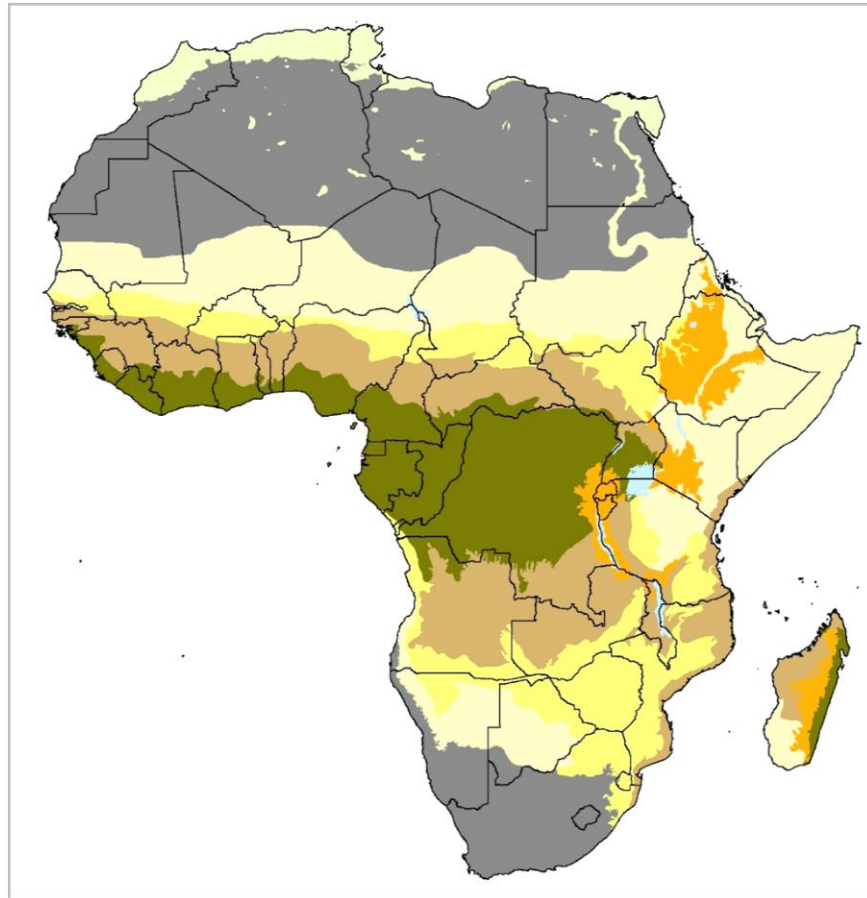


Mapping the Risk and Distribution of Epidemics in the WHO African Region

A Technical Report



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Cover photo: Modified climatic ecological zones of Africa (source: <http://www.fao.org/docrep/004/y1997e>)

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*See Accompanying MS PowerPoint file for district maps of outbreaks and epidemics by time period.

Executive Summary

Disease epidemics result in substantial ill health and loss of lives and therefore pose a threat to global health security, undermine socio-economic lives and destabilize societies. Disease surveillance is a critical component in detecting and effectively responding to epidemics to minimize loss of life and their disruptive consequences. Carefully assembled surveillance data at the highest possible spatial resolutions also permit the understanding of the burden of epidemics, their co-occurrence and the key biological, ecological, economic, health system and governance determinants. It is for this purpose that the WHO-AFRO has commissioned this report. The overarching objective was to develop a comprehensive spatially defined database of outbreaks and epidemics and delineate the ecological zones of diseases that are classified as Public Health Emergency of International Concern (PHEIC) according to the International Health Regulations (IHR) 2005 and malaria.

The main tasks included the assembly of an inventory of all epidemics reported in Africa from 1970-2016 characterised by date of occurrence, length of epidemic and magnitude and district of occurrence; definition of ecological zones of PHEIC diseases and malaria; the assembly of data on important socio-economic, health systems and environmental correlates and an basic statistical analysis of their relationship with occurrence and frequency of epidemics and outbreaks.

Through this study, several products have been developed including time series graphs of outbreak and epidemic occurrence by country, maps of the ecologies of the PHEIC diseases and epidemics, the distribution of these diseases by district. Overall, over 1730 outbreaks/epidemics have been reported in the WHO African region in the period 1970 to 2016. Because the outbreak/epidemic thresholds of the different diseases vary and the actual case data is incomplete, it is difficult to compare which diseases are most prevalent or pervasive. However, in terms of frequency of events, cholera, the arboviruses, measles and meningitis rank the highest. Of the nearly 5250 administrative units analysed in this study, almost each one has reported some form of a disease outbreak in the period 1970-2016, with cholera being the most geographically widespread. The resulting databases are spatially defined and should serve as the basis of subnational inventory of disease outbreaks and epidemics in the region.

Several challenges were encountered in the process of implementing this exercise:

- There is limited information on the definitions and thresholds of outbreaks used over time and how this may have been affected by changing diagnostics and case definitions. This results in uncertainties in the temporal comparison of data.
- There were inconsistencies between the major databases used in this report in terms of occurrence and magnitude of outbreaks. Agreement across more than two databases supported with literature review and consultation with the WHO AFRO and HQ teams helped with data verification.
- Poor access to national surveillance bulletins, which are an important source of original outbreak and epidemics data, was a challenge to the data verification process and the development of online portals of national surveillance reports is critical.
- There is limited data before 1980, most likely as a consequence of poor reporting or archiving of outbreak and epidemic data in libraries outside of Africa. In contrast, there is a greater frequency of reported outbreaks in the last 15 years as diagnosis and surveillance improved. For these reasons, extreme caution must be exercised when interpreting the trends in disease outbreaks and epidemics in Africa.

- The description of the location of outbreak and epidemic events were variable. In some cases the name of village, town or district were reported. In others, the spatial definition of data was at regional or country levels. The aim of this project was to harmonize these data was to define events by district and where this was not possible, the data were reflected in the time series graphs but are not shown on the district maps.
- Most of the potential correlates of epidemics, particularly those on socio-economic and health system development, are rarely available by district restricting the analysis to national level.

The databases and maps produced in this report should be considered as the foundation for tracking epidemics sub-nationally within the WHO African region. However, they require continuous verification, improvements in spatial resolution and regular updating. Finally, these data can also serve as the inputs for disease specific risk and vulnerability analysis. For example, the simple analysis in this report of the correlates shows that urbanization, gross domestic product (GDP) per capita, percentage GDP expenditure on health, human development index, global hunger index, conflicts, El Nino occurrence and forest cover seemed to correlate with patterns of epidemics. Combining such correlates with the detailed district level outbreak and epidemic data developed under this report could be the basis of further analysis of the assessment of risk of and vulnerability to the PHEICs.

1. Introduction

There is an increasing recognition of the threat epidemics pose to global security, beyond its impact on human health [<https://ghsagenda.org/>; WHO 2015a; Sands et al. 2016]. Epidemics impact on human security through the catastrophic loss of life, the fear it creates in communities and the potential disruption of political and public order [Sands et al. 2016]. It also impacts on economic activity through the loss of labour and productivity and restrictions on travel and movement of goods. Low income countries, where the burden of infectious diseases are also generally high and the health systems are ill equipped to even respond to the basic health needs of the population, face greater vulnerabilities to the consequences of epidemics, setting back hard-earned health and socio-economic gains. Increased global connectivity and human population movement and economic interdependence mean that the risk and consequences of infectious diseases spreading across borders has grown dramatically and the threat to global security of an outbreak in a 'distant' corner of the world can no longer be ignored.

The recent Ebola virus disease (EVD) outbreak in West Africa and its consequences is a poignant reminder of the global threat of epidemics [Moon et al 2015; Sands et al. 2016]. The outbreak began in Guinea in December 2013 and rapidly spread to Liberia in March 2014 and Sierra Leone May 2014 as a result of imported infections from Guinea [Moon et al 2015; WHO 2015b]. In all three countries, a full blown epidemic occurred and has only recently being brought under control. Small outbreaks also occurred in Nigeria and Mali and imported cases have been reported in Senegal, USA, the United Kingdom and other parts of the world. In the three main affected countries, over 28,000 people have become infected and 11,000 lives have been lost since [Moon et al 2015]. The economic losses as a result of the Ebola epidemic were estimated to be up to 2.2 billion US dollars in 2015 alone [World Bank 2016]. Although the epidemic has been largely controlled, cases have been reported in all countries in 2015.

The rapid spread of the EVD and its catastrophic consequences were attributed to several national and international weaknesses [Moon et al 2015; Sands et al. 2016]. In February 2014, the Global Health Security Agenda (GHSA) was launched with a vision of '*a world safe and secure from the global health threats posed by infectious diseases...*' [<https://ghsagenda.org/about.html>]. By November 2015, 48 countries, including 10 from the WHO African region, had become members of the GHSA. Eleven action package areas (4 on prevention, 5 on detection and 3 on response) have been identified as part of the roadmap to implement the IHR (2005) [<https://ghsagenda.org/packages.html>].

Throughout the post-Ebola discussions, the existence of important surveillance gaps in several African countries was seen as a major obstacle to the prevention, preparedness, detection and response of future epidemics on the continent. The WHO African Regional Office (AFRO) has undertaken several activities including the critical assessment of country readiness for International Health Regulations (IHR) 2005 requirements, the scale up and improvements of integrated disease surveillance and response (IDSR) systems and the strengthening of country laboratory capacity to detect diseases of international public health importance [WHO 2015c; CDC-IDSR 2015].

As part of this response, the WHO-AFRO has identified the need to develop a comprehensive, high resolution and spatially defined database of past outbreaks and epidemics to understand the disease specific epidemiological risks, the sub-national distribution of outbreaks and to support epidemic risk vulnerability analyses necessary for prioritizing country support. It for these reasons that this work was commissioned.

2. Objectives

The occurrence of disease causing pathogens, host susceptibility, and environmental and contextual factors necessary for transmission are the key determinants of infectious outbreaks and epidemics [Janeway et al 2001]. Epidemics are likely to occur under conditions where there has been an increase in amount or virulence of the agent, introduction of the agent into a non-immune population, change in the host susceptibility, or pathogen susceptibility to drugs or enhanced transmission pathways increasing infection rates [Kelsey et al 1986].

The main objective of this project, therefore, was to develop a comprehensive spatially defined database of outbreaks and epidemics and delineate the ecological niche of diseases that are classified as Public Health Emergency of International Concern (PHEIC) according the International Health Regulations (IHR) 2005¹, and malaria, in the WHO African region. Under the IHR (2005), diseases classified as PHEIC were small pox, poliomyelitis due to wild-type poliovirus, human influenza caused by a new subtype and severe acute respiratory syndrome (SARS), pneumonic plague, yellow fever, viral hemorrhagic fevers, and West Nile fever and Zika virus.

2.1 Specific objectives

- 1) Develop an inventory of all epidemics reported in Africa from 1970-2016 and characterise data by date of occurrence, length of epidemic and magnitude.
- 2) Define the ecological zones of diseases that are classified as PHEIC and malaria.
- 3) Link the assembled data on outbreaks and epidemics to highest geographic resolution, preferably by district or equivalent
- 4) Identify and assemble data on important socio-economic, health systems and environmental factors and implement a statistical analysis of their relationship with occurrence and frequency of epidemics

3. Assembly of outbreak and epidemics data

3.1 Identification of sources and developing a unified database

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