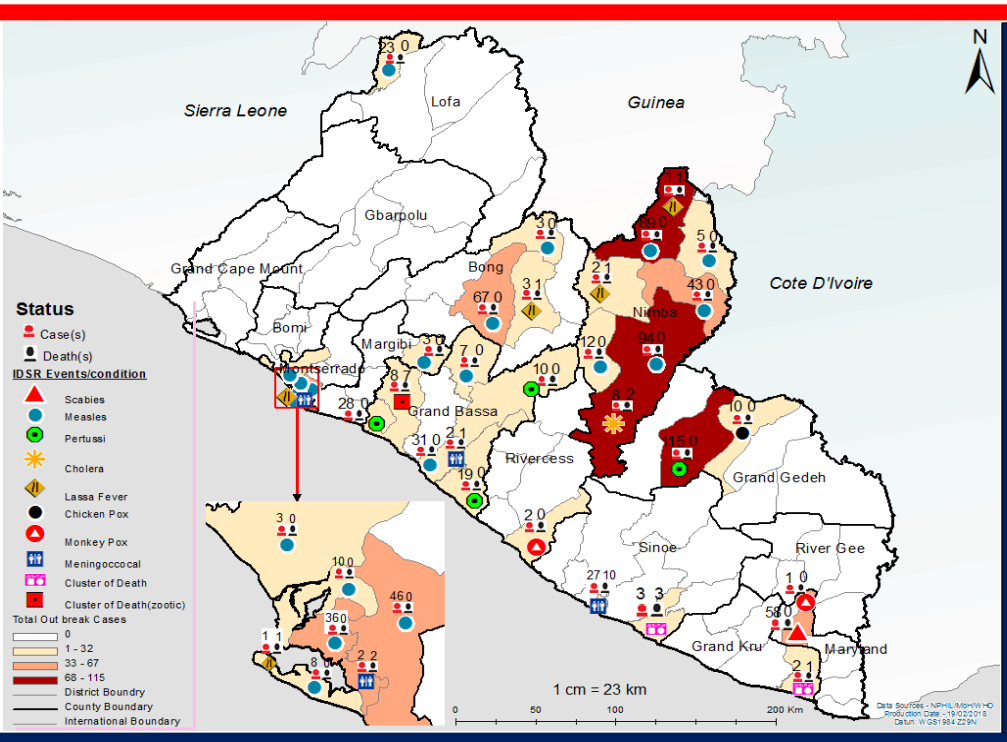
REPUBLIC OF LIBERIA

2017 EPIDEMIOLOGICAL REPORT (INTEGRATED DISEASE SURVEILLANCE AND RESPONSE BULLETIN)

Preventing and Controlling Public Health Threats

JANUARY – DECEMBER 2017



39
Disease Outbreaks

3
Humanitarian Events

Division of Infectious Disease and Epidemiology
National Public Health Institute of Liberia

Message from the Director General

The Ebola Virus Disease (EVD) outbreak has left an indelible memory and the lessons have been the catalyst for the robust implementation of Integrated Disease Surveillance and Response (IDSR) in Liberia. As part of the implementation of the National Investment plan to build a resilient health system, the National Public Health Institute of Liberia (NPHIL) has been established with a mandate to ensure prevention and control of public health threats by promoting healthy outcomes.

The country has also succeeded in the adaptation of the second edition of the national technical guidelines for IDSR and the subsequent training of surveillance officers at national, county, and district levels in Field Epidemiology since 2016 to present.

Within NPHIL, the Division of Infectious Disease Epidemiology (DIDE) has produced this 2017 epidemiological report (IDSR Annual Bulletin) as part its responsibilities to monitor, control, and communicate public health threats for early warning, epidemic preparedness, and response.

This report is intended to provide concise and succinct progress made in the implementation of public health surveillance preparedness and response at each level of the surveillance system. The information from this report is important for strengthening IDSR, which not only contributes to the control of communicable diseases in Liberia, but also enhances the capacity to implement the WHO International Health Regulations [2005].

All these captivating progress in the surveillance system of Liberia could not have been achieved without the appreciated support and contributions of our partners. We are extremely grateful to the leadership of the Ministry of Health, World Health Organization (WHO), US Centers for Disease Control and Prevention (CDC), and all other valuable partners that continue to provide technical and operational support to facilitate our work.

Congratulations to everyone!

Tolbert G. Nyenswah, LLB, MPH
Director General

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EDITORIAL

The National Public Health Institute of Liberia (NPHIL) is pleased to present the 2017 annual epidemiological bulletin. This bulletin provides information on the progress of IDSR performance in 2017. It highlights the successes and the challenges. The information from this bulletin is important for strengthening IDSR, which not only contributes to the control of communicable diseases in Liberia, but also enhances the capacity to implement the World Health Organization's International Health Regulations (2005), a legally-binding agreement that provides a new framework for coordinating and managing public health threats, which came into effect in June 2007.

1. IDSR Performance

- Completeness and timeliness of weekly IDSR reports remained well above the 80% national target at all levels of the health system
- Immediate notification of suspected cases (within 24 hours) increased from 20% in week 40, 2016 to 100% as of week 52, 2017
- We recorded an increase in reporting of IDSR diseases and events with a total of 4,729 suspected cases reported for 10 immediately reportable diseases and events in 2017 compared to 3,812 in 2016
- Reporting of suspected cases with case-based forms or line list increased from 30% in week 40, 2016 to 90% as of week 52, 2017
- Over 80% of the suspected cases recorded (those requiring laboratory confirmation) were investigated by Laboratory
- Joint national supportive supervision/mentorship conducted in 15 (100%) counties showed appreciable level of compliance in the implementation of IDSR core functions

2. Outbreaks and Humanitarian Events

- A total of 39 outbreaks and 3 humanitarian events were detected, investigated, and responded to
- There were investigation reports for 85% of outbreaks compared to 53% in 2016
- Eighty-two (82%) of outbreaks were responded to within 48 hours compared to 37% in 2016

3. Public Health Diagnostics

- Sustained public health diagnostic capacity at three laboratories – National Public Health Reference, Jackson F. Doe, and Phebe hospital laboratories
- Improved in-country public health diagnostic capacity from five IDSR priority diseases in 2016 to seven IDSR priority disease by week 52 in 2017
  - Added meningitis, Lassa fever
  - Developed laboratory screening capacity for rabies
- Overall laboratory turn-around time improved by 15% from 35% in the first half of the year, to 50% of alerts being confirmed or ruled-out by laboratory testing within 4-days of alert notification, by the end of 2017

4. Electronic Disease Surveillance

- E-IDSR was launched and piloted in two counties (Grand Cape Mount and Margibi) covering all health facilities
- AVADAR was launched and piloted in four health districts in Montserrado County
- Use of open data kit (ODK) to conduct IDSR supervision commenced thus enhancing visualization, rapid transmission, and validity of reports

5. Training and Capacity Building

- A total of six hundred twenty-two (622) national and county level staff were trained as trainers in IDSR
  - This comprised 285 local authorities trained in IDSR leadership and coordination and 337 technical staff trained (at least each county has 5 IDSR modular trainers)
- The Liberia Field Epidemiology Training Program (LFETP) has trained 146 surveillance officers at the national, county and district levels of the surveillance system in the Frontline and 14 national and county officers in Intermediate FETP

Many other gains have been made in areas of emergency medical services, points-of-entry, and epidemic preparedness and response including the formulation of contingency plans and the conduct of at least one simulation exercise at two points-of-entry.

Despite these strides, key system challenges/constraints include:

- Settling the newly established NPHIL as a specialized institute as well as aggressively responding to over 30 outbreaks is resource intense
- System resilience to outbreak response still need the desired coverage of above 90%
- Inadequate operational support to surveillance officers

However, strong dedication and commitment to excellence in our work to prevent and control public health threats continue to allow us to surmount these hurdles.

We are grateful to the World Health Organization (WHO), US Centers for Disease Control and Prevention (CDC), and all

other valuable partners that continue to provide technical and operational support to facilitate our work.

I. OVERVIEW OF IDSR IN LIBERIA

The major incidence of preventable diseases in Liberia as recorded in 2017, ranges from endemic and re-emerging such as measles, viral hemorrhagic fevers, tuberculosis, monkeypox and cholera (Weekly Epidemiological Bulletin, 2017). Among the several strategies put in place by the health sector to address this disease burden is a functional public health surveillance system with an early warning system which uses the IDSR platform.

The World Health Organization (WHO) Regional Office for Africa (AFRO) proposed the IDSR approach for improving public health surveillance and response in Africa linking community, health facility, district, county, and national levels. This was widely adopted in Africa, including Liberia, in 2004 (1st edition) and 2016 (second version of the 2010 edition). This strategy promotes rational use of resources by integrating and streamlining common surveillance activities.

In the aftermath of the Ebola outbreak in 2015, Liberia began revitalization of IDSR with the adaptation of revised technical guidelines in 2016, development of the operational guide for health facilities (IDSR in practice), and the subsequent training of health workers at all levels of the health system.

The broad objective of IDSR in Liberia is to contribute to the reduction of mortality, morbidity and disability from diseases through accurate, complete and timely reporting and analysis of data for public health action.

Diseases of public health importance in Liberia were identified and categorized into 3 reporting frequencies, those that are designated for routine reporting to district, county or national level on a monthly basis; those that are diseases, conditions and events of international concern that require reporting under International Health Regulations (IHR) 2005 to WHO; and those that are of high epidemic potential and require immediate and weekly reporting. The diseases, conditions and events selected for reporting are collectively referred to as priority diseases and conditions (Table 1).

The priority diseases for IDSR in Liberia are selected based on the following criteria:

- Diseases with high epidemic potential for serious public health impact due to their ability to spread rapidly within Liberia and internationally
- Conditions that require notification under IHR
- Diseases that are principle causes of morbidity and mortality in the region
- Country decision-based on disease burden and/or consideration for elimination or control

Table 1. Priority reportable diseases, conditions, and events, Liberia, 2017

Immediately reportable epidemic prone diseases/conditions and events	Diseases or events of international concern that are notifiable under IHR 2005	Monthly reportable diseases/conditions of public health importance
Acute Bloody Diarrhea (Shigella)	Guinea Worm (Dracunculiasis)	Acute Watery Diarrhea
Acute Flaccid Paralysis (AFP)	Human Influenza (due to a new subtype)	Acute Viral Hepatitis
Cholera (Severe AWD)	Severe Acute Respiratory Syndrome (SARS)	Adverse Events Following Immunization (AEFI)
Human Rabies	Smallpox	Cataract
Lassa fever		Diabetes
Maternal Deaths	Other Public Health Event of International Concern (PHEIC) Includes: infectious, zoonotic, foodborne, chemical, radio nuclear, or due to unknown condition	Diarrhea w/dehydration (in <5 years)
Measles		Encephalitis
Meningitis		Epilepsy
Neonatal Deaths		HIV/AIDS (new cases)
Neonatal Tetanus		Hypertension
Viral Hemorrhagic Fevers (including Ebola Virus Disease)		Hookworm
Yellow fever		Injuries (RTAs, domestic violence)
Unexplained cluster of health events		Malaria
Unexplained cluster of deaths		Malnutrition (<5 years)
		Mental Health
		Onchocerciasis
		Pertussis (Whooping Cough)
		Severe Pneumonia (<5 years)
		Schistosomiasis
		Sexual Assault
		STIs
		Trachoma
		Trypanosomiasis
		Tuberculosis
		Typhoid

II. IDSR PERFORMANCE

A. Reporting Coverage

i. *Reporting System*

Fourteen diseases, conditions, and events are designated for immediate reporting under IDSR in Liberia. The data for these diseases and conditions are collated for weekly submission to the national level. Ledgers for capturing IDSR data are placed in all health facilities, at district level for summarizing health facilities data, and at county level for summarizing health districts data. The IDSR system stipulates a defined time for each level of the health system to submit the weekly reports. Completeness and timeliness of reports are monitored each week. Completeness of reports is defined as the proportion of expected reports received while timeliness is defined as the proportion of expected reports received at a designated time.

ii. *Health Facility Level*

Weekly reports from health facility to district level were mainly paper-based. In some instances, VHF radio or mobile phones were used to transmit reports to the district level. A copy of the weekly summary of the data is required to be submitted to the District Surveillance Officer (DSO) by 17:00 GMT every Saturday. The weekly national average for completeness and timeliness of health facility reports was calculated to determine trend (Figure 1). The national target is 80%. All seven hundred sixty-one health facilities regularly submitted weekly IDSR data to the district level for most parts of the year. Due to some

administrative challenges, few reports were submitted in weeks 35 and 45 to 47. Corrective measures have been instituted.

iii. *Health District Level*

Weekly reports from district to county level were mainly paper-based. In some counties with internet coverage at the district office, the reports were compiled on an excel spread sheet and transmitted to the county level by email. A copy of the weekly summary of data is required to be submitted to the county surveillance officer by 17:00 GMT every Sunday. Completeness and timeliness of health district reports were monitored each week (Table 2). The national target is 80%. Ninety-eight percent (98%) and ninety-six percent (96%) of health districts met the annual target for completeness and timeliness respectively.

iv. *County Level*

Weekly reports from county to national level were transmitted electronically via email. In very few instances due to internet interruptions, reports were transmitted to national level via mobile phone. A copy of the weekly summary of data for the previous week is required to be submitted to the national level by 17:00 GMT every Monday. All 15 counties met the cumulative target of 80% for completeness and timeliness respectively (Figure 2).

v. *National Level*

IDSR data for the previous week were reported to WHO Liberia Country Office through the Division of Infectious Disease and Epidemiology of the National Public Health Institute by 17:00 GMT every Wednesday as part of the country's commitment to report.

Figure 1: Weekly Completeness and Timeliness of IDSR Health Facility Report, Liberia, Week 1 - 52, 2017

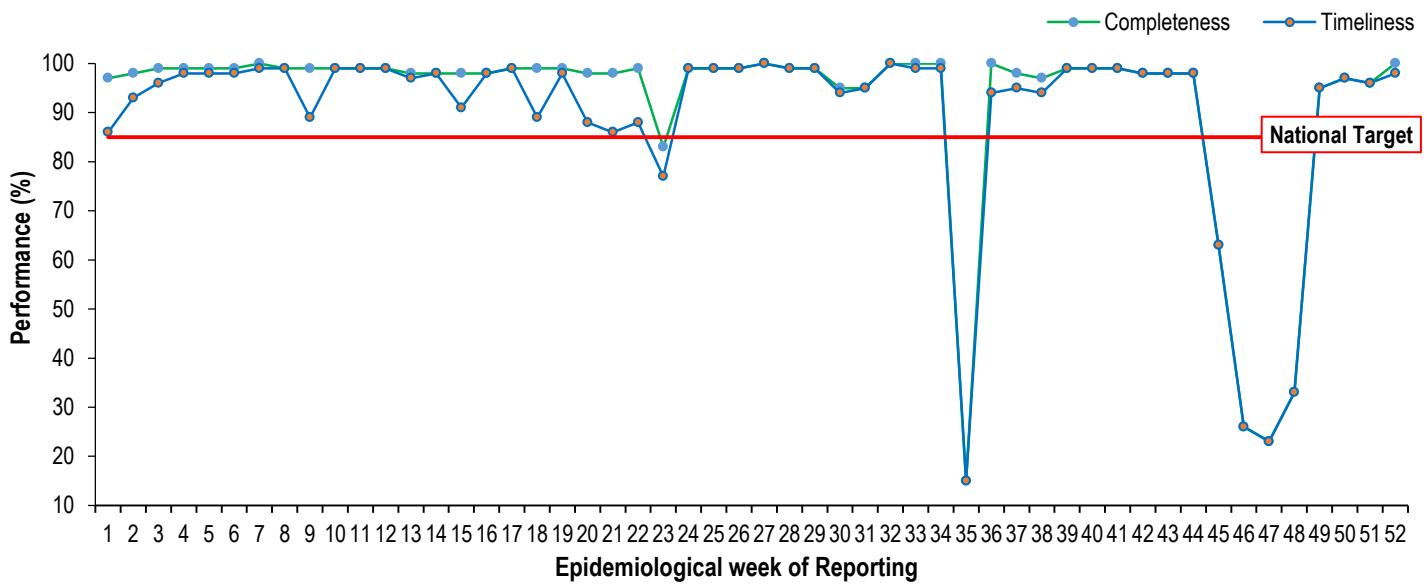
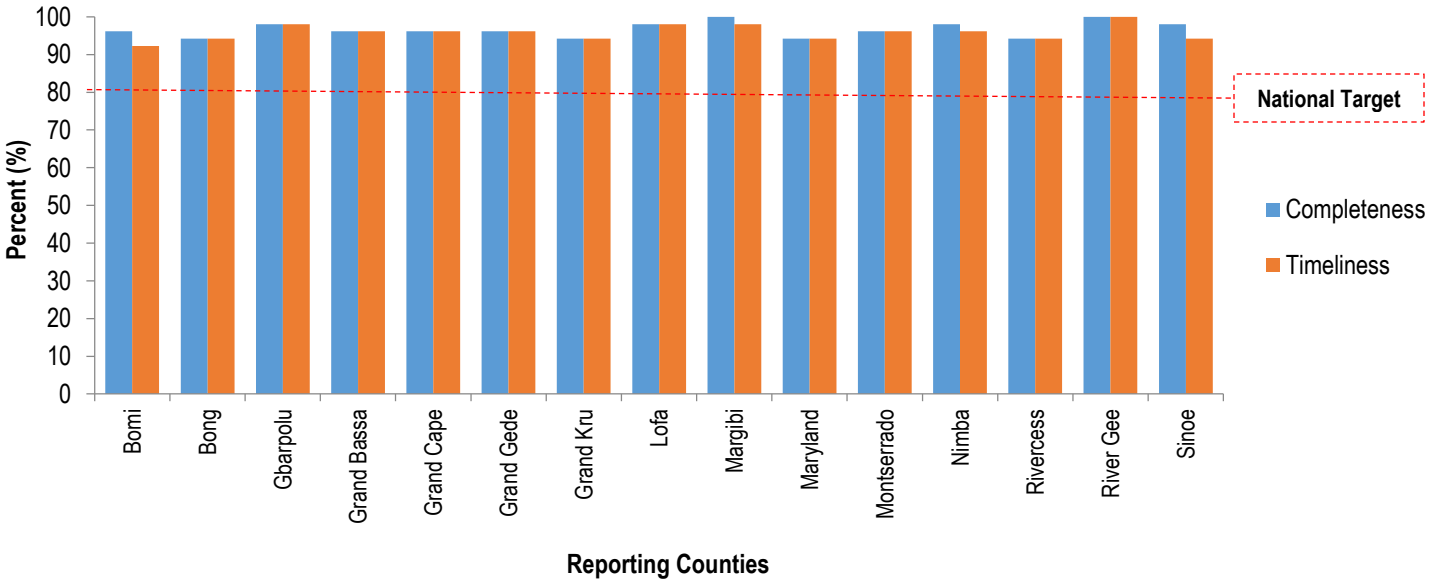


Table 2. Completeness and Timeliness of Weekly IDSR Health District Report, Liberia, Week 1 – 52, 2017

Figure 2. Average Weekly Completeness and Timeliness of IDSR Reports by Counties, Liberia, 2017



B. Selected IDSR Performance Indicators

The following five core performance indicators monitored throughout the year have been presented in this bulletin: immediate notification of suspected cases (within 24 hours) from health facilities, suspected cases reported with case-based forms filled in completely or line listed, completeness and timeliness of weekly health facility reports, suspected cases with sample collected (those requiring laboratory confirmation), and proportion of cases detected at community level (Figure 3).

Immediate notification of suspected cases from health facility to the next level improved from 20% in week 40, 2016 to 100% in week 52, 2017. This marks a 400% increment in performance. The national technical guidelines required all suspected cases of epidemic prone diseases and events to be immediately notified to the next level within 24 hours of identification.

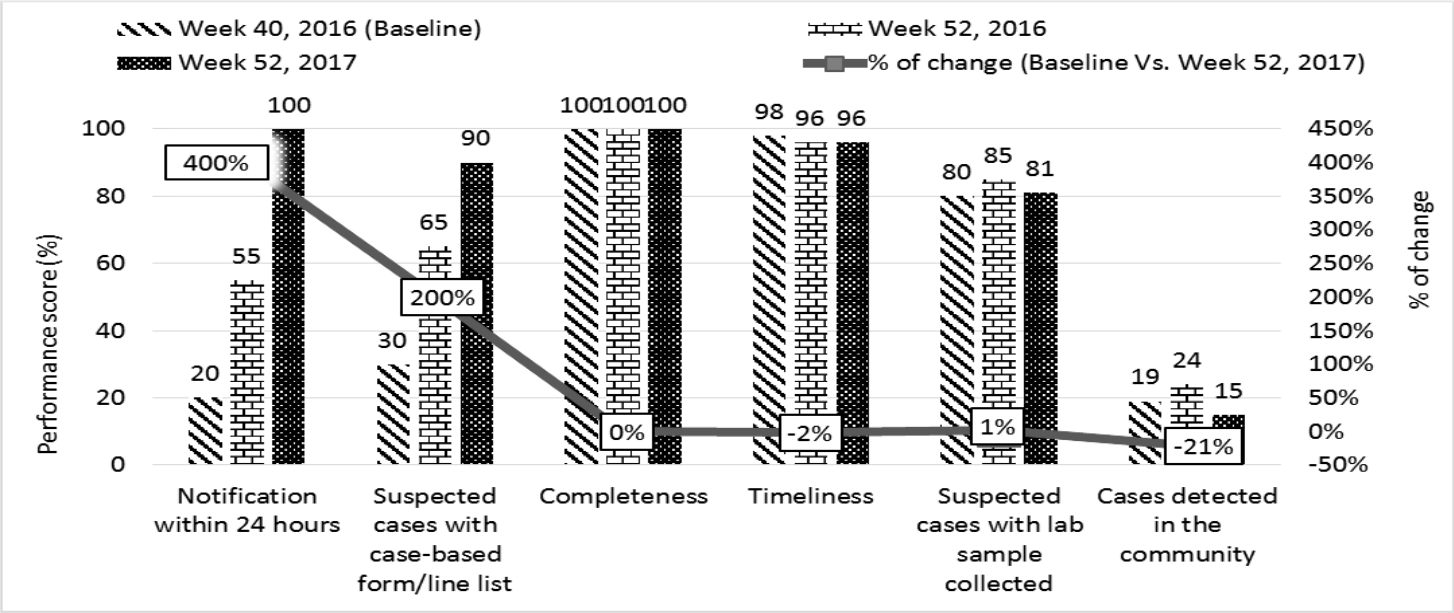
Case-based forms are required to be filled in completely for all suspected cases reported from health facilities. Cases reported during an outbreak should be line listed appropriately. In 2017, 90% of the cases reported to the national level had case-based forms filled in and were line listed. This is a marked improvement from 30% in week 40, 2016 to 90% in week 52, 2017.

Completeness and timeliness of weekly health facility IDSR reports were maintained above the 80% national target in 2017.

There is no significant change in the proportion of suspected cases with samples collected. A 1% improvement was recorded from 80% in week 40, 2016 to 81% in week 52, 2017. At least 80% of suspected cases requiring laboratory investigation must have samples collected for testing.

The proportion of total IDSR suspect cases detected in the community decreased from 19% in week 40, 2016 to 15% in week 52, 2017. This indicator assesses the contribution of community events-based surveillance (CEBS) to the detection and reporting of immediately reportable priority diseases in the country. Even though a decrease was noted, it is important to highlight the important contributions of CEBS and the need to strengthen this area of work.

Figure 3. Comparison of selected IDSR performance Indicators from 2016 to 2017



C. National IDSR Supervision

From September to November 2017, the national level conducted IDSR supervisory visits at sub-national levels (county, district, health facility, and community levels) and points-of-entry in fulfillment of requirements in the national technical guidelines for IDSR to conduct quarterly national IDSR supervision for assessing implementation and providing mentorship in the field.

NPHIL staff with technical and operational support from WHO used supervisory checklists deployed on mobile phones (ODK platform) to conduct the exercise.

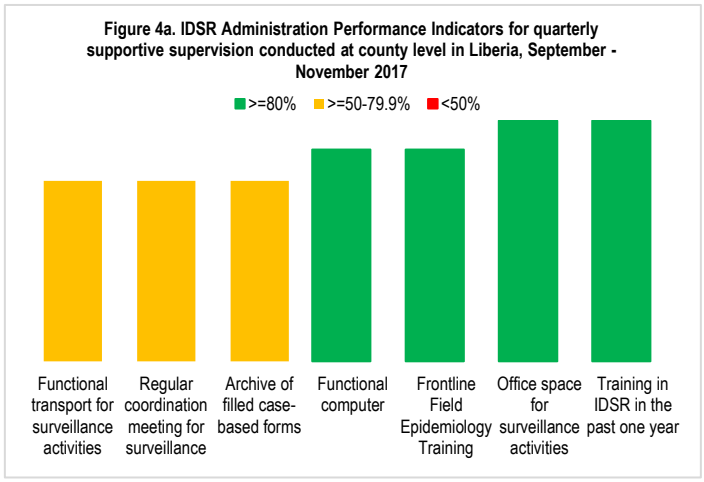
Each of the 15 counties was visited with a total of 190 (25%) health facilities supervised across the country based on the sampling size. Out of this number, 24 were hospitals constituting 60% of all hospitals, 27 were health centers constituting 71% of all health centers, and 139 were clinics constituting 21% of all clinics. Also, 77 (85%) health districts and 7 (25%) points-of-entry were supervised.

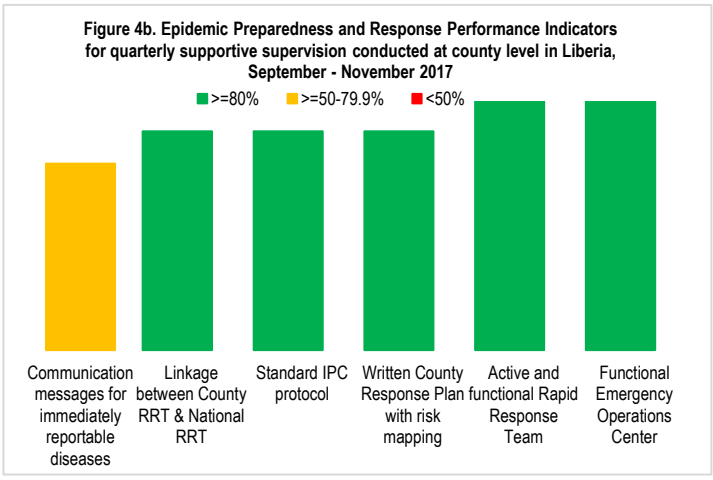
Selected findings from the exercise have been presented below (Figure 4).

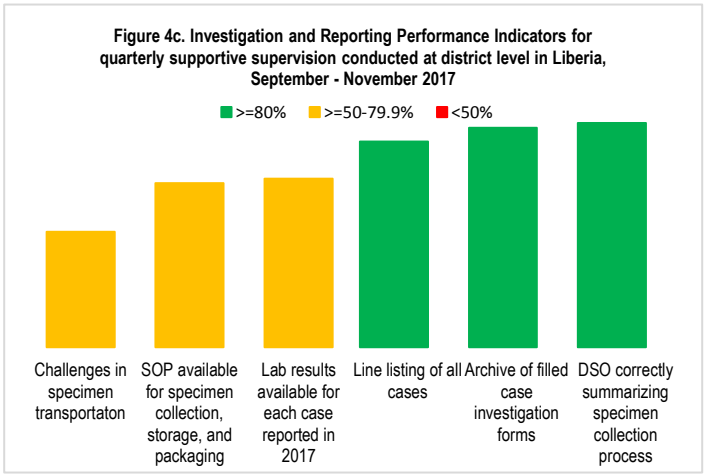
Although much desired is still to be achieved, the results showed an appreciable level of compliance within one year of revision of the national technical guidelines at all of the levels supervised. Mentorship was provided to health workers to improve in areas of weaknesses while key findings and recommendations were submitted at all levels for strengthening IDSR implementation.

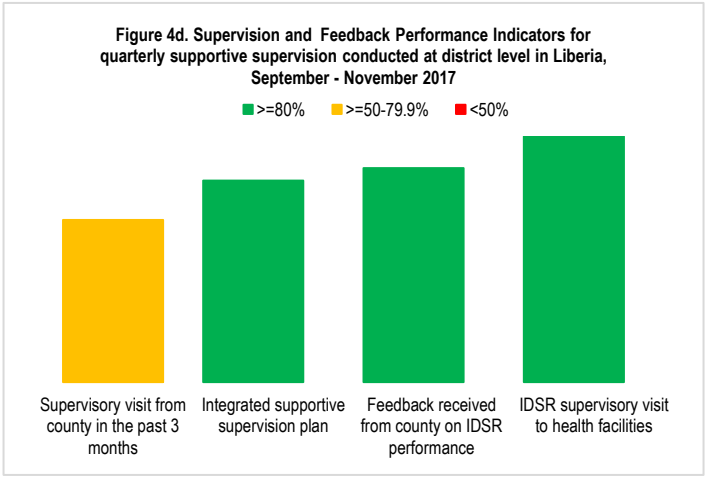
It is also important to note that routine IDSR supervision is also being conducted monthly at the county and district levels.

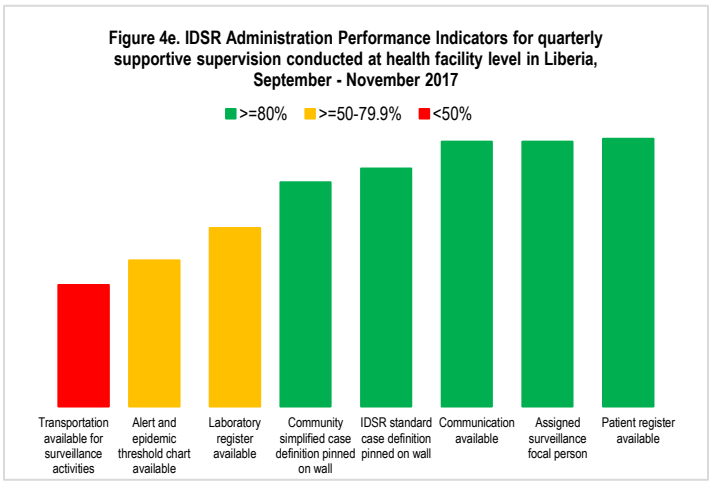
Figure 4. National Integrated Disease Surveillance and Response Supervisory Findings, Liberia, September – November 2017

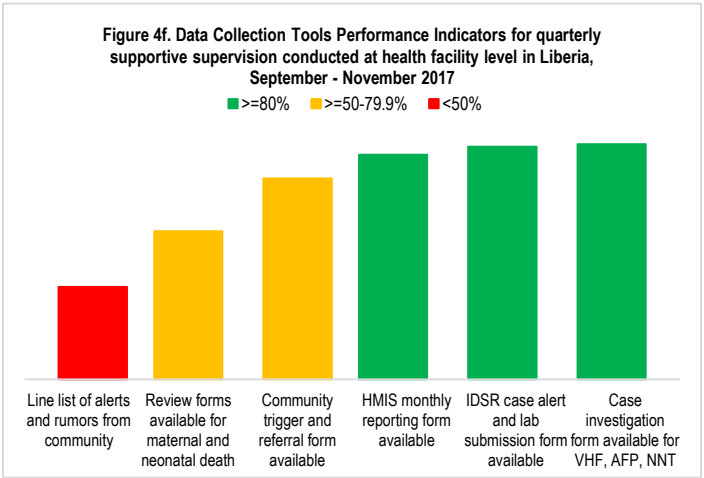


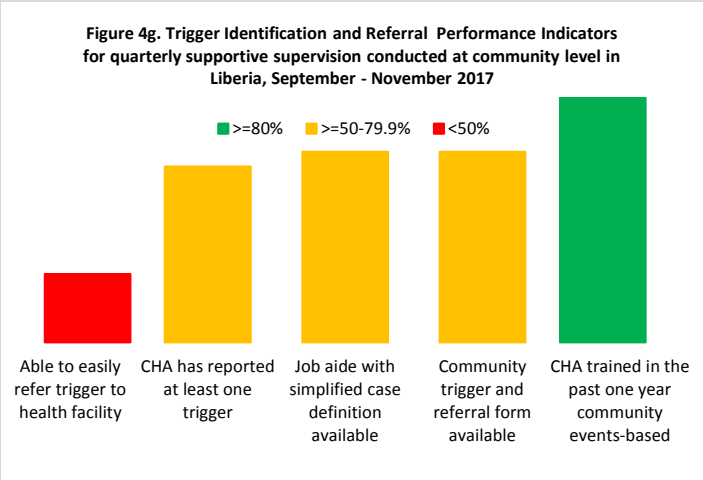


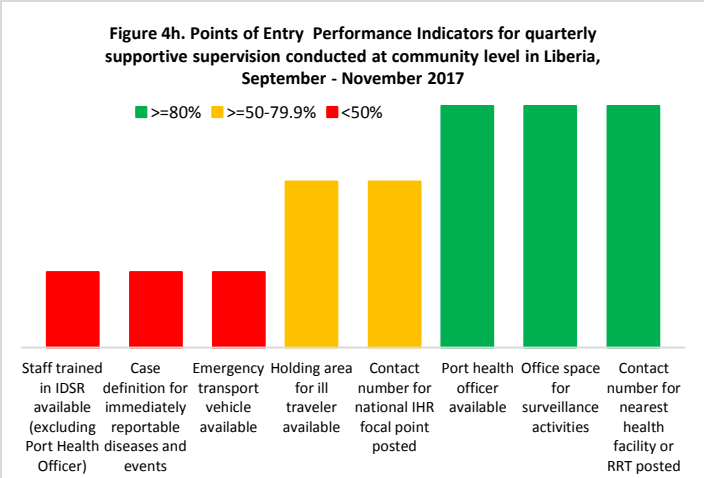








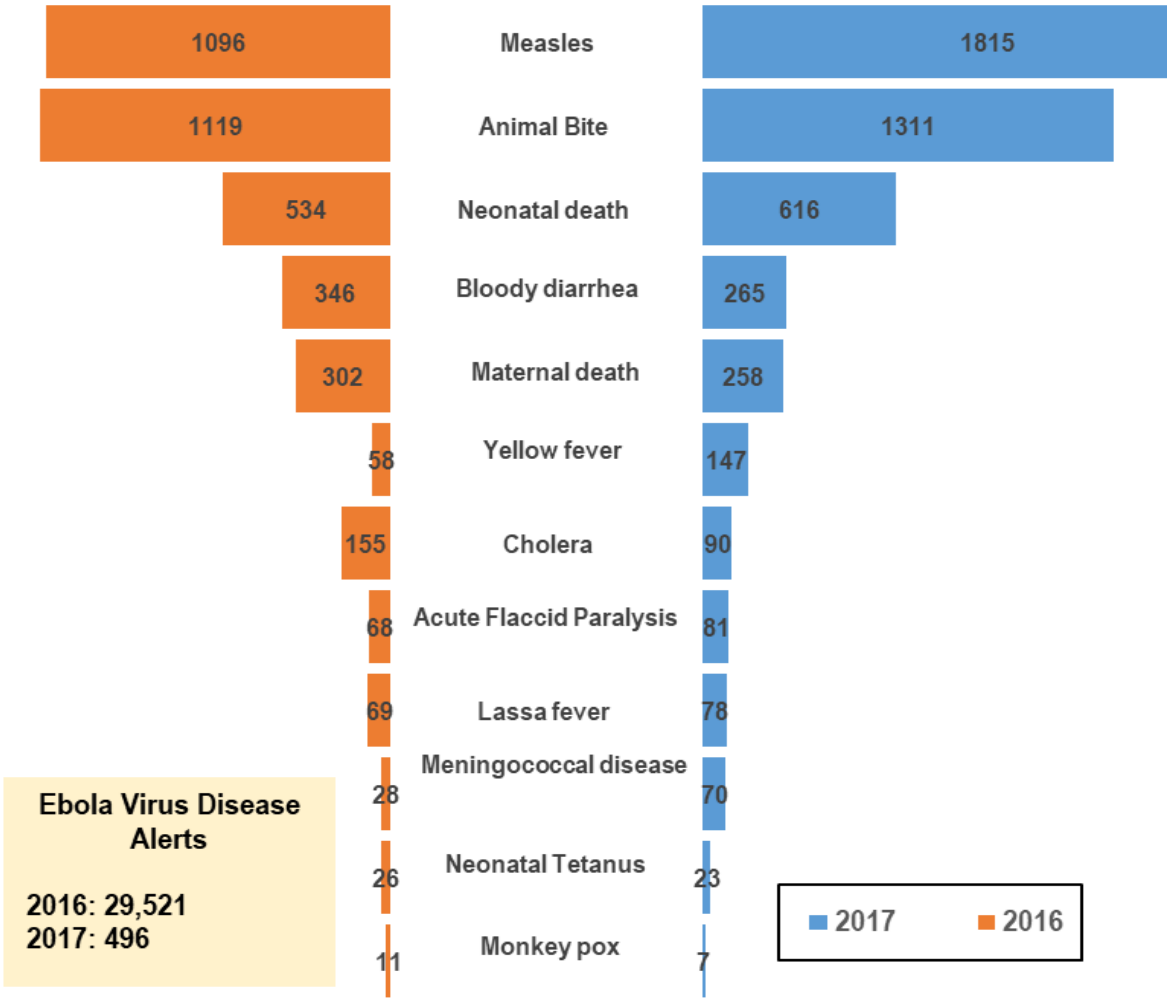




D. IDSR Immediately Reportable Diseases/Events

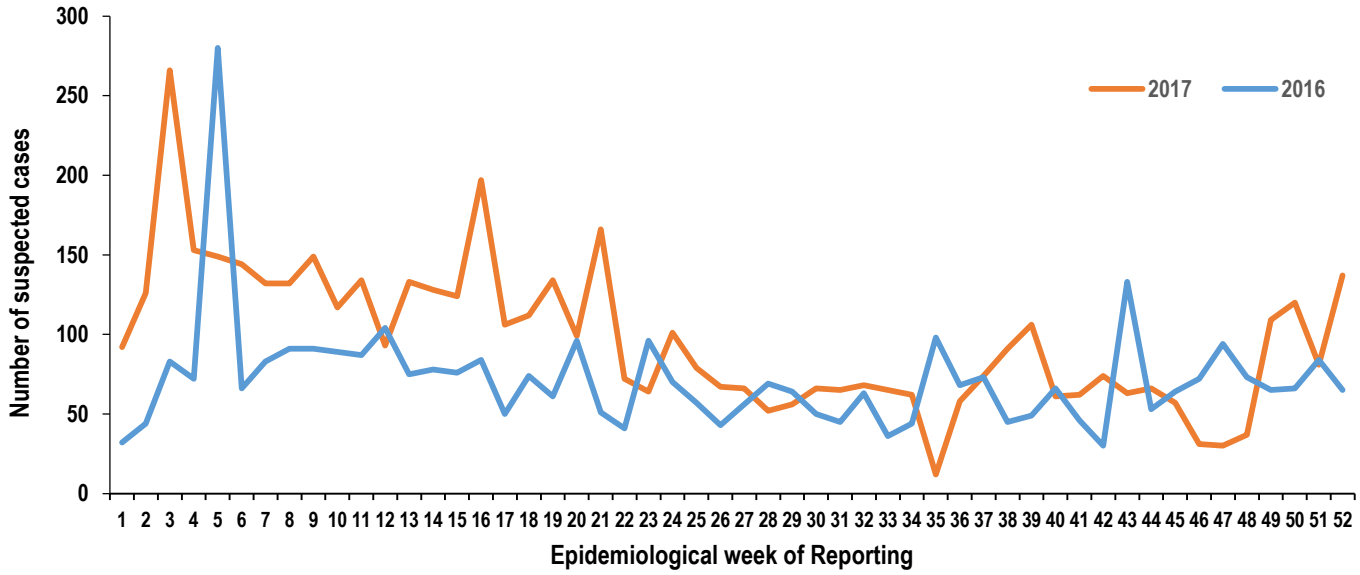
A total of 4,761 suspected cases of immediately notifiable diseases were reported through IDSR in 2017, an increase of over 3,812 reported in 2016. Ebola alerts have been excluded due to the use of the outbreak case definition in 2016 which led to very high number of alerts reported at the

Figure 5. Comparison of cumulative suspected cases reported for IDSR diseases/conditions in Liberia, 2016 & 2017



time.

Figure 6. Comparison of cumulative weekly IDSR trends for suspected cases reported weekly in Liberia, Epi week 1 - 52, 2016 & 2017



E. IDSR Monthly Reportable Diseases/Conditions

Figure 7. Comparison of number of new cases reported for diseases and conditions under passive surveillance in Liberia, 2016 & 2017

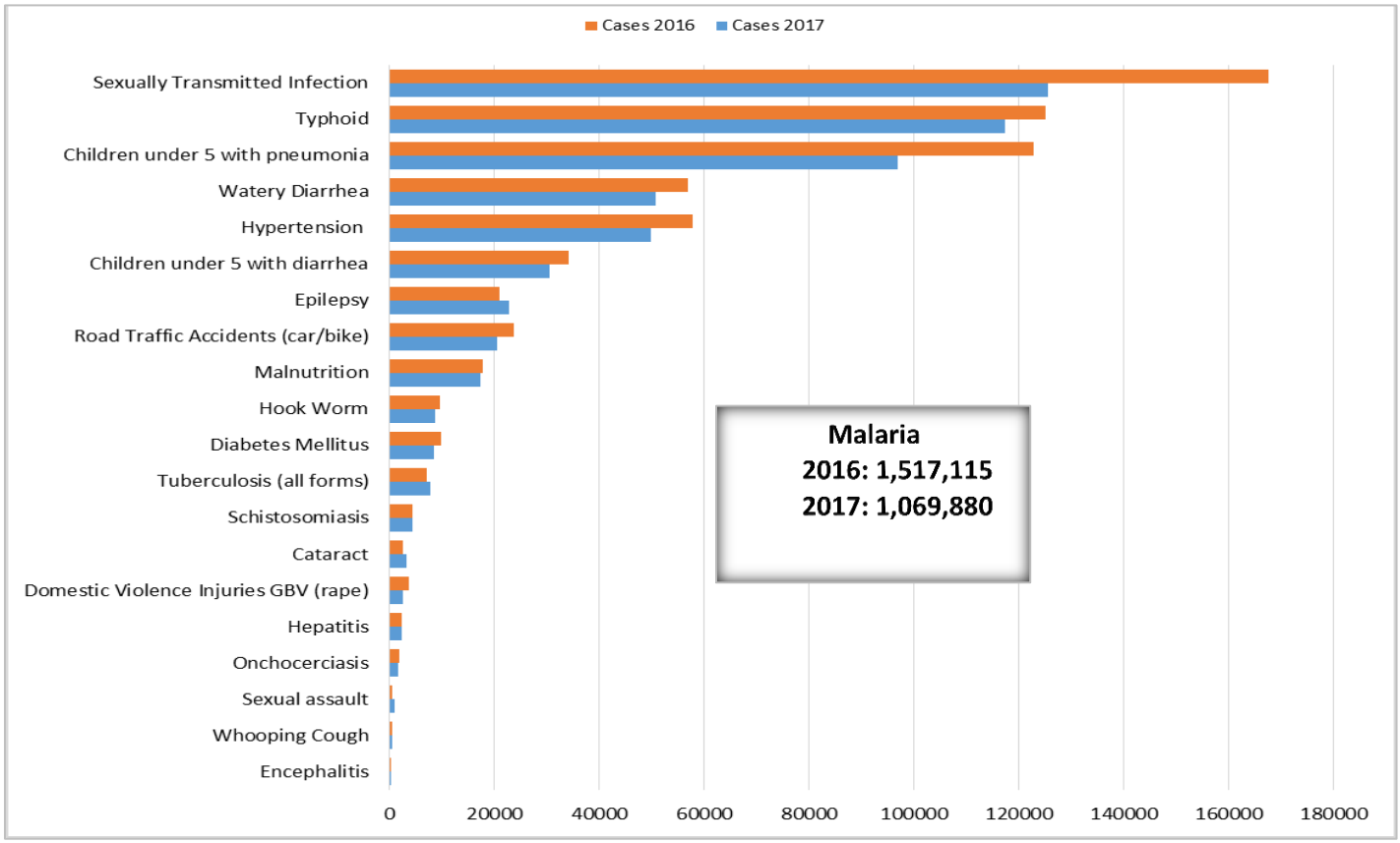
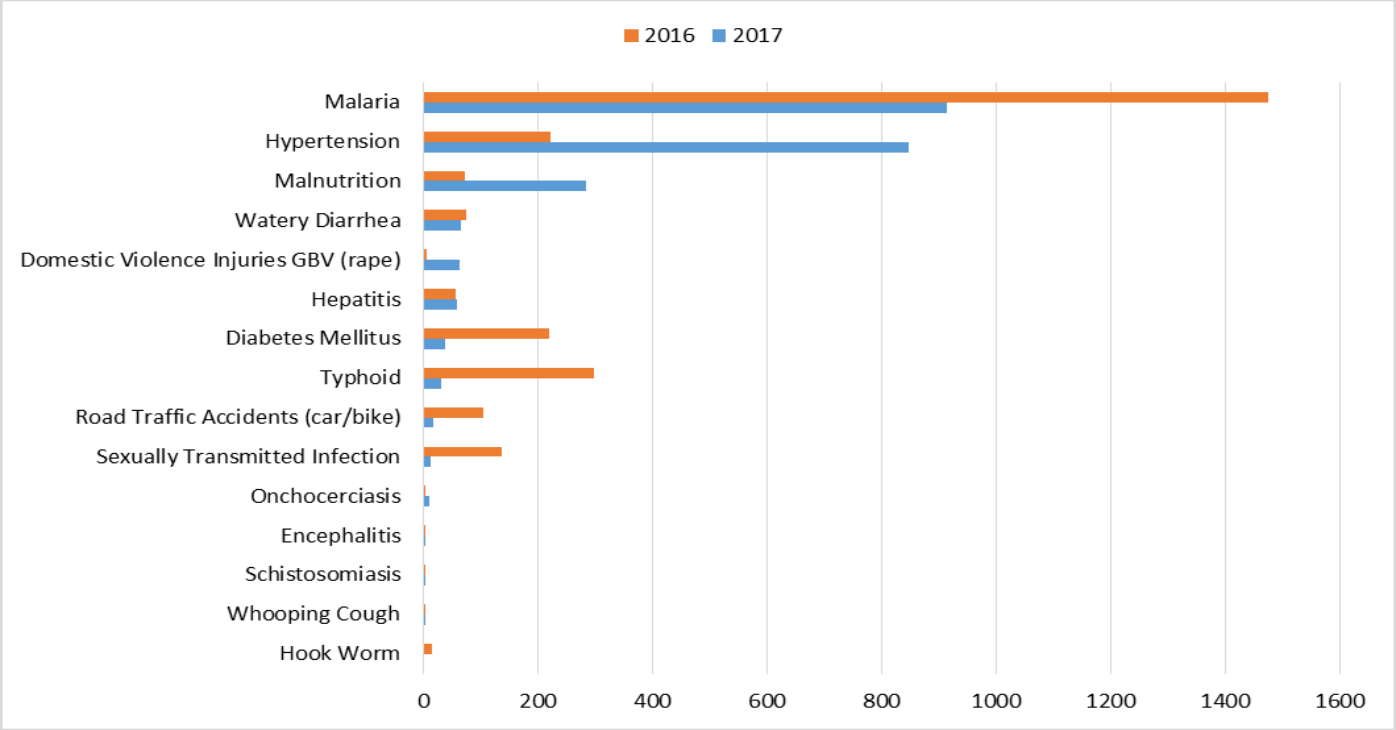


Figure 8. Comparison of number of OPD/IPD Deaths of selected priority diseases and conditions under passive surveillance in Liberia, 2016 & 2017



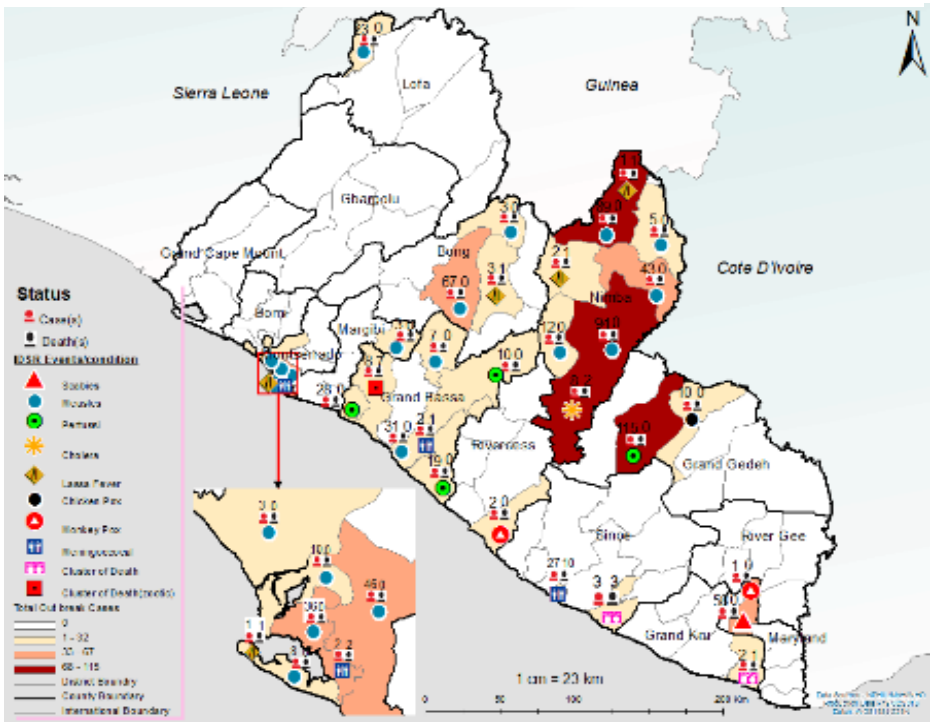
III. OUTBREAKS AND HUMANITARIAN EVENTS

A. Introduction

A total of 39 outbreaks and 3 humanitarian events were reported in 2017 (Table 3). Eleven out of 15 counties reported disease outbreaks and humanitarian emergencies with the most frequent being measles (20), Lassa fever (5) and pertussis (5). The high frequency of measles outbreaks may be related to its endemicity and the high number of susceptible children in the population. Recurring outbreaks of Lassa fever were also noted particularly in Nimba and Bong Counties. Two health emergencies involving flood and mudslides in Margibi and Bong Counties as well as an incident of chemical spills in Bong County were reported during the period (Figure 9).

All outbreaks were managed at the county level with support from NPHIL, WHO, US CDC, LFETP, and other partners.

Figure 9. Geographical distribution of outbreaks, Liberia, January – December 2017



The average time for initiating investigation and response to outbreaks at the county level was two days with a range of less than 24 hours to 10 days. Eighty-two percent (82%) of disease outbreaks were investigated and responded to within 48 hours.

There has been a significant improvement in outbreak documentation. Outbreak investigation reports (initial situation reports, situation updates, epidemiological analysis, and line lists) were routinely reported to the national level for most of the outbreaks. Situation Reports were received for 33 (85%) of the outbreaks. End of outbreak investigation reports and after-action review were completed for some outbreaks notably, meningococcal septicemia in Sinoe.

Table 3. Frequency of disease outbreaks reported in Liberia, January – December 2017

			Duration between notification and response		
Disease/Event	**Frequency**	**Number of outbreaks with Investigation reports**	**≤ 2 days**	**3 - 7 days**	**> 7 days**
Measles	20	14	19	0	1
Lassa fever	5	5	4	1	0
Pertussis	5	5	2	3	0
Monkeypox	2	2	1	1	0
Unexplained cluster of illness and death	2	2	2	0	0
Chickenpox	1	1	1	0	0
Cholera	1	1	1	0	0
Meningococcal disease	1	1	1	0	0
Scabies	1	1	0	0	1
Unexplained cluster (Epizootic)	1	1	1	0	0
Total	**39**	**33**	**32(82%)**	**5(13%)**	**2(5%)**

B. Measles

i. Epidemiological Description

Cumulatively, a total of 984 confirmed cases including four deaths with onset from January to December 2017 were recorded. Case fatality rate is 0.4%. Out of this number, 324 are lab-confirmed, 308 epi-linked, and 352 clinically compatible. Age distribution among confirmed cases (laboratory confirmed, epi-linked, and clinically compatible) were as follows: <9 months: 80 (8.1%), 9 – 11 months: 37 (3.8%), 1 – 4 years: 388 (39.4%), ≥5 years: 497 (50.5%). Vaccination status among confirmed cases were as follow: vaccinated – 273 (27.7%), not vaccinated – 149 (15.1%), and unknown – 562 (57.1%). Attack rate is 23 per 100,000 population.

Sixteen health districts reached epidemic threshold at least at once during the year. A total of 476 confirmed cases[1] including one death were reported as part of outbreaks. Case fatality rate among outbreak cases is 0.2%. There are currently six health districts in epidemic phase.

National routine immunization coverage for 2017 was 86%. However, disaggregating this coverage by counties showed that 7 out of 15 counties were below the 80% coverage target. The total number of susceptible accumulated from 2013 to 2017 is estimated to be 267,041 people.

Figure 10. Geographical distribution of confirmed measles cases, Liberia, January – December 2017

[1] The epidemic threshold for measles is defined as 3 or more laboratory confirmed cases in a district or health facility within one month. The epidemic threshold was used to confirm an outbreak of measles.

ii. Public Health Responses

a. **Coordination:** The national epidemic preparedness and response committee (NEPRC) led by NPHIL with involvement of the Ministry of Health, WHO, US CDC, UNICEF, USAID, and other partners have deliberated and developed a national plan to respond to the frequent measles outbreaks.

In affected counties, the incidence management system (IMS) headed by the County Health Officer was activated to respond to outbreaks. At sub-national levels, NPHIL, MoH, WHO, UNICEF, MSF and other partners provided technical and operational support to the CHT in the areas of surveillance, laboratory, case management, and vaccine supplies for reactive campaign.

b. **Epidemiology and Surveillance:** Active case search for measles has been ongoing in epidemic communities with involvement of community health volunteers. Health workers were sensitized to report all suspected cases immediately. Record reviews are also being routinely conducted in all health facilities whose catchment communities continue to report cases of measles.

c. **Case Management:** All cases are being provided symptomatic management with high dose of vitamin A at various facilities across the country. Case management protocol has been provided for clinical management of cases.

d. **Laboratory:** Blood samples were collected from 80% of all suspected cases and tested at the National Reference Liberia (NRL). Laboratory materials were prepositioned at health facilities and couriers stationed at designated points to transport specimens to the NRL.

e. **Immunization:** Eight reactive immunization campaigns were conducted in 2017 targeting various age groups depending on the local epidemiology of the disease. For most of the campaigns, the main age group targeted were 6 to 59 months old. A total of 6,874 people below 10 years were vaccinated in three counties - Bong, Nimba, and Margibi Counties. A reactive immunization campaign in Montserrado was planned for early January 2018 in Montserrado County.

A national supplementary immunization campaign (SIA) is expected to take place from February to March 2018 with a target population of 727,549 aged 6 to 59 months. The readiness assessment tool has been updated by the MoH and micro-planning has been ongoing in all 15 counties.

f. **Social Mobilization and Community Engagement:** Awareness activities have intensified in affected communities aimed at encouraging the population to utilize routine vaccination services, report all suspected cases of measles and seek urgent care at health facilities for all persons suspected of measles. Community volunteers are being used to conduct these activities in catchment communities.

Figure 11. Confirmed measles cases reported by week of onset, Liberia, January – December 2017 (n=984)

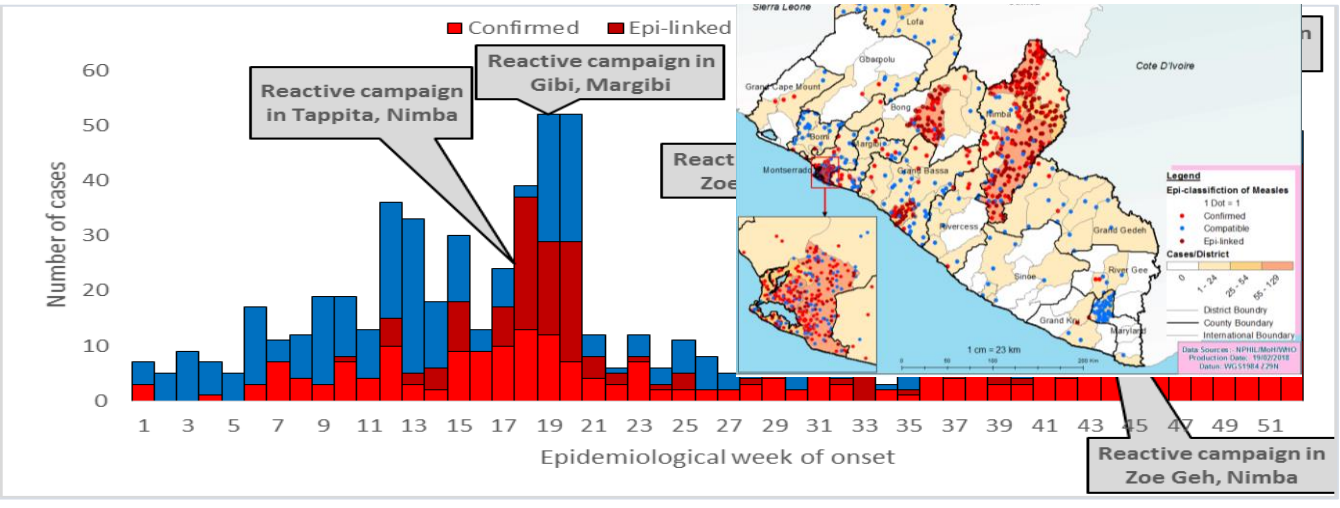


Table 4. Measles reactive immunization campaigns, Liberia, January – December 2017

Dates of reactive campaign	County	Health District	Communities	Age Group Targeted	Number Targeted	Number Vaccinated	Coverage (%)
1 – 5 May 2017	Nimba	Tappita	New Tappita, Christian Community, Kola Tree, Central Tappita, Mano Camp, Grenpea, Power Plant, Vahn Town	6 – 59 months	1290	1746	135%
8 – 12 May 2017	Margibi	Gibi	Kpelleh Jacob Town	9 – 11 months	420	355	85%
14 – 18 August 2017	Nimba	Zoe Geh	Mahnplay	6 – 59 months	193	111	57%
18 – 29 September 2017	Bong	Suakoko	Kayata Community	6 months – 10 years	1002	839	84%
18 – 29 September 2017; 6 – 24 November 2017; 11 – 15 December 2017	Nimba	Sanniquellie	Neipa, Underground Community, Airfield Zone-1, etc…	6 – 59 months	1816	715	39%
16 – 30 October 2017	Bong	Suakoko	Gboimue and Suakoko Town	6 months – 10 years	1491	1969	132%
23 – 27 October 2017	Nimba	Zoe Geh	Zlantuo Community	6 – 59 months	399	300	75%
4 – 7 December 2017	Bong	Zota	Gbansu-Suloma, Kororollie, Boryaquelleh, Dene-ta and Gaou	6 months – 10 years	1015	839	83%

iii. Situational Context

Measles is endemic in Liberia with sporadic outbreaks reported in most parts of the country. Enhanced surveillance for measles through IDSR couple with rapid testing by the NRL has led to the increase in detection of measles cases across the country. A recent risk assessment conducted by the Expanded Program on Immunizations (EPI) program of the Ministry of Health for potential measles epidemic considering population immunity, program performance, and threat probability concluded that 6 counties were at very high risk of measles outbreak. Three counties were found to be at high risk and four counties found to be at medium risk. Only two counties were considered at low risk for potential measles outbreaks. Efforts are being made to reduce the high incidence of measles with focus on reviewing immunization cold chain for vaccine potency, strengthening outreach activities, and introduction of booster doses. A nation-wide measles campaign targeting age group 6 to 59 months is planned for February and March 2018.

C. Lassa fever

i. Epidemiological description

The country has been reporting sporadic cases of Lassa fever. In 2017, a total of 78 suspected cases including 26 deaths (case fatality rate 33.3%) were reported from 9 counties in Liberia. Out of this, 30 cases were confirmed for Lassa virus infection, including 12 deaths from seven counties. The case fatality rate among confirmed cases is 40%. Nine other suspected cases including 6 deaths were reported but not tested.

A. Montserrado County: The first confirmed case reported during the year was a 67-year-old male who travelled from Ganta, Nimba County and presented at a hospital in Central Monrovia, Montserrado County, on 6 January 2017. Post-mortem laboratory results of the case was released as ELISA antigen positive on 15 January 2017. None of the contacts identified both in Montserrado and Nimba Counties became symptomatic.

B. Nimba County: Nine confirmed cases including 4 deaths were reported from two districts – Sanniquellie Mah (3) and Saclepea Mah (6). Case fatality rate is 44.4%. Four of the cases were males and five were females. Age range of the cases was from 15 to 47 years old.

C. Bong County: Seven confirmed cases including 5 deaths were reported from two districts – Suakoko (4) and Jorquelleh (3). Case fatality rate is 71.4%. Five of the cases were males and two were females. Age range of the cases is from 5 to 36 years old. These two districts are known to be endemic for Lassa fever with confirmed cases reported every year.

D. Grand Bassa County: Nine cases were confirmed in District #3, Grand Bassa County. There were no deaths reported among confirmed cases. Three of the cases were males and six were females. Age range of the cases is from 18 to 40 years. District #3 is known to be endemic for Lassa fever.

E. Margibi County: Two confirmed cases including one death were reported from Kakata district. Case fatality rate is 50%. The first case, a 36-year old male for Sao Farm Community, developed symptoms on 23 May 2017 and was admitted at a hospital in the county on 30 May 2017 having presented with general weakness, fever, and bloody discharges from the mouth and anus. Blood sample was collected on 30 May 2017 and tested positive on 11 July 2017 at the Regional Reference Laboratory in Kenema, Sierra Leone. He died while in admission at the health facility.

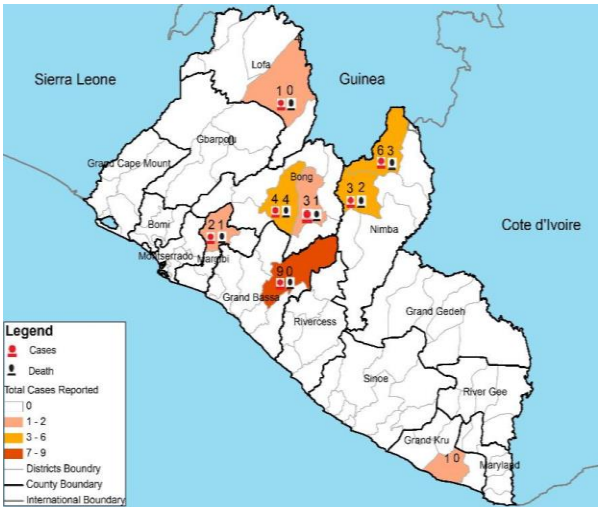
The second case, a 9-year-old male from Telecom community, developed symptoms on 15 September 2017, after reportedly being bitten by a rat. On 4 October 2017, the case-patient presented to a facility in the county with fever, weakness, headache, and abdominal pain. Blood samples collected from the patient at time of admission tested positive on 6 October 2017 at the Kenema Regional Laboratory in Sierra Leone for Lassa fever infection. The case-patient was treated and discharged.

No contacts of any of the two cases became symptomatic.

F. Grand Kru County: One confirmed case was reported from Barclayville district. The case-patient, 11-year-old male from Newaken community, Barclayville district, developed symptoms on 1 October 2017 and was admitted at the county hospital on 5 October 2017. Blood sample collected on 5

October 2017 tested positive by RT-PCR on 20 October 2017 at the NRL. The patient was treated and discharged. This area was not originally known as one of the Lassa fever endemic areas. No travel history to any of the Lassa fever endemic county was reported for the case-patient.

Figure 12. Geographical distribution of confirmed Lassa fever cases, Liberia, 2017



G. Lofa County: A case of Lassa fever was confirmed in Zorzor district, Lofa County. The case-patient, a 44-year-old male from Kpassagizia, Zorzor district, developed symptoms after reportedly returning from a burial ceremony of a close relative in Guinea in the past two weeks prior to symptoms onset. He presented at a Clinic on 21 January 2017 and sample was collected on the same day. He died on 26 January 2017 while undergoing care. Laboratory results released on 30 January 2017 confirmed the case as positive by both RT-PCR and ELISA antibody-IgM tests. Five contacts were identified and monitored but none became symptomatic.

ii. Public Health Response

a. Coordination: In each of the affected counties, response to incidence of Lassa fever was coordinated by the CHT under the leadership of the County Health Officer. WHO Field Offices, County Hospitals and Local partners also supported response activities. Rapid response teams consisting of surveillance officers, laboratory staff, WHO field epidemiologist, and other county health team staff were usually deployed to initiate case investigation, contact tracing, infection prevention and control, and community engagement activities. Reports were submitted periodically to the national level.

At the national level, the NEPRC under the leadership of NPHIL with support from MoH, WHO, US CDC, and other partners monitored each event and provided technical support to the counties in the areas of surveillance, laboratory, case management and drug supplies, and community engagement.

b. Epidemiology and Surveillance: Active case search and contact tracing activities were initiated for each of the confirmed cases. A total of 834 contacts were identified and monitored in 2017. None of these contacts became symptomatic. Orientation of clinical staff on identification and reporting of suspected cases of Lassa fever were conducted routinely at county level. Community Health Assistants (CHAs) were also trained to identify and report suspected cases in the community using simplified case definition. A national line list of all cases was compiled and periodically updated with clinical, epidemiological, and laboratory data.

c. Laboratory: Blood samples were collected from 69 out of 78 suspected cases reported. Samples from 30 suspected cases were confirmed either by RT-PCR or serology tests. All serology tests were conducted at the Kenema Regional Laboratory in Sierra Leone. The NRL in Liberia gained RDT and RT-PCR testing capacity in June 2017 and has since been conducting test for Lassa virus infection. Sample transportation from point of collection to the NRL is mainly by the courier system with Riders stationed at designated point to collect samples and convey to NRL.

d. Case Management: clinical management of cases were mainly done at designated treatment centers across the country. The main treatment unit is at Phebe Hospital in Bong County. In Nimba County, Saclepea Comprehensive Health Center and Kpein Clinics are the two main treatment centers for Lassa fever. In Grand Bassa, all cases were managed at LAC Hospital while in Margibi cases were managed at C.H. Rennie Hospital. Rally Time Hospital in Grand Kru provided clinical management of the case. All hospitalized cases received ribavirin drug as well as symptomatic treatment. An appreciable stock of ribavirin is available at national level and has been prepositioned at county level.

e. Infection Prevention and Control (IPC): Standard and transmission-based precautions were reinforced at all health facilities managing cases of Lassa fever. Safe burial was conducted under the supervision of environmental health technicians for 20 out of the 30 confirmed cases to prevent human-to-human transmission of infection. Prevention of human exposure to body fluid and excreta of mastomy rats, the vector for Lassa virus, have also been highlighted in several community engagement meetings.

f. Risk Communication and Social Mobilization: Laboratory results were disseminated to affected family members. Awareness meetings involving community stakeholders were held in all affected communities on preventative methods and reporting of suspected cases.

iii. Situational Context

Lassa fever is endemic in Liberia, with sporadic cases and occasional outbreaks reported annually. In endemic areas, poor sanitation coupled with improper food storage and handling (which attract the Lassa virus-carrying Multimammate rats (Mastomys natalensis), have been considered a risk factor for the high incidence of the disease.

Overcrowding and poor environmental management are also contributing factors facilitating transmission of the disease among the population.

Concerted efforts have been made in recent years to strengthen active surveillance for Lassa fever in the country, through training of healthcare workers in IDSR. Additionally, infection control practices have greatly improved in healthcare facilities (in the aftermath of the Ebola outbreak) and this may be the reason why no hospital-acquired infection of Lassa fever has been reported in 2017.

The high case fatality rate would also need to be studied highlighting the need for early detection and treatment of cases. The national level is developing a new Lassa fever preparedness and response plan to robustly strengthen response and control efforts.

D. Human Monkeypox

i. Epidemiological description

Since November 2016, a cumulative total of 18 suspected cases including 2 deaths have been identified and reported from three counties – Rivercess (12), Grand Cape Mount (5), and Maryland (1). Case fatality rate among suspected cases is 11%. There are equal number of males and females affected. Ages range from 5 to 43 years old. Samples were collected from 13 out of 18 suspected cases for laboratory investigation. Serology test results released by the US CDC Laboratory in Atlanta, USA, in 2017 for six cases found presence of orthopoxvirus antibodies (IgM-antibody) in two of the case-patients and (IgG-antibody) in four cases. Two cases were positive for monkeypox virus DNA.

Rivercess County: The first cluster involved 8 suspected cases from Yarnee District, Rivercess County. The first case, a 34-year-old male, from ACFI Mission Community, Yarnee District, Rivercess County, presented to a health facility on 9 November 2016 with signs and symptoms of rash/skin lesions and fever which began on 28 October 2016. The case-patient initially developed fever followed by rashes 2 to 3 days later which spread from the lower limbs and became generalized. The skin lesions began as raised macular-papular rashes with central umbilication, then opened to vesicles and open sores. The lesions were intensely pruritic and described as having sharp needle-like pains. The case-patient was treated on an OPD basis and discharged. No sample was collected.

The second case, a 2-year-old male and son of the first case, developed symptoms on 5 November 2016. The third case, a 30-year-old female who is mother of the second case and wife of the first case, developed signs and symptoms on 7 November 2017. Both cases presented at a health facility on 14 November 2016 with similar signs and symptoms as the first case including rashes which had spread to the face. The case-patients were treated on an outpatient basis and discharged. No samples were collected.

A total of five other cases from the same community and belonging to this cluster had symptoms onset during 7 - 25 November 2016. All were treated on an outpatient basis and discharged initially without sample collection. Retrospective investigation led to collection of blood samples from four of the cases in this cluster on 21 November 2017. Serology tests conducted at US CDC Laboratory in Atlanta found orthopoxvirus antibodies (IgG-antibody) in all four samples.

The second cluster in Rivercess County involved two suspected cases from Dodain District reported in June 2017 to the national level. The first case in this cluster was an 8-year-old male from Buedue Town who developed symptoms on 7 June 2017 and presented to a clinic on 9 June 2017 with fever, headache, and rashes spread over the body. The lesions were noticed to be pruritic. The second case, a 31-year-old female nurse and mother of the first case, developed symptoms on 9 June 2017. Both cases were treated on an outpatient basis and

blood samples collected. Six contacts were monitored. No test results have been released.

The third cluster involved two suspected cases reported from Yarnee District, Rivercess County to the national level on 2 December 2017. The first case in this cluster was an 11-year-old female and the second case a 14-year-old male. Blood samples were collected from both cases. Serology test results released by US CDC Laboratory found the 14-year-old case-patient as positive.

Grand Cape Mount County

The first cluster in Grand Cape Mount County involved the first two suspected cases.

The first case, a 23-year-old pregnant female, from Wacco Community, Garwula District, developed symptoms on 5 December 2016. The case-patient sought treatment and was admitted at a health center in the district on 8 December 2016 having presented with complaints of skin rashes (deep, vesicles of different sizes mainly concentrated in the trunk) for 3 days, generalized body pain and weakness for 2 days, and high-grade fever. Laboratory investigation at the health center ruled out hepatitis b and HIV infection. Blood sample was collected and sent to NRL for monkeypox investigation. Upon insistence from family members, the case-patient was discharged against medical advice on 10 December 2016. The case-patient reportedly died in her home on 11 December 2016. She was reported to have experienced blurred vision and hemorrhage immediate prior to her death at home. Eight contacts were identified for monitoring. One of the contacts became symptomatic. Case investigators found that one week prior to symptom onset the case-patient provided care to her sister who had conditions of skin rashes and was admitted at a hospital in Monrovia but later recovered and was discharged.

The second case, a 26-year-old male and husband of the first case, developed symptoms on 25 December 2016. The case-patient, isolated in a hut on a nearby farm, was notified to the contact tracing team by the local Town chief on 27 December 2016. On assessment, the team found rashes on the face, thorax, arms, back and abdomen. Dried scars were also observed as the result of the traditional herbs that had been applied by his mother. Blood sample was collected from the case-patient and symptomatic management provided. The case fully recovered. Four contacts were identified and monitored.

The third case, a 15-year-old female from Up Town community, Commonwealth District was identified on 24 March 2017 in the community by surveillance officers. She reported to have had symptom onset since end of December 2016. The case-patient was found alert and poorly nourished with couple of rashes and scars over the body. The lesions were noted as pruritic. No links were established with previous cases. Blood sample was collected and sent to the NRL.

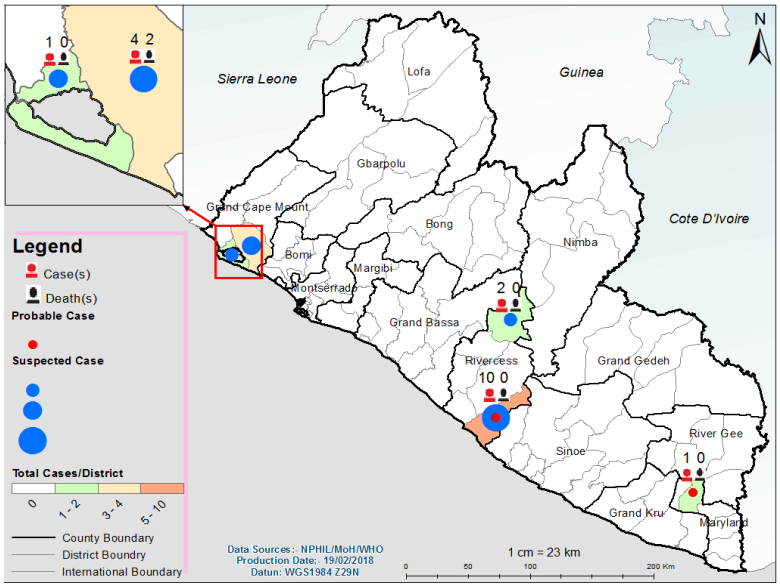
The fourth and fifth cases belong to the second cluster in Grand Cape Mount County.

The fourth case, an 11-year-old female from Garwula District, reportedly developed rashes on 25 April 2017 which spread throughout the body. She did not attend any facility but received home treatment until full recovery. She was identified through retrospective investigation after recovery.

The fifth case, a 39-year-old male and father of case 4 from Sinje Estate Community, Garwula District, developed symptoms on 3 May 2017 and was identified in the community on 12 May 2017 with generalized body rashes including the face. Blood sample was collected and sent to NRL with antibiotics (Erythromycin) and Ibuprofen treatment initiated.

The case-patient later sought treatment at a hospital in Monrovia but died in admission in June 2017. He was reported to have cared for case 4.

Figure 13. Geographical distribution of suspected and probable human monkeypox cases, Liberia, October 2016 to November 2017



Maryland County

Maryland County Health Team notified the national level of a suspected case of monkeypox on 8 December 2017. The case-patient, a 5-year-old male from Tenken Town, Barrobo Farjah District, Maryland County with symptoms onset on 26 November 2017 presented at a clinic on 29 November 2017 with fever, headache, muscle aches, backache, swollen lymph nodes, chills and exhaustion. The case-patient received initial treatment and was referred to the county hospital on 1 December 2017 at which time he presented rashes in addition to symptoms previously reported. The rashes reportedly progressed from the face and then spread to other parts of the body including the soles of the feet. The rashes started as flat (macular) lesions and progressed to blisters filled with clear fluid, then pustular and finally dry up into a crust-like lesion. The lesions were clustered from a few to several hundred on the face and legs and affected the genitals as well.

On 2 December 2017, JJ Dossen Hospital notified the DSO with initial diagnosis of chickenpox. A subsequent review of the case by the surveillance team considered monkeypox as a differential diagnosis. The case-patient was treated and has reportedly recovered with visible scars on the body and returned to his community of residence. Five contacts were identified and monitored.

Three samples (wound swab, whole blood sample, and skin snip) were collected from the case-patient and sent to US CDC laboratory in Atlanta. Test results returned positive.

Public Health Responses

a. Coordination: In each of the affected counties, response to incidence of suspected cases of monkeypox was coordinated by the County Health Team under the leadership of the County Health Officer. WHO Field Offices and County Hospitals also supported response activities. Rapid response teams consisting of surveillance officers, laboratory staff, WHO field epidemiologist, and other county health team staff were usually deployed to initiate case investigation, contact tracing, and community engagement activities. Reports were submitted periodically to the national level.

National level coordination was led by NPHIL with support from MoH, WHO, US CDC, and other partners.

b. Epidemiology and Surveillance: Contact tracing activities were initiated for each of the confirmed cases. Due to the need for additional clinical, epidemiological, and laboratory information, a retrospective investigation was conducted in November 2017 by staff from the national level comprising disease investigators and laboratory technicians. Rivercess and Grand Cape Mount Counties were visited. A national line list of all cases was compiled and has been updated with clinical and epidemiological information. The national risk prioritization of zoonotic diseases concluded the addition of monkeypox to the list of immediately notifiable diseases in Liberia. Tools for detecting, reporting, and investigating suspected cases have been developed.

c. Laboratory: No diagnostic capacity for monkeypox is available in Liberia, however, specimens were sent to the US CDC Laboratory in Atlanta for confirmation. Blood samples were collected from a total of 13 out of 18 suspected cases. Because of compromised status of some of the samples initially collected, blood samples were recollected from a total of 5 suspected cases who had already recovered during retrospective investigation in November 2017 in Rivercess County. Serology test results released for a total of six suspected cases found two cases as IgM-positive and four cases as IgG-positive. The presence of IgM-antibodies in the only case from Maryland and the last case reported from Rivercess is indicative of recent infection. The presence of IgG antibodies may have been due to the fact the case-patients were in the convalescent stage at the time of sample collection. Due to absence of direct detection of virus (antigen or DNA) the cases will remain classified as probable cases.

d. Case Management: Sixteen out of the 18 case-patients sought care at a health facility and two were admitted while the others were treated on an outpatient basis and sent home. One of the cases died in admission. Two cases did not seek treatment at any health facility. Clinical management was mainly symptomatic with the administration of antibiotics.

e. Risk Communication and Social Mobilization: Awareness meetings involving community stakeholders were held in all affected communities on preventative methods and reporting of suspected cases.

ii. Situational Context

Monkeypox is a rare disease that occurs primarily in remote parts of Central and West Africa, near tropical rainforests. The monkeypox virus, first identified in 1958, is transmitted to people from various wild animals but has limited secondary spread through human-to-human transmission. Typically, case fatality in monkeypox outbreaks has been between 1% and 10%, with most deaths occurring in younger age groups. There is no treatment or vaccine available although prior

The current suspected cases are being reported from remote parts of Liberia. Unlike Rivercess and Grand Cape Mount Counties where there have been suspected cases reported in the previous year, this is the first time a suspected case has been reported from Maryland County. This also happens in light suspicion of monkeypox which is usually clinically diagnosed as chickenpox, varicella zoster.

The lack of local testing capacity and the delay in release of definitive laboratory results to determine the etiological agent has created anxiety and suspicion from suspected cases and their family members from whom samples have been collected. There is a need to strengthen laboratory confirmation in order to aid effective surveillance activities.

A recent infectious disease risk prioritization workshop held in November 2017 under the NPHIL leadership identified the need to strengthen surveillance and preparedness for monkeypox, as one of the emerging infectious diseases. A decision was reached to include monkeypox among the list of immediately notifiable conditions across the country. Work has already started for adaptation of case definitions and investigation tools.

E. Meningococcal Disease

From 23 April – 7 May 2017, a cumulative total of 31 cases with 13 deaths (case fatality rate of 41.9%) were reported from three counties as part of an outbreak of meningococcal disease. Majority of the cases were reportedly exposed to the pathogen at funeral events (wake, burial, repass) which took place on 21 - 22 April 2017 in Greenville, Sinoe County. However, there were two secondary cases, one from Grand Bassa and one from Montserrado who did not participate in the funeral events. A total of 14 cases were males and 17 were females. The affected age group range from 10 to 62 years with a median age of 15. No new cases and deaths related to the event were reported after 7 May 2017. The outbreak was declared over on 17 May 2017 by NPHIL. *See the IDSR 2017 semester bulletin for details (http://moh.gov.lr/idsr-first-semester-bulletin-2017/)*

Figure 15. Geographical distribution of outbreak cases of meningococcal disease, Liberia, 2017

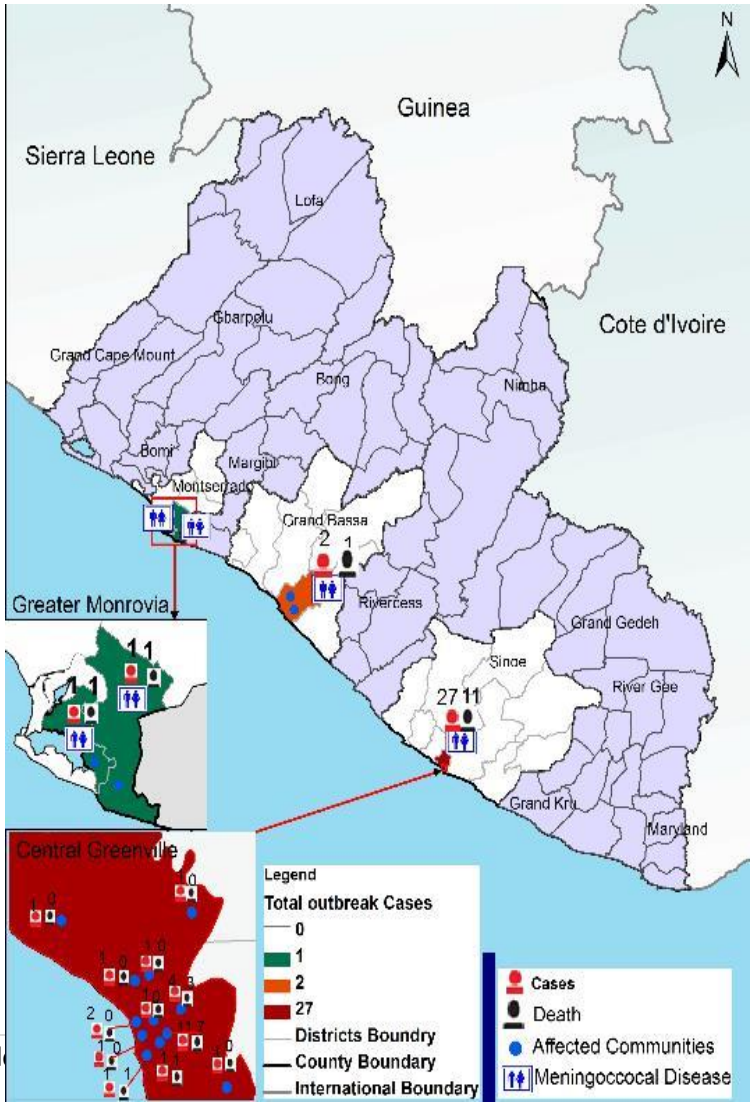
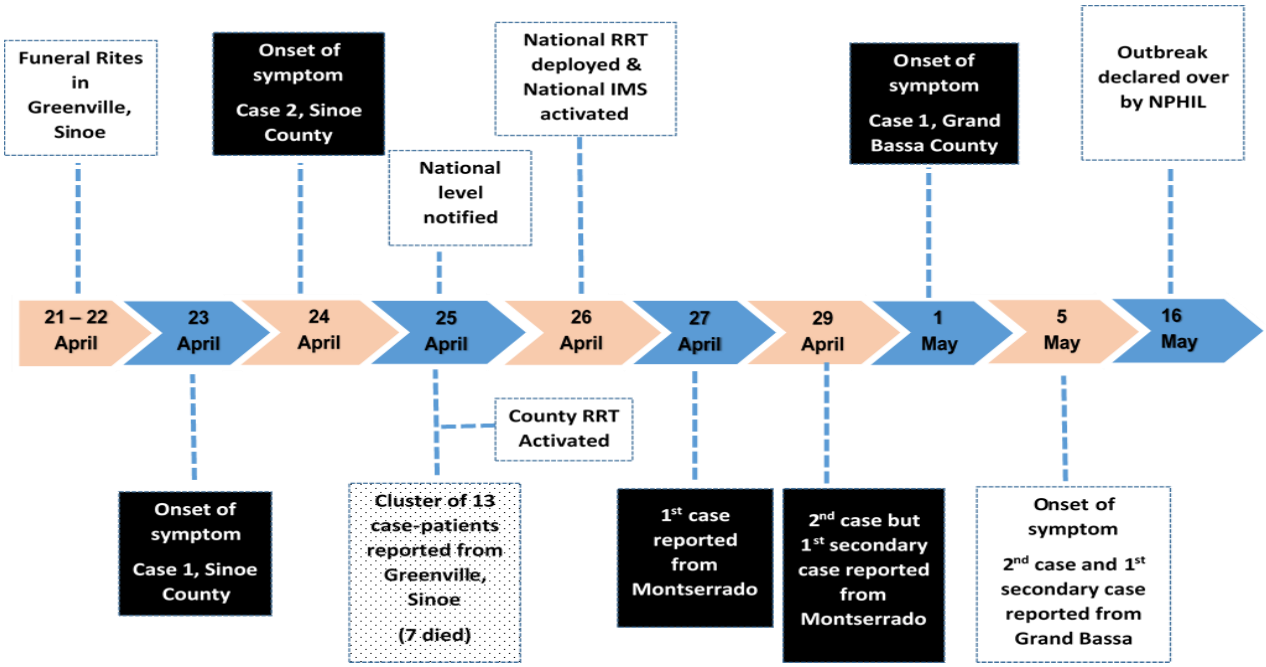


Figure 16. Trend of events meningococcal disease outbreak, Liberia, 21 April – 16 May 2017



F. Floods/Mudslides

Two notable incidents of flood and mudslide were reported to the national level from Bong and Margibi Counties. Floods are significant health events owing to the humanitarian crisis and accompany disease outbreaks which many families tend to suffer. There is normally high risk of water-borne disease outbreaks during such events which makes monitoring and support to response activities a critical piece of disease control efforts.

Bong County

i. Description of the Event

Heavy down pour of rain on the morning of 13 September 2017 in Bong Mines, Fuamah District led to mud slide at one of the concession sites of Bong Mines, an Iron Ore Mining Company, resulting in the damage of 24 houses in the area. A total of 41 households (350 people) were rendered homeless as a result of the incident. The stockpile of earth had been abandoned since 2014 when the company ceased operations due to the Ebola outbreak. An open well serving as source of water to the community was also damaged. No death or injury related to this incident was reported.

ii. Response

Response to the incident was coordinated by local county authorities with involvement of several agencies of the government including the Environmental Protection Agency, Ministry of Lands, Mines, and Energy, Bong CHT, and a host of relief organizations.

Margibi County

i. Description of the Event

On 14 September 2017, Margibi County notified the national level of flooding in two districts - Mamba Kaba and Kakata Districts which had affected 14 communities rendering 3,190 people including 7 pregnant women homeless. The flood was due to overflowing of the Farmington River in the area due to heavy downpour of rain which started on the night of 12 September 2017.

Flood water spread from the communities along the main route from Monrovia to the Roberts International Airport rendering the road impassible by motorist. A bridge in the area was also damaged. Academic activities for school-going kids were suspended in the area.

ii. Response

Response to the event was coordinated by the local county authorities with support from the Ministry of Internal Affairs, Margibi CHT, Liberia National Red Cross, NPHIL, WHO, and a host of other partners. Safe drinking, food, clothing, water treatment guard, and mosquito nets were provided to affected families. Active surveillance was initiated for water-borne diseases. No confirmed case was reported.

G. Chemical Spills

i. Description of Event

On 2 October 2017, Bong County Health Team notified the national level of creek water contamination near Sayweh Town, Kokoyah District leading to 36 cases in the town. The incident reportedly occurred as a result of heavy down pour of rain on 28 September 2017 during which reservoir of a mining company in the area containing chemicals such as cyanide, carbon, burnt coconut shell, hydrochloride, and methyl got flooded thus causing spill of the substances in the nearby creek. All 36 cases were identified in the town on 2 October 2017 with signs and symptoms of intense pruritis, diarrhea, and eye and body pain and referred to Phebe Hospital in Bong County for treatment. In addition to the signs and symptoms mentioned, one of the cases reported vaginal itching, skin rashes, headache, and skin burns. All cases were treated and discharged with no death reported. The cases were reportedly exposed as a result of domestic use of the creek water for cooking, drinking, and bathing as well as walking through the creek water to travel to nearby towns. The town has an estimated population of 1,000 people.

ii. Response

On 2 October 2017, a rapid response team comprising of Bong CHT, WHO Field Office, and AFRICARE was deployed to investigate the situation and initiate response activities. All cases were identified, referred to Phebe Hospital and treated. Thirty of the cases were treated on an outpatient basis while six were admitted. A team from the Environmental Protection Agency, Ministry of Lands, Mines and Energy, and Ministry of Justice also visited the site for investigation. Water samples were reportedly collected for testing. Local community meetings were held in addition to mass media awareness concerning the contamination of the creek that aired via local radio station. Affected families were provided water and food items by the mining company.

IV. DISEASES/CONDITIONS OF PUBLIC HEALTH IMPORTANCE

A. Maternal Death

i. Epidemiological Description

A cumulative total of 258 maternal deaths were reported through IDSR in 2017, out of which 232 (90%) were investigated at health facility and county levels. The annual maternal mortality ratio is 133 per 100,000 live births. A total of 192 (74%) of maternal deaths were reported to have occurred in health facilities. In spite of active surveillance, there is caution that the number of maternal deaths reported may have been lower than the actual deaths that occurred during the period. Montserrado County recorded a total of 67 deaths, representing 26% of all maternal deaths reported in the country. A total of 69 (27%) deaths occurred among women who had never been to school while 5 (2%) of the deaths were recorded among women who had earned college diplomas. One hundred eighty-seven (72%) of deceased women had no known HIV status, however, 7 (3%) were found to be HIV-positive. It was also found that 111 (43%) deceased did not attend any Antenatal Care (ANC) visits while 38 (16%) completed 4 or more ANC visits. The age range of deceased women was from 15 to 47 with a median age of 29 years. Out of the 232 deaths reviewed, 65 (28%) had at least one previous abortion prior to their death. A total of 74 (29%) of all deaths occurred in the immediate post-partum period (within first 24 hours of delivery).

Sixty-five percent of deaths were due to direct obstetric causes, of which hemorrhage accounted for 32%. Anemia was found to be the leading cause of indirect deaths accounting for 7% of maternal deaths. After thorough review of contributory factors to maternal deaths involving 100 of the deceased, long distance to the nearest health facility was found to be the leading contributing factor accounting for 23%.

Table 5. Number of maternal deaths by county and place of death, Liberia, 2017

						Place of death				
County	Maternal Death	Total Number of maternal deaths reviewed	% of Maternal deaths investigated	Est. Live Birth (4.3% of population)	Maternal mortality ratio (per 100,000 Live Births)	Hospital/Other formal health facility n(%)	Home n(%)	En route to a health facility n(%)	En route from a health facility n(%)	Don't Know n(%)
Bomi	8	8	100%	4286	187	7	1	0	0	0
Bong	38	37	97%	17223	221	26	6	6	0	0
Gbarpolu	5	5	100%	4323	116	3	1	1	0	0
Grand Bassa	23	22	96%	11307	203	12	8	1	2	0
Grand Cape Mount	2	2	100%	6588	30	1	1	0	0	0
Grand Gedeh	12	9	75%	6494	185	11	0	1	0	0
Grand Kru	8	8	100%	2871	279	5	2	1	0	0
Lofa	14	13	93%	14354	98	12	1	1	0	0
Margibi	19	18	95%	10883	175	12	3	2	0	2
Maryland	9	9	100%	6659	135	7	1	1	0	0
Montserrado	67	51	76%	73230	91	51	8	0	8	0
Nimba	32	30	94%	24125	133	29	0	3	0	0
River Gee	7	6	86%	3463	202	6	1	0	0	0
Rivercess	4	4	100%	3707	108	1	0	3	0	0
Sinoe	10	10	100%	4593	218	9	1	0	0	0
Liberia	***258***	***232***	***90%***	***194107***	***133***	***192 (74%)***	***34 (13%)***	***20 (8%)***	***10 (4%)***	***2 (1%)***

Figure 17. Stage of pregnancy at time of death, Liberia, 2017 (n=258)

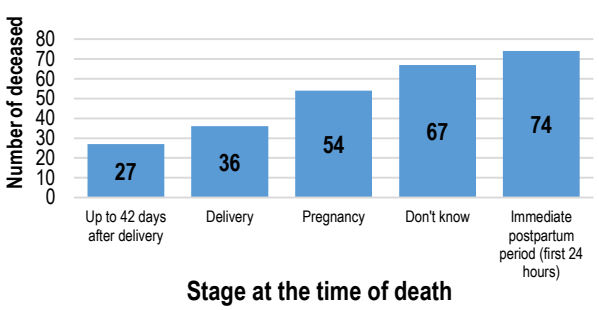


Figure 18. Type of delivery among deceased women who give birth, Liberia, 2017 (n=205)

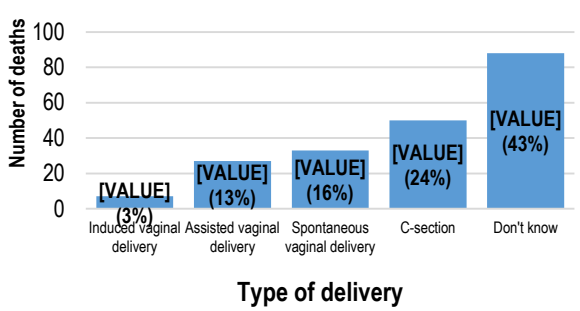


Table 6. Number of maternal deaths by educational and HIV status and number of antenatal visits prior to death

Contributory factors	Frequency	Percentage
Long distance from patient home to nearest health facility	23	23%
Lack of appropriate clinical care at health facility	14	14%
Delay in referral of patient from home	11	11%
Lack of recognition of danger sign	11	11%
Lack of necessary supplies/equipment at health facility	10	10%
Delay in attending to patient at health facility	8	8%
Lack of vehicle for prompt referral	8	8%
Home delivery	7	7%
Delay in referral of patient from peripheral health facility	5	5%
Poor quality ANC service	4	4%
Lack of appropriate staff	4	4%
Herbal Ingestion	3	3%

Sinoe	0	0	1	0	2	7	0	8	2	5	1	2	1	1	0
Liberia	5 (2%)	15 (6%)	18 (7%)	24 (9%)	69 (27%)	127 (49%)	7 (3%)	64 (25%)	187 (72%)	111 (43%)	24 (9%)	38 (15%)	21 (8%)	38 (15%)	26 (10%)

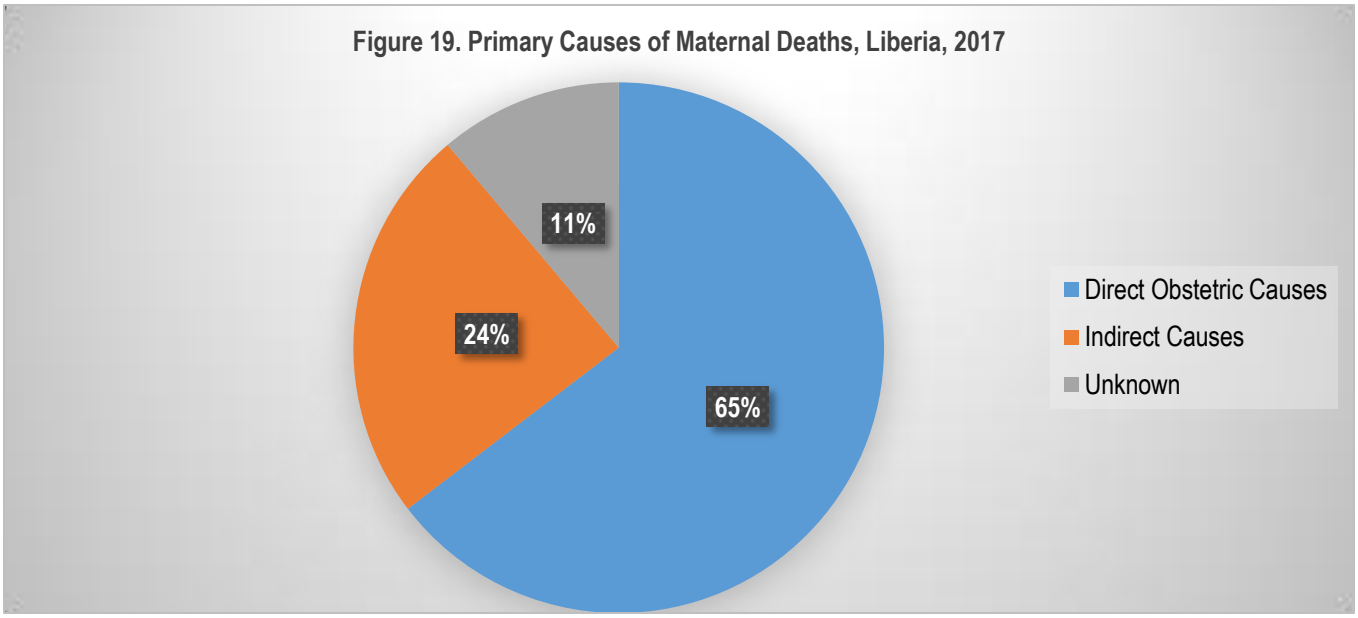
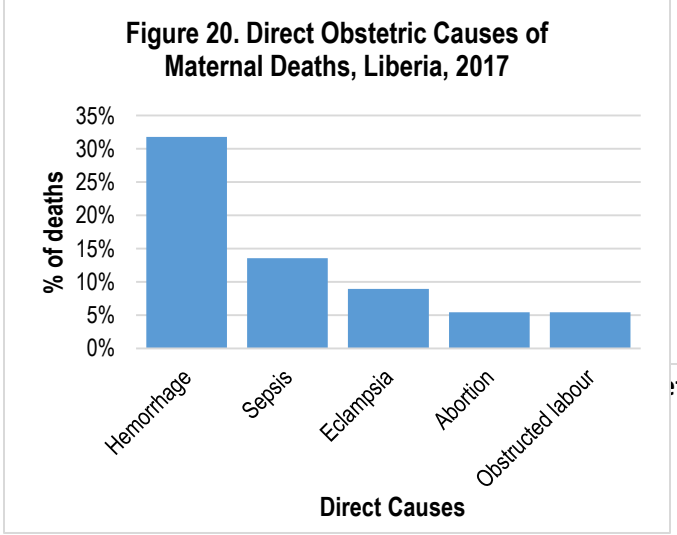
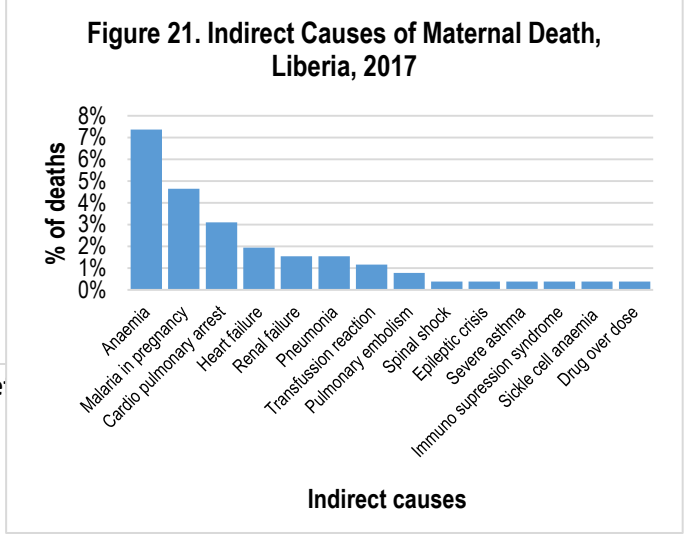


Table 7. Contributory factors to maternal deaths, Liberia, 2017 (n=100)





Discharged early after surgery	2	2%
Lack of family availability during critical period	1	1%
Lack of money to transport patient	1	1%
Refusing referral to a hospital	1	1%
Patient refusal to follow doctor order	1	1%
Lack of blood bank	1	1%
Lack of follow up on post-operative patient	1	1%

Percentage do not add up to 100% because each death may have more than one contributory factors

ii**. Public Health Response**

a. Coordination

The maternal and neonatal death surveillance and response (MNDSR) technical working group was first established in 2009 and revamped in 2016 with expanded membership to coordinate surveillance and response activities for the reduction of maternal and neonatal deaths. Leadership of the national MNDSR committee is provided by the full involvement of NPHIL, UNFPA, WHO, US CDC, JICA, UNICEF, and other partners. At the sub-national level, the MNDSR committee has been decentralized under the leadership of the county health team with involvement of all partners working in maternal and child health programs. Trainings, review of maternal deaths, and monitoring the implementation of key findings and recommendations are coordinated through the MNDSR committee. New technical guidelines for maternal and neonatal death surveillance and response has been developed and launched by the national MNDSR committee.

b. Surveillance: New case investigation tools have been developed for conducting maternal death investigation and verbal autopsy. A national training of trainers' workshop was conducted in July 2017 for training of all county surveillance and reproductive health officers in the use of the new tools. Roll out trainings were conducted from August to November 2017 in 8 out of 15 counties targeting district level supervisors and health facilities. Surveillance for maternal deaths has been enhanced at both health facility and community levels through IDSR as part of the conditions requiring immediate notification. Simplified case definitions are also provided to community health assistants, trained traditional midwives and volunteers to report all maternal and newborn deaths in the community. Maternal and newborn death data are reviewed and analyzed weekly and presented in the weekly IDSR bulletin. Ninety percent of maternal deaths reported in 2017 were investigated compared to 60% in the previous year.

c. Maternal waiting homes: Maternal waiting homes on communities more than 5km away from the health facilities. A total of 6 maternal waiting homes were constructed in 2017 with support from WHO through the H6 SIDA Partnership. A total of 540 women have utilized these waiting homes and no deaths have been recorded among women who utilized these homes. Non-medical services to women in these homes are provided by the local community, the families and the County Health Teams.

d. Preventive health care: Pregnant women are encouraged to have a minimal number of four antenatal care visits at the health facilities; the full package of services including medical, diagnostic and nutritional support and education is offered to each ANC client. The UN, civil society and government are actively supporting the provision of these services.

e. Functional Referral Services: Ambulances, radio communication services: A total of 7 ambulances were procured by WHO with financial support from the H6 Partnership and the multi partner trust fund and distributed to 7 counties to support emergency response to pregnant women and sick newborns. Each ambulance was fitted out with HF radios and

linked to the health facility through corresponding base radios.

f. Social Mobilization and Community Engagement: Community meetings were held in different parts of the country to provide knowledge to local communities on the need for utilization of health services during pregnancy, timely referral of pregnant women, as well as risk associated with deliveries at home or by traditional attendants. The roles of traditional midwives have been redefined where they are advised NOT to perform deliveries. Community leadership is actively enforcing this new scheme and levy a fine on any traditional midwife who defies this call.

g. Task Shifting and Sharing: An Innovative Task sharing approach for improving maternal and newborn care is being implemented in Liberia in partnership with the Maternal Child Advocacy International (MCAI) with technical and financial support by WHO, UNFPA, the Liberia Medical and Dental Association and the Liberia Board for Nursing and Midwifery. The approach comprises task sharing projects in advanced obstetrics and advanced neonatal care. The innovation trains mid-level health professionals principally midwives, initially and later other cadres of mid-level health professionals in these critical service delivery areas. To date, two midwives have been trained over a period of three years and certificated to provide advanced obstetric services; a mix of additional nine mid-level professionals are undergoing internship at various major hospitals in Monrovia and selected counties (Margibi, Lofa, Grand Gedeh and River Gee) for a rotational period of six months at each location after completing two of the three years of training in advanced obstetrics. Four trainees are undergoing the training in advanced neonatal care for a period of two years. Ten new recruits are undergoing the three years training in advanced obstetrics.

B. Tuberculosis

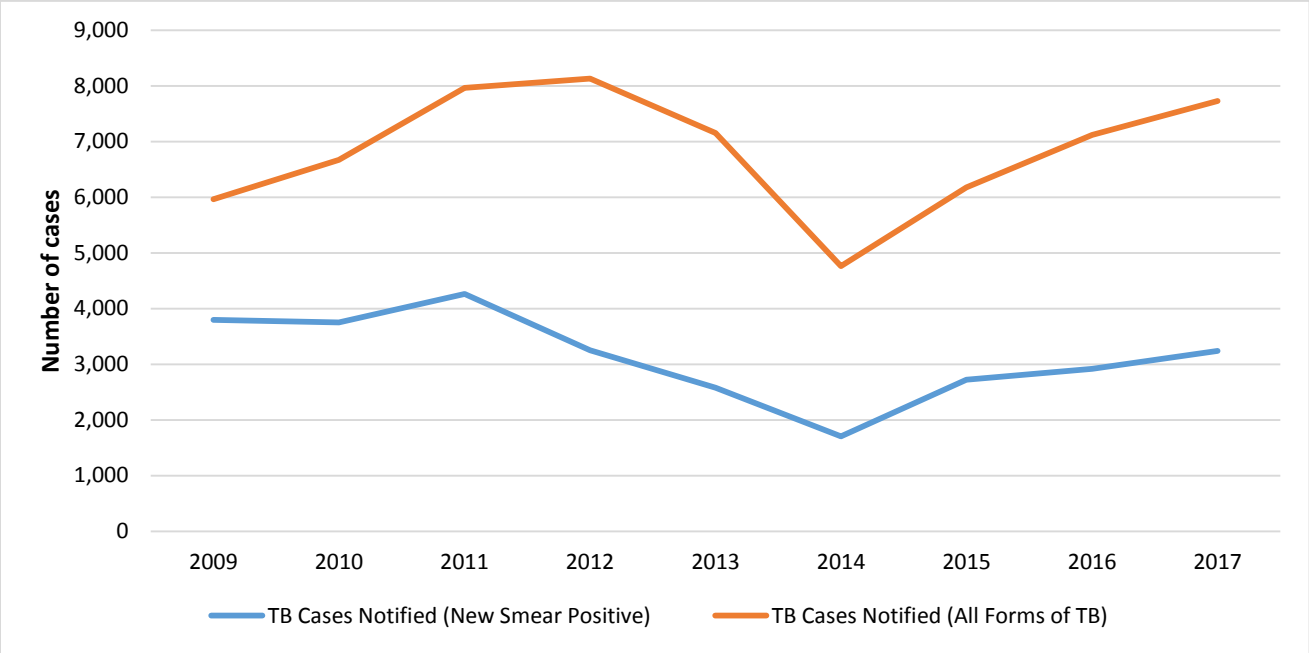
A total of 7,728 cases of all forms of tuberculosis (TB) were reported in 2017. This is a 7% increase in the number of cases reported compared to 2016 when a

of the country's TB prevalence has been on the increase since 2005, however, from 2010 to present, the rate has been relatively stable

Table 8: TB Cases Estimated and Reported from 2009 – 2017

Classification	Years								
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Estimated Population	3,549,617	3,624,159	3,700,266	3,777,972	3,857,309	3,938,313	4,021,018	4,105,458	4,191,673
Estimated TB Cases of All Forms	9,655	9,858	10,065	10,276	10,492	10,712	10,937	12,645	12,957
Estimated Smear Positive TB Cases	4,189	4,277	4,366	4,458	4,552	4,647	4,745	5,690	6,201
TB Cases Notified (***New Smear Positive***)	3,796	3,750	4,261	3,249	2,579	1,704	2,724	2,919	3,232
TB Cases Notified (***All Forms of TB***)	5,964	6,668	7,965	8,132	7,153	4,763	6,176	7,119	7,728
Case Detection Rate (***New Smear +ve***)	91%	88%	98%	77%	57%	37%	57%	64%	68%
Case Detection Rate (***TB Cases of All Forms***)	62%	68%	78%	60%	56%	34%	56%	67%	60%

Figure 22. Trend of TB Case Notification, Liberia, 2009 - 2017



Smear Positive TB cases make up 42% percent of all cases registered and extra-pulmonary TB accounts for 32% which is a 1% increase from 2016. The other types of TB cases diagnosed are: smear not done (11%) and relapse (1.5%). Table 9 presents types of TB cases in 2017.

Table 9: Types of TB Cases Diagnosed in 2017

Categories of TB Cases	Number	Percent
New Smear Positive	3232	42%
Relapse	113	1.5%
Failure	9	0.1%
Lost to Follow-up	28	0.4%
Smear Negative	1044	14%
Smear Not Done	865	11%
Extra-Pulmonary	2437	32%
Total	**7728**	**100%**

Multi-Drug Resistance (MDR) TB

Liberia's first MDR cases (5) were laboratory confirmed in 2009 by the Massachusetts Institute Laboratory where samples were sent; 3 out of these 5 cases completed treatment. In 2015, forty-eight (48) new cases were identified. In 2016, the number of MDR patients increased to 92 MDR and the treatment success rate was 47% (n=8/17).

C. Malaria

Malaria has been the leading cause of morbidity and mortality in Liberia for over a decade. In 2009 (LMIS), malaria accounted for 32% of outpatient morbidity. It declined to 28% in 2011 (LMIS) due to cost effective proven malaria interventions. Data from HMIS revealed that 4,729,411 consultations were made in 2017 of which 1,069,880 (23%) were

attributed to malaria. Table 10 presents malaria cases diagnosed and treated by County in 2017.

Table 10. Malaria Cases Diagnosed and Treated by County in 2017

County	Consultation	Malaria Cases	Malaria Cases by Age		% of Cases Treated with ACT
			< 5 years	>= 5 years	
Bomi	114,049	41,949	17,175	24,774	74.8
Bong	446,217	95,197	39,440	55,757	92.1
Gbarpolu	69,594	16,817	6,962	9,855	92.9
Grand Bassa	285,009	33,706	13,998	19,708	70
Grand Cape Mount	129,104	23,875	10,405	13,470	90.2
Grand Gedeh	170,478	43,189	15,135	28,054	72.8
Grand Kru	115,008	26,208	11,731	14,477	88.5
Lofa	542,819	99,896	36,845	63,051	89.5
Margibi	277,755	75,726	25,641	50,085	68.3
Maryland	180,856	28,271	8,806	19,465	81.6
Montserrado	1,436,809	348,505	123,812	224,693	58.3
Nimba	605,875	170,490	74,456	96,034	77.2
River Gee	121,030	23,948	9,620	14,328	93
Rivercess	81,666	12,851	5,152	7,699	94.2
Sinoe	153,142	29,252	11,032	18,220	86.1
National	**4,729,411**	**1,069,880**	**410,210**	**659,670**	**76**

V. PUBLIC HEALTH DIAGNOSTICS

A. Introduction

There are three main laboratories with public health diagnostic capacity in Liberia, namely: NRL, Phebe Hospital laboratory and Jackson F Doe Hospital laboratory. These laboratories provide diagnostic services aimed at supporting the confirmation and control of epidemic-prone diseases as well as aiding surveillance and research. Additional testing occurs at selected sites as indicated in table 11.

Table 11. Public health diagnostic capacity for laboratories[1] in Liberia, January – December 2017

Laboratory	Testing capacity	Testing method
National Reference Laboratory (NRL)	Acute bloody diarrhea	Culture & DST
	Hemorrhagic fever (EVD)	RT-PCR; GeneXpert
	Lassa Fever	RDT, PCR
	Measles/rubella	Serology (ELISA)
	Meningitis	Culture & DST; RT-PCR
	Severe acute watery diarrhea	Culture & DST
	Yellow fever	Serology (ELISA)

Jackson F Doe hospital	Acute bloody diarrhea	Culture & DST
	Hemorrhagic fever (EVD)	RT-PCR, GeneXpert
	Meningitis	Culture & DST
	Severe acute watery diarrhea	Culture & DST
Phebe hospital	Hemorrhagic fever (EVD)	RT-PCR; GeneXpert
	Acute bloody diarrhea	Culture & DST
	Severe acute watery diarrhea	Culture & DST
	Meningitis	Culture & DST
Redemption hospital	Hemorrhagic fever (EVD)	GeneXpert
	Acute bloody diarrhea	Culture & DST
	Severe acute watery diarrhea	Culture & DST
	Meningitis	Culture & DST
	Rotavirus	Serology (ELISA)
ELWA III[2]	Hemorrhagic fever (EVD)	GeneXpert
Veterinary	Rabies screening	Immuno-fluorescent microscopy

Nine out of the fourteen immediately reportable diseases and conditions contained in the national technical guidelines for IDSR require laboratory diagnosis for confirmation. Specimens are currently being collected from suspected cases of the immediately reportable diseases. As indicated in Table 12, seven[3] of the nine diseases are tested in country. AFP and Rabies specimens are referred for international testing. Lassa fever specimens were initially (first half of the year) referred to the Kenema laboratory in Sierra Leone for confirmatory testing, but this ended by the second half of the year due to establishment of in-country testing. Measles and yellow fever specimens are referred to reference laboratories in Ivory Coast and Senegal, respectively, for external quality control. Additional capacity for Rabies screening is available at the Ministry of Agriculture veterinary laboratory.

Liberia has established arrangements with international accredited laboratories to provide additional testing capacity that is not available in-country, for other epidemic prone diseases, as and when needed.

Table 12. Laboratory Testing Capacity for IDSR Implementation in Liberia, January – December 2017

In-Country diagnostic capacity	Referral for international testing
1. Acute bloody diarrhea 2. Hemorrhagic fever (EVD) 3. Lassa fever 4. Measles/rubella 5. Meningitis Rabies (screening)3 6. Severe acute watery diarrhea 7. Yellow fever	1. AFP 2. Rabies 3. Other epidemic prone diseases e.g. Zika, Monkeypox, …

Additionally, in 2017, specimens were sent to additional international laboratories including National Institute for Communicable Diseases (NICD) in South Africa, CDC-Meningitis laboratory in Atlanta, CDC-Monkeypox laboratory in Atlanta, Institute Pasteur in France, Centre for Analytical Chemistry in Vienna-Austria, to confirm epidemics, when capacity was not available in-country.

B. Specimen Transport Pathway

Specimen transportation within the country is conducted by Riders for Health (Riders). Riders has 60 couriers covering 302 pick-up sites in all 15 counties. Using a linked pathway, specimen from pick-up sites are delivered to the respective testing laboratories. CHTs and partners support transportation of specimens from remaining peripheral facilities to the pick-up sites for onward transportation by Riders. Transportation of specimens for international testing is conducted through international courier agencies including DHL, world courier, among others, as and when needed.

[2] ELWA III laboratory was a mobile laboratory established to support enhanced EVD testing during heightened EVD surveillance in Liberia. It was closed on 31st March 2017

[3] The Rabies testing capacity available at the Ministry of Agriculture is for screening purposes, therefore, specimens have to be referred to international laboratories for diagnosis.

C. Specimen Turn-around Time

In 2017, a total of 2365 specimens were collected across all 15 counties for laboratory testing for 8 of the 9 immediately reportable epidemic prone-diseases requiring laboratory confirmation, including: Ebola Virus Disease (EVD), Meningitis, Severe Acute Watery Diarrhea (SAWD), Acute Bloody Diarrhea (ABD), Measles/Rubella, Yellow fever, Lassa fever, and Acute Flaccid Paralysis (Polio).

Overall, 30% and 25% of alerts received laboratory testing (results) within four days and seven days of alert notification, respectively (Figure 23). The overall turn-around time improved by 15%, from 35% of alerts being confirmed or ruled-out within four days in the first half of the year to 50% overall by the end of the year.

Figure 23: Duration from sample collection to testing for IDSR priority disease by County, Liberia, January – December 2017

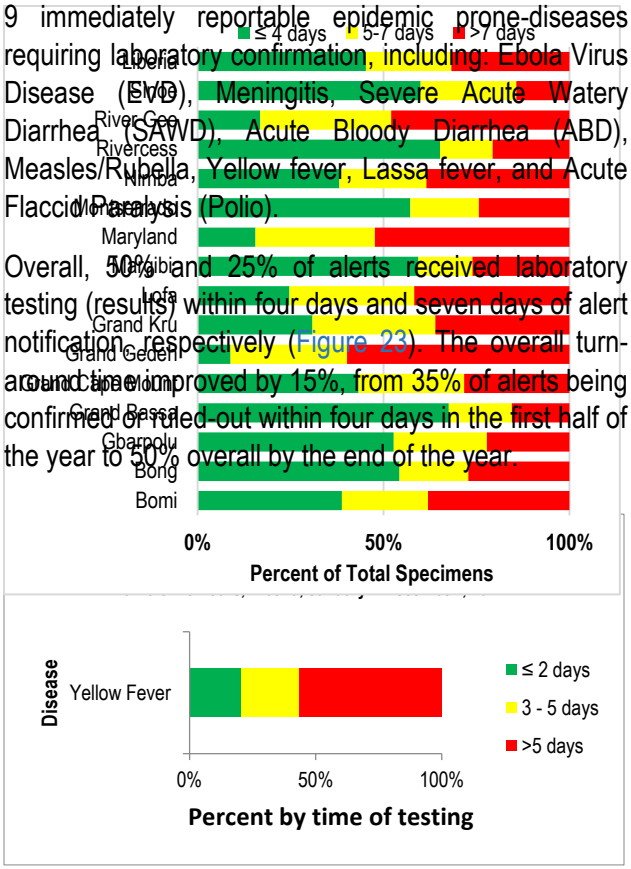
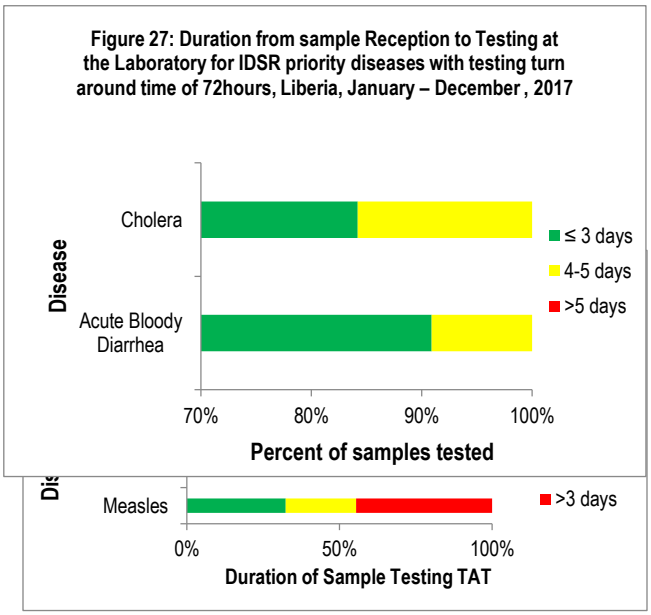


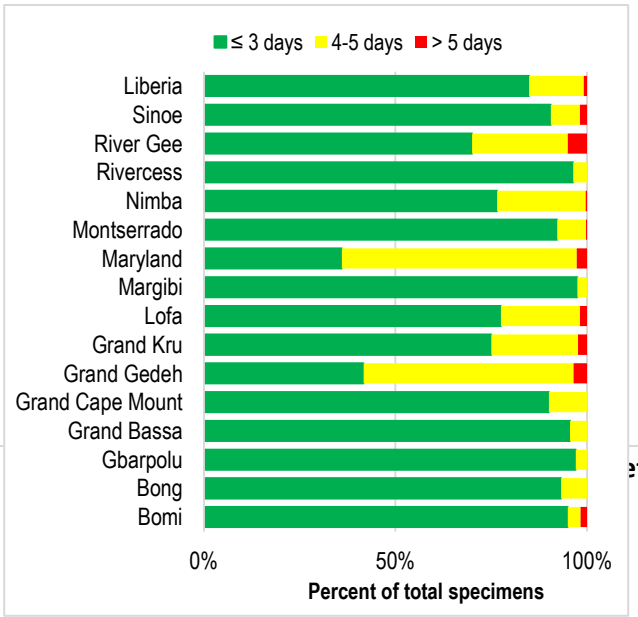
Figure 24: Duration from sample collection to Reception at the Laboratory for IDSR priority diseases, Liberia, January – December 2017

Rivercess and River Gee, took longer to reach the testing laboratories mainly due to longer distance to the testing laboratories as well as very challenging road conditions.

Figure 27: Duration from sample Reception to Testing at the Laboratory for IDSR priority diseases with testing turn around time of 72hours, Liberia, January – December , 2017



Thirty-two percent (32%) and 22% of specimens received at the laboratories were tested within 24 hours and 72 hours of reception, respectively (Figure 25). AFP testing as well as Lassa fever confirmation for the first half of the year, were conducted at international laboratories hence the long testing turn-around-time. Bacteriology (ABD, SAWD & Meningitis) testing normally takes 2-5 days to yield results hence the prolonged overall testing turn-around-time.



A. Situational context

As part of health system strengthening to build a resilient health care system, efforts continue to be

made to improve laboratory capacity in Liberia. With donor and partner support, interventions including: procurement of essential equipment, reagents and consumables; human resource expansion and development through personnel recruitment and training; deployment of new robust and rapid diagnostic platforms, as well as deployment of international human resources to support capacity development, have been implemented, at both clinical and public health laboratories.

These interventions have facilitated restoration and expansion of previously existing diagnostic capacity, as well as improved coordination of specimen referral, thereby improving the overall efficiency of the laboratory system. This has supported timely epidemic confirmation and contributed to improved efficiency of the disease surveillance system.

Great progress has been made especially with public health diagnostic capacity, however, there are gaps that still need to be addressed to further improve the efficiency of the system, especially with respect to human resource development to create a resource that can maximally utilize, maintain and manage the robust technologies developed to-date, and efficiently manage the system under establishment.

With over 70% of personnel in clinical laboratories being of low cadre (46% laboratory aides and 25% laboratory assistants) clinical diagnostic capacity development needs more efforts to ensure capacity to conduct, monitor and sustain essential basic clinical diagnostics, in addition to malaria, HIV and TB diagnostics, to support adequate patient management.

In addition, the poor road network in remote areas negatively impacts on timely specimen referral for testing, especially during the rainy season.

More efforts to address gaps in laboratory quality, supply chain and human resource capacity (quality and quantity) will greatly aid further development and improvement in efficiency of the laboratory system in Liberia

VI. ELECTRONIC DISEASE SURVEILLANCE

A. Electronic Integrated Disease Surveillance and Response (E-IDSR)

In March 2017, with support from US CDC, E-Health Africa, WHO, and UNICEF, Liberia began the design of an electronic Integrated Disease Surveillance and Response (E-IDSR) platform that enables the immediate reporting of IDSR diseases and events through the use of mobile phones. The E-IDSR framework leverages the existing District Health Information System 2 (DHIS2) software that is currently being used for health management information system (HMIS) in Liberia. Alerts are reported from health facilities through SMS messaging which is built on the mHero concept that uses RapidPro, drawing health worker contact information from iHRIS (Human Resource Information System), and facility information from the facility registry (currently DHIS2). This enables a more automated system that alerts the surveillance system at all levels in real time.

The pilot phase began in June 2017 in two counties, Margibi and Grand Cape Mount, with the training of health workers on the use of the platform. There is ongoing supervision with the hope of improving field-

based issues on the use of the platform. It is expected to be scaled up in the coming years.

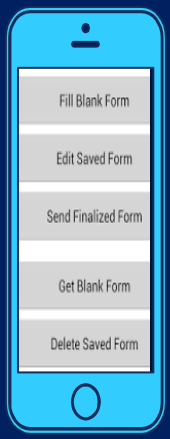
B. Auto-visual AFP Detection and Reporting (AVADAR)

Auto Visual AFP Detection and Reporting (AVADAR) is an electronic reporting surveillance system designed to improve community engagement with AFP detection and reporting and improve silent reporting districts. AVADAR is currently being piloted in seven countries - Cameroon, Chad, Democratic Republic of Congo, Liberia, Nigeria, Niger and Sierra Leone. Funded by Bill and Melinda Gates Foundation and technically supported by WHO, eHealth and Novel-t, the project was launched in Liberia in 2017. The pilot phase began in March 2017 in Montserrado County covering four health districts in Montserrado County – Commonwealth, Central Monrovia, Careysburg, and St. Paul districts. A total of 383 staffs which include community health workers have been recruited from the 4 districts and trained to identify and report all alerts of AFP cases using electronic tools (mobile phones).

A total of 757 AFP alerts were reported in 2017 through AVADAR. Of the 757 alerts, 12 were found to be true AFP cases thus representing a 300% increase in detection of true AFP cases from the pilot sites when compared to the same time period in 2016 when 3 true AFP cases were detected. This has contributed to improvement in the county performance in the detection and reporting of AFP cases in 2017 with 16 AFP cases reported thus allowing the county non-polio AFP rate to be well above the target.

C. Open Data Kit (ODK)

In order to ensure reliability and validity of field level IDSR supervision reports, open data kit was utilized for administering IDSR supervisory checklists and transmitting reports onsite during the national IDSR supervision. Android mobile phones were utilized with IDSR supervisory checklists/questionnaires pre-loaded on it to be administered at all levels – community, health facility, district, and county levels. The platform has features for GPS tracking and allowing data to be entered offline and later submitted. Visualization of data from the field is made easy with pre-defined features on the platform.



This platform is also mainly used by WHO field officers and CSOs routinely for conducting Integrated Supportive supervision (ISS) at sub-national level. A total of 825 ISS visits to health facilities were conducted using this platform for immunization and vaccine preventable disease surveillance. Additionally, 433 visits for active case search for AFP were conducted on the same platform.

VII. TRAINING AND CAPACITY BUILDING

A. IDSR Training

With funding from WHO Liberia Country Office, modular trainings adapted from Liberia's 2016 revised national technical guidelines for integrated disease surveillance and response were conducted from 3 May – 3 June 2017, throughout the 15 counties of Liberia. The trainings targeted county and district levels surveillance officers, health program supervisors, and local government authorities with an objective of providing knowledge and skills required to perform the core functions of IDSR.

A total of 622 people divided into two categories were trained across all 15 counties. The first category composed of 337 health workers (District Health Officers, District Surveillance Officers, Environmental Health Technicians, Reproductive Health Officers, Expanded Programme Immunization Officers, et al) were trained in all of the ten IDSR modules. The second category was composed of 285 local government officials (County Superintendents and District Commissioners) as well as County Health Officers

and Hospital Medical Directors who were trained in the IDSR module on leadership and coordination. The training module on IDSR leadership and coordination is the first of its kind and was developed to reinforce local health administrators' roles and responsibilities in the implementation of IDSR as well as increased moral commitment amongst key stakeholders especially local government officials.

Facilitation of the trainings was conducted by national level staff from NPHIL and County Surveillance Officers with technical support from WHO and US CDC staff. All facilitators were previously trained in the national and regional level training of trainer's workshop held in December 2016.

The IDSR modules were as follow:

- Module 1. Leadership & Coordination
- Module 2. Identify Cases of Priority Diseases, Conditions and Events
- Module 3. Laboratory Specimen Collection, Handling and Documentation
- Module 4. Report Priority Diseases, Conditions and Events
- Module 5. Analyze and Interpret Data
- Module 6. Investigate and confirm suspected cases, outbreak and other events of public health importance
- Module 7. Preparedness and Response to Outbreak and other Public Health Events
- Module 8. Monitoring and Evaluation
- Module 9. Risk Communication of Public Health Information
- Module 10. Supervision and provide feedback

Participants take pre-test during IDSR training in Nimba County, Liberia, 2017

Group work during IDSR regional training in Grand Bassa County, Liberia, 2017

B. Liberia Field Epidemiology Training Program

i. Background

The LFETP started in 2015 as a frontline program to support the building of local capacity for surveillance, outbreak investigation and response at the frontline level. In April 2017, the intermediate level of FETP was added. To date, the program has trained 146 surveillance officers at the national, county and district levels of the surveillance system in the Frontline FETP, and 14 national and county officers in Intermediate FETP. Currently 24 officers from the national, district and facility levels form the seventh cohort of the Frontline training, expected to complete their training in March 2018.

The Frontline FETP training lasts three months, while Intermediate FETP lasts nine months. In both cases, 75% of the period of training is spent on the field, with 25% in-class.

Upon completion, graduates are awarded certificates of completion. The program is owned by the MoH and NPHIL, funded by the US CDC and currently implemented by the African Field Epidemiology Network (AFENET). At the beginning of the standing

up of the Program in Liberia (2015/2016), Emory University played a significant role as partners in the implementation process.

iii. Achievements in 2017

- Intermediate field epidemiology program launched in April 2017 with first cohort comprising fourteen (14) surveillance officers completing training and graduating on 1 December 2017 after almost nine months of training.

Intermediate Cohort 1 Graduation Ceremony, 1 December 2017

- Twenty-two zonal surveillance officers and two national officers were trained as the sixth cohort for the Frontline training from March to May 2017
- The intermediate trainees conducted a study on Maternal Choices for Delivery Site in Liberia as part of their training. They identified that majority of women who had delivered in the previous year had chosen health facility delivery as their first choice, and that 80% of those who abandoned their initial choice of home delivery ended up having caesarian section at the health facility
- In the course of their training, Intermediate trainees were supervised by faculty to support the meningococcal outbreak investigation in Sinoe in April 2017
- Through the training, capacity was built for surveillance in data capture, analysis, interpretation and reporting. Surveillance officers also developed computer skills, particularly in the use of Microsoft Excel, and how to develop PowerPoint presentations. Trainees learnt to conduct surveillance system evaluations and surveillance data quality audits
- Two graduates of the program participated in the TEPHINET Conference held in Thailand in August 2017 during which event the following scientific reports on their surveillance activities were presented:

a. Measles outbreak investigation - Foya District, Lofa County, Liberia, August, 2016
b. Suspected Yellow fever outbreak investigation, Nekree Community Jedepo District, Liberia, 2016

Liberia FETP Faculty and Trainees at TEPHINET Conference, Thailand, August 2017

Annex 1. Summary of Outbreaks and Humanitarian Events in 2017

No.	Year	Date Reported	Disease/Condition	County	District	Communities	No. of confirmed cases	No. of deaths	CFR (%)	Onset date of index case	Date of initial response	Status (Ongoing, Under-controlled)	Duration from Notification to Response (days)	Response within 48 hours?
1	2017	11-Jan-17	Unexplained cluster of illness and death	Sinoe	Dugbe River	Nana Kru	3	3	100	1-Jan-17	11-Jan-17	Under controlled	0	Yes
2	2017	15-Jan-17	Lassa fever	Montserrado	Central Monrovia	Catholic community	1	1	100	23-Dec-16	13-Jan-17	Under controlled	2	Yes
3	2017	15-Jan-17	Unexplained cluster (Epizootic)	Grand Bassa	District #1	Workden	8	7	87.5	14-Jan-17	14-Jan-17	Under controlled	1	Yes
4	2017	20-Jan-17	Pertussis	Grand Gedeh	Gbao	Gboe	115	0	0	10-Jan-17	17-Jan-17	Under controlled	3	No
5	2017	20-Jan-17	Chickenpox	Grand Gedeh	Cavalla	Tojillah	10	0	0	17-Jan-17	20-Jan-17	Under controlled	0	Yes
6	2017	22-Jan-17	Pertussis	Grand Bassa	Owengrove	Bah's Town	28	0	0	1-Dec-16	22-Jan-17	Under controlled	0	Yes
7	2017	24-Jan-17	Lassa fever	Nimba	Sanniquellie Mah, Saclepea Mah	Doumpa, Blagay Town	2	1	50	15-Jan-17	24-Jan-17	Under controlled	0	Yes
8	2017	31-Jan-17	Pertussis	Grand Bassa	District #4	Gueh Town	9	0	0	21-Dec-16	26-Jan-17	Under controlled	5	No
9	2017	18-Feb-17	Measles	Montserrado	Commonwealth		25	0	0	13-Feb-17	17-Feb-17	Under controlled	1	Yes
10	2017	6-Mar-17	Measles	Montserrado	Somalia Drive		31	0	0	2-Mar-17	6-Mar-17	Under controlled	0	Yes
11	2017	20-Mar-17	Pertussis	Grand Bassa	District #3C	Garjay community	10	0	0	7-Mar-17	17-Mar-17	Under controlled	3	No
12	2017	27-Mar-17	Cholera	Nimba	Tappita	Diallah	8	2	25	20-Feb-17	27-Mar-17	Under controlled	0	Yes
13	2017	27-Mar-17	Lassa fever	Bong	Jorquelleh	Iron Gate Community	1	1	100	18-Mar-17	21-Mar-17	Under controlled	6	No
14	2017	31-Mar-17	Measles	Lofa	Foya	Karpee town, Kimbalo town	23	0	0	25-Mar-17	29-Mar-17	Under controlled	2	Yes
15	2017	3-Apr-17	Measles	Grand Bassa	Campwood	Garno town	7	0	0	21-Mar-17	1-Apr-17	Under controlled	2	Yes
16	2017	24-Apr-17	Measles	Nimba	Yarwin Mehnsonoh	Kwendin Town, Gbulupea, Fleedin	12	0	0	21-Apr-17	24-Apr-17	Under controlled	0	Yes
17	2017	25-Apr-17	Meningoccocal disease	Sinoe,Montserrado, Grand Bassa	Greenville, Central Monrovia, Buchanan	Greenville (Teah Town, Congo Town, Down Town, Red Hill); Monrovia (Police Academy, Baptist Seminary); Buchanan (New Barrack, pearchuzohn)	31	13	41.9	22-Apr-17	25-Apr-17	Under controlled	0	Yes
18	2017	27-Apr-17	Measles	Nimba	Tappita	Tappita City	79	0	0	8-Apr-17	17-Apr-17	Under controlled	10	No
19	2017	8-May-17	Measles	Margibi	Gibi	Kpalee Jacob Town	3	0	0	5-May-17	8-May-17	Under controlled	0	Yes
20	2017	11-May-17	Measles	Bong	Suakoko	Kandakai Town, Gbartala, Garbeh Town	24	0	0	29-Apr-17	11-May-17	Under controlled	0	Yes
21	2017	20-May-17	Pertussis	Grand Bassa	District #4	Buegbo town	10	0	0	15-May-17	18-May-17	Under controlled	2	Yes
22	2017	27-May-17	Unexplained cluster of illness and death	Grand Kru	Trehn health district	Behwan community	2	1	50	26-May-17	27-May-17	Under controlled	0	Yes
23	2017	29-May-17	Scabies	Maryland	Barrobo Farjah	Rock town community	58	0	0	8-May-17	19-May-17	Under controlled	10	No
24	2017	21-Jul-17	Measles	Nimba	Sanniquellie Mah	Ganta City and surrounding communities, Sanniquellie City	89	0	0	17-Jul-17	21-Jul-17	Ongoing	0	Yes
25	2017	11-Aug-17	Measles	Nimba	Zoe Geh	Miahplay, Bahn communities	43	0	0	4-Aug-17	10-Aug-17	Under controlled	1	Yes
26	2017	14-Sep-17	Measles	Bong	Suakoko	Kayata, Gboimue Town	43	0	0	6-Sep-17	14-Sep-17	Under controlled	0	Yes
27	2017	4-Oct-17	Measles	Nimba	Gbehlay Geh	Zogowee, Nyantuo	5	0	0	20-Sep-17	4-Oct-17	Under controlled	0	Yes
28	2017	15-Oct-17	Measles	Nimba	Tappita	Zoeongehn, Tappita City	15	0	0	12-Oct-17	15-Oct-17	Under controlled	0	Yes
29	2017	25-Oct-17	Measles	Montserrado	Somalia Drive		5	0	0	19-Oct-17	24-Oct-17	Ongoing	1	Yes
30	2017	1-Nov-17	Measles	Montserrado	Commonwealth	Pipeline, ELWA, etc	21	0	0	28-Oct-17	1-Nov-17	Ongoing	0	Yes
31	2017	1-Nov-17	Measles	Montserrado	Central Monrovia		8	0	0	28-Oct-17	1-Nov-17	Ongoing	0	Yes
32	2017	10-Nov-17	Lassa fever	Bong	Jorquelleh	Kokoyah Road, Frog Island	2	1	50	5-Nov-17	10-Nov-17	Under controlled	0	Yes
33	2017	15-Nov-17	Measles	Bong	Zota	Gbansue Sulon	3	0	0	8-Nov-17	14-Nov-17	Under controlled	1	Yes
34	2017	24-Nov-17	Measles	Montserrado	St. Paul	Brewerville, VOA	3	0	0	21-Nov-17	24-Nov-17	Ongoing	0	Yes
35	2017	27-Nov-17	Monkey pox	Rivercess	Yarnee	Gbor	2 (1 confirmed)	0	0	24-Nov-17	2-Dec-17	Under controlled	5	No
36	2017	1-Dec-17	Measles	Montserrado	Bushrod	Bushrod Island, Clara Town, Doe Community, etc	10	0	0	24-Nov-17	1-Dec-17	Ongoing	0	Yes
37	2017	2-Dec-17	Monkey pox	Maryland	Barrobo Farjah	Tenken	1	0	0	26-Nov-17	4-Dec-18	Under controlled	2	Yes
38	2017	6-Dec-17	Measles	Grand Bassa	Buchanan	Taye Town, Peaker Town	31	1	3.225806	25-Nov-17	5-Dec-17	Under controlled	1	Yes
39	2017	16-Dec-17	Lassa fever	Nimba	Sanniquellie Mah	Gboloyee	1	1	100	13-Dec-17	15-Dec-17	Under controlled	1	Yes

This is the official 2017 Epidemiological Report (IDSR annual bulletin) of the National Public Health Institute of Liberia.

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Data Sources:
Data are from IDSR weekly reports, outbreak situation reports, maternal death case investigation forms, and HMIS.