
RESEARCH ARTICLES**COVID-19 waves in Africa: Effects of outbreak response and interventions**Olayinka Stephen Ilesanmi^{1,2} & Aanuoluwapo Adeyimika Afolabi^{1&}¹ Department of Community Medicine, College of Medicine, University of Ibadan, Oyo State, Nigeria² Department of Community Medicine, University College Hospital, Ibadan, Oyo State, Nigeria

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Abstract

Introduction: Public health safety measures (PHSM) have been advocated for towards the effective containment of COVID-19. This study aimed to assess the effects of PHSM implemented during different phases of the COVID-19 pandemic in Africa.

Methods: We conducted a retrospective analysis of the COVID-19 control measures implemented across Africa. We extracted and collated data on COVID-19 cases, deaths, and stringency level (SL) from online data repositories between 18 July, 2020 and 18 December, 2020 in Africa.

Results: In the South African region, COVID-19 cases increased when there was partial closure of work sectors (SL = 41.67), but decreased with complete closure of work sectors (SL=46.30) in South Africa. In North Africa, COVID-19 cases increased when there was limited contact tracing (SL = 23.15), but decreased with comprehensive contact tracing (SL = 75.00) in Tunisia. In West Africa, COVID-19 cases increased when there was partial school closure (SL = 50.93), but decreased with complete school closure (SL = 65.74) in Nigeria. In East Africa, COVID-19 cases increased when contact tracing was limited (SL = 28.70), but decreased with comprehensive contact tracing (SL = 51.85) in Sudan. In Central Africa, COVID-19 cases increased when there was partial school closure (SL = 43.52), but decreased with complete school closure (SL = 56.48) in Congo.

Conclusion: PHSM should be intensified to ensure the effective containment of COVID-19 in Africa. Evidence-based decisions should be made by policy makers and contextualized in each African country as the COVID-19 pandemic evolves.

Keywords: Coronavirus, COVID-19, COVID-19 control measures, Public health safety measures, Africa.

Introduction

The novel outbreak of the Coronavirus disease (COVID-19) was first reported in December 2019, in Wuhan city, China, where symptoms such as pneumonia were manifested among many individuals [1-4]. COVID-19 became declared a public health emergency of international concern by the World Health Organization on 11 January, 2020 [5,6]. Thereafter, COVID-19 was declared a global pandemic on 12 March, 2020 after more than 100,000 persons globally had been infected with SARS-CoV-2, the causative organism for COVID-19 [7,8]. Presently, COVID-19 has been spread across 213 countries across the globe [9]. Steady records of a high

proportion of COVID-19 cases (> 1 million) have been recorded in Brazil, India, Russia, and the United states, and every continent has had its share of the COVID-19 experience [9]. Due to this shared experience, many public health safety measures (PHSM) such as border closures, public health campaigns, regular hand hygiene, and the compulsory use of face masks have been implemented in many countries and continents [10-12].

On the African continent, the index case of COVID-19 was first reported in North Africa by Egypt on 14 February, 2020, while the second COVID-19 case was reported in sub-Saharan Africa by Nigeria on 27 February, 2020 [11,12]. Despite hypothetical deductions

that the African continent was “immune” to the COVID-19 outbreak, SARS-CoV-2 had spread across the entire continent within three months [13,14]. The last sovereign state which had previously been free of the COVID-19 outbreak also reported a COVID-19 case on 13 May, 2020 [15,16]. As of 18 December, 2020, over 70 million COVID-19 cases have been recorded globally, of which Africa totaled 2,432,319 cases, majorly reported from South Africa, Morocco, Mozambique, Tunisia, and Egypt [17]. As of the reference date, more than 1,500,000 deaths have been recorded globally, and a high proportion of COVID-19 deaths in Africa have been recorded in South Africa, Morocco, Tunisia, Egypt, and Algeria [17]. The South African region has reported nearly 50% of COVID-19 cases in the African Union, where South Africa bears the greatest burden [17].

Compared to other continents, Africa is the least affected by the COVID-19 pandemic [18]. A high mortality rate was anticipated from the region due to the burden of non-communicable diseases and risk factors for high mortality from SARS-CoV-2 [12]. In addition, the low socio-economic status, poor access to healthcare, and the fragile health system in many African countries were notable factors which could have driven the COVID-19 morbidity and fatality within the region [18]. However, it seems likely that the low testing capacity (evident in the testing rate per 100,000 population) in many African countries could have led to some individuals missing out on COVID-19 testing activities [19]. In such cases, deaths of many of these individuals could have gone unreported, and such crucial figures would have been undocumented.

Prior to the detection of COVID-19 in Africa, the African Union launched a joint continental COVID-19 strategy with the Africa Centers for Disease Control and the WHO to enable adequate preparedness of member states [12]. During this period, the public health institutes utilized the surveillance and contact tracing systems that were initiated for the control of local transmission of the West African Ebola outbreak [12]. Similarly, other structures such as molecular testing that were being used for other disease programs such as *Lassa* fever and drug-resistant tuberculosis infection were scaled up for the COVID-19 context [12]. Besides the medical provisions, PHSM were implemented across African countries. The PHSM included enforcement of border closures and travel bans to prevent importation of COVID-19 cases, school closures, restrictions on social or religious gatherings, physical distancing, compulsory use of face masks, testing, and hand hygiene in public places [11,18]. It has been reported across literature that some PHSM, e.g. border closures and travel restrictions, had limited effectiveness in submerging the spread of influenza [20]. However, a modelling study from Australia reported the effectiveness of border closure in delaying the spread of COVID-19 [21].

Many countries are becoming less stringent in the PHSM being implemented during the COVID-19 pandemic, for instance, school closures are no longer at all levels, and gatherings are now being held on a regular

basis [22]. Thus, it is imperative to investigate the contributions of each PHSM in increasing or reducing the transmission of SARS-CoV-2. Knowledge gained in this regard would inform policy decisions on specific PHSM that need to be enforced to break the chain of transmission of SARS-CoV-2. This study therefore aimed to assess the effects of the implemented outbreak responses and interventions during different phases of the COVID-19 pandemic in Africa.

Methods

Study design

This is a retrospective analysis of the COVID-19 control measures implemented across all the countries in Africa with clear PHSM and policies. We extracted and collated data between 18 July, 2020 (when there was an increase in COVID-19 cases in the region) and 18 December, 2020 (when there was a decline in COVID-19 cases in the region). Data were extracted from online repositories of the Oxford University Blavatnik School of Government from the Oxford COVID-19 Government Tracker (OxCGRT) [22]. The OxCGRT systematically collects information from publicly available sources of government websites on the local policy responses taken by national governments towards the effective containment of the COVID-19 outbreak. OxCGRT collects and reports information on measures including school and workplace closures, health policies (such as testing requirements), and economic policies in the English language. The OxCGRT helps to inform a Risk of Openness Index which permits understanding of the safety of “opening up” or “closing down” different sectors while tackling the COVID-19 outbreak [22].

Data collection process

We obtained the details of the PHSM and the periods in which they were either tightened or loosened at nationwide level in each country. Data collection commenced in July, 2020, when a rise in COVID-19 cases was recorded across many African countries, and spanned through December, 2020 when another surge in COVID-19 cases was recorded in the region. Using this data, we determined the epidemic phase of each country as of the reference period. Countries in epidemic phase “1” were defined as those that never flattened the curve, or had low case numbers until August when they rose significantly. Countries in the epidemic phase 2 were defined as those that flattened the curve after cases peaked in July, but are now seeing another rise in numbers, while countries in epidemic phase “3” were defined as those that have had a sustained decline in cases over time (after an initial rise). The same search strategy was used for all the countries under consideration [22]. The PHSM described included border closures, screening and/or quarantine for international travelers, restrictions on gatherings, policy on the use of facial coverings, testing policies, workplace and school closures, and contact tracing. Using the available data on the OxCGRT for each country, we defined PHSM that contributed to a rise in COVID-19

cases as the measures in place within the immediate past two weeks before the rise in COVID-19 cases was reported. On the other hand, PHSM that contributed to a decline in COVID-19 cases were defined as the implemented measures within the immediate past two weeks before a decline in COVID-19 cases was reported. Data on the stringency level (SL), a composite measure based on nine indicators such as school and workplace closures, testing policies, and restrictions on international travel, were rescaled from a range of “0” indicating “lowest level of national strictness” to “100” indicating “highest level of national strictness”.

Study area

The study was conducted across Africa. Africa is divided into five regions; the South, North, West, East, and Central. The South African region is made up of 10 countries; South Africa, Angola, Mozambique, Malawi, Zambia, Zimbabwe, Eswatini, Lesotho, Botswana, and Namibia. The North African region is made up of 6 countries, namely: Morocco, Western Sahara, Algeria, Tunisia, Libya, and Egypt. The West African region comprises of 16 countries; Nigeria, Ghana, Benin, The Gambia, Sierra Leone, Mauritius, Liberia, Niger, Cote d'Ivoire, Senegal, Guinea, Mali, Togo, Burkina Faso, Carbo Verde and Guinea Bissau. The East African region is made up of fourteen (14) countries; Djibouti, South Sudan, Kenya, Uganda, Mauritius, Rwanda, Tanzania, Eritrea, Comoros, Madagascar, Somalia, Seychelles, and Amharic. The Central African region is made up of 9 countries; Burundi, Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, DR Congo, and Sao Tome and Principe [23].

Inclusion criteria

We included PHSM implemented in each African country between 18 July and 18 December, 2020. During these two periods, most African countries experienced two peaks in the COVID-19 cases. All PHSM implemented before 18 July, 2020 and after 18 December, 2020 were excluded.

Ethical consideration

This study was conducted according to the Helsinki declaration. However, no human subject directly participated in this study, hence no ethical approval was required to conduct this study. All the PHSM assessed posed no form of harm to the African population studied.

Results

The total COVID-19 case and death counts in each African country provided in Tables 1-5 were retrieved from the OxCGRT as of 18 December, 2020 [22]. In the South African region, South Africa is in the first phase of the COVID-19 pandemic, and has recorded 892,813 COVID-19 cases, with 1,537 cases recorded per 100,000 population, and 24,011 deaths as of 18 December, 2020. When there was closure of some work sectors, restrictions on gatherings of 11-100 people, and border closures (SL = 41.67), there was an increase in COVID-19

cases in South Africa. However, when there was closure of all work sectors, restrictions on gatherings of 101-1000 people, and screening for international travelers (SL = 46.30), South Africa recorded a decrease in COVID-19 cases. Botswana is however in the second phase of the COVID-19 pandemic, and has recorded 12,873 COVID-19 cases, with 536 cases recorded per 100,000 population, and 164 deaths as of 18 December, 2020. When there was limited contact tracing, and requirement of facial coverings in all public places (SL = 52.78), Botswana recorded a rise in COVID-19 cases. However, when there was comprehensive contact tracing, and facial coverings at all times outside the home (SL = 63.89), Botswana recorded a decrease in COVID-19 cases (Table 1).

In the North African region, Morocco is in the first phase of the COVID-19 pandemic, and has recorded 409,746 cases, with 1,120 cases per 100,000 population, and 6,804 deaths as of 18 December, 2020. When there was testing of only asymptomatic persons, and recommendations on the closure of public transport (SL = 60.19), Morocco reported a rise in COVID-19 cases. On the other hand, when there was general availability of COVID-19 testing and the enforcement of closure of public transport (SL = 65.74), there was a decrease in COVID-19 cases in Morocco. Tunisia is however in the second phase of the COVID-19 pandemic, and has recorded 115,966 cases, with 983 cases per 100,000 population, and 4,032 deaths as of 18 December, 2020. When there was quarantine for international travelers, limited contact tracing, and facial coverings in all public places (SL = 23.15), there was an increase in COVID-19 cases in Tunisia. On the other hand, when there was ban on internal travel, comprehensive contact tracing, and facial coverings at all times outside the home (SL = 75.00), Tunisia recorded to a decrease in COVID-19 cases (Table 2).

In the West African region, Togo is in the first phase of the COVID-19 pandemic, and has recorded 3,330 cases as of 18 December, 2020, with 41 cases per 100,000 population, and 66 deaths. When there was recommendations of school closures, without any implementation (SL = 50.93), there was an increase in COVID-19 cases in Togo. However, when there was partial implementation of school closures (SL = 56.48), Togo recorded a decrease in COVID-19 cases. Nigeria is in the second phase of the COVID-19 pandemic, and has recorded 76,207 deaths as of 18 December, 2020, with 38 cases recorded per 100,000 population, and 1,201 deaths. When there was partial closure of school and work sectors (SL = 50.93), COVID-19 cases increased in Nigeria. On the other hand, when there was total closure of school and work sectors (SL = 65.74), there was a decrease in COVID-19 cases in Nigeria (Table 3).

In the East African region, Uganda is in the first phase of the COVID-19 pandemic, and has recorded 29,361 cases as of 18 December, 2020, with 108 cases recorded per 100,000 population, and 1,831 deaths. When there was partial closure of work sectors and limited contact tracing (SL = 45.37), there was an increase in COVID-19

cases in Ethiopia. However, when there was total closure of work sectors and comprehensive contact tracing (SL = 61.11), COVID-19 cases decreased in Ethiopia. Sudan, on the other hand, is in the second phase of the COVID-19 pandemic, and has recorded 22,265 cases, with 52 cases recorded per 100,000 population, and 1,408 deaths as of 18 December, 2020. COVID-19 cases increased when there was ban on international travel and only testing of symptomatic persons (SL = 28.70), but decreased when screening for international travelers, and testing of symptomatic and eligible persons (SL = 51.85) was done (Table 4).

In the Central African region, DR Congo is in the second phase of the COVID-19 pandemic, and has recorded 15,089 cases, with 17 cases per 100,000 population, and 366 deaths as of 18 December, 2020. When screening services for international travelers and facial coverings in all public places (SL = 22.22) were implemented, there was a rise in COVID-19 cases in DR Congo. On the other hand, when there was closure of public transport, facial coverings at all times outside the home, and quarantine for international travelers (SL = 40.74), there was a decrease in COVID-19 cases in DR Congo. Cameroon is in the third phase of the COVID-19 pandemic, and has recorded 25,472 cases, with 100 cases recorded per 100,000 population, and 445 deaths as of 18 December, 2020. When there was border closures and the lack of protection for elderly people (SL = 31.48), there was a rise in COVID-19 cases in Cameroon. However, when screening for international travellers and protection for elderly people were done, (SL = 60.19), COVID-19 cases decreased in Cameroon (Table 5).

Discussion

In countries such as South Africa and Mozambique where the COVID-19 curve was never flattened, this study found that the implementation of PHSM on a full-fledged level was advantageous. For example, complete closure of work sectors contributed to a decline in the COVID-19 cases recorded. However, it is interesting to note that partial school closures contributed to a decrease in COVID-19 cases in December in Mozambique. Results obtained in this regard therefore validate the knowledge that children of school age are at lesser risk of being infected by SARS-CoV-2 or transmitting the virus on to others [25-28]. Similarly, border closures were the international travel control implemented when increases in COVID-19 cases were recorded in South Africa where the COVID-19 curve was never flattened. A likely explanation for the observed increase during this period is the porosity of the borders in South Africa and other African countries [29,30].

In addition, anecdotal evidence presents that the international borders were not completely closed as reported on the media, and this laxity at the international borders could have contributed to the observed rise in COVID-19 cases. The implementation of screening and/or quarantine for international travelers in South Africa thereafter took into account the existing porosity

in the borders, and therefore provided an opportunity for controlled exit and entry of individuals [29,30]. This finding therefore implies that screening and/or quarantine should be adequately implemented during the COVID-19 pandemic to keep the infection rates at a minimal level. Likewise, the adoption of the COVID-19 testing policy to symptomatic persons only in Morocco could have increased the risk of onward transmission of COVID-19 by asymptomatic persons who did not meet the testing criterion. Therefore, in Morocco, missing out on these asymptomatic COVID-19 positive persons that could transmit SARS-CoV-2 to others could have contributed to a rise in the COVID-19 cases recorded. To submerge the COVID-19 pandemic, evidence-based reports present that enhanced testing freely made available to everyone, whether symptomatic or otherwise is crucial. This therefore provides valid explanation for the observed decline in cases when the COVID-19 testing policy was made generally available. Therefore, increasing national capacity for testing through increased purchase of testing kits, supplies, and skilled manpower should be given top priority in the COVID-19 outbreak response.

Findings from this study revealed that partial closures of schools and work sectors contributed to an increase in COVID-19 cases in countries that flattened the curve after cases peaked in July but are now seeing another rise in numbers (for example, Algeria, Tunisia, Niger, and Nigeria). In addition, limited contact tracing and facial coverings in all public places were also implemented in these settings. However, total school and work closures, facial coverings at all times outside the home, and comprehensive contact tracing contributed to a decline in COVID-19 cases in these countries. These arrays of evidence therefore approve of the suitability of these public health measures to keep COVID-19 cases within limits [31-32]. These findings also confirm that the recommended public health measures were pre-empted from valid scientific evidence, and not mere speculations which lacked credence [18]. In some instances, such as Liberia where restrictions on gatherings of 101-1000 people were implemented in July, a resulting increase in COVID-19 cases was recorded. However, the enforcement on restrictions on gatherings of 11-100 people in these countries in December contributed significantly to a decline in the cases recorded.

Contrary to Liberia, Seychelles and Namibia implemented restrictions on gatherings of fewer than 10 people when a rise in COVID-19 cases was recorded, but the restriction was extended to over 1000 people when a decline in COVID-19 cases was recorded. Although the decline in Seychelles and Namibia could have been wholly attributed to the stringent gathering restrictions when a rise in COVID-19 cases was observed, it could be assumed that the enforcement of other measures such as school closures at all levels contributed to the reported experience. Since large gatherings have been identified as risk factors for enhanced transmission of SARS-CoV-2 [11,12,18], the enforcement of these restrictions yielded positive results to prevent high incidence rates of

COVID-19. In lieu of this finding, restrictions of gatherings and other measures such as school closures during the COVID-19 pandemic should be accorded top priority in the COVID-19 PHSM.

Some countries such as Zambia, Malawi, and Lesotho have had a sustained decline in COVID-19 cases over time after an initial rise. In these instances, we found that facial coverings in a few public places, and the lack of policies on cancellation of public events contributed to an initial rise in COVID-19 cases. Such countries also banned international travels; however, international travel bans have been identified as a not-too effective public health safety measure amid the COVID-19 pandemic [12]. This is because total closure of the land borders seems unlikely in many African countries (e.g. Zambia, Burundi, and Chad), and thus could prevent total control of entry of foreigners into the countries [11]. Therefore, the ineffective border control measures could have contributed to an increased proportion of untested travelers crossing the borders, and ultimately a rise in the COVID-19 cases observed. Screening and/or quarantine for international travelers, generally available COVID-19 testing, and enforcement of facial coverings in all public places contributed to a decline in these countries. The sequence in these findings therefore posits that a direct relationship exists between the uptake of COVID-19 tests and screening and/or quarantine activities among travelers. In addition, a reduction in the COVID-19 infection rate was achieved by preventing intending travelers who had tested positive for COVID-19 from traveling.

Restrictions on gatherings was loosened from fewer than 10 to 11-100 people and contributed to a decline in COVID-19 cases in Gabon and Lesotho. Though restrictions on gatherings was loosened, it could be inferred that the intensified testing and the use of facial coverings in public places contributed to the reduction in COVID-19 cases. Therefore, these findings suggest that PHSM during the COVID-19 pandemic should not be implemented in isolation. Rather, coupling two or more of these measures and enforcing them would enhance the reduction of COVID-19 incidence on a nation-wide level. It should also be noted that the COVID-19 PHSM, such as the use of face masks at all times outside the home, should be enforced.

Limitations

The OxCGRT reported COVID-19 containment measures across the world in the English language. This implies that language translations must have been done by experts to capture reports from non-English-speaking countries. Some key information could have either been missed or incompletely translated. Despite this potential limitation, this study presents rich knowledge on COVID-19 trends across African countries and the implemented public health safety measures that contributed to the observed results.

Conclusion

Many countries on the African continent are in different phases of the COVID-19 pandemic and PHSM were implemented. These were however implemented at varying levels. When there were border closures, facial coverings in few public places, limited contact tracing, and closure of some work sectors, there was an increase in COVID-19 cases in many settings. On the other hand, COVID-19 cases decreased when there was generally available testing policy, screening and/or quarantine for international travelers, cancellation of public events, and comprehensive contact tracing. However, the decline in cases could not have been achieved with only one of these public health measures. The more stringent the combined COVID-19 control measures, the lower the COVID-19 cases reported in the countries. Therefore, we recommend the enforcement of the use of PHSM such as face masks in public places. COVID-19 pandemic fatigue regarding screening and quarantine should be addressed early enough by the national government. To this effect, competent public health personnel should be responsible, and adequate surveillance systems to ensure adherence to quarantine standards should be established. Furthermore, COVID-19 testing services should be continually made available through the provision of COVID-19 test kits such as the Reverse Transcriptase-Polymerase Chain Reaction by the national government. Similarly, more funds should be set apart by the policy makers in each country to enable an effective COVID-19 outbreak response. Likewise, non-governmental organizations and private individuals should support the national outbreak response by supplying more material, financial, and human resources.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 1. COVID-19 experience and public health policy implemented across countries in the South African region as of 18 December, 2020

Country	Cases	Cases/10,000	Deaths	Stringency level		Epidemic phase	Public health safety measures implemented	
				When COVID-19 cases increased	When COVID-19 cases decreased		That contributed to an increase in COVID-19 cases	That contributed to a decrease in COVID-19 cases
South Africa	892,813	1,537	24,011	41.67	46.30	1	<ul style="list-style-type: none"> • Partial closure of work sectors • Restrictions on gatherings of 11-100 people • Border closure 	<ul style="list-style-type: none"> • Complete closure of work sectors • Restrictions on gatherings of 101-1000 people • Screening for international travelers
Malawi	6,138	31	187	54.47	55.56	3	<ul style="list-style-type: none"> • Border closure • Testing of (symptomatic and eligible persons only) 	<ul style="list-style-type: none"> • Quarantine for international travelers • Testing of symptomatic persons only
Mozambique	177,256	55	145	55.09	62.04	1	<ul style="list-style-type: none"> • Complete school closure • No recommendations on closure of public transport • Border closure 	<ul style="list-style-type: none"> • Partial school closure • Closure of public transport • Quarantine for international travelers
Zambia	18,504	102	369	50.93	56.48	3	<ul style="list-style-type: none"> • Quarantine for international travelers • Testing of symptomatic and eligible persons only 	<ul style="list-style-type: none"> • Screening of international travelers • Generally available testing
Zimbabwe	11,866	69	314	67.59	71.30	2	<ul style="list-style-type: none"> • Complete school closure • Border closure 	<ul style="list-style-type: none"> • Partial school closure • Quarantine for international travelers
Eswatini	7,093	507	135	38.89	50.93	2	<ul style="list-style-type: none"> • Partial closure of work sectors • Border closure 	<ul style="list-style-type: none"> • Complete closure of work sectors • Quarantine for international travelers
Lesotho	2,365	103	46	47.22	71.30	3	<ul style="list-style-type: none"> • Restrictions on gatherings of 11-100 people • Quarantine for international travelers 	<ul style="list-style-type: none"> • Restrictions on gatherings of 101-1000 people • Screening for international travelers
Botswana	12,873	536	38	52.78	63.89	2	<ul style="list-style-type: none"> • Limited contact tracing • Facial coverings required in all public places 	<ul style="list-style-type: none"> • Comprehensive contact tracing • Facial coverings required at all times outside the home.
Namibia	17,607	677	164	37.96	61.11	2	<ul style="list-style-type: none"> • No enforcement of workplace closure (only recommendations) 	<ul style="list-style-type: none"> • Enforcement of workplace closure • Restrictions on gatherings of 101-1000 people

							<ul style="list-style-type: none"> Restrictions on gatherings of 11-100 people 	
Angola	16,484	52	382	71.30	65.74	3	<ul style="list-style-type: none"> Absence of testing policy Home stay, with exceptions No policy on the use of facial coverings 	<ul style="list-style-type: none"> Generally available testing Home stay, with no exceptions Enforcement on facial coverings in all public places

Source: <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data> [22]

*1: Those that never flattened the curve, or had low case numbers until August when they rose significantly; 2: Those that flattened the curve after cases peaked in July, but are now seeing another rise in numbers; 3: Those that have had a sustained decline in cases over time (after an initial rise)

Table 2. COVID-19 experience and public health policy implemented across countries in the North African region as of 18 December, 2020

Country	Cases	Cases/10,000	Deaths	Stringency level		Epidemic phase	Public health safety measures implemented	
				When COVID-19 cases increased	When COVID-19 cases decreased		That contributed to an increase in COVID-19 cases	That contributed to a decrease in COVID-19 cases
Morocco	409,746	1,120	6,804	60.19	65.74	1	<ul style="list-style-type: none"> • Testing of symptomatic persons only • No enforcement on closure of public transport, only recommendations 	<ul style="list-style-type: none"> • Generally available testing • Enforcement on closure of public transport
Western Sahara	30	5	3	-	-	3	<ul style="list-style-type: none"> • No data available 	<ul style="list-style-type: none"> • No data available
Algeria	93,933	220	2,640	72.22	79.63	2	<ul style="list-style-type: none"> • No testing policy • Limited contact tracing 	<ul style="list-style-type: none"> • Testing of symptomatic persons only • Comprehensive contact tracing
Tunisia	115,966	983	4,032	23.15	75.00	2	<ul style="list-style-type: none"> • Quarantine for international travelers • Limited contact tracing • Facial coverings required in all public places 	<ul style="list-style-type: none"> • Ban on international travel • Comprehensive contact tracing • Facial coverings required at all times outside the home
Libya	93,283	1,413	1,337	79.63	85.19	1	<ul style="list-style-type: none"> • Partial school closure • Contact tracing (No policy available) 	<ul style="list-style-type: none"> • Complete school closure • Limited contact tracing
Egypt	123,701	122	7,015	62.96	75.93	3	<ul style="list-style-type: none"> • No closure of work sectors • No restrictions on internal movement • Quarantine for international travelers • No closure of public event 	<ul style="list-style-type: none"> • Complete closure of work sectors • Restrictions on internal movement • Screening for international travelers • Closure of public events

Source: <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data> [22]

*; 1: Those that never flattened the curve, or had low case numbers until August when they rose significantly; 2: Those that flattened the curve after cases peaked in July, but are now seeing another rise in numbers; 3: Those that have had a sustained decline in cases over time (after an initial rise)

Table 3. COVID-19 experience and public health policy implemented across countries in the West African region as of 18 December, 2020

Country	Cases	Cases/ 100,000	Deaths	Stringency level		Epidem ic phase*	Public health policy implemented	
				When COVID-19 cases increased	When COVID-19 cases decreased		That contributed to an increase in COVID-19 cases	That contributed to an decrease in COVID-19 cases
Cabo Verde	11,502	1,917	110	67.13	71.3	3	<ul style="list-style-type: none"> Stay-at-home policy, only recommended 	<ul style="list-style-type: none"> Stay-at-home, enforced for all persons
Niger	2,506	11	84	17.59	21.30	2	<ul style="list-style-type: none"> Partial school closure No international travel controls 	<ul style="list-style-type: none"> Complete school closure Screening for international travelers
Nigeria	76,207	38	1,201	50.93	65.74	2	<ul style="list-style-type: none"> Partial closure of work sectors Partial school closure 	<ul style="list-style-type: none"> Complete closure of work sectors Complete school closure
Ghana	53,553	177	331	38.89	44.44	2	<ul style="list-style-type: none"> Border closure Partial closure of work sectors 	<ul style="list-style-type: none"> Screening for international travelers Complete closure of work sectors
Cote d'Ivoire	21,762	85	133	15.74	39.81	2	<ul style="list-style-type: none"> Partial school closure Ban on international travel 	<ul style="list-style-type: none"> Complete school closure Screening for international travelers
Senegal	17,451	104	355	37.96	40.74	3	<ul style="list-style-type: none"> No border closure No policy on the use of facial coverings 	<ul style="list-style-type: none"> Border closure Facial coverings required in all public places
Guinea	13,485	101	80	39.35	70.83	3	<ul style="list-style-type: none"> Quarantine for international travelers Restrictions on gatherings of 101-1000 people 	<ul style="list-style-type: none"> Ban on international travels Restrictions on gatherings of 11-100 people
Mali	6,049	31	211	37.96	52.78	2	<ul style="list-style-type: none"> Partial school closure Partial closure of work sectors 	<ul style="list-style-type: none"> Complete school closure Complete closure of work sectors
Burkina Faso	4,611	22	73	22.22	36.11	2	<ul style="list-style-type: none"> Border closure Testing of symptomatic and eligible persons only 	<ul style="list-style-type: none"> Screening for international travelers Generally available testing
The Gambia	3,786	172	123	35.65	75.93	3	<ul style="list-style-type: none"> Border closure Closure of public transport 	<ul style="list-style-type: none"> Screening for international travelers No closure of public transport

Guinea Bissau	2,447	122	44	-	-	3	<ul style="list-style-type: none"> Data not available 	<ul style="list-style-type: none"> Data not available
Benin	2,090	26	44	40.74	47.22	2	<ul style="list-style-type: none"> No testing policy Limited contact tracing 	<ul style="list-style-type: none"> Testing of symptomatic persons only Comprehensive contact tracing
Togo	3,330	41	66	50.93	56.48	1	<ul style="list-style-type: none"> Recommendations on school closure 	<ul style="list-style-type: none"> School closure (implemented at some levels)
Sierra Leone	2,464	31	75	32.41	40.74	3	<ul style="list-style-type: none"> Partial school closure Restrictions on gatherings of 101-1000 people 	<ul style="list-style-type: none"> Complete school closure Restrictions on gatherings of 11-100 people
Liberia	1,779	36	83	50.0	60.19	2	<ul style="list-style-type: none"> Restrictions on gatherings of fewer than 10 people Stay-at-home, required with exceptions 	<ul style="list-style-type: none"> Restrictions on gatherings of 11-100 people Stay-at-home, with no exception

Source: <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data> [22]

*, 1: Those that never flattened the curve, or had low case numbers until August when they rose significantly; 2: Those that flattened the curve after cases peaked in July, but are now seeing another rise in numbers; 3: Those that have had a sustained decline in cases over time (after an initial rise)

Table 4. COVID-19 experience and public health policy implemented across countries in the East African region as of 18 December, 2020

Country	Cases	Cases/ 100,000	Deaths	Stringency level		Epidemic phase*	Public health policy implemented	
				When COVID-19 cases increased	When COVID-19 cases decreased		That resulted in an increase in COVID-19 cases	That resulted in an increase in COVID-19 cases
Eritrea	741	14	0	75.0	86.11	3	<ul style="list-style-type: none"> Restrictions on gatherings of fewer than 10 people Testing policy, for symptomatic & eligible only No policy on the use of facial coverings in public places 	<ul style="list-style-type: none"> Restrictions on gatherings of 11-100 people Generally available testing Facial coverings required in some public places
Djibouti	5,770	577	61	43.52	50.93	3	<ul style="list-style-type: none"> Partial school closure Border closure 	<ul style="list-style-type: none"> Complete school closure Screening for international travelers
Ethiopia	118,481	108	1,831	51.85	65.74	3	<ul style="list-style-type: none"> Partial closure of work sectors Limited contact tracing 	<ul style="list-style-type: none"> Complete closure of work sectors Comprehensive contact tracing
Sudan	22,265	52	1,408	28.70	51.85	2	<ul style="list-style-type: none"> Ban on international travel Testing policy for symptomatic persons only 	<ul style="list-style-type: none"> Screening for international travelers Testing policy for symptomatic & eligible persons only
South Sudan	3,223	24	62	-	-	3	<ul style="list-style-type: none"> No data available 	<ul style="list-style-type: none"> No data available
Somalia	4,662	30	124	28.70	62.96	3	<ul style="list-style-type: none"> No measures on cancellation of public events No measures on the use of facial coverings in public places 	<ul style="list-style-type: none"> Cancellation of public events Facial coverings required in some public places

Kenya	93,405	179	1,618	64.81	68.52	3	<ul style="list-style-type: none"> • Restrictions on gatherings of fewer than 10 people • Border closure • Generally available testing • Limited contact tracing 	<ul style="list-style-type: none"> • Restrictions on gatherings of 11-100 people • Screening for international travelers • Testing for only symptomatic persons • Comprehensive contact tracing
Uganda	29,361	64	228	45.37	61.11	1	<ul style="list-style-type: none"> • Absence of school closure 	<ul style="list-style-type: none"> • Partial school closure
Seychelles	202	202	0	31.48	39.81	2	<ul style="list-style-type: none"> • Partial school closure • Restrictions on gatherings of fewer than 10 people 	<ul style="list-style-type: none"> • Complete school closure • Restrictions on gatherings of over 1000 people
Tanzania	509	1	21	12.04	17.59	3	<ul style="list-style-type: none"> • Ban on international travel • Facial coverings in some public places 	<ul style="list-style-type: none"> • Screening for international travelers • Facial coverings in all public places
Comoros	643	71	7	-	-	3	<ul style="list-style-type: none"> • Facial coverings in some public places 	<ul style="list-style-type: none"> • Facial coverings in all public places
Mauritius	524	40	10	16.67	22.22	3	<ul style="list-style-type: none"> • Border closure • Generally available testing 	<ul style="list-style-type: none"> • Quarantine for international travelers • Testing of symptomatic persons only
Madagascar	17,587	65	259	40.74	58.33	3	<ul style="list-style-type: none"> • Partial school closure • Border closure 	<ul style="list-style-type: none"> • Complete school closure • Ban on international travels
Rwanda	7,032	55	57	52.78	75.93	2	<ul style="list-style-type: none"> • Border closure 	<ul style="list-style-type: none"> • Screening for international travelers

Source: <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data> [22]

*; 1: Those that never flattened the curve, or had low case numbers until August when they rose significantly; 2: Those that flattened the curve after cases peaked in July, but are now seeing another rise in numbers; 3: Those that have had a sustained decline in cases over time (after an initial rise)

Table 5. COVID-19 experience and public health policy implemented across countries in the Central African region as of 18 December, 2020

Country	Cases	Cases/ 100,000	Deaths	Stringency level		Epidemic phase*	Public health policy implemented	
				When COVID-19 cases increased	When COVID-19 cases decreased		That resulted in an increase in COVID-19 cases	That resulted in an increase in COVID-19 cases
DR Congo	15,089	17	366	22.22	40.74	2	<ul style="list-style-type: none"> No measure on the closure of public transport Facial coverings required in all public places Screening for international travelers 	<ul style="list-style-type: none"> Closure of public transport Facial coverings required at all times outside the home Quarantine for international travelers
Burundi	751	6	1	13.89	14.81	3	<ul style="list-style-type: none"> Partial school closure 	<ul style="list-style-type: none"> Complete school closure
Central African Republic	4,936	103	63	20.37	56.48	2	<ul style="list-style-type: none"> No restriction on gatherings Limited contact tracing 	<ul style="list-style-type: none"> Restrictions on gatherings of 11-100 people Comprehensive contact tracing
Chad	1,818	12	102	64.81	70.37	3	<ul style="list-style-type: none"> Partial school closure Limited contact tracing Facial coverings required in all public places 	<ul style="list-style-type: none"> Complete school closure Comprehensive contact tracing Facial coverings required at all times outside the home
Congo	6,200	113	100	43.52	56.48	3	<ul style="list-style-type: none"> Partial school closure Border closure Facial coverings required in all public places 	<ul style="list-style-type: none"> Complete school closure Quarantine for international travelers Facial coverings required in all public places
Gabon	9,373	446	63	70.47	72.18	3	<ul style="list-style-type: none"> Partial closure of work sectors Restrictions on gatherings of fewer than 10 people 	<ul style="list-style-type: none"> Complete closure of work sectors Restrictions on gatherings of 11-100 people
Equatorial Guinea	5,214	372	85	-	-	3	No data available	No data available

Sao Tome and Principe	1,011	506	17	-	-	3	No data available	No data available
Cameroon	25,472	100	445	31.48	60.19	3	<ul style="list-style-type: none"> • Border closure • No protection for elderly people 	<ul style="list-style-type: none"> • Screening for international travelers • Protection for elderly people (implemented)

Source: <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data> [22]

*: 1: Those that never flattened the curve, or had low case numbers until August when they rose significantly; 2: Those that flattened the curve after cases peaked in July, but are now seeing another rise in numbers; 3: Those that have had a sustained decline in cases over time (after an initial rise)

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How to cite this article: Ilesanmi OS & Afolabi AA. COVID-19 waves in Africa: Effects of outbreak response and interventions. *Global Biosecurity*, 2021; 3(1).

Published: April 2021

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