

One Health – A New Paradigm in Fighting Infectious Diseases in West Africa

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Abstract

Zoonotic infectious diseases have been an important concern to humankind for more than 10,000 years. Today, approximately 75% of newly emerging infectious diseases (EIDs) are zoonoses that result from various anthropogenic, genetic, ecologic, socioeconomic, and climatic factors. Zoonotic EIDs remain a major global concern, and such threats are expanding, especially in less developed regions. Current Ebola epidemic in West Africa is an extreme stark reminder of the role animal reservoirs play in public health, which reinforces the urgent need to operationalize a One Health approach. Building opportunities to overcome the challenges largely depends on four key capacity-building needs: (1) development of adequate science-based risk management policies, (2) skilled-personnel capacity building, (3) accredited veterinary and public health diagnostic laboratories with a shared database, and (4) improved use of existing natural resources and implementation. This paper highlights the key issues as building block for synthesis of the One Health approach to address the challenges and opportunities for tackling infectious diseases at the human, animal, and environment interface in low-resource settings. Health laboratory services are essential for the efficient delivery of quality and cost-effective healthcare. Training in laboratory services has long been a neglected part of the one health approach in countries like Sierra Leone. Njala University is actively working with other partners of Royal Netherlands Embassy (RNE) Post-Ebola Resilience Project, further reinforcing the One Health Concept by focusing on both human and animal health and its interface.

Keywords: One Health Paradigm, Key Capacity Building Needs, Emerging Infectious Diseases, Zoonoses, Post-Ebola Resilience Project, Sierra Leone, West Africa

Introduction

Zoonotic infectious diseases have been an important concern to humankind for more than 10,000 years, and infectious diseases remain a significant cause of mortality and morbidity globally; approximately 75% of emerging infectious diseases (EIDs) are zoonoses [1].

The phenomenon of emerging and reemerging infectious diseases is driven by various anthropogenic factors. These include genetic and biological factors, such as microbial adaptation to macro- and micro-environmental changes along with changes in host susceptibility to infection. Others are environmental factors, including climate change, changes in ecosystems, and changes in human and animal population densities. These are also compounded by socioeconomic and political factors, such as increasing international travel and commerce, social inequality, poverty, conflict, famine, lack of political will, and changes in economic development and land use. In the nutshell, Smolinski et al., referred to as a “convergence model,” with these forces creating the perfect microbial storm to accelerate the emergence of new infectious diseases [2].

Over the last 15 years, our planet has faced more than 15 deadly zoonotic or vector-borne global outbreaks, both viral (e.g., Hanta, Ebola, highly pathogenic avian influenza [H5N1 and recently H7N9], West Nile, Rift Valley fever, norovirus, severe acute respiratory syndrome [SARS], Marburg, influenza A [H1N1]) and bacterial (e.g., Escherichia coli O157:H7, Yersinia pestis, and Bacillus anthracis, the causes of hemolytic uremic syndrome, plague, and anthrax, respectively). Since 1980, more than 87 new zoonotic and/or vector-borne EIDs have been discovered [3].

Key priority concerns for One Health approach include: the interconnectedness of infectious diseases and One Health, the emergence and reemergence of vector-borne parasitic diseases and the role of the environment, respiratory diseases of regional and global significance, food and waterborne diseases, the role of wildlife in newly emerging pandemics, drug development and antimicrobial resistance, environmental health, immunology and vaccine development, and One Health capacity-building needs. This paper highlights the key issues as building block for synthesis of the One Health approach to address the challenges and opportunities for tackling infectious diseases at the human, animal, and environment interface in low-resource settings.

Recent Situation Analysis of Infectious Diseases in West Africa

The difficulty in controlling the spread of the virus has caused the

2014 outbreak to be the most severe in terms of number of cases and human fatalities since the discovery of the virus in 1976. Although at least 20 outbreaks of Ebola virus disease (Ebola) have occurred since the virus was first recognized in humans in 1976, the 2014 outbreak was unprecedented in size and severity [4]. By the end of December, over 20 000 persons had been infected and close to 8000 had died, with 99% of cases originating in the West African nations of Guinea, Liberia and Sierra Leone [5]. Furthermore, the risk of re-emergence or outbreaks of EVD and other emerging infectious diseases such as Lassa fever, dengue, cholera, Marburg fever, and yellow fever remain in the region. This is because as opined by Snyder et al. poverty, a weak healthcare system, lack of access to resources, recent civil conflicts and their aftermath and the prevalence of informal settlements, with overcrowded living conditions and weak hygiene infrastructure, are key among the broader social determinants of Ebola [6]. There is a continued need for pro-active response to engage with communities in increasing their resilience and preparedness to manage future infectious outbreaks [7,8]. The main question for policymakers, the national and international health community, and civil society is how to ensure that future infection events do not become epidemics and unravel into a complex political, environmental, medical, economical, and public health emergency [9].

According to Taylor et al (2014), the virus causing Ebola has been present in fruit bats and marsupials for at least 10 million years. Based on the findings by WHO (2014b), the disease was only first recognized in humans less than 40 years ago. Looking at it from the Geo-Epidemiology of the disease, Ebola outbreaks, until now, have been small in East and Central Africa, and none has been as deadly or geographically widespread as the current outbreak in West Africa [1,10].

Key Challenges in One Health Approach in West Africa

The current epidemic of Ebola virus in West Africa serves as stark reminders of the unpredictable nature of pathogens and the importance of animals in the ecology and emergence of viral strains. The ongoing pandemic of a disease such as tuberculosis (TB) is worrisome given a growing rate of highly resistant bacterial strains and infections in immune-compromised hosts such as those with HIV infection. Despite the promising progress in the development of improved diagnostics, therapies, and vaccines and progress in identifying biomarkers of exposures and/or disease and associated host susceptibility [11,12].

Other researchers have reported that virulent pathogenic stains from infected wildlife shared a similar molecular pattern with sampled livestock, suggesting that transmission between livestock and wildlife has occurred [13,14]. Transboundary migration and migration across continents are additional risk factors that also remain major means of transmission.

The urban population in sub-Saharan Africa is expected to double to nearly 800 million people by 2030, and the resulting increase in population density will only exacerbate problems of transmission of virulent pathogens [15]. The rapid physical infrastructure development in sub-Saharan Africa has not kept pace with massive urban in-migration, resulting in increased population density and the expansion of urban slums, creating a variety of public health challenges and the potential for catastrophic epidemics [16].

The majority of the emerging diseases appear to be zoonotic, transmitted either directly between animal and human hosts or indirectly via consumption of raw food containing flesh from domestic or feral animals, consumption of food and water contaminated by animal or human feces, or via arthropod vectors, which can be impacted by ecological or climatic changes.

The success of preventive measures will require an efficient network of public health intervention measures including routine surveillance for disease in humans and animals. Retrospectively, strengthening the veterinary surveillance and inspection infrastructure at the slaughterhouse is a milestone for amelioration of the food-related problems.

Capacity-Building Needs in Low-Resource Developing Countries

One of the most important aspects related to the control of pathogens at the human, animal, and environment interface is the development of adequate science-based risk management policies that respect transboundary regulations. Efforts have been recently made to incorporated initiatives among intergovernmental organizations, with the FAO and WHO for pandemic threats in Anglophone West Africa in effort to jointly pursue the One Health approach, working in close collaboration with research institutions, academia, intergovernmental organizations, the private sector, nongovernmental organizations, civil societies, and other stakeholders.

Adequate surveillance system, including a strong laboratory network, is a key component of any meaningful prevention and control of zoonotic diseases. In order to develop an effective One Health implementation plan for strengthening capacity at national and regional levels, there are needs to reexamine the existing systems/structures, resources, and management. Inherent to overall surveillance is improved practice applying environmental monitoring methods to better characterize sources and profiles of environmental contaminants and pathways (i.e., air, food, and water) and modes (i.e., inhalation and ingestion) of both human and animal exposures to pathogenic agents.

Laboratory Strengthening at Njala University in Sierra Leone

The Royal Netherlands Embassy (RNE) in Ghana 2-year funded project, "Preparedness against Ebola and other emerging infectious diseases in Sierra Leone and Guinea" was initiated in June 2015. This project involves a consortium of institutions including Njala University (Sierra Leone), Sonfonia University (Guinea), Noguchi Memorial Institute for Medical Research (Ghana), the Wageningen University, University of Amsterdam and the Royal Tropical Institute (the Netherlands). The overall aim of the project is to establish a system for preparedness and resilience of Ebola virus disease (EVD) and prevention of other infectious diseases with epidemic potential in Sierra Leone and Guinea. This is to be achieved under three interrelated components or work packages (WPs): WP1 - Community-based surveillance; WP2 -Laboratory capacity strengthening; and WP3 - Results-based financing.

The laboratory component (WP2) aims to strengthen zoonotic and public health laboratory services of Njala University to ensure rapid and safe sample collection, transportation, and management, as well as rapid and accurate sample testing and rapid results

communication in an effective response to selected infectious diseases with epidemic potential.

The laboratory activities are focused on five priority infectious zoonotic viral diseases. These were selected based on their documented presence in Sierra Leone and the potential to cause pandemics or severe epidemics:

- Ebola viral disease by Ebola virus including the closely related filovirus, Marburg virus
- Lassa fever caused by the Lassa virus
- Rift Valley fever caused by the RVF phlebovirus
- Rabies, caused by Lyssaviruses
- Highly pathogenic Influenza viruses

Additionally, the Global wake call for Zika has also raised concern for inclusion into the mini projects.

Overall Aim and Objective

The overall aim of the project is to develop an innovative system for preparedness and resilience of Ebola virus disease (EVD) and prevention of other infectious diseases with epidemic potential in Sierra Leone and Guinea.

Specific Objectives

The specific objectives of the project are as follows:

1. To establish a laboratory at Njala University to perform molecular and serological testing on human and animal samples for infectious diseases.
2. To train a pool of laboratory experts that can perform these tests in a safe and reliable way leading to high quality results.
3. To make the newly established laboratory services at Njala University attractive and provide laboratory support to the general public health and veterinary services in Sierra Leone.
4. To train a pool of laboratory experts to design and execute research projects that will provide evidence-based rational interventions in infectious disease control.
5. To create a pool of trainers that can provide training modules in basic laboratory diagnostic techniques on infectious diseases at Njala University.

Relevance of the Project

- Health laboratory services are essential for the efficient delivery of quality and cost-effective healthcare
- Over the past few years the crucial role of laboratories in diagnosis, treatment, monitoring and public health disease outbreaks is becoming more and more recognized and the attention for the quality of laboratory services in resource poor countries has increased tremendously
- International Health Regulations (IHR, 2005) requires WHO member states to ‘establish mechanisms to provide reliable and timely laboratory diagnosis of infectious agents and other hazards potentially causing public health emergencies of national and international concern’
- One Health concept envisaged seeks to improve health and well-being through the prevention of risks and the mitigation crises that originate at the interface between humans, animals and their various environments; through which the laboratory provides evidence-base for rational interventions
- As the laboratory will be part of the university-wide initiatives, it will provide opportunities for students to gain important

practical expertise

Conclusion and Recommendations

Concomitant to the emerging discussions and presentations in this symposium, a lot more could be added to the issues and strategies in this report. Nonetheless, a vivid understanding of the one health concept for implementation at the national and regional levels is recommended as follows:

- In order to successfully implement One Health among countries in West Africa, the development of adequate science-based risk management policies is essential.
- The global community has the responsibility for strengthening skilled manpower and infrastructure capacity in these low-resource countries in West Africa in order to effectively prevent and control diseases at the interface of human, animal, and environmental health and make the world a safer place.
- The One Health paradigm therefore, requires working across discipline and administrative barriers; this is a crucial component for effectively tackling complex One Health issues.

The inspiring vision of Njala University is to chart a way forward for the accomplishment of outcomes in the process of establishment of the Post-Ebola Laboratory for capacity strengthening in Sierra Leone. These are set in deliverables for timely achievement in following stepwise approach:

- Upgrade the level of technical knowledge and expertise of current and new staff via training of trainers, training and exchange visits
- Enhance the ‘one-health’ concept regarding emerging outbreaks of zoonotic diseases, in particular viral haemorrhagic fevers
- Upgrade lab facilities and equipment to facilitate routine diagnostic testing
- Integrate lab services into the national health machinery
- Develop, implement and sustain a quality assurance system
- Initiate the implementation of a quality management system based on ISO15189:2012.

Achievement of these deliverables, however, is foreseen to be challenged with the lack of mobility of the staff involved, especially for timely sample collection, rapid detection and safe sample management, timely and accurate sample testing and timely results communication [17,18].

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