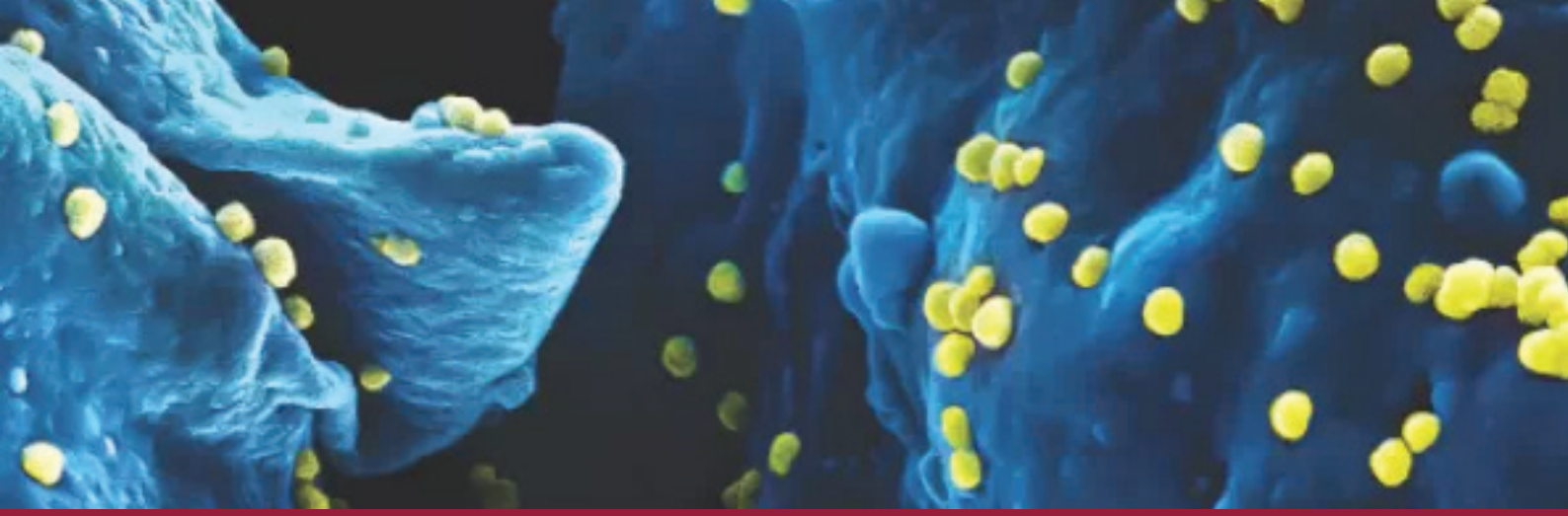

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Priority setting for epidemic-prone diseases in Africa using a risk ranking and analysis for effective emergency preparedness and response

HEALTH EMERGENCY PREPAREDNESS AND RESPONSE DIVISION

JULY 1, 2022 | FIRST EDITION-2022

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Acknowledgments

Africa CDC expresses gratitude to all partners, and individuals who participated and contributed to the technical discussions during the technical working group meetings and in the development of this report.

Africa CDC also acknowledges the excellent collaboration between its institution and the European Centre for Disease Prevention and Control (ECDC) in coordinating this exercise.

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Glossary

All-hazards approach

A strategy for managing the full range of emergency risks and events that is founded on the understanding that managing these risks, including responding to almost all emergencies, requires common elements and capacities.

Depending on the particular jurisdiction and the emergency's nature, an EOC's organization and functioning may change. Staff members often come from relevant organizations like emergency management, law enforcement, fire and rescue, public health, transportation, and public works. The EOC's goal is to provide a centralized and coordinated response effort that ensures efficient resource management and a coordinated response to the event.

Disaster

A disaster is defined as a sudden, substantial occurrence or set of events that cause significant damage, casualties, and disruptions to daily life in a community or civilization. Natural occurrences, human activities, or a combination of both can result in disasters. They frequently go beyond what the affected area can respond to and recover from on its own.

Disasters can have a wide range of repercussions on people, communities, and society as a whole. They can result in food and water shortages, tax healthcare and emergency response systems, wreak havoc on transportation and communication networks, and create psychological and emotional suffering.

Emergency Management

The term "emergency management" describes the organized process of anticipating, addressing, recovering from, and minimizing the effects of catastrophes or disasters. To effectively address the effects of an emergency incident, it entails coordinating and integrating several resources, persons, and organizations. Saving lives, preserving property and the environment, and ensuring the quick and efficient recovery of impacted communities are the main objectives of emergency management.

Emergency Operation Centre (EOC)

During a crisis or disaster, a central command and coordination structure known as an emergency operations center (EOC) acts as the focal point for managing and coordinating emergency response and recovery efforts. In reaction to important events that call for a multi-agency or multi-disciplinary response, the EOC is often activated.

Emergency

An emergency is defined as a circumstance or an occurrence that creates an urgent risk to safety, life, property, or the environment and necessitates quick response to address or mitigate the problem. There are many different types of emergencies, including man-made disasters like fires, terrorist attacks, or industrial accidents as well as natural catastrophes like earthquakes, storms, floods, or wildfires.

Epidemic Prone Diseases

Epidemic-prone diseases, also known as infectious or communicable diseases, are illnesses that have the potential to spread rapidly and affect a large number of people within a population or geographic area. These diseases are caused by infectious agents such as bacteria, viruses, parasites, or fungi and can be transmitted from person to person, through vectors (such as mosquitoes), or through contaminated food or water.

Hazard	A process, occurrence, or human activity is a hazard if it has the potential to degrade the environment, inflict property damage, human injury, or other negative health effects. According to the WHO classification of hazards, natural hazards (biological, extraterrestrial, geophysical, and hydro-meteorological), human-induced hazards (technological, societal), and environmental hazards (environmental degradation) are all examples of risks that can be singular, sequential, or combined in their origin and effects. The United Nations Office for Disaster Risk Reduction has established additional descriptions and categories of risks
	Identifying, gathering, connecting, synthesizing, analysing, assessing, and generating a wide range of information for actionable insights and disseminating these for informed and effective decision-making to protect and improve the health of populations are all core responsibilities of public health intelligence.
One Health	A comprehensive, unifying strategy that seeks to optimally and sustainably balance the health of people, animals, plants, and ecosystems. It acknowledges the interdependence and intimate connections between the health of people, domestic and wild animals, plants, and the larger environment (including ecosystems).
Pathogen Prioritization	This is the process of assessing and ranking pathogens based on their potential impact on human health, the likelihood of their emergence or re-emergence, and the availability of effective control measures. This prioritization helps public health authorities, researchers, and policymakers allocate resources efficiently and focus efforts on the most significant threats.
Preparedness	The term "preparedness" refers to the actions and procedures done ahead of time to improve capability and readiness to respond to anticipated emergencies or disasters. It entails preparing people, communities, organizations, and governments by planning, organization, and equipping in order to lessen the effects of catastrophes and enable a prompt and well-coordinated response. Emergency management must include preparation because it can drastically cut down on fatalities, injuries, and property damage from disasters.
Public Health Events	Events that have a substantial impact on the health and welfare of a population or community are referred to as public health events. In order to prevent, address, and lessen the effects of health-related issues, these events frequently entail collaboration between public health organizations, healthcare providers, and other stakeholders. Some examples of Public Health Events include Disease outbreaks, Natural Disasters, Environmental Health Crises etc.
Response	The efforts taken immediately before, during, and after a disaster or emergency to handle the problem and lessen its effects are referred to as the response phase of emergency management. The goal of the response phase is to safeguard the safety and well-being of those who have been harmed as well as the affected persons and communities. Implementing emergency plans and carrying out particular response tasks entails the mobilization of assets, personnel, and organizations.
Risk assessment	is a continuous, systematic process of information gathering, evaluation, and documentation to determine the level of risk to human health associated with an event based on three factors: hazard evaluation, exposure evaluation, and context evaluation (including vulnerability and coping capacity). A risk assessment serves as the foundation for guiding efforts to lessen the adverse effects of public health incidents through preparedness and response initiatives.

Risk Matrix	A risk matrix, also known as a risk assessment matrix or risk probability matrix, is a visual tool used to assess and categorize risks based on their likelihood and potential impact. It provides a structured framework for evaluating and prioritizing risks in terms of their severity and probability of occurrence. The risk matrix provides a visual representation of risks, allowing stakeholders to quickly understand the relative significance of different risks and make informed decisions regarding risk management strategies and resource allocation. However, it's important to note that the risk matrix is just one tool in the risk management process and should be used in conjunction with other risk assessment techniques and qualitative judgment.
Risk Ranking	Risk ranking is a systematic process of assessing and prioritizing risks based on their likelihood and potential impact. It involves evaluating different risks and assigning them a relative ranking to identify those that require immediate attention and allocation of resources. Risk ranking helps organizations or decision-makers allocate resources efficiently and focus their efforts on managing the most critical risks.
Risk	The potential loss of life, injury, or lost or damaged assets that could occur to a system, society, or community in a certain period of time, assessed probabilistically as a function of hazard, exposure, vulnerability, and capacity.
Secure public health worldwide	the proactive and reactive measures needed to lessen the risk and effects of acute public health events that put people's health at risk across national and international boundaries.
Surveillance (Public health surveillance)	the methodical, continuing gathering, compiling, and analysis of data for public health purposes, as well as the prompt transmission of public health information for evaluation and, if necessary, public health response.
Threat	A person, place, thing, development, or a mix of these that poses a real or perceived risk to one's health and security. Examples include environmental dangers like climate change or antimicrobial resistance. Threats can also relate to intentional actions like the intention to discharge a harmful chemical.

Executive summary

Africa reports over 100 health emergencies annually. Such magnitude and burden of infectious disease outbreaks and other health emergency events demands significant human, financial and material resources and always pushes the already overstretched health system to the breaking points. The purpose of this publication is to present a tool for the Priority setting for epidemic-prone diseases in Africa using a risk ranking and analysis for effective emergency preparedness and response, based on a set of criteria and indicators that reflect their potential impact on public health and society. The tool was developed and adapted by a multidisciplinary team of experts from Africa Centres for Disease Control and Prevention (Africa CDC), European Centre for Disease Prevention and Control (ECDC), United Kingdom Health Security Agency (UKHSA), United Kingdom Public Health Rapid Support Team (UKPHRST), United States Centers for Diseases Control and Prevention (US CDC) and other institutions, following a review of best practices and existing methodologies in this field.

The tool is not meant to be prescriptive or definitive, but rather to serve as a guide for comparing and evaluating infectious disease threats based on available evidence and expert judgment on the African context. The tool is subject to limitations and should be used with caution and critical thinking. Being the first time in use, it is intended that in the nearest future and in reality, to the prevailing circumstances, efforts should be made to update the tool to reflect new information and developments in the field of infectious disease epidemiology.

The tool is an Open Data Kit (ODK) based platform that enables users to enter data on numerous infectious disease concerns, including their epidemiology, transmission, severity, prevention and control strategies, availability of countermeasures, social and economic drivers, and environmental drivers all summed up into three criteria; Risk trajectory, Epidemic potential and the Disease severity. Based on a weighted average of these signs, the tool is used to determine a score for each disease and ranks them in order of priority. A graphic representation of the findings along with a summary table outlining average scores of each ailment is computed using arithmetic means. Ethical, legal and societal issues related to priority setting for epidemic prone diseases such as equity, fairness, accountability and communication were put into consideration by the team while using the tool.

It is expected that the tool will serve as a guide for public health experts, PHEOC managers and decision-makers to prioritize and rank the most pressing and pertinent infectious disease threats in their context and environment. It can be employed for many different purposes, including organizing surveillance operations, allocating resources, developing preparedness plans, conducting risk assessments, and guiding research and development agendas. The tool is versatile and flexible, and it can be tailored to the needs and tastes of the user.

This publication provides strategic and targeted approach to better prepare for and respond to common and high-impact epidemic diseases in the African continent. It also provides a common framework for international collaboration and coordination for funding allocations, research collaborations and capacity building. Priority diseases identified should be seen as candidates for further in-depth analysis of their importance in preparedness planning and to identify capacities and capabilities gaps for further strengthening.

Introduction

Emerging and re-emerging infectious diseases have increased nearly fourfold over the past 60 years. Africa reports over 100 health emergencies annually. Such magnitude and burden of infectious disease outbreaks and other health emergency events demands significant human, financial and material resources and always pushes the already overstretched health system to the breaking points. It is thus critical to improve the level of preparedness and the level of public awareness, to the potential and imminent epidemics in order to reduce their disastrous impact to health and economy.

The International Health Regulations (IHR-2005) identify mapping and using priority health risks and resources as one of the core capacities in Public Health Emergency Preparedness and Response (PHEPR). Effective preparedness and swift response to epidemic is the goal of Africa Centres for Disease Control and Prevention (Africa CDC). In this regard, Africa CDC in collaboration with the European Centre for Disease Prevention and Control (ECDC), applied a methodology to rank infectious diseases requiring a rapid and efficient response with the use of a tool and a multidisciplinary consultation forum.

The methodology considered the changing context of the African continent where emerging and re-emerging diseases give rise to outbreaks with greater impact on communities within a member state or across the borders. Priority setting must be placed in the broader context of public health emergency preparedness and response planning cycle to guide resource allocation and capacity building and informed decision making aligned with public health preparedness and response plans. The identification and prioritization of risks serves to define preparedness options and resource needed to reach emergency response objectives.

Scope

Limited resources and already overstretched health systems have very minimal band-width to handle all health emergencies in the community with the same levels of efforts in terms of deployment of resources. Even a trial of such an exercise will cripple the health systems and will cost provision of basic and essential health services. Preparing for all-hazard health emergencies will be the ideal when the resources permit; however, in the African and other low- and middle-income countries (LMIC) context, this has been a challenge as a good number of member states are still behind in achieving the IHR-2005 core capacities.

Risk ranking and pathogen prioritization for epidemic prone diseases is intended to focus and deliberate on the efforts by member states and other partners in strengthening preparedness activities to the recurring and high impact pathogens.

Target Users

The idea of priority setting for epidemic-prone diseases in Africa using a risk ranking and analysis for effective emergency preparedness and response was created to aid all member states and partners involved in emergency preparedness and response in prioritizing and allocating resources appropriately.

Its main purpose is to serve as a guide for national public health authorities (such as health ministries, national public health institutes, and public health emergency management authorities) who are in charge of public health surveillance, laboratories, emergency preparedness, and response, as well as partners and other stakeholders who support these activities. Additionally, it can help donor organizations, academic institutions, businesses, and other partners concentrate technical and financial resources on crucial logistic requirements for emergency preparedness.

Purpose and objectives

The purpose of prioritizing risks of epidemic-prone diseases is to inform Africa CDC strategic planning in allocating resources based on evidence, to mitigate and respond effectively to health emergencies, limiting the spread of diseases, preventing/minimizing morbidity and mortality as well as social- and economic disruptions for an early socio-economic recovery. Specifically, the objectives for conducting risk ranking (RR), for selected infectious diseases of epidemic potential was:

1. To identify the priority diseases for emergency preparedness planning.
2. To use the results of the RR in the broader context of the following:
    - Strategic emergency preparedness planning, capacity building and resourcing;
    - Targeted prepositioning of essential medical and non-medical countermeasures; i.e., medical supplies, diagnostics, therapeutics and vaccines; and plan for logistics for emergency preparedness and response;
    - Liaise with other respective Divisions in Africa CDC and in partner organizations for the development of essential diagnostics, therapeutics and vaccines lists, needed for emergency response;
    - Contribute towards research, development and innovation prioritization, in new and advanced technology and public health actions for prevention, early detection and rapid response; including pathogen-genomic surveillance expansion in Africa.

Methodology: Risk ranking Process

There are seven steps used for risk ranking including planning, selecting diseases/events for prioritization, formulating risk criteria for assessing diseases, scoring each disease against the criteria, ranking diseases based on relative scores, weighting criteria against importance and evaluating. Below is the brief description of the steps we undertook:

I. Planning

A planning team comprised of members from the Emergency Preparedness and Response division in Africa CDC and the Emergency Preparedness and Response section in ECDC was formed to organize and prepare the risk ranking exercise. The team met virtually once a week since November 2021 to May 2022. The team was introduced and oriented to the risk ranking and guidelines and tools (developed and initially used by ECDC in the context of Europe), and soon realized the need to modify and adapt them into the African context and Africa CDC work.

The team clearly defined the objectives, scope, geographical coverage, stakeholders to be involved and established a timetable to conduct the exercise. A multidisciplinary consultative group was then formed comprised of members of Emergency Preparedness and Response, Surveillance and Disease Intelligence, Laboratory and systems Network, Public Health Institute and Research divisions and Regional Collaborating Centres of the Africa CDC, United Kingdom Health Security Agency (UKHSA), United States Centers for Diseases Prevention and Control (US CDC) and ECDC. The scope of the risk prioritization and disease ranking was based on the continental perspectives taking into account the multiple disease outbreaks that occur in the different regions of the continent.

II. Selection of diseases/events for prioritization

The Africa CDC Event Based Surveillance (EBS) database from 2020 to 2021 was reviewed and 36 events/conditions were identified. Of these events, 18 diseases were identified as a public health concern and selected for prioritization:

a) Vaccine-preventable diseases such as influenza (pandemics), COVID-19, Neisseria Meningitidis, Measles and Vaccine-derived Poliomyelitis;
b) Water-borne diseases such as cholera,
c) Zoonosis such as Lassa fever, rabies, anthrax, plague, and monkeypox;
d) Vector-borne diseases such as yellow fever, dengue fever, rift valley fever and chikungunya;
e) Viral haemorrhagic fevers including Crimean-Congo haemorrhagic fevers and Ebola Virus Diseases; and
f) Disease due to unknown pathogen.

Selection of risk criteria

For the ranking process to work, ranking criteria have to be defined. Ideally, the criterion considers the risk notion of the disease. Risk notion is the perception and conception of the probability that an illness or disease will occur. After consultations and inputs from the multidisciplinary stakeholders and based upon Multi-Criteria Decision Analysis (MCDA) methodology, a total of 19 criteria categorized into four broad groups were selected. The criteria selected were distinct and precisely expressed. They include:

Risk trajectory:

1) Probability of the pathogen circulating among humans in the African region in the next five years; and
2) Probability that the risk increases in the next five years in Africa.

Epidemic potential:

1) Transmissibility of the pathogen in comparison to other pathogens being prioritized;
2) Population susceptibility: how many regions in Africa have high pools of susceptible populations, in comparison to the other pathogens being prioritized;
3) Probability of the pathogen causing a cross-country outbreak: what is the likelihood, compared to other pathogens being prioritized, that the pathogen could lead to a cross-country outbreak.

Disease severity:

1) Peak infection fatality rates;
2) Proportion of cases that lead to severe disease;
3) Estimated economic impact of an outbreak of 1000 cases of the disease; and
4) Estimated social impact of an outbreak of the disease in comparison to other diseases being prioritized.

Preparedness and countermeasures:

Level of public health preparedness to deal with an outbreak of the disease in comparison to other diseases being prioritized;

1) Vaccines (availability of vaccines; effectiveness of vaccines; anticipated societal acceptance of vaccines);
2) Pharmaceutical countermeasures (availability of pharmaceutical countermeasures, effectiveness of pharmaceutical countermeasures, anticipated societal acceptance of pharmaceutical countermeasures) and
3) Public health and social measures particularly non-pharmaceutical interventions (availability of non-pharmaceutical measures for controlling an outbreak (e.g., case isolation, contact tracing, mosquito-nets, etc.), effectiveness of non-pharmaceutical measures for controlling an outbreak; and anticipated social acceptance of non-pharmaceutical measures.

III. Diseases Scoring against criteria

A risk ranking tool was developed using the open data kit (ODK), Kobo toolbox. The embedded questionnaire in the tool, included the selected diseases to be assessed with the use of the agreed criteria, resulting from three (3) consultative meetings with the participating experts.

IV. Ranking diseases based on relative scores

The questionnaire results were collected and compiled. Disease scores were calculated using measures of central tendency (median, mean), dispersion (interquartile range), and standard deviations. We combined the risk trajectory and epidemic potential criteria into one criterion and named it “Risk trajectory & Epidemic potential” criteria. The average mean of the arithmetic mean score of each criterion within the grouped criteria were calculated for each disease. A geometric mean score was used for preparedness criteria. A risk rank matrix was plotted for the “Risk trajec-

tory and Epidemic potential" against the "Disease severity" group of criteria and it was presented into a 2x2 table. The variations in responses, arithmetic means and correlation between the criteria for each disease were presented using the boxplot, table and scatterplot respectively.

V. Weighting criteria against importance

For this analysis we did not include weighting and we considered all criteria of equal importance.

VI. Multisectoral consultative meetings

A total of three consultative meetings were conducted to engage participants of various disciplines, from Africa CDC in every step of the risk ranking process from March to May 2022. The consultative group reviewed and critiqued the list of diseases and the ranking criteria, and discussed scores and weighting of the criteria against their importance. The participating experts were requested to complete and submit the ODK questionnaire form online. In addition, during the three consultative meetings and following a Delphi approach the experts were provided the opportunity to inform changes, suggest, discuss and finally agree on modifications that would improve the feasibility, simplicity and overall utilization of the tool.

Results

A total of 14 (29%) out of 49 experts responded to the online questionnaire. There are wide variations in the perceived risks for risk trajectory & epidemic potential, compared to disease severity and preparedness groups of criteria. There were also outliers for Ebola and Lassa-fever for risk trajectory and epidemic potential criteria; Marburg, polio-virus and yellow fever for disease severity; and cholera and measles for preparedness. Nevertheless, there is a consistency in the pattern that risks are valued for Ebola and cholera and measles, in each one of the three groups of criteria and polio virus and disease of unknown aetiology for preparedness and the disease severity criteria respectively (Figure 1).

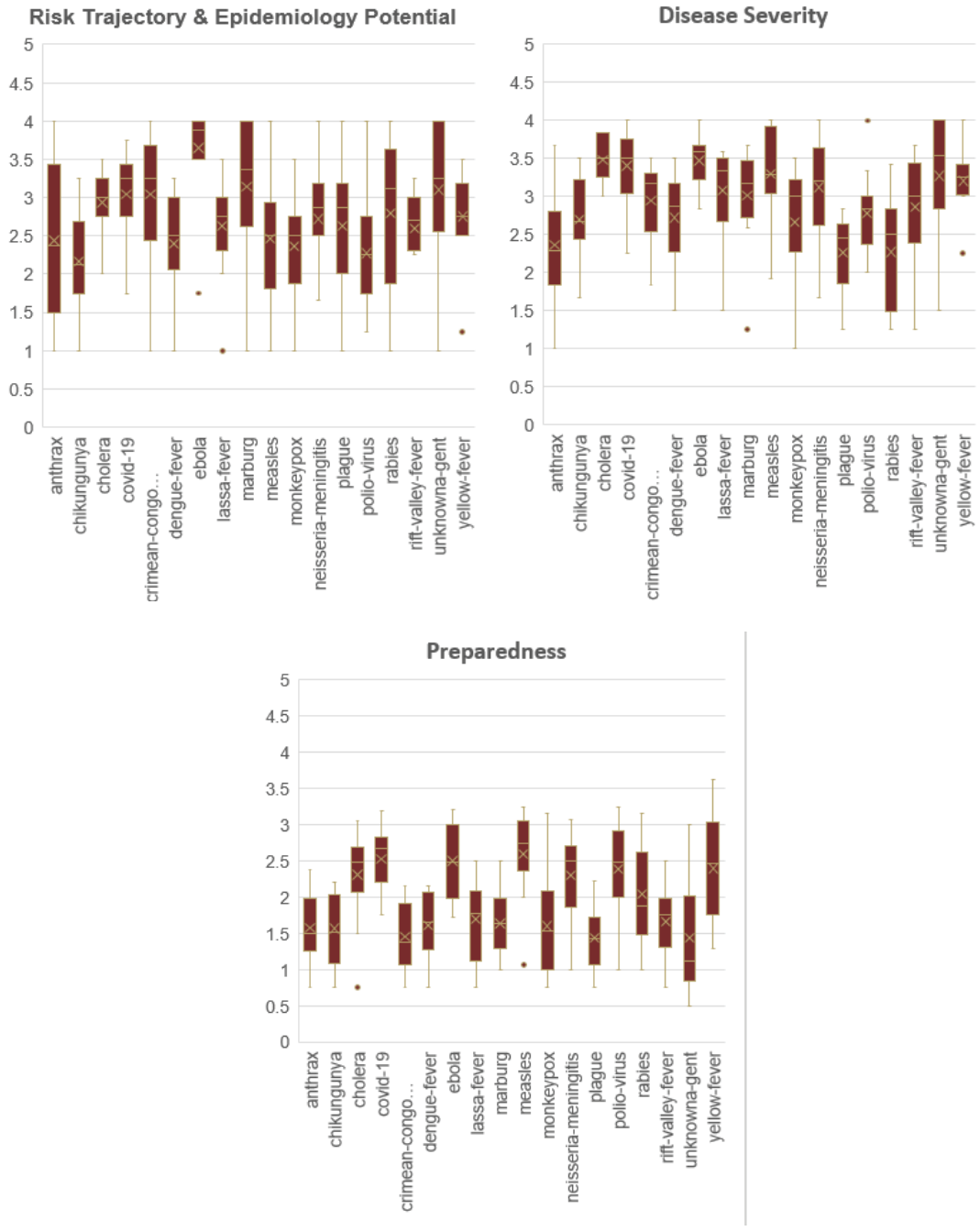


Figure 1: Box plot distribution of disease risks under the three criteria categories. Risk ranking, Africa CDC HQ, March-May 2022

Diseases such as cholera, COVID-19 and Ebola had the highest mean score for risk trajectory and epidemic potential (3.5); Ebola for disease severity (3.7); and measles (2.6), Ebola and COVID-19 (2.5) for preparedness and medical countermeasure (Table 1).

Table 1: Distribution of the average mean, maximum and minimum average value of the risk of each prioritized disease, Risk ranking, Africa CDC HQ, March-May 2022

	Risk & Epidemiologic			Disease Severity			Preparedness		
Disease	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**
Anthrax	4.0	2.5	1.0	4.0	2.6	1.0	2.4	1.6	0.8
Chikungunya	3.5	2.7	1.7	3.3	2.2	1.0	2.2	1.6	0.8
Cholera	4.0	3.5	3.0	4.0	3.0	2.0	3.1	2.3	0.8
Covid-19	4.0	3.5	2.3	4.0	3.1	1.8	3.2	2.5	1.8
Crimean-Congo-Haemor-rhagic-Fever	3.5	3.0	1.8	4.0	3.1	1.0	2.2	1.5	0.8
Dengue-fever	3.5	2.8	1.5	3.3	2.4	1.0	2.2	1.6	0.8
Ebola	4.0	3.5	2.8	4.0	3.7	1.8	3.2	2.5	1.7
Lassa-fever	3.8	3.1	1.5	4.0	2.7	1.0	2.5	1.7	0.8
Marburg	3.8	3.1	1.3	4.0	3.1	1.0	2.5	1.6	1.0
Measles	4.0	3.4	1.9	4.0	2.5	1.0	3.3	2.6	1.1
Monkeypox	3.5	2.7	1.0	3.5	2.4	1.0	3.2	1.6	0.8
Neisseria-meningitis	4.0	3.2	1.7	4.0	2.8	1.0	3.1	2.3	1.0
Plague	2.8	2.3	1.3	4.0	2.6	1.0	2.2	1.4	0.8
Polio-virus	4.0	2.9	2.0	4.0	2.3	1.3	3.3	2.4	1.0
Rabies	3.8	2.4	1.3	4.0	2.8	1.0	3.2	2.0	1.0
Rift-valley-fever	3.8	2.9	1.3	3.3	2.6	1.0	2.5	1.7	0.8
Unknown-agent	4.0	3.0	1.0	4.0	3.1	1.0	3.0	1.3	0.3
Yellow-fever	4.0	3.3	2.3	4.0	2.8	1.3	3.6	2.4	1.3

Ebola, Cholera and COVID-19 observed to have the highest scores for disease severity, risk and epidemic potential as well as some level of preparedness in terms of availability of vaccines, medical and non-medical countermeasures (Figure 2).

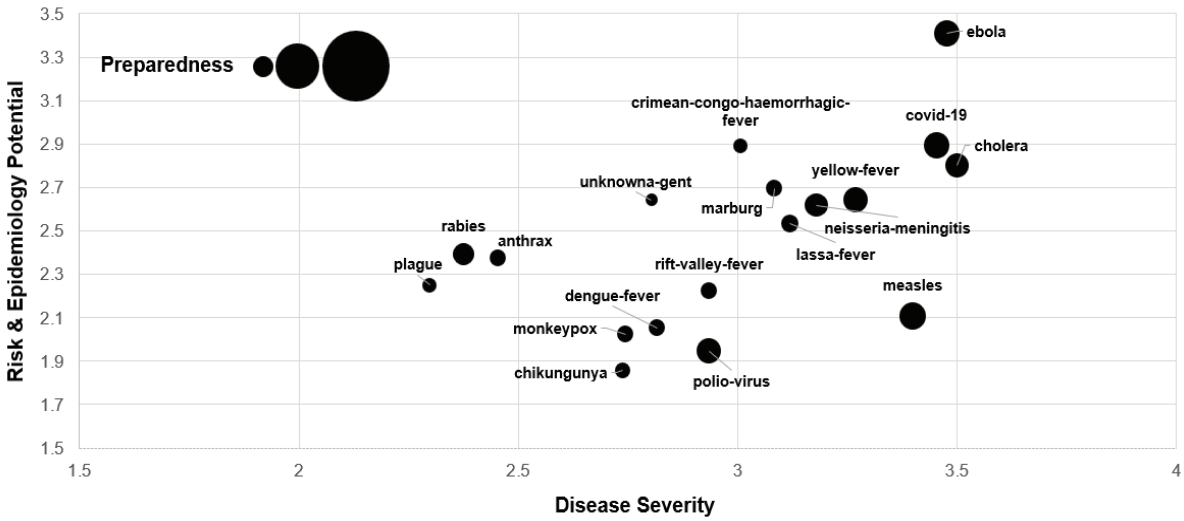
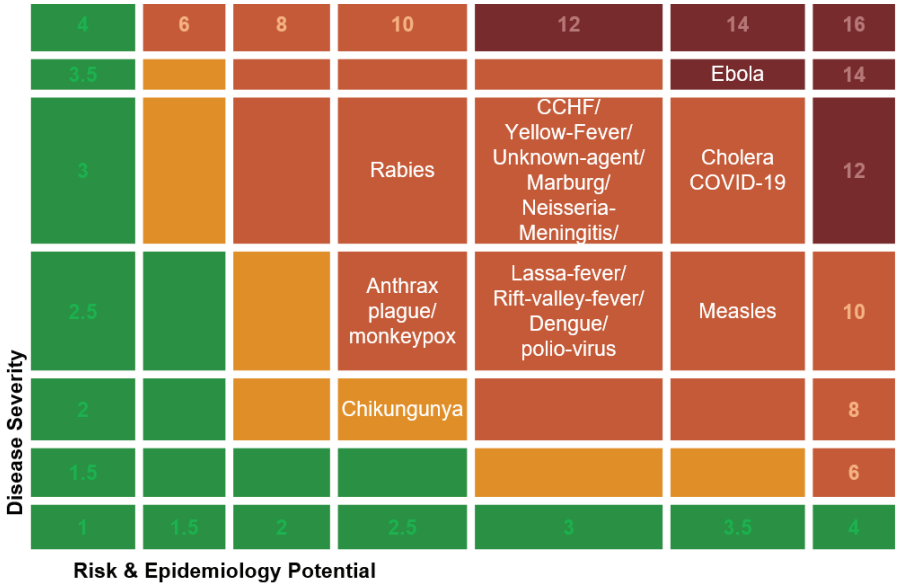


Figure 2: The scatterplots showing the correlation of prioritized diseases against the risk criteria, Risk ranking, Africa CDC HQ, March-May 2022

Diseases with the highest ranks were Ebola (mean score =12.25), Cholera (mean score =10.50) and COVID-19 (mean score =10.50) whilst monkeypox (mean score =6.25), anthrax (mean score =6.25), plague (mean score =6.25) and Chikungunya (mean score =5.00) had the lowest ranks (Table 2).

Table 2: Risk ranking matrix, Africa CDC HQ, March-May 2022



Disease	Rank (Multiplication of mean of rounded scores)	Preparedness (Mean Scores)
Ebola	12.25	2.5
Cholera	10.50	2.3
Covid-19	10.50	2.5
Crimean-congo-haemorrhagic-fever	9.00	1.5
Yellow-Fever	9.00	2.4
unknown-agent	9.00	1.3
Marburg	9.00	1.6
Neisseria-Meningitis	9.00	2.3
Measles	8.75	2.6
Lassa-fever	7.50	1.7
Rift-valley-fever	7.50	1.7
Dengue-fever	7.50	1.6
Polio-virus	7.50	2.4
Rabies	7.50	2.0
Monkeypox	6.25	1.6
Anthrax	6.25	1.6
Plague	6.25	1.4
Chikungunya	5.00	1.6

Note: The mean actual values have been rounded off to the nearest 0.5

Limitations

- There is quite a wide variety in risk ranking for some of the diseases, this could be attributed by:
    - The assessment was conducted on the continent level and therefore the outcomes might not be generalizable to all regions.
    - There was no adequate geographical representation of the whole continent hence need to ensure participants represents all the regional zones of the continent.
    - Small sample size hence a larger sample size might be required for this to give more power.
    - As this is expert consultation, professional bias and inadequate representation of different disciplines might affect the scores.

Hence, the results do not represent an absolute value; caution should be applied when interpreting the final results, as final ranks are only an indication of the relative importance of diseases against one another. Priority diseases should be seen as candidates for further in-depth analysis of their importance in preparedness planning and to identify capacities and capabilities gaps for further strengthening.

Conclusion

This product provided insight on what diseases to focus for emergency preparedness actions and for generation of research agenda. This exercise is the first of its kind for Africa CDC to scientifically base decisions on resource allocations for health emergency preparedness planning which is applicable across divisions. It is an iterative process which will often be done after every 2 - 3 years. Further steps are required to assess gaps, capacities and capabilities existing in the continent to effectively respond to the priority hazards and risks identified.

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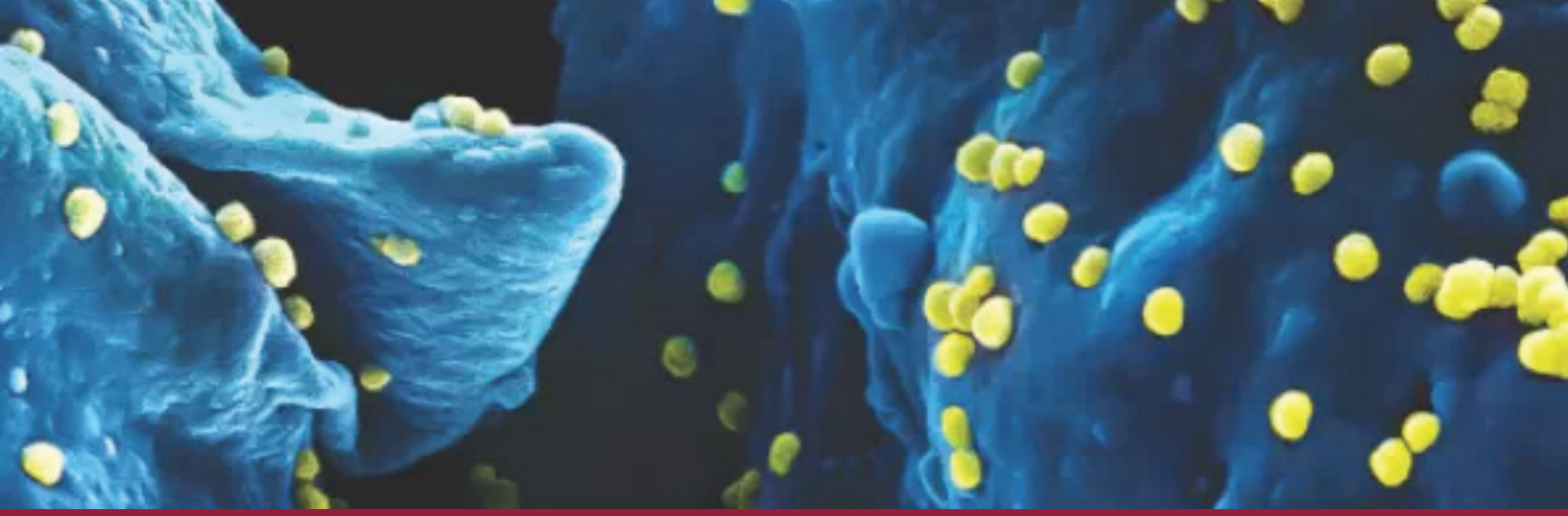

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