

National estimates of critical care capacity in 54 African countries.  
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## **Abstract**

### *Background*

The coronavirus disease (COVID-19) pandemic is an emerging threat across the African continent where national critical care capacity is underdeveloped or unknown. In this paper, we compile data on critical care capacity -- including number of ICU beds, number of ventilators, and number of physician and non-physician anesthesia providers -- for 54 African countries.

### *Methods*

Data was compiled from a variety of resources including World Bank databases, local and international news media, government reports, local healthcare workers, and published scientific literature.

### *Results*

Overall, data on number of ICU beds were available for 49 (91%) countries and on number of ventilators for 46 (85%) countries, respectively. Data on physician anesthesia providers and non-physician providers was available for 47 (87%) and 37 (69%) of the 54 African countries.

### *Conclusion*

Most low and lower middle-income African countries have limited critical care capacity available to cope with potential surges in critical care demand due to COVID-19 outbreaks.

*Keywords: COVID-19, SARS-CoV-2, critical care capacity, ICU, ventilators, Africa*

## **Introduction**

On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus outbreak a pandemic. Since it first appeared in late 2019, there have been over 4 million cumulative confirmed COVID-19 cases and over 270,000 deaths reported globally. Many countries have implemented measures to reduce COVID-19 transmission and to prevent health facilities from being overwhelmed by demand for hospital care, intensive care unit (ICU) beds, and ventilator therapies needed to treat severe infections. Despite these interventions, many well-equipped countries have faced shortages in health equipment and trained personnel.

The first confirmed COVID-19 case in Africa occurred in Egypt on February 14, 2020. Thus far, African countries have reported lower disease incidence with only 46,829 confirmed COVID-19 cases and 1,449 deaths across the continent as of 12 May 2020 (WHO, 2020). Most African countries implemented airport closures, curfews, lockdowns, and other social distancing measures in March or April 2020 (WHO, 2020). However, infectious disease surveillance and reporting infrastructure remains highly underdeveloped in many African countries, and COVID-19 testing is limited given the shortage of human resources and appropriate laboratory facilities. In addition, projections of COVID-19 case burden predict that most African countries will experience an uptick in total and severe COVID-19 infections in the next one to three months (CDDEP, 2020).

Across Africa, critical care capacity is far below international norms and public health officials have suggested there is a severe lack of ICU beds and ventilators (Murthy, 2015; Dunser, 2016; Okafor, 2009). According to a COVID-19 Readiness Survey conducted by WHO in March 2020, an estimated 9 ICU beds are available per 1 million people across the continent (WHO, 2020). However, self-reported information from 34 out of the 47 WHO member countries gave a largely incomplete picture of the current situation with regards to the region's critical care capacity.

To better understand critical care capacity across the continent, we compiled data on number of ICU beds, number of ventilators, and number of physician anesthesia providers (PAP) and non-PAP, among other datapoints, for 54 African countries. This data is intended to inform and assist policy makers and public health officials at the national, regional, and international levels in equipping and preparing African countries to tackle the COVID-19 pandemic.

## **Data and Methods**

National critical care capacity datapoints relevant to COVID-19 treatment included in the database were number of ICU beds, number of ventilators, and number of PAP and non-PAP. The estimated numbers of ICU beds and ventilators were obtained from published government reports or statements, published scientific literature, reports or statements from aide and other non-governmental organizations, local and international media (in all major continental languages), and in-country informants including government or public health officials and other local researchers and healthcare workers (Appendix 1, 2). Where possible, we cross-checked ICU bed and ventilator estimates with multiple sources.

The number of PAP and non-PAP was obtained from the World Federation of Societies of Anaesthesiologists Global Anesthesia Workforce Survey (World Federation of Societies of Anaesthesiologists, 2019; Kempthorne, 2017).

National demographic and economic information for the most recent year for which data was available was obtained from a variety of sources. Gross domestic product (GDP) at purchasing power parity (PPP) per capita in current international dollar for each country was obtained from the World Bank (The World Bank International Comparison Program Database, 2020). Population data and hospital beds per 1,000 people, and physicians per 1,000 people were obtained from the World Bank's World Development Indicators database (The World Bank, 2020).

Regional sub-groupings of African countries followed those of the United Nations Statistics Division and do not represent official endorsement or geopolitical position (United Nations Population Division, 2020). Disputed and dependent territories were excluded.

For comparisons across countries and regions, we translated available count data and data reported per 1,000 people into rate data reported per 100,000 people.

## **Results**

### *Data Availability*

Data availability is summarized in Table 1, and a complete index of data availability is provided in Appendices 1 and 2. Data on GDP PPP per capita, population, hospital beds per 100,000 people, and physicians per 100,00 people were available for over 90% of the 54 African countries.

Local and international news media were the major sources for data on number of ICU beds and ventilators. Data on number of ICU beds were available for 49 (91%) countries and on number of ventilators for 46 (85%) countries. Data on physician anesthesia providers (PAP) and non-physician providers (non-PAP) was available for 47 (87%) and 37 (69%) countries, respectively.

It was not possible to discern equipment and human resources capacity at public versus private health facilities or in rural versus urban settings. In addition, we were unable to separately estimate equipment and human resources available for pediatric versus adult patient populations. Therefore, numbers presented here represent total equipment and human resources availability across country and patient segments.

Table 1. Summary of Data Availability

<b>Data Point</b>	<b>Year(s)</b>	<b>Number of Countries with Available Data, out of 54 (Percent)</b>
GDP at PPP per capita in current international dollar	2018 except for Djibouti (2011), Eritrea (2011), and South Sudan (2014)	53 (98%) Data not available for Somalia.
Income group classification	2018	54 (100%)
Population	2018 except for Eritrea (2011)	54 (100%)
Hospital beds per 100,000	2004 to 2015	52 (96%) Data not available for Eswatini, South Sudan
Physicians per 100,000	2014 to 2017 except for Eritrea (2004), Cameroon (2011), Congo (2011), Comoros (2012), and DRC (2013)	50 (93%) Data not available for Lesotho, Namibia, Sierra Leone, and South Sudan.
Number of ICU beds per 100,000	2015 to 2020	49 (91%) Data not available for Benin, Comoros, Equatorial Guinea, Madagascar, and Mozambique.
Number of ventilators per 100,000	2017 to 2020	46 (85%) Data not available for Benin, Comoros, Congo, Lesotho, Malawi, Mauritius, Seychelles, and Tanzania.
PAP per 100,000	2015 to 2016	47 (87%) Data not available for Central African Republic, Comoros, Equatorial Guinea, Eswatini, Liberia, Sao Tome and Principe, and Somalia.
Non-PAP per 100,000	2015 to 2016	37 (69%) Data not available for Cabo Verde, Central African Republic, Comoros, Congo, Djibouti, Equatorial Guinea, Eritrea, Eswatini, Gabon, Guinea-Bissau, Lesotho, Liberia, Mauritius, Sao Tome and Principe, Seychelles, Somalia, and South Africa.

### *Critical Care Capacity*

Critical care capacity data segregated by income and region is summarized in Figures 1 and 2 and Table 2, and a complete listing of data is available in Appendix 2. (Of the 54 countries included in the analysis, there was only one country, Seychelles, classified as high income. It is therefore omitted from Table 2 which reports averages across income groups.)

Across the continent, there were an average of 135.19 hospital beds and 35.36 physicians per 100,000 people ranging from 67.39 beds and 9.57 physicians per 100,000 people in low-income countries to 302.50 beds and 115.24 physicians in upper middle-income countries. The average number of hospital beds per 100,000 was highest in Southern Africa and lowest in West Africa while the average number of physicians per 100,000 was highest in North Africa and lowest in West and Middle Africa.

Across all 54 countries included in the analysis, there was an average of 3.10 ICU beds and 0.97 ventilators per 100,000 people. The average number of ICU beds per 100,000 people ranged from 0.53 in low-income countries to 8.59 in upper-middle countries and 33.07 in Seychelles, the sole high-income country included in this analysis. The average number of ventilators per 100,000 people ranged from 0.14 in low-income countries to 2.49 in upper-middle income countries. The average number of ICU beds was lowest in West Africa with only 1.10 ICU bed per 100,000 people, and the average number of ventilators was lowest in East Africa with only 0.23 ventilators per 100,000 people.

Overall, there was an average of 2.42 total (physician and non-physician) anesthesia providers per 100,000 people ranging from 1.24 and 0.66 in low-income countries and in the Middle African region, respectively, to 6.91 and 6.64 providers per 100,000 in upper middle-income countries and the North Africa region, respectively.

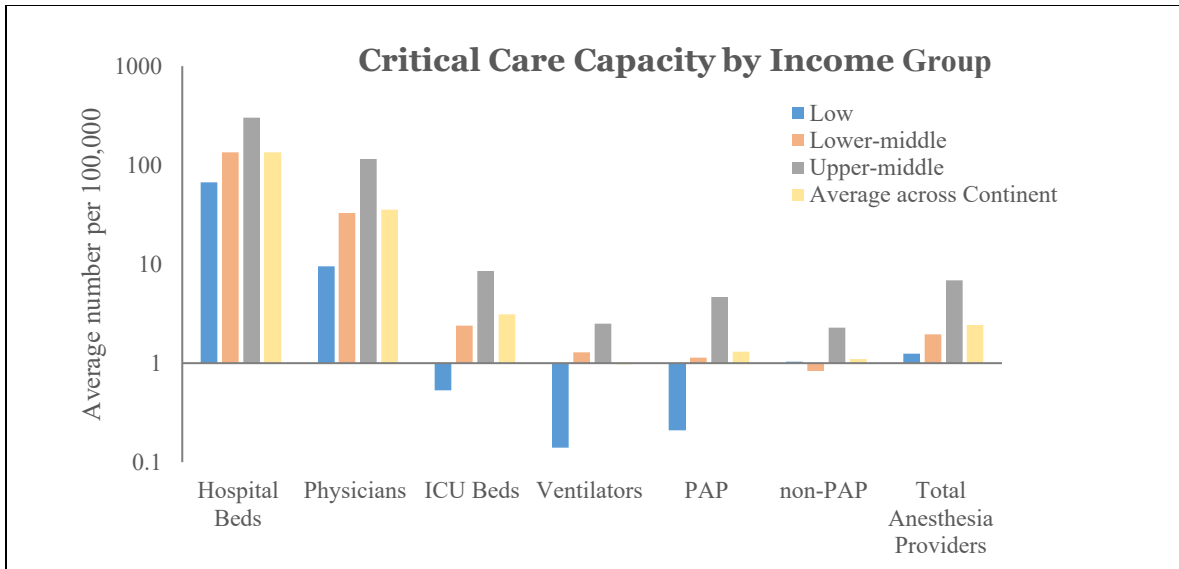


Figure 1. Summary of critical care capacity by income classification.

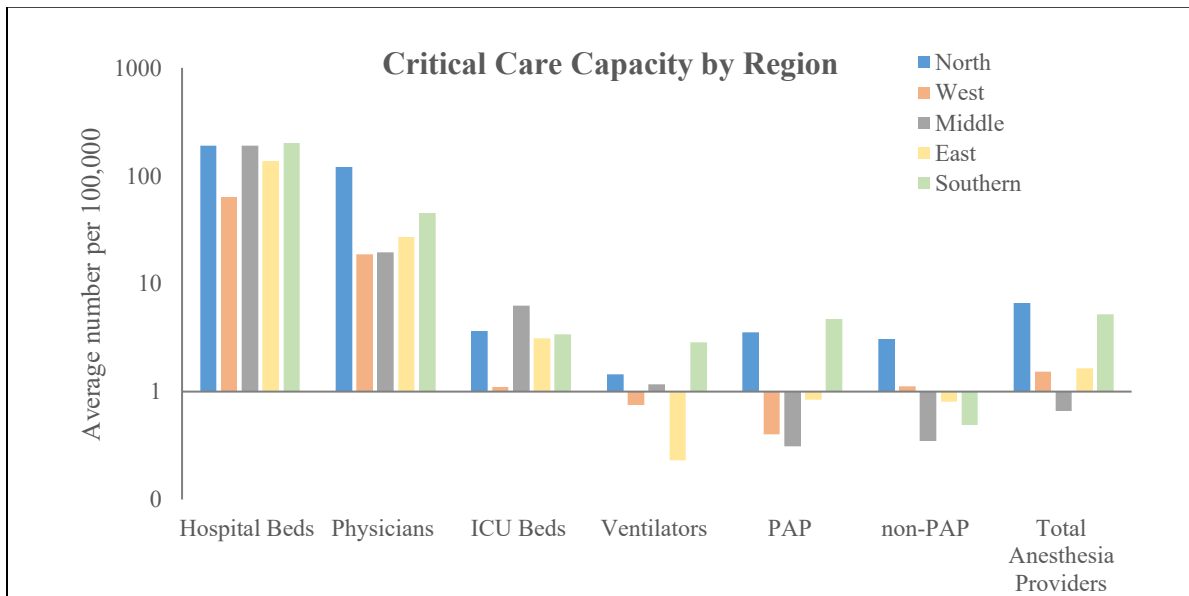


Figure 2. Summary of critical care capacity by region.

Table 2. Summary of Critical Care Capacity by Income Group and Geographic Region

Income					
Average Number (per 100,000)	Low (n=24)	Lower-middle (n=21)	Upper-middle (n=8)	Average across all 54 Countries	
Hospital Beds	67.39	135.00	302.50	135.19	
Physicians	9.57	33.05	115.24	35.36	
ICU Beds	0.53	2.38	8.59	3.10	
Ventilators	0.14	1.29	2.49	0.97	
PAP	0.21	1.13	4.64	1.31	
Non-PAP	1.03	0.83	2.27	1.11	
Total Anesthesia	1.24	1.96	6.91	2.42	
Region					
Average Number (per 100,000)	North (n=6)	West (n=16)	Middle (n=9)	East (n=18)	Southern (n=5)
Hospital Beds	190.00	63.75	191.11	137.65	202.50
Physicians	119.80	18.71	19.42	26.95	45.28
ICU Beds	3.65	1.10	6.28	3.10	3.37
Ventilators	1.45	0.75	1.17	0.23	2.85
PAP	3.56	0.40	0.31	0.84	4.69
Non-PAP	3.07	1.12	0.35	0.81	0.49
Total Anesthesia Providers	6.64	1.52	0.66	1.65	5.18

## Discussion and Limitations

Overall, the availability of hospital beds, physicians, ICU beds, ventilators, and anesthesia providers in 54 African countries is far below the capacities of other countries where the demand from COVID-19 has exceeded existing resources. As expected, there is particularly limited critical care capacity in low and lower middle-income African countries. For comparison, in the US, Italy, Germany, and China, there are between 280 and 1,200 total hospital beds and between 240 and 710 ICU beds per 100,000 people (Kamal, 2020; Wunsch, 2008)

For most countries included in this analysis, there was a lack of verified data available from published scientific papers and reports, or from government Ministries of Health, or other equivalent national agencies. Where possible, we attempted to cross-check our data with multiple sources. In addition, for several countries, we were unable to identify various data points. Despite these limitations, this database on African critical care capacity is the most comprehensive available to our knowledge, and alongside COVID-19 case burden projections, may be useful in guiding and informing national, regional, and continental outbreak preparedness and response.

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## Appendix

Appendix 1. Demographic, Economic, and Health Workforce Data by Country with Year of Data*												
Country	Region	GDP per capita, PPP (current international \$)	Year	Income Group (2018)	Population	Year	Number of Hospital Beds per 1,000	Year	Physicians per 1,000	Year	Physician anesthesia provider (2015/2016)	Non-physician anesthesia provider (2015/2016)
Algeria	North	15,481.79	2018	Upper middle	42,228,429	2018	1.9	2015	1.8	2016	1550	3500
Angola	Middle	6,452.36	2018	Lower middle	30,809,762	2018	0.8	2005	0.2	2017	60	210
Benin	West	2,424.76	2018	Low	11,485,048	2018	0.5	2010	0.2	2016	61	200
Botswana	South	18,615.79	2018	Upper middle	2,254,000	2018	1.8	2010	0.4	2016	18	0
Burkina Faso	West	1,984.88	2018	Low	19,751,535	2018	0.4	2010	0.1	2016	51	450
Burundi	East	744.18	2018	Low	11,175,378	2018	0.8	2014	0.1	2016	6	328
Cabo Verde	West	7,454.06	2018	Lower middle	543,767	2018	2.1	2010	0.8	2015	11	0
Cameroon	Middle	3,785.08	2018	Lower middle	25,216,237	2018	1.3	2010	0.1	2011	83	24
Central African Republic	Middle	859.94	2018	Low	4,666,377	2018	1	2011	0.1	2015	--	--
Chad	Middle	1,968.26	2018	Low	15,477,751	2018	0.4	2005	0.0	2016	1	22
Comoros	East	2,913.40	2018	Lower middle	832,322	2018	2.2	2010	0.2	2012	--	--
Congo	Middle	5,662.06	2018	Lower middle	5,244,363	2018	1.6	2005	0.1	2011	9	--
Côte d'Ivoire	West	4,207.09	2018	Lower middle	25,069,229	2018	0.4	2006	0.2	2014	167	304
Democratic Republic of the Congo	Middle	932.17	2018	Low	84,068,091	2018	0.8	2006	0.1	2013	98	1003
Djibouti	East	2,744.30	2011	Lower middle	958,920	2018	1.4	2014	0.2	2014	9	--
Egypt	North	12,412.31	2018	Lower middle	98,423,595	2018	1.6	2014	0.8	2017	5500	0
Equatorial Guinea	Middle	22,743.82	2018	Upper middle	1,308,974	2018	2.1	2010	0.4	2017	--	--
Eritrea	East	2,103.00	2011	Low	3,214,000	2011	0.7	2011	0.1	2004	56	--
Eswatini	South	10,637.80	2018	Lower middle	1,136,000	2018	--	--	0.1	2016	--	--
Ethiopia	East	2,022.14	2018	Low	109,224,559	2018	0.3	2015	0.1	2017	51	750
Gabon	Middle	17,875.76	2018	Upper middle	2,119,275	2018	6.3	2010	0.4	2016	22	--
Gambia	West	2,612.00	2018	Low	2,280,102	2018	1.1	2011	0.1	2015	4	35

Ghana	West	4,746.68	2018	Lower middle	29,767,108	2018	0.9	2011	0.2	2017	10	640
Guinea	West	2,504.87	2018	Low	12,414,318	2018	0.3	2011	0.1	2016	3	40
Guinea-Bissau	West	1,799.07	2018	Low	1,874,309	2018	1	2009	0.2	2015	2	--
Kenya	East	3,467.56	2018	Lower middle	51,393,010	2018	1.4	2010	0.2	2014	202	586
Lesotho	South	3,219.46	2018	Lower middle	2,108,000	2018	1.3	2006	--	--	5	--
Liberia	West	1,308.63	2018	Low	4,818,977	2018	0.8	2010	0.0	2015	--	--
Libya	North	20,764.16	2018	Upper middle	6,678,567	2018	3.7	2014	2.2	2017	330	375
Madagascar	East	1,891.32	2018	Low	26,262,370,000	2018	0.2	2010	0.2	2014	55	200
Malawi	East	1,311.00	2018	Low	18,143,310,000	2018	1.3	2011	0.0	2016	6	195
Mali	West	2,316.66	2018	Low	19,077,690	2018	0.1	2010	0.1	2016	53	85
Mauritania	West	4,150.97	2018	Lower middle	4,403,319	2018	0.4	2006	0.2	2017	21	115
Mauritius	East	23,750.99	2018	Upper middle	1,265,300	2018	3.4	2011	2.0	2015	55	--
Morocco	North	8,611.71	2018	Lower middle	36,029,138	2018	1.1	2014	0.7	2017	650	1500
Mozambique	East	1,459.70	2018	Low	29,495,962	2018	0.7	2011	0.1	2017	60	257
Namibia	South	11,101.83	2018	Upper middle	2,448,000	2018	2.7	2009	--	--	60	48
Niger	West	1,063.42	2018	Low	22,442,948	2018	0.3	2015	0.1	2014	14	118
Nigeria	West	5,990.85	2018	Lower middle	195,874,740	2018	0.5	2004	0.4	2013	1050	250
Rwanda	East	2,251.56	2018	Low	12,301,939	2018	1.6	2007	0.1	2017	31	454
Sao Tome and Principe	Middle	3,418.59	2018	Lower middle	211,028	2018	2.9	2011	0.3	2015	--	--
Senegal	West	3,782.54	2018	Lower middle	15,854,360	2018	0.3	2008	0.1	2016	94	50
Seychelles	East	30,557.08	2018	High	96,762	2018	3.6	2011	0.9	2016	4	
Sierra Leone	West	1,601.97	2018	Low	7,650,154	2018	0.4	2006	--	--	6	72
Somalia	East	--	--	Low	15,008,154	2018	0.9	2014	0.0	2014	--	--
South Africa	South	13,686.88	2018	Upper middle	57,780,000	2018	2.3	2010	0.9	2017	8814	--
South Sudan	East	1,920.60	<b>2014</b>	Low	10,975,920	2018	--	--	--	--	2	40
Sudan	North	4,767.69	2018	Lower middle	41,801,533	2018	0.8	2013	0.4	2015	190	160
Togo	West	1,773.90	2018	Low	7,889,094	2018	0.7	2011	0.0	2015	17	203
Tunisia	North	12,502.82	2018	Lower middle	11,565,204	2018	2.3	2015	1.3	2016	570	0

Uganda	East	2,038.07	2018	Low	42,723,139	2018	0.5	2010	0.1	2015	72	430
United Republic of Tanzania	East	3,240.26	2018	Low	56,318,348	2018	0.7	2010	0.0	2014	50	180
Zambia	East	4,223.91	2018	Lower middle	17,351,822	2018	2	2010	0.1	2016	79	115
Zimbabwe	East	3,029.79	2018	Lower middle	14,439,018	2018	1.7	2011	0.1	2014	87	193
*Year of data only listed in separate column where there was variation across countries. Otherwise, year of data point is listed under the column name. “—” indicates no data available.												

<b>Appendix 2. Number of ICU Beds and Ventilators, Year of Estimate and Data Source by Country</b>						
<b>Country</b>	<b>Number of ICU Beds</b>	<b>Year of Data Point/Estimate</b>	<b>Source*</b>	<b>Number Ventilators</b>	<b>Year of Data Point</b>	<b>Source*</b>
Algeria	400	2020	Local or international news	250	2020	Local or international news
Angola	110	2020	Local or international news	220	2020	Local or international news
Benin	--	--	--	--	--	--
Botswana	150	2020	Government official in public statement	70	2020	Government official
Burkina Faso	11	2020	Local or international news	11	2020	NGO
Burundi	10	--	--	5	2020	Local or international news
Cabo Verde	26	2020	Local or international news	50	2020	Local or international news
Cameroon	3500	--	--	40	2020	Local or international news
Central African Republic	12	2020	Local or international news	3	2020	Local or international news
Chad	60	2020	Local or international news	22	2020	Local or international news
Comoros	--	--	--	--	--	--

Congo	20	--	Local or international news	--	--	--
Côte d'Ivoire	150	2020	Local or international news	80	2020	Local healthcare workers
Democratic Republic of the Congo	60	2020	Local or international news	60	2020	Local or international news
Djibouti	0	2020	Local or international news	0	2020	Local or international news
Egypt	11,000	2020	Local or international news	3,000 to 6,000	2020	Local or international news
Equatorial Guinea	--	--	--	21	2020	Local or international news
Eritrea	9	--	Local or international news	0	2020	Local or international news
Eswatini	6	2015	Government report	13	2020	Local or international news
Ethiopia	570	2020	Local or international news	557	2020	Local or international news
Gabon	700	2020	Local or international news	100	2020	Local or international news
Gambia	8	2020	Local or international news	5	2020	Local or international news
Ghana	545	2020	Local or international news	200	2020	Local or international news
Guinea	40	2020	Local or international news	20	2020	Local or international news
Guinea-Bissau	50	2020	Local or international news	0	2020	Local or international news

Kenya	518	2020	Local or international news	259	2020	Local or international news
Lesotho	10	2013	NGO	--	--	--
Liberia	180	2020	World Health Organization	6	2020	NGO
Libya	48	2020	Local healthcare workers	20	2019	Local healthcare workers
Madagascar	--	--	--	34	2020	Local or international news
Malawi	25	2020	Local or international news	--	--	--
Mali	37	2020	Local or international news	3	2020	Local or international news
Mauritania	10	2020	Local or international news	1	2020	Local or international news
Mauritius	121	2020	Local or international news	--	--	--
Morocco	1640	2020	Local or international news	500	2020	Local or international news
Mozambique	--	--	--	34	2020	Local or international news
Namibia	85	2020	Local or international news	39	2020	Local or international news
Niger	64	2020	Local or international news	12	2020	Local or international news
Nigeria	350	2020	Local or international news	169	2020	NGO
Rwanda	50	2020	Local or international news	46	2020	Local or international news

Sao Tome and Principe	4	2020	Local or international news	4	2020	Local or international news
Senegal	56	2020	Local or international news	20	2020	Local or international news
Seychelles	32	2020	Local or international news	--	--	--
Sierra Leone	30	2020	World Health Organization	13	2020	NGO
Somalia	20	2020	Local or international news	19	2020	NGO
South Africa	3300	2020	Local or international news	3200	2020	Local or international news
South Sudan	24	2020	Local or international news	4	2019	NGO
Sudan	64	2017	Sulieman, H et al.	74	2017	Sulieman, H. et al.
Togo	45	2020	Local or international news	15	2020	Local or international news
Tunisia	500	2020	NGO	250	2020	Local or international news
Uganda	55	2020	Atumanya, P. et al.	100	2020	Local or international news
United Republic of Tanzania	38	2019	Mtango, S. et al.	60	2020	Local or international news
Zambia	100	2020	Local or international news	100	2020	Local or international news
Zimbabwe	61	2020	Local or international news	35	2020	Local or international news

\*In many cases, multiple sources were reviewed to verify the accuracy of the data; however only the first identified source is listed here. “—” indicates no data available.

