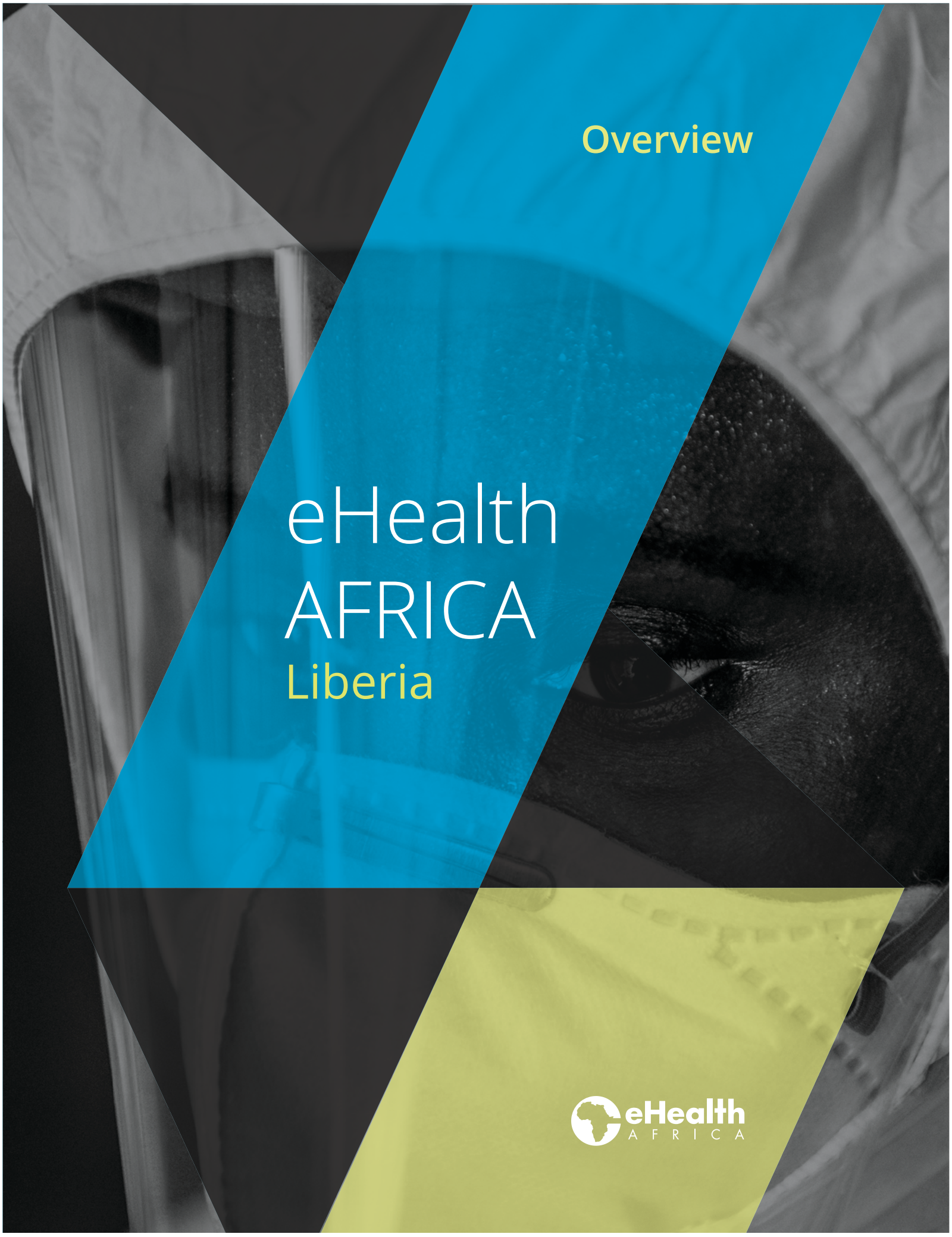


Overview

eHealth AFRICA

Liberia

eHealth AFRICA

eHA's Liberia country office opened in 2014, in response to the onset of the Ebola virus disease outbreak in West Africa. Over the next four years, eHA's aim was to work with Liberia's Ministry of Health (MOH) to improve health systems and data management to ensure that such outbreaks do not occur in the future.

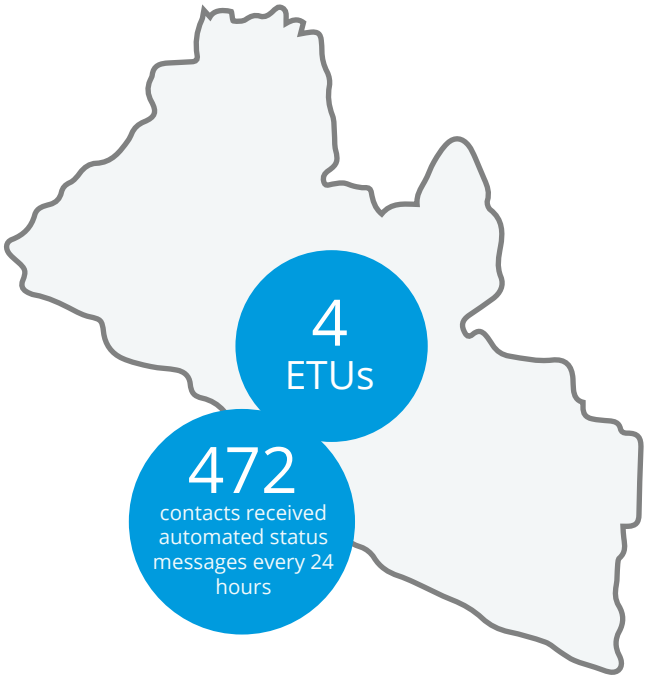
In Liberia, eHA's initial objectives involved the setting up of Emergency Management infrastructure, in collaboration with the US Centres for Disease Control and Prevention (CDC) and the CDC Foundation. eHA worked closely with CDC and the MOH and quickly developed programs across three pillars - Emergency Management and Preparedness, Laboratory and Diagnostic Systems, and Disease Surveillance, for the purpose of mitigating the risk of another outbreak.

Emergency **Management & Preparedness**

Starting in 2014, eHA supported the setting up and operation of Emergency Operations Centers (EOCs) in each of Liberia's 15 counties, as well as the National EOC in Monrovia. These EOCs provide the infrastructure needed to support country-level emergency preparedness and management functions to thwart potential public health emergencies. The facilities also serve as the coordination platforms for disease surveillance reporting, and for responding to new outbreaks. The availability of EOCs during emergencies determines how quickly health teams, partners, and stakeholders can mobilize resources to mitigate potential outbreaks.

15

Country EOCs and 1 National EOC were established by eHA and MOH



In 2015, eHA, in partnership with UNICEF, designed and implemented the Trace and Go (TaG) application, which utilized SMS technology to notify family members of a patient's status once he or she entered an Emergency Treatment Unit (ETU). This use of technology to keep family informed of their relative's status was a groundbreaking success, lessening the mistrust which had developed between health workers and local communities. Since the Ebola virus disease outbreak and response, EOCs have continued to play a critical role in the Liberian government's capacity to detect and respond to public health emergencies. eHA has continued to work with the MOH and the National Public Health Institute of Liberia (NPHIL) to support Emergency Management infrastructure and capacity development throughout the country, and has expanded the EOC functions beyond responding to outbreaks of Ebola virus disease. In April 2017, for example, the Sinoe EOC was integral to the MOH's ability to detect and respond to the Meningococcal Meningitis outbreak. In addition to continued operational support to the EOC infrastructure throughout the country, eHA continues to provide support for the development of human capacity in Emergency Management functions. In May 2017, eHA and CDC conducted a Threat and Hazard Identification and Risk Assessment (THIRA) workshop for 44 MOH staff members. Participants learned to identify and contextualize potential public health threats, establish capability targets, and execute effective response plans.

> "EOC facilities have continued to play a critical role in the Liberian government's capacity to detect and respond to public health emergencies.

Laboratory **Diagnostic Support**

Starting in 2014, eHA supported Liberia's laboratory systems by providing renovations and operational support to five priority laboratories, including:

- **Redemption Hospital**
- **The Liberian Institute of Biomedical Research (LIBR)**
- **ELWA Hospital**
- **Tappita Lab**
- **Bong Lab**

eHA has supported the development of a Laboratory Data Information System (LDIS) to include data quality management, information stream sharing, dashboard displays, and DHIS2 integration. Furthermore, eHA supported the development of a Laboratory Information System (LIS) strategic plan to allow management of laboratory data.
eHA continued to support Liberia's Laboratory system to improve timely reporting of collected specimens. With the absence of new Ebola virus disease cases in Liberia, eHA also supported the development of new diagnostic reporting systems in the labs, which produce data regarding cases of a variety of infectious diseases beyond just Ebola.

In 2015, eHA also provided Lab Desk Officers and trained these staff to process samples and enter data into an Access database. In 2017, eHA provided follow-up refresher workshops, in which participants were trained in sample storage and handling, data reporting and analysis, and use of new electronic Integrated Disease Surveillance and Response (eIDSR) tools.

Roberto Koimenee is one of the four lab desk officers that eHA worked with via the laboratory support program. He is deployed at Bong Lab to enter Ebola virus disease (EVD) data and report daily samples test results to the Liberia's Ministry of Health and eHealth Africa.

From Roberto
"I got involved with eHealth Africa-Liberia through an application and CV submission during the Ebola outbreak in September, 2014 in Liberia. I was called by eHA for an interview which was followed by training as a Lab Desk Officer. I was assigned to Bong EVD Lab. I was motivated to work in the lab because I wanted to help in the fight against Ebola in Liberia. Since eHealth is a technology driven company, with my knowledge in data management, I decided to help in this fight against Ebola by entering data from samples tested and submit report for decision making at the National level.

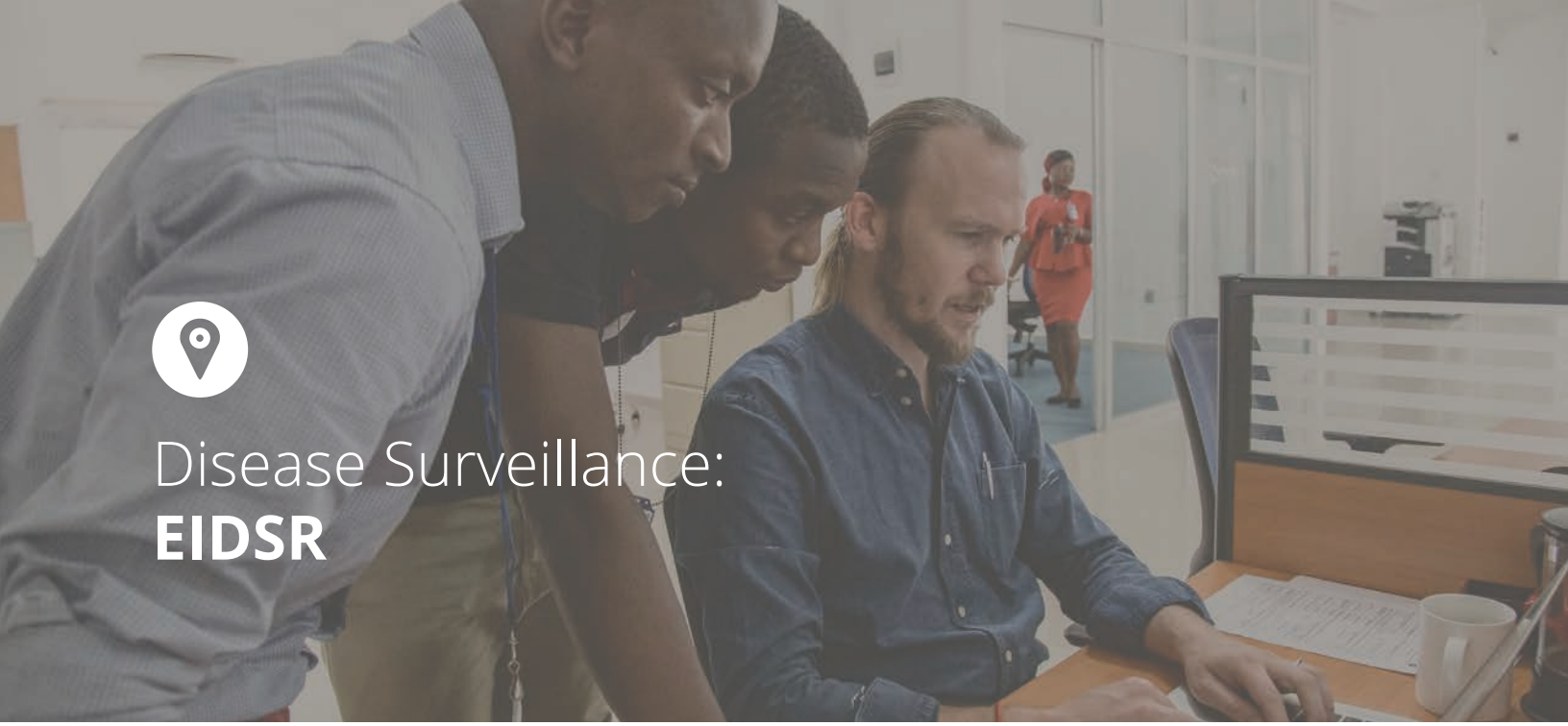
I have more than eight years of experience as an Administrative staff and four years of experience as a data officer at eHealth Africa-Liberia, where I have won some performance awards. I love managing database and solving data issues. I am a person who thrives to work out things when it's difficult to do and work independently to solve complicated problems", he explains.

I participated in a three-day training conducted by eHA and this training impacted my life and work by increasing my knowledge in the following topics: Sample handling storage, and processing; Confidentiality/Document control, Data entry and analysis. Today, I know how to control and secure patient information and report accurate and reliable results to requisite and identified individuals responsible to receive said information or results.

The part of the training I like the most was the off-line tracker although it has not been fully utilized by Bong Lab. The off-line tracker is so unique in that it tracks all data or information in all the four (4) regional labs in the country (Liberia). Each lab can see and access information including reports/results of specimen tested. This system can be used without internet. However, that training especially the off-line tracker needs to be fully utilized for the safety, reliable and secure of lab information/data.

Although I worked with other institutions before eHealth Africa came to Liberia, but life was not too good for me and my family. My salary was too small to cover all my expenses including undertaking house construction project. But after I was employed by eHA, my salary was encouraging that enable me and my family to live better life."
Roberto's wife, Christiana Hne Koimenee, believes her husband made a good decision working for eHA in the fight against Ebola in Liberia, even though she expressed fear over her husband doing one of the riskiest jobs, and comes to the conclusion it was worth it.

"It was sad and worrisome for individuals like my husband to be at the frontline to test Ebola specimen. But it was also historical for him and those who stood firm to help in the process of fighting Ebola in Liberia."
— Christiana Hne Koimenee



Disease Surveillance: **EIDSR**

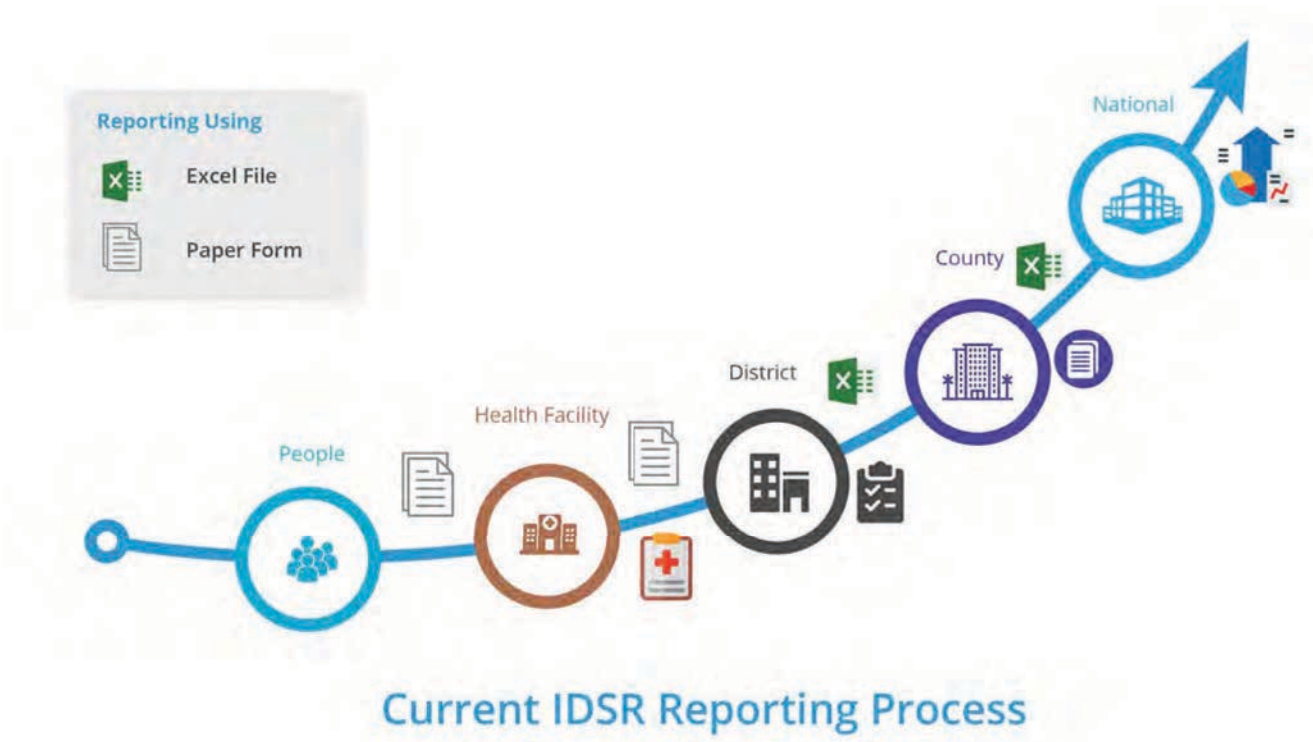
Prior to the Ebola outbreak, the public health system in Liberia had limited capacity to detect, report, and respond to emerging public health threats. In order to establish an effective and responsive public health system, reliable and robust surveillance tools needed to be put in place.

Starting in 2015, eHA worked with the MOH to strengthen in-country capacity for epidemiological surveillance. eHA and the MOH developed an electronic Integrated Disease Surveillance and Response (eIDSR) system which allows health facilities to report potential new disease cases.

eHA recognized that the current paper- and Excel-based IDSR process created several challenges, which hindered the MOH's ability to detect and collect data on new outbreaks. These challenges were:

- Data quality: incomplete forms and incorrect data entries greatly reduced the accuracy of reporting;
- Data consistency: the numbers of reported cases varied across health facility, district, county, and national levels;
- Security: Excel reports containing sensitive patient data were shared via email and USB drives; compromising data security;
- Double entry of data: the health facility workers had to complete two copies of the same report; one would be sent to the lab with the patient sample and the other to the District Surveillance Officer (DSO).
- Manual data aggregation: Paper reports had to be manually aggregated at the national level. This process is cumbersome, time consuming, and prone to errors; and
- Timeliness: Reports regularly take 2-3 weeks to reach the central level, and health facilities would frequently send their reports late.

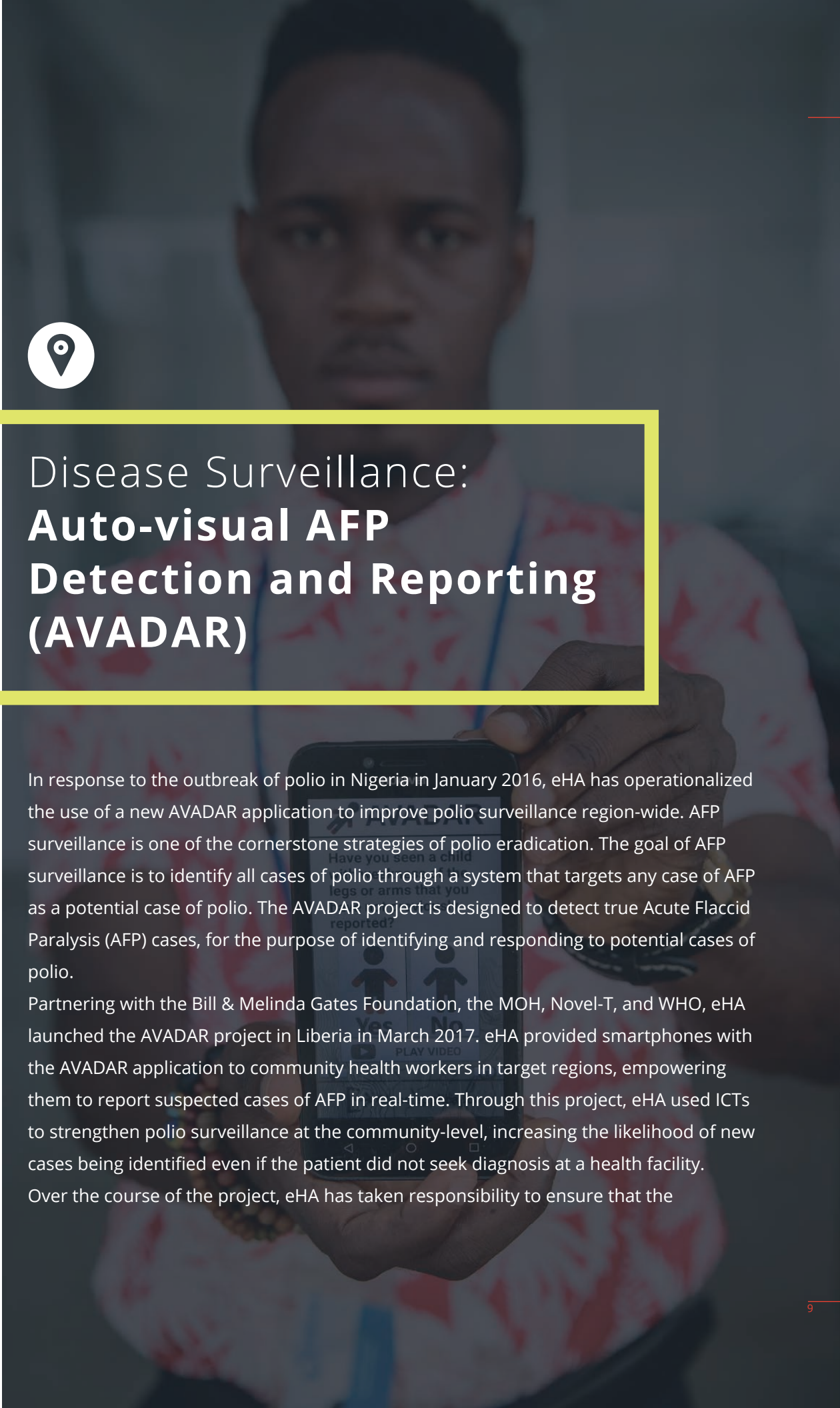
> Using eIDSR, the MOH will be able to detect new disease outbreaks throughout the country as they occur, and mobilize rapid responses.



Current IDSR Reporting Process

To address these challenges, eHA worked with the MOH, CDC, USAID, Johns Hopkins University, Riders for Health, and IntraHealth to develop an electronic system to report new cases in real-time. Rather than depending on paper forms, Health Facility workers submit reports via SMS. This SMS report generates alerts at the district, county, and national levels instantaneously. DSOs can provide investigation data directly into the system, and lab technicians can send notifications back through the system to the health facilities regarding sample test results.

Furthermore, eHA developed an offline data entry tool for the DSOs and Lab technicians to input patient information, which is synchronized with DHIS2 and Epi-info. This application captures information entered, stores it on the device, and automatically synchronises the data once an internet connection becomes available.
As a result of this eIDSR system, new diseases can be reported on a case-by-case basis to all administrative levels in real time, and with higher data quality and accuracy than the paper-based system. Using eIDSR, the MOH will be able to detect new disease outbreaks throughout the country as they occur, and mobilize rapid responses. eHA also built dashboards in DHIS2 to allow the MOH to analyze eIDSR reports and make data-driven decisions regarding public health systems.
The MOH rolled out the first phase of eIDSR in November 2017, launching it in Grand Cape Mount and Margibi counties.

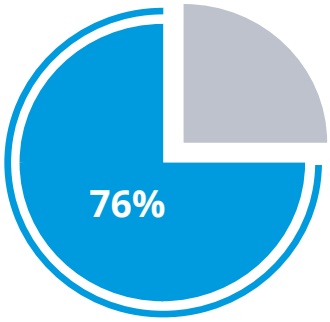


Disease Surveillance: **Auto-visual AFP Detection and Reporting (AVADAR)**

In response to the outbreak of polio in Nigeria in January 2016, eHA has operationalized the use of a new AVADAR application to improve polio surveillance region-wide. AFP surveillance is one of the cornerstone strategies of polio eradication. The goal of AFP surveillance is to identify all cases of polio through a system that targets any case of AFP as a potential case of polio. The AVADAR project is designed to detect true Acute Flaccid Paralysis (AFP) cases, for the purpose of identifying and responding to potential cases of polio.

Partnering with the Bill & Melinda Gates Foundation, the MOH, Novel-T, and WHO, eHA launched the AVADAR project in Liberia in March 2017. eHA provided smartphones with the AVADAR application to community health workers in target regions, empowering them to report suspected cases of AFP in real-time. Through this project, eHA used ICTs to strengthen polio surveillance at the community-level, increasing the likelihood of new cases being identified even if the patient did not seek diagnosis at a health facility.

Over the course of the project, eHA has taken responsibility to ensure that the



322 Out of 423 technical issues were resolved by eHA in 2017

Community Informants' devices are consistently functional. eHA's team of Technical Officers travelled regularly to the field over the duration of the project to troubleshoot issues and ensure that informants were able to submit timely reports.

As of March 2018, a total of 360 informants were presently in the Liberia AVADAR network, providing real-time AFP surveillance.

Disease Surveillance: **Health Facility Registry (HFR)**

Recognizing the need to be able to collect, curate, store, and distribute standardized and current health facility information, eHA and the MOH have been working to develop an interactive Health Facility Registry.

Beginning in 2017, eHA and the MOH worked together to harmonize and validate existing data for public and private health facilities in Liberia. Once this Master Facility List was complete, eHA collaborated with CSH and

began development of an interactive registry application based in DHIS2. Designed to be the sole true source of health facility data, this application allows the MOH, other government ministries, and the general public in Liberia, to search for health centers by region, facility type, and services provided.

As of 2018, eHA supported the MOH to complete the classification and harmonization of HFR data from heterogeneous data sources. The MOH has captured data for 844 health facilities to date, to be uploaded into the health facility registry. This registry allows the MOH to search for and run reports on health facility data nationwide. The registry will also integrate with other Health Informations Systems, such as the electronic Logistics Management Information System to allow effective supply chain management of health commodities to health facilities. It will furthermore integrate with the eIDSR system, to provide data regarding the locations of new cases of infectious diseases.

844

Health Facilities incorporated into the Master Facility List as of 2018

Disease Surveillance: **Interoperability**

eHA has been working with the MOH to build a Health Information Systems Interoperability infrastructure, with the aim of facilitating data sharing from disparate, and increasingly electronic, subsystems. Once achieved, this architecture will allow subsystems to “talk” to each other, giving the MOH a much greater capacity to analyze and visualize information and make data-driven public health decisions.
In 2015-16 eHA constructed and equipped a Strategic Information and Analytics (SIA) Room at the MOH to display critical data regarding potential outbreaks. More recently, eHA and the MOH have reviewed existing health information data sources and created an interactive data catalog. eHA also conducted a Data Integration and Maintenance training for MOH staff to start building the capacity to maintain the data catalog and interoperability systems.
In 2018, eHA developed a Data Warehouse to allow data integration from disparate subsystems. Working with MOH personnel, eHA also built human capacity to maintain these subsystems and make modifications as required.

> This interoperability will enable systems "talk" to each other and give the MOH a greater capacity to make data- driven public health decisions.

Additional
Capacity-Building Conducted

Linux Administration Training

In June 2016, in partnership with Jumping Bean, eHA launched Africa's first Linux Foundation Administrator Certification course. eHA delivered this program for participants from the Ministry of Health and Redemption Hospital. At the conclusion of the course, ten participants became certified Linux System Administrators.

Linux systems are prevalent throughout the world, within companies like Google, HP, IBM, Facebook, and eBay, along with 75% of the world's stock exchange. The most popular open source software project, Linux is free with several built-in operating systems. For this reason, Linux is easily adaptable in low-resource environments. It will run on a variety of hardware, including aging computers with little RAM.

Risk Communications

In April 2017 eHA and CDC delivered an intensive four-day training in Risk Communications to 65 participants, including County Health Promotion Focal personnel, representatives from the National Health Promotion Division, health promotion implementing partners, and MOH Department of Representatives employees.
At the end of the workshop, all country-level focal persons were trained to draft risk communication strategies for their respective counties.

65

MOH personnel trained in Risk Communication

Amazon Web Services (AWS) Training

Given the MOH's goal to migrate all of its data systems from physical servers into the Cloud, eHA provided an intensive and customized seven-week training program for the MOH's ICT staff on AWS maintenance and infrastructure.
eHA engaged external and in-house experts to instruct participants in the ecosystem of DevOps tools necessary to deploy, manage, and maintain applications in AWS.
eHA's experts provided in-depth training in the following topics:

Linux
Many basic command line operations
SSH, SCP, managing file permissions, Installing software from package managers

AWS
Working with the AWS Console
Creating EC2 Instances
Creating RDS Services
Creating Docker Container Repositories
Creating IAM Roles
AWS Lab: Deploying DHIS2 in a Docker Container on AWS
AWS VPC, Networking and Security
IAM Best Practices Plus Keeping Secrets (CredStash)

EC2 Deep Dive
Auto Scaling and Load Balancing
AWS Lab: Setting Up Auto Scaling and the ALB
RDS Deep Dive

Docker
Docker Basics
Docker Lab: Building Docker Images with Dockerfile
Docker Compose Basics

Terraform
Terraform Basics
Automated IAM and Docker Registry Setup
Pushing Docker Images to an AWS Container Registry
Automation Lab: Automating DHIS2 Deployment

Monitoring
AWS CloudWatch Monitoring
AWS Cost Monitoring (Billing Services)

Process Management

DHIS2 Training

In order to strengthen the Surveillance System of Liberia through the management and maintenance of DHIS2 server in the cloud, eHA conducted a three-day advanced-level training in DHIS2 for six MOH employees from various HMER departments (ICT, M&E, HIS and SIA/ Research) in the following topics:
Analyzing data using pivot tables
Creating and managing dashboards
Running SQL queries in the SQL view to create

additional tables and analytics
Case-based reporting using the Tracker module for disease surveillance
Importing and exporting metadata between DHIS2 instances
DHIS2 system administration training
DHIS2 troubleshooting
Migrating DHIS2 instances from one server to another
Upgrading DHIS2 versions
Setting up a server to run DHIS2
Customization of DHIS2

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