

To this end, the NERC, in collaboration with the Republic of Sierra Leone Armed Forces (RSLAF) and the Joint Inter-Agency Task Force (JIATF) – itself a collaboration between Britain’s Department for International Development (DFID) and the British military (BritMil) – created constituent DERCs.¹⁰⁴ Most were officially opened in October, 2014, including those in

¹⁰³ Also referred to as “command centers”.

¹⁰⁴ Ostensibly, the United Nations Mission for Emergency Ebola Response (UNMEER) supported this process. However, in the words of an EVD response coordinator who asked to remain anonymous, UNMEER “seriously did nothing”.

Port Loko and Kambia. Even Freetown, the location of the NERC, currently falls under the operational jurisdiction of the Western Area DERC.

The responsibility of the DERC is simple: to comply with and operationalize NERC policy directives, and to coordinate EVD response activity across all response bodies, not limited to the work of NGOs, the DHMT, the African Union (AU), and RSLAF.

Management structure

Those ultimately responsible for coordination and control (C2) in the DERC were called the *command team*. The command team consisted of the following individuals:

- The District Coordinator (DC). The position is a NERC creation. The DC is the formal representative of the NERC at the district level.
- The District Medical Officer (DMO). The position preceded the EVD response. The DMO is the formal representative of the MoHS at the district level, and is responsible for DHMT staff and operations.
- The ranking RSLAF officer. This individual (in Port Loko a full Colonel, in Kambia a Major) is formally responsible for coordinating RSLAF's district EVD-response activity.
- The Team Leader (TL). The position was filled by a member of JIATF's Stabilization Unit (SU). The TL is the representative of JIATF at the district level, and is responsible for DFID and BritMil's district EVD-response activity.

In Kambia, the *command team* also included the DCC (see page 35).

Underneath this command team sat eleven "pillars" of operation. Each pillar was coordinated by the DERC directly, and otherwise managed or advised by some combination of NGOs, the DHMT, WHO, World Food Program (WFP), United Nations Children's Fund

(UNICEF), United Nations Population Fund (UNFPA), Ministry of Social Welfare (MoSW), or CDC. A DERC organogram (Figure 18) conveys this complexity and disorganization, the implications of which will be discussed on page 89-97.

Before discussing pillar management, it is important to identify the management structure of various district offices, as outlined in Figure 18. Most district-level offices have relatively linear management structures. The CDC is a good example. The ultimate CDC authority rests with their Atlanta office, followed by their Sierra Leone country lead, their national office, their district Field Coordinator, and finally their district staff.¹⁰⁵ Sierra Leonean government ministries (i.e. MoHS and MoSW) are similarly linear, with an identified authority at each layer of geographic division.

This is contrasted by the United Nations (UN) constituent organizations. The WHO, WFP, UNFPA, and UNICEF field offices are all managed by a respective Field Coordinator. However, each respective Field Coordinator is managed by both a UN Field Coordinator, and their national offices. Their national offices, in turn, are managed by both the UN Mission for Ebola Emergency Response (UNMEER) and their international headquarters.

This muddled organogram has enormous implications for operational management. Per Figure 18, the DERC is ultimately responsible for the C2 of all EVD response activity, with the actual operations conducted by the AU, RSLAF, NGOs, and the DHMT, with small operational exceptions carved out for UNFPA and WFP. Ostensibly, the WHO and UNICEF are purely advisory. Specifically, the WHO is responsible for advising the surveillance, case management, and laboratory pillars, and UNICEF is responsible for advising the social mobilization, psychosocial, and family liaison pillar.

¹⁰⁵ To add one layer of complexity, the CDC also had a *regional* management body, responsible for coordinating CDC activity across the West Africa Ebola Epidemic.

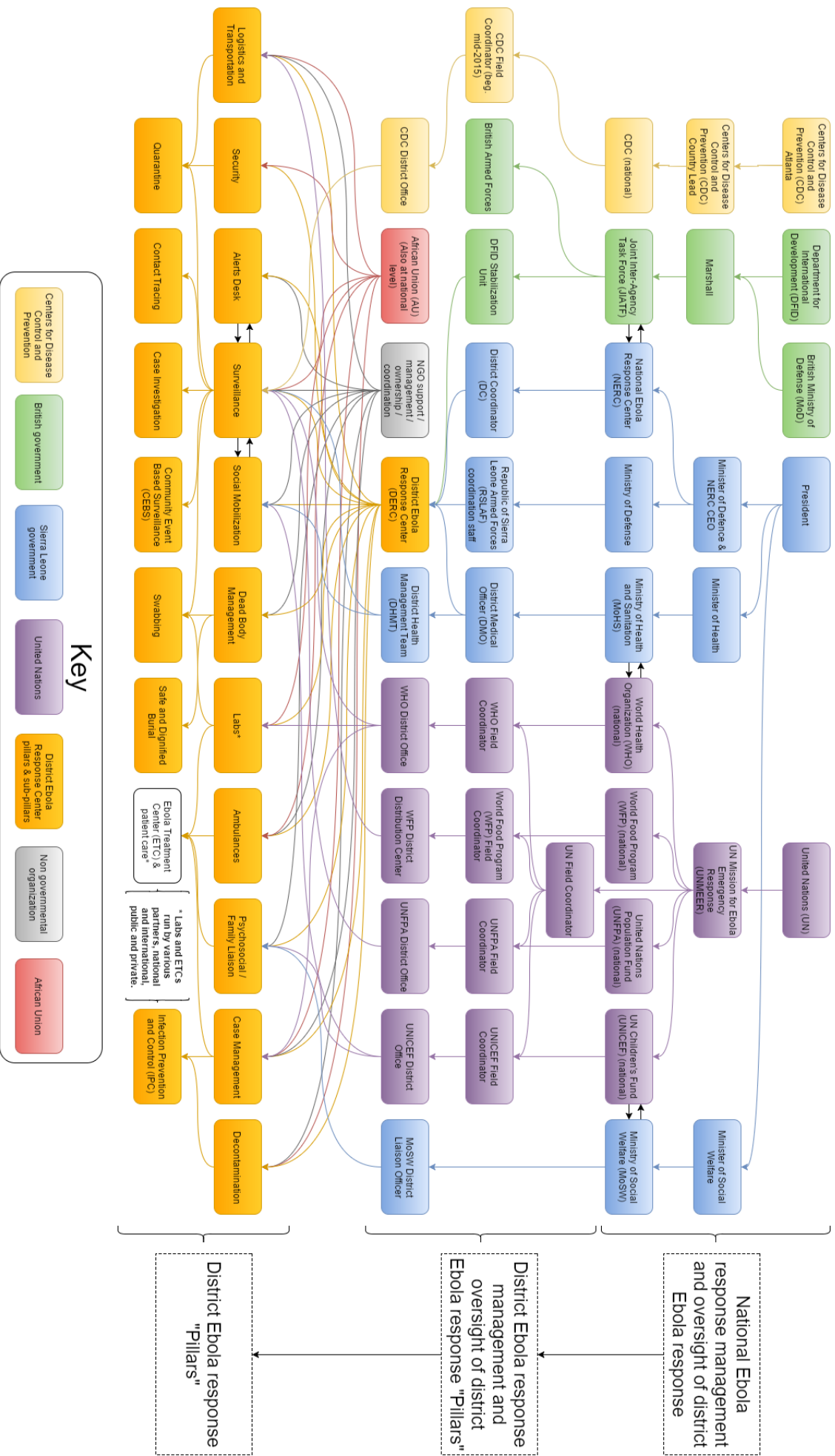


Figure 18: DERC organogram (Image source: Author)

However, in attaching such politically powerful institutions alongside the established DERC management structure, the advisory role of the WHO in particular immediately encroached on operational decision making and management. A discussion of why this happened, and its implications, can be found on pages 89-97. As such, while the WHO and UNICEF are both listed below as being responsible for pillar management and operation, it should be noted such authority was never intended, but rather the result of specific historical processes throughout the West Africa EVD Epidemic in Port Loko and Kambia.

The Pillar System

Every DERC, Port Loko and Kambia included, is broken into eleven “pillars” of operation, each filling a specific operational need of the EVD response. Each pillar is itself broken into constituent sub-pillars. Every pillar has a specific function, and is vertically managed, operationalized, and advised by various organizations. Below, each pillar is discussed briefly, including its function and management (Figure 19). As it is the primary focus of this paper, the surveillance pillar (including its three primary constituent pillars: contact tracing, case investigation, and community event based surveillance) will be discussed at length elsewhere (pages 52-63). As noted in Figure 19, every pillar (and all but two specific pillar functions) has multiple organizations (an average of 3.1) providing either operational, managerial, or oversight function.¹⁰⁶ The implications of the Pillar System and its management structure on surveillance are discussed on page 97.

¹⁰⁶ The exceptions are security to District Surveillance Officers in the field, and the receipt of ambulance requests and subsequent dispatch of ambulances, both tasks performed admirably by RSLAF.

Pillar	Function	Operational, management, or oversight responsibility											Count
		NGO	RSLAF	AU	DHMT	MoSW	WHO	WFP	UNICEF	Other			
Logistics and transportation	Provide for the DERC's logistical needs, i.e., electricity, fuel, food, etc	Y	-	-	-	-	-	Y	-	Y	-	Y	3
	Provide fleet management for DHMT/DERC EVD response vehicles	Y	-	-	-	-	Y	Y	-	Y	-	Y	4
	Oversee or operate the District Medical Store (DMS)	-	Y	-	Y	-	-	-	-	-	-	Y	3
	Distribute food, quarantine, and discharge packages to quarantined homes	Y	-	Y	-	-	-	-	Y	Y	-	-	4
Security	Provide security to the DERC	-	Y	-	-	-	-	-	-	-	-	Y	2
	Provide security for District Surveillance Officers in the field	-	Y	-	-	-	-	-	-	-	-	-	1
	Enact quarantine	-	Y	-	Y	-	Y	-	Y	-	-	Y	4
	Provide security and oversight to quarantined homes	-	Y	-	-	-	-	-	-	-	-	Y	2
Alerts Desk	Operate roadblocks and health screening checkpoints	-	Y	-	-	-	-	-	-	-	-	Y	2
	Receive sick and death alerts from the national hotline	Y	Y	-	Y	-	-	-	-	-	-	-	3
	Receive and process sick and death alerts from the district hotline	Y	Y	-	Y	-	-	-	-	-	-	-	3
	Communicate alerts to Surveillance or Dead Body Management	Y	Y	-	Y	-	Y	-	-	-	-	-	4
Social Mobilization	Record alert response progress for the DERC	Y	Y	-	Y	-	-	-	-	-	-	-	3
	Coordinate and oversee activity of district's Social Mobilizers	Y	-	-	Y	-	-	-	-	Y	-	Y	4
	Write and distribute educational messaging	Y	-	-	Y	-	-	-	-	Y	-	Y	4
	Engage political and community members for community support (unofficially) Provide intelligence to the DERC	Y	-	-	Y	-	-	-	-	Y	-	Y	4
Dead Body Management	Oversee or manage Burial Teams and Swabbers	Y	Y	-	Y	-	-	Y	-	-	-	Y	5
	Collect and dispatch death alerts to relevant Burial Team and Swabber	Y	Y	-	Y	-	-	-	-	-	-	Y	4
	Swabbers: Collect swab from corpses and transport to the nearest lab	Y	-	-	Y	-	Y	-	-	-	-	Y	3
	Burial Team: Collect corpses from the community (all, not just EVD)	Y	-	-	Y	-	-	-	-	-	-	Y	3
Labs	Burial Team: Perform Safe and Dignified Burial for all corpses	Y	-	-	Y	-	-	-	-	-	-	Y	3
	Ensure swabs are being satisfactorily performed	Y	-	-	Y	-	-	Y	-	-	-	-	4
	Ensure swab sample labels and data collection are accurate	Y	-	-	Y	-	-	Y	-	-	-	-	4
	Perform diagnostic testing on swabs and blood samples (from ETCs)	Y	-	-	Y	-	-	Y	-	-	-	Y	4
Ambulances	Communicate sample results to the DERC for onward operations	Y	-	-	Y	-	-	Y	-	-	-	Y	4
	Receive and dispatch ambulance requests	-	Y	-	-	-	-	-	-	-	-	-	1
Psychosocial / Family Liaison	Oversee or manage Ambulance Team	-	Y	-	-	-	-	Y	-	-	-	-	2
	Provide psychosocial support to EVD-affected families and communities	Y	-	-	-	-	Y	-	-	Y	-	-	3
Case Management	Communicate patient status and messages to a patient's family	Y	-	-	-	Y	-	-	-	Y	-	-	3
	Help coordinate ambulances	-	Y	-	-	-	-	Y	-	Y	-	-	2
Decontamination	Create protocols for patient movement, transfer, and care	Y	-	-	Y	-	-	Y	-	Y	-	-	3
	Ensure effective Infection Prevention and Control is in place	Y	-	-	Y	-	-	Y	-	Y	-	-	4
Decontamination	Oversee or manage Decontamination Teams and decontamination process	Y	-	-	Y	-	-	Y	-	-	-	-	3
	Decontaminate quarantined household after EVD case is removed	Y	-	-	Y	-	-	Y	-	-	-	-	2
	Decontaminate quarantined household when quarantine is completed	Y	-	-	Y	-	-	Y	-	-	-	-	2
	Re-supply household with items destroyed in the decontamination process	Y	-	-	Y	-	-	-	-	Y	-	-	3

Figure 19: DERC pillars, function, operation, management, and oversight (Image source: Author)

DISEASE SURVEILLANCE IN PORT LOKO AND KAMBIA DISTRICTS

This section contains information specific to surveillance in Port Loko and Kambia. In conjunction with the organizational analysis of the DERC that precedes this section, and the DSO survey that follows, the observations contained herein will underlie this paper's analysis (pages 76-102). The section begins with an overview of surveillance: what surveillance is, including important terminology, and what surveillance entailed during the West Africa EVD Epidemic. This information is intended to contextualize the field, and convey the intrinsic complexity of conducting disease surveillance in resource-limited West Africa. This is followed with a discussion of EVD surveillance prior to the creation of DERCs in Port Loko and Kambia, and prior to intervention by GOAL. This, in turn, is followed with a discussion of post-intervention structural adjustments implemented by GOAL and others to resolve pre-intervention challenges. This information is drawn from the qualitative, participatory observations of this paper's author. The outcome of these interventions, and how resulting improvements were felt more significantly in Port Loko than in Kambia, is discussed in the final subsection.

Surveillance: an overview

Infectious disease surveillance is the process of identifying disease transmission across a geographic space (see pages 11-13 and 52-55). This includes finding cases, identifying a source, identifying case contacts, quarantining contacts as necessary for the duration of a disease's incubation period, monitoring contacts for sickness, and evacuating anyone who MCD. In short, it is intelligence gathering for the purpose of effectively responding to ongoing transmission.

In the West Africa EVD Epidemic, disease surveillance was divided into three constituent responsibilities: Case Investigation, Contact Tracing (CT), and Community Event Based Surveillance (CEBS). All three components fall under the disease surveillance umbrella.

However, in the EVD response, ‘surveillance’ and ‘case investigation’ were generally conflated: as such, ‘DSO’ was interchangeable with ‘case investigator’; additionally, ‘surveillance teams’ referred to case investigation teams, and not contact tracers or CEBS monitors. Hereafter, unless noted otherwise, I will use these EVD-specific definitions,¹⁰⁷ and refer to the broader concept that includes CT and CEBS as ‘disease surveillance’.

DSOs conducted both *active* and *passive* disease surveillance, though due to limited human resource, predominantly performed the latter. *Active* disease surveillance involves seeking out undiscovered cases. *Passive* surveillance involves waiting for alerts of sickness and death, and then responding to them. Upon finding a sick individual, a DSO performs a case investigation. They identify travel history, source cases, case contacts, and decide whether the sick individual MCD and requires evacuation to an ETC, and whether or not to enact quarantine.

The following is a real, unpublished case investigation into Sierra Leone’s January 14, 2016 EVD case, presented unedited to convey the type and complexity of information collected by DSOs in the course of an investigation. This includes extensive travel history, visits to traditional healers, multiple visits to government health facilities, and an unsafe burial involving body washing. This case was confirmed less than twelve hours after the WHO declared West Africa EVD-transmission free, and therefore rescinded the region’s transmission-free status.

The index case travelled from Lunsar, Port Loko to Barmoi Luma in Kambia District on 27 December, at which point she was not showing any symptoms. On 2 January, she reported symptoms of headache and constipation, and consulted a native herbalist in Kambia but her condition did not improve. She was seen in the morning of 6 January at the Barmoi Luma MCHP in Kambia where she was treated for an infection. She was then taken to Magburaka town in Tonkolili District on the same day. Between 7 and 9 January, a herbalist visited her twice. On 9 January, she went to Magburaka Government Hospital as an out-patient. On the same day (9 January), she travelled to Bombali district to visit an herbalist there. She stayed overnight into 10 January with the herbalist and her son, and then returned to Magburaka village. On the morning of 11 January, she was reportedly feeling well

¹⁰⁷ I.e., surveillance as case investigation, surveillance teams as case investigation teams.

again, but deteriorated that same evening. She died on the morning of 12 January. Her body was washed by at least four women and her clothes were washed by another woman. Her body was wrapped and carried to a mosque by an unknown number of unidentified people. Her body was then carried in a coffin from the mosque to a gravesite by four pallbearers.

This single case was found to have 256 known contacts across four districts, 42 of whom were considered high risk (i.e., had direct contact with the sick individual). 55 additional high risk contacts were identified but untraceable, having left the area of investigation prior to quarantine and containment. Any of the hundreds of simultaneous EVD cases (see Figures 7 and 15-16) that occurred earlier in the outbreak could incur similarly complex and imbricating investigations, with active EVD contacts numbering in the tens of thousands across the country at any one time.

After a DSO has generated an investigation and line list (the list of all possible case contacts) as above, they pass the line list to CT. CT is then responsible for monitoring all case contacts twice a day for the duration of the 21-day incubation period. If at any time they notice a case contact has fallen ill, they immediately communicate this to a DSO, who returns to perform a clinical assessment and decide whether the patient's illness MCD. If the DSO's clinical assessment finds the patient MCD, the DSO calls the DERC for an ambulance to evacuate the patient to an ETC, at which point they conduct a new investigation of the patient's history and contacts.

In both Port Loko and Kambia, about twenty independently mobile Contact Tracing Supervisors (CTS) were supported by NGOs and coordinated from the DERC. In Port Loko, Marie Stopes International (MSI) was responsible for CTS until April, 2015, when responsibility was handed to GOAL. In Kambia, Action Contre La Faim (ACF) was responsible for CTS until November, 2015, when responsibility was handed to GOAL. CTS were also partly managed and

overseen by the WHO. Throughout each district, hundreds of Community Contact Tracers (CCTs) were trained by UNFPA, and performed day to day CT functions with CTS oversight.

CEBS is a network of community monitors – theoretically one per village – responsible for alerting DSOs and the DERC of concerning activity that could relate to EVD transmission. CEBS community monitors were given a one-week training by IFRC in Port Loko and ACF in Kambia before being deployed. The Port Loko and Kambia CEBS networks were not brought online until late summer, 2015, and as such had little significant impact over the period of this paper’s study.

Ultimately, there were as many as eleven different groups involved in the operation, management, and oversight of disease surveillance in Port Loko and Kambia during the West Africa EVD Epidemic, including the DERC, DHMT, four IOs (the WHO, UNFPA, UNICEF, and the AU), the CDC, and by the most conservative count, four separate NGOs. The implications of this milieu are discussed on pages 89-97.

Pre-intervention

Prior to the creation of DERCs in October, 2014, there was essentially *no* formalized, rigorous EVD surveillance in Port Loko and Kambia. Sick individuals would sometimes show up for care at a PHU or hospital, but there were no district laboratories to test their EVD status, and no district ETCs that could accept positive patients even if there were. At this point, people were simply dying in the street, often literally. In a report from Port Loko in early November, 2014, BBC journalist Andrew Harding provides this heartbreaking first-person account:¹⁰⁸

An empty road, and empty houses. We’re driving into the new stronghold of the virus. There is a cluster of children on one side of the road. We soon discover why: on the other side, everyone is either dead, or dying. We have to be very careful where we walk. There [are] dead bodies all around here... But still, in this village,

¹⁰⁸ Andrew Harding, “Ebola: How one village road separates the dying from the living”, *BBC News*, November 4, 2014, accessed February 10, 2016, <http://www.bbc.com/news/world-africa-29900101>.

we have [living] Ebola victims... and they're all believed to have the virus. And they're just left here, presumably to die.

In the same report, Mr. Harding interviews the Paramount Chief of Lokomasama, one of Port Loko's eleven chiefdoms. His remarks indicate the totally inadequate surveillance and response capacity at this time in the outbreak:

I have been calling, calling, calling for help, to the WHO, to the WFP, to everyone, and nothing has come. Nothing at all... People are dying.

In short, there was nothing.

At this point in time, the situation was apparently less dire in Kambia. Indeed, the district's first *confirmed* case of EVD did not occur until September, 2014, seventeen weeks after Port Loko, so the scale of tragedy mentioned by Mr. Harding above did not appear to exist in Kambia. However, this was not because the district's response structure was established any faster or was more effective than Port Loko's. Rather, precisely the opposite was true: EVD had most likely been ravaging Kambia for some time, especially given the virus' Sierra Leonean epicenter was in neighboring Port Loko. Figure 20 shows West Africa's caseloads one week prior to Kambia's first confirmed case.¹⁰⁹ Note the conspicuously blank Kambia, indicating no history of cases whatsoever, immediately adjacent to dark-blue-and-red Port Loko, indicating both a large number of historical cases and significant active transmission (i.e. around one hundred EVD cases per week).

In short, any suggestion that Kambia was less susceptible to EVD at this time is based on superficial and poor-quality data, and is more an indication of inadequate surveillance than low levels of EVD transmission: while no information was good information as far as Kambia was

¹⁰⁹ Adapted from the World Health Organization's *How the Ebola outbreak and WHO's response unfolded*, February 1, 2016, The World Health Organization, accessed February 07, 2016, <http://www.who.int/csr/disease/ebola/en/>.

concerned, surveillance infrastructure was worse than Port Loko's at this point in time. Port Loko, at the very least, had better and more trafficked roads, and passersby could not avoid the hundreds of dying people and bodies by the side of the road. Even if no formal surveillance infrastructure existed, it was painfully clear there *were* cases, and a lot of them.

The concurrent arrival of DERCs and WHO field offices in October, 2014 did improve surveillance, but this meant little relative to what existed (or rather, did not exist) previously. In both Port Loko and Kambia, the WHO worked with the DHMT to identify a small number of PHU CHOs to be trained as DSOs. In Port Loko, 15 CHOs were removed from their PHUs, given a crash-training in disease surveillance and case investigation by the WHO, and supplied 10 vehicles by the WFP. In Kambia, six were trained, and were supplied three vehicles.

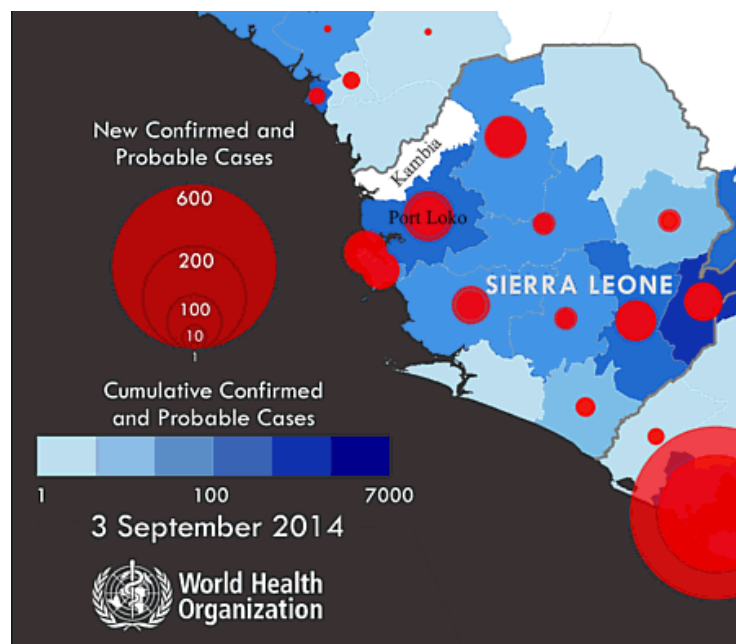


Figure 20: Port Loko and Kambia active transmission and cumulative cases, September 3, 2014

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This was supplemented by international WHO and CDC field epidemiologists, who had large vehicle fleets compared to their Sierra Leonean DSO ERWs. However, while this support was crucial under such dire circumstances, language barriers meant the help was limited.

All told, the WHO, CDC, and new DERC surveillance teams amounted to about 15 independently mobile teams on any one day in Port Loko, and about half that number in Kambia, leaving roughly 22 teams responsible for investigating every instance of sickness and death among a collective population of 850,000 and across 3,400 square miles. Significantly more support was required.

Post-intervention

In early January, 2015, GOAL was awarded a DFID grant to provide support to Port Loko surveillance. GOAL and the WHO collaboratively trained thirty additional DSOs in mid-January, who were provided seven additional vehicles, bringing the total number of DERC surveillance teams to 17, with roughly two DSOs per vehicle. At its peak in the spring and summer of 2015, Port Loko had 75 DSOs and 33 vehicles, i.e., 33 surveillance teams. Basic telecommunications were provided to all teams, as was breakfast and lunch for morale. Dispatching and daily coordination was removed from DHMT and WHO oversight and delegated to RSLAF, a more effective C2 body.

Major structural changes were put in place, as codified in an SOP (Appendix E):¹¹⁰

- Rather than dispatching surveillance teams to any new alert, surveillance teams were each assigned a specific chiefdom. Any alert that arose in their assigned chiefdom would

¹¹⁰ Primarily the work of paper author Samuel Boland, with edits by WHO and CDC.

be their primary responsibility. This prevented haphazard deployment and created consistency and local knowledge for each team.

- Surveillance teams were dispatched to their assigned chiefdom regardless of whether there was a pending alert. This meant new alerts could be dispatched to a prepositioned team. Absent pending alerts, DSOs could also build relationships with the communities in their jurisdiction, and actively investigate quiet areas for signs of EVD. The value of such trust building and intelligence gathering was quickly realized: a separate SOP was written to dictate activity under such conditions (Appendix F).¹¹¹
- An “After Action Review” (AAR) was implemented (Appendix G),¹¹² requiring all DSOs to return to the Port Loko DERC at the end of the day to discuss their investigations. This both provided the opportunity to give DSOs daily trainings, and for surveillance intelligence to be returned to the DERC the same day it was collected.
- The CDC created a standardized CIF (Appendix B) that all DSOs were required to use for their investigations. This had a number of advantages over investigations being done on blank loose-leaf paper:
 - The form guided DSOs through their case investigation, ensuring they did not forget to ask important information from the patient or patient’s family. This ensured comprehensive investigations, reliable data, and expedited data analysis.
 - Each form had a unique patient identifier. This unique identifier would follow a patient to the ETC, who would report the patient’s lab results back to the DERC using the same number. As such, forms held by DSOs could not be disassociated

¹¹¹ Primarily the work of paper author Samuel Boland and his colleagues in GOAL, with edits by WHO and CDC.

¹¹² The work of paper author Samuel Boland and his colleagues in GOAL, with edits by WHO and CDC.

with lab results. This resulted in fewer mistakes due to misplaced paperwork, and ensured greater accountability for surveillance officers' work.

- Placing two DSOs in one vehicle made investigations dramatically more efficient, which was very important given the high number of daily alerts and insufficient teams to respond to them. Case investigation has two major components: the completion of the CIF, and line listing. Collecting such information at the point of investigation is crucial, even though the status of the patient is unknown at the time: in the 24-72 hours between a patient being taken to an ETC for testing and the laboratory-confirmed diagnosis being given, patient contacts could move or, if fearful of quarantine, run away. Having a general idea of who will require quarantining provides accountability, and also gives contact tracers, the WFP and security a 24-hour head start on preparing for the monitoring, food, and security needs of a quarantined home.
- Case investigation of corpses was taken away from swabbers, many of whom had not completed any education and were illiterate. The responsibility was given to the trained DSOs, which ensured death investigations were done reliably. Additionally, swabbers joined the surveillance team's vehicle, instead of traveling independently. This meant the unique identifier on a CIF could be written on a swab sample prior to delivery to the lab. As such, lab results of corpse samples could not be disassociated from a CIF.
- In late Spring 2015, multidisciplinary teams were created, whereby a social mobilizer joined the surveillance team. The surveillance team now comprised of five individuals: a driver, swabber, social mobilizer, and two DSOs. This further increased community trust and engagement, as social mobilizers were generally well-known and well-liked within their communities, unlike DSOs who were often considered outsiders and harbingers of

EVD.¹¹³ While including a social mobilizer did not entirely resolve issues of community trust, physical attacks on DSOs and their surveillance teams did abate.

Following these substantial structural changes, the 117 alert response process was as follows

(Figure 21):¹¹⁴

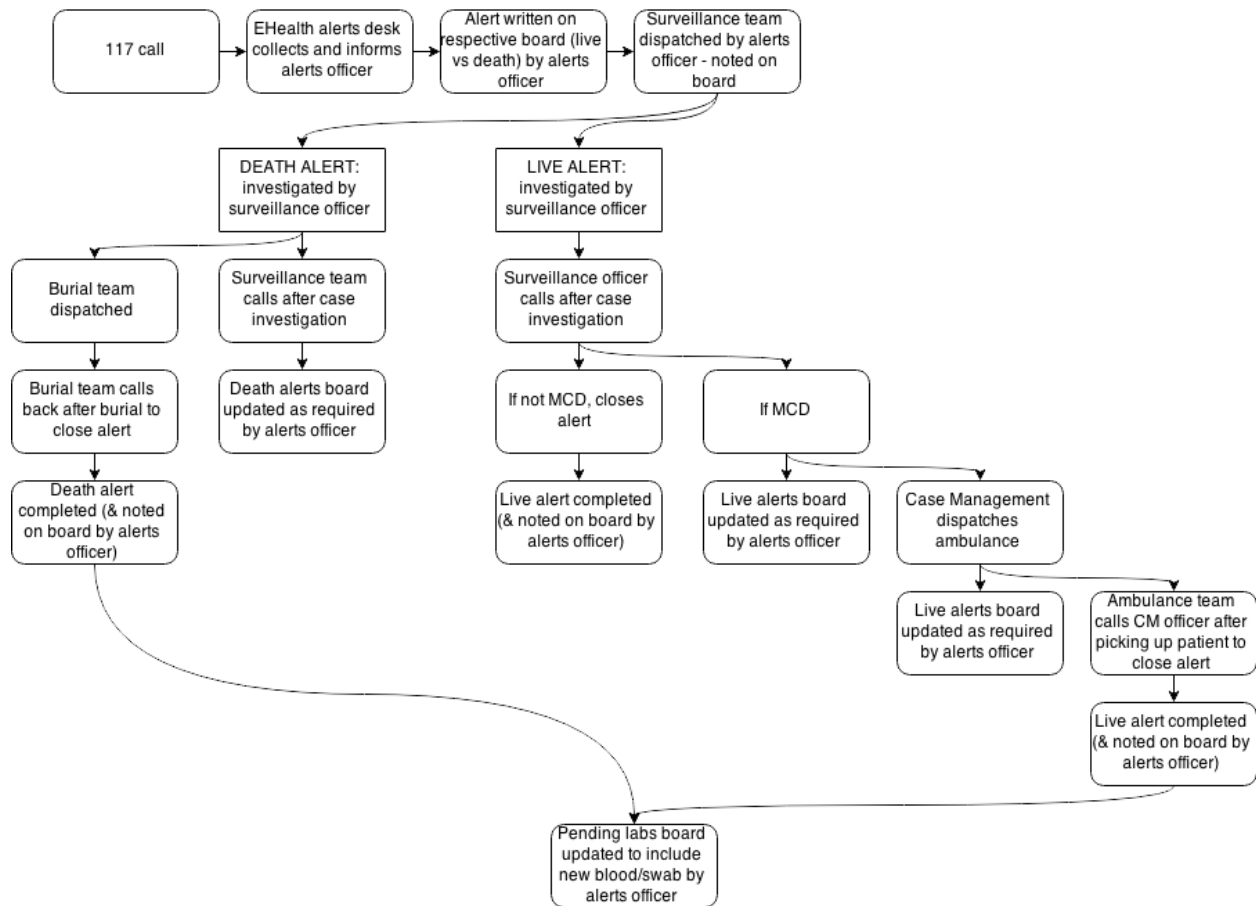


Figure 21: Alert response process (Image source: Author)

Furthermore, ERWs at various geographic divisions were integrated into coordinated task forces, creating an ideal EVD response framework (Figure 22). This drew heavily on political divisions outlined in Figures 13-14. At every village, the government Ward Councilor, head

¹¹³ “Attacks on health workers hamper Ebola fight”, *Deutsche Welle*, February 2, 2015, accessed February 10, 2016, <http://www.dw.com/en/attacks-on-health-workers-hamper-ebola-fight/a-18265868>.

¹¹⁴ 117 was the national hotline for reporting sickness and death – most alerts came in through 117; Figure 17 is an unpublished SOP flow-chart created by paper author Samuel Boland.

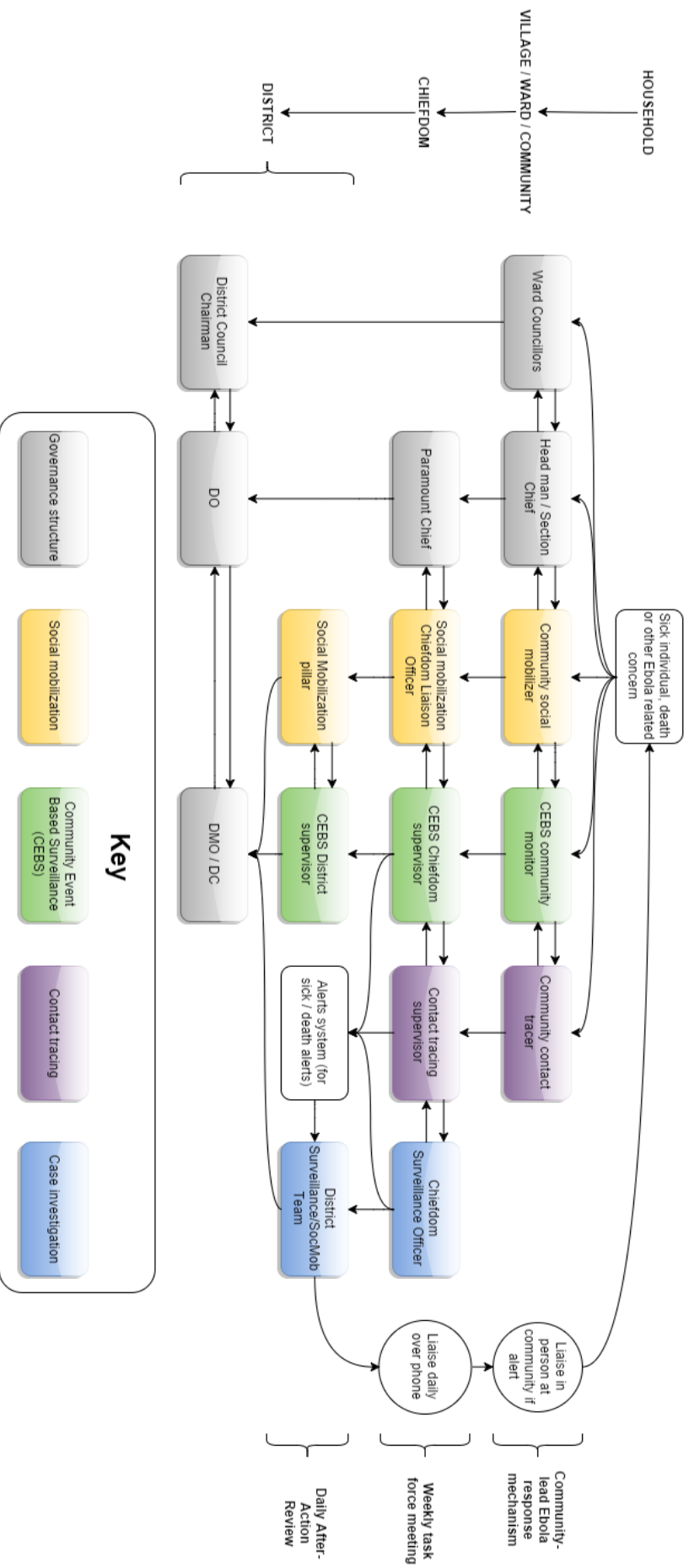


Figure 22: Ebola response framework (Image source: Author)

man, community social mobilizer, CEBS monitor, and CCT were introduced and began communicating with one another. In every chiefdom, the Paramount Chief, Social Mobilization (SocMob) Chiefdom Liaison Officer (CLO), CEBS Chiefdom Supervisor, CTS, and Chiefdom Surveillance Officer (CSO) did the same. This horizontal integration, layered over existing vertical integration, greatly lowered barriers to intelligence gathering and sharing, which in turn provided for the quick communication of alerts at a rural home to the DERC and DSOs. The DSOs, in turn, could efficiently action this intelligence and conduct a detailed case investigation.

Results

The results of these structural changes were unequivocal. By mid-February, five key performance indicators (KPIs) dramatically improved in Port Loko. For example, the number of days from symptom onset to case investigation, a measure of both response efficiency and community trust (i.e., how quickly a sick individual calls for help after experiencing symptoms) dropped from 3.8 days in December to 1.6 days in February. While the KPI followed an existing downward trend (Figures 23),¹¹⁵ this nevertheless represents an astonishing improvement.

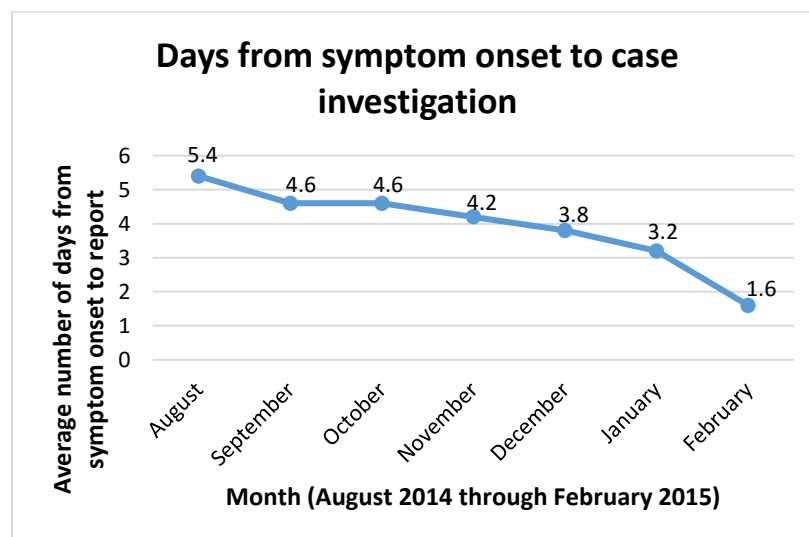


Figure 23: Days from symptom onset to case investigation (Image source: Author)

¹¹⁵ Adapted from an unpublished CDC Port Loko situation report, March 08, 2015.

The average percent of EVD-confirmed cases found dead at the time of case investigation, a similar metric of response efficiency and community trust, fell from 22% in December and 21% in January to only 7% in February (Figure 24).¹¹⁶

Over this same time period, the percent of confirmed cases with a known source case rose from 26% to 79%, the average number of contacts line listed per case rose from 12 to 17, and the

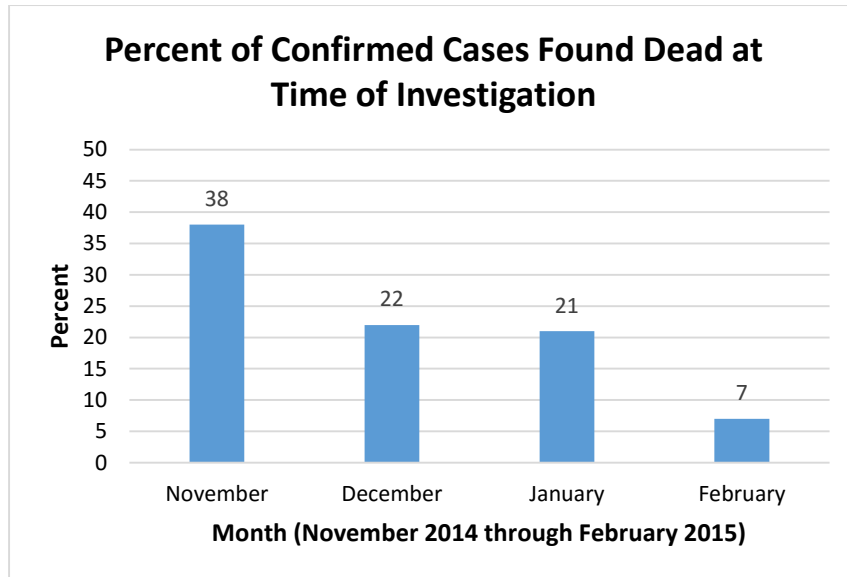


Figure 24: Percent of confirmed cases found dead at time of investigation (Image source: Author)

percent of confirmed cases on an existing line list rose from 15% to 50%. This last KPI is the strictest measure of investigative quality, as it means the new case was already known to be at risk for EVD and was being actively monitored. That this statistic more than trebled is testimony to the successes of the structural overhaul of surveillance conducted by GOAL.

As investigative quality and community engagement improved, so did contact monitoring and quarantine implementation. In turn, EVD caseloads plummeted. By mid-April, three short months after experiencing the persistent brunt of one hundred confirmed cases per week, Port Loko went two consecutive weeks with no confirmed cases of EVD whatsoever.

¹¹⁶ Ibid.

Through this January to April period of dramatic improvement in Port Loko, Kambia continued to haphazardly rely on six DSOs and three vehicles to meet their surveillance needs. Most investigative work was being completed by international staff of the WHO and CDC, who might have had substantial technical training, but lacked the cultural and linguistic skill to effectively complete case investigations. While Kambia never experienced caseloads anywhere near as high as Port Loko's historical peak, the district did not show any signs of improvement (Figure 16) and EVD cases did not abate.

This was recognized by the NERC and DFID, and in early April, 2015, GOAL was awarded additional DFID funding to replicate Port Loko's new surveillance structure in Kambia. Up until this point, Kambia had no NGO partner specifically tasked with supporting surveillance. However, despite GOAL's intervention, Kambia did not improve nearly as dramatically as Port Loko: cases continued to transpire. While Port Loko experienced its last case of EVD in early July, 2015, Kambia did not accomplish the same until September that year.

For a discussion of why, we first turn to the perceptions and thoughts of the DSOs themselves.

SURVEY METHODOLOGY

All DSOs in Port Loko and Kambia (N = 50 and N = 25, respectively) were asked to participate in an anonymous retrospective cohort survey regarding their work experiences over the course of the EVD response (Appendix A). The survey asked respondents to evaluate the significance of certain externalities to their work and the country of Sierra Leone, and to evaluate the performance of various organizations. Of the survey's 80 questions:

- 54 ordinal questions asked participants to scale their response from 1 (not significant) to 5 (most significant)
- 23 nominal questions asked participants to indicate categorical responses
- 3 questions asked participants to provide open responses

Questions were developed in conversation with five DSOs, as well as two individuals working for GOAL and one for the WHO. Both organizations were among those responsible for supporting surveillance in Port Loko and Kambia. DSO, GOAL, and WHO input ensured survey questions were pertinent and effective. Survey participation was strictly voluntary and anonymous. Participants were fully informed of their rights and provided verbal consent prior to survey administration. Participants were free to skip any and all questions. Participants were not remunerated for their participation.

One nominal risk to participants was identified. Some survey questions asked participants to provide opinions and critiques of organizations with whom they worked, which includes the WHO, GOAL, CDC, DERC, NERC, BritMil, RSLAF, and DHMT. The accidental disclosure of identifiable responses could possibly jeopardize working relationships with these organizations. Such risk was addressed in a number of ways, including the use of anonymized forms, undocumented verbal consent, secure and sealed storage of completed surveys within Sierra

Leone, and secure and certified shipping of completed surveys to the United States for out-of-country review and analysis. All surveys were destroyed following data entry. Any open response question with identifiable information was not included in the dataset. No other significant risk to survey participants was identified. This, along with the broader survey methodology, was reviewed and approved by the University of Chicago Social and Behavioral Science Institutional Review Board and both the Port Loko and Kambia DMO prior to survey administration.

Surveys were administered according to DSO availability between November 1, 2015, and December 31, 2015. 27 DSOs in Port Loko and 16 DSOs in Kambia agreed to participate in the survey. This distribution approximately reflects the general allocation of DSOs between districts, as referenced above (page 66). Upon receipt in the United States, survey data was entered into International Business Machines Corporation (IBM) SPSS Statistics for data storage and analysis. Quantitative responses were analyzed for response differentiation. Open response answers were left unaltered, to be used as complimentary qualitative analysis.

Possible limitations include the following four points. Each possible limitation is followed by a response justifying or mitigating the concern.

1. On November 7, 2015, Sierra Leone was officially declared EVD-transmission free, following the requisite 42-day window.¹¹⁷ This significant occasion falls within the November 1, 2015 and December 31, 2015 survey administration period.

This did not affect surveillance activities in Port Loko and Kambia, as, per surveillance protocol, all sickness and all deaths continued to be investigated for an additional 90-day period. Accordingly, all surveillance activities were sustained through

¹¹⁷ *EVD transmission free* does not imply EVD-free: see pages 26-28 for a longer discussion.

the end of survey administration.¹¹⁸ Therefore, the November 7, 2015 declaration should have incurred no effect on respondents' memory and survey responses more generally.

2. Quantified (i.e., scaled) responses are limited to pre-selected answers.

Survey questions were chosen in consultation with five DSOs, two employees of GOAL, and one employee of the WHO, to most effectively anticipate respondent answers. Additionally, each section included an open-response question designed to incorporate missing prompts.

3. Analysis does not differentiate responses by age, gender, educational background, length of employment as a DSO, respective district, or any other metric. Ideally, responses could be broken down to consider constituent populations.

Given the geographic proximity and similar socioeconomic and educational background of all respondents (pages 29-32), and the broadly similar EVD response structures in Port Loko and Kambia, respondents are a highly homogenous population. As such, survey analysis should remain reflective and nuanced.

4. Questions asking for opinions and thoughts on various organizations might be influenced if the organization employs or pays the respondent.

This will be addressed in the paper's analysis section (pages 76-102).

¹¹⁸ A new EVD case in Sierra Leone was reported on January 14, 2016, returning the country to EVD-endemic status. As this fell within the 90-day window following the temporary EVD-transmission free declaration on November 7, 2015, surveillance activities have not ceased at any time to date (April 26, 2016). The 42 (two quarantine periods) + 90-day window until Sierra Leone's surveillance activities will draw down will occur in June 2016, presuming no additional cases of EVD occur in the country.

SURVEY DATA

DSOs were asked to rate how challenging various issues were to their work. They could choose one of five responses, each with a corresponding number: (1) not challenging, (2) a little bit challenging, (3) challenging, (4) very challenging, or (5) extremely challenging. When asked to indicate the significance of a challenge in this way (rather than directly ranking challenges in relation to one another as below), DSOs provided the mean responses found in Figure 25.

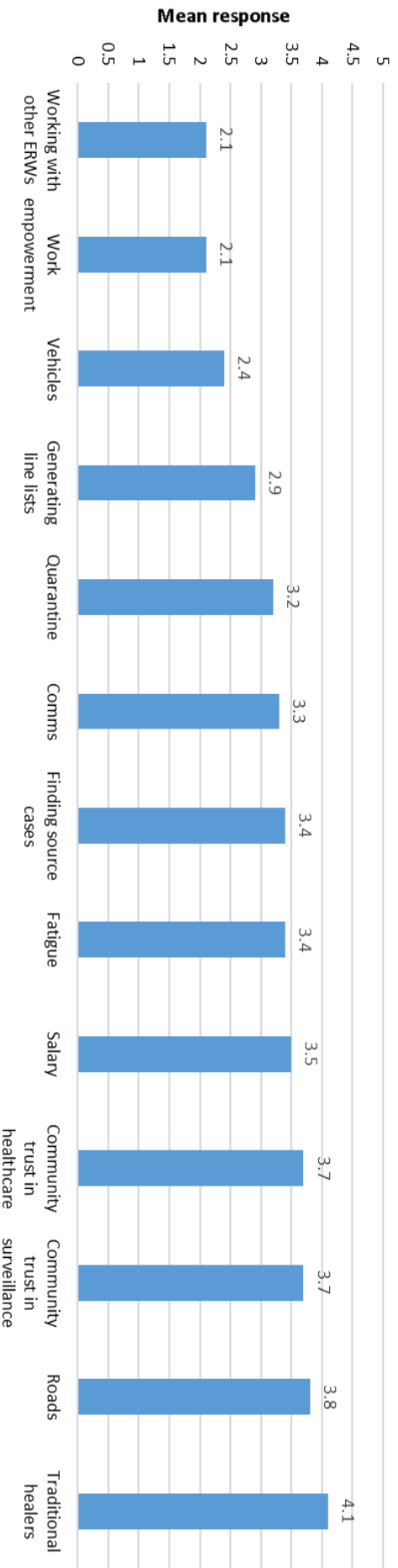
DSOs were then asked to rank challenges in relation to one another, by listing the most, second most, and third most significant challenge to their work. The first analysis of this data (Figure 26) looks at the percent of respondents who included each possible answer in their top three challenges (e.g., 77 percent of respondents included community trust as one of their top three challenges). As such, how DSOs ranked challenges among their top three holds no relevance to this presentation, only that they ranked the challenge *somewhere* in their top three.

Using data from the same question, a raw count of how many times each challenge was indicated by a DSO as the singularly most significant challenge was compiled (Figure 27).

The following five analyses asked DSOs to provide their assessment and opinion of eight different organizations responsible for supporting them or working in surveillance to some degree. DSOs were first asked to state which organization was most important to them successfully completing their work. Figure 28 presents the proportional response as a percent of total responses.

DSOs were then asked to rate how involved each organization was with their surveillance activities (Figure 29), how well the organization listened to their opinions and concerns (Figure 30), how much the organization supported them (Figure 31), and how much the organization cared about them, their activity, and their work (Figure 32).

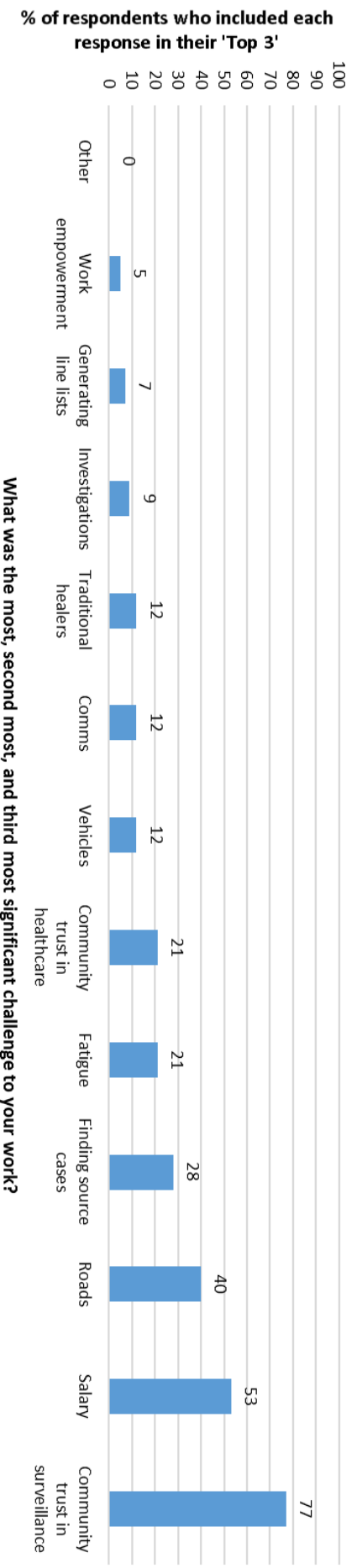
Challenge Significance



On a scale of 1 to 5 (1 = not at all, 5 = most), how significant was each listed challenge to your work?

Figure 25: Challenge significance (Image source: Author)

Challenges in the 'Top 3'



What was the most, second most, and third most significant challenge to your work?

Figure 26: Challenges in the 'Top 3' (Image source: Author)

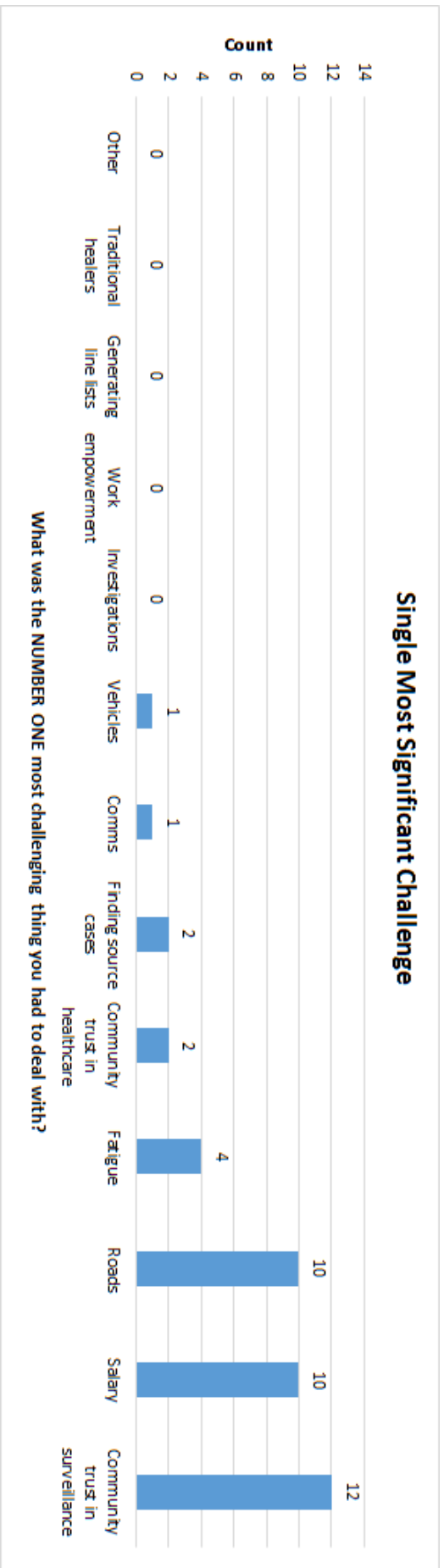


Figure 27: Number one most significant challenge (Image source: Author)

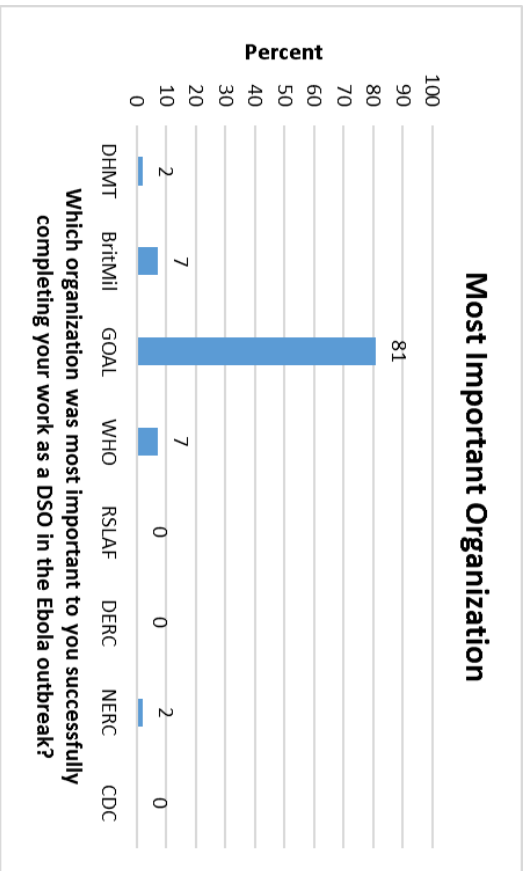


Figure 28: Organizational importance (Image source: Author)

For each of the four latter questions (organizational involvement in surveillance, receptiveness to DSO’s concerns, support for DSOs, and care for DSOs, Figures 29-32 respectively), DSOs were not asked to rank organizations directly against one another. Rather, each organization was presented separately, and DSOs were asked to choose from one of five responses, each with a corresponding number. For example, DSOs were asked “Do you feel that GOAL really listened to your opinions?” and could respond with one of the following: (1) GOAL did not listen to my opinions at all, (2) GOAL only listened to my opinions a little bit, (3) GOAL listened to my opinions somewhat, (4) GOAL listened to my opinions a lot, or (5) GOAL listened to my opinions all time. For each of the eight organizations involved in surveillance and supporting DSOs, all four questions (involvement, receptivity, care, and support) were presented in this way. DSOs provided the following mean responses (Figures 29-32). Note the order of organizations in each figure is not identical: it is ordered from least to most, left to right, in each category.

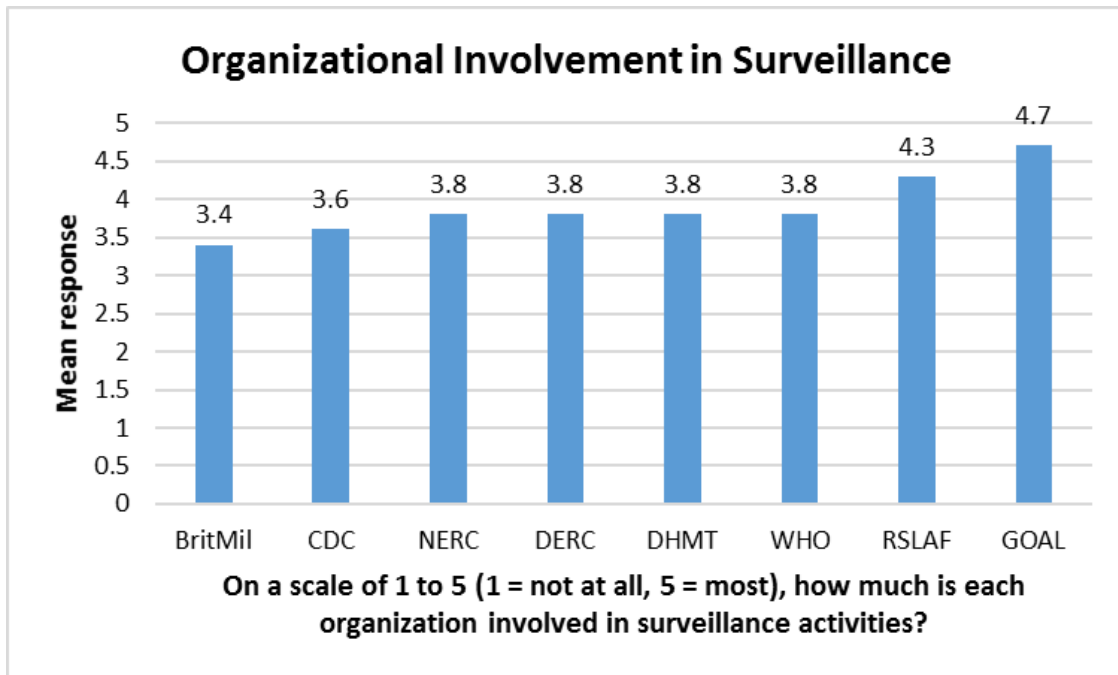


Figure 29: Organizational involvement (Image source: Author)

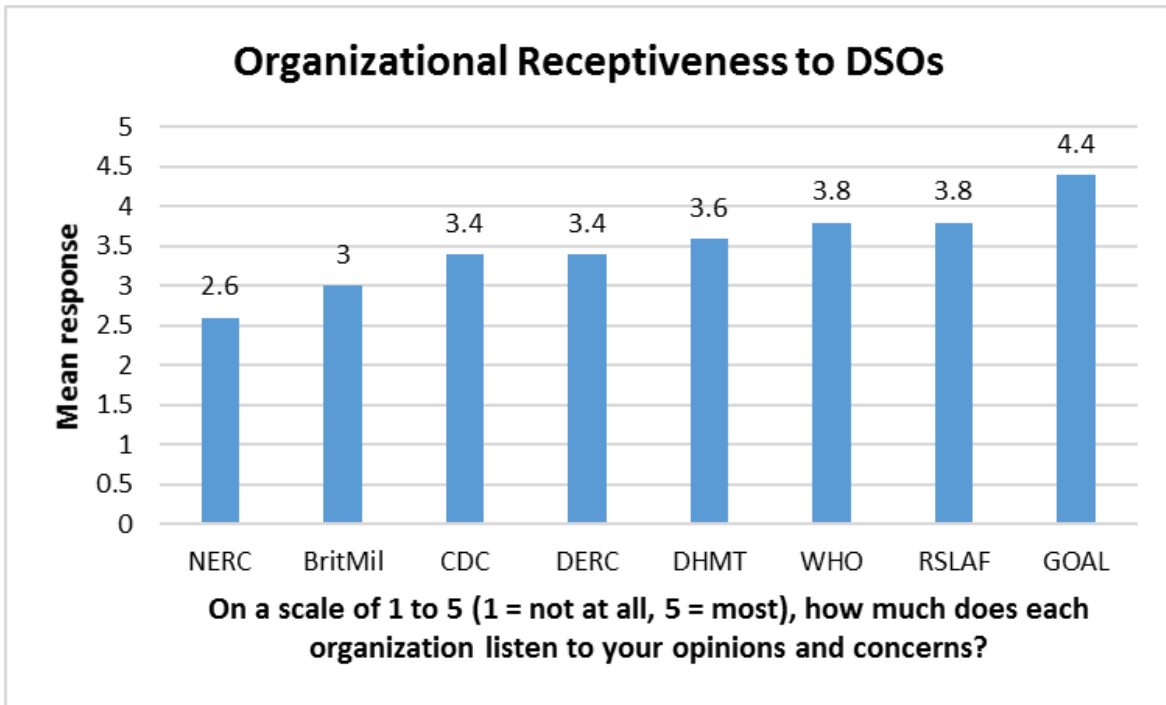


Figure 30: Organizational receptiveness (Image source: Author)

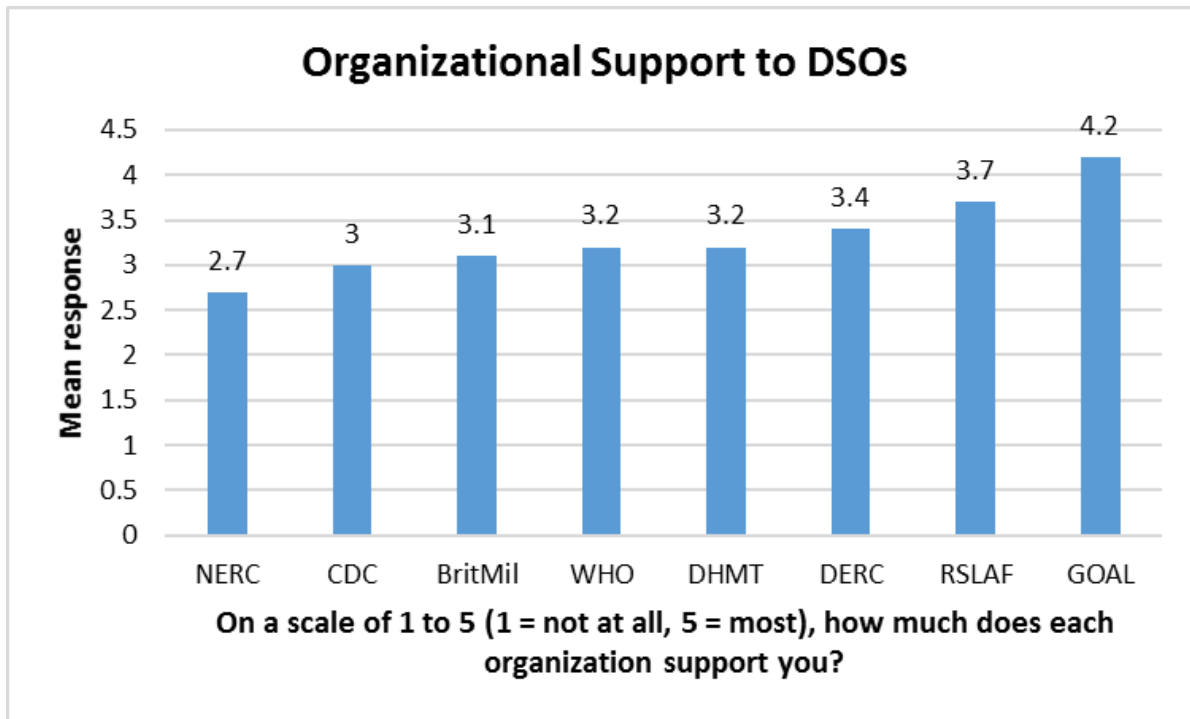


Figure 31: Organizational support (Image source: Author)

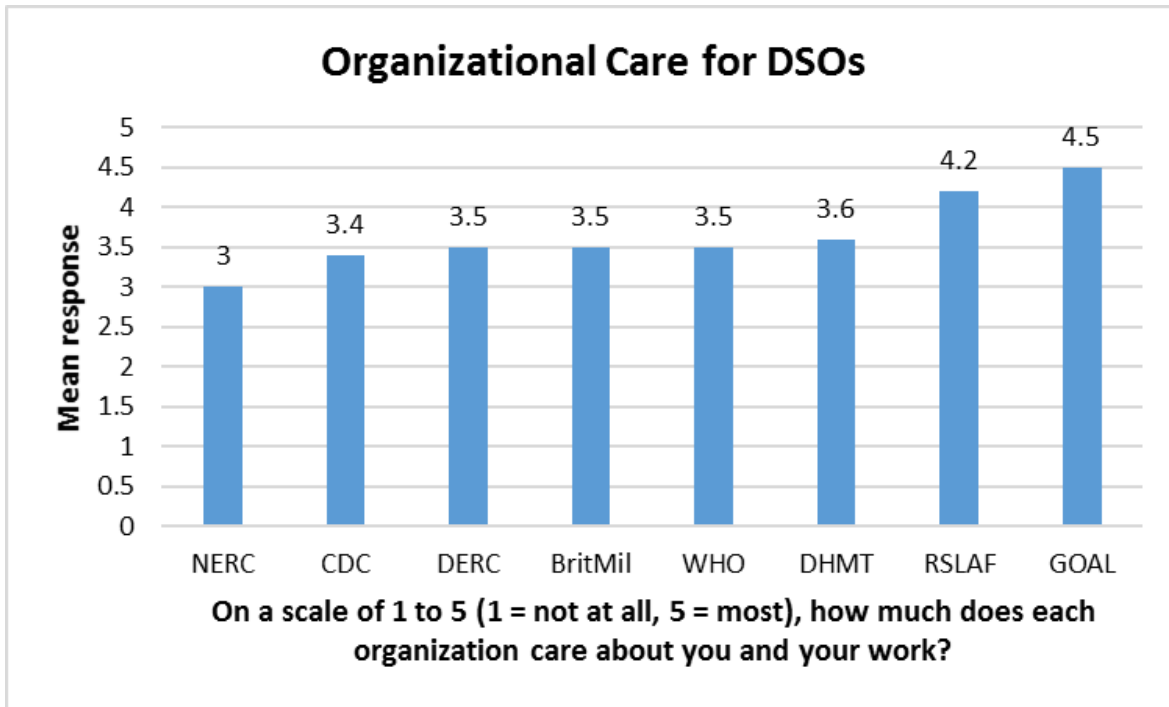


Figure 32: Organizational care (Image source: Author)

Finally, DSOs were asked to rank what they considered to be the most significant public health crisis affecting Sierra Leone over the course of the West Africa EVD Epidemic. Respondents could rank the following as the first through fifth most significant public health crisis: people getting EVD, under-five (U5) mortality, people not trusting PHUs and not going to PHUs when they were sick, maternal mortality, and the shutdown of government health services at PHUs and hospitals. Respondents' rankings were recoded as follows (Figure 33) so that the presentation of the responses (Figure 34) indicated greater significance with a higher number, and is therefore consistent with data presentation found in Figures 25-32.

Answer	Recoded answer
First most significant public health crisis	5
Second most significant public health crisis	4
Third most significant public health crisis	3
Fourth most significant public health crisis	2
Fifth most significant public health crisis	1

Figure 33: DSO's recoded responses (Image source: Author)

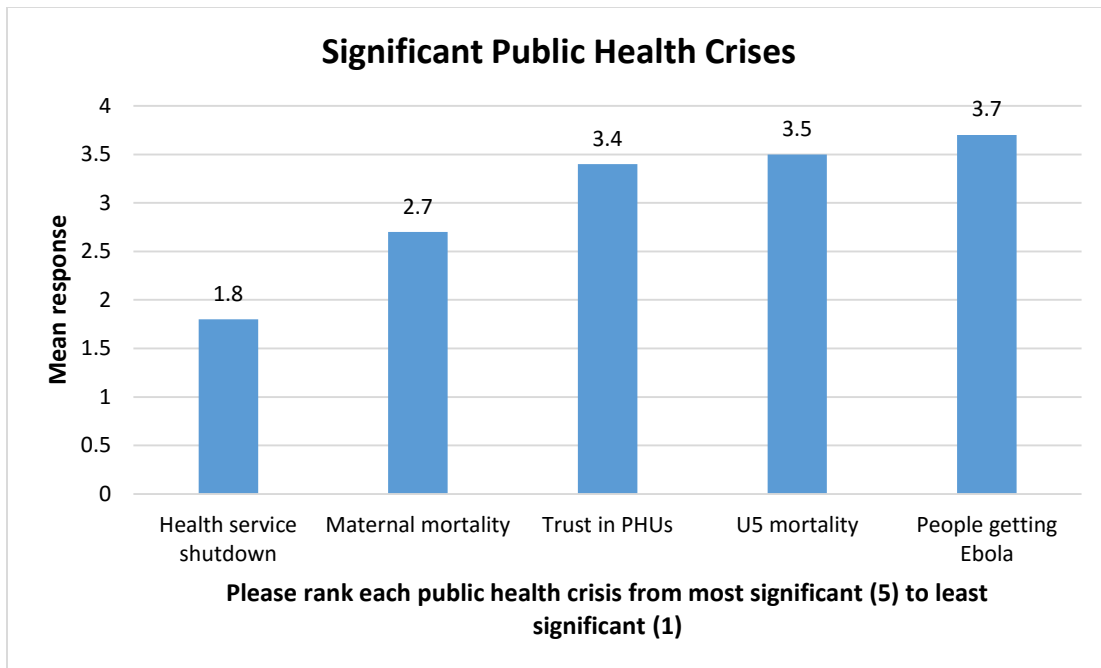


Figure 34: Significant public health crises (Image source: Author)

Three questions allowed DSOs to provide open responses. These responses will be included as qualitative support for the following analysis (pages 76-102).

ANALYSIS

Previous sections of this paper have provided an overview of EVD, the West Africa EVD Epidemic, and how we can expect the international response to move forward in the coming months; contextualized Port Loko and Kambia's geography and demographics, community and political structures, health service delivery, and EVD epidemiology; presented DERC background, management structure, and Pillar System of organization; discussed disease surveillance in Port Loko and Kambia during the West Africa EVD Epidemic, namely its pre-intervention state, post-intervention changes, and the results of these changes; and finally, presented DSO opinions from a retrospective cohort survey. The following analysis synthesizes the totality of this information, specifically that with implications for DSO work and disease surveillance more broadly during the West Africa EVD Epidemic in Port Loko and Kambia. To this end, each implication and the challenges that follow are categorized into one of four conceptual areas for analysis and discussion. While many may fall neatly into a single category of this analytic framework, many are complex. For exigence, each challenge is discussed within its most broadly applicable category: its inclusion therein should not imply it cannot be considered elsewhere.

Challenges fall into one of four categories: 1) environmental and infrastructural, 2) sociocultural, 3) political and organizational, and 4) epidemiological. Categories 1 and 2 are primarily drawn from the *Overview* and *Port Loko and Kambia Districts* chapters, as corroborated by the DSO survey. Category 3 is primarily drawn from the *Organization of the DERC* and *Disease Surveillance in Port Loko and Kambia Districts* chapters, as corroborated by the DSO survey. Category 4 is primarily drawn from DSO survey responses.

From this analysis, it is clear that DSOs and surveillance in Port Loko and Kambia throughout the West Africa EVD Epidemic faced a litany of extremely complicated and often imbricating challenges. Many of the most significant challenges were and remain unresolvable within the scope of the West Africa EVD Epidemic – entrenched environmental challenges, infrastructural deficiencies, and sociocultural realities require years of concerted effort to overcome. However, many of the most significant challenges arose from political and organizational inadequacies that were decidedly resolvable, even within the short time frame of the epidemic. To the detriment of DSOs in Port Loko and Kambia, the nature of these significant and resolvable challenges did not align with the focus and prioritization of the international community and WHO more specifically. As such, political deference to the WHO and their focus on epidemiology over logistical and operational needs had a strong and negative impact on the efficacy of both Port Loko’s, and particularly Kambia’s, EVD response.

Environmental and infrastructural challenges

Port Loko and Kambia experience a number of environmental and infrastructural challenges to effective disease surveillance, namely, limited mobility due to poor roads, the districts’ riverine area, and the region’s inundating rainfall, untraceable EVD transmission due to Kambia’s proximity to Guinea, and a dearth of telecommunication infrastructure, reliable vehicles, and health infrastructure, all required for effective surveillance. Understanding these environmental and infrastructural challenges to DSOs and their work is necessary not only to contextualize how surveillance unfolded during the West Africa EVD Epidemic, but also necessary groundwork for policy recommendations (pages 103-110).

The Port Loko and Kambia riverine area is almost inaccessible to vehicle travel (Figure 12). To a large extent this explains why Kambia, with a larger riverine area and fewer paved

roads, did not appear to have EVD until September, 2014, despite Port Loko's substantial caseload (see discussion, pages 56-57). In the DSO survey, DSOs were not specifically asked to comment on the riverine area itself: however, an effective peripheral measure can be found in commentary of road conditions and the challenge road conditions presented to DSO work. The condition of roads is both an environmental and infrastructural challenge, but will be discussed here. When asked to rate the challenge of road conditions to their work on a one to five scale, DSOs responded that road conditions were very challenging to their work (average response = 3.8). Forty percent of DSOs considered road conditions one of the three most significant challenges to their work (Figure 26); 24 percent considered road conditions the single most significant challenge to their work (Figure 27). As such, road conditions and the associated difficulty of intra-district movement constituted a top concern of DSOs, after the challenge presented by inadequate salaries, poor community trust, and traditional healers.

Riverine mobility was further restricted by Sierra Leone's prolific rainy season. All of Kambia and Port Loko experience enormous rainfall from May through September, but the coastal area is particularly affected (Figure 35).¹¹⁹ Throughout much of Port Loko and Kambia, the five-month rainy season brings between two and three meters of rainfall. Along the Atlantic coastline, in the riverine area, this rises to an average of three to four meters. Other than the tarmacked Conakry-Freetown highway, any roads that do exist are washed away. As such, road conditions were little better throughout the non-riverine areas of either district. For example, Kambia's August 2015 EVD outbreak was focused around two small towns called Sella and Kafta (referred to collectively as Sellakafta). Sellakafta is 40 kilometers from the Kambia DERC,

¹¹⁹ Asamoah Larbi, "Annual rainfall distribution in Sierra Leone", 2012, The Food and Agriculture Organization, accessed January 09, 2016, <http://www.fao.org/ag/agp/agpc/doc/counprof/Sierraleone/sierraleonepics/Figure%207.jpg>.

along one of the district’s best roads. However, after heavy rains in June, July, and August, the road was almost impassable. While some road movement was possible, much of the necessary food and equipment distribution to Sellakafta had to be completed by helicopter. Two vehicle movement was mandated by the DERC, at least one of which was required to have a winch for vehicle extractions.

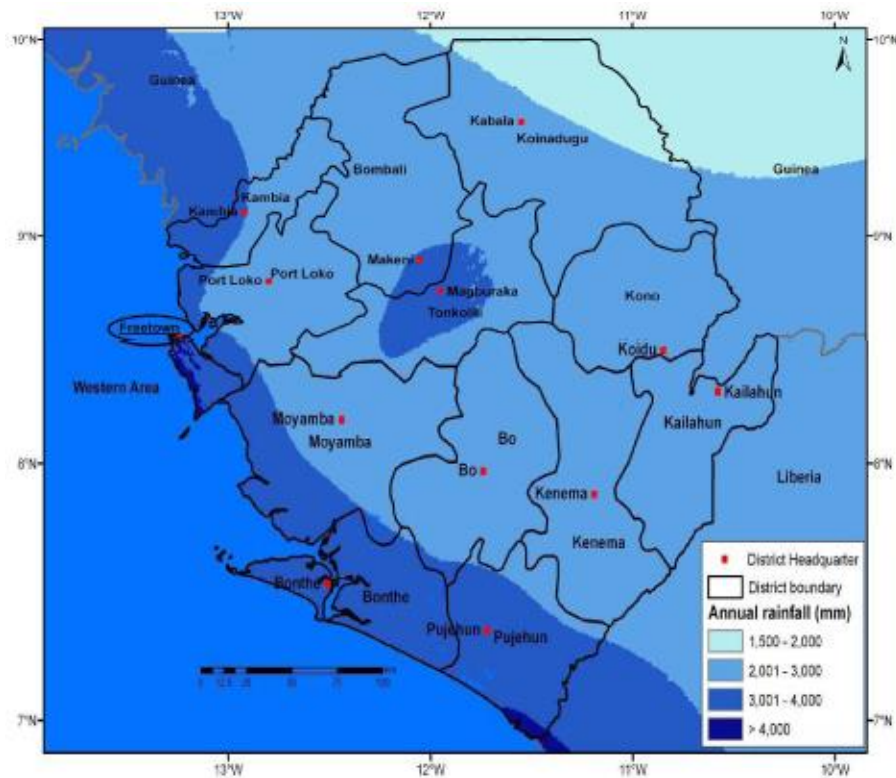


Figure 35: Annual rainfall in millimeters

An evacuation of three suspect EVD cases from Kambia’s riverine region in late May, 2015 is an effective example of how challenging and dangerous these environmental conditions can be. DSOs were called to an alert in Kychom Village, Samu Chiefdom, along the riverine coastline. Driving as far as the road permitted, the surveillance team completed the last five kilometers of their journey by boat. Arriving at their destination, the surveillance team found three profoundly sick individuals, all later confirmed EVD-positive. An evacuation of these individuals to an ETC was urgently required.

However, given the area's lack of accessibility, no ambulance was able to get within five kilometers of the town. The three patients were far too sick to walk, and due to transmission risk, physically assisting them was out of the question. The patients needed to be stretchered, but carrying a stretcher five kilometers in Personal Protective Equipment (PPE) was similarly impossible: heat exhaustion, suit perforations, and other IPC mistakes were bound to happen over so great a distance.

The RSLAF were able to secure a boat to assist, with the hopes of evacuating the three patients from the nearest beach, several hundred meters from their household. Thirty burial team workers were seconded to the evacuation, totally dismantling the district's ability to bury corpses that day. The 30-strong team traveled by boat to Kychom to perform the evacuation. The burial team members (experienced in carrying heavy loads while wearing PPE) arranged themselves into six teams of five: four individuals per stretcher, and a fifth spraying decontaminating chlorine. Three teams of five carried the three patients half way to the waiting boat, at which point they approached the safe limit of physical exertion while wearing PPE. While the first fifteen individuals carefully doffed their PPE, the next fifteen individuals relayed the patients the remaining distance.

However, organizing the teams and getting the three patients to the coastline had taken longer than expected, and the tide was going out. When trying to place the three patients in the boat, the now-partially beached boat capsized. The three highly infectious patients fell into the water alongside the ERWs assisting them, an enormous IPC failure.

The patients were carefully removed from the water. The WHO Field Coordinator, present at the evacuation, made a snap decision: six individuals donned PPE and three motorcycles from the local community were commandeered. On each motorcycle, the EVD-

positive patient was sandwiched between a PPE-wearing driver at the front and PPE-wearing ERW at the back. The profoundly sick patients were driven overland five kilometers to the waiting ambulances. The ERWs did successfully transport the patients to the waiting ambulances: however, all six had badly torn PPE, and were required to submit to a 21-day quarantine in case they had acquired EVD during the evacuation.¹²⁰

Unfortunately, the complexity of mobility within the riverine area meant too much time had passed between the initial alert and the arrival of the three patients at the ETC. Shortly after arriving at the Kambia ETC, all three patients died.

Kambia's proximity to Guinea's EVD epicenter also proved incredibly challenging. The Kambia-Guinea border is notoriously porous, with 48 crossing points identified by the International Organization for Migration (IOM). Most are little more than footpaths through the densely forested region. Tellingly, even within Guinea's EVD epicenter in Kigbali,¹²¹ Sierra Leonean cellular signal was strong: the border, marked by a particularly tall tree, was only one kilometer to the south. Monitoring movement across this border and encouraging collaboration between English-speaking Sierra Leone and French-speaking Guinea was unduly complicated, not least because Kambia surveillance teams had no legal jurisdiction or protection within Guinea and vice-versa. As a result, new local outbreaks of EVD in Kambia were regularly the result of the movement of people from Guinea, unnoticed and untraceable by Kambia DSOs. The government did pass a Cross-Border (XB) Memorandum of Understanding (MoU) that created a framework for policy discussions, but beyond several meetings to discuss the dire need to coordinate XB activity, no effective coordination transpired.

¹²⁰ This, in turn, had far-reaching implications for the ability to conduct timely burials in Kambia for the duration of the 21-day quarantine.

¹²¹ Guinea's epicenter from August – September 2015.

Telecommunications infrastructure also posed a significant challenge to DSO work. When asked to rate the challenge of telecommunications to their work on a one to five scale, DSOs responded that telecommunications were between challenging and very challenging to their work (average response = 3.3). Twelve percent of DSOs considered telecommunications one of the three most significant challenges to their work (Figure 26); two percent considered telecommunications the single most significant challenge to their work (Figure 27). While this places telecommunications as the eighth most significant challenge to DSO work, it is still within one significance category (e.g., challenging to very challenging, or very challenging to extremely challenging) of the most significant challenge to DSO work, traditional healers.

Vehicles (i.e. the quality of vehicles and breakdown predilection) were not considered to be significantly challenging by DSOs. On the one to five scale, DSOs indicated vehicles were between somewhat challenging and challenging (average response = 2.4). Of 13 possible responses, this places vehicles as the 11th most challenging, ahead of work empowerment and ERW cooperation, but behind all else. Twelve percent of DSOs listed vehicles as one of their top 3 challenges (Figure 26), but only two percent of DSOs considered vehicles the primary challenge to their work (Figure 27).

Broader health infrastructure posed a significant challenge in various ways. As discussed on pages 36-42, health infrastructure was totally inadequate and could not be relied on for EVD-related healthcare. ETCs had to be built, and ERW staff trained, but this took many months. MoHS and DHMT coordination was impotent (pages 46-47). In the time it took to build DERCs and ETCs, sick individuals had few options for care. They could die at home, as many did (pages 55-56), or they could seek traditional healing (pages 41-42 and 86-88). Tellingly, even during the West Africa EVD Epidemic, on the one to five scale DSOs considered maternal mortality (2.7),

community trust in PHUs (3.4), and U5 mortality (3.5) as only marginally less significant public health crises as people acquiring EVD (3.7) (Figure 34). This, in turn, had enormous implications for EVD surveillance and EVD transmission in Port Loko and Kambia. Not only did the lack of available government health services (pages 36-42) revoke already-limited community trust in the response and government authority: the prolific use of unlicensed traditional healers also resulted in untraceable sickness and many new local outbreaks of EVD (pages 86-88).

While overhauling road, telecommunications, or health infrastructure does demand discussion and resolution (pages 106-113), resolving any of these complexities is a multi-year process that would require billions of dollars of investment. As such, these concerns were and remain difficult to address during a crisis measured in epi weeks. There are some quick but imperfect resolutions which were considered and implemented by GOAL. For example, high quality rain gear was provided to DSOs whose job requires significant time outdoors, high quality 4x4 vehicles were provided, each with a wet-weather rescue kit, and ERWs on motorcycles were reassigned to surveillance teams in closed vehicles during the rainy season. While these positive changes were welcomed by DSOs, the underlying causes continued to hamper effective response throughout the West Africa EVD Epidemic in Port Loko and Kambia, and little emphasis was given by most organizations to resolving these concerns where possible.

Sociocultural challenges

Sociocultural challenges to disease surveillance and DSO work in Port Loko and Kambia are similarly significant and protracted, and thus demand attention in any discussion – and the policy recommendations that follow – of the challenges facing DSOs in the West Africa EVD Epidemic. The sudden and intense involvement of the international community, here as in any response, will necessarily abut sociocultural complexities. Navigating them, educating where

necessary, and providing resources to resolve underlying causes, is the onus of the Sierra Leonean government and the international community. Within the context of the West Africa EVD Epidemic, the sociocultural challenges with implications for DSO work and surveillance include issues of anti-ERW stigma, violence, and a lack of community trust in DSOs. These sociocultural challenges also include a lack of community trust in facility-based healthcare, a conversation which includes traditional healing and unreported sickness, as well as the significant movement of people for trade and travel, religious body washing practices, extensive social networks, and Sierra Leonean naming convention.

Questions on stigma and violence against DSOs were not directly included in the DSO survey, and would be valuable future research. Questions on community trust in DSOs *were* included, and provide some insight into the collective problem of community antagonism. When asked to rate the challenge of community trust on a one to five scale, DSOs responded that community trust was between challenging and very challenging to their work (average response = 3.7), third only to road conditions and traditional healers. 77 percent of DSOs considered community trust one of the three most significant challenges to their work (Figure 26); 29 percent considered community trust the single most significant challenge to their work (Figure 27), more than any other. Open responses were particularly telling. Of 28 open responses, 13 DSOs took the opportunity to directly reference issues of stigma, violence, or community trust. In the words of one DSO: *Sometimes you are cursed. Sometimes you are stoned. Community intimidation was a serious problem.*

Such community antagonism is the result of a number of factors, one of which is the impact of the Sierra Leonean Civil War on local communities, which ended only eleven years prior to the arrival of EVD in Sierra Leone. Substantial trauma was experienced, and

reconciliation failed, particularly in Kambia (see pages 31-32).¹²² Because of this, political violence and aggression is not uncommon in Port Loko and Kambia. A February 10, 2016 email from the Kambia DERC to Kambia organizations describes one such tense situation:

Dear All, this message was sent last night regarding the events in Tonkolimba Chiefdom, Kambia. Please relay this message to your teams working in Kambia District, and tell them to avoid the area for a few days. In the late afternoon in Tonko Limba Chiefdon, Kambia, two rival groups clashed over the control of Kamatotor village. Kamatotor village is an isolated community approximately 50 minutes from Kambia town. Fighting included the use of some guns and machetes. A number of people were injured and taken to the government hospital in Kambia for treatment. In addition it was reported that the house of the Paramount Chief was burned down... A full investigation is now ongoing. The SLP will provide more detail on the 11th February. In the meantime, all partners are advised to exercise caution if operating in the Tonko Limba Chiefdom.

Such community and anti-authority violence spills over to ERWs, even international staff in branded vehicles as shown in a photograph from a separate incident on January 26 2016 (Figure 36).



Figure 36: UNICEF vehicle damage after being attacked by a Kambia community (January 26, 2016) (Image source: Author)

¹²² Sierra Leone: Kambia District Profile; Human Rights Abuses in a War Against Civilians.

Another factor that contributed to community antagonism was the EVD response itself, which put additional strain on already tense communities: the government demanded strict concessions from their people, but did not deliver support that could justify them to the population. Many sociocultural factors with implications for EVD transmission and surveillance (discussed below) were restricted by the government, with transgressions punishable by fines and jail time. Movement and trade restrictions were put in place, households and sometimes entire communities were placed in quarantine, travel was banned after dark, and bush meat consumption, body washing (pages 88-89), traditional healing (pages 41-42 and below), and social gatherings were banned in their entirety. Such government restrictions were codified in the EVD response bylaws (Appendix C), which came into force in early August, 2014. In short, Sierra Leoneans were being asked to aggressively curb their behavior to help contain EVD, well before ETCs came online (December 2014, page 45 and 55) or effective response mechanisms were put in place (January 2015, see pages 58-65). This, in turn, exacerbated already tense communities and furthered antigovernment sentiment, which revoked community trust in the EVD response more broadly, including in DSOs.

This was further exacerbated by a lack of community trust in facility-based healthcare, and the subsequent reliance on traditional medicine, despite its official ban. Community trust in facility based healthcare was considered very challenging by DSOs (average response = 3.7). 21 percent of DSOs considered community trust in facility based healthcare one of the three most significant challenges to their work (Figure 26); five percent considered community trust in facility based healthcare the single most significant challenge to their work (Figure 27). This lack of trust in facility-based healthcare, largely the result of totally inadequate health infrastructure unable to provide even basic care to the people of Sierra Leone, drives many of the country's

citizens to access their healthcare among the region's extensive network of traditional healers (pages 41-42). In addition to this, poor patients who rely on subsistence agriculture for their and their family's sustenance (pages 29-32) have little reason to engage with facility-based healthcare that could result in extended confinement in ETC treatment, and if EVD-positive, home quarantine. Farms require consistent and intensive labor: while WFP provided food for the duration of a 21-day quarantine,¹²³ three weeks of unmanaged fields ensured crop failure and family hunger.¹²⁴ Thus, lack of community trust in facility-based healthcare and the challenges posed by traditional healers are inextricable.

The use of such unlicensed 'off the grid' healthcare provision was inordinately complicating for DSOs, and given there was little recourse for replacing their livelihood, traditional healers largely ignored calls to stop their work. Traditional healers were considered between very and extremely challenging by DSOs (average response = 4.1): no other challenge was considered so significant. While existing hospital infrastructure is unable to provide quality care to the Sierra Leonean people, PHUs and hospitals could provide intelligence and refer sick patients to the DERC and DSOs.¹²⁵ Traditional healers have no such intrinsic integration with government services (pages 37 and 41-42). They perform their work divorced of government oversight: sick individuals – whom all Sierra Leoneans were legally obliged to report per the EVD bylaws mentioned above – were often never brought to the DERC's attention. Furthermore, in the course of their work, traditional healers also came into frequent contact with EVD-positive

¹²³ The minimum length of an EVD quarantine – 21 days assumes there is no secondary transmission, an unlikely prospect.

¹²⁴ Like GOAL's partial resolutions for wet weather challenges, the DERC was similarly able to creatively mitigate some of these effects: later in the response, with ONP funds, the Port Loko and Kambia DERC were able to pay local laborers to farm the land of quarantined families which greatly reduced the incentive not to report sickness through 117.

¹²⁵ For an extended discussion of how haphazard facility-based surveillance reporting was and remains in Sierra Leone, and the paramount importance of improving existing DHIS2 architecture by systematizing data aggregation and analysis for the realization of IDSR, see page 106-110.

patients, and thus fell sick themselves. To further exacerbate the effect of traditional healers on EVD transmission and surveillance, their frequent movement across districts and countries often returned EVD from far-flung hotspots to areas without ongoing transmission.

Significant movement of people for trade and travel also had large implications for EVD transmission in Port Loko and Kambia, particularly along the Conakry-Freetown highway (pages 30-31). Frequent trade and travel not only moved goods and services, but also disease: an outbreak in rural Guinea, for example, could be communicated to Kambia or Port Loko in a matter of hours, a reality that no previous EVD outbreak has had to contend with (pages 18-22). Few IPC or surveillance measures were considered or implemented at the significant border crossing between Guinea and Sierra Leone on the highway, located on Kambia's northern border. While returnees from West Africa to the United States submitted to intensive health monitoring for 21 days, health monitoring at the Sierra Leone-Guinea border consisted of one (often neglected) temperature check, with no further follow-up or contact tracing. As such, while in many ways an asset to DSO mobility and EVD response work more generally, the Conakry-Freetown highway was therefore largely responsible for the rapid proliferation of cases in and between Guinea and Sierra Leone: EVD outbreaks in Port Loko and Kambia were often strung along this thoroughfare, which then filtered into the districts' hinterlands.

The Muslim custom of washing and bathing the dead has significant implications for EVD transmission as well. Around 80 percent of Port Loko and Kambia's population practices Islam (pages 29-32), and washing the deceased prior to burial is an important religious ritual. However, at the point of death, EVD viral load is higher than any other point. As such, bodies are highly infectious, far more so than living EVD-positive patients. It is on this basis that Safe and Dignified Burials were implemented, and bylaws making body washing illegal were created.

Ostensibly, bodies should be left untouched, collected by a burial team wearing full PPE, and then taken to a cemetery for burial. However, especially in more rural or otherwise inaccessible parts of Port Loko and Kambia, oversight and accountability of a population's compliance was impossible. For example, one Port Loko chiefdom, Sanda Magbolonto, did not report a single death from January to June 2015, despite the statistical impossibility of this occurring among its population.

Lastly, large social networks and naming convention were sociocultural challenges to surveillance. One case of EVD in Sellakafta, for example, had 945 identified contacts: deaths and funerals are highly social events in Sierra Leone, within which EVD transmission can rapidly proliferate. Furthermore, reliably identifying and thus tracing large numbers of individuals within such extensive social circles can be extremely challenging, given Sierra Leonean names are often incredibly similar. For example, among a selection of 54 DSOs, three have the surname Turay, three have the surname Sesay, five have the surname Bangura, and six have the surname Kamara. While DSOs have the local knowledge to partially mitigate the resulting confusion, this sociocultural milieu proved significantly challenging to international epidemiologists from the WHO and CDC who were unnecessarily integral to surveillance in Kambia (page 65 and 93).

Political and organizational challenges

Unlike the intractable challenges posed to DSOs and surveillance by environmental, infrastructural, and sociocultural realities, resolvable political and organizational challenges were both created and often ignored throughout the course of the West Africa EVD Epidemic. Three major political and organizational challenges dogged EVD response efforts in Port Loko and Kambia, namely: mission creep resulting in duplicated, confused, and unresponsive

management, overly vertical pillar management, and the inclusion of organizations ill-suited to crisis conditions. These challenges were created within the structure of the response, in part by accident, and in part by design. All had significant logistical and operational implications, which actively impeded DSO work and the realization of effective surveillance. In short, the international community failed to address these three concerns, resulting in the unnecessary loss of life both directly and indirectly.

Alongside the creation of the DERCs (pages 46-51), WHO district offices were established in October 2014. By attaching such a politically powerful institution to the intended DERC management structure, the advisory role of the WHO immediately encroached on operational decision making and management, initially due to lacking C2: with the exception of the SU TL, their British support staff, and RLSAF, Command Team management was incredibly poor. The DC and the DMO in both Port Loko and Kambia were largely absent, incompetent and unprepared to support the coordination of such an enormous operation.¹²⁶ NGO support for certain pillars, particularly the surveillance pillar, did not arrive until after the creation of WHO district offices: as such, the WHO was required to operationally and logistically support certain DERC activities prior to NGO arrival. In short, the Command Team's C2 needs, and absence of early NGO support, resulted in the heavy reliance by the SU TL on the WHO as an advisory *and* coordinating, operational body.

When NGO support arrived in Port Loko (GOAL in January 2015, pages 58-64), the DERC was only three months old. During these three months, Port Loko experienced prolific EVD caseloads (pages 42-43). As such, there was little attempt to understand or clarify

¹²⁶ In the spring of 2015, the Port Loko DMO suffered a stroke and was replaced. Both the original Port Loko DMO and his replacement were exceptional, in contrast to the Kambia DMO, and both Port Loko and Kambia's DCs. However, this unusual competence was almost entirely curbed by a poorly resourced and ineffectual DHMT and MoHS.

management structure as the response functioned in crisis mode: the DERC, WHO, and other organizations would take all the help they could get. On this basis, GOAL could effectively reclaim management and operational authority over the surveillance pillar in Port Loko.

However, the story was very different in Kambia. Kambia's EVD caseload was substantially lower (page 44) and therefore never experienced the crisis management culture that was unavoidable in Port Loko. As the EVD response needs were so great in Port Loko, and human resources across Sierra Leone were generally limited, support to Kambia was not considered a priority until late Spring 2015 – NGO support (GOAL) did not arrive until April, 2015. The superficially relaxed EVD outbreak in Kambia (pages 56-57), and the half year of WHO operational support prior to NGO arrival, meant any attempt to claim operational authority directly encroached on an entrenched management culture.

In short, the WHO demanded and was awarded management of the surveillance pillar, despite the DERC's clearly articulated operational authority. In other words, NGOs responsible for on-the-ground activity were themselves responsible not only to the DERC and their own organization's management, but often to the WHO as well. This meant the structural adjustments performed so successfully in Port Loko (pages 58-65) could not be implemented in Kambia, to the serious detriment of the Kambia EVD response.

This also resulted in duplicated management for all pillars (pages 50-51), especially the surveillance pillar, which was operated by, overseen, and managed by up to eleven separate organizations at any one time. This, in turn, created confusing and damaging coordination, and did not firmly establish any single organization as the advocate for DSOs, and largely prevented resolution of DSO needs like work fatigue and salaries. These two major DSO concerns could have been addressed by response organizations had there been sufficient management clarity. On

the basis that both concerns could have been addressed, even within the short and intense window of the West Africa EVD Epidemic, but largely were not, these two issues deserve particular attention and speak to deeper truths about the inadequacies of the response.

During the outbreak, DSOs in Port Loko and Kambia were asked to work seven days a week, on end, with no scheduled time off, vacations, or other periods of rest. From an operational standpoint, this was quite necessary: even with additional surveillance officers brought on board by GOAL (page 58 and 93), human resource was lacking. There was little to no staff redundancy. Taking time off on the weekend was not an option: while much EVD response work stopped on Saturdays and Sundays, sickness, death, and EVD transmission did not respect the 40-hour workweek. As all sickness and death had to be investigated within 24 hours to avoid cataclysmic onward transmission, there was no opportunity for DSOs to rest on weekends. On this basis, DSOs considered work fatigue between challenging and very challenging to their work on the one to five scale (average response = 3.4). Of thirteen possible selections, this places work fatigue as the sixth most significant challenge facing DSOs. However, if you exclude protracted infrastructural or societal problems, work fatigue is the second most significant challenge to DSOs and their work. 21 percent of DSOs considered work fatigue one of the three most significant challenges to their work (Figure 26); ten percent considered work fatigue the single most significant challenge to their work (Figure 27).

At primary fault was the over-management of the surveillance pillar.¹²⁷ Without one direct authority to redress such concerns, DSOs were being told to work by up to eleven separate agencies at any one time. Even if a DSO could convince one or even several agencies that they

¹²⁷ This was a problem for every pillar in the response, as discussed on page 50, and presented in Figure 18. However, surveillance was particularly affected: while the average number of organizations operating, overseeing, or managing any one pillar is 3.1, there were up to eleven district-level organizations doing the same for surveillance.

deserved time off, there was inevitably at least one other organization demanding they be present and working. More DSOs could have been trained and brought online. However, this was a political non-starter in Kambia: additional staff – who would have to be brought in from outside the district due to Kambia’s dire HRH needs – was seen as encroaching by the entrenched management structure that existed in the district.

There were multiple opportunities for and offers of additional DSO support, but all were rejected by the WHO, and transitively the DERC. Additionally, blanket policies by NERC, government payroll, and their United Nations Development Programme (UNDP) support staff meant that hiring additional workers was a non-starter either way: from Freetown’s perspective, by mid-spring 2015, national EVD transmission had dropped precipitously (Figure 7). Despite ongoing transmission in both Port Loko and Kambia, any attempt to add new ERWs to government payroll was aggressively rejected as unnecessary given the state of EVD transmission nationally. This government line in the sand did not change until ONP in June 2015. While this relieved DSO overwork in Port Loko to a great extent, the aforementioned political infighting in Kambia meant the district only boosted its DSO staff from 13 to 18, versus Port Loko’s eager jump from 35 to 70.

Of even greater concern was the issue of DSO salaries.¹²⁸ During the West Africa EVD Epidemic, DSOs were technically unpaid, but were provided 400,000 Sierra Leonean Leones (SLL) (about \$80) of hazard allowance per week. This hazard allowance, provided by the Sierra Leonean government to all ERWs, was related to level of workplace risk. The highest category (with weekly remuneration of 500,000 SLL) was reserved for those working inside the ‘Red Zone’ of ETCs, that is, working directly with EVD-positive patients or blood samples. DSOs,

¹²⁸ From my nine months working with DSOs in Port Loko and Kambia, this was categorically the single biggest failure of the EVD response.

often responsible for working without PPE in close proximity to sick patients and corpses in the field (Figure 37), arguably put themselves at greater risk. Nevertheless, there was some degree of appreciation of the risk DSOs faced, and as such, DSOs were included in the 400,000 SLL/week allowance category.



Figure 37: A Port Loko DSO (in white) interviews a suspect EVD case (sitting) (Image source: Author)

This allowance is fairly generous by Sierra Leonean standards. However, of protracted concern was how infrequently and haphazardly payments were distributed. Often, they never were. A February 16, 2015 letter from the Port Loko DMO to UNDP, responsible for assisting the Sierra Leonean government with processing payments, lists a total backlog of 92,400,000 SLL (\$18,480) among 53 DSOs and surveillance team members dating back to October 2014. This averages to more than a month's missed pay per person. These October to February back payments were not processed until May 2015. Meanwhile, February to May 2015 payments

remain, to a large extent, undistributed. There were further issues with UNDP's erroneous relegation of DSOs to lower-waged hazard categories, clerical errors by UNDP and NERC that removed legitimate ERWs from payroll despite DERC protestations, among a litany of both unconscious oversights and conscious malfeasance.¹²⁹

Many DSOs literally went hungry. GOAL attempted to help by providing all surveillance team members breakfast and lunch, and when available, bags of rice. However, this was little consolation or replacement for ERW salary: provided the muddled and unresponsive over management of the pillar, any and all support was haphazard, disorganized, and not comprehensive. As such, on the one to five scale, DSOs considered salaries between challenging and very challenging to their work (average response = 3.5). When one only includes immediately addressable problems,¹³⁰ salaries were the most significant challenge to DSOs. 53 percent considered salaries one of the three most significant challenges to their work (Figure 26); 24 percent considered salaries the most significant challenge to their work (Figure 27).

One particularly tragic story is that of Peter Lamin, a Port Loko DSO who died of EVD. Peter acquired EVD in the line of work in December 2014. Like most of the other DSOs, Peter had not been paid his October, November, or December pay before he tragically passed away. His family came to the Port Loko DERC to enquire about collecting his wages. Multiple and increasingly aggressive attempts by the DERC to advocate for Peter's family, and push UNDP to

¹²⁹ A third of Sierra Leone's government funds for the EVD response disappeared. Of \$18 million in treasury funds set aside to pay ERWs, \$6 million was nowhere to be found. Of the remaining \$12 million, \$10.2 million had been distributed, but to where will never be known – there is no supporting documentation. Thomas K Grose, "If You Know Where The Missing \$6 Million Is, Please Tell Sierra Leone," *National Public Radio*, April 2, 2015, accessed February 11, 2016, <http://www.npr.org/sections/goatsandsoda/2015/04/02/397084731/if-you-know-where-the-missing-6-million-is-please-tell-sierra-leone>.

¹³⁰ "Immediately addressable" is not an overstatement – GOAL had the funds and the logistical capacity to pay every DSO indefinitely, an action the organization advocated for many months. This was blocked by UNDP until DFID overrode their authority at the national level in June, 2015.

process payments, failed. Peter's family was eventually paid by charitable contributions of various DERC staff to make up for the lost income.

The issue of late and missed salary payments was not isolated to Port Loko, nor was it isolated to the few instances listed above. It was a continuous and pressing problem. As indicated by many DSOs in open response answers, it was also an indication of disrespect by the government for the DSO's hard and dangerous work. When asked *What are some things NERC could have done better?* and given the opportunity to respond openly, all but one of 38 respondents listed late or non-payment of salaries.

Help for DSOs did arrive in the form of ONP, a carte-blanche from DFID to eradicate EVD once and for all from Port Loko and Kambia. GOAL advocated for taking over hazard allowance responsibility from NERC and UNDP – sentiments of sustainability and accountability were of little use, argued GOAL, when people were dying and EVD continued to cascade across both districts. GOAL was awarded such authority, to this point an unprecedented delegation of oversight to a single coordinating body, and was able to pay all DSOs directly. This did nothing to address copious back pay,¹³¹ but ensured that DSO morale and dignity was upheld through the eradication of EVD transmission in Port Loko and Kambia.

It is hardly surprising, on this basis, that when DSOs were asked to indicate the organization most important to their work, 81 percent listed GOAL. The next highest was the British forces (SU and BritMil) and WHO, tied with 7 percent. This can be read as evidence of bias, as DSOs were being remunerated by GOAL at the time the survey was conducted. However, the payment of DSOs by GOAL does not necessarily discredit the DSOs' approval of the organization. GOAL was in constant conversation with DSOs throughout their involvement

¹³¹ To date, no pre-ONP back pay has been distributed to DSOs by NERC.

in Port Loko and Kambia, and after political changes permitted, became the primary organization advocating for their salaries and support. GOAL fought for the ability to pay DSOs directly after witnessing the distress its caused them and the result it had on the quality of their work. As such, it is as much an example of listening, advocacy, care, and support (reflected in Figures 29-32) as it is a question of biased response.

Despite the haphazard management of surveillance, with acutely negative implications for DSO work and surveillance more generally, each pillar was nevertheless a protected space within which specific pillar work was coordinated, with varying degrees of success. However, many different pillars are required to perform complimentary work. Due to this political division, emphasizing horizontal integration and co-management was profoundly challenging, often resulting in a lack of effective inter-pillar cooperation. An attempt was made to rectify this, as well as to integrate the wider political and community structures into an EVD response framework that was fundamentally vertical *and* horizontal (pages 61-63). While this framework proved a useful rhetorical tool for implementing some policy changes, broader efforts were protracted given the codification of task distribution in such a vertical fashion. This was a missed opportunity for engaging all political and community structures into the surveillance framework, which would have been a crucial step in realizing effective surveillance in the West Africa EVD Epidemic.

Further complicating political and organizational challenges was the inadequate capacity to perform crisis response by a number of response organizations in Port Loko and Kambia. The WHO clearly struggled to operationalize surveillance, and their exercise of political power in Kambia damaged the response effort as a whole. In short, the organization was not designed for emergency response. The lethargy with which the WHO declared a PHEIC (page 23), which in

turn delayed international response across West Africa by a number of months, can be attributed to similar bureaucratic hurdles. Further WHO limitations included the lack of a logistical arm beyond the WFP,¹³² and haphazard employment practices: their incredibly high staff turnover (4-6 week rotations) resulted in little to no institutional memory within the organization; the organization's staff are not pulled from a central office, but rather from offices around the world as they become available. It is only coincidence if employees are working alongside individuals they have a previous working relationship with, and given the WHO's decentralized regional offices, they may be used to and expect a completely different management structure.

Many NGOs were similarly unprepared, particularly MSI, ACF, and Partners in Health (PIH). MSI and ACF were responsible for CTS in Port Loko and Kambia, respectively. However, MSI is a women's health organization, while ACF is a nutrition and food security organization. Like the WHO, neither had any institutional history or skill that would lend itself to emergency response.

PIH proves a particularly egregious example of how this not only limited response efficiency and operational strength, but directly resulted in the loss of human life. The organization has a strong and self-proclaimed interest in community health and CHWs.¹³³ Per discussions on pages 36-38, this work is undeniably crucial to improving patient care in Sierra Leone. PIH also has a history of emergency response: they supported Haiti following the 2010 earthquake by supplying a large number of doctors to populate Haiti's existing hospitals while the country rebuilt and resurrected itself. When EVD hit Sierra Leone, PIH decided to use a

¹³² The WFP was only responsible for specific logistical needs like food distribution to quarantined households. They were not responsible for the broad needs of the overall response, or the surveillance pillar specifically (Figure 19).

¹³³ "Community Health Workers," *Partners in Health*, accessed February 11, 2016, <http://www.pih.org/priority-programs/community-health-workers>.

similar tactic. They staffed Port Loko's first ETC, an MoHS built and MoHS supplied facility. However, instead of independently overseeing the design of the facility (Appendix H) and independently resourcing hospital supplies, PIH relied on the MoHS.¹³⁴ PIH provided no management staff and no logisticians. They only provided medical staff. The mismanagement that ensued is nothing short of criminal.

As described by the New York Times, the MoHS/PIH facility had a pattern of safety lapses.¹³⁵ Because they had no logisticians and relied on the MoHS District Medical Store (DMS), PIH staff had inconsistent PPE supplies. PPE consistency is critical, as different PPE variations require different donning and doffing techniques. A minor mistake in the doffing process was frequently the cause of ETC-acquired EVD infection. The organization's staff knew and openly acknowledged the danger of PIH's arrangement with MoHS and their work at the ETC.¹³⁶

The lack of consistency stemmed in part from the lack of unified leadership, given that both the health ministry and Partners in Health were running operations. "From day 1 there wasn't somebody in charge of the whole scene," said Mr. Sarchet [an American volunteer at the site]. "You were constantly trying to work within two different systems. That was a huge hardship."

The facility not only had "inadequate protective clothing" but also "inconsistent protocols in using it, and inappropriate disposal of contaminated waste products."¹³⁷ Such inadequacies are particularly damning, as not only were staff at the facility aware of the shortcomings, but they

¹³⁴ An effective ETC should be very carefully designed to limit IPC breaches, see page 39-41 and Appendix H.

¹³⁵ Sheri Fink, "Pattern of Safety Lapses Where Group Worked to Battle Ebola Outbreak," *New York Times*, April 12, 2015, accessed February 11, 2016, <http://www.nytimes.com/2015/04/13/world/africa/pattern-of-safety-lapses-where-group-worked-to-battle-ebola-outbreak.html>.

¹³⁶ *Ibid.*

¹³⁷ *Ibid.*

also understood the facility's bed space was no longer required as EVD caseloads had collapsed, and two other ETCs had opened in the district.¹³⁸ Despite this,¹³⁹

the medical group kept its American staff at the site..., deferring to government officials who wanted it to remain open and with whom the aid group needed to maintain good relations in order to work in the coming years on strengthening health care there.

In short, PIH was knowingly trading risk for political capital.

In mid-March, an American doctor and Sierra Leonean clinician developed EVD concurrently, a direct result of these IPC and organizational failures. PIH abandoned the ETC, evacuating all their medical staff back to the United States.¹⁴⁰ Both the American doctor, who was evacuated for treatment in the United States, and the Sierra Leonean clinician, who was not, survived.

However, unreported by the New York Times is what happened at the PIH facility after the American staff were evacuated. When PIH made the decision to evacuate their staff, there were nine patients being treated in the ETC's Red Zone. PIH's American staff were the only doctors at the facility – the remaining MoHS staff were hygienists and caretakers, but not clinicians. PIH's evacuation was so immediate and unannounced that international staff were pulled before the patients could be transferred to one of the other two Port Loko ETCs. The organization assumed that the remaining national staff would coordinate patient transfers after they departed. Tragically, this did not occur. National staff, aware that the sudden evacuation of all PIH doctors meant the ETC would imminently close, and that they were soon to lose their

¹³⁸ *Ibid.*

¹³⁹ *Ibid.*

¹⁴⁰ This was in part due to the fact the organization, unlike most, did not have a 'no touch policy'. This in itself is evidence of the lack of effective oversight and respect for the hugely infectious and dangerous Ebola virus. Whereas GOAL and IMC, the NGOs that ran the two other Port Loko ETCs, had no touch policies – that is, no staff is allowed to physically touch any other person at any time – PIH did not. Staff regularly hugged, danced, and shook hands. When their American member staff fell ill, all other international staff were contacts of the case, and at risk of developing EVD.

jobs, decided that the only way to continue being paid by MoHS was if the facility had patients. As long as there were patients, the facility could not be shut down.

As PIH management had left, the DERC was unaware that patients in dire need of professional medical care remained inside the facility. However, overnight looting of the ETC by ex-staff drew the DERC's attention, and the DERC decided a physical review of the facility was required. As the facility's Red Zone was blocked by tarpaulin, the DERC asked GOAL to send a team wearing PPE. The team found the nine EVD patients near death, abandoned inside the facility by PIH 24 hours prior. Ambulances were brought to evacuate the patients for care at one of the other ETCs. However, by the time the patients had been transferred, approximately 36 hours had passed since they had received professional care. All passed away within four hours of transfer.

This anecdote reflects a lack of preparation and institutional incompatibility with emergency response, coupled with a dangerous eagerness to participate in an (often lucrative, financially and politically) international crisis. Many organizations, not limited to PIH, MSI, and ACF, fell afoul of similar processes. This political and organizational challenge, alongside mission creep and overly vertical pillar management, led to inefficiencies across the EVD response structure including surveillance, which resulted in the avoidable loss of human life.

Epidemiological challenges

Epidemiological challenges relevant to DSOs included line listing, finding source cases, and case investigations. This work is foundational to surveillance, and as such, became the overwhelming focus of IOs and the WHO in particular. However, while they consumed huge human, financial, and political resources that ultimately prevented resolution of many of the greater concerns discussed above, epidemiological challenges were of relatively minor concern

to DSOs in Port Loko and Kambia. Of particular note was the focus in which advisory and technical organizations – namely the WHO – placed in this ‘hard science’, a convenient and exigent outlet for highly educated staff rotating through their district offices. Of roughly twenty staff in Port Loko and fifteen in Kambia, all but the respective Field Coordinators were involved in field epidemiology or data analysis. These analyses were undeniably crucial, and to an extent did help inform surveillance: however, ultimately, the information used to perform the highly technical calculations was collected and communicated by DSOs. As such, the quality of their work, and the intelligence they generated, defined the quality and efficacy of resulting WHO analysis.

DSOs recognized the limited significance of epidemiological concerns to their work, relative to the challenges discussed above. On a one to five scale, DSOs considered line listing somewhere between somewhat challenging and challenging (average response = 2.9); only seven percent considered it a top 3 challenge, and none considered it the most significant. Finding source cases was somewhere between challenging and very challenging (average response = 3.4); 28 percent of DSOs listed finding source cases as one of their top 3 challenges, and only five percent considered it the most significant challenge they faced. Ten percent of DSOs listed case investigations as one of their top 3 challenges, and none considered it their most significant.

In short, while these epidemiological challenges are undeniably real and noteworthy, the implications of the litany of environmental, infrastructural, sociocultural, political, and organizational challenges discussed above are all more significant challenges to DSOs, and thus demanded (but were not provided) more attention and resource for their resolution in Port Loko and Kambia throughout the West Africa EVD Epidemic.

RECOMMENDATIONS

1. The WHO should not hesitate to declare a PHEIC. Doing so in August 2014 was far too late (page 23 and 97), especially as the international community took several additional months to organize and operationalize their support. Similarly, the CDC should not hesitate to declare EOC Level I Activation. Both organizations did so for the Zika Virus in early February 2016, two months after initial concern. This constituted the fourth PHEIC declaration by the WHO and the fourth EOC Level I activation by the CDC in history, an indication that both organizations are appropriately eager to engage emergency protocols following the West Africa EVD outbreak.¹⁴¹
2. In the absence of a WHO or CDC alert, international bodies such as DFID or the United States Agency for International Development (USAID) should respond if they have reason to believe the need is urgent. A January 2016 British House of Commons committee report on the EVD outbreak found the same.¹⁴²
3. Vertical response structures should be combined with formal channels of horizontal communication to facilitate and institutionalize collaborative work (page 97).
4. Organizations should prioritize understanding the complexities of sociocultural milieus, and include local staff in management structures to ensure cultural literacy, and that all response work remains informed and sensitive to community needs (pages 83-89).

¹⁴¹ “WHO statement on the first meeting of the International Health Regulations (2005) (IHR 2005) Emergency Committee on Zika virus and observed increase in neurological disorders and neonatal malformations,” *World Health Organization statement*, February 1, 2016, <http://www.who.int/mediacentre/news/statements/2016/1st-emergency-committee-zika/en/>; Gillian Mohnney, “Zika Virus Outbreak Prompts CDC to Activate Highest Emergency Ops Level,” *ABC News*, February 8, 2016, <http://abcnews.go.com/Health/zika-virus-outbreak-prompts-cdc-activate-highest-emergency/story?id=36796510>.

¹⁴² “UK should have listened to Ebola warnings, report says,” *BBC News*, January 19, 2016, <http://www.bbc.com/news/uk-politics-35349081>.

5. The United Kingdom's government should dramatically increase funding for SU, and the United States' government should dramatically increase funding for the equivalent Office of the Coordinator for Reconstruction and Stabilization (S/CRS). As a Civilian-Military (CivMil) collaborative body, SU was extraordinarily effective at coordinating the EVD crisis response, far more so than coordination from the WHO (pages 89-97).

Additionally, response leaders should have a strong history of C2 and preferably CivMil collaboration (pages 97-102), as well as relevant technical or medical training and preparation.
6. Only NGOs with an institutional history of disaster and crisis response should be provided contracts by donor countries and agencies (pages 97-102). Additionally, organizational self-reliance should be required (i.e. in-house logistics, human resources, and finance departments). This will reduce the number of NGOs available for crisis response: however, a smaller number of more highly skilled organizations will have a twofold benefit. Not only will work be of higher and more reliable quality, but it will also provide greater space for strong organizations to perform unilateral management (page 96). The latter is crucial for effective crisis response.
7. Debilitating staff turnover should be eliminated among response organizations by requiring a minimum 6-month contractual commitment (pages 97-98).
8. When lives are at stake and the opportunity to save them is presented, response efficiency should be prioritized, even if doing so does not conform to a sustainable development model (page 96).
9. Significant float capital and distribution mechanisms should be provided for unexpected needs. Comprehensively pre-budgeting is often impossible within an unfolding disaster

response. The UN Quick Impact Project (QIP) and DFID Emergency Ebola Response Fund (DEERF) programs were both effective means to this end, and may be used to fill small needs unmet by organizations' pre-planned budgets (page 83 and 87). Similar programs should be duplicated in future emergency responses.

10. Legal accountability and redress should be ensured and widely advertised for when NGOs or IOs cause harm (pages 97-102). Currently, no such reliable mechanism exists. Only if organizations are held accountable will the international community build the trust of those they aim to serve.
11. No stakeholder should be denied recognition or access to response decision-making, regardless of the nature of their work. Had the EVD response engaged with traditional healers and supported them with alternative livelihoods for the duration of the outbreak, many EVD cases would have been prevented (page 86-88).
12. Pragmatism and 'on the ground' considerations should always be taken into account (pages 83-89).
13. Most importantly, health infrastructure should be developed to prevent crises from occurring in the first place, and to ensure effective disease surveillance occurs at all times. For an extended discussion of how this might be approached and accomplished within Sierra Leone, see *Moving Forward: IDSR and HIS* (pages 106-110).

MOVING FORWARD: IDSR AND HIS

Current situation and overall problem

Sierra Leone health facilities currently utilize monthly paper based reports, which are collected by roving DHMT employees and subsequently entered into the DHIS2, a national digital HIS database. The underlying HIS architecture, as it exists now, is compatible with the WHO push for IDSR.

However, given the challenges of the paper based system, this trove of national data is not currently utilized to effect systematic analysis and reporting. As such, much valuable and actionable data remains untouched on a central MoHS server, only recalled and analyzed on an ad hoc request basis (a ‘pull’ system, rather than an ideal ‘push’ system).

In addition to being underutilized, the paper based system has a myriad of problems, not limited to:

- Physically accessing every health facility to collect paper reports is exceedingly difficult, due to poor road conditions, heavy rains, and lack of available vehicles and staff
- Oversight and accountability for incomplete data collection is limited, as the data is unactioned and therefore inaccuracies incur no consequence
- Clerical mistakes arise because data collection, at the health facility, is divorced from data entry, at the centralized DHMT
- Clerical mistakes arise because manual data aggregation and analysis against predefined significant event thresholds is prone to user error
- Response efficiency is significantly retarded and real-time response is impossible, as paper collection, manual data entry, and manual data analysis takes weeks or months, rather than seconds

In addition to the challenges of paper based reporting within the current HIS architecture, there is also no comprehensive database that provides an accurate reflection of available HRH and essential supplies such as drugs and medical equipment. By not having a robust system that can accurately track health facility staff, CHWs, and other HRH, the ability for long term planning of health worker resources by DHMTs and MoHS is unfeasible. Additionally, the absence of a system that accurately tracks drug and medical equipment distribution currently leaves many health facilities without proper supplies to provide medical care, further limiting patient care and community trust in health facilities.

In short, while Sierra Leone has an effective infrastructure and HIS architecture for implementing IDSR, it is currently underutilized, ineffective and un-actionable due to paper based reporting structures.

Proposed solution

Nationalized systematic digital data reporting and analysis has the potential to dramatically improve understanding of not only significant events such as disease outbreaks, but also geographically pinpoint which health units are at highest risk of observing particular diseases and other significant health-related incidents. Such an understanding facilitates the effective targeting of resources and training allocation by the MoHS to prepare for – and in the event of a significant event, respond to – specific health needs across the country. In short, if disease surveillance data is effectively built into existing health infrastructure, collected into a central server, automatically analyzed for significant events, and then distributed as an alert to responsible DHMT and MoHS response teams, one has realized IDSR. With nominal input, the strength of the existing system is sufficient for the rapid adoption of such an automated and

systematic HIS that creates dramatic improvements for disease surveillance and population health.

Alongside extensive training and a clearly defined transitional plan (Appendix I), internet-connected mobile technology and tablets should be introduced at all PHUs and health facilities. All paper based reporting should be moved to tablet entry, for automatic communication to a central DHMT and MoHS server. Where necessary, booster antennas and solar infrastructure should be introduced to ensure connectivity. Appendix I includes the estimated total program costs and project timeframe, assuming the project was piloted in Port Loko.

Overall goal and impact

The overall goal of interventions is to secure effective reporting at all levels of health provision across a district, and to automate the aggregation, analysis, and reporting of this data to relevant authorities and health facilities. After such data architecture is established and after extensive capacity building, the management, ownership, and oversight can be handed over to MoHS and DHMT with residual NGO and WHO advisory staff to complement operations.

Such analysis and reporting can provide national, district, and community health responders with the information necessary to identify areas of particular concern or interest, and subsequently to effectively target resource and training allocation. Furthermore, the implementation of effective HIS provides effective and immediate disease surveillance, commensurate with the WHO/MoHS plan to implement IDSR nationally.

Secondary benefits include increased integration of community health networks and established health facilities, increased trust and access to health facilities by local populations, increased oversight and accountability of health facilities via automated health facility reports

delivered to the DMO and Medical Superintendent (MS), and the provision of sustainable electronic infrastructure to all health facilities. Additional secondary benefits include the ability for a health facility to efficiently track and communicate needs for drugs and medical supplies, and the ability to immediately communicate any other concern to the DHMT.

A review of 34 articles on such systems by Harvard researchers in the *Journal of Maternal and Child Health* found “the integration of mobile health for... health services has demonstrated positive outcomes.”¹⁴³ Other research at the Swiss Tropical and Public Health Institute finds such a system is a “low cost method of addressing certain health system needs in developing countries, [including] for disease prevention [and] surveillance... [and] in general, [are] well accepted by the population.” Such systems have been found to be effective responses to managing disease surveillance in disaster prone areas,¹⁴⁴ and provide great promise in pandemic surveillance in developing countries.¹⁴⁵ In short, such a system is “an appropriate and promising tool for disease control interventions in developing countries.”¹⁴⁶

Routine reporting and analysis would exist per Figure 38. Significant event response structure, following the indication of a significant event by the HIS architecture, would exist per Figure 39. The combination of routine data collection and analysis with an effective significant event response framework substantiates the full realization of IDSR and HIS in Sierra Leone, and would provide material benefit to Sierra Leone’s health infrastructure and citizens.

¹⁴³ Tamrat, Tigest, and Stan Kachnowski. “Analysis of mHealth in Maternal and Newborn Health Programs and Their Outcomes Around the World.” *Maternal and Child Health Journal*, 2012.

¹⁴⁴ Yang, Changhong, Jun Yang, Xiangshu Luo, and Peng Gong. “Use of mobile phones in an emergency reporting system for infectious disease surveillance after the Sichuan earthquake in China”. *Bulletin of the World Health Organization*, 2009.

¹⁴⁵ Li, Junhua, N Moore, S Akter, and S Bleisten. “mHealth for Influenza Pandemic Surveillance in Developing Countries”. Asia Pacific Ubiquitous Healthcare Resource Centre, University of New South Wales, 2010.

¹⁴⁶ Deglise, Carole, L Suzanne Suggs, and Peter Odermatt. “SMS for disease control in developing countries: a systematic review of mobile health applications.” *Journal of Telemedicine and Telecare*, the Royal Society of Medicine Journals, and the Swiss Tropical and Public Health Institute, 2012.

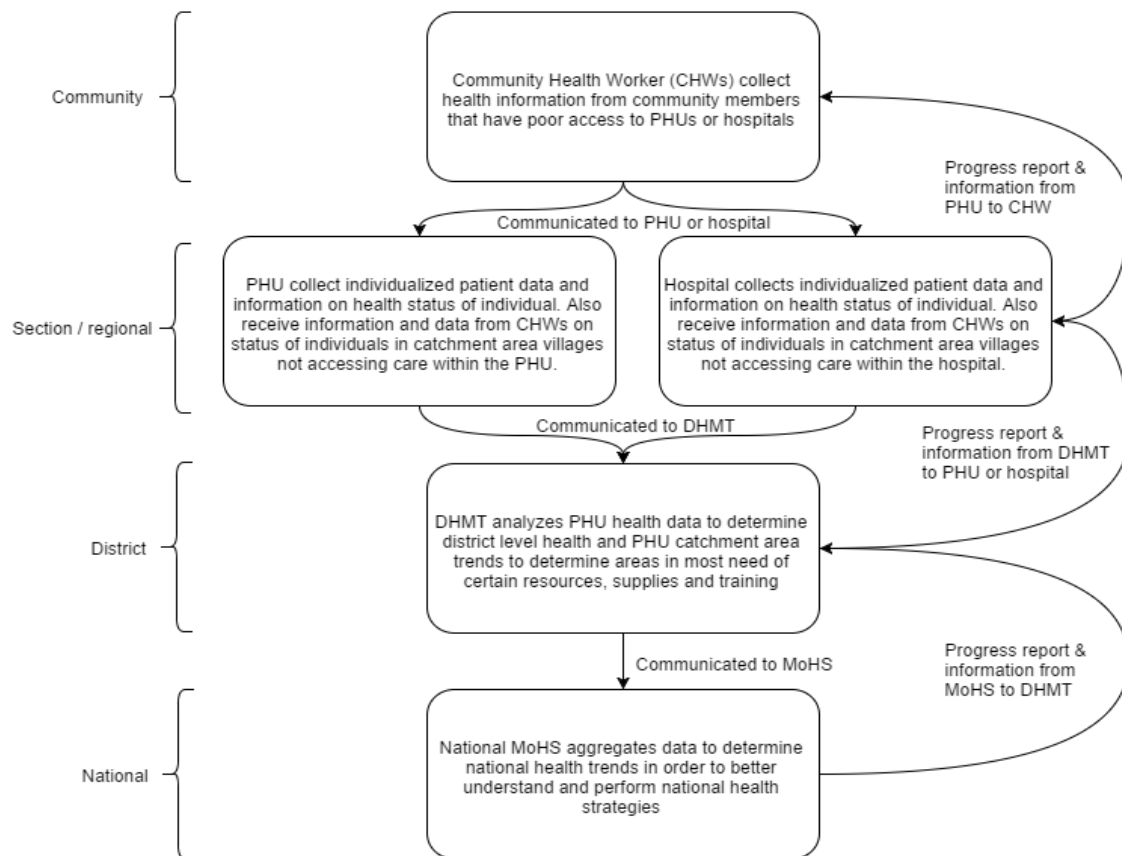


Figure 38: Routine reporting and analysis (Image source: Author)

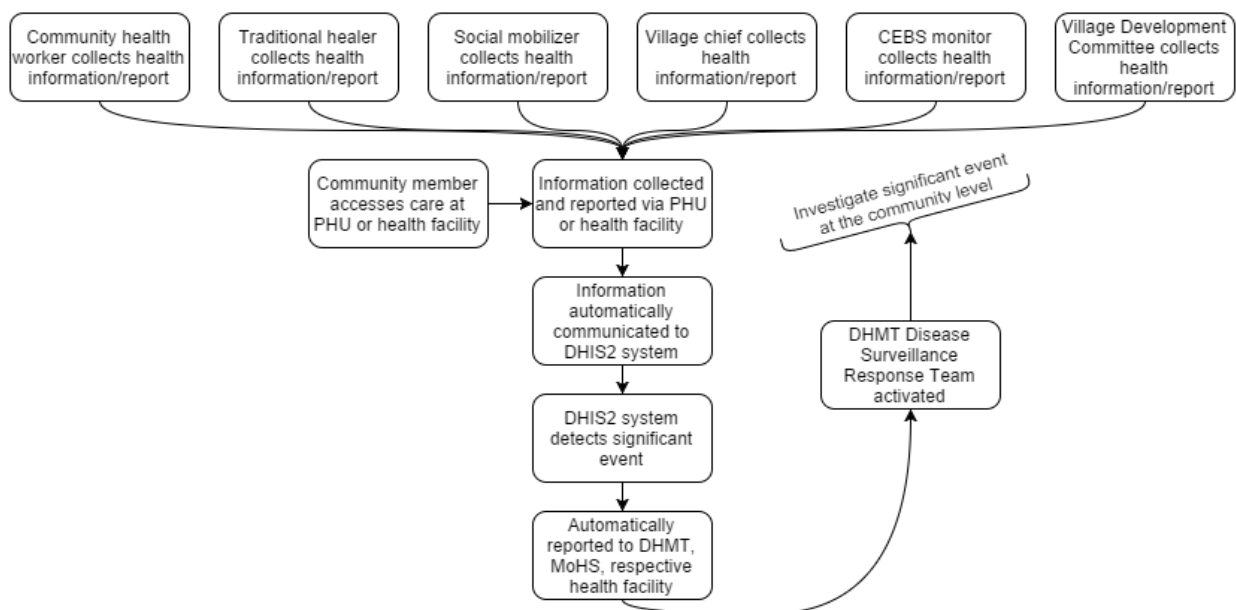


Figure 39: Significant event response structure (Image source: Author)

CONCLUSION

The West Africa EVD Epidemic exacted an incredible toll on Sierra Leone and West Africa. Close to 12,000 lives were lost, and probably many more. Thankfully, while the outbreak is not yet over, it shows no signs of re-appearing with the severity it once had. Following the WHO's late PHEIC declaration, the international community scrambled – admirably – to respond to what was now, officially, an international emergency. Response structure was put in place in October, 2014 in the form of the NERC and constituent DERCs, though it took several months longer for most ETCs to come online and give that response structure any outlet. As international support and aid ramped up, cases crept down. For this, the international community, despite their blunders, deserve enormous credit for supporting the Sierra Leonean people who were the foundation of the response.

However, these blunders demand investigation and analysis. Most significantly, delegation of logistical and operational management of surveillance to the WHO, an advisory body, did little to resolve the needs of the West Africa EVD Epidemic's first responders. Indeed, this environment created many of the challenges most significant to DSOs in Port Loko and Kambia Districts of Sierra Leone. The most immediately resolvable problems – DSO work fatigue and pay – were of little interest to the WHO, an organization with no budget beyond what it could spend on itself. Nevertheless, between Fall 2014 and Spring 2015, the WHO carved out the political clout required to resolve such problems. Subsequently, they actively blocked others' attempts to address DSO challenges as an encroachment on WHO authority. The issues of staff fatigue and pay were only resolved when DFID unilaterally supported ONP in the summer of 2015, but it was far too little and late. For most of the outbreak, DSO morale and work efficiency was significantly curbed as a result. This, in turn, arguably delayed the end of the worst outbreak of EVD in history. At the least, it failed to confer the dignity so deserved by the heroic Sierra

Leonean DSOs in Port Loko and Kambia. Mission creep, duplicative management structures, lack of horizontal response integration, and the inclusion of incompetent organizations further stained and retarded the response. In some cases, such as with PIH in Port Loko, these failures directly resulted in patient death.

Beyond this lies a much deeper need, which demands discussion and deserves the concluding thought of this paper. The little health infrastructure that did exist in Sierra Leone was largely destroyed through years of civil war in the 1990s and early 2000s. It has been unrepaired, unsupported, and undeveloped in the years before, during, and since the conflict. While cases of EVD dwindle, the widespread and unnecessary loss of life in Sierra Leone from other preventable maladies persists. Deaths from malaria, tuberculosis, measles, childbirth, malnutrition, and diarrhea devastate the country and continent. Millions die from curable and treatable disease each year. The sheer magnitude of this avoidable human tragedy unfolding throughout much of our world is difficult to grasp. But it cannot be ignored, for without significant international attention and investment this catastrophe will continue unabated, and in Sierra Leone, EVD will return.¹⁴⁷

As we have seen with Zika and others, such outbreaks will become increasingly common, increasingly devastating, and increasingly expensive, without effective local containment that presupposes substantial and effective health infrastructure worldwide. Africa, South East Asia, and the broader Global South are no longer in the shadows: new roads, air travel, and other developments have removed the veneer of seclusion and forced the Global North to reconcile and grapple with a fundamentally connected world, including the world of disease.

¹⁴⁷ Marie Wolfrom, "Veteran scientist warns 'Ebola will return'," *Business Insider*, May 30, 2015, accessed February 20, 2016, <http://www.businessinsider.com/afp-ebola-will-return-veteran-scientist-warns-2015-5>.

More than 12,000 people have died of EVD in West Africa, and millions more from other diseases, not because of unprecedented virulence or because diseases are untreatable, but because the world with money has abandoned the world without. It is imperative that the international support provided to Sierra Leone does not end alongside the EVD outbreak. Massive investment in health systems strengthening, including IDSR and HIS architecture, must be created in Sierra Leone and across the developing world. Simple IPC improvements and basic infrastructural needs, like running water and electricity in hospitals, must be met.

This is no small feat, and will require a fundamental change in the distribution of global wealth and prioritization of commitments by the international community. However, while “mixing politics into public health makes for uncomfortable conversation, we can’t prevent another catastrophe without having that conversation.”¹⁴⁸ Only in doing so will we realize the dignity and right to health that we so frequently espouse for all the citizens of our global human family.

¹⁴⁸ “The Ebola Lessons Reader: What’s being said, what’s missing and why it matters.”

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APPENDICES

Ebola Virus Disease Surveillance in Port
Loko, Sierra Leone

DISTRICT SURVEILLANCE OFFICER
QUESTIONNAIRE

APPENDIX A: SURVEY

Background

1. What is today's date?

Day: ___ Month: _____ Year: _____

2. Are you, or have you ever been, a surveillance officer in the Ebola response?

Yes No

3. What month and year did you become a surveillance officer?

Month: _____ Year: _____

4. Are you still working as a surveillance officer?

Yes No

5. If you answered "No" to Question 4, what month and year did you stop being a surveillance officer? If you answered "Yes" to Question 4, please skip this question.

Month: _____ Year: _____

6. What is your title? Are you a

CHA CHO SECHN EHO EDCU

MCHA Other (please write): _____

APPENDIX A: SURVEY

Challenges

This section will ask you about challenges you faced during the Ebola outbreak. For each item, please indicate on the scale below how challenging this thing was.

7. How much were bad roads challenging to your work as a surveillance officer?

- | | | | | |
|--------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Not challenging | A little bit
challenging | Challenging | Very
challenging | Extremely
challenging |

8. When you starting working as a surveillance officer, how much were problems with vehicles (not having enough vehicles, problems with vehicles breaking down, not having enough fuel, and so on) challenging to your work as a surveillance officer?

- | | | | | |
|--------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Not challenging | A little bit
challenging | Challenging | Very
challenging | Extremely
challenging |

9. Today, how much are problems with vehicles (not having enough vehicles, problems with vehicles breaking down, not having enough fuel, and so on) challenging to your work as a surveillance officer?

- | | | | | |
|--------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Not challenging | A little bit
challenging | Challenging | Very
challenging | Extremely
challenging |

10. How much were problems with communications, phone networks, and phone coverage challenging to your work as a surveillance officer?

- | | | | | |
|--------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Not challenging | A little bit
challenging | Challenging | Very
challenging | Extremely
challenging |

11. How much were problems with salary from NERC challenging to your work as a surveillance officer?

- | | | | | |
|--------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Not challenging | A little bit
challenging | Challenging | Very
challenging | Extremely
challenging |

APPENDIX A: SURVEY

12. How much was being tired and not having enough vacation or days off challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

13. How much were people in the community not telling you the truth challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

14. How much was not having a voice or a say in your activity challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

15. How much was difficulties finding source cases challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

16. How much was generating a line list (contact list) challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

17. How much was difficulty with your investigations challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

APPENDIX A: SURVEY

18. How much were traditional healers (not calling in sickness, not being honest) challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

19. How much were people in the community not going to PHUs or hospitals when they were sick challenging to your work as a surveillance officer?

- Not challenging A little bit challenging Challenging Very challenging Extremely challenging

20. Was there something else that you thought was very or extremely challenging to your work as a surveillance officer?

No: Yes: If yes, what is it? _____

21. If you had to pick the *three most challenging* things, the three things that made your work more challenging than anything else, what would those challenges be?

You can write in your own answer, or, if it is something asked in a question above, you can simply write in the number of that question. For example, if bad roads were one of the three most challenging things, you can just write “Question 7” on the line, because it is Question 7 from before. There is a lot of space for you to answer – you do not need to fill all the space, the space is there in case you want to write a lot about that challenge.

Answer A. One of the three most challenging things was: _____

Answer B. Another of the three most challenging things was: _____

Answer C. Another of the three most challenging things was: _____

APPENDIX A: SURVEY

22. If you can pick, what was the *most* challenging thing of all?

I cannot pick, because the three things I wrote above in Question 19 were all equally challenging

If you can pick, what was the *most* challenging thing of all? Was it what you wrote in Question 19 for Answer A, Answer B, or Answer C?

Answer A in Question 19
was the most challenging
thing of all

Answer B in Question 19
was the most challenging
thing of all

Answer C in Question 19
was the most challenging
thing of all

23. What was the biggest health-related problem facing Sierra Leone during the Ebola outbreak? You can put a number 1, 2, 3, 4, or 5 for each of these things, but can only use each number once. You should give the BIGGEST problem a number “1”, the next biggest problem a number “2”, and so on.

If you would like, you can add your own category. If you do so, please remember that now the answers need to be out of 6 things, not 5. If you do not understand, please ask the person who gave you this survey to help you understand the question.

People getting Ebola was the number _____ biggest health problem facing Sierra Leone during the Ebola outbreak.

Under-five mortality was the number _____ biggest health problem facing Sierra Leone during the Ebola outbreak.

People not trusting PHUs and not going to PHUs when they were sick was the number _____ biggest health problem facing Sierra Leone during the Ebola outbreak.

Maternal mortality was the number _____ biggest health problem facing Sierra Leone during the Ebola outbreak.

The shutdown of health services at PHUs and hospitals was the number _____ biggest health problem facing Sierra Leone during the Ebola outbreak.

Add your own: Another big health problem, the number _____ biggest health problem facing Sierra Leone during the Ebola outbreak, was _____

APPENDIX A: SURVEY

Your thoughts on different organizations

This section asks you about your thoughts and opinions on different organizations and groups that were involved in surveillance in Port Loko. You will be asked the same set of questions about GOAL, CDC, WHO, the DERC, the NERC, the DHMT.

Please remember that everything you write is confidential, and no one working for any of these organizations will look at your surveys. Only Samuel Boland (who does not work for GOAL any more) will see this survey, but he will not know who wrote it. Samuel Boland will not share this survey with anyone else. If you write anything that could identify you, it will not be included in any publicized use of your writing.

Please be as honest and critical as you feel comfortable being. The more honest and critical you are, the better we can learn about your challenges and how things can be made better in the future.

If you do not feel comfortable answering a question, you should feel free to skip the question!

Questions about GOAL

24. How much was GOAL involved in surveillance operations and needs?

- | | | | | |
|---------------------------------------|---|--|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| GOAL was not involved in surveillance | GOAL was only a little involved in surveillance | GOAL was somewhat involved in surveillance | GOAL was very involved in surveillance | GOAL was extremely involved in surveillance |

25. How much did you feel that GOAL cared about you and your work?

- | | | | | |
|--|---|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| GOAL did not care about me and my work | GOAL only cared about me and my work a little | GOAL cared about me and my work somewhat | GOAL cared very much about me and my work | GOAL really really cared about me and my work |

26. Do you feel that GOAL really listened to your opinions?

- | | | | | |
|---|--|---------------------------------------|------------------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| GOAL did not listen to my opinions at all | GOAL only listened to my opinions a little bit | GOAL listened to my opinions somewhat | GOAL listened to my opinions a lot | GOAL listened to my opinions all the time |

APPENDIX A: SURVEY

27. How much support do you feel GOAL gave you to successfully complete your work?

- | | | | | |
|----------------------------------|--------------------------------------|---|-------------------------------|---------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| GOAL did not give me any support | GOAL gave me a little bit of support | GOAL gave me some support but not a lot | GOAL gave me a lot of support | GOAL really really supported me |

28. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|---|--|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for GOAL | There were some international people working for GOAL but not enough | There were the right number of international people working for GOAL | There were too many international people working for GOAL | There were far too many international people working for GOAL |

29. What is something GOAL did very well? Please write in your own words. You can write as much or as little as you want.

30. What is something GOAL could have done better?

Questions about the WHO

31. How much was the WHO involved in surveillance operations and needs?

- | | | | | |
|--|--|---|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The WHO was not involved in surveillance | The WHO was only a little involved in surveillance | The WHO was somewhat involved in surveillance | The WHO was very involved in surveillance | The WHO was extremely involved in surveillance |

APPENDIX A: SURVEY

32. How much did you feel that the WHO cared about you and your work?

- | | | | | |
|---|--|---|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The WHO did not care about me and my work | The WHO only cared about me and my work a little | The WHO cared about me and my work somewhat | The WHO cared very much about me and my work | The WHO really really cared about me and my work |

33. Do you feel that the WHO really listened to your opinions?

- | | | | | |
|--|---|--|---------------------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The WHO did not listen to my opinions at all | The WHO only listened to my opinions a little bit | The WHO listened to my opinions somewhat | The WHO listened to my opinions a lot | The WHO listened to my opinions all the time |

34. How much support do you feel the WHO gave you to successfully complete your work?

- | | | | | |
|-------------------------------------|---|--|----------------------------------|------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The WHO did not give me any support | The WHO gave me a little bit of support | The WHO gave me some support but not a lot | The WHO gave me a lot of support | The WHO really really supported me |

35. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|--|---|---|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for the WHO | There were some international people working for the WHO but not enough | There were the right number of international people working for the WHO | There were too many international people working for the WHO | There were far too many international people working for the WHO |

APPENDIX A: SURVEY

36. What is something the WHO did very well? Please write in your own words. You can write as much or as little as you want.

37. What is something the WHO could have done better?

Questions about the CDC

38. How much was the CDC involved in surveillance operations and needs?

- | | | | | |
|--|--|---|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The CDC was not involved in surveillance | The CDC was only a little involved in surveillance | The CDC was somewhat involved in surveillance | The CDC was very involved in surveillance | The CDC was extremely involved in surveillance |

39. How much did you feel that the CDC cared about you and your work?

- | | | | | |
|---|--|---|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The CDC did not care about me and my work | The CDC only cared about me and my work a little | The CDC cared about me and my work somewhat | The CDC cared very much about me and my work | The CDC really really cared about me and my work |

40. Do you feel that the CDC really listened to your opinions?

- | | | | | |
|--|---|--|---------------------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The CDC did not listen to my opinions at all | The CDC only listened to my opinions a little bit | The CDC listened to my opinions somewhat | The CDC listened to my opinions a lot | The CDC listened to my opinions all the time |

APPENDIX A: SURVEY

41. How much support do you feel the CDC gave you to successfully complete your work?

- | | | | | |
|-------------------------------------|---|--|----------------------------------|------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The CDC did not give me any support | The CDC gave me a little bit of support | The CDC gave me some support but not a lot | The CDC gave me a lot of support | The CDC really really supported me |

42. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|--|---|---|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for the CDC | There were some international people working for the CDC but not enough | There were the right number of international people working for the CDC | There were too many international people working for the CDC | There were far too many international people working for the CDC |

43. What is something the CDC did very well? Please write in your own words. You can write as much or as little as you want.

44. What is something the CDC could have done better?

Questions about the DHMT

45. How much was the DHMT involved in surveillance operations and needs?

- | | | | | |
|---|---|--|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The DHMT was not involved in surveillance | The DHMT was only a little involved in surveillance | The DHMT was somewhat involved in surveillance | The DHMT was very involved in surveillance | The DHMT was extremely involved in surveillance |

APPENDIX A: SURVEY

46. How much did you feel that the DHMT cared about you and your work?

- | | | | | |
|--|---|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The DHMT did not care about me and my work | The DHMT only cared about me and my work a little | The DHMT cared about me and my work somewhat | The DHMT cared very much about me and my work | The DHMT really really cared about me and my work |

47. Do you feel that the DHMT really listened to your opinions?

- | | | | | |
|---|--|---|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The DHMT did not listen to my opinions at all | The DHMT only listened to my opinions a little bit | The DHMT listened to my opinions somewhat | The DHMT listened to my opinions a lot | The DHMT listened to my opinions all the time |

48. How much support do you feel the DHMT gave you to successfully complete your work?

- | | | | | |
|--------------------------------------|--|---|-----------------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The DHMT did not give me any support | The DHMT gave me a little bit of support | The DHMT gave me some support but not a lot | The DHMT gave me a lot of support | The DHMT really really supported me |

49. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|---|--|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for the DHMT | There were some international people working for the DHMT but not enough | There were the right number of international people working for the DHMT | There were too many international people working for the DHMT | There were far too many international people working for the DHMT |

APPENDIX A: SURVEY

50. What is something the DHMT did very well? Please write in your own words. You can write as much or as little as you want.

51. What is something the DHMT could have done better?

Questions about NERC

52. How much was NERC involved in surveillance operations and needs?

- | | | | | |
|---------------------------------------|---|--|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| NERC was not involved in surveillance | NERC was only a little involved in surveillance | NERC was somewhat involved in surveillance | NERC was very involved in surveillance | NERC was extremely involved in surveillance |

53. How much did you feel that NERC cared about you and your work?

- | | | | | |
|--|---|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| NERC did not care about me and my work | NERC only cared about me and my work a little | NERC cared about me and my work somewhat | NERC cared very much about me and my work | NERC really really cared about me and my work |

54. Do you feel that NERC really listened to your opinions?

- | | | | | |
|---|--|---------------------------------------|------------------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| NERC did not listen to my opinions at all | NERC only listened to my opinions a little bit | NERC listened to my opinions somewhat | NERC listened to my opinions a lot | NERC listened to my opinions all the time |

APPENDIX A: SURVEY

55. How much support do you feel NERC gave you to successfully complete your work?

- | | | | | |
|----------------------------------|--------------------------------------|---|-------------------------------|---------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| NERC did not give me any support | NERC gave me a little bit of support | NERC gave me some support but not a lot | NERC gave me a lot of support | NERC really really supported me |

56. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|---|--|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for NERC | There were some international people working for NERC but not enough | There were the right number of international people working for NERC | There were too many international people working for NERC | There were far too many international people working for NERC |

57. What is something NERC did very well? Please write in your own words. You can write as much or as little as you want.

58. What is something NERC could have done better?

Questions about DERC

59. How much was DERC involved in surveillance operations and needs?

- | | | | | |
|---------------------------------------|---|--|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| DERC was not involved in surveillance | DERC was only a little involved in surveillance | DERC was somewhat involved in surveillance | DERC was very involved in surveillance | DERC was extremely involved in surveillance |

APPENDIX A: SURVEY

60. How much did you feel that DERC cared about you and your work?

- | | | | | |
|--|---|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| DERC did not care about me and my work | DERC only cared about me and my work a little | DERC cared about me and my work somewhat | DERC cared very much about me and my work | DERC really really cared about me and my work |

61. Do you feel that DERC really listened to your opinions?

- | | | | | |
|---|--|---------------------------------------|------------------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| DERC did not listen to my opinions at all | DERC only listened to my opinions a little bit | DERC listened to my opinions somewhat | DERC listened to my opinions a lot | DERC listened to my opinions all the time |

62. How much support do you feel DERC gave you to successfully complete your work?

- | | | | | |
|----------------------------------|--------------------------------------|---|-------------------------------|---------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| DERC did not give me any support | DERC gave me a little bit of support | DERC gave me some support but not a lot | DERC gave me a lot of support | DERC really really supported me |

63. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|---|--|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for DERC | There were some international people working for DERC but not enough | There were the right number of international people working for DERC | There were too many international people working for DERC | There were far too many international people working for DERC |

64. What is something DERC did very well? Please write in your own words. You can write as much or as little as you want.

APPENDIX A: SURVEY

65. What is something DERC could have done better?

Questions about the British forces (the British military and DERC Team Leader)

66. How much were the British forces involved in surveillance operations and needs?

- | | | | | |
|--|--|---|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The British forces were not involved in surveillance | The British forces were only a little involved in surveillance | The British forces were somewhat involved in surveillance | The British forces were very involved in surveillance | The British forces were extremely involved in surveillance |

67. How much did you feel that the British forces cared about you and your work?

- | | | | | |
|--|---|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The British forces did not care about me and my work | The British forces only cared about me and my work a little | The British forces cared about me and my work somewhat | The British forces cared very much about me and my work | The British forces really really cared about me and my work |

68. Do you feel that the British forces really listened to your opinions?

- | | | | | |
|---|--|---|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The British forces did not listen to my opinions at all | The British forces only listened to my opinions a little bit | The British forces listened to my opinions somewhat | The British forces listened to my opinions a lot | The British forces listened to my opinions all the time |

APPENDIX A: SURVEY

69. How much support do you feel the British forces gave you to successfully complete your work?

- | | | | | |
|--|--|---|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The British forces did not give me any support | The British forces gave me a little bit of support | The British forces gave me some support but not a lot | The British forces gave me a lot of support | The British forces really really supported me |

70. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|---|--|--|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for the British forces | There were some international people working for the British forces but not enough | There were the right number of international people working for the British forces | There were too many international people working for the British forces | There were far too many international people working for the British forces |

71. What is something the British forces did very well? Please write in your own words. You can write as much or as little as you want.

72. What is something the British forces could have done better?

APPENDIX A: SURVEY

Questions about RSLAF

73. How much was RSLAF involved in surveillance operations and needs?

- | | | | | |
|--|--|---|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RSLAF was not involved in surveillance | RSLAF was only a little involved in surveillance | RSLAF was somewhat involved in surveillance | RSLAF was very involved in surveillance | RSLAF was extremely involved in surveillance |

74. How much did you feel that RSLAF cared about you and your work?

- | | | | | |
|---|--|---|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RSLAF did not care about me and my work | RSLAF only cared about me and my work a little | RSLAF cared about me and my work somewhat | RSLAF cared very much about me and my work | RSLAF really really cared about me and my work |

75. Do you feel that RSLAF really listened to your opinions?

- | | | | | |
|--|---|--|-------------------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RSLAF did not listen to my opinions at all | RSLAF only listened to my opinions a little bit | RSLAF listened to my opinions somewhat | RSLAF listened to my opinions a lot | RSLAF listened to my opinions all the time |

76. How much support do you feel RSLAF gave you to successfully complete your work?

- | | | | | |
|-----------------------------------|---------------------------------------|--|--------------------------------|----------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RSLAF did not give me any support | RSLAF gave me a little bit of support | RSLAF gave me some support but not a lot | RSLAF gave me a lot of support | RSLAF really really supported me |

APPENDIX A: SURVEY

77. Were there too many international people in the organization, that is, would the organization have been better at supporting surveillance if there were more Sierra Leoneans in the organization?

- | | | | | |
|--|---|---|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| There were no international people working for RSLAF | There were some international people working for RSLAF but not enough | There were the right number of international people working for RSLAF | There were too many international people working for RSLAF | There were far too many international people working for RSLAF |

78. What is something RSLAF did very well? Please write in your own words. You can write as much or as little as you want.

79. What is something RSLAF could have done better?

This is the last question of the survey. I want to thank you so much for participating. If you have anything else you would like to express, you can write on the back of this page.

80. Which organization or agency was most important to you to successfully do your work as a surveillance officer in the Ebola outbreak?

- | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| DHMT | The British forces | GOAL | WHO |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RSLAF | DERC | NERC | CDC |

APPENDIX B: CASE INVESTIGATION FORM (CIF)

EBOLA CASE INVESTIGATION FORM – Sierra Leone

Date of Case Report: DD / MM / YYYY

Outbreak Case ID: **KAM0510511**

Patient is a followed contact: **Convert to CASE in VHF**

Complete at end of interview: suspect probable unk



Patient's Last Name: _____ **First Name:** _____

Age: _____ **Unit:** Years Months **Gender:** Male Female

Patient Status at Time of This Report: Alive Dead **If dead, Date of Death:** _____

Permanent Residence:

Head of Household: _____ **Village/Town:** _____

District: _____ **Chiefdom:** _____ **Mobile phone #:** _____

Patient's Occupation:

Healthcare worker (includes anyone involved with the patient: nurse, ambulance driver, hospital cleaner, etc.)

Position: _____ **Healthcare facility:** _____

Other; please specify occupation: _____

Location Where Patient Became Ill:

Village/Town: _____ **District:** _____ **Chiefdom:** _____

Date Patient First Became Sick: DD / MM / YYYY

Read each one aloud and mark an answer for every symptom occurred during this illness (not only right now):

Fever	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Headache	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Vomiting/nausea	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Difficulty breathing	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Diarrhea	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Difficulty swallowing	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Conjunctivitis (red eyes)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Skin rash	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Intense fatigue/weakness	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Hiccups	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Anorexia/loss of appetite	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Unexplained bleeding	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk
Abdominal pain	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	If yes, please specify: _____			
Muscle pain	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	Other symptoms: <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unk			
Joint pain	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unk	If yes, please specify: _____			

At the time of this report, is the patient hospitalized or being admitted to the hospital? Yes No Unk

If yes, Date of Hospital Admission DD / MM / YYYY

Hospital Name: _____ **District:** _____

Is the patient now, or will he/she soon be, in an Ebola treatment unit? Yes No Unk

If yes, date of admission (or future admission to the ETU (isolation): DD / MM / YYYY

Was the patient hospitalized or visited a clinic previously for this illness (this includes any type of care: pharmacist, traditional healer, etc.)? Yes No Unk

If yes, Dates of Hospitalization: DD / MM / YYYY

Hospital Name: _____ **District:** _____

Uniprint-F SA



APPENDIX B: CASE INVESTIGATION FORM (CIF)

EBOLA Clinical Specimens and Laboratory Testing

Outbreak Case ID: **KAM0510511**

Sample 2

Date of Specimen Collection: / /



Patient's Last Name: _____	First Name: _____
Age: _____ Unit: <input type="checkbox"/> Years <input type="checkbox"/> Months	Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female
Permanent Residence:	
Head of Household: _____	Village/Town: _____
District: _____	Chiefdom: _____
Mobile phone #: _____	
Date Patient First Became Sick: <input type="text"/> / <input type="text"/> / <input type="text"/>	
Specimen/shipping instructions: •Label sample with patient name, date of collection, and case ID •Send sample cold with a cold/ice pack , and packaged appropriately •Collect whole blood in a purple top (EDTA) tube green or red top tubes acceptable if purple not available • Preferred sample volume = 4ml (minimum sample volume = 2ml)	

Unprint-F SA

Has this patient had a sample submitted previously? Yes No Unk

Sample Type: Whole blood Skin biopsy
 Post-mortem heart blood Other specimen type, specify: _____

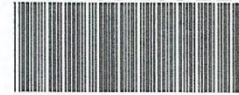
----- TEAR HERE -----

EBOLA Clinical Specimens and Laboratory Testing

Outbreak Case ID: **KAM0510511**

Sample 1

Date of Specimen Collection: / /



Patient's Last Name: _____	First Name: _____
Age: _____ Unit: <input type="checkbox"/> Years <input type="checkbox"/> Months	Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female
Permanent Residence:	
Head of Household: _____	Village/Town: _____
District: _____	Chiefdom: _____
Mobile phone #: _____	
Date Patient First Became Sick: <input type="text"/> / <input type="text"/> / <input type="text"/>	
Specimen/shipping instructions: •Label sample with patient name, date of collection, and case ID •Send sample cold with a cold/ice pack , and packaged appropriately •Collect whole blood in a purple top (EDTA) tube green or red top tubes acceptable if purple not available • Preferred sample volume = 4ml (minimum sample volume = 2ml)	

Unprint-F SA

Has this patient had a sample submitted previously? Yes No Unk

Sample Type: Whole blood Skin biopsy
 Post-mortem heart blood Other specimen type, specify: _____

APPENDIX C: EBOLA BYLAWS



MINISTRY OF LOCAL GOVERNMENT & RURAL DEVELOPMENT
NATIONAL COUNCIL OF PARAMOUNT CHIEFS
BYELAWS FOR ALL CHIEFDOMS IN SIERRA LEONE



BYELAWS FOR THE PREVENTION OF EBOLA AND OTHER DISEASES

The following Byelaws on the Prevention of Ebola and other Diseases are approved by the Honorable Minister of Local Government and Rural Development and made pursuant to the Public Health Emergency declared by the President of the Republic of Sierra Leone and approved by Parliament on Friday 8th August 2014 under section 29 of the Constitution of Sierra Leone Act No. 6 of 1991.

The Byelaws shall come into force on the 12th day of August 2014

1. Communication of Ebola

Section 1: No one should keep or harbour any person suspected of having contracted the Ebola virus disease. Nobody shall conceal any person who is sick from any disease. All illness must be reported to competent health authorities promptly. Any breach of these provisions is liable to a fine of up to Five Hundred Thousand Leones (Le.500, 000) and/or a term of Six (6) months imprisonment.

Section 2: All strangers arriving in any residential area shall be immediately reported by their host, guest house or hotel to the competent chiefdom authorities having the rank of at least a Paramount Chief, Speaker, Section Chief, Sub-Chief or Village Chief. Any person who knowingly harbours an unregistered stranger is liable to a fine of up to Five Hundred Thousand Leones (Le.500, 000) and/or a term of Six (6) months imprisonment.

Section 3: It is an offence under this Bye-law to distort or send any misleading information on Ebola virus disease or other diseases. Any information on Ebola or other diseases must be geared towards the prevention and control of Ebola or the said disease. Any breach of this provision is liable to a fine of up to Five Hundred Thousand Leones (Le.500, 000) and/or a term of Six (6) months imprisonment.

2. Treatment of Ebola Patients

Section 4: The Government Hospitals, Peripheral Health Units (PHUs) or hospitals or treatment centres approved by Government for the treatment of the Ebola virus disease and other contagious diseases shall be the only recognized facilities for the treatment of these diseases. No person (including herbalists and 'pepper doctors') shall offer or be involved in the treatment of a patient for the Ebola virus disease or other contagious disease at home. Any breach of this provision is liable to a fine of up to Five Hundred Thousand Leones (Le.500, 000) and/or a term of Six (6) months imprisonment, and loss of professional certificate where applicable.

Section 5: Any person who is suspected of having contracted the Ebola virus and other contagious diseases shall be quarantined and monitored for twenty one (21) days or more by the appropriate medical personnel and the security forces. Any breach of this provision is liable to a fine of up to Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment.

Section 6: All patients successfully treated for the Ebola virus and other contagious diseases shall, on return to their home communities, report and present their Discharge Cards to the Paramount Chief. Any former patient who fails to do so shall be liable to a fine of up to One Hundred Thousand Leones (Le. 100,000)

Section 7: Patients treated and recovered from Ebola Virus and other contagious diseases shall be welcomed within their communities without any stigma. Any person who acts in a way that intends to stigmatise a recovered patient shall be liable to a fine of up to Two Hundred Thousand Leones (le. 200,000)

3. Death and Burial

Section 8: All deaths must be reported to the appropriate chiefdom authority, Paramount Chief, Section Chief, Sub-Chief or Village Chief. It is an offence under this Byelaw for any person to be involved in the burial of the dead without the permission from the Paramount Chief, Section Chief, Sub-Chief or Village Chief. Any breach of these provisions is liable to a fine of Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment.

APPENDIX C: EBOLA BYLAWS

Section 9: All washing of the dead is prohibited without a permit from the Paramount Chief, Section Chief, Sub-Chief or Village Chief in consultation with the relevant health authority. Any breach of this provision is liable to a fine of Five Hundred Thousand Leones (Le.500, 000) and /or a term of Six (6) months imprisonment.

Section 10: No cemetery worker or community grave digger shall allow or permit anyone to be buried without the permission of the Paramount Chief, Section Chief, Sub-Chief, Village Chief or the Local Council where applicable. Any breach of this provision is liable to a fine of Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment.

Section 11: All Funeral Rites including wakes, 3rd day, 7th day, 40th day and other ceremonies, are suspended until such time when the temporary ban has been lifted by the appropriate authority. Any breach of this provision is liable to a fine of Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment.

4. Miscellaneous Provisions

Section 12: All secret societies and initiations are prohibited by this bye-law until such time when the temporary ban has been lifted by the appropriate authority. All forms of circumcision for fowl (fo) is outlawed. Any breach of these provisions is liable to a fine of Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment for both the initiator and parent/guardian of the child.

Section 13: All hunting or sale of any bush meat in the chiefdom or locality is prohibited until such time when the temporary ban has been lifted by the appropriate authority. Any breach of this provision is liable to a fine of Two Hundred Thousand Leones (Le.200, 000) and confiscation of the said meat by the Paramount Chief/Sub-Chiefs /Section Chiefs /Village Chiefs who must destroy the meat immediately.

Section 14: All Lumas/Doweis and public gatherings are prohibited until such time when the temporary ban has been lifted by the appropriate authority. Any breach of this provision is liable to a fine of Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment.

Section 15: It is an offence for any unauthorized person to move in or out of a quarantined area, or for any means of transportation (e.g. boats, lorries, cars or bikes) to enter or leave without the permission of the relevant authority. Any breach of this provision is liable to a fine of up to Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment.

Section 16: All public places, including places of worship, mosques, churches, temples shall endeavor to have buckets with chlorinated water or soap available for visitors and worshippers to wash their hands before entering.

Section 17: Any public official, including but not limited to officials of government, local government or chiefdom or law enforcement officers, who impedes the application or enforcement of any of these Byelaws shall be guilty of an offence. Any breach of this provision is liable to a fine of Five Hundred Thousand Leones (Le.500, 000) and / or a term of Six (6) months imprisonment, and the official shall be reported to the appropriate authority.

Section 18: All Paramount Chiefs, Section Chiefs, Sub-Chiefs, Town Chiefs, Village Chiefs and their Speakers shall ensure strict compliance with the provisions of these Byelaws within their locality. Any chief who has been found negligent in the application and enforcement of these Bye-laws is liable to a fine of Five Hundred Thousand Leones (Le.500,000) and / or summary suspension from office.

Section 19: Notwithstanding the fines and other punishment set out for offences under these Byelaws, chiefdom authorities retain the right to pursue legal action in the Local Courts or courts of higher jurisdiction, for flagrant violations of these Bye laws.

Signed this 11th day of August 2014



Hon. Finda Diana Konomanyi Kabba

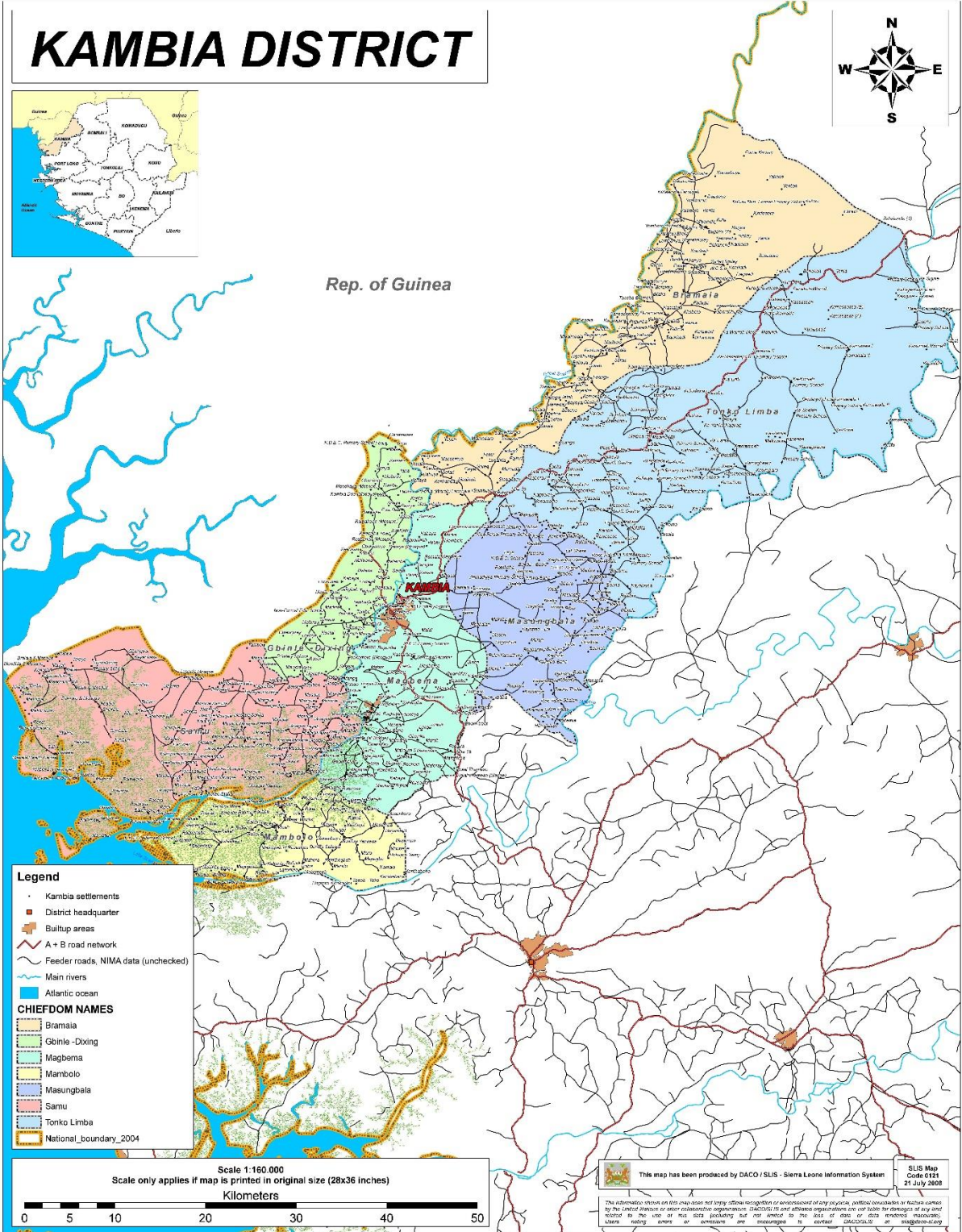
Minister of Local Government &
Rural Development



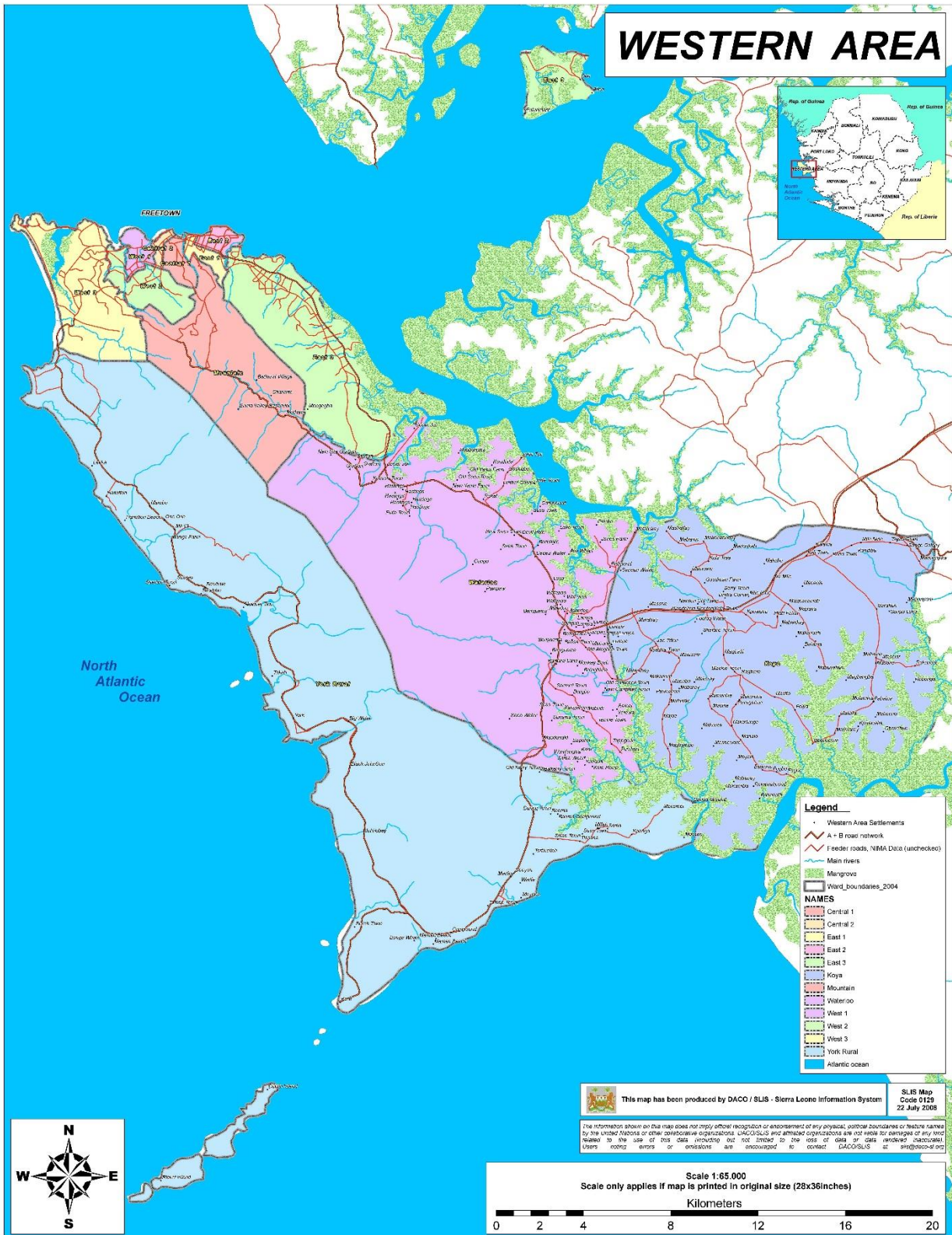
P.C. Charles Caulker, Chairman

National Council of Paramount
Chiefs

APPENDIX D: MAPS OF PORT LOKO DISTRICT, KAMBIA DISTRICT, AND WESTERN AREA



APPENDIX D: MAPS OF PORT LOKO DISTRICT, KAMBIA DISTRICT, AND WESTERN AREA



APPENDIX E: KAMBIA SURVEILLANCE STANDARD OPERATING PROCEDURE

March 16, 2015
Samuel Boland
Surveillance Liaison Officer, GOAL

Kambia Centralized Surveillance

Standard Operating Procedure for daily activities

Newly proposed centralized surveillance teams will operate in Kambia alongside chiefdom-level district surveillance officers (DSOs) to ensure effective and efficient case investigation throughout the Kambia district. These new centralized teams (hereafter 'surveillance teams') will consist of:

1. Driver
2. Case Investigator / Team Leader
3. Sprayer / Line Lister
4. Swabber
5. Social Mobilizer

As this model is in many ways new or an adaptation of existing structures, GOAL proposes the following SOP for daily operations of surveillance teams.

Expected daily activity: overview

Surveillance teams assemble at Kambia District Ebola Response Centre (hereafter 'DERC') at 0800 daily. 0745 – 0815 surveillance teams receive food distribution (breakfast and lunch) facilitated and supported by GOAL. During this time surveillance teams also receive any overnight death and sick alerts from DERC/alerts deks. From 0815 – 0845 the CDC/WHO epi teams will brief surveillance teams on daily operations and ensure any questions and concerns are responded to, blank case investigation forms (CIFs) are distributed, etc. During this time surveillance teams will liaise with the contact tracing supervisor (CTS) for their assigned chiefdom to inform them of their expected activity and follow up on any concerns from CTSs from the previous day. Surveillance teams deploy from the DERC at 0845 to their assigned chiefdom.

Surveillance teams first check in with chiefdom-level DSOs at their respective primary health units (PHUs) to address any concerns and update chiefdom-level DSOs on their expected activity. If PHU responsibilities permit, the chiefdom-level DSO will follow the surveillance teams to their death and live alerts.

Surveillance teams are responsible for addressing all daily death and live alerts and performing case investigation at each. Surveillance teams are responsible for prioritizing live alerts, followed by death alerts, followed by re-investigation and re-line listing of households with positive blood and swab results. If at any time a surveillance team believes they will not be able to respond to each live and death alert they have been assigned, they must *immediately* inform the officer in charge (OIC) of surveillance so the OIC can dispatch a surge team. If a surveillance team has no alerts or positive labs to address, they are responsible for following the low-transmission SOP.

The surveillance team should report back to DERC for 1700 after action review (AAR). *If the surveillance team has pending alerts, the surveillance team is not responsible for returning on time for AAR. The*

APPENDIX E: KAMBIA SURVEILLANCE STANDARD OPERATING PROCEDURE

surveillance team prioritizes pending alerts over the AAR. The AAR runs from 1700 – 1830 and is conducted by WHO/CDC epi teams. Dinner or snacks / refreshments will be provided by GOAL.

During a live alert

1. The surveillance team liaises with the chiefdom-level DSO. PHU commitment providing, the chiefdom-level DSO will attach themselves to the surveillance team for daily operations.
2. The surveillance team calls the assigned contact tracing supervisor en route to their respective alert. If possible, the surveillance team should liaise with contact tracing supervisor or assigned contact tracer at the point of case investigation to ensure the contact tracing network is primed for potential future contact tracing.
3. The surveillance team stops at the house of the village head man to inform them of their expected activity in his village. If possible, the village head man should join the surveillance team during their investigation. If the village head man is not available the surveillance team should continue with step 4.
4. The surveillance team parks at the village head man's house. The driver and swabber remains with the vehicle. The surveillance team continues to household under investigation on foot.
5. The surveillance team approaches the household under investigation.
6. Social mobilizer is responsible for dispersing any crowds or gathering people (before and during case investigation).
7. The surveillance team asks to speak with the head of household, introduces themselves and informs the head of household of their purpose and the individual in question. The head of household should assist in identifying the sick individual. If the head of household cannot or will not assist in identifying the sick individual, the village head man should provide assistance and support.
8. The case investigator / team leader and chiefdom-level DSO conducts a case investigation. If patient meets case definition, this includes completing *all* of the following in block (capital) letters:¹
 - a. Original CIF form in its entirety
 - b. Photocopied CIF form in its entirety
 - c. *Both* lab slips
9. **If case investigator / team leader and chiefdom-level DSO decides patient meets case definition during case investigation**
 - a. Case investigator / team leader calls DERC for ambulance dispatch and to inform DERC surveillance liaison of activity.
 - b. Case investigator provides ORS (*to be performed by chiefdom-level DSO if available*) and then continues case investigation.
 - c. Sprayer / line lister line lists contacts while case investigator continues case investigation. Line listed contacts should include all residents of the sick individual's household *and all other reported contacts*. A line list should never consist of only *intrahousehold contacts*.
 - d. Social mobilizer liaises with any community based social mobilization representative to inform them of what is happening, why an ambulance is coming, and to perform

¹ See CIF and line list process flow diagram

APPENDIX E: KAMBIA SURVEILLANCE STANDARD OPERATING PROCEDURE

proactive education for the household under investigation regarding social distancing, the importance of calling in to 117 if any one falls ill or dies, etc.

- e. Once sprayer / line lister has completed their line listing, the sprayer / line lister should decontaminate the bed space occupied by the suspect Ebola patient.
- f. The surveillance team thanks the family for their cooperation and informs them of an estimated time of arrival for the ambulance team. If known, the surveillance team provides the name, location and contact information for the facility to which the patient is being evacuated.
- g. *If the ambulance has not arrived before the completion of investigation, line listing and decontamination*, the surveillance team asks the village head man to remain with the family until the arrival of the ambulance. The case investigator/ line lister leaves the *original CIF form and both lab slips* with the village head man (or ambulance driver, if it arrives on time). The case investigator holds onto the photocopied CIF form and the line list. The surveillance team provides their contact information for the village head man and the head of household for the household under investigation.
- h. The sprayer sprays the bottoms of the shoes of all surveillance team members.
- i. The surveillance team returns to their vehicle and moves to their next alert. If next alert is death alert, the surveillance team calls/liases with the burial team.

10. **If case investigator / team leader decides patient does not meet case definition during case investigation**

- a. Case investigator / team leader calls DERC for non-Ebola ambulance dispatch (if need be) and to inform DERC surveillance liaison of activity.
- b. Case investigator / team leader provides ORS and ceases case investigation (*to be performed by chiefdom-level DSO if available*).
- c. Case investigator tears CIF pack in half and disposes before returning to DERC.
- d. Social mobilizer talks with head of household and village head man to inform them that the patient does not meet case definition for Ebola. Social mobilizer and the rest of the surveillance team thanks the household and the village head man for their cooperation with Ebola response activities.
- e. *If available and if need be*, chiefdom-level DSO remains to provide necessary care while waiting for ambulance (if ambulance is needed) or for referral / guidance moving forward.
- f. The surveillance team returns to their vehicle and moves to their next alert. If next alert is death alert, the surveillance team calls/liases with the burial team.

During a death alert

1. Repeat steps 1-8 as listed above under 'During a live alert'. Edit step 4: the swabber does not wait with the vehicle and joins the surveillance team to the household under investigation.² In addition, as soon as a surveillance team is aware of a death alert they should immediately call/liase with the respective burial team.
2. *Before anyone dons personal protective equipment (PPE)*, the case investigator takes KAM stickers from the CIF and places one on each of the following:

² Note: the burial team should not conduct a burial or initiate burial / body movement until the surveillance team and swabber have investigated the case and taken a swab, respectively.

APPENDIX E: KAMBIA SURVEILLANCE STANDARD OPERATING PROCEDURE

- a. Sample tube (being careful not to cover the existing sticker)
 - b. Primary biohazard bag
 - c. Secondary biohazard bag
3. Case investigator writes the name, age, and gender of the corpse on the label on the lab tube
 4. Social mobilizer liaises with any community based social mobilization representative to inform them of what is happening and to perform proactive education for the household under investigation regarding social distancing, the importance of calling in to 117 if any one falls ill or dies, etc.
 5. Swabber and sprayer assist one another in donning PPE.
 6. During swab process, case investigator continues case investigation and completes line list.
 7. Swabber and sprayer approach body. *The sprayer does not spray the body or area yet.*
 8. Swabber conducts swab under the oversight of the sprayer and appropriately packages swab with support of sprayer.³
 9. Sprayer decontaminates the space around the body. Sprayer decontaminates body.
 10. Sprayer and swabber exit household / site of death. Sprayer assists swabber doff PPE and vice-versa.
 11. *If chiefdom-level DSO is available* Chiefdom-level DSO returns swab, original CIF and lab slips to DERC for transfer to lab. The case investigator holds on to the CIF photocopy and original line list.
 12. The surveillance team thanks the family for their cooperation and informs them of an estimated time of arrival for the burial team.
 13. The sprayer sprays the bottoms of the shoes of all surveillance team members
 14. The surveillance team returns to their vehicle and moves to their next alert. If next alert is death alert, the surveillance team calls/liaises with the burial team.

Intra-DERC communication

Given the new process of attaching swabbers to surveillance teams (versus their attachment to burial teams), there is the necessary integration of surveillance and dead body management pillars. As such, the OICs for surveillance and dead body management will need to consistently and efficiently communicate and coordinate to ensure the timely response to all alerts. Key points include: 1) a morning discussion between the respective OICs regarding overnight sick and live alerts 2) the immediate communication of any daily sick or death alert between both OICs 3) coordination of chiefdom-based surveillance and burial teams and the *immediate* communication to surge teams if they are needed to efficiently respond to death alerts.

Additional SOPs or process flows relevant to this SOP

- Low transmission SOP
- CIF and line list process flow diagram
- Swab SOP
- Swab data flow

³ See Swab SOP

APPENDIX F: LOW-TRANSMISSION STANDARD OPERATING PROCEDURE

May 2, 2015

Revised SOP for Surveillance Officers: Activities During Periods of Low Ebolavirus Transmission to Strengthen Community-based Surveillance

Background

There has been a drastic decline in the number of Ebola Virus Disease (EVD) cases in Port Loko over the past several months. As a result, the number of alerts is decreasing. At the same time, there is movement nationwide to develop more capacity for community-based surveillance. In considering the reduced number of alerts, in addition to the need to bolster surveillance activities at the community level and verify that all illnesses and deaths are being reported to the DERC, surveillance officers should be spending an increasing proportion of their time on non-case-based activities. The emphases of most of these activities should be related to surveillance officers verifying whether surveillance systems are in place in their chiefdom and mentoring relevant actors to improve their activities.

There are certain activities, outlined below, which should be occurring in all chiefdoms. Other activities may be specific to the needs or unique characteristics of a given chiefdom.

Surveillance officers who work in chiefdoms, in collaboration with the DSO and other partners, will develop a chiefdom-specific plan to verify and strengthen surveillance activities in their chiefdoms. Surveillance managers/mentors, who are now in the practice of reviewing investigations with surveillance officers daily, will also review non-case-based activities to ensure they are being carried out according to the plan. The overall contents of the plan should be reviewed monthly to ensure that all activities are still relevant and in alignment with national and district direction.

Activities to be Carried Out in all Chiefdoms:

1. Each school should be visited a minimum of once per month. These visits should include verification of the following:
 - Thermometer is available and functioning.
 - A surveillance focal person has been identified at the school.
 - A suitable isolation area has been designated.
 - Hand-washing facilities are available and being used.
 - **A five-person management team has been established (per UNICEF request).**
 - There is a log for recording abnormal temperatures. Log should include child/staff name, address, date of abnormal temperature, temperature reading(s), any other symptoms present, and action taken
 - There is an up-to-date and complete attendance registry. A completed registry should have accurate end dates for each week and include the average attendance for each week for each class. Surveillance officers should take note of whether attendance has declined in the last 1-2 weeks. SOs should follow up with PHU nurse, chiefs and other leaders to help ascertain whether an outbreak may be occurring.

Additionally, items to cover during visit:

- Ask school official to explain screening process. Process should meet this standard:

APPENDIX F: LOW-TRANSMISSION STANDARD OPERATING PROCEDURE

- All children and staff are checked before entering the building in the morning. A second check is done in the afternoon.
- Any person with a temperature 38° C or above should be moved to the designated isolation area. Re-check temperature in 20 minutes.
- If the temperature remains $\geq 38^{\circ}\text{C}$ the child should be brought to the PHU. The nurse will determine the appropriate medical action and whether an alert should be called in.
- Ambulances will not be dispatched directly to schools, but only to the PHU after an assessment by the nurse and subsequently, the surveillance team.
- School officials should alert the local PHU of any enrolled student who is absent for ≥ 3 days.
- The surveillance officer should maintain an accurate contact list for all of the school focal persons in his chiefdom.
- Any IPC concerns should be documented. Surveillance managers/mentors should refer details to UNICEF.
- A brief health education talk (~5 minutes) to students or staff may be given quarterly.

2. Visits to PHUs:

- Frequency of Visits:
 - High-priority PHU: weekly; medium-priority PHU: biweekly; low-priority PHU: monthly
 - St. John's Hospital, Lungi Hospital and Port Loko Government Hospital should be visited twice weekly.
- Visits should encompass:
 - Verification that all health care providers can state the case definition for a suspected Ebola case, and that they know all symptoms of the disease.
 - Review of Registers: 1) "Under-fives;" 2) OPD; 3) Emergency Department; and 4) Triage registers.
 - For any patient meeting the case definition of Ebola for whom an alert was NOT called in, the register should indicate that the patient was positive for malaria using an RDT test. SOs should stress that the patient must have confirmed malaria if an alert was not called in. (Note that the SOs will have to train staff to record symptoms in the register because there is no column for this currently.)
 - The PHU must have a process in place that malaria cases are seen after 1 day to verify that they are improving (including home visits as necessary). If charts are available, the SOs should select a few to verify that this is taking place. If patients have not improved and they meet the case definition for suspect Ebola, an alert should be called in. The follow up visit, its outcome and the date must be documented in the register.
 - Determine whether surveillance team and/or 117 was alerted to any patient meeting the definition of a suspect Ebola case who did NOT have a positive RDT for malaria.

APPENDIX F: LOW-TRANSMISSION STANDARD OPERATING PROCEDURE

- Check to see whether an unusually high number of patients were recorded with similar symptoms including diarrhoea, rash, vomiting, jaundice, suggesting a possible disease outbreak. Teams should also ask staff specifically if they are aware of any outbreak in the community. Albert (Carlos) Kamara or another DSO should be advised of these situations so he/she can determine if any follow actions are necessary.
 - Surveillance officers should review the folder that contains the monthly disease reports. They should verify that reports have been filled out, signed by the supervisor and sent each week even when there have been no cases to report.
 - IPC: This will not be the focus of surveillance officers' visit, but they will use the opportunity to ensure that PHU has:
 - A triage outside the building
 - A functioning hand-washing station
 - Functioning thermometer
 - If there are any concerns, the surveillance managers/mentors are responsible to provide the relevant information to the IPC team, led by Dr. George.
 - The SOs will ensure each health facility has a current list of all traditional healers within their catchment population.
3. Private Clinics-
- Surveillance officer should verify if any private clinics in their chiefdom have re-opened. A list should be maintained.
 - Any clinics that have re-opened should be visited twice monthly. At this point, the emphasis should be on developing relationships with the clinics and ensuring staff know the Ebola suspect case definition as well as the SO's contact information. Registers should be reviewed in the same fashion as they are at PHUs.
4. Traditional healers and Traditional Birth Attendants (TBA) **This section of the SOP is not currently being implemented. The effort with traditional healers right now is just to try to get PHUs to create or update the list of healers in their catchment area.**
- Purpose of visit is to establish rapport and encourage cooperation.
 - Ensure that community leaders have engaged traditional healers and TBAs in their areas.
 - Develop list of traditional healers and TBAs within the chiefdom to include name, address and telephone number.
 - Educate traditional healers and TBAs on Ebola symptoms, the importance of triaging and calling 117 EARLY if anyone is exhibiting signs of Ebola.
 - Educate TBAs on risk of EVD transmission during birth, stress importance of referral of EVD survivors to PHUs/hospitals for delivery (as to reduce risk of EVD transmission).
 - Inform traditional healers that they should deny care for suspected EVD cases, BUT encourage and provide guidance on how to seek appropriate Ebola treatment.
 - SOs should visit traditional healer and TBA every quarter.
5. Silent **Sections**

APPENDIX F: LOW-TRANSMISSION STANDARD OPERATING PROCEDURE

- Meet with paramount chiefs and section chiefs. Ask them who has died recently and record them (name, address, nickname, age, gender, age, symptoms upon death, length of illness). If the surveillance team did not know about any of these deaths, they should call DERC to find out if a death alert was called in. If not, then the team should visit the community with the paramount chief or section chief. **Not currently implemented due to complexity of task. Would need specific training and mentoring.**
 - Meet community leaders and PHU staff to verify deaths and discuss barriers to safe and dignified burials.
 - Reference information below general strategies for engaging communities.
 - It will be the responsibility of WHO to identify silent chiefdoms based on the analyses of pre-Ebola mortality rates and the DERC death alert system.
 - Work with CLOs and contact tracers to ensure that CIS/PALMTREES systems are in place and that village-level information is being properly collected.
6. Previous hotspots should be visited monthly. **SO have been asked to de-emphasize this due to other activities being a higher priority.**
- Discuss with the chief and other village elders the structures that are in place to prevent the re-introduction of Ebola or contain it once a suspect case is identified (task force; regular active case search; community watch for visitors; areas designated for isolation).
 - Follow-up with any EVD survivors: sensitize on importance of safe practices during sex due to EVD transmission up to 3 months after recovery.
 - Verify when the most recent social mobilization activities took place. Report absence of activity or other need for assistance to Social Mobilization Desk in the DERC.
 - Visit the contact tracer and verify his/her involvement in prevention and surveillance activities, specifically focusing on completion of CIS activities. Verify with the chief the activities of the contact tracer. The team leader should report any concerns to at the After-action review. Additionally, they can be reported to the Contact Tracing Supervisor at the DHMT.
 - Consider attending a taskforce or other community engagement meeting to assess its effectiveness and to provide encouragement, education, etc.
7. Areas bordering another chiefdom. High-priority border villages (based on location and number of patient visits at PHUs) should be visited monthly to review:
- The system in place for monitoring outsiders coming into the village. Based on the information gathered, we will determine ideal systems for monitoring.
 - The process for reporting ill persons from other areas. (Surveillance officers or 117 should be called, in addition to the relevant stakeholders in the community in the other district.) Ensure that contact information for chiefs and health workers in the nearby communities across the border is known by the SOs and the PHUs.
 - Visit with contact tracers in the area, assess their activities, and provide suggestions that may be unique to that area.
 - Visit any health posts or PHCs on the other side of the border which meet either of these criteria:
 - Facility which is frequently used by Port Loko residents.

APPENDIX F: LOW-TRANSMISSION STANDARD OPERATING PROCEDURE

- Facility is within 2 miles of the border.

Review Ebola case definition. Ensure that staff know the phone numbers of the Port Loko surveillance team. For any suspected Ebola case, the facility should elicit contacts from patient and notify the Port Loko team, in addition to their own district's team.

The following are general activities that should be carried out when conducting surveillance in any community:

- Liaise with community leaders to build supportive relationships that encourage information sharing.
- Communicate with contact tracing coordinators / contact tracers, social mobilization, community liaison officers and youth group representatives. Follow up on any information of concern.
- Communicate with PHU staff to identify any issue of concern.
- Investigate reports of secret burials and other trigger events (e.g. uncovered graves; the use of traditional healers), report immediately to DERC/command team and fill out appropriate template.
- Educate community leaders about EVD and remind them of the importance of calling 117 promptly whenever someone is sick

The activities named above, in addition to others that may be outlined in the chiefdom-specific plans, should be conducted any time a team has finished its alerts for the day. Since these activities are in fact required, surveillance officers should bring to the attention of the surveillance managers/mentors if they are having difficulty accomplishing them due to the number of alerts or other tasks they are being assigned. Managers/mentors should address this with RSLAF staff and others assigning work. Community surveillance activities are not optional, so management must assist to make sure surveillance officers have time to carry them out.

In order to use the surveillance officers most effectively and for their intended purpose, they should be discouraged from conducting activities unrelated to surveillance, such as conducting general health education and vaccination sessions. Managers/mentors should provide feedback as necessary on appropriateness of activities when reviewing the daily work.

This plan should be reviewed and updated as necessary no later than **June 15, 2015**.

APPENDIX G: AFTER-ACTION REVIEW STANDARD OPERATING PROCEDURE

Kambia District Surveillance After-Action Review: Standard Operating Procedures

Background

There is a need for a systematic review of case investigations and other surveillance activities carried out by each surveillance team. In order to disseminate the data and information collected by surveillance teams more effectively, each surveillance team should report back to the DERC at 1630 daily for after-action review (AAR). After-action reviews are held daily at the DERC from 1630 - 1800. *If a team has pending alerts, members are not responsible for returning on time for AAR. The surveillance team prioritizes pending alerts over the AAR.* The leader of each surveillance team is required to attend the AAR. If the leader is unavailable, he should send a delegate except if the entire team is still in the field attending to alerts or other significant EVD surveillance activities.

Format of Meeting

The AAR will be conducted in a group format. Each leader will present the day's investigations the group. In addition, the team will explain any community surveillance activities carried out for the day. Community surveillance activities are explained in detail in the Revised Low Transmission SOP. The group and the facilitators will ask questions and provide feedback to the presenting team. So as to build local capacity, the facilitators should make a special effort to garner input from permanent DHMT staff on the teams, as well as the DSOs.

AAR Facilitation Responsibility

Facilitators from CDC, WHO, DHMT, and GOAL will be assigned to attend the AAR. It is expected that the facilitators have been designated by their agency and will have an on-going commitment to the meeting. A team's facilitators should communicate among themselves to ensure there is always adequate coverage for their team (minimum of two facilitators). Facilitators' on-going commitment to the AAR will foster surveillance officers' commitment to these meetings.

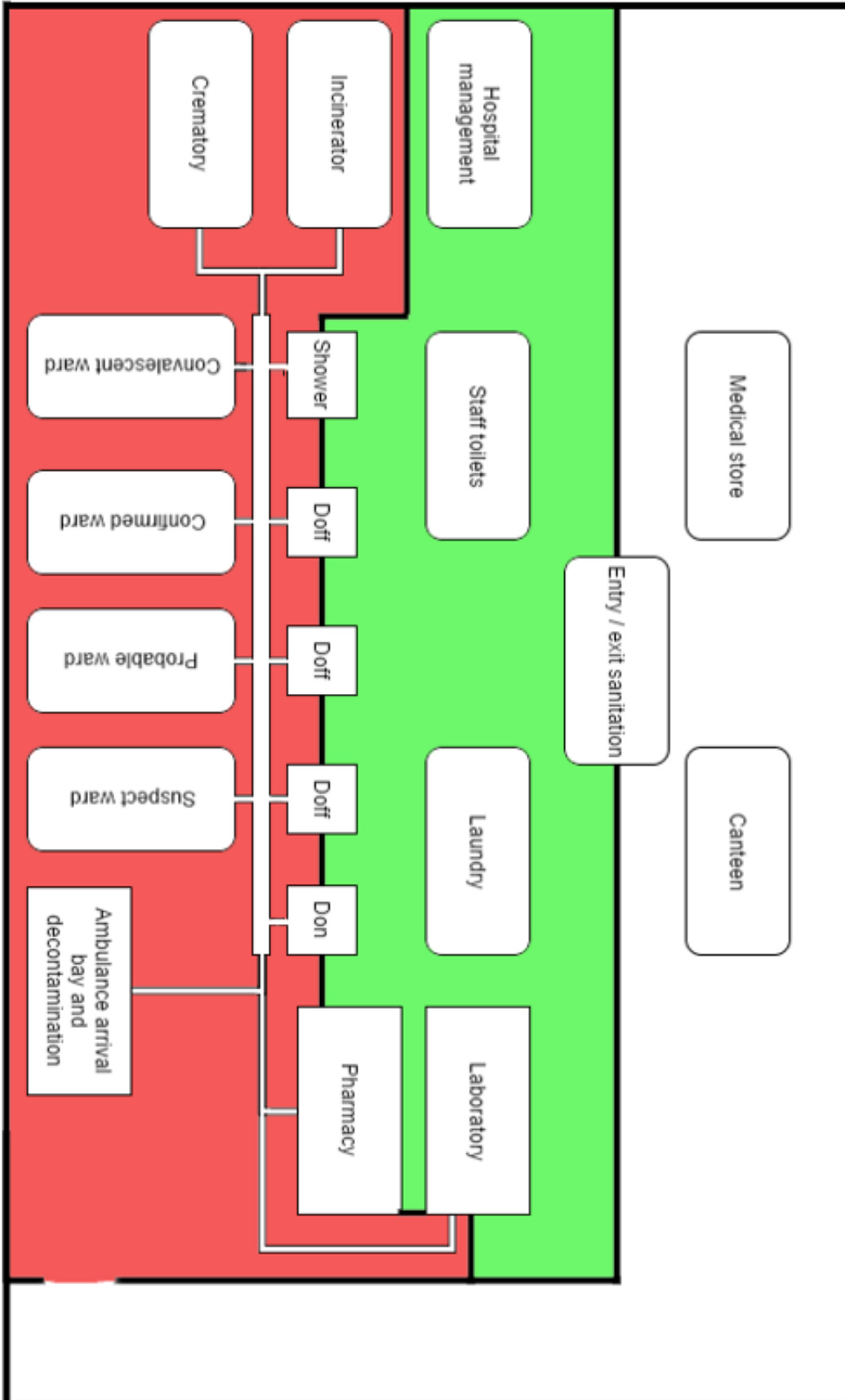
The AAR will focus on the following:

1. Discuss the context of each alert and collect critical epidemiological information including:
 - a. Type of alert – dead or live
 - b. If the alert met case definition or did not meet case definition.
 - c. The team will state any additional symptoms the patient had and a facilitator will record these on the AAR form.
 - d. The immediate action that was taken after the investigation (refer to PHU, request Ebola ambulance or non-Ebola ambulance, etc.)
 - e. Travel history, including throughout their village for social, business, work, as well as travel outside of Kambia to other districts or to Guinea.
 - f. Risk information for which there are no questions on the form: visitors to home; health-care workers who visited patient in home; contact with boyfriend/girlfriend and other friends; other wives; and depending on occupation, co-workers.
 - g. Number of contacts within and outside of the household. Explanation for any deficiencies in the contacts such as an unrealistically low number or an absence of contacts outside the home. As necessary, specific suggestions should be provided on how the contact listing could have been done better.

APPENDIX G: AFTER-ACTION REVIEW STANDARD OPERATING PROCEDURE

- h. If sick alert, ask about community involvement. Was contact monitor present? If village, was chief aware of illness previously? If sick or dead alert and person was a visitor, was the chief previously aware of visitor's presence?
 - i. If patient was in the hospital, was the chart reviewed? What were the symptoms upon presentation? Was the patient inappropriately treated in the health-care facility (as opposed to the ETU)? What feedback was given to the facility?
- 2. Thoroughly reviewing each Case Investigation Form (CIF) to ensure accuracy and completeness.
- 3. Thoroughly reviewing each contact line list to ensure accuracy and completeness.
- 4. Ensure the consistency of the information provided on the CIF and the line list.
- 5. After the team's investigations have been reviewed, members should present the other activities carried out during the day. The facilitators should verify that these activities coincide with the chiefdom plan for community surveillance. Facilitators should likewise provide feedback on these activities, as well as suggestions for the future.

APPENDIX H: EBOLA TREATMENT CENTER DESIGN



APPENDIX I: HIS-IDSR BUSINESS CASE

Justification for expanded use of mobile and tablet technology in Health Information Systems

The Ebola Virus Disease (EVD) outbreak in West Africa highlighted the structural weaknesses of Health Information Systems (HIS), especially in the most impacted countries of Guinea, Liberia, and Sierra Leone. Inadequate resources and structure within Sierra Leone's HIS had allowed Ebola to spread undetected for weeks/months and weak data systems could not keep up with the scale of the outbreak. In order to prevent or contain future disease outbreaks, HIS must be strengthened. An HIS where data can be rapidly aggregated from the lowest levels up through districts to the national levels will go a long way to establishing stronger disease detection and response systems.

Currently paper registers are being used at all Peripheral Health Units (PHUs) All PHU registers are collected by District Monitoring and Evaluation teams once a month and then aggregated into the National District Health Information Systems 2 (DHIS2). The system faces several challenges:

1. Aggregating the paper forms is often cumbersome, time-consuming, and has high susceptibility to user-input error.
2. Because of the challenges to the paper system PHU and general health data is often not comprehensive, incomplete, or not analyzed in a timely manner which delays the use of health data to improve population health.

Mobile technology, more sophisticated data architecture, and database infrastructure is believed to be the key to making a stronger HIS viable. The use of mobile and tablet technology that enhances the existing data architecture and data indicators would reduce the amount of time to aggregate health data and would make it instantly accessible for analysis.

Proposal to strengthen HIS in health facilities and healthcare workers

The GOAL Surveillance team proposes to conduct a pilot project that would strengthen HIS within health facilities and its connections to community health workers. The location of the proposed pilot would be Port Loko district where GOAL has substantial connections to the District Health Management Team (DHMT) as well as in-depth understanding to the health systems data architecture already existent within the district. The proposed pilot would focus on the following:

1. Identifying key health indicators that are collected at each PHU (malaria, respiratory infections, vaccinations, etc.)
2. Establishing proper monthly thresholds and baselines for the identified indicators
3. Establishing a PHU electronic database system specifically designed for mobile and tablet data collection at PHUs that is compatible and connected to Sierra Leone's DHIS2
4. Establishing mobile phone data collection and management systems for community health workers that supplement data being collected at PHUs
 - a. Connecting PHU data with follow-up visits conducted by Community Health Workers
5. Conduct weekly and monthly data analysis to track disease trends

By completing the above objectives, the program will be able to ensure that data around PHU visits and follow-up visits by community health workers are being collected in an accurate and timely fashion. By collecting more accurate and timely health indicator data, the DHMT can more readily identify disease trends that may not be within the normal baselines, thus indicating the need to respond to potential health threats identified through the HIS.

GOAL's comparative advantage in establishing HIS at the district level

APPENDIX I: HIS-IDSR BUSINESS CASE

GOAL has operationalized and supported EVD surveillance in Port Loko District since January 2015 and Kambia District since March 2015. Through providing operational, structural, and strategic technical support GOAL has gained a large and intimate understanding of the flow of information and data through the DHMT, including the data architecture and health data indicators for district health facilities. These relationships and knowledge give GOAL a comparative advantage over other organizations in establishing HIS at the district level.

Program Cost Estimates

Item	Justification	Unit Cost (\$)	Number Required	Frequency	Total Amount (\$)
Android Tablets	Android Tablets for use by 106 PHUs and extras included in case of damages or losses	200	150	1	30000
Smartphones	Smartphones to be used by community health workers to connect community health follow-ups to PHUs. 2 smartphones per PHU (212). Extras included in case of damages or losses	100	250	1	25000
Solar Chargers	Solar chargers required to recharge smart phones and tablets at PHUs. 1 per each of the 106 PHUs. Extras included in case of damages or losses	75	150	1	11250
Sim cards/mobile data plans	Monthly Mobile data plans required to continuously upload data to network into DHIS2 servers	20	318	12	76320
Closed User Group Mobile phone line	Costs of a Closed User Group mobile phone line that allows all persons within the network to call each other without any costs to them. Will allow increased communication flow between PHU leads (106), community health workers (212), program management staff (13)	2000	1	12	24000
Software development	Cost to develop a PHU and community health worker HIS that is interoperable with the National DHIS2 system	50000	1	1	50000
Motorbikes	Each chiefdom level HIS supervisor provided a motorbike for easier transportation. Extras included in case of damages or losses	2000	15	1	30000
Motorbike fuel and maintenance	Monthly fuel and maintenance for motorbikes	150	11	15	24750
HIS Chiefdom supervisor	Monthly salaries for national staff managers for each of the 11 Port Loko chiefdoms - trouble shooting issues at PHUs and with community health workers. Ensuring all units are reporting data and trying to find local solutions to program challenges	500	11	12	66000
HIS Data Manager	Monthly salary for national Staff data manager that assists the HIS program manager to analyze and organize data. Will work closely alongside the DHMT M&E officer	500	1	12	6000
HIS Program Manager	Monthly salary for international staff overall HIS program manager that is responsible for reporting, overall strategic direction and reporting to surveillance team	4200	1	12	50400

APPENDIX I: HIS-IDSr BUSINESS CASE

Training	Training for 106 PHU staff, 212 community health workers on using the smartphone and tablet system. Includes sessions, food, and travel per diem for each participant. 3 separate trainings over the course of a year	10	318	3	9540
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Total Hardware Costs	\$66250
Total Software and Connectivity Costs	\$150320
Total HR Costs	\$122400
Total Transportation costs	\$54750
Total Training Costs	9540
Estimated Total Program Costs	\$403260