Analysis of Biosecurity preparedness of East African Countries with respect to Global Health Security Agenda.

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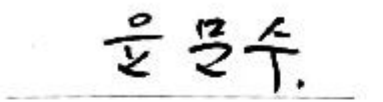
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List of abbreviations

e-SPAR   Electronic State Party self-assessment Annual Reporting tool

FAO   Food and Agricultural Organization

GDP   Gross domestic product

IDSR   Integrated Disease Surveillance and Response

IHR   International Health Regulations

JEE   Joint External Evaluation

MDR TB   Multi Drug Resistant Tuberculosis

PHEIC   Public Health Emergency of International Concern

SARS   Severe Acute Respiratory Syndrome

WHO   World Health Organization

XDR TB   Extensively Drug Resistant Tuberculosis

ABSTRACT

Background: Biosecurity are all precautionary measures put in place to ensure that biological materials are protected from being abused. The abuse means that these agents may be used to cause harm to humans, animals, agriculture and environment. All necessary safeguards are employed to ensure that the materials are not susceptible to theft, loss, diversion including intentional and unintentional release which can harm. The materials can either be in a research institution, hospital setting or during transport of highly infectious agents but not limited to laboratory setting.

Methodology

This study was a qualitative retrospective study which involved analysis of the data published online by WHO on country's level of preparedness capacity in implementation of GHSA agenda. Eleven of the thirteen capacity areas related to biosecurity were extracted from the electronic state party self-assessment reporting tool as it is compulsory for every member to report yearly. The scores were compared between the countries and also with the WHO Africa regions average. The information was presented in charts.

Results

Two countries had 50% and above average score for 2018 namely Rwanda and Uganda while Kenya, Burundi and Tanzania had scores below the mark. For 2019, Tanzania, Uganda and Rwanda had scores above 50% of 52.9, 65.2 and 76.4 respectively. Kenya was the least prepared followed by Burundi by the end of year 2019. However, Kenya is more economically developed followed by Tanzania, Uganda, Rwanda and Burundi respectively.

Conclusion

Political commitment to IHR (2005) was the greatest factor that contributed to the different levels of capacity attained by the countries followed by susceptibility to recurrent epidemics which necessitate national preparedness to rapidly and effectively respond whenever they occur. There was no observable relationship between the level of a country's preparedness and their economic status.

1.0 Introduction

With the advent of COVID-19 and challenges thereof, there is no time in recent history that biosecurity has taken precedence in routine activities as now. The emerging and reemerging infectious diseases pose a significant public health risk that are haunting human civilization in the past several decades. These pathogens should be regarded as high threats to human, animals and environment. As witnessed in the year 2020, a virus from the family of coronaviridae called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that cause the coronavirus disease 19, and was reported first in Wuhan City, Hubei province of China,[1] spread quickly across the world attaining the status of public health emergency of international concern (PHEIC). A short while after a PHEIC declaration, the World Health Organization (WHO) declared the disease as a pandemic. In this regard, many measures focusing on biosafety and biosecurity that focus on one health aspect of the disease outbreaks, and control of spread of it are of paramount importance. Furthermore, standard precautions and control measures should also be instituted at personal and community level to prevent the spread of contagious diseases.[2] For instance, employers have devised methods of scheduling shifts of their workers, ensuring that the different groups do not come into contact with each other and maintaining social distancing during the shift to ensure biosecurity.[3] Sometimes, biosecurity is misconstrued to mean only biological material in a laboratory set up. However, biosecurity covers a lot of spheres like in healthcare facilities of highly specialized clinics handling highly infectious diseases like

Viral hemorrhagic fever, SARS, MDR and XDR- tuberculosis and others hence requires a good understanding of its scope.[4]

Besides safeguarding human health, biosecurity is applied in many sectors of the economy and even others employ some preventive measures without knowing that what they are involved in is actually biosecurity. Cattle farmers for instance, have restricted access by strangers to their herds to control diseases. They also disinfect vehicles or equipment. Furthermore, they introduce foot wash for workers or anyone who is legible to access the area occupied by animals. This is observed before and after the visit. In the same regard, the farmers ensure that the animals that are to be introduced to the farm are of known health status. In this regard, farmers have banned introduction of new herds completely to their area hence preventing the introduction of diseases to their farms. Furthermore, these farmers ensure that proper vaccination is done to their animals to prevent diseases hence cut cost in having to treat their animals against some diseases. This promotes prevention of antimicrobial resistance that can be brought about by use of antimicrobials to treat vaccine preventable diseases[5] Similarly, biosecurity measures are applied in other types of livestock farming including but not limited to the largescale chicken farmers. For instance, the farmers in Australia employ biosafety measures to protect their livestock against highly pathogenic Avian Influenza.[6] On the other hand, plant protection from various pests and other threats as covered by the international plant protection convention, and various organizations under FAO that are concerned with animal life and health, food safety, plant health including associated environmental risks, advocate for continuum integration of

various departments. The departments are tasked with ensuring that no new biological agents that cause threats are introduced to their country through any activities that fall within their mandate. This ensures a fully integrated system.[7] Though sometimes biosecurity definition seems ambiguous, the approaches may seem different but with similar goals.[8] A lot of efforts is involved to ensure environmental protection hence foster sustainability.[9] The departments of agriculture for instance has to make sure that any exotic crops introduced have been carefully examined before being allowed to be grown freely. Furthermore, they have to ensure that animals imported to the country are free from diseases and also do not carry insects which can infest other local animals. The customs department also has to ensure that the goods that are imported do not harbor hitch hikes that may constitute a breach to biosecurity for the country.

Biosecurity in relation to Global Health Security Agenda (GHSA), refers to application of biosecurity in safeguarding human and animal health from infectious diseases that pose danger globally due to the current world interconnectedness. The initiative was launched in February 2014 as these infectious diseases have had devastating human, security and economic impact at the country, regional and global level. Global health security is a shared responsibility that cannot be achieved by a single actor or sector of government but rather depends upon the collaboration among health, security, trade, environmental and agricultural sectors. GHSA acknowledges the essential need for a multilateral and multi-sectoral approach to strengthen both the global capacity and nations' capacity to prevent, detect and respond to infectious threats.[10]

2.0 Literature Review

Biosecurity is set of procedures designed and employed with a purpose of prevention or, reduction of generation or release of highly infectious biological organisms or toxin that can cause harm to human, livestock, agriculture or environment. Initially, this terminology was employed when dealing with highly infectious organisms with respect to biosafety level 3 or 4 laboratories. However, the scope has been widened to ensure that any infectious biological material whether on transit, in an isolation facility in a healthcare setting or laboratory is taken into consideration. It is also imperative to include the protection of relevant literature pertaining these infectious agents and toxins, research findings, equipment and processes from unauthorized access even from family members of the people working with such materials.[11]

Mostly, in biosafety level 3 or 4 laboratories, the biosecurity component involves physical security of the facility including access control and security services. Material accountability and security including during handling and transportation is also covered. The other aspect is the scrutiny of the personnel. This encompasses identity verification of those with access to highly infectious organisms including measures to check on insider misuse of the biological materials. It also includes measures like ensuring that at least two people are working at the facility at any given time. Biosecurity sometimes employs access keys or passwords. This is gradually being overtaken by retinal recognition or thumb print unlocking mechanisms as the former were prone to theft. Furthermore, there is need to

ensure that the staff who work in biosecurity sector undergo psychological vetting to ensure that they are not people with distorted ideologies.[12]

Biosecurity is a system that requires multidisciplinary approach as the various threats affect different areas of the ecosystem. This include environment, plants, animals and humans. As these fall in different dockets, specific organizations have to be tasked with the responsibility of protecting specific sectors from biological threats with a central organization to facilitate sharing of information as biosecurity requires a collective and integrated approach. For instance, the agriculture department is wary of introduction of new materials that may contain pathogens for the plants. This includes introduction of new plants from neighboring or other countries whose crops are affected by certain pathogens. Worth noting is the fact that, some plants introduced to a new environment can constitute a biosecurity threat. The plants may be invasive in their growth characteristic that may cause ecological imbalance constituting a biosecurity breach.

The plants are also susceptible to attack by diseases and exotic pests which may be imported from other countries during trade or accidentally due to high movement of people and goods across the globe. The importation may also be intentional by people with hidden agenda to cause harm or economic sabotage. There is also a possibility of biota introduction which may negatively affect the new environment. The agriculture sector is also responsible in regulation of importation of animals and animal products. This calls for continued surveillance as some animals imported or plants which are legally traded may contain diseases that can cause biosecurity breaches.[13] Animals can suffer from diseases

caused by imported microorganisms and also bovine spongiform encephalopathy for cows caused by prion.[14] Genetic engineered organisms are also not spared in this aspect as their sustainability is not predictable in the long run.[15]

With the current trend of emergence of highly infectious pathogens where small scale infections expand spontaneously putting pressure on existing infrastructure, it is incumbent that continuous knowledge and preparation is necessary to be at par with such challenges. Furthermore, there is need to ensure biosecurity amid these disasters to avert further exploitation by groups or individuals with questionable agenda. For instance, the emerging infectious diseases mostly attract treatment and prevention of spread in the population only. However, less effort is made to ensure that those patients isolated are not within reach of unauthorized individuals which constitutes a biosecurity threat. The specimens obtained from suspected cases must be properly secured in terms of transport, analysis and disposal so that they do not get diverted to illegal use. Furthermore, the publicity such epidemic events attract is so enormous that it is imperative for the administration to come up with mitigation measures to prevent access of specimen containing highly infectious materials from unauthorized access and use. The biological agents may access the country through illegal or legal means which requires continuous monitoring by various state agencies through which the activities take place. For instance, the activities may include globalization of trade, international travel for tourism or for other purposes, change in land uses, smuggling and bioterrorism to mention a few. Biosecurity requires multi-sectoral approach, integrated and coordinated from a central command with the sole target of

prevention, early detection and quick response to bio-threats to ensure biosecurity as explained hereunder.

Prevention

This is the first priority for biosecurity and the most cost effective undertaking. All necessary measures should be employed to prevent introduction or spread of a harmful biological agent. This is important as for it is normally very difficult to fight some agents once they have been introduced in a population or environment. First, it requires time and resources to implement and may sometimes prove impossible to immediately identify the affected so that targeted treatment can be initiated. In some instances, it may require long term treatment which will put pressure on the resources available for such activities. Furthermore, the agent may be highly infectious that can spread to populations far and wide within a short time causing a humanitarian catastrophe. Prevention requires trained personnel and technologies packed by regulatory legislation and policies. These teams should have a collaboration leeway to work with other counterparts in other countries to ensure some of the threats are prevented from reaching the local area or population. Surveillance teams composed of technically competent staff with well-equipped laboratories are important in monitoring biological agents including zoonotic pathogens as they constitute 75% of the emerging infectious diseases in the last century.[16] The laboratory should have good biosafety and biosecurity, proper specimen referral and transport system in addition to provision for priority disease testing. Prevention may also involve ensuring

that the country from which goods are imported have replica biosecurity guidelines for clearing the goods at the port of departure as for the importing country.

- **Early Detection.**

This is the second most important component of biosecurity. Once there is a lapse in prevention, the other second best opportunity to avoid large scale spread of a biological agent is early detection. This requires continued bio-surveillance so as to identify bio threats early. Various methods of surveillance are employed which are either indicator based or syndromic. Indicator based is more accurate like use of sentinel herds for zoonotic diseases like Rift Valley Fever (RVF) which involves monitoring the disease in small ruminant stock of sheep and goats. The disease is an epizoonotic type transmitted by Aedes genus and is maintained through transovarian route by the flood water mosquitoes.[17] The other methods like utilizing the number of confirmed cases in the laboratory setting are also important. However, they are quite slow to generate and interpret while syndromic is fast to provide the necessary alert once the preset thresholds of public health events have been attained. Despite the robustness of syndromic surveillance, caution has to be taken when interpreting the signal for alert and requires epidemiologic interpretation to avoid generating false alarms.[18] When effective detection mechanisms are in place, they make control easy as the area is small and the number total number of persons affected is small hence will require less resources to address.

Alertness and Rapid Response

This is the third strategy for biosecurity. It is incumbent for the response teams to act quickly once they have been notified of existence of an infectious or dangerous biological agent. This calls for a standby command center to coordinate such activities with ready financial support. This is important as the effectiveness of containment, elimination or eradication depends on swiftness of the response teams. It is imperative to put strategies of obtaining surge capacity of human resource in case of a widened spread of a biological agent beyond the capability of the existing teams. There is need to identify the infected persons early and isolate them to prevent spread of the infection. Furthermore, it is imperative to carry out decontamination in time for bio-threats that require so while taking into consideration the five psychosocial aspects of incident management. These include likely public behavior, communication strategy, vulnerable groups, responder management style and privacy/modesty concern bearing in mind that, effective communication and respect for casualties' needs are critical in ensuring that decontamination is completed quickly and effectively.[19] In addition, there is urgency of identifying their close contacts by contact tracing and quarantining awaiting investigation. This is important as some of the emerging infectious diseases can be spread by asymptomatic carriers and due to long incubation period of some of these agents, it may lead to a great number of cases that may overwhelm the health system.[20] Moreover, the inflow of data containing information pertaining a public health threat is enormous during such occasions. This in itself is disastrous to the responding agency as it is unstructured. There must be robust filtering of

this information, and effective communication strategy to ensure the information passed to the public by authorities is accurate and most current as possible. With the current state of social media platforms that provide alternative communication channels to the public, it is imperative that social media provides an opportunity for real time information that can be harnessed by authorities.   When this information is taken into consideration by the authorities, it can help in prevention of a bottom up communication hence relieving pressure on the government authorities.[21] The attributes of effective risk communication play a critical role at this stage. The communicating authority must strive to be right, to be first, build trust, to show empathy and demonstrate action hence command the public confidence as the sole source of credible information.

For effective prevention, detection and early rapid response against highly infectious biological agents, the crosscutting issues for these main activities must be addressed. These activities rely heavily on multidisciplinary well trained teams, detailed policies and relevant legislative framework, coordination and partnership among stakeholders, easy access to up to date information and public support. They also should have support of a good information communication technology system with research and management findings, curated specimen collections and standardized databases which are easily accessible for efficient delivery of their mandate. On the other hand, there must be commensurate increase in staffing of these sectors, and training them to acquire specific competencies. Steps should be taken to ensure that jurisdictional challenges and conflicts are addressed for harmonious coordination of their activities.[22] Despite constituting all the necessary teams,

it is imperative to carry out simulation exercises to test the operability of these systems. Minor table top exercises like the insider exercise, decision making exercises and large-scale national simulation exercise is handy in coming up with ways of improving the preparedness. In a research carried out by European Union (EU) AniBio Threat between 2010 and 2013 to improve capacity to counter animal bio-threats in terms of awareness, prevention and contingency, carrying out demonstration exercises against bio-threats identified gaps and opportunities for improvement. These included areas like legal matters, coordinated decision making, situation awareness, complexity of sharing information concerning diseases and crime investigation, and also challenges of fostering a holistic mindset and collaborative culture. The findings led to the recommendation by the research team that national multi-sectoral simulation exercise is critical for effective prevention and response to biological threats and other biological threat reduction actions.[23]

2.1 Problem statement

Despite various emphasis put in biosecurity in different fora, most countries lag behind in instituting various mechanisms and measures as stipulated in international treaties. Sometimes, the failure by countries may not be attributed to lack of resources but lack of recognition that, some of those recommended steps can be achieved with minimum or not much of resources required at all beyond the country's capability. The current SAR-CoV-2 pandemic has demonstrated glaring weaknesses in biosecurity preparedness, detection

and response across the globe and has been termed a world war in some quarters.[24] The research sought to look at various aspects of biosecurity in the five countries of East Africa. This was meant to identify biosecurity discrepancies within them as these countries have common trade agreements. These agreements allows free movement of people and goods within their borders. The relaxed trade regulations means that a biosecurity threat in one country is a threat to its trade partners hence the optimum biosecurity across the block depends on the least level attained by one of the members. This is the basis of this research to demonstrate that some of what seems challenging can be overcome without much input. The research also aims at coming up with recommendations on how the situation can be improved.

2.2 Objectives

The following were the objectives of the research:

- To find out the status of biosecurity preparedness of East Africa countries.
- To find out how East African countries' score compare with Region's average
- To find out if there is any progress towards attaining capacity in biosecurity.

3.0 Methodology

3.1 Study design

This study was a qualitative retrospective study which involved analysis of data published online by WHO on country's level of capacity preparedness in implementation of GHSA agenda and also data from World Bank reports on gross domestic product (GDP). The five Eat African countries underwent the Joint External Evaluation which was based on the nineteen technical areas with 48 indicators. A technical area consisted between one and five indicators. However, Electronic State Party self-assessment Annual Reporting tool (e-SPAR), whose data was used in this study is based on 13 capacity areas with 24 indicators. This capacity areas were drawn from the nineteen technical areas covered under the JEE. A capacity area has between one and three indicators on which it is assessed and the score is between 1 and 5 for each indicator which is converted into a percentage. The capacity score is the average percentage score for the total indicators under it.

Eleven of the thirteen capacity areas related to biosecurity were extracted from the electronic state party self-assessment reporting tool as it is compulsory for every member to report annually. The capacities considered were Legislation and Financing, IHR coordination and National IHR focal point functions, Zoonotic events and Human-animal interface, Food Safety, Risk Communication, Laboratory, Capacity in Health service provision, Surveillance, National Health Emergency Framework, Human Resources and Point of entry capacity. The 2018 and 2019 scores were compared against the WHO Africa

region's average and also the difference between the countries. The change for capacity scores in 2019 were compared for each country from the previous year to check improvement and the least and most improved countries were identified. The total average score was also compared to the international score to find out how far it was from the 50% level. The variables were presented in a 100% scale depicting the level of preparedness which are very poor for 19 points and below, poor for above 20 and 39 points, average above 40 and 59 points, good representing above 60 and 79 points while very good ranges from above 80 points to 100 in relation to internationally recognized criteria. The data was extracted and presented in charts.

3.2 Study Population

The study involved all the East African countries that underwent joint external evaluation (JEE) and submitted their reports to WHO by electronic state parties self-assessment annual reporting tool (e-SPAR).

3.3 Inclusion Criteria.

All East African countries who are state parties to international health regulation (IHR) and had submitted their country's Joint External Evaluation report to WHO. The country also

must have filed yearly reports using the electronic state parties' self-assessment tool. All eleven of the thirteen capacity areas covered by e-SPAR which are related to biosecurity were included in this study.

3.4 Data management and analysis

Data was collected from the East African countries reports which were published by WHO January 2016 and December 2019 and was stored in a computer. The variables of interest were capacities in Legislation and Financing, IHR coordination and National IHR focal point functions, Zoonotic events and Human-animal interface, Food Safety, Risk Communication, Laboratory, Capacity in Health service provision, Surveillance, National Health Emergency Framework, Human Resources and Point of entry capacity. The e-SPAR data was used as it is compulsory and was disaggregated for 2018 and 2019. The information was presented as charts for easy interpretation.

3.5 Hypothesis:

There exists no relationship between the level of biosecurity preparedness and the individual country's economic status.

4.0 Results

The following charts show the percentage capacity levels of the eleven of the thirteen GHSA agenda related to biosecurity.
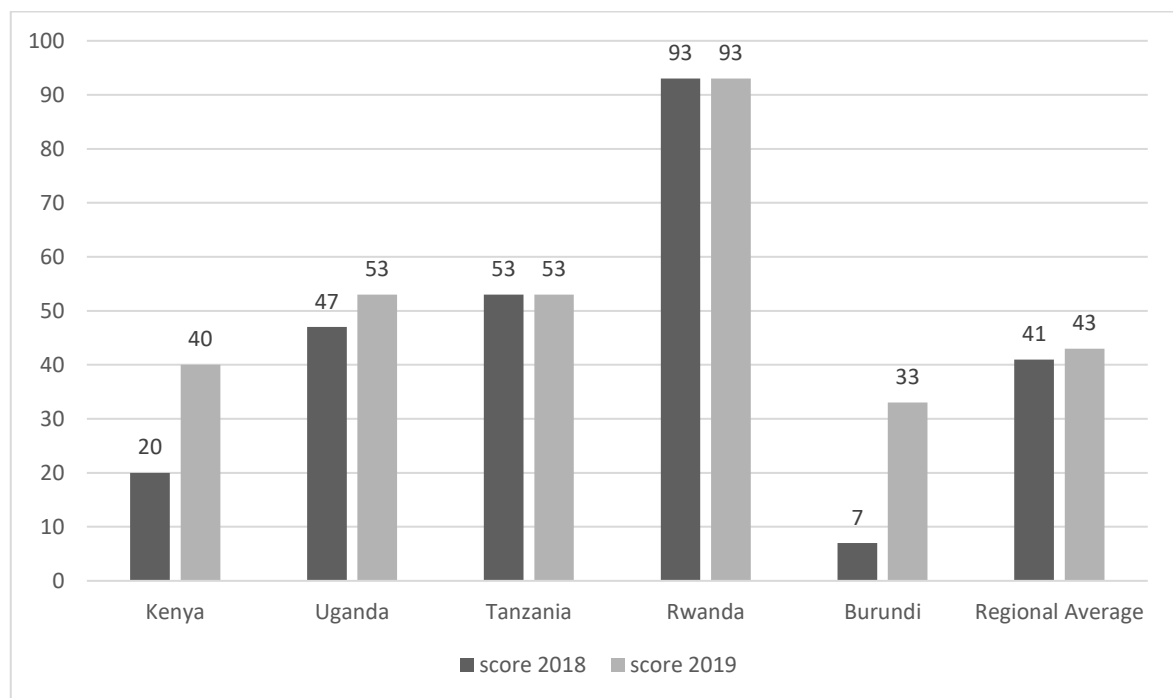

Figure 1. Average percentage score in Legislation and financing

.

Burundi had the lowest score of 7% while Kenya and Uganda followed with 20% and 47% respectively. Tanzania had 53% while Rwanda led in this category by 93% for year 2018. The same trend was maintained in year 2019. However, the most improved country was Burundi which experienced an increase of 26% while Kenya and Uganda followed with 20% and 6% increase respectively. Rwanda and Tanzania experienced no change from the

previous years' score. Despite the tremendous improvement by the two countries which had their average below the WHO Africa regions' average of 41% in 2018, still they were not able to reach the region's average for 2019 missing the 43% mark by an average of 3% and 10% for Kenya and Burundi respectively. Only two countries had an average of 50% and above in 2018 but were three in 2019 after Uganda experienced an increased score to 53% reaching the same mark with Tanzania. The Africa WHO region average also increased in 2019 unlike the previous year by 2%.
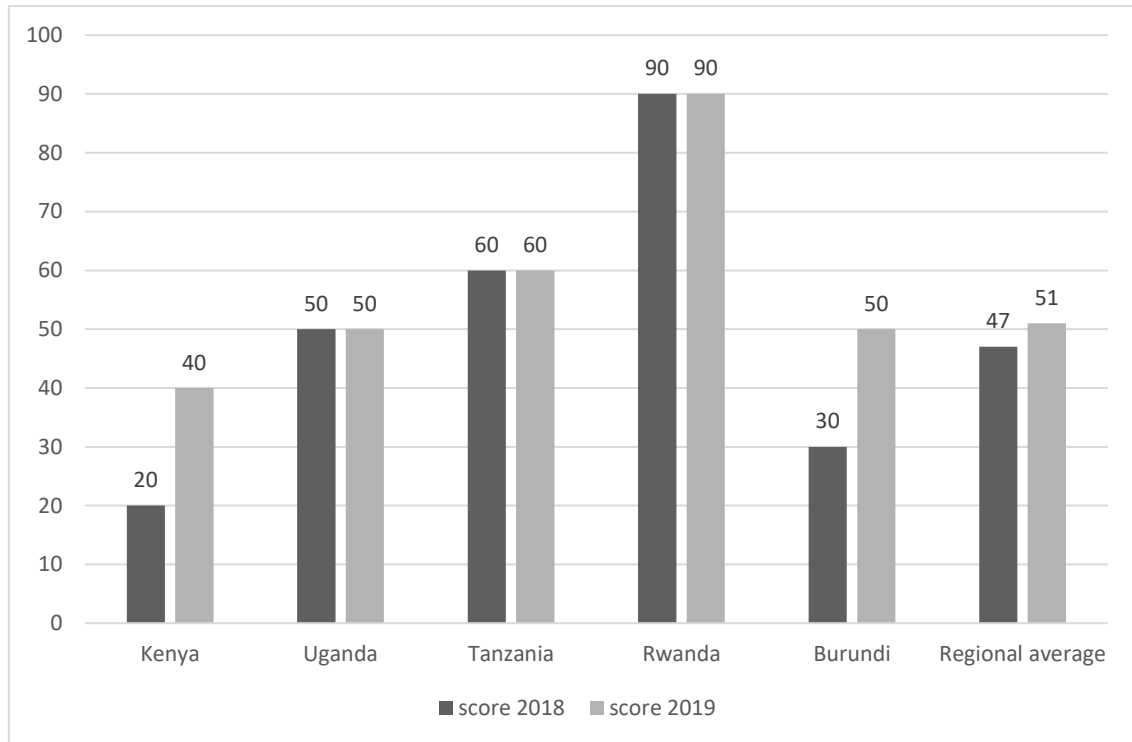
Figure 2 Average capacity in IHR coordination and National focal point.

Kenya and Burundi attained a score below the African regions' average of 47% missing the mark by 27% and 17% respectively for 2018. On the other hand, in 2019 three countries namely Kenya, Uganda and Burundi failed to attain the WHO African region average score of 51%. Their differences with the score were 21% for Kenya while Uganda and Burundi missed the mark by 1% each. Rwanda was leading with 90% while Tanzania followed by 60%. The countries that experienced improvement were Kenya and Burundi with an increase of 20% each from what they had the previous year. In general, all countries had

50% and above except Kenya in 2019. There was a general increase in the average score

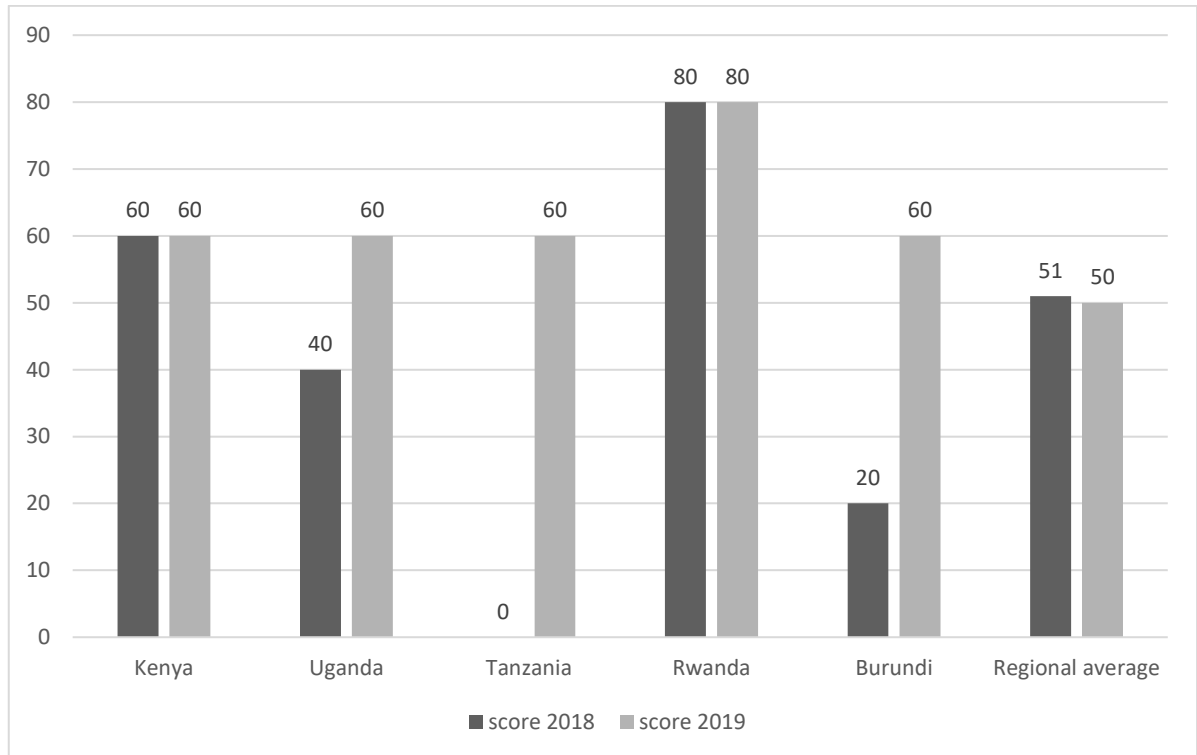the African WHO regions' average by 4%.

Figure 3. Average capacity in Zoonotic events and Human-animal interface.

Burundi and Uganda had scores of 20% and 40% respectively which were below the WHO Africa region's average score of 51% for 2018 while Tanzania did not report. Kenya had a score of 60% while Rwanda was leading with 80% which was maintained in the following year. In 2019, all countries had a score of 60% apart from Rwanda which had 80%. All countries exceeded the WHO Africa region's average which stood at 50%. The country with most improvement from 2018 was Burundi which saw an increase of 40% while Uganda had an increase of 20%. The general region's average for this parameter dropped by 1% from the previous year
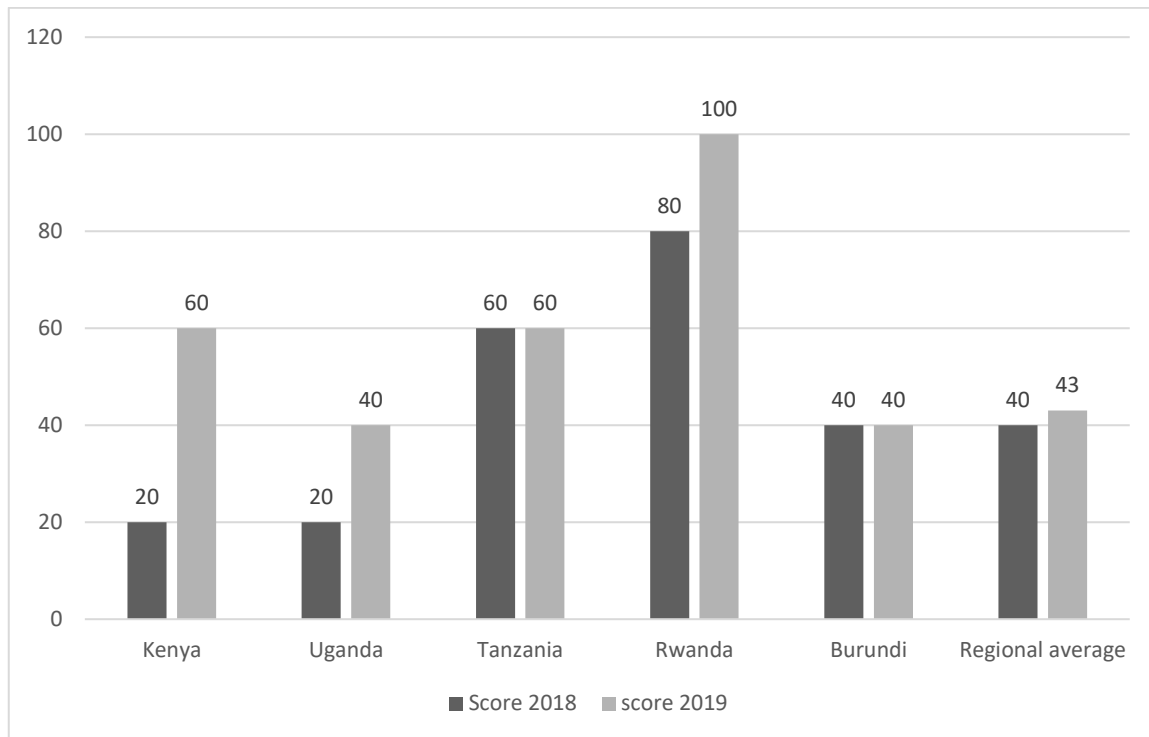
Figure 4. Average capacity in food safety

Uganda and Kenya had 20% each and did not attain the WHO Africa region's average of 40% in 2018. For 2019, only Uganda and Burundi failed to reach the African region's average of 43% by a margin of 3%. The most improved country was Kenya by a margin of 40% followed by Uganda and Rwanda with 20% each while Tanzania and Burundi had no change from their previous year's score. To sum up, there were two countries namely Tanzania and Rwanda that had a score above 50% in 2018 while in 2019 they were three after Kenya attained 60%
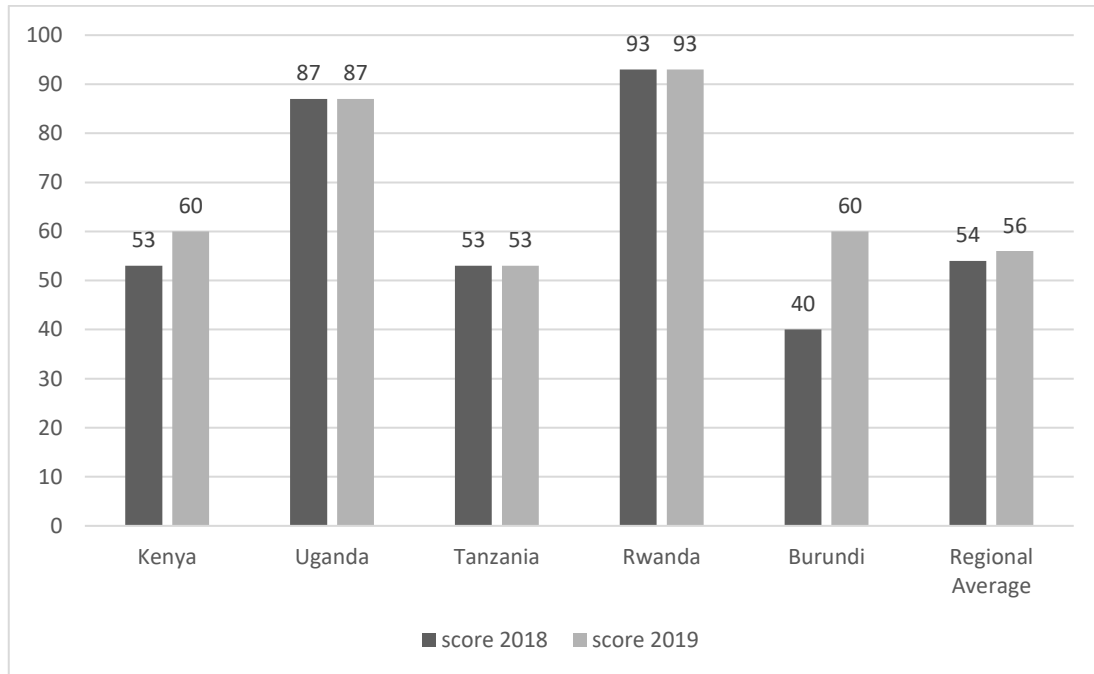
Figure 5. Laboratory Capacity

Kenya, Tanzania and Burundi failed to reach the WHO Africa region's target for 2018 0f 54% with scores of 53% each for Kenya and Tanzania while Burundi had 40%. Uganda and Rwanda had 87 and 93% respectively. In 2019, all countries attained a score more than the region's average of 56% except Tanzania which maintained the previous year's score of 53 hence missing the regions average by 3%. The countries which experienced improvement in score for 2019 were Kenya and Burundi which had an increase of 7 and 20% respectively. The leading country was Rwanda at 93% followed by Uganda with 87%. All countries had more than 50% score in 2019 unlike in 2018 whereby one country had a score below the mark.
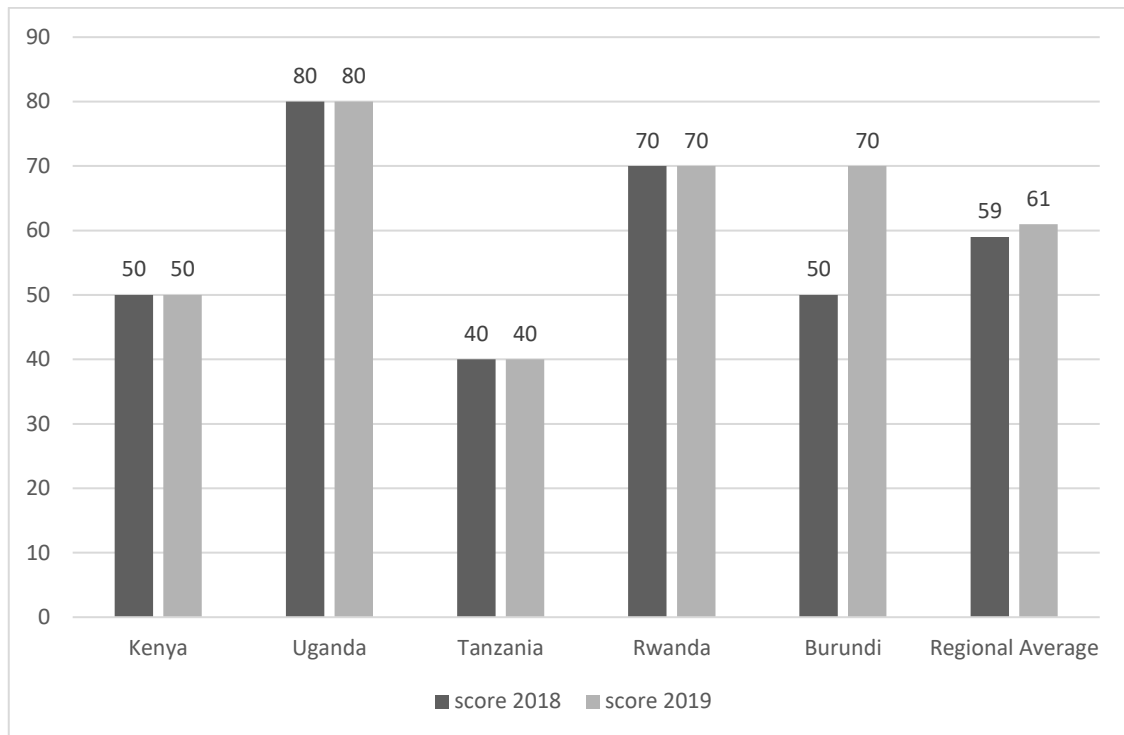
Figure 6. Average capacity in surveillance.

Tanzania had the least score of 40% followed by Kenya and Burundi with 50% each. The three countries did not meet the Africa region's average of 59% for the year 2018. In 2019 only Burundi experienced improvement from the previous year's score by 20% to be at par with Rwanda at 70% while other countries maintained their previous scores. Only Tanzania and Kenya failed to reach the year's region average of 61% as they maintained their previous year's score of 40 and 50% respectively. Uganda was leading with 80%. For the two years under consideration, only Tanzania failed to reach 50% capacity for the two years in a row.
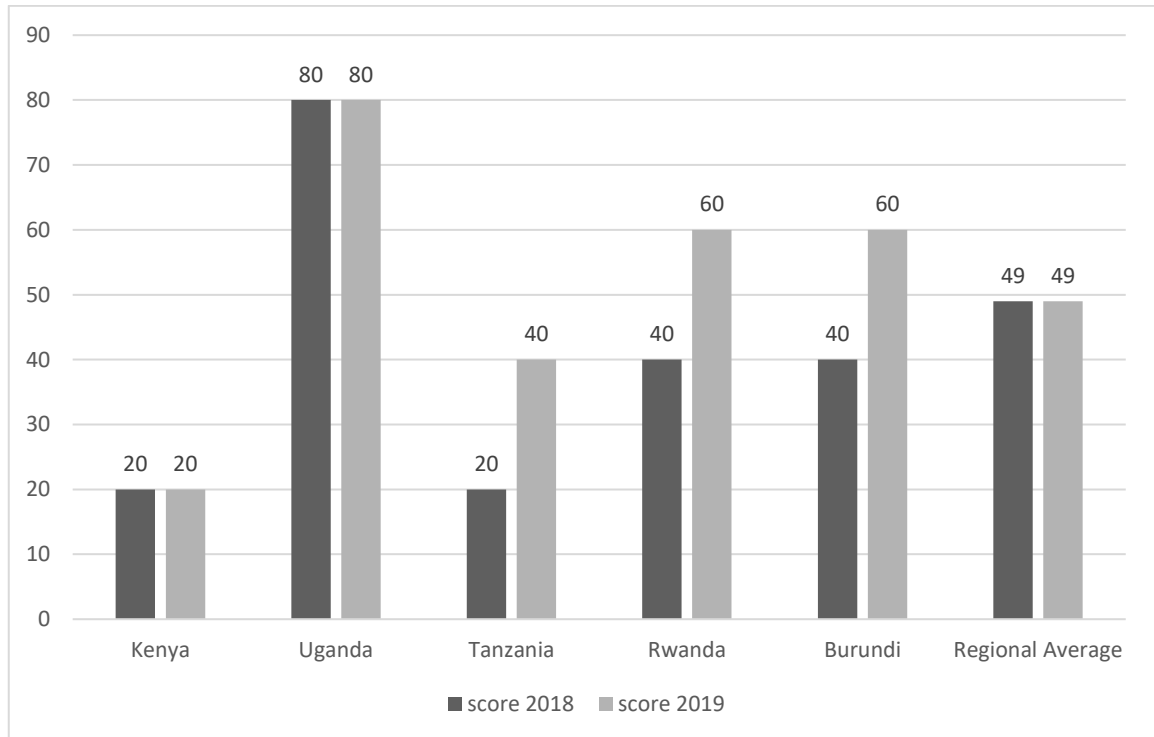
Figure 7. Average Capacity in Human Resources

Kenya and Tanzania had a score of 20% each while Rwanda and Burundi had 40% each in the same period which was below the African region's average of 49%. However, Uganda exceeded the 2018 average by 31% scoring 80%. In 2019, only Kenya and Tanzania failed to reach the year's Africa average score of 49% scoring 20 and 40% respectively. There was improvement in scores for Tanzania, Rwanda and Burundi by 20% each. Only Rwanda, Burundi and Uganda had a score of 50% and above in 2019. Uganda was leading in this category by 80% in both years.
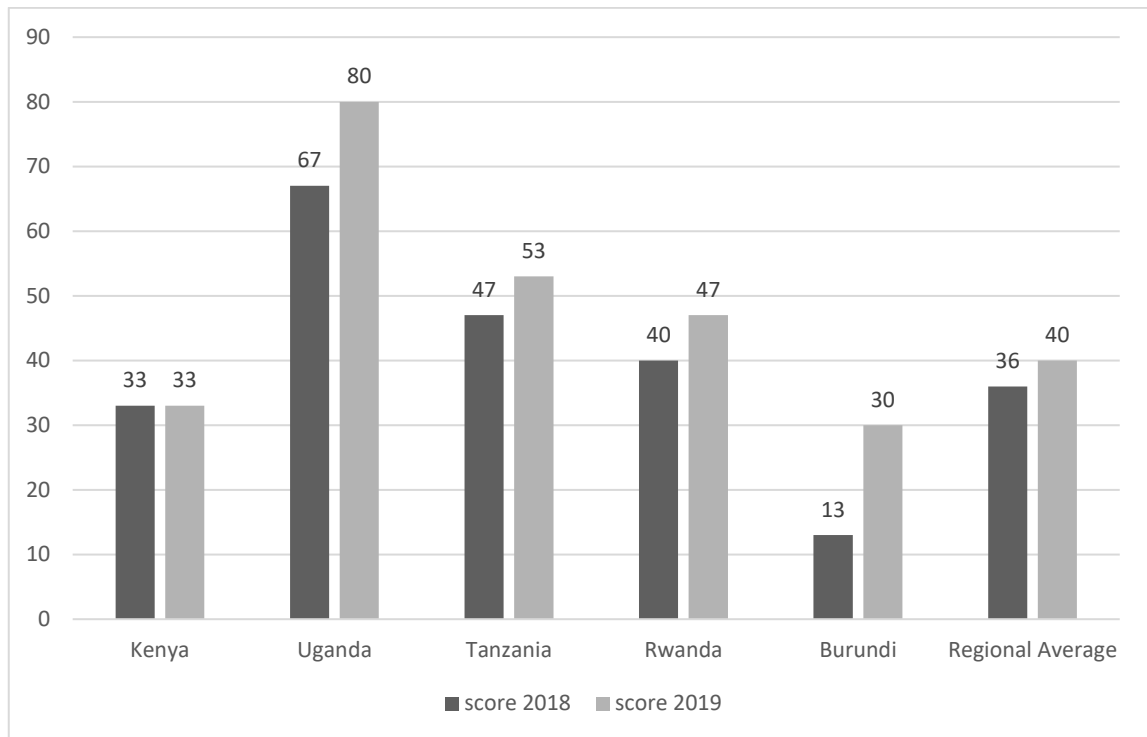
Figure 8. Average capacity in National Health Emergency Network

Burundi had the least score at 13% followed by Kenya with 33%. Rwanda and Tanzania followed with 40 and 47% respectively while Uganda was leading with 67% for year 2018. Only Burundi and Kenya failed to meet the region's average of 36% for the year. In 2019, all countries experienced an increase in score from what they had in the previous year except Kenya which had no change. Burundi had an increase of 17% followed by Uganda with an increase of 13%, Rwanda had 7% increase while Tanzania had 7%. By the end of 2019, only Tanzania and Uganda with 53 and 80% respectively had scores above 50%.
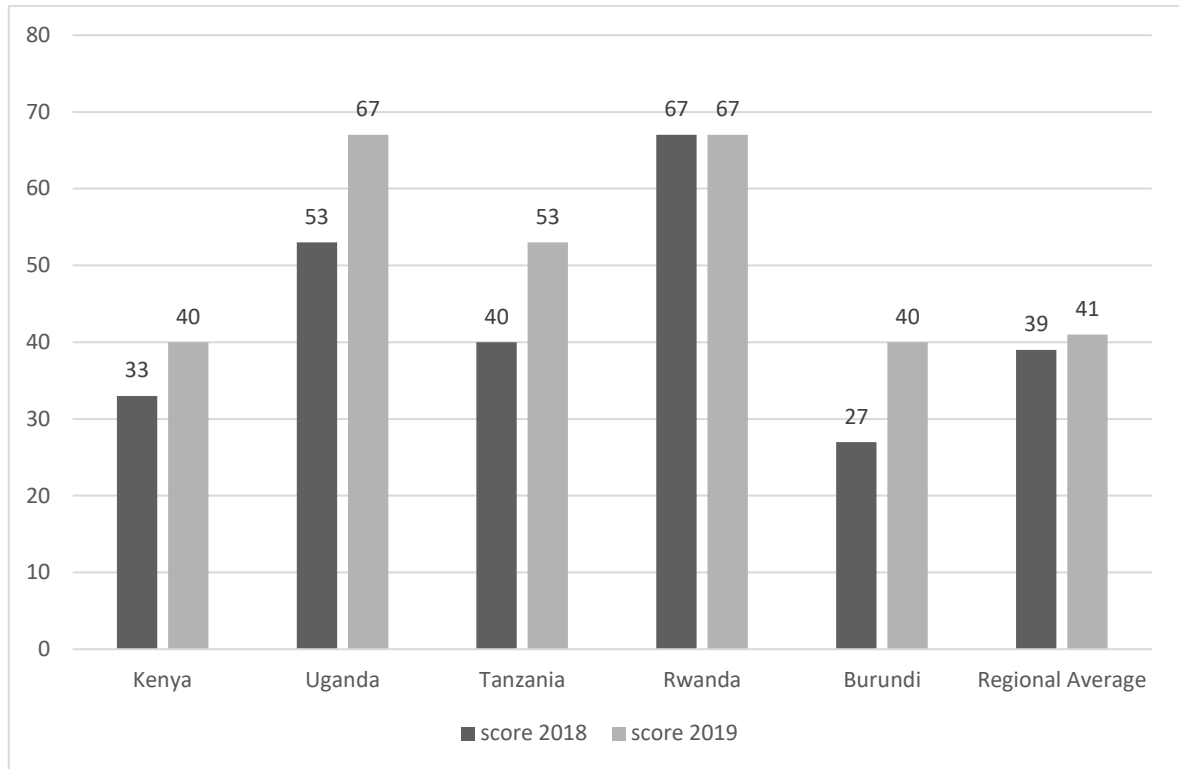
Figure 9. Average Capacity in Health Service Provision

Burundi and Kenya did not meet the average of African region score of 39% for 2018. They

scored 27 and 33% respectively. Tanzania had 40, Uganda 53% while Rwanda was leading

with 67%. In 2019, Kenya and Burundi had a score of 40% each while Uganda and

Tanzania had 53% each. Rwanda maintained the previous year's score of 67%. The country

with the greatest increase in score was Uganda by 14% followed by Tanzania and Burundi

each with 13%. Kenya experienced the lowest improvement by 7%. Two countries had a

score above 50% namely Uganda and Rwanda in 2018 while in 2019 the number increased
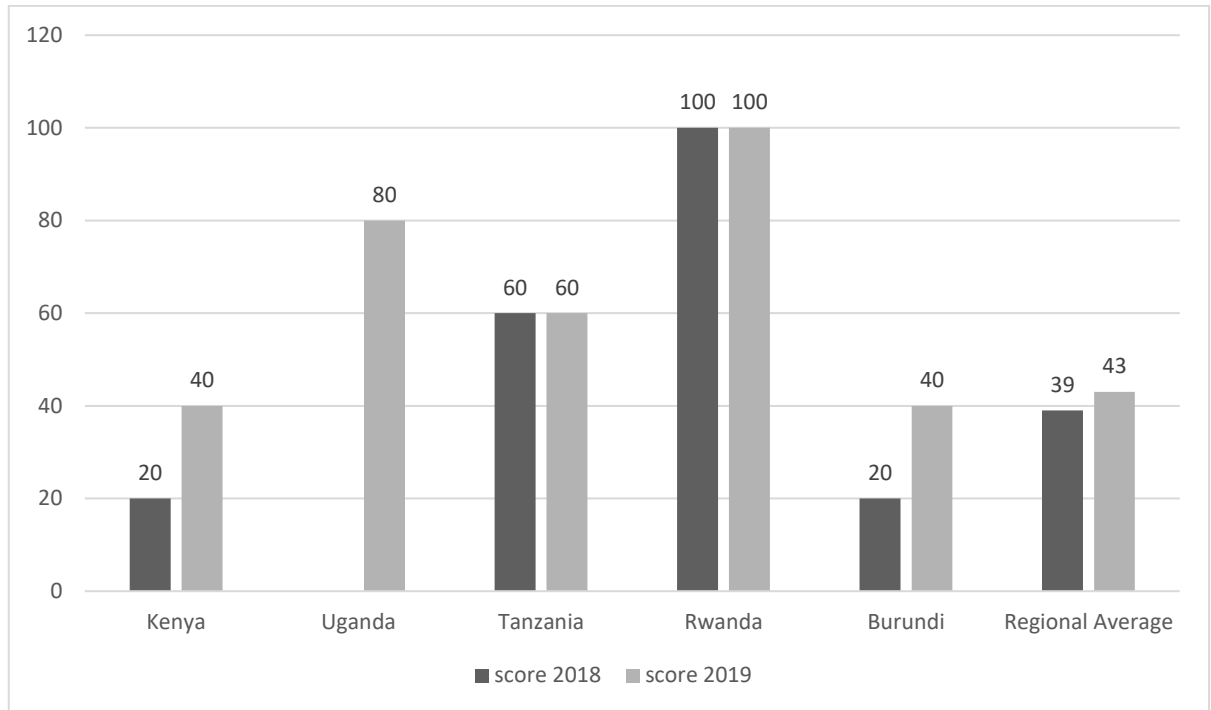
to three due to Tanzania.

Figure 10. Average Capacity in Risk Communication

Burundi and Kenya failed to reach the African region's score for 2018 of 39% by scoring 20% each. Uganda did not report while Tanzania and Rwanda had 60 and 100% score respectively. In 2019, Kenya and Burundi experienced an increase of 20% from what they had previously reaching 40%. Uganda reported 80% while Tanzania and Rwanda maintained their previous scores of 60 and 100% respectively. Despite the increase experienced by Kenya and Burundi, they both failed to reach the African region's average for 2019 of 43%. Only three countries had an average score above 50% in 2019 namely

Tanzania, Uganda and Rwanda in ascending order with scores of 60, 80 and 100% respectively.
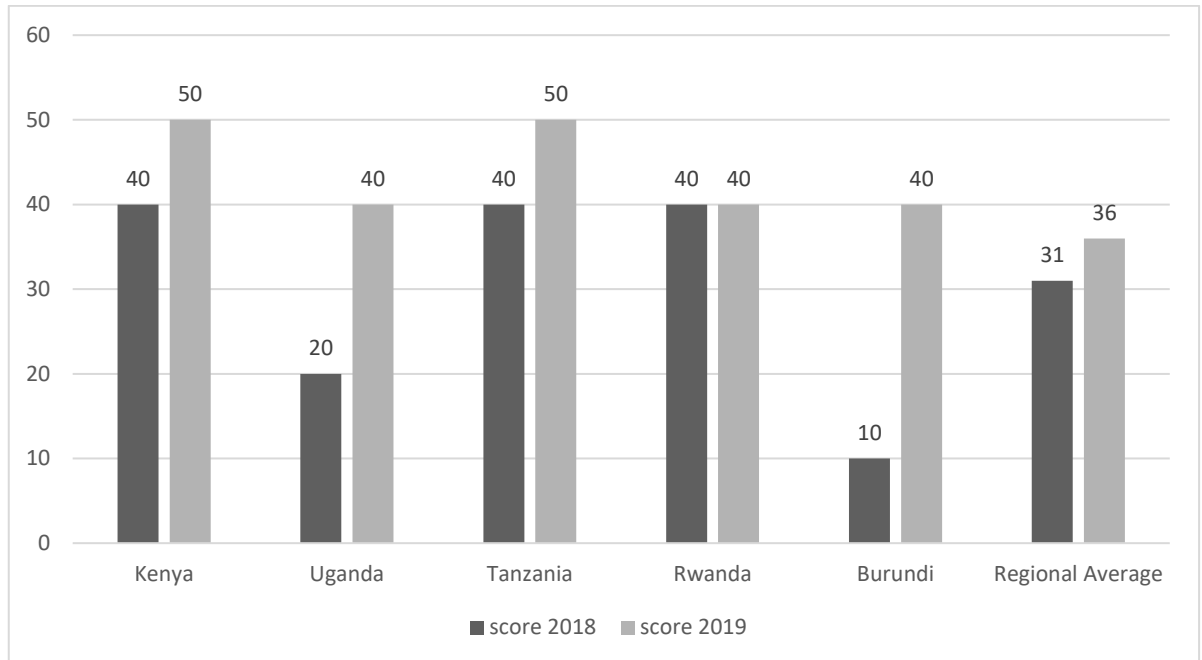
Figure 11. Average Capacity at Points of Entry

Two countries namely Burundi and Uganda did not reach the WHO African region's average for 2018 which was 31%. They had a score of 10 and 20% respectively. The other three countries had a same score of 40% in 2018. In 2019, all countries surpassed the African regions average which was 36%. Uganda, Rwanda and Burundi had a score of 40% each while Kenya and Tanzania had 50% each. Burundi had the greatest improvement by 30% followed by Uganda by 20% while Kenya and Tanzania experienced the same improvement of 10%. Rwanda had no change in scores from the previous year. No country had a score of 50% and above for year 2018 while despite all the improvement experienced

in all countries except Rwanda, only Kenya and Tanzania managed a score of 50% each

for 2019.
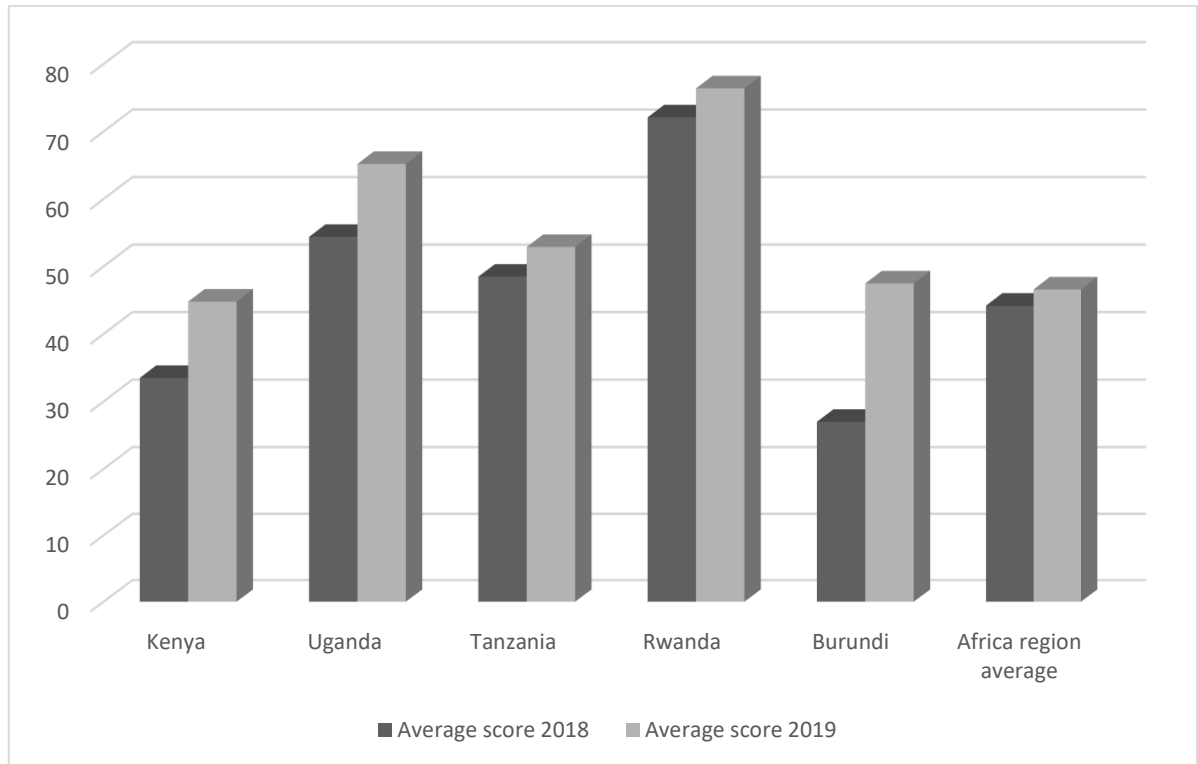
Figure 12. Average scores for the 11 capacity areas for the year 2018 and 2019

There was an increase in preparedness in 2019 from the previous year. Burundi experienced the greatest improvement from a figure which was 17.2% lower than the WHO African region's average of 44.2% for 2018 to 0.9% above the average for 2019 which was 46.6%. Kenya was second in improvement and had an increase of 11.3% but failed to reach the African region's average by 1.8%. Uganda was third in improvement and exceeded the African region's average for 2019 by 18.6% unlike 10.2 the previous year. Tanzania had a 4.4% increase from the previous year that exceeded the African region's average for 2019

by 6.3%. The country which experienced the least improvement was Rwanda despite being the leading in average score and had an increase of 4.3% from the previous year's score. Rwanda exceeds the African region's average by 29.8%. Despite the observed improvement, only Tanzania, Uganda and Rwanda had scores above 50% in 2019 of 52.9, 65.2 and 76.4 respectively.
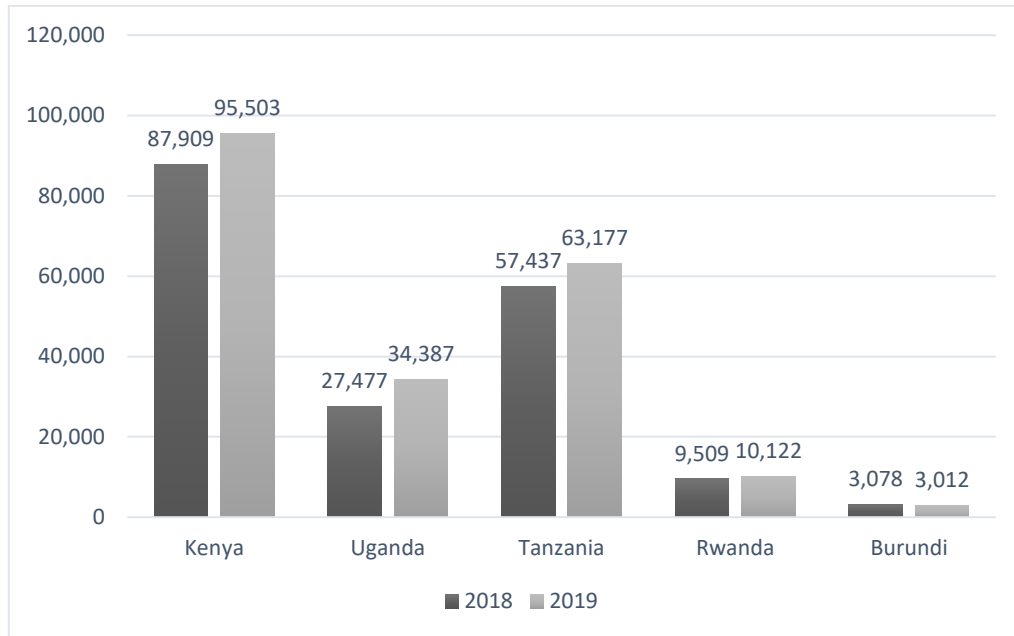
Figure 13. Showing the GDP for the east African countries for 2018 and 2019 (million USD).

Kenya has the greatest GDP followed by Tanzania, Uganda, Rwanda and Burundi respectively. There was an increase in GDP for the year 2019 from the previous year for all countries except Burundi which had a decline. Kenya was leading in Increase followed by Uganda, Tanzania and Rwanda respectively.

5.0 Discussion

The findings indicate that Rwanda was a head of the rest in six capacity areas besides the capacity on Health Service provision in which the score was equal with that for Uganda. The six capacity areas were Legislation and Financing, IHR coordination and National IHR focal point functions, Zoonotic events and Human-animal interface, Food Safety, Risk Communication, and Laboratory. Uganda was second, leading in three of the eleven capacity areas excluding the capacity in Health service provision. The three capacity areas were Surveillance, National Health Emergency Framework and Human Resources. Tanzania and Kenya were leading on Point of entry capacity. In average performance for 2018, Rwanda was leading followed by Uganda, Tanzania, Kenya and Burundi in descending order. For 2019, the order for 2018 was maintained only for Burundi to interchange positions with Kenya though with improvement in the average score for all countries. In a study conducted in 2015 to assess the implementation of IHR 2005 capacities or their components, in which 51 articles were analyzed from 77 countries representing all WHO regions, 44 lessons were learnt from the eight capacity areas which were considered. The major themes were to mobilize and sustain political commitment to adapt global requirements based on local social-cultural, epidemiological, health system and economic contexts and also conduct baseline and follow-up assessment, and to monitor the status of IHR implementation.[25] In another study, it was found that centralized political, technical and fiscal authority is key to developing a robust sustainable and integrated health security across government.[26] For instance, a study conducted in Rwanda aimed at

assessing the level of strengthening communicable diseases surveillance and targeting the laboratory network found that, success was due to a structured governing framework for public health surveillance, political commitment to promote strong leadership for stronger laboratory capacities, defined roles and responsibilities for each level, coordinated approaches between technical and funding partners, coordination with external laboratories and use of performance results in advocacy with national stakeholders.[22]

Exposure to recurrent epidemics also played an important role in achievement of success in IHR capacities. For instance, Uganda is an ecological spot with infectious diseases transmission belts which exacerbates its vulnerability to epidemics. Its proximity to the Congo basin, climate change pressure systems, increased international travel and globalization, and influx of refugees due to the porous borders which worsens the problem. Due to these, the country developed a multi-hazard plan with the purpose of harmonizing processes and guiding stakeholders on strengthening emergency preparedness and response.[27] On the same note, in 2010, collaboration between Uganda Virus Research Institute and the Health Ministry on one hand, and US Center for Disease Control and Prevention's Viral Special Pathogen Branch on the other, established Uganda's National viral Hemorrhagic fever surveillance and laboratory program to enhance Uganda's Integrated Disease Surveillance and Reporting (IDSR) to rapidly detect, diagnose, report, and respond to viral hemorrhagic fever as well as other emerging infectious zoonotic diseases.[28] To highlight this, similar studies have shown more preparedness in the way countries affected by epidemics build more prepared systems for future public health

emergencies. For instance, South Korea has effectively responded to COVID-19 due to improved system preparedness due to the disastrous MERS outbreak in 2015.[29] In a similar manner, the Chinese government realized the importance of addressing microbial threats like severe acute respiratory syndrome (SARS) hence committed substantial resources in disease surveillance[30]. Furthermore, it has been recognized that, national security is not only a protection of the country from state and non-state actors, but also encompasses protection from emerging infectious diseases and other health outcomes that can threaten the nation's economic vitality and its very way of life.[31] In a study conducted in 2017 to assess the importance of public health legal preparedness, it was established that having laws is important in achieving set targets. It prioritizes planning, allocates responsibility, enhances collaboration and coordination, and also establishes responsive funding.[32] However, legislation and policy depend on political will indicating that political commitment provides a critical component to the success of IHR.[33] Finally, one could expect more economically stable countries to be more prepared but that was not the case. Kenya, which is the biggest economy of the five countries was least prepared followed by Burundi which has the lowest economy of the five countries. Tanzania was third in level of preparedness while it is the second biggest economy after Kenya. Uganda which is third in the level of economy was second in biosecurity preparedness while Rwanda which is the fourth economy was the best overall.

Conclusion

The levels of biosecurity preparedness varies greatly within East African countries as the process of designing and implementation of various capacity areas requires financial and technical strategies. Rwanda and Uganda are most prepared compared to Tanzania, Burundi and Kenya. The success is mainly due to political commitment to attainment of capacity in IHR (2005). Recurrent epidemics also contributed positively to Uganda's level of preparedness. There was no relationship between the countries' economic status and their levels of biosecurity preparedness.

Limitations.

The study used secondary data which may contain errors. Furthermore, the data was general but not disaggregated to show to what degree the various components of biosecurity contributed to the final score. The data relies on individual country's assessment hence may contain biases. The data also covered only two years hence may not be the true picture in long-term.

Recommendation

There is need for sustained campaigns for political commitment in Global Health Security Agenda to ensure a safer world which is better prepared to tackle public health threats.

Furthermore, there is need for more detailed research to be conducted to find out the degree of preparedness of each component of biosecurity hence help in designing task specific actions.

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