

COVID-19 Transmission Dynamics and Response: Opinions and Perspectives from Africa

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Abstract

Coronavirus disease 2019 (COVID-19) since its declaration as a pandemic by world health organization (WHO) has spread across the various continent with little known about the most effective public health response for containing and mitigating the transmission of the epidemic. It is important to state that some authors have published on the lessons learned from transmission and management of COVID-19 infection but only a few considered it from the Africa perspective. Despite the late arrival of the pandemic in Africa and the notion that the virus may not thrive because of the high temperature in the continent; today the narrative has changed with the number of infected patients increasing daily. Herein, the authors have shared their perspectives and opinions on the dynamics and response to COVID-19 from Africa context to create more awareness and approach in mitigating the spread of the virus should the continent becomes the epicenter of COVID-19.

Keywords: COVID-19; infectious disease; transmission; response; Africa

Background

Since the outbreak of the coronavirus disease 2019 (COVID-19) in Wuhan, China, there has been a sporadic spread of the pandemic across the world with its late arrival in the Africa continent. Several clinical data have been published on immune responses from infected patients among westerners and Asians to various treatment regimens [1-3], whereas little is known from Africa. Since the first case was reported in Wuhan, China on December 31, 2019, to April 16, 2020, the world has a toll of about 2,100,667 total number of confirmed cases, 1,440,687 total number of active cases, 136,048 total number of death, and 523,932 total number of recovery spread across over 200 countries including 52 in Africa[4, 5]. The World Health Organization (WHO), on January 30, 2020, announced COVID-19 as a pandemic and listed it as a Public Health Emergency of International Concern [6]. At the time, the spread of the virus was delocalized in Mainland, China majorly with no reported cases in Africa. As of April 16, 2020, Africa has recorded 18,106 total number of confirmed cases, 13,302 total number of active cases, 915 total number of deaths, and 3,889 total number of recovery[5]. The earlier reported cases in Africa were majorly through imported transmission, however, the narrative has changed: now the cluster of cases being reported is via local transmission and the pandemic statistics keep rising.

Update on Africa's Cases

Following the WHO guidelines and as evident by China's preventive and control approaches in containing COVID-19, several African Governments, particularly in South Africa, Ghana, Cameroon, Nigeria, Egypt, and Algeria, have sanctioned several measures, especially lockdown and social distancing, in the drive to contain and/or mitigate the spread of COVID-19. This is gradually being adapted to a new normal, perhaps a new culture. Notwithstanding, new cases are

being reported daily. A two-week survey we undertook between March 31 and April 13, 2020, culling data from the World Health Organization situation reports[4, 7], depicted that Africa is in the middle of the COVID-19 pandemic. All five geographical regions including West Africa, Southern Africa, East Africa, North Africa and Central Africa including 52 countries and 2 territories (Mayotte and Réunion) have evidence of COVID-19 reported cases, death, and recovery (Figure 1a-c). From the African perspective, the North can be ascribed as the epicenter of COVID-19 (Figure 1a-c). Since the first case was declared in Egypt on February 15, 2020, each of the five African regions has proportionately witnessed a rise in the spread of COVID-19 (Figure 1a). Although many countries within the five regions are yet without an estimated number of total tests, our survey highlighted overall testing capacity which in increasing order include the Central (854), Eastern (32,650), Northern (50,167), Western (51,827) and Southern regions (91,108) (Figure 1d). However, within this survey period, the toll [cases, death, and recovery] in Africa contributes a very low percentage (0.40-1.2%) of the world's total statistics of the pandemic (Figure 2).

Predicted Transmission Dynamics in Africa

Reportedly, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) can be transmitted by fomites; hence the practice of personal hygiene is included in the public health guidelines for COVID-19 preparedness[8]. However, the practice of effective hand washing (hand hygiene) is subject to the availability of water. These are key issues in as many African States which underscore its preparedness. Jawhara highlighted the important roles played by lifestyle, diet, and environment in the development of specific antibodies to combat a virus [9]. But COVID-19 pandemic is rapidly spiking in Africa notwithstanding the limitation in testing capacity across the nations therein. These issues cannot be overemphasized in the continent where infrastructures and well-equipped facilities are limited for testing.

Some mathematical models have been developed in the wake of the pandemic and predicted transmission patterns in different parts of the world[10]. Meanwhile, what these models have sought to do is to predict the dynamics of the COVID-19 infection along with its transmission frequency and efficiency in the phase of all the attending problems associated with African countries. A typical modeling study by Marius Gilbert and colleagues[11] identifies each African country's risk of importation of COVID-19 from China, using data on the volume of air travel from three airports in provinces in China to African countries. Gilbert and colleagues used two indicators to determine the capacity of countries to detect and respond to cases: preparedness, using the WHO International Health Regulations Monitoring and Evaluation Framework; and vulnerability, using the Infectious Disease Vulnerability Index. Based on their analysis, Egypt, Algeria, and South Africa had the highest importation risk, and a moderate to high capacity to respond to outbreaks. Nigeria, Ethiopia, Sudan, Angola, Tanzania, Ghana, and Kenya had moderate risk with variable capacity and high vulnerability. In the model, the risk mainly originates from Guangdong, Fujian, and Beijing. The study provides a valuable tool that can help countries in Africa prioritize and allocate resources in their responses to the potential spread of COVID-19. In the face of all these, there is need to evaluate the current interventions put in place against developed metrics in scaling up efforts to flatten the curve in Africa.

Immune Responses

Immunity plays a crucial role in protecting and helping organisms fight infection. While the immune system can be very active in certain individuals but less effective in others – we may need to question how this could impact the susceptibility to COVID-19 and treatment plan to adopt in various races especially Africa. To further help understand the rationale for personalized medicine from the Africa context, we need to decipher the factors that affect our response to viral infections and why some people are predisposed to diseases.

Helene *et al.*, in their study, provided comprehensive information on the impact of genetic variation on transcriptional responses to immune cell activation and revealed evolutionarily salient determinants of host immune responsiveness [12]. Using RNA-sequencing data from 100 Africans and 100 European ancestries, the authors characterized how human monocytes, a well-known immune cell attributed to innate immune responses, respond to bacterial or viral ligands and Influenza A virus. Their study highlighted certain variants at the cellular and molecular level especially genes involved in inflammatory and antiviral responses underlying host immunity to pathogen attack and susceptibility to disease amongst the African and European populations. This observation provided information that can help broaden knowledge on the reason some populations are particularly susceptible to diseases such as lupus, which is more common in Africa than in Europe.

Preparedness/ Response Lessons So Far

This pandemic reveals lag in Africa's coordinated response, low level of preparedness, mismanagement of information or rather, undermining of the contagion. Asia, America, and Europe appear to be the worst hit by the COVID-19 pandemic. Asia was first considered the world's epicenter of the pandemic; however, the tide turned as Europe also worn the tag. It is like a moving train that has stopped over at America as it has overtaken the statistics and can be regarded as the new pandemic epicenter. Although the data still looks fair for Africa relatively, can Africa muscle out any response to challenge COVID-19 should it become the pandemic epicenter of the world? Several factors would have to be considered if there be any chance of trumping the scourge. These factors cut across many aspects that can be classified under surveillance, diagnosis or testing, prevention and control, infected persons' management, risk communication, and research and development. All these aspects commonly need capacity

building[6] and perhaps, financial resources. Africa is vehemently short of these; but other palliatives can be adopted, particularly in terms of hygiene and herd immunity.

Testing or diagnosis limitations also cast doubt on the success of surveillance or contact tracing as well as the figures on display in Africa. In retrospect, as of mid-March, the total number of confirmed cases in some European countries and the UK were in their hundreds; and two weeks later, many have hit their unit or tens of thousands[7]. The upsurge could be due to testing capacities that are being ramped up.

Bringing to fore again, the limitation of testing in Africa, we project that many Africans might be asymptomatic carriers of SARS-CoV-2; and in the coming weeks, its healthcare systems and makeshift isolation centers could become overwhelmed should there be an exponential rise in the number of cases. At these unprecedented times, perhaps, the most likely reprieve or hope for Africa is to allow the virus to run its course to increase its population herd immunity. However, this could be at the detriment of the most vulnerable including the aged, neonates as well as the sick, whose immunity level is low or rather compromised. Nonetheless, herd immunity cannot be initiated if the virus's basic reproductive number (R_0) and effective reproductive number (R_t) in a given population are not estimated[13]. Thus, we suggest calculating these two variables in an African population to estimate the minimum critical level of African population immunity (P_{crit}) that can be acquired naturally (post COVID-19 recovery) to stop COVID-19 spread in Africa.

Interestingly, a group of researchers at Cambridge University published a paper on the phylogenetic of SARS-CoV2 and highlighted 3 variants of the virus (Type A, B, and C) predominant in several parts of the world apart from Africa [14]. Type A viruses were more in infected patients from the US and Australia. Also, type A strains were closely related to the virus sequenced from bats and pangolins. Thus, the researchers referred to the type A virus as the origin of the outbreak. Notably, few cases of this variant were observed in Wuhan and

reported to be from Americans residing in Wuhan. On the other hand, type B strains were seen in patients from China and within East Asia while type C strains dominated Europe, Singapore, Hong-Kong and South Korea. Surprisingly, type C viruses were not found in China. The authors suggested that type C strain evolved from B, while B was a mutation of A variant [14]. The limitation of this phylogenetic classification is the lack of knowledge on strain/s predominant in Africa since most of its earlier cases were imported. Therefore, it will be paramount to understand the exact strain amongst the Africa population for effective evaluation of the epidemiological and clinical outcomes of COVID-19 infection. Besides, this could benefit the proper treatment regimen and consequently vaccine production for Africa. It is also noteworthy from unpublished data that some African countries (Nigeria and Ghana) have begun sequencing genomes of the virus which will help in the development of country-specific interventions for treatment.

Challenges/ Way forward

Considering the late arrival of COVID-19 in Africa and media speculation that Africans immune system may be resistant to the survival of the virus supported by the temperate weather, a recent study published in Science Translational Medicine shed more insight as to why Africa healthcare leaders should take more proactive measures in curtailing the spread of the virus[15]. In this study, Danika et al., established that immune system development in children is dependent on age, genetics, population, and anemia indices. Although lessons learned from China and other western countries [such as Italy, US, UK] with the fast spread of COVID-19 are very important, they cannot be completely extrapolated into the Africa healthcare management system without considering certain essential factors.

Lastly, while lockdown measures are in place, it is critical to point that it is not total as food and other essential commodity markets are very much open in as many communities, especially in the suburbs. To make matter worse, the method being utilized by local authorities in distributing relief materials flouts the WHO guideline on social distancing. In Africa, COVID-19 is perceived as a disease that cannot withstand the heat of the tropics, so only the rich can contract given the ambiance of comfort. Although an average temperature of 5-11°C was reported for some United States cities with significant community spread[16], there is evidence of COVID-19 spread in Africa where the temperatures are 10-20°C higher. Also, Africa's combined estimated testing capacity is lower compared to the total in as many individual countries in Europe (Germany, Italy, Russia, Spain, France or Turkey) or single state in the USA such as New York[4]. This is a big source of concern as the distribution of the pandemic in Africa might be misrepresented; therefore ramping up test capacity must be Africa's top priority. As such, there is a possibility this contagion is on every street in Africa from our projection; however, the fair presented an outlook of COVID-19 in Africa to date might favor a herd immunity strategy in Africa. Notwithstanding, this is speculative, but Africa is not ready to face COVID-19 like Europe and America currently are.

Abbreviations

Coronavirus disease 2019 (COVID-19); Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2); World Health Organization (WHO).

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Author's contribution

All authors contributed equally to this work. Author SEB is the most senior author who conceived the idea. Author AOA and AAO wrote the first draft. Author SEB reviewed and edited the manuscript. Author AOA, AAO, and SEB read and approved the final draft.

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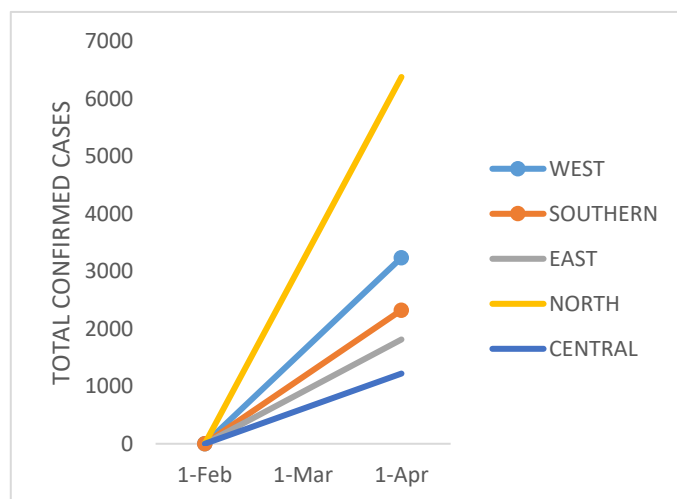
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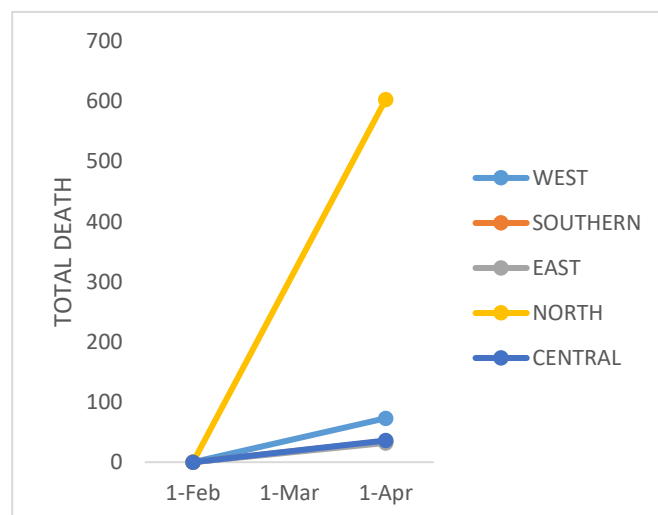
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B.



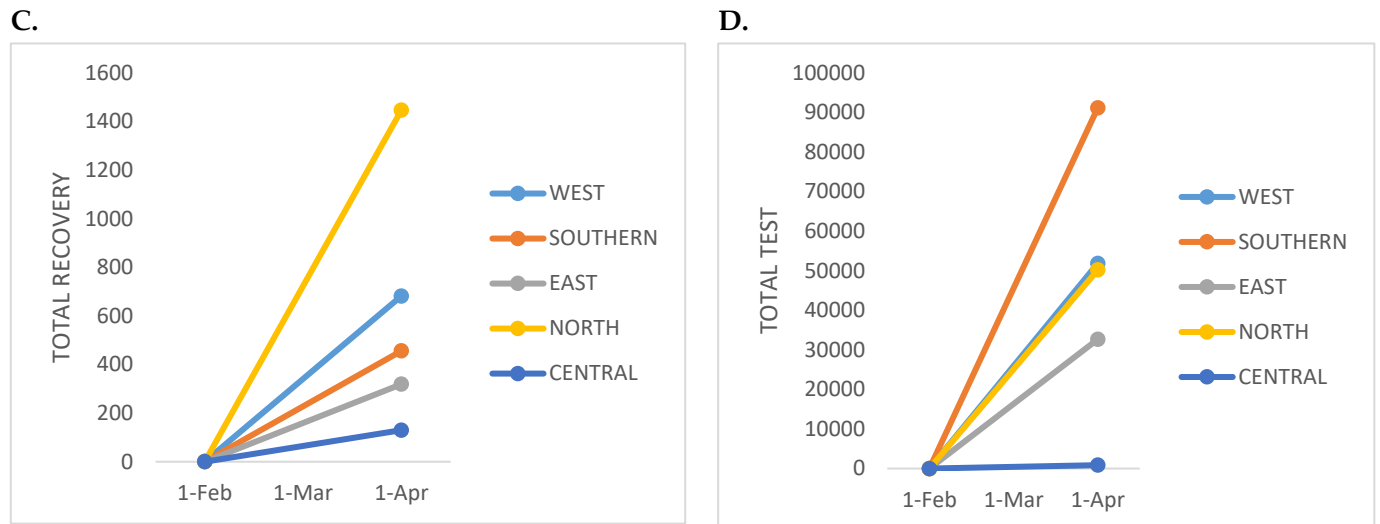


Figure 1: Regional distribution of COVID-19 pandemic between March 31 and April 13, 2020. (A) The total number of cases reported from the five regions ($\Sigma=14,976$); (B) The total number of death reported from the five regions ($\Sigma=779$); (C) The total number of recovery reported from the five regions ($\Sigma=3034$); and (D) The estimated total number of test done in the five regions ($\Sigma=226,606$).

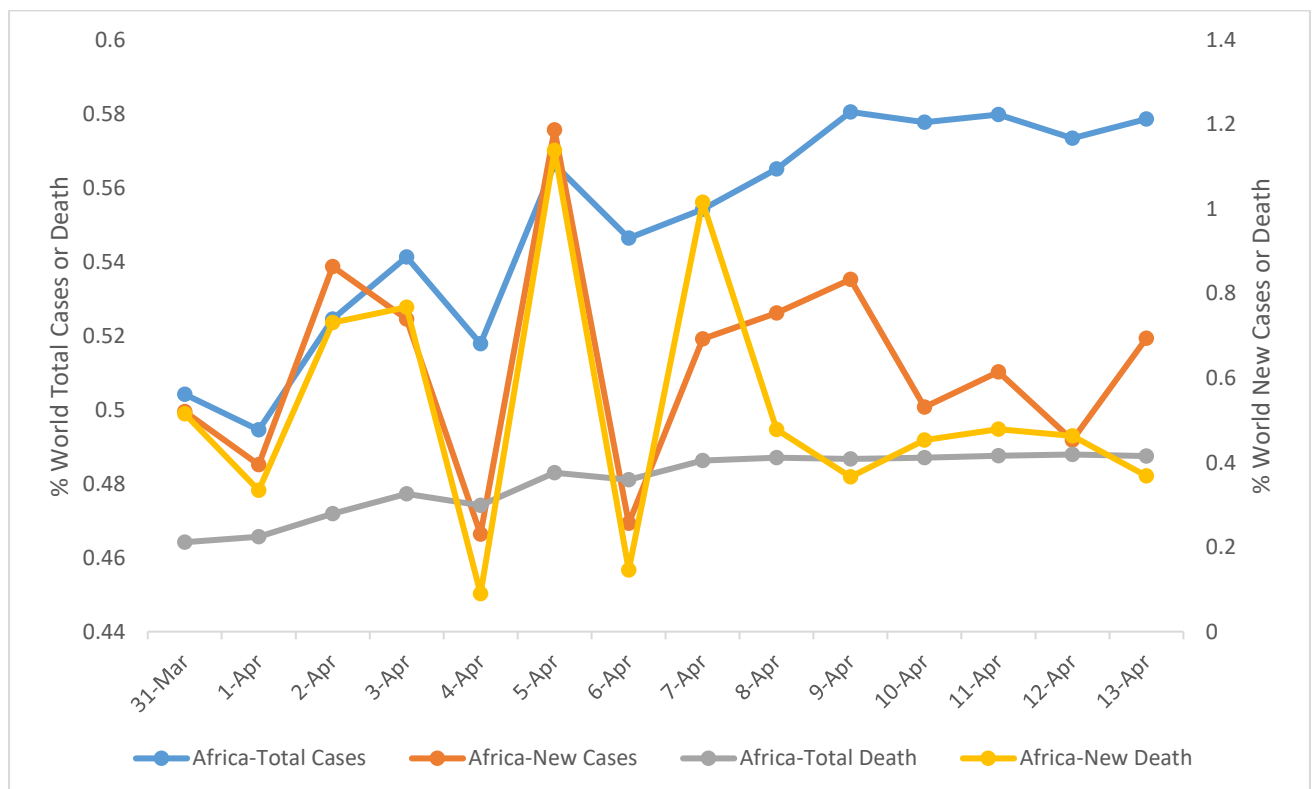


Figure 2: Africa percentage of global distribution of COVID-19 pandemic between March 31 and April 13, 2020. Africa total COVID-19 cases percentage of increased from 0.5% to 0.6% within this period. The percentage of global new cases and death (0.4-1.2%) fluctuated within this period while a slight increase was observed for percentage total death.

