The first and second waves of the COVID-19 pandemic in Africa: a cross-sectional study

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Summary

Background Although the first wave of the COVID-19 pandemic progressed more slowly in Africa than the rest of the world, by December, 2020, the second wave appeared to be much more aggressive with many more cases. To date, the pandemic situation in all 55 African Union (AU) Member States has not been comprehensively reviewed. We aimed to evaluate reported COVID-19 epidemiology data to better understand the pandemic's progression in Africa.

Methods We did a cross-sectional analysis between Feb 14 and Dec 31, 2020, using COVID-19 epidemiological, testing, and mitigation strategy data reported by AU Member States to assess trends and identify the response and mitigation efforts at the country, regional, and continent levels. We did descriptive analyses on the variables of interest including cumulative and weekly incidence rates, case fatality ratios (CFRs), tests per case ratios, growth rates, and public health and social measures in place.

Findings As of Dec 31, 2020, African countries had reported 2 763 421 COVID-19 cases and 65 602 deaths, accounting for 3·4% of the 82 312 150 cases and 3·6% of the 1 798 994 deaths reported globally. Nine of the 55 countries accounted for more than 82·6% (2 283 613) of reported cases. 18 countries reported CFRs greater than the global CFR (2·2%). 17 countries reported test per case ratios less than the recommended ten to 30 tests per case ratio range. At the peak of the first wave in Africa in July, 2020, the mean daily number of new cases was 18 273. As of Dec 31, 2020, 40 (73%) countries had experienced or were experiencing their second wave of cases with the continent reporting a mean of 23 790 daily new cases for epidemiological week 53. 48 (96%) of 50 Member States had five or more stringent public health and social measures in place by April 15, 2020, but this number had decreased to 36 (72%) as of Dec 31, 2020, despite an increase in cases in the preceding month.

Interpretation Our analysis showed that the African continent had a more severe second wave of the COVID-19 pandemic than the first, and highlights the importance of examining multiple epidemiological variables down to the regional and country levels over time. These country-specific and regional results informed the implementation of continent-wide initiatives and supported equitable distribution of supplies and technical assistance. Monitoring and analysis of these data over time are essential for continued situational awareness, especially as Member States attempt to balance controlling COVID-19 transmission with ensuring stable economies and livelihoods.

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Introduction

The first case of COVID-19 in Africa was reported in Egypt on Feb 14, 2020, just 14 days after WHO had declared the outbreak a public health emergency of international concern.[1,2] In an act of continental solidarity and leadership, the African Union (AU) Commission, through the Africa Centres for Disease Control and Prevention (Africa CDC), convened an emergency meeting of all ministers of health on Feb 22, 2020, to develop and endorse a Joint Continental Strategy for COVID-19 Outbreak.[3] Since February, 2020, Africa CDC has rolled out six additional pandemic response initiatives across the continent targeting surveillance and testing; medical supply availability; public health and social measures (PHSMs); safe travel, livelihoods, and economies; pathogen genomics; and vaccine development and supply.[4–6]

To successfully and equitably inform the implementation of the continental strategy and all of the associated initiatives across the continent, it was important to understand the regional and AU Member State-specific infection rates, mortality rates, testing capacity, ability to implement mitigation measures, and overall pandemic effect. Africa CDC has monitored the evolution of the pandemic across the globe since early January, 2020, through routine event-based surveillance. Within Africa, this information provided situational awareness and informed continental response efforts.

Despite the spread of COVID-19 to almost all countries in Africa within 3 months, country-reported case counts suggest that the pandemic has spread much slower on the continent than in the rest of the world.[7–9] To date, a comprehensive analysis of the heterogeneity of the pandemic across all five AU regions and 55 Member

Research in context

Evidence before this study

We did a general literature review to look for reports of COVID-19 surveillance and epidemiological studies in Africa. Several earlier studies sought to predict the importation and evolution of COVID-19 in Africa. These predictions overestimated the number of cases and falsely indicated that most of the initial transmission would be from travellers coming from China and not Europe. However, few analyses have reviewed the epidemiology across and within the African continent to inform these predictions. Previous studies describing the epidemiology of COVID-19 in Africa have not included data, shared only limited data, or have focused on a few specific countries or regions.

Added value of this study

Africa Centres for Disease Control and Prevention started monitoring the COVID-19 situation and aggregating event-based surveillance data reported by the African Union Member States before the first reported cases on the continent. We used these COVID-19 epidemiology, testing, and public health and social measure data to provide the first report of the epidemiological situation of the whole African continent, its five regions, and 55 countries.

Implications of all the available evidence

This comprehensive cross-sectional analysis of the COVID-19 epidemic in Africa provides a better understanding of the nature of the pandemic in Africa across and within all regions and Member States. Understanding the heterogeneity of the pandemic within the continent has further informed continental response efforts and promoted the principles of equity in resource allocation.

States has not been done.[9–16] Further, many of the initial modelling projections, response recommendations, and pandemic evolution discussions about COVID-19 in Africa have come wholly or partly from entities outside of the continent trying to fit other global experiences to Africa, not fully appreciating the diversity and differences across the continent.[17–24]

Africa is characterised by the heterogeneity in its demography, geography, economy, culture, politics, language, social equity, and disease patterns.[25] These differences are seen at the regional, country, and subnational levels and extend into areas of social services, health systems, and attainment of International Health Regulation capacity; these elements affect each country's response to the COVID-19 pandemic.[26,27] The differences across Africa show the importance of evaluations that go beyond an aggregated case number for the continent, which can misrepresent the true situation within. We aimed to analyse epidemiology, testing, and PHSM-related data reported from the five AU regions and all 55 AU Member States to further understand the COVID-19 situation across the continent.

Methods

Study design and data sources

Between Feb 14 and Dec 31, 2020, we did a cross-sectional observational analysis using Africa CDC's event-based surveillance aggregate epidemiology data and publicly available data for PHSMs in place on the continent. As part of Africa CDC's routine online event-based surveillance activities, it began monitoring reports of newly confirmed COVID-19 cases globally in January, 2020. To assess the spread of COVID-19 within Africa, a team of seven epidemiologists (including SJS and SS) screened both official (ie, national ministry of health or other government websites, dashboards, situation reports, laboratory reports, press releases, and Facebook and Twitter social media feeds) and unofficial (ie, media reports) data sources two times per day. Any unofficial data sources were verified by direct communication with Member States' focal points or other official sources before inclusion in the Africa CDC datasheet. We aggregated data for confirmed COVID-19 cases, deaths, recoveries, and tests done for all 55 AU Member States. For PHSM data, we referenced the Oxford COVID-19 Government Response Tracker dataset.[28] We grouped data by the five AU regions (Central, Eastern, Northern, Southern, and Western) to look for regional differences and more easily align these countries to regional collaborating centre-related response efforts. Not all Member States shared their case definitions with Africa CDC; thus we assumed that all 55 AU Member States used the WHO COVID-19 case definitions when reporting cases, deaths, and recoveries.[29,30] Given International Health Regulation reporting requirements for COVID-19 and the high data concordance seen when comparing Africa CDC's weekly COVID-19 outbreak briefs with WHO situation reports,[8,31] we felt comfortable in making this assumption regarding case definition. Data for testing were further verified by direct reports from Member States to Africa CDC regarding the number of molecular and antigen tests done. We reviewed the Oxford COVID-19 Government Response Tracker data for reports through the Partnership for Evidence-Based Response to COVID-19 dashboard[4] on the most stringent PHSMs (ie, affecting movement and gatherings) put in place: closure of public transportation, restrictions on internal movement between cities or subnational administrative units, restrictions on international travel for foreign travellers, workplace closures, stay at home or shelter in place requirements, closures for schools and universities, restrictions on the

size of private gatherings, and cancellations of public events. We also identified the dates when countries started, tightened, loosened, or ended PHSMs in place and did a subanalysis for the most populous country in each region (Nigeria, Ethiopia, Egypt, DR Congo, and South Africa) focusing on PHSM implementation during each country's initial wave of COVID-19 cases. PHSM data were available for all but five AU Member States (Comoros, Equatorial Guinea, Guinea-Bissau, São Tomé and Príncipe, and Sahrawi Arab Democratic Republic). For global epidemiology data comparisons, official WHO daily situation reports and the WHO COVID-19 dashboard were referenced.[8]

Statistical analysis

Descriptive analyses were done to establish cumulative cases, cumulative incidence (cases per 100 000 population), weekly incidence (new cases reported over one epidemiological week per 100 000 population), case fatality ratio (CFR; number of deaths reported per number of cases reported×100), testing ratio (number of tests per 1 million population), and tests per case. Population estimates for 2019 were taken from the UN Population Fund.[32] We used WHO's recommended range of ten to 30 tests per reported COVID-19 case as a measure for optimal testing coverage in the population.[33] Number of active COVID-19 cases was calculated by subtracting the total number of reported deaths and recoveries from the cumulative total reported. To establish COVID-19 case growth rates in relation to weekly incidence and PHSM implementation, we used the growth rate of the past 7 days compared with the previous week. This calculation was done by taking the change in new cases from the past 7 days (the current day to 6 days before) as compared with 7 days before this date (days 7–13 before current date) and divided this change by the new cases from days 7–13 before. To establish the frequency and time period associated with an initial or subsequent wave of cases that occurred in a Member State, we looked at both peak and trough weekly incidence rates, weekly growth rate change, and epidemic curves of each country across the study period. We defined an epidemic wave or phase as a rising number of COVID-19 cases with a defined peak, followed by a decline in cases or trough period, in which transmission had decreased. To establish the test per case ratio for the epidemic wave analysis, we divided the number of tests reported from the current week, as well as the previous and subsequent weeks, by the cases over the same 3-week period. We used 3 weeks of data to give a more accurate depiction of this metric, as test reporting can be batched, which at times leads to spurious results when looking at shorter time intervals. The mean number of cases per day from wave start to peak was calculated by summing the total new cases reported from the epidemiological week the wave started to the epidemiological week of the wave's peak divided by the total days over this same period. If the peak had not yet been reached by the last date of our analysis (Dec 31, 2020), we calculated this rate from the wave start to Dec 31, 2020. We defined an epidemiological week using the international standard week starting on Monday and ending on Sunday.

Role of the funding source

There was no funding source for this study.

Results

As of Dec 31, 2020, 2 763 421 cases of COVID-19 were reported from the 55 AU Member States (table 1), representing 3·4% of the 82 312 150 cases reported globally.[8] 31 (56%) of 55 countries detected their first cases between March 8–21, 2020. Sahrawi Arab Democratic Republic was the last country to report its first case on July 24, 2020 (appendix p 1). The proportion of cumulative cases and deaths varied across the five geographical AU regions: 43% of cases and 46% of deaths in the Southern region, 12% of cases and 9% of deaths in the Eastern region, 34% of cases and 37% of deaths in the Northern region, 3% of cases and 2% of deaths in the Central region, and 9% of cases and 5% of deaths in the Western region. The Southern region reported more cases than the other regions (table 1). Nine countries accounted for 2 283 613 cases, 82·6% of the COVID-19 cases reported in Africa: South Africa (38·3%), Morocco (15·9%), Tunisia (5·1%), Egypt (5·0%), Ethiopia (4·5%), Libya (3·6%), Algeria (3·6%), Kenya (3·5%), and Nigeria (3·2%). The remaining 46 countries reported between 34 and 55 000 cases each (table 1, figure 1). Cabo Verde (1973·3), South Africa (1819·6), Libya (1526·4), Morocco (1200·0), and Tunisia (1191·2) reported the highest cumulative incidence of cases per 100 000 population. By region, the Southern region had the highest incidence (640·5) per 100 000 population, primarily driven by the high incidence in South Africa (table 1).

See Online for appendix

65 602 deaths were reported from 54 (96%) AU Member States, with most (77%) coming from five countries: South Africa, Egypt, Morocco, Tunisia, and Algeria (table 1). The continent has maintained a CFR of 2·4% since Aug 25, 2020. Of 53 (96%) countries actively reporting and reporting more than 100 COVID-19 cases, 17 reported CFRs higher than the continental and global CFR of 2·2%: Sudan (6·1%), Egypt (5·5%), Chad (4·9%), Liberia (4·6%), Mali (3·8), Tunisia (3·4%), DR Congo (3·3%), The Gambia (3·3%), Niger (3·1%), Malawi (2·9%), Sierra Leone (2·9%), Algeria (2·8%), Somalia (2·8%), South Africa (2·7%), Zimbabwe (2·6%), Mauritania (2·3%), and Angola (2·3%). The Southern region reported the most deaths (30 453 [46·4%]) and both the Northern and Southern regions reported the highest regional CFRs (both 2·6%).

Regarding laboratory testing and testing ratios, as of Dec 31, 2020, more than 26 million COVID-19 tests (19 956 tests per million population) were done by the 55 AU Member States (table 1). Six countries (South Africa,

Morocco, Ethiopia, Kenya, Egypt, and Nigeria), representing four regions, accounted for more than 62% of all tests performed. By the end of March, 2020, most countries (n=49; 89%) had the ability to test for SARS-CoV-2 by PCR; expanding to all 55 AU Member States by July, 2020 (appendix p 1). Since mid-March, 2020, the continent has maintained a crude ratio of tests per case reported between nine and 18. In December, 2020, the Northern region had the highest proportion of countries (five [71%] of seven) that reported less than

	Cases	Cases per 100 000 population	Deaths	Case fatality ratio	Recoveries	Tests	Testing ratio*	Tests per case ratio
Central	75 166	49·0	1483	2·0	68 198	1 585 477	10 336	21·1
Burundi	818	7·1	2	0·2	687	76 962	6635	94·1
Cameroon	26 277	103·9	448	1·7	24 892	781 009	30 870	29·7
Central African Republic	4963	103·4	63	1·3	4873	35 303	7355	7·1
Chad	2141	13·6	104	4·9	1704	68 217	4318	31·9
DR Congo	17 998	20·8	591	3·3	14 701	95 223	1098	5·3
Equatorial Guinea	5277	376·9	86	1·6	5136	76 864	54 903	14·6
Gabon	9571	455·8	64	0·7	9388	371 281	176 800	38·8
Republic of the Congo	7107	129·2	108	1·5	5846	73 120	13 295	10·3
São Tomé and Príncipe†	1014	507·0	17	1·7	971	7498	37 490	7·4
Eastern	325 472	83·7	6082	1·9	256 380	5 175 185	13 314	15·9
Comoros†	765	85·0	9	1·2	626	6227	6919	8·1
Djibouti	5831	583·1	61	1·0	5728	100 294	100 294	17·2
Eritrea†	1252	23·6	1	0·1	676	23 693	4470	18·9
Ethiopia	124 264	112·9	1923	1·5	112 096	1 800 236	16 351	14·5
Kenya	96 458	184·8	1670	1·7	78 737	1 046 667	20 051	10·9
Madagascar	17 714	65·6	261	1·5	17 228	100 305	3715	5·7
Mauritius†	527	40·5	10	1·9	496	301 345	231 804	571·8
Rwanda	8383	65·5	92	1·1	6542	730 136	57 042	87·1
Seychelles†	256	256·0	0	0·0	212	21 504	215 040	84·0
Somalia†	4714	30·2	130	2·8	3612	26 509	1699	5·6
South Sudan	3558	26·8	63	1·8	3131	105 002	7895	29·5
Sudan†	25 730	60·5	1576	6·1	15 240	158 804	3737	6·2
Tanzania‡	509	0·8	21	4·1	178	3880	64	7·6
Uganda	35 511	77·7	265	0·7	11 878	750 583	16 424	21·1
Northern	932 564	456·7	24 323	2·6	776 895	7 002 858	34 294	7·5
Algeria†	99 610	233·3	2756	2·8	67 127	230 553	5399	2·3
Egypt†	138 062	136·4	7631	5·5	112 105	1 000 000	9881	7·2
Libya	100 744	1526·4	1478	1·5	73 252	549 138	83 203	5·5
Mauritania	14 364	305·6	337	2·3	11 380	145 381	30 932	10·1
Morocco	439 193	1200·0	7388	1·7	407 504	4 457 349	121 785	10·1
Tunisia	140 557	1191·2	4730	3·4	105 499	620 308	52 568	4·4
Sahrawi Arab Democratic Republic	34	5·7	3	8·8	28	129	215	3·8
Southern	1 185 617	640·5	30 453	2·6	971 679	8 968 128	48 450	7·6
Angola	17 553	55·2	405	2·3	11 044	305 810	9617	17·4
Botswana	14 805	616·9	42	0·3	12 136	544 167	226 736	36·8
Eswatini	9358	668·4	184	2·0	7073	92 315	65 939	9·9
Lesotho	3094	134·5	51	1·6	1480	33 109	14 395	10·7
Malawi	6471	32·8	189	2·9	5700	84 986	4314	13·1
Mozambique	18 642	59·4	166	0·9	16 663	271 947	8661	14·6
Namibia	23 941	920·8	196	0·8	20 076	209 155	80 444	8·7
South Africa	1 057 161	1819·6	28 469	2·7	867 597	6 609 208	113 756	6·3
Zambia	20 725	114·5	388	1·9	18 660	601 003	33 205	29·0
Zimbabwe	13 867	80·2	363	2·6	11 250	216 428	12 510	15·6

(Table 1 continues on next page)

	Cases	Cases per 100 000 population	Deaths	Case fatality ratio	Recoveries	Tests	Testing ratio*	Tests per case ratio
(Continued from previous page)								
Western	244 602	63·0	3261	1·3	218 915	3 601 780	9278	14·7
Benin†	3251	27·6	44	1·4	3061	379 760	32 183	116·8
Burkina Faso	6707	32·1	85	1·3	5100	96 866	4634	14·4
Cabo Verde	11 840	1973·3	113	1·0	11 559	107 817	179 695	9·1
Côte d'Ivoire	22 490	88·2	137	0·6	21 934	258 506	10 137	11·5
The Gambia	3800	172·7	124	3·3	3669	30 329	13 786	8·0
Ghana	55 168	183·3	335	0·6	53 928	672 364	22 338	12·2
Guinea	13 738	102·5	81	0·6	13 153	304 347	22 712	22·2
Guinea Bissau	2447	122·4	45	1·8	2378	36 588	18 294	15·0
Liberia†	1800	36·0	83	4·6	1406	39 870	7974	22·2
Mali	7090	36·0	269	3·8	4650	141 653	7191	20·0
Niger	3323	14·3	102	3·1	1825	62 421	2691	18·8
Nigeria	87 564	43·6	1289	1·5	73 713	948 048	4717	10·8
Senegal	19 140	114·6	410	2·1	17 254	280 040	16 769	14·6
Sierra Leone†	2611	33·1	76	2·9	1892	65 275	8263	25·0
Togo	3633	44·3	68	1·9	3393	177 896	21 695	49·0
All countries								
Total	2 763 421	209·4	65 602	2·4	2 292 067	26 333 428	19 956	9·5

*Testing ratio was the number of molecular and antigen tests per 1 million population. †Countries where complete testing data were not available. ‡Countries not reporting case or testing information for more than 2 weeks.

Table 1: **COVID-19 cases, deaths, recoveries, and tests as of Dec 31, 2020**

ten tests per case (figure 1). For the 40 countries where testing data were available at the start of their first peak, 28 (70%) had adequate testing capacity (test per case ratios >10, range 10·2–381·9). This figure decreased to 26% (14 of 53 countries) during the peak of the first wave and 36% (four of 11 countries for which data were available) during the peak of the second wave, and increased to 85% (40 of 47) during the trough periods after the first wave and 75% (three of four countries for which data were available) during the trough period after the second wave. Four (8%) of 53 countries (Algeria, Sahrawi Arab Democratic Republic, Somalia, and Sudan) reported test per case ratios less than ten and CFRs greater than 2·2 during both the first wave peak and trough (appendix p 2).

For active cases and recoveries, of the 2 763 421 reported cases as of Dec 31, 2020, 2 219 663 (80·3%) were reported as having recovered from COVID-19. Six countries (Central African Republic, Cabo Verde, Côte d'Ivoire, Djibouti, Gabon, and Ghana) were all reporting COVID-19 recovery rates equal to or greater than 98% (table 1). As of Dec 31, 2020, 478 156 people with confirmed COVID-19 were considered actively infected. Most (54·2%) of the active cases were reported from South Africa (n=161 095) and Libya (n=98 418). The highest numbers of active cases per 100 000 population were reported in Libya (n=1491), South Africa (n=277), Tunisia (n=257), Eswatini (n=150), and Namibia (n=141).

Between Feb 14 and Dec 31, 2020, PHSM reports were monitored using the Partnership for Evidence-Based Response to COVID-19 dashboard[4] and Oxford COVID-19 Government Response Tracker.[28] For the 50 Member States for which PHSM data were available, 36 (72%) reported implementing their first stringent PHSM a mean of 15 days (range 1–68) before reporting their first COVID-19 case, whereas the remaining 14 Member States reported implementing their first stringent PHSM a mean of 9 days (1–30) after their first case. By April 15, 2020, 48 (96%) Member States reported having five or more stringent PHSMs in place, with the most common being international travel controls (50 Member States [100%]), school closures (49 Member States [98%]), cancelled public events (49 Member States [98%]), and restrictions on gatherings (48 Member States [96%]). By Dec 31, 2020, the number of Member States with five or more stringent PHSMs in place had decreased to 36 (72%).

For the most populous countries in each region (DR Congo in the Central region, Ethiopia in the Eastern region, Egypt in the Northern region, South Africa in the Southern region, and Nigeria in the Western region), three had at least one or more stringent PHSMs in place between 5 days and 12 days before their first case or cases were reported. All seven stringent PHSMs were reported to be in place between March 24–30, 2020, for all five countries. The weekly growth rate for the most populous country in each region 1 day before implementing all seven stringent PHSMs was 366% (range 30 to 1000). The weekly growth rate after implementing all seven stringent PHSMs for 14 days was 17% (–17 to 78). All countries reported maintaining

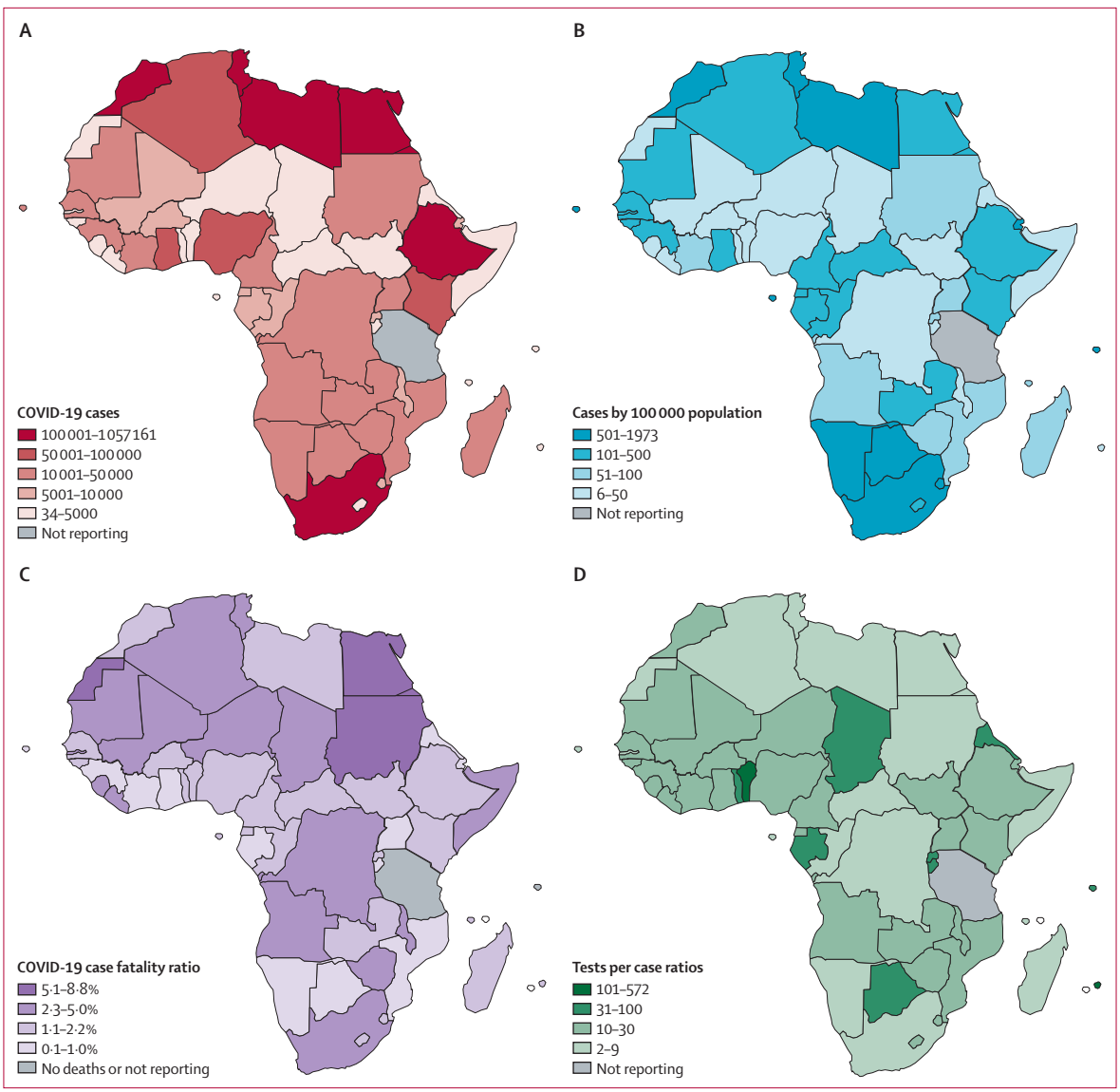

Figure 1: **COVID-19 cases in Africa**
African Union Member States reporting COVID-19 cases by cumulative cases (A), incidence (B), estimated case fatality ratio (C), and tests per case ratio reported (D), as of Dec 31, 2020.

these seven stringent PHSMs through the peak of their first wave of cases; however, three countries (Egypt, Nigeria, and South Africa) loosened two or more PHSMs before the peak of their first wave (figure 2). The first PHSMs were loosened a mean of 108 days (range 36 to 194) after they were put in place. Restrictions on public transportation were the most commonly loosened PHSMs (three [60%] of five countries; table 2). For these five countries, the weekly growth rate 14 days after easing of the first PHSM was 10% (range –17 to 57).

For wave analysis, at the continental level, the peak weekly incidence (97) of the first wave occurred in mid-July, 2020, with a mean of 18 273 new cases being reported per day for epidemiological week 29. By the end of December, 2020, the African continent had not yet declared the peak of its second wave; however, the weekly incidence reported for epidemiological week 53 was 129 and mean number of new daily cases was 23 790. As of Dec 31, 2020, 14 (25%) of 55 countries had only experienced or were still experiencing their first wave of cases, 40 (73%) had experienced or were still experiencing a second wave of cases, and four (7%) had experienced or were still experiencing their third wave of cases. No information was available to assess the pandemic progression for Tanzania. Of the 40 countries who had experienced or were starting to experience a second wave of cases, 24 (60%) reported a mean increase of 403% (range 10–4602) in the mean number of new cases per

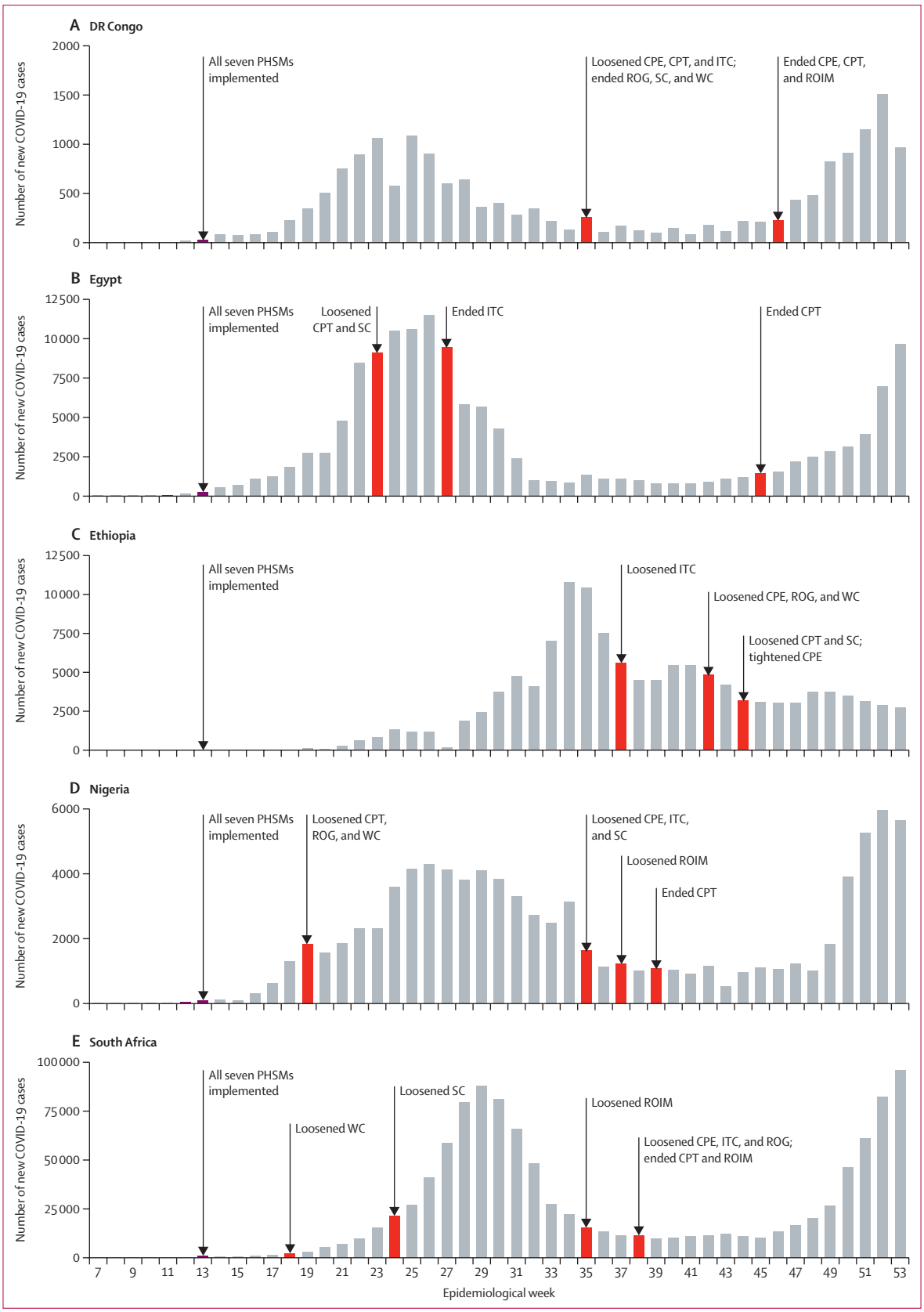

***Figure 2*: Daily COVID-19 cases and PHSMs in place**
Number of new COVID-19 cases reported daily in relation to stringent PHSMs for DR Congo (A), Egypt (B), Ethiopia (C), Nigeria (D), and South Africa (E), epidemiological weeks 7–53 (Feb 15, 2020, to Jan 3, 2021). PHSMs=public health and social measures. CPE=cancelled public events. CPT=closed public transport. ITC=international travel controls. ROG=restrictions on gatherings. ROIM=restrictions on internal movement. SC=school closures. WC=workplace closures.

	Date of first COVID-19 case	Date of first PHSM	PHSM type initiated	Date all seven PHSMs in place	Date first PHSM loosened	PHSM type loosened	Number of cases			Growth rate* (%)			
							1 day before seven PHSMs	14 days after seven PHSMs	14 days after first PHSM loosened	1 day before seven PHSMs	14 days after seven PHSMs	1 day before first PHSM loosened	14 days after first PHSM loosened
DR Congo	March 10	March 1	ITC	March 24	Aug 27	CPT, ITC, SC, WC, ROG, CPE	45	183	10 343	1000%	55%	–3%	24%
Egypt	Feb 14	March 15	SC	March 25	June 7	CPT, SC	402	1450	55 233	50%	78%	67%	1%
Ethiopia	March 13	March 1	ITC	March 30	Sept 11	ITC	21	74	71 687	30%	–8%	24%	–17%
Nigeria	March 27	March 18	WC, ROG, CPE	March 29	May 4	CPT, WC, ROG	97	323	6175	275%	–25%	99%	–17%
South Africa	March 5	March 1	ITC	March 26	May 1	WC	709	1934	13 524	476%	–17%	26%	57%
Mean	..	..	..	..	..	..	255	793	31 392	366%	17%	43%	10%

PHSM=public health and social measure. CPT=close public transport. ITC=international travel controls. SC=school closures. WC=workplace closures. ROG=restrictions on gatherings. CPE=cancelled public events. *Growth rates are calculated as the weekly growth rate from the previous week compared to the week before.

Table 2: **Cumulative COVID-19 cases and growth rates associated with the implementation of stringent PHSMs in the most populous African Union Member State of each region, 2020**

day being reported from wave start to peak when comparing the first and the second waves. Of the 38 countries that previously experienced or were experiencing a second wave and reporting on PHSM implementation, 17 (45%) had a mean of two (range 1–6) less PHSMs in place during the second wave than the first (appendix p 1).

Discussion

By the end of 2020, most of the African continent was experiencing a fast evolving second wave of the COVID-19 pandemic, reporting a 30% increase in both the weekly incidence and the mean daily new cases when comparing the peak of the first wave to epidemiological week 53. Progression, response, and effect have varied greatly among the AU regions and Member States reporting COVID-19 cases. Compared with other continents, it appears that Africa has not experienced the pandemic at the same magnitude with respect to the overall COVID-19 case and death counts.[7,34] However, when the situation is examined for a few African countries like Cabo Verde, South Africa, Libya, and Morocco, whose cumulative incidence rates have been particularly high in comparison to other African countries, we observed stark similarities to what other countries across the world are reporting.[7,8]

The late importation of cases and early implementation of PHSMs[4] compared with other continents bought time for some African countries to boost their detection and response capacity.[7] The continent went from three countries having COVID-19 diagnostic capacity at the beginning of February, 2020, to 49 countries representing all five regions by the end of March, 2020, and to all 55 AU Member States by July, 2020. Although the high availability of diagnostic testing and a continental push to increase testing volumes in June, 2020,[35] has resulted in nearly achieving the WHO recommended tests per case ratio for the continent as a whole, as of Dec 31, 2020, a third of countries (including most of the countries in the Northern region) had reported less than ten tests per reported COVID-19 case identified, suggesting a less than adequate distribution or use of tests within communities. Further, it is noted that although most countries are able to maintain adequate testing capacity beyond the peak infection, many struggle to maintain adequate testing volumes during the peak outbreak periods. This finding supports the need to continue promoting laboratory capacity building initiatives like the Partnership to Accelerate COVID-19 Testing[35] and the use of rapid antigen tests[36] in specific countries and regions, while still ensuring the continent has enough capacity in the face of the global shortage of testing reagents and extraction kits.

The initial capacity building activities by Africa CDC and other partners focused on regional training aimed at strengthening a countries' surveillance capacity to quickly detect and contain cases at points of entry and within the community.[37] The high tests per reported case ratios (>50) reported from several Member States in the Eastern (Ethiopia, Eritrea, Uganda, and Rwanda) and Southern (Angola, Lesotho, and Zimbabwe) regions at the start of their initial wave of cases could indicate a focus on points of entry surveillance as the countries were likely to be testing more people at the borders and ports before entering the country. Although it is recommended that countries transition from border screening to active case finding in the community via contact tracing or other surveillance efforts once local transmission occurs,[38] countries might be reluctant to abandon aggressive border screening efforts if they border or continue to receive travellers from countries

that either report many cases or are not transparent about reporting or tracking cases.[39–41] To address these concerns, cross-border COVID-19 management and data sharing efforts are underway for the Eastern and Southern regions.[42]

Early PHSM implementation is assumed to have slowed the pandemic in Africa; however, this analysis suggests that it is necessary to review multiple indicators down to the country level to fully understand the situation.[4,7] Despite facing a second wave of cases and new, more transmissible variants of the virus,[43,44] many countries had not implemented the same degree of PHSMs as they had early on in the pandemic. Additionally, for some countries where cases continue to increase despite maintaining most of their stringent PHSMs, other factors like changes in population behaviour are likely to be present. Increasing reports of PHSM adherence fatigue[45,46] leaves the continent's population at risk and highlights the need to reinvigorate and update existing communication strategies. These data indicate that Member States not only need to remain vigilant in collecting and analysing COVID-19 data to inform PHSM adjustments in place, but they also need to monitor PHSM adherence and ensure public health and case management capacities are sustained as cases rise.

Most of the countries reporting higher CFRs than the continental and global ratios also simultaneously reported having decreased testing capacity. This result suggests that limited surveillance and testing capacity might have played a role in the observed higher CFRs as not all cases were identified. The Northern and Southern regions reported the highest regional CFRs despite typically having better developed health systems than the rest of the continent.[47] The higher CFRs in the Northern region might also be explained by truly high CFRs due to an older population and a higher prevalence of non-communicable diseases (comorbidities), which can both contribute to poorer clinical outcomes.[47]

This study has some limitations. Although Africa CDC was able to collect basic epidemiological data from Member States, absence of case-specific information regarding age, gender, occupation (eg, health-care workers), comorbidities, and clinical outcomes for all Member States limited our ability to provide regional or Africa-wide information regarding these variables. Additionally, not all countries reported COVID-19 case and testing data daily, which might have skewed growth rate calculations, CFRs, active cases, and tests per case ratios. Further, our understanding of the dynamics for the spread of COVID-19 was limited by the different testing approaches used to diagnose COVID-19. Some countries started using rapid antigen tests on a limited basis to diagnose cases, which might have higher false negative results; and some countries included repeat tests in the numbers they reported, which could lead to elevated testing numbers and tests per case ratios. Additionally, some regional trends might have been affected by variance within the region, which might misrepresent the situation seen across that region as a whole (eg, cases, deaths, and tests in South Africa compared with other countries in the Southern region). Although the intent of this analysis was to provide a high-level understanding of the COVID-19 situation across the continent, future analyses could benefit from inclusion of additional variables that measure the effect of COVID-19 within the Member States.

Despite the limitations, these regional and country-specific analyses have helped inform the joint continental response efforts in the allocation of testing reagents and equipment, deployment of response staff, and identification of areas requiring training. For example, in countries without existing COVID-19 PCR capacity, the repurposing of existing GeneXpert platforms for COVID-19 has improved testing capacity.[48–50] In addition to supplying the SARS-CoV-2 GeneXpert cartridges to these countries, Africa CDC and WHO also provided traditional PCR equipment to address the poor capacity. As part of the Partnership to Accelerate COVID-19 Testing initiative,[35] a continental procurement platform, Africa Medical Supply Platform, has been put in place to allow Member States to collectively purchase commodities needed for their own response efforts. The recruitment and deployment of community health workers, epidemiologists, risk communicators, and laboratory staff for this initiative are being driven by the epidemic situation and capacity needs of each Member State. As surveillance and testing efforts transitioned from border-focused to communities, training opportunities and guidance materials were produced to help meet the Member State demands. Further, collaborations like the Partnership for Evidence-Based Response to COVID-19 are using these epidemiology, testing, and PHSM data along with qualitative measures such as survey data to inform Member States' response efforts and improve risk communication regarding best practices that should be put in place.[4]

In the face of a second and possibly third wave of cases, Africa CDC remains vigilant in monitoring the COVID-19 outbreak on the continent. Although rapid PHSM implementation probably contributed to the relatively low initial continental case numbers being reported, several factors are likely to have led to a larger second wave of cases. Anecdotal evidence from across the continent indicates mask wearing and physical distancing behaviours are markedly decreasing, probably from adherence fatigue and economic necessity. Additionally, new variants of concern—reported to be more transmissible,[44] more deadly,[51] and with the potential to escape existing immunity[52,53]—are circulating among Member States and likely to be changing disease dynamics.

Efforts to better understand the true burden of COVID-19 and the outcomes associated with new circulating SARS-CoV-2 variants and their effect on vaccine efficacy are needed, along with campaigns to

maintain population practices to prevent spread. Africa CDC is supporting Member States with the implementation of seroprevalence surveys, excess mortality surveillance, and genomic surveillance to better understand some of these outstanding questions. We want to highlight the need to measure the effect of COVID-19 intervention measures on other communicable diseases such as malaria and tuberculosis, which are prevalent in many countries across Africa. Having a holistic, data-driven understanding of the situation across, as well as within, the continent is imperative for preventing transmission, severe illness, and death from COVID-19; informing vaccination and other intervention strategies; and minimising the social and economic harms associated with the pandemic.[54]

Contributors

SJS and JM designed and coordinated the study. SJS, YK, and SS acquired data and did statistical analyses. SJS and JM wrote the report. All authors provided critical conceptual input, analysed and interpreted data, and critically revised the report. SJS and SS verified the data. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Declaration of interests

We declare no competing interests.

Data sharing

For **data collected by Africa CDC** see https://africacdc.org/covid-19/

All COVID-19 case, death, recovery, testing, and PHSM data collected by Africa CDC are posted daily on our website. To gain access to a complete export of our dataset, please contact AfricaCDCEBS@africa-union.org to sign a data access agreement.

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