Evaluating Liberia's Public Health Surveillance System's Capacity to Identify and Respond to Health Emergencies

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Abstract-Like many developing nations, Liberia has enormous difficulties in keeping up a reliable public health surveillance system. The nation's capacity to recognise and handle emergencies is still a major concern because of its turbulent past and faltering economy. The Ebola outbreak of 2014–2016 exposed the nation's inadequate public health infrastructure. Even though a lot has changed since then, it is still necessary to evaluate the public health monitoring system in Liberia in order to make sure that the country is ready for any future medical emergencies. The study aims to evaluate how well Liberia's public health surveillance system identifies medical emergencies. This study examines the strengths and weaknesses of Liberia's surveillance system employing data analysis and qualitative and quantitative techniques, such as interviews, desk/documents reviews. It also identifies areas for improvement and possible strategies for enhancing the system's ability to detect and respond to health emergencies. Quantitative information on the prevalence and reporting of infectious and non-communicable diseases was gathered from the Ministry of Health in Liberia as well as other pertinent health organizations. Interviews with important participants in public health surveillance, such as government officials, medical professionals, and representatives of international organizations, were used to collect qualitative data. The study discovered that the fundamental skills required for a functioning surveillance system (case detection and reporting) were present, therefore conclude that the Liberian surveillance and response system can detect and respond to potential outbreaks, but it may not do so effectively. We proposed future research projects to inform progress, as there are prospects for improvements to strengthen the current system.

Key Words: **Public Health, Surveillance system, Health System, Global Health, Outbreaks, Disease Surveillance, Epidemics, Pandemic**

INTRODUCTION

Background:

Public Health Surveillance is the continuous, routine gathering, analysis, and interpretation of health-related data necessary for public health planning, execution, assessment, and evaluation of public health measures, as well as for informing decision-makers about the prevention and control of health-related issues. It's about communicating information in an effective and timely manner" (Nsubuga P, 2012). It is a vital part of public health systems and is important for the early diagnosis, prevention, and management of illnesses and medical emergencies (Choi, 2012). West African nation of Liberia has experienced serious health issues, such as the Ebola outbreak that occurred there between 2014 and 2016, which brought attention to the country's shortcomings in its public health system.

Accurate and timely surveillance statistics are essential in Liberia public health emergencies because they can supply data required for staffing and resource needs planning, evaluation of the effectiveness of the response, and appropriate resource allocation. This was particularly true during the West African Ebola epidemic of 2014–2016. The CDC and numerous other organizations overcome obstacles to carry out efficient surveillance in Liberia during the outbreak, a country with a severely underdeveloped public health infrastructure.

West African nation of Liberia is home to an estimated 5.18 million people as of 2021. It is separated into fifteen counties, which are political subdivisions, and then into ninety health districts, which are selected from among more than one hundred political districts. The community or village is the lowest geographic unit in Liberia. There are four tiers of government in the health system: district, county, national, and community. District health teams are found in districts, and "county health teams" are found in every county. These regional health teams were created to have the same organizational structure and healthcare-related duties as the MOH's organogram at the federal level. The health system is divided into three levels; the Primary Healthcare level, Secondary Healthcare level and Tertiary Healthcare level. Clinics and

community health initiatives, such as surveillance initiatives like Community Events Based Surveillance (CEBS), are included in the primary health care level. County hospitals and health centres make up the secondary level. There are two health referral hospitals at the tertiary level (Chretien JP and Lewis SH, 2008).

Key Challenges of the Liberia's Public Health Surveillance Systems

The effectiveness of surveillance efforts, case definition, case data management, laboratory testing, contact tracing, information technology, and case management are all impacted by a number of challenges that Liberia's public health surveillance faces. These challenges include a lack of resources, infrastructure limitations, disease outbreaks, problems with data management, and ongoing workforce shortages.

Limited Resources and Infrastructure: The inadequacy of funding, human resources, and fundamental infrastructure in Liberia's healthcare system impedes its capacity to carry out surveillance operations efficiently. This restriction may cause delays in the identification and mitigation of health risks. This was demonstrated during the 2014–2016 Ebola outbreak in West Africa, which included Liberia. The nation struggled to contain the virus because of inadequate infrastructure and healthcare resources, which had a major negative impact on the economy and resulted in a large number of fatalities (WHO - Ebola situation reports).

Disease Outbreaks: Lassa fever, cholera, and malaria are just a few of the infectious diseases that can strike Liberia. These diseases' outbreaks put a burden on the nation's resources and surveillance systems, frequently overwhelming medical staff and facilities. The Ebola outbreak of 2014–2016, which brought attention to Liberia's susceptibility to newly emerging infectious diseases, serves as evidence of this. Weak surveillance systems first made it more difficult to identify and contain the outbreak, which accelerated its spread (CDC - Ebola in West Africa).

Data Management: Inadequate systems and procedures for data management make it difficult to gather, analyse, and distribute health data in a timely manner. This makes it more difficult to produce useful insights for prompt and efficient decision-making and action. During disease outbreaks, for example, incomplete or erroneous data reporting can mask the real scope of the issue, delaying response efforts and causing resource misallocation.

Human Resource Constraints: Liberia's ability to carry out thorough surveillance operations and efficiently handle health emergencies is hampered by a lack of qualified epidemiologists and public health specialists. In times of health emergency, such as disease outbreaks or natural disasters, a lack of qualified personnel may make it difficult to send out rapid response teams and carry out control measures.

Communication and Coordination Challenges: Good public health surveillance necessitates effective coordination and communication between multiple stakeholders, such as governmental organisations, medical professionals, and foreign partners. On the other hand, prompt information sharing and cooperation in Liberia's surveillance are hampered by poor communication and coordination. During disease outbreaks, poor communication between international organisations and local health authorities can cause delays in response efforts and misalign interventions, which can exacerbate the situation. This was particularly evident during the Ebola and Corona virus outbreaks in Liberia.

METHODOLOGY

Data Gathering

From the beginning of the nation's operations in 2004 until the start of the EVD pandemic in early 2014, we examined the case of Liberia's disease surveillance, epidemic preparedness, and response plan (that is, until January 2014, prior to the EVD outbreak in March 2014). Our qualitative approach took into account two data sources: (1) a desk/document review; and (2) in-depth interviews with key informants. The two data sources were used, as is typical in case study research, to ensure comprehensive findings and facilitate data triangulation (Eisner EW, 1991; Bowen GA, 2009).

Document/desk reviews

In order to comprehend the creation, acceptance, and application of IDSR, In addition to reviewing peer-reviewed journals and grey literature, we conducted a document/desk review of official policy documents and guidelines (either physical or electronic copies,

depending on availability). The National Public Health Institute of Liberia, the Ministry of Health, and the Government of Liberia all signed data-sharing agreements and granted us permission to use certain documents, such as project or conference reports. PubMed, SCOPUS, and Medline searches were used to find peer-reviewed articles and grey literature. For electronic sources, text terms and key search terms were employed.

Comprehensive Interview with the key informant

Key informant conversations provided the second source of evidence. Those who created or were implementing IDSR in Liberia prior to the Ebola outbreak were considered key informants. Each selected key informant was interviewed in-depth to get their take on IDSR efficiency and obstacles to implementation. A series of demographic questions were asked at the start of each interview, and the answers were combined to determine the study population. Three people conducted the interview using the tools after receiving training in both qualitative and quantitative research methods. Interviews were conducted in English, taped, and then recorded.

A Brief Overview of Liberia's Surveillance System

MOH is in charge of organizing Liberia's national, regional, and local public health surveillance systems. It includes a number of elements, such as event-based surveillance, environmental surveillance, laboratory surveillance, and disease surveillance. The Community Events Based Surveillance system is one of the most widely utilised surveillance systems in Liberia.

From the most elevated locations at the district and federal levels to the ground zero at the local and health centres. At the lowest level, community disease surveillance officers are Community Health Services Supervisors and trained community health assistants who carry out community event-based surveillance. Each of Liberia's 92 health districts, which are dispersed erratically throughout its 15 counties, is home to a district surveillance officer. The DSO is in charge of disease surveillance operations, which are then reported to the County Surveillance Officers. The Fifteen (15) CSOs, which provide information to the national surveillance system, oversee the coordination of disease surveillance efforts at the county level. In Liberia, the national health system obtains disease surveillance data from communities, districts, and counties in a descending order. Every reporting site (such as neighbourhoods or hospitals) provides the immediate supervisors with surveillance data on a regular basis.

Factors Influencing the Introduction And Implementation of IDSR.

Our analysis of the data from the desk review and key informant interviews led to the identification of five factors that influenced the creation, uptake, and application of IDSR during the time period.

1. The background of surveillance in the nation.
2. The surveillance was conducted within the health information system (HIS);
3. there are multiple simultaneous health security and disease threats.
4. Community involvement and risk sharing.
5. HR and training are essential for surveillance.

Together with the organizational and logistical requirements for structured surveillance, these five factors also represented the broader epidemiological, sociocultural, political, and economic context.

Factor 1: surveillance history in Liberia

In many African nations, including Liberia, a significant vulnerability in their national health surveillance and response systems was identified by 1998 (Fall IC. Et al., 2019). In response, the US CDC and the WHO African Region (WHO AFRO) developed an IDSR strategy to improve public health surveillance and response systems. This eventually resulted in the implementation of IDSR in Liberia in 2004. The adoption of the IDSR in Liberia in 2004 and the development of certain policy guidelines were confirmed by all of the key informants and documents we examined. The majority of MoH officials and representatives from foreign organisations attested to the fact that just one employee was tasked with implementing the IDSR in each of the 15 regions where it was implemented. There were other things going on, like training. Finance for follow-up care for acute flaccid paralysis was used to purchase supplies (motorcycles, etc.).

A key informant from a donor agency explained that:

"…Liberia was at the time the third country in Africa to amend the IDSR strategy and guidelines in 2004. Although the revised strategy was a beautiful document, the systems and structures needed to support the implementation of the strategy were limited. That was another interview, clearly several problems emerged: there were no resources in the Ministry of Health, human resource capacity was still limited, and things were uneven in the regions because the regional health teams were not strong enough. time. So the whole initial phase had its drawbacks." Donor#009.

"…well, the first thing I would say is that in 2013, before that, the strength of the IDSR implementation was that the health care system had a dedicated unit at the MOH. This unit was connected and linked to WHO as the closest partner. There was a system in place. As faulty as it was, the devices reported to the central level. The Ministry of Health has invested in training specialist staff for these roles and responsibilities. Liberia had just emerged from civil war, so all these issues were not on the government's radar." Govt./MOH #003.

Factor 2: Health Information System (HIS)

A health information systems specialist explained the DHIS2 system and how this HMIS system was revolutionary:

"…is considered the world's largest information system, developed in a global collaboration led by the University of Oslo, Norway." Govt./MOH #003.

"This system is efficient and simplifies reporting compared to the paper system we had before." Govt./MOH #003.

Factor 3. Multiple Health And Safety Threats

The threats that Liberia is constantly facing were brought to light by the Joint National Action Plan for Health Security (NAPHS). There were multiple concurrent threats, when Liberia saw the historic Ebola virus disease outbreak. It was a matter of "when," not "if," the Ebola outbreak would take the post-conflict health system, which was already vulnerable, by surprise and overwhelm it. Donor #009.

Factor 4: Community Engagement And Risk Communication

Health promotion and risk communication initiatives were uncommon and primarily concentrated on polio eradication efforts prior to community involvement in the Ebola epidemic. This made it difficult to communicate risks at the beginning of Ebola pandemic. The response effort was also negatively impacted by the virus's wild propagation of rumours and false information. For fear of being placed under quarantine or being moved to an Ebola Treatment Unit (ETU), some communities have been reluctant to report ill loved ones and relatives. In order to get around the government's cremation policy, secret burials were frequently conducted, and there were an increased number of illnesses and deaths in homes. It is now more challenging to stop the virus from spreading.

Risk communication must now be used in order to inform the public about Ebola in real time and in an understandable manner while also promoting public involvement in response activities. Community engagement and risk communication initiatives were started in October 2014 by the Ebola Response Task Force and Liberia's National Health Promotion Division. Risk communication is taken into account through a variety of channels, including mass media, radio news, social mobilization, community health workers, and one-on-one conversations. In order to prevent infection, the messaging encouraged people to identify sick people in their community, identify them, avoid handshakes, wash their hands with soap and water, avoid contact with sick people who might be infected, allow safe burials, and call the EVD hotline to arrange for the sick people to be picked up.

Health promotion initiatives were still hampered by misunderstandings, skepticism, and community opposition despite advancements. A "Gateway to Health Communication" document from the US CDC stressed how crucial it is for surveillance and response to comprehend the cultural quirks and customs of the African context. In a traditional society, adherence to native laws and customs is considered sacred and frequently recognized as a rite of passage for individuals. Any outbreak response must include appropriate community involvement and risk communication. One of the cultural quirks that needed to be considered in the reaction to the disease was Liberia's religious diversity.

Factor 5: Human Resources for Health and Capacity Building

The goal of this study was to comprehend the Ministry of Health's pre-Ebola financial, supervisory, and

logistical tasks as well as the capacity that was already in place and the activities that were being undertaken to strengthen it. Support for IDSR hardware and software was one of these features. The participation of stakeholders in the delivery of these services piqued our interest as well. Before Ebola, we outline the players, laws, and regulations that impacted IDSR's human resource capacity from 2004 to 2014. "....therefore, the Ministry of Health of the Government of Liberia lacked the necessary resources and, in the event that any limited policies existed, they were not put into practice. At the time, the center was meant to offer basic medical care. Partners such as Merlin, USAID, and WHO were crucial". NGO#027.

In a similar vein, the health sector was dependent on outside assistance and lacked the means to support its expanding workforce without formalising things like putting workers on the payroll. One respondent said, "Even before the Ebola crisis, three health worker strikes led to problems with maintaining health workers' salaries." This made the Ebola situation within the healthcare system even worse. The respondent continues: "…so one of the big mistakes we made was we kept hiring people, but those people didn't become civil servants, meaning they didn't get on the government payroll over time. NGOs paid salaries to civil servants. This kind of system has created problems of fragmentation and division of the health system. Workers' loyalty was paid to whoever paid their wages, fragmented and overburdened the reporting system. Vertical program staff sent their reports to either GAVI, Fixed Access Reimbursable Agreement (FARA), USAID funded health project, Global Fund, PMI, UNICEF or Pool Fund." NGO#027.

Data Analysis

The evaluation of Liberia's public health surveillance system yielded key findings, patterns, and themes that were discovered through thematic analysis of qualitative interview data. When available, quantitative data were entered into MS Excel and examined using descriptive statistics to evaluate benchmarks and performance indicators.

Key Components of the Liberia's Public Surveillance System

Liberia's surveillance system comprises essential elements such as information sharing, response coordination, data collection and analysis, case detection, and reporting. These elements are interdependent and depend on cooperation between different local, national, and international stakeholders.

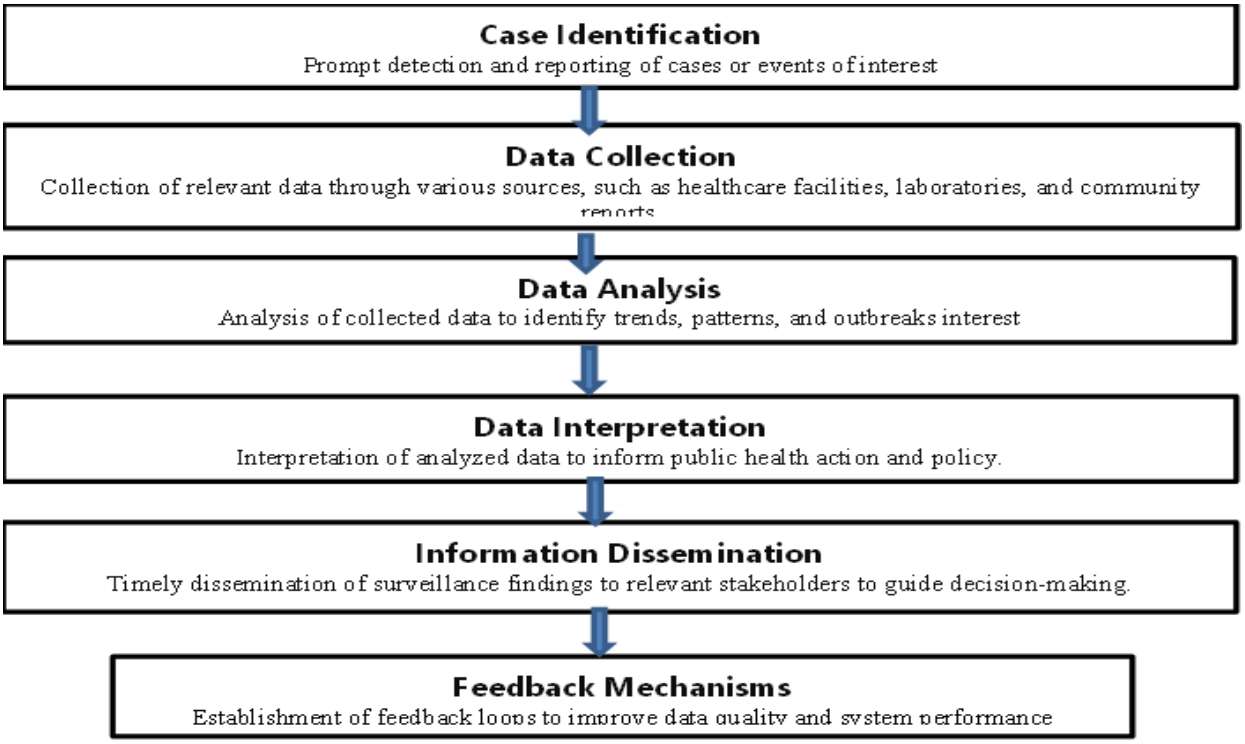

Fig 1.0: Components of the Liberia's Public Health Surveillance

RESULTS

The research found that the Liberian surveillance and response system can detect and respond to potential outbreaks, but it may not do so effectively. We proposed future research projects to inform progress, as there are prospects for improvements to strengthen the current system.

The most commonly used surveillance system in Liberia is the Integrated Disease Surveillance and Response (IDSR).

Strengths and Progress identified by the research

Liberia has made progress in establishing a basic surveillance infrastructure and has demonstrated resilience in addressing to medical emergencies, such as the Ebola pabdemic. Liberia has also demonstrated resilience in addressing health crises like the Ebola pandemic. The country has shown a commitment to strengthening its surveillance capacity through partnerships and international support.

The surveillance system in Liberia has demonstrated effectiveness in detecting known diseases such as malaria, tuberculosis, and HIV/AIDS. However, challenges still remain in detecting emerging and re-emerging threats due to limitations in laboratory capacity and disease-specific surveillance programs.

Different diseases and regions have different reporting timeliness, with lags observed in remote and underserved locales. Timely reporting can be enhanced by improving communication networks, transportation logistics, and training of healthcare workers.

The reliability and precision of surveillance data is impacted by data quality issues, such as under-reporting, incorrect classification, and incomplete case investigation. Enhancing data management strategies, standardizing reporting procedures, and enhancing education are vital for enhancing data integrity.

Regional and global health networks, such as WHO and the African Center for Disease Control, are linked to the surveillance system. Information sharing, technical assistance, and access to resources during health emergencies can be achieved through collaboration with international partners.

Feedback mechanisms for surveillance data are essential for public health actions and decision-making. Feedback mechanisms for surveillance data are essential for informing public health actions and decision-making. Emergency operation centers and multi-sector coordination mechanisms have been established in Liberia since the Ebola outbreak.

Weakness and challenges identified through the evaluation.

Limited resources, weak data quality, inadequate workforce capacity and disparities in surveillance coverage are some of the challenges. Surveillance efforts in remote locales are hindered by infrastructure limitations and geographical obstacles.

There may be differences in surveillance capacity across different regions or demographic groups within Liberia. Rural and marginalized communities may have limited access to healthcare services and surveillance infrastructure, leading to underreporting of health data.

Possibilities for improvement.

There are opportunities for Liberia to strengthen its surveillance system by investing in infrastructure, enhancing data quality and timeliness, expanding coverage, and leveraging technology for improved surveillance capabilities. Mobilising resources and enhancing capacity can be facilitated by cooperation with foreign partners and stakeholders. Building capacity and mobilising resources can also be facilitated by cooperation with international partners and stakeholders.

DISCUSSION.

Liberia has made significant progress in enhancing its public health surveillance system, achieving notable successes in the areas of health prevention and averting health crises. These triumphs have been made possible by investments in infrastructure, workforce growth, and alliances.

The effectiveness of Liberia's surveillance system is hindered by persistent challenges, including resource constraints, infrastructure deficits, and human resource shortages. Early detection and response to health emergencies can be hindered by weaknesses in data quality, timeliness, and coordination.

There are opportunities for enhancing surveillance capacity through technology innovation, training programs, and community engagement initiatives. Utilizing digital health tools, mobile devices, and community-based surveillance methods can enhance the tenacity and responsiveness of Liberia's medical infrastructure.

The findings have implications for public health policy and planning in Liberia and emphasize the need for sustained investments in surveillance infrastructure, workforce development, and intersectoral collaboration. Enhancing the efficiency of health surveillance systems should be a top priority in policy recommendations.

Expanding coverage to underserved areas, strengthening workforce capacity through training and recruitment, encouraging collaboration with stakeholders, and leveraging technology for innovation and efficiency are some of the ways to strengthen Liberia's surveillance apparatus.

RECOMMANDATIONS

1. Strengthening surveillance infrastructure and data quality assurance requires investments in laboratory facilities, information systems, and data management tools.
2. Training and capacity building should be prioritized to improve skills, knowledge, and competencies in disease surveillance and outbreak response.
3. Enhancing collaboration with international partners is important for leveraging technical know-how, funding possibilities, and knowledge transfer in public health surveillance.
4. Adopting innovative technologies, such as electronic health records, mobile applications, and geographic information systems (GIS), can streamline data collection, analysis, and reporting procedures, enhancing surveillance effectiveness and effectiveness.
5. Improved communication and community involvement are needed to involve communities in disease prevention and early detection efforts through community surveillance programs, health education initiatives, and risk communication tactics.

CONCLUSION AND FUTURE DIRECTIONS OF THE RESEARCH

The assessment of Liberia's public health surveillance system reveals both its strengths and its weaknesses when it comes to identifying health emergencies. Despite notable advancements, obstacles persist, necessitating comprehensive approaches for enhancement.

Building a resilient and responsive public health surveillance system in Liberia depends on addressing the identified gaps and implementing the recommended strategies. Securing the health and well-being of its populace can be safeguarded by prioritizing investments in infrastructure, workforce growth, and collaboration in Liberia.

The necessity of implementing timely and accurate surveillance under emergency conditions made the development of an active public health surveillance system in Liberia challenging. The necessity of being ready for public health emergencies before they arise is highlighted by the numerous difficulties encountered during the implementation of public health surveillance. The development and agreement upon standardized response systems with well-defined protocols and goals prior to outbreaks, as well as the prompt implementation of these systems during an outbreak, have facilitated public health response.

Future research should focus on follow-up studies, program evaluations, and tactical investigations to evaluate the long-term consequences of interventions aimed at enhancing surveillance capabilities in Liberia.

COMFLICTS OF INTEREST

The authors declare no conflict of interests

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