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An Overview of COVID-19 in Sub-Saharan Africa: the Transmissibility,Pathogenicity, Morbidity and Mortality so far

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Abstract

This narrative review documented the available knowledge on the transmissibility, pathogenicity, morbidity and mortality of COVID-19 in sub-Saharan African region in order to inform recommendations of future containment of the virus. Internet search for studies on COVID-19 transmission, pathogenicity, morbidity and mortality in Africa was conducted from February to July 2020. Although Africa was classified among the high-risk continents due to high volume of human air traffic occasioned by international trade relations and poor health facilities, available data showed that most sub-Saharan African countries were prepared with strategies to reduce and manage the disease beyond expectations. However, despite health guidelines, which include but are not limited to personal hygiene, maintaining social and physical distancing, avoiding crowded places, use of nose and mouth or face masks that will limit its spread, the high burden of other diseases in Africa, such as malaria, diabetes mellitus, cancer, and asthma among others coupled with poor health facilities have been attributed to contribute significantly to the cause of coronavirus mortality in Africa. While information on the pathogenicity and therapeutic management of coronavirus continue to evolve, medicinal plants with potent metabolites are reported to be effective in early treatment of the virus abound in African countries, thus bringing a positive development with futuristic hope for cheaper and effective medication. A potentially significant contribution to reduced severity of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic in sub-Sahara Africa may be due to the elevated temperatures of climate in this part of the world.

Keywords: COVID-19, world pandemic, Africa, pathogenicity, health guidelines, mortality.

1. Introduction

The last several decades have been faced with emerging novel strains of coronaviruses which cause severe respiratory disease (Alfaraj *et al.,* 2019). In December 2019, another outbreak of unusual respiratory disease was recorded in Wuhan, China. This reported unusual disease was later found to be caused by an unfamiliar coronavirus named 2019-nCoV by the World Health Organization (WHO, 2020a; CDC, 2019). On 30th January, 2020, this disease outbreak was declared an emergency of international concern on public health as the virus and its infectivity rapidly expanded to many other countries of the world. On March 11, 2020, WHO renamed the disease and called it 'coronavirus disease 2019 (COVID-19)' and declared it a global pandemic (WHO, 2020b). COVID-19 was later identified based on a phylogenetic analysis as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the Coronavirus Study Group (CSG) of the International Committee on Virus Taxonomy. COVID-19 caused by coronavirus is the first ever pandemic associated with the virus (Coronaviridae Study Group, 2020; WHOc, 2020). Today, COVID-19 is known to affect people of all ages with higher severity in the elderly especially those above 60 years and those with compromised health status such as those living with heart disease, chronic respiratory disease or cancer (Chen *et al.,* 2020).

Some health experts arguably suggest that minimal records of SARS-CoV-2 cases experienced in African continent were probably due to low flight patronage to the region, which made it easier for identification and isolation of initial cases and limit its transmission (Njenga *et al.,* 2020). Besides, the rate of introduction of imported cases was further mitigated by the initial implementation of partial or complete travel restriction which facilitated identification and isolation of initial cases, tracing of their contacts and thereby limit its transmission. Compelling evidence has shown that sub-Sahara Africa demonstrated strong resolve in carrying out preventive protocols for SARS-CoV-2 transmission, mainly via the structures adopted by the WHO aided Integrated Disease Surveillance and Response (IDSR) and the knowledge

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acquired from reoccurring episodes of Ebola viral infections in the region (Ihekweazu and Agogo, 2020). However, the preventive and control protocols for COVID-19 epidemics in African region were grossly inadequate when compared to that obtainable in most European countries and countries in the United States of America due to poor standard of living occasioned by poor income status of majority of people in the region, poor healthcare system, and lack of adherence to rules that reduce virus spread (https://www.worldbank.org/en/region/afr/publication/for-sub-saharanafrica-coronavirus-crisis-calls-for-policies-for-greater-resilience). Literature has revealed that the low numbers of severe COVID-19 cases and deaths in sub-Sahara Africa may be due to the fact that majority of them are at their youthful stage of life with mean age bracket of 20 years compared to those in most European countries and countries in the United States of America with mean age bracket of 38 years and above (https://population.un.org/wpp/. Accessed May 3, 2020) Dowd *et al.,* 2020). This notion is plausible; nevertheless, other causative factors such as malnutrition, cultural factors and overcrowding within urban settlements may have contributed substantially to it (Njenga *et al.,* 2020).

2. Transmission of SARS-COV-2 in sub-Sahara Africa

The wet animal market located at the Wuhan city of Hubei Province where animals were regularly sold was suspected as the point of human–animal transmissible origin of COVID-19 as many people exposed to this wet animal market were infected with the virus. Researchers have made several efforts in a bid to look for a reservoir or intermediate host where the virus infection was transmitted to humans. Two species of snake have been recognized to be probable primary host of COVID-19 in an earlier study. At present, there is no reliable or scientific evidence of coronavirus reservoirs other than mammals and birds (Bassetti *et al*., 2020). However, genome analysis has revealed a strong link between human COVID-19 and two bat-derived severe acute respiratory syndromes (SARS)-like coronaviruses, which showed 88 % similarity (Lu *et al.,* 2020). Accumulating pieces of evidence have shown that COVID-19 infection could be spread from person-to-person. This was corroborated by cases that took place within families and among people who did not visit the wet animal market in Wuhan (Wu *et al.,* 2020). Transmission from individual to individual occurs mainly through direct contact or via droplets released by coughing or sneezing from infected person (Rothan and Byrareddy, 2020). Previous study has shown no evidence of the virus transmission from COVID-19 positive mothers to child, but it is still uncertain whether transmission can occur during vaginal birth (Chen *et al.,* 2020).

The transmission from individual to individual is mainly from symptomatic infected individuals. However, in Germany, transmission of coronavirus infection from SARS-CoV-2 patients not displaying any symptoms has been reported which has generated debate on the elucidation of present transmission dynamics of the virus (Rothe *et al.,* 2020). The transmissibility of the pandemic is greatly influenced by the presence of asymptomatic or mildly symptomatic persons.

In an imported case, the methods of transmission are via spread of droplet, fecal-oral route, conjunctiva and fomites (Xu *et al.,* 2020; Ong *et al.,* 2020). Besides, the transmission and infectivity of the virus locally could be by infected person's bodily fluids like respiratory droplets, saliva, feces, and urine (Ong *et al.,* 2020). The virion has high survival rate at lower temperature, i.e 4°C in comparison with 22°C (Kampf *et al.,* 2020). Previous study by van Doremalen *et al.* (2020), revealed a resemblance for SARS-CoV-1 and SARS-CoV-2 stability under similar experimental conditions. This was an indication that the variance in the epidemiologic features of these viruses most likely stem from other factors, besides elevated high viral loads in the upper respiratory tract and the capability of SARS-CoV-2 patients to shed and spread the virus while not displaying any symptom of the disease (asymptomatic) (Bai *et al.,* 2020). From their result, there was strong indication that SARS-CoV-2 could be spread via aerosol and fomite transmission since the virus can stay alive and be transmissible in aerosols for hours and on surfaces up to days. Similar findings were reported for SARS-CoV-1, where transmission patterns were linked with some forms of nosocomial spread and super-spreading events and they provide facts on the alleviation of the pandemic. The residence time of SARS-CoV-2 virion on surfaces varies. The SARS-CoV-2 half-life in copper, aerosols, stainless steel, plastic and cardboard are 1 hour, 1.5 hours, 5.6 hours, 6.8 hours and 3.4 hours, respectively while the active life span of SARS-CoV-1 in similar media are 4 hours, 3 hours, 48 hours, 72 hours and 24 hours, respectively (van Doremalen *et al.,* 2020)

Speculations have projected that Sub-Sahara Africa may have a higher risk index in terms of transmission and contacting of COVID-19 epidemics due to high volume of air traffic and trade between China and African countries (Nkengasong and Mankoula, 2020). Public health experts were worried about COVID-19 becoming all year-round viral pandemic with continued transmission similar to influenza, as seen in several countries now (http://outbreaknewstoday. com/italy-covid-19-case-count-now-79-government-introduces-urgentmeasures-37376/. accessed Feb 23, 2020). They were concerned about the fate of most African countries with poor health-care systems, insufficient tracing and laboratory facilities, and inadequate skilled public health labour force and inadequate or no finances peradventure there are reoccurring episodes of the pandemic. In addition, without vaccination or treatment and in the absence of pre-existing immunity, the impact would be catastrophic following many health challenges bedeviling the continent already such as endemic diseases like human immunodeficiency virus, tuberculosis, malaria, Ebola virus disease, Lassa fever, higher non-communicable diseases in existence, in addition to rising population growth and increased movement of people. Incidentally, on the 11th of March, 2020, the WHO declared COVID-19 a global pandemic due to its acceleration and spread globally (Bedford *et al.,* 2020). In Africa, the first index case reported for COVID-19 was in Egypt. It was reported and recorded on February 14, 2020. This was followed by Algeria which confirmed her first case on February 25, 2020 while Nigeria confirmed her first index case on February 27, 2020. The first country in the southern African region to report

confirmed case of COVID-19 on the 5th March 2020 was South Africa. All these cases were mainly imported from Europe (Anjorin, 2020). The disease has virtually spread to all African countries with South Africa having the highest number of cases.

3. Pathogenicity of SARS-COV-2

Coronavirus is known to cause human respiratory tract infection or animal intestinal infection. The host cell membrane surface receptors are involved in the course of virus invasion of the body. The surface of coronavirus contains the S-protein which can detect and become attached to the receptor and consequently have access into the human host cell via clathrin-mediated endocytosis (Wang *et al.,* 2008). For this inversion, disparate coronaviruses make use of different receptors. For instance, aminopeptidase N (referred to as CD13) is the human coronavirus 229E (HCoV-229E) receptor, severe acute respiratory syndrome coronavirus (SARS-CoV) has angiotensin-converting enzyme 2 (ACE2) receptor (Kuba *et al.,* 2005) while Middle East respiratory syndrome coronavirus MERS-CoV has dipeptidyl peptidase 4 (DPP4) also known as CD26 receptor (Lu *et al.,* 2013). Recent report has shown that ACE2 can be employed by SARS-CoV-2 receptors unlike aminopeptidase N and DPP4 (Zhou *et al*., 2020).

Every coronavirus has genes particularly in open reading frames (ORF1) at the downstream regions that produce proteins which the viruses use to replicate and develop nucleocapsid and spikes (van Boheemen *et al.,* 2012). On the periphery of coronaviruses lies the glycoprotein spikes which facilitates its entrance to host cells. The virus could perhaps infect many hosts because the receptor-binding domain (RBD) is not firmly bound within the virus (Raj *et al.,* 2013). For invasion of human cells, the main receptor mostly recognized by other coronaviruses are aminopeptidases or carbohydrates but in the case of SARS-CoV and MERS-CoV, the key receptor primarily recognized is exopeptidases (Wang *et al.,* 2013). The mode of invasion of COVID-19 virus is dependent on proteases such as human airway trypsin-like protease (HAT), cathepsins and transmembrane protease serine 2 (TMPRSS2) that process the spike proteins and then modify the cellular components allowing the viruses to gain access (Glowacka *et al.,* 2011)

SARS-CoV-2 has spike protein and equally possesses other polyproteins in its structures typical of coronaviruses. Such polyproteins include nucleoproteins and membrane proteins such as RNA polymerase, 3-chymotrypsin-like protease, papain-like protease, helicase, glycoprotein, and accessory proteins (Wu *et al.,* 2020; Zhou *et al.,* 2020). Like other coronaviruses, SARS-CoV-2 is an enclosed single-strand, positive sense RNA virus. The spike protein that regulates the host cell tropism and infectivity equally facilitates receptor binding and membrane fusion (Li, 2016). For cell invasion, SARS-CoV and SARS-CoV-2 make use of human angiotensin-converting enzyme II receptor. The receptor-binding domain structure of SARS-CoV-2 is akin to that of SARS-CoV in spite of the fact that some differences exist in amino acids at key residues (Lu *et al.,* 2020). Despite the fact that SARS-CoV-2 genome encodes an exonuclease enzyme, it also has a fairly high mutation rate per genome replication. Hence, it may comfortably adjust to its new host and become infectious from one individual to another. The 3-D structural configuration in the receptor-binding domain (RBD) region of the SARS-CoV-2 spike protein functions to conserve the van der Waals forces (Xu *et al.,* 2020).

The lysine 31 residue on the human angiotensin-converting enzyme 2 (ACE2) receptors facilitates the recognition of the 394-glutamine residue in the RBD region of SARS-CoV-2 (Wan *et al.,* 2020). Thus, SARS-CoV-2 mode of pathogenicity in human is briefly elucidated from its attachment to human host and replication within the host (Figure 1).

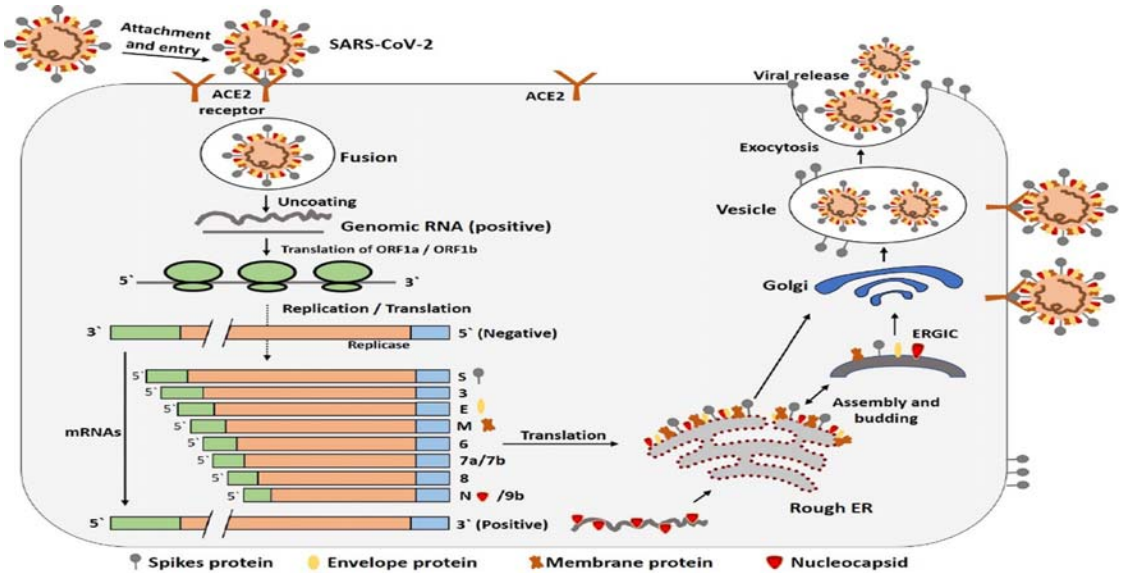

Figure 1. The life cycle of SARS-CoV-2 in host cells. ACE2 = angiotensin-converting enzyme 2; ER = endoplasmic reticulum; ERGIC= ER–Golgi intermediate compartment. (Source: Shereen *et al*. (2020).

The SARS-CoV-2 begins its infectivity of the host when its S-protein becomes attached to ACE2 receptor. Upon binding with ACE2 receptor, there is alteration in the shape of the S-protein which promotes the integration of the viral envelope with the host cell membrane via the endosomal pathway. Thereafter, RNA is liberated by SARS-CoV-2 into cell hosting it. The viral replicase polyproteins pp1a and 1ab produced from the translation of the RNA genome are thereafter degraded into miniature products by proteinases. Through discontinuous transcription, the polymerase enzyme catalyzes the production of a string of sub-genomic mRNAs which are ultimately converted to relevant viral proteins by the processes of translation. Later on, the viral proteins and RNA genome are congregated into virions in the endoplasmic reticulum and Golgi and subsequently conveyed through vesicles and liberated out of the cell (Shereen *et al.,* 2020).

4. Morbidity, Comorbidity and Mortality in Africa

Reports have argued that the minimal incidences of COVID-19 in Africa may not be attributed to decreased inspection and fewer testing because shooting up of the number of COVID-19 cases may be observed via reports of high incidences of pneumonia cases at local hospitals and these have not been observed. Assuming that the COVID-19 monitoring and testing are low in Africa due to scarce resources, the high viral incidence witnessed in Asia, Europe, and North America would implicate that local transmission in highly populated metropolis in continent of Africa such as Lagos or Nairobi would culminate in high incidences of pneumonia cases at local hospitals (Pan *et al.,* 2020). A differing notion that SARS-CoV-2 transmission in the continent may be comparable to that elsewhere but that its development to clinical disease outcomes is significantly lower may be acceptable (Yang *et al.,* 2020). Many public health professionals are amazed that the case fatality rate (CFR) in Africa has not escalated despite her high burden of chronic diseases such as tuberculosis, HIV/AIDS, malaria and other infections, including the prevalence of other underlying situations, for instance malnutrition and unorganized settlement with high population density in urban areas with dirty environment. For instance, in Nigeria, the CFR based on the Nigeria Centre for Disease Control (NCDC) is only 1.8%. Nevertheless, it is worthy noting that comorbidities linked with severe COVID-19 disease like diabetes mellitus and asthma are not much prevalent in the region (Yang *et al.,* 2020; Saeedi *et al.,* 2019). In spite of the profound poor health systems in sub-Sahara Africa, the CFR has been below the average in global records compared to that of European countries and those in the United States of America as at 31st July, 2020. It is therefore highly probable that the elevated temperatures of the climate in sub-Saharan Africa may contribute significantly to the decreased survivability of the virus in the environment and consequent decreased disease severity and mortality in the population. This may be evidenced in the graphs of Figures 2 and 3 where death rates are relatively less in countries around the equator compared to geographical extremes of Africa in the North and South such as Egypt, Algeria and South Africa.

Respiratory failure has been identified as the principal cause of human death in COVID-19 cases and it is similar to those caused by flu infection. Recently, recovery from respiratory failure caused by this COVID-19 incidence has been promoted through the use of invasive mechanical ventilation until the lung's injury heals (Zhou *et al.,* 2020). Extra-corporeal membrane oxygenation could be employed if the situation gets worse (Tao *et al.,* 2017). Septic Shock and multiple organ failure have been strongly implicated as other causes of high mortality rate experienced in COVID-19 infection. The role of reoccurring bacterial infections in increased incidences of mortality due to COVID-19 is not well-documented in literature (Meo *et al.,* 2020). Others causes associated with increased mortality due to COVID-19 include acute kidney injury and cardiogenic shock resulting from acute myocardial injury or myocarditis (Paudel, 2020). This era of the global pandemic, deaths due to COVID-19 are hardly differentiated from others caused by overload of cases in hospitals. Critically ill persons infected and associated mortalities with COVID-19 for now do not have access to adequate medical attention because of limited resources in terms of personnel, funds and inadequate hospital facilities (Tao *et al.,* 2017).

In Africa, the daily cases of COVID-19 have been on the increase and the number of deaths reported daily has also increased drastically. As at 31 July 2020, the ten most hit countries with COVID-19 in Africa is as shown in Figure 2. Data from African Centre for Disease Control reveals increasing cases of death resulting from COVID-19 in the last three months and experts' project that the cases may not have reached peak due to poor health facilities and increased community transmission in these African countries. The rise in the death rates from March to July in five most affected countries are shown in Figure 3.

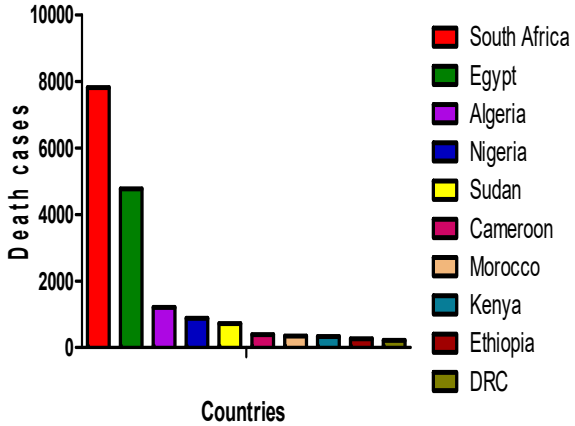

Figure 2. COVID-19 Total Death Counts in ten most affected Countries in Africa **as at** July 31, 2020.

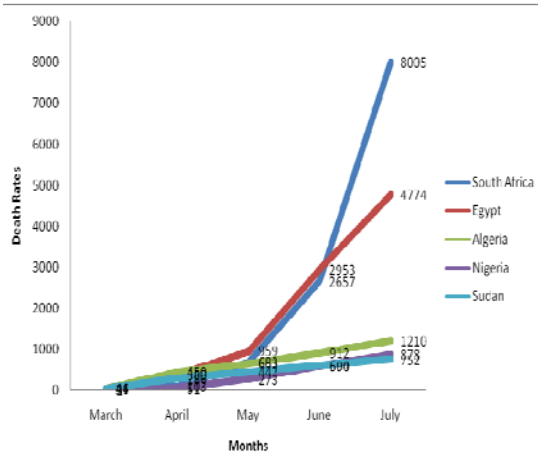

Figure 3. COVID-19 Total Death Counts **as at** July 2020 in five most affected Countries in Africa.

COVID-19 pandemic is a relatively new and understudied disease and as such, there is limited available data. In Africa individuals having comorbidities such as diabetes mellitus, hypertension and malignancy had low recovery performance following COVID-19 infection treatment (Saeedi, 2019). However, from the cases reported to have emerged from Africa, it was observed that infections were increased by comorbidities. Recent health information and clinical experience indicate that the elderly, particularly those with protracted health problems and any other persons irrespective of age with serious underlying health conditions are prone to getting COVID-19 (Paudel, 2020). Reports have shown that vulnerable population with chronic medical conditions like diabetes and cardiovascular or lung disease and the aged are not only prone to developing severe illness but are also at greater risk of death if they develop ill (Saeedi, 2019). Individuals with underlying unchecked medical conditions like diabetes, hypertension, lung, liver, and kidney disease, cancer patients on chemotherapy. Reports have also shown that transplant recipients, smokers and patients on steroids drugs are more prone to COVID-19 infection (Paudel, 2020).

5. Sub-Sahara African Mitigation Measures and Challenges in Tackling COVID-19

Africa is better ready and equipped than before for any outbreak of any infectious viral disease like COVID-19. There has been significant improvement since the Ebola outbreak of 2014-2016 and the lessons garnered previously and ongoing outbreaks in addition to marked investment in surveillance and preparedness (WHO, 2020d; Hoffman and Silverberg, 2018). African countries have thus far intensified effort and have been on the alert for detection and isolation of any imported case of COVID-19. Prior to the reported case of COVID-19 from Africa, there has been a very quick response to the COVID-19 epidemic by the **sub-Sahara** public health systems of Africa. The re-organization of WHO as well as the establishment of the World Health Emergencies Programme, the setting up of Africa CDC, (http://www.africacdc.org/. accessed 17 February, 2020) the establishment and funding of development partners like ONE-HUMAN-ANIMAL-HEALTH Africa- Europe research, training and capacity development network (PANDORA-ID-NET) (PANDORA-ID-NET, 2020) for handling emerging and re-occurring infections with epidemic potential facilitated the rapid response. This ONE-HEALTH network will work in all the regions in Africa continent alongside locally approved disease control authorities and public health institutes, such as Nigeria CDC, Africa CDC and other African and global public health agencies to effectively and efficiently tackle health problems such as the coronavirus pandemic (NCDC, 2020).

Concerted efforts were made by the Africa CDC, country specific CDC like Nigeria CDC, African Union, PANDORA-ID-NET and other research and capacity development and training consortia in preparation to deal with any imported case or in the wake of local outbreaks of COVID-19. Screening for COVID-19 patients on arrival at airports and at some seaports was launched by several African countries. There was a meeting of public health emergency responders from Africa in early February, 2020 in Senegal to keep themselves abreast of newest advances in COVID-19 diagnostics, (Corman *et al.,* 2020) prevention and healthcare knowledge. Many countries in Africa have set up isolation and quarantine centers, swiftly attending to suspected cases by carrying out laboratory test and in some cases quarantining them while laboratory tests were being performed (Kapata *et al.,* 2020).

In Africa, Nigeria was among the first to acknowledge the danger and commenced strategic planning to contain the COVID-19 pandemic. In preparedness, the National Coronavirus Preparedness Group was set up by Nigeria CDC on 7th January, 2020, seven days after the republic of China announced the first confirmed case and twenty-one days prior to the declaration of the COVID-19 as disease of international concern. Nigeria under one month established three diagnostic laboratories for COVID-19, In the same vein, the National Coronavirus Preparedness Group was set up by the Nigeria CDC that meets on daily basis for the assessment of the risk posed by the coronavirus pandemic and review of her response to it (Kapata *et al.,* 2020).

Many countries in African have put up thermal body scanners at all ports of entry to detect travelers displaying the symptoms of the virus. In south Africa, the national and provincial response teams were put in place, while 300 health personnel were stationed at ports of entry to enable them screen all travelers from China. Several participants from different countries in Africa have been trained by the Africa CDC to facilitate COVID-19 detection at points-of-entry in partnership with US-CDC, WHO, and the International Civil Aviation Authority (WHOe, 2020). Different bodies and unions such as the Africa Union, West African Health Organization (WAHO) and external donors have been swift in the provision of assistance to the Africa CDC. There have been many consortia sending in applications for research grants and capacity development in response to the containment of COVID-19 emergency grant calls.

Sequel to the confirmation of first case of COVID-19 in Africa, the Africa CDC, Nigeria CDC and other national public health institutes in collaboration with the World

Health Organization were putting up concerted effort in African region to help countries in carrying out the recommendations as provided by WHO International Health Regulations Emergency Committee. The WHO emergency committee proposed that all countries by prepared for containment, surveillance and contact tracing, early detection and isolation, case management, and preventive measures to forestall transmission of SARS-CoV-2. Besides, diagnostic kits reagents and positive controls were sent to 29 laboratories in Africa by the WHO through PANDORA-ID- NET partner in Germany, Charité-Universitätsmedizin Berlin Institute of Virology to facilitate the capacity to screen and test while some African countries including DRC leveraged on the facilities, they have set up for Ebola screening, to screen for COVID-19 (WHO, 2020f).

In a bid to checkmate the transmission of the virus, different precautionary and preventive measures as recommended by the WHO were adopted. There was serious public enlightenment campaign both in radio, television and other print media on the need for regular washing of hands with water and soap at least 30 seconds, the use of nose and mouth masks, use of hand sanitizers when water and soap are not readily available, discouragement from touching eyes, nose, and mouth, social and physical distancing. Additionally, people were advised to distance themselves from people, to cover their mouth and nose while coughing or sneezing with a tissue and thereafter cast the tissue in the dustbin for quick disposal (Sandaradura *et al.,* 2020). Likewise, people were advised to always wash and sterilize objects and surfaces mostly touched employing household cleaning spray or wipe (NCDC, 2020). There was an embargo on social gatherings like burials, wedding ceremonies, birthday party and religious activities in most African countries. People were encouraged to seek medical attention when they have a fever, cough and difficulty in breathing or call in advance the local health authority and were warned to avoid unneeded visits to medical facilities to protect themselves and their loved ones. Other measures taken include border closures and screening at airports and checkpoints. In Nigeria, there was initial total lockdown of Lagos and Ogun states including the nation's capital territory, Abuja. Subsequently there was interstate lockdown while curfew was imposed in areas where cases were reported in some states.

Despite so many efforts being made by several Africa countries in the fight against COVID-19 pandemic, they were confronted with a lot of challenges. The majority of the African countries are low-middle income countries (LMICs) that lack the capacity to test in a large scale. Thus, they faced several problems ranging from diagnosis of suspected cases, contact tracing of suspected carriers for confirmatory tests and plans on active surveillance testing. There have been reported cases of test kit shortages in different African countries (VOA, 2020) owing to high global demand. The COVID-19 RT-PCR test kits are exorbitant, making it difficult for LMICs to embark on large-scale testing. In addition, the PCR machines and adequately equipped BSL-2 labs are expensive to come by and this required highly skilled manpower which limit the testing capacity for COVID-19 by many African countries (Kobia and Gitaka, 2020).

In Africa, social coherence and social gatherings are highly valued. For instance, attendance of weekly religious activities is reported highest in most Africa countries with reported rates of about 82% in Uganda and Ethiopia. Consequently, mitigation measures based on social and physical distancing as in health guidelines may be more difficult to achieve, as attested by the Senegalese protest on 20 March 2020 after public gatherings, including gatherings at mosques were banned as cases of COVID-19 rose. The high prevalence of malnutrition, anemia, malaria, HIV/AIDs, and tuberculosis in African population is a critical challenge in containing the escalation of the pandemic. For instance, Liberia has the highest rate of stunting globally, one out every three children under the age five years are stunted. Increase in the incidence of malnutrition has been witnessed recently. Besides, there is early onset of rainy season this year, which implies rapid increment in malaria cases in 2020 which its peak coincided with the present COVID-19 pandemic being experienced. All these factors wear out the immune system and make the population more vulnerable (https://www.weforum.org/agenda/2020/03/why-sub-saharan-africa-needs-a-unique-response-to-covid-19/. accessed March 30, 2020).

Even though, the lock-down imposed in most **sub-Sahara** African countries will have the benefit of reducing spread, fatality and disability from the virus but the aftermath on the Africa's economy is worrisome. In the continent, many countries are already in economic dips, the lockdown and decrease in economic activities due to the pandemic will further diminish the economic growth of many African countries. In addition, the decline in oil prices and international commodities which most African countries are dependent upon will further worsen the situation and will probably occasion grave economic recession for the continent. This will culminate to increment in poverty rate which many may view as bad for the African continent as the COVID-19 pandemic itself (Okonofua *et al.,* 2020).

6. Conclusion

Sub-Sahara African countries like other countries of the world have been negatively impacted by COVID-19 with comorbidities worsening its progression and outcomes. There is, therefore, a need to take all the precautions rolled out by approved health guidelines to avoid contacting SARS CoV-2 infections. Precautionary measures recommended include regular hand washing using detergents and soap in running water, regular application of safe alcohol-based hand sanitizer, reduction in the number of person-to-person contact, maintenance of social distancing, covering of nose and mouth or face with approved mask in public places, and generally reducing public activities involving physical contacts with as many persons as possible. Also, there is urgent need for increased public health campaign to create more awareness on the need to reduce the burden of comorbid illnesses capable of causing increase in the numbers of deaths in patients infected with COVID-19.

Since reports have shown that a combination of health guidelines is likely to contribute to reduction in the incidences of transmission and disease severity in Africa,

contrasting reports linked to the pandemic in different countries herein presented are grounds for further studies. From this review, it can be inferred that warmer weather and large population mostly in the youthful age contribute to low transmission incidences of COVID-19 disease and severity in Africa.

Although acquired immunity as a result of earlier exposure to cross-reacting corona viruses is a novel area, more research studies are needed for better understanding. It is pertinent to note that the WHO has forewarned that Africa may experience increased cases and deaths as reported in Brazil and so need all hands-on deck to avert the danger of the dreaded COVID-19 virus.

Again, although reports have shown that some African countries have deployed medicinal plants products (herbal remedies) such as COVID-19 organics used in Madagascar and other phytochemicals-rich-compounds for the earlier treatment of the disease, research is on-going for validation of these claims and if successful, then African countries will make rapid progress as medicinal plants with these potent bioactive compounds abound in the continent. In the final analysis, it may well be that the elevated temperatures of sub-Saharan climates may be a major contributing factor to the reduced severity of the COVID-19 pandemic in this part of the world.

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