Quintile distribution of health resourcing in Africa

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Africa has a limited health workforce that tackles the morbidity of complex, variable and highly prevalent diseases, often with limited resourcing. This study assesses health worker resourcing in African regions and countries stratified in quintiles (Q). African countries were categorized according to five regions viz. Northern, Western, Central, Eastern and Southern Africa. Each region was assessed according to the distribution of the (medical) doctor and nurse (and midwife) density, nurse to doctor ratio, and hospital bed density, followed by ranking of the health resources and even distribution across Q i.e. Q1-5, with Q1 reflecting the best resourced, Q2-4 intermediate resourced and Q5 the most under-resourced countries in Africa. The doctor and nurse densities, nurse to doctor ratio, and hospital bed availability in Q1 African countries were all higher compared to Q2-5 African countries, reflecting better health resourcing. Both nurse densities and nurse to doctor ratios were higher in Q2 African countries relative to Q4 and Q5 African countries; with hospital bed availability in Q2 African countries higher compared to Q3-5 African countries, and in Q3 African countries compared to Q5 African countries. The best resourced African countries (Q1) were better geared to provide decent healthcare, particularly those meeting global standard thresholds, whereas the remaining countries (Q2-4), and particularly the most under-resourced (Q5) countries, lagged the best resourced African countries, and face extreme challenges in providing decent health care.

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Marlon Cerf’s global health focus is on health strategy, the socio-economic determinants of health and disease, and health worker resourcing, particularly in low- and middle-income countries. He also has a strong interest in research capacity and sustainable development. This research reports on the limited health resourcing in African regions and countries, and highlights the need for enhancing health resourcing through cohesive continental partnerships, national strategies, relevant quality training and skills programs, and task shifting and sharing, to improve health worker resourcing particularly in the poorest resourced African regions and countries.

PUBLISHER’S STATEMENT

Africa is diverse with a high disease burden and limited health resources. Most of the 53 African countries, categorized in five regions, had insufficient doctors, nurses and hospital beds. Some of the best resourced African countries barely met the global health resourcing to deliver health services, and there were intra-regional disparities. Relevant, quality health worker training and skills programs, and task shifting and sharing, can improve health service delivery to benefit patients. Increasing hospital bed capacity by transferring patients to offsite locations will enhance patients’ access to health services. Greater continental and regional healthcare coverage should be pursued and supported by nationally cohesive health systems and the sharing of limited resources to enable partnerships that address the continental challenge for better health resourcing thereby fostering development. Communities should also be empowered to contribute to healthcare. People should value and take ownership of their health and adopt preventative strategies by living healthier.
healthcare. Health resourcing across Africa requires urgent strengthening to enable better healthcare delivery.

**Subjects:** Health & Society; Nursing; Public Health Policy and Practice

**Keywords:** doctor density; global health; hospital bed availability; human resources for health; nurse density; nurse to doctor ratio

1. Introduction

There are 55 African countries across five regions: Northern (7 countries), Western (15 countries), Central (9 countries), Eastern (14 countries) and Southern (10 countries) Africa (African Union, 2019), with most countries located in sub-Saharan Africa (SSA; four of the five regions, with the exclusion of Northern Africa). The 46 countries in SSA are in one of the poorest regions in the world with amongst the most limited health resourcing. In SSA, >50% of the world’s population live in extreme poverty (Zheng et al., 2019). Fortunately, some countries such as Tanzania, Chad and the Republic of Congo are reducing extreme poverty (Zheng et al., 2019). However, infrastructural and economic lags prevail that constrain the delivery of healthcare (Cerf, 2019).

The health workforce includes doctors (medical doctors, physicians or clinicians); nurses (and midwives); pharmacists; hospital managers and administrators; hospital and medical data analysts, officers and administrators; and community health workers (Bhatnagar et al., 2018), and include all employees in the health sector. These health workers provide and deliver health services to citizens. Healthier citizens are more productive and contribute to greater economic activity. The global health worker and skills shortage, between and within countries, presents a major global health challenge as the scarcity of skilled labor constrains job creation in the health sector (Mugo et al., 2018; World Health Organization, 2016b). Further, Africa has a high disease burden with multi-morbidities and polypharmacy, limited medical supplies, and health worker shortages exacerbated by high migration and attrition due to employment in non-health sectors, and health services also have to cover a large geographical range to serve rural communities (Cerf, 2021a). These factors intensify the health worker shortage and constrain health service delivery. In addition, health workers are at risk of exposure to infectious diseases such as high human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis (TB) and hepatitis (McDiarmid, 2019) including outbreaks such as SARS, Ebola and Covid-19. The HIV/AIDS burden, the increasing prevalence of non-communicable diseases (NCDs), and health worker shortages constrain health systems and therefore negatively impact service delivery (Gouda et al., 2019; Kurth et al., 2016), further exacerbated by the Covid-19 pandemic. In Africa, the health worker shortage is exacerbated, and compounded with limited infrastructure, underfinancing of health, and a high burden of disease, which constrains the delivery of quality, affordable and equitable healthcare (Cerf, 2021a). The dynamic African health landscape and scarcity of health worker resources therefore present barriers to healthcare (Cerf, 2018).

A country’s health needs are (i) defined as the number of health workers required to attain the health system’s objectives and (ii) estimated based on a threshold of minimum availability of health workers to address priority population health issues (Scheffler et al., 2018). The WHO benchmark of 4.45 doctors and nurses per 1000 population seems unattainable for some low- and middle-income countries (LMICs), particularly with a marked needs-based shortage in low-income countries (Liu et al., 2017; World Health Organization, 2016a). In 2013, the largest needs-based estimate for health workers was 17.6 million in LMICs which is projected to increase to ~22 million by 2030 (Scheffler et al., 2018). The largest projected increase in need for health workers is 45% in low-income countries (Scheffler et al., 2018). Further, Africa has the largest projected increase of need for health workers at 51% (Scheffler et al., 2018). The needs-based shortage in low-income countries or the African region of over 4 million health workers is projected to increase to 6 million by 2030 (Scheffler et al., 2018).
In the present study, doctor and nurse densities (as the main providers of healthcare), nurse to doctor ratios, and hospital bed availability, were assessed to gauge health resourcing across Africa. Given the great inter and intra-regional variation in health resourcing in Africa, the countries were evenly distributed in quintiles to assess health resourcing. The objectives were (i) to determine the Q1-Q5 African countries, and to compare Q1-5 African countries' health resourcing to (ii) global targets and (iii) across quintiles.

2. Materials and methods
Fifty three African countries were analyzed with data of (medical) doctors, nurses (and midwives) and hospital beds retrieved from the WHO Global Health Observatory data repository (World Health Organization, 2018). The nurse to doctor ratio, per 10,000 population, was calculated for each country as number of nurses per 10,000 population divided by the number of doctors per 10,000 population. Adjustments were made to determine the doctor and nurse densities per 1000 population. Two African countries viz. South Sudan and Sahrawi Republic were excluded as there were no data available. All countries were ranked 1 to 53 for doctor density (Table S1), nurse density (Table S2), nurse to doctor ratio (Table S3), and hospital bed availability (Table S4). After ranking, countries were assigned to quintiles.

2.1. Quintile distribution
The 53 countries were ranked and categorized in quintiles for relative even distribution of the countries per quintile (Tables S1-4). The African regions were also listed viz. Northern, Western, Central, Eastern and Southern Africa (Tables S1-4). Data were then arranged in quintiles (Q) with n = 10 for Q1 and Q5; and n = 11 for Q2, Q3 and Q4. However, for the hospital bed availability per 10,000 population, the numbers per quintile were adjusted as some countries had the same bed numbers that straddled quintiles. Therefore, the number of beds per quintile was n = 11 for Q1, Q3 and Q5; n = 13 for Q2; and n = 7 for Q4. Most African countries lagged global health resourcing levels; and the health resourcing was compared across all quintiles. Q1 represented the best resourced, and Q5 represented the most under-resourced, whereas Q2-4 represented the intermediate resourced African countries for densities of doctors, nurses and hospital beds per 10,000 population, and nurse to doctor ratios.

2.2. Statistical analysis
Quintile statistical analysis was by one-way Anova followed by Tukey's multiple comparisons using GraphPad Prism version 8.0 for Windows (GraphPad Software, San Diego, California USA, www.graphpad.com). Data are presented as box and violin plots reflecting the minimum and maximum values. Significance was established at 0.05 with p < 0.0001 denoted by ****; p < 0.001 denoted by ***; p < 0.01 denoted by **; and p < 0.05 was denoted by *.

3. Results

3.1. Q1-5 African countries and global standards
The Q1 African countries had a doctor density of 11.84 (Table S1a) and nurse density of 32.68 (Table S2a) per 10,000 population, which at 44.52 met the minimum global threshold of 44.5 (Figure S1) (World Health Organization, 2016a). When adjusted per 1000 population, this was 1.18 doctors and 3.27 nurses totalling 4.45 doctors and nurses. The under-resourced Q5 African countries had a doctor density of 0.39 (Table S1a) and nurse density of 2.39 (Table S2a) per 10,000 population, which at 2.78 was only 6% of the global threshold (World Health Organization, 2016a). When adjusted per 1000 population, this was 0.04 doctors and 0.24 nurses totalling 0.28 doctors and nurses.

The Q2 countries had a doctor density 2.01 (Table S1a) and nurse density of 14.60 (Table S2a) per 10,000 population, which at 16.61 met 37% of the minimum global threshold (Figure S1) (World Health Organization, 2016a). When adjusted per 1000 population, this was 0.20 doctors and 1.46 nurses totalling 1.66 doctors and nurses. The Q3 countries had a doctor density 0.90 (Table S1a) and nurse density of 9.01 (Table S2a) per 10,000 population, which at 9.91 met 22% of
the minimum global threshold (Figure S1) (World Health Organization, 2016a). When adjusted per 1000 population, this was 0.09 doctors and 0.90 nurses totalling 0.99 doctors and nurses. The Q4 countries had a doctor density 0.31 (Table S1a) and nurse density of 5.33 (Table S2a) per 10,000 population, which at 5.64 met 13% of the minimum global threshold (Figure S1) (World Health Organization, 2016a). When adjusted per 1000 population, this was 0.03 doctors and 0.53 nurses totalling 0.56 doctors and nurses.

3.2. Q1–5 African countries and global standards

Upon analyzing the doctor density in African countries according to quintiles, Q1 doctor densities were higher compared to Q2-5 (Figure 1). Doctor density per quintile (mean ± SD) was 11.84 ± 6.10 in Q1, 2.97 ± 0.83 in Q2, 1.42 ± 0.34 in Q3, 0.76 ± 0.11 in Q4, and 0.39 ± 0.14 in Q5 (Table S1a).

3.3. Best resourced (Q1)

Half (50%; 5/10) of Q1 doctor density was populated with five of the six Northern African countries (Table 1) (representing 83% of the Northern African countries, Mauritania excluded (Table S1b)) reflecting how well Northern Africa was resourced for doctors relative to other African regions. Eastern Africa (three countries) was the next best resourced region for doctors, followed by Western and Southern (one country each) Africa with no representation from Central Africa in Q1 doctor density (Table 1).

The highest doctor densities were in Libya (21.581), Mauritius (20.246), Algeria (18.3) and Tunisia (12.722; Table S1b), all with >10 doctors per 10,000 population as per the global standard. Within Q1, the doctor density had a wide range from 4.1 in Sudan to 21.58 in Libya reflecting the variable doctor density across countries (Table S1b).

3.4. Most under-resourced (Q5)

Western (four countries) and Eastern (three countries) Africa had the lowest doctor densities, followed by Central (two countries) and Southern (one country) Africa (Table 1). There were no
Table 1. Quintile distribution for doctor density: countries per region

| Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 | n  |
|------------|------------|------------|------------|------------|----|
| Northern   | 5 (50%; 83%)| 0 (0%; 0%) | 1 (9%; 17%)| 0 (0%; 0%) | 0 (0%; 0%)| 6  |
| Western    | 1 (10%; 7%) | 3 (27%; 20%)| 4 (36%; 27%)| 3 (27%; 20%)| 4 (40%; 27%)| 15 |
| Central    | 0 (0%; 0%) | 3 (27%; 33%)| 1 (9%; 11%) | 3 (27%; 33%)| 2 (20%; 22%)| 9  |
| Eastern    | 3 (30%; 23%)| 2 (18%; 15%)| 4 (36%; 31%)| 1 (9%; 8%) | 3 (30%; 23%)| 13 |
| Southern   | 1 (10%; 10%)| 3 (27%; 30%)| 1 (9%; 10%) | 4 (36%; 40%)| 1 (10%; 10%)| 10 |

For each quintile (column), the number of countries per region are presented followed by the percentage of countries for that region in that quintile relative to the total number of countries in that quintile; then percentage of countries in that region compared to the total countries of that region.

Northern African countries in Q5 doctor density (Table 1). Malawi (0.157), Somalia (0.229) and Sierra Leone (0.25) had the fewest doctors (Table S1b).

3.5. Intermediate resourced (Q2-4)

Q2 doctor density was evenly distributed across Western, Central, Eastern and Southern Africa (three countries per region, each accounting for ~a quarter of Q2) with no representation from Northern Africa (Table 1). Q3 doctor density was mostly represented by Western and Eastern Africa (each region accounting for ~a third of Q3), with single country representation from Northern, Central and Southern Africa (Table 1). For Q4, there was even distribution of doctor density for Western, Central and Southern Africa (3–4 countries each), followed by Eastern Africa (one country) and no representation from Northern Africa (Table 1).

3.6. Nurse density

The nurse densities in African countries in Q1 were higher than in Q2–5, and in Q2 compared to Q4 and Q5 (Figure 2). Thus, Q1 countries were well resourced for nurses relative to all the other countries in Q2–5, with Q4 and Q5 countries greatly lagging both Q1 and Q2. Nurse density per quintile (mean ± SD) was 32.68 ± 13.06 in Q1, 14.60 ± 2.55 in Q2, 9.01 ± 1.15 in Q3, 5.33 ± 0.97 in Q4, and 2.39 ± 1.16 in Q5 (Table S2a).

3.6.1. Best resourced (Q1)

Whereas Northern Africa dominated the continent for Q1 doctor density (Table 1), Q1 nurse density was more evenly distributed across Northern, Southern, Central and Eastern Africa, with no representation from Western Africa (Table 2). Northern and Southern Africa were best represented for nurse densities (three countries each), followed by Central and Eastern Africa (two countries each), with no representation from Western Africa in Q1 (Table 2).

The highest nurse densities were in Libya (67.416), South Africa, Mauritius, Botswana and Seychelles (in descending order; all with nurse densities of 30 < 40; Table S2b), with only Libya meeting the >40 nurses per 10,000 population as per the global standard.

3.6.2. Most under-resourced (Q5)

Western Africa accounted for half of the Q5 nurse density, followed by Central and Eastern (two countries each) and Southern (one country) Africa with no representation from Northern Africa (Table 2). Madagascar (1.059), Liberia (1.007) and Somalia (0.611) had the fewest nurses (Table S2b).

3.6.3. Intermediate resourced (Q2-4)

Western Africa also accounted for half of the Q2 nurse density, followed by Southern Africa (three countries) and single representation from Northern, Central and Eastern Africa (Table 2). For Q3
nurse density, Eastern Africa dominated (accounting for ~a third of Q3 nurse density), with even distribution across Northern, Western and Central Africa (two countries each), and single representation from Southern Africa (Table 2). Q4 nurse density was again dominated by Eastern Africa (accounting for ~a third of Q4 nurse density), followed by Western, Central and Southern Africa (2–3 countries each) with no representation from Northern Africa (Table 2).

3.7. Nurse to doctor ratio
The nurse to doctor ratio in African countries in Q1 were higher than in Q2-5; and in Q2 compared to Q4 and Q5 (Figure 3). Therefore, Q1 countries were far better resourced relative to Q2-5 countries, and Q4-5 countries also lagged Q2 countries in nurse to doctor ratio. Nurse to doctor ratio per quintile (mean ± SD) was 17.24 ± 8.99 in Q1, 8.21 ± 1.08 in Q2, 5.96 ± 0.61 in Q3, 3.43 ± 0.59 in Q4, and 1.61 ± 0.52 in Q5 (Table S3).

3.7.1. Best resourced (Q1)
Central and Southern Africa (three countries each) had the highest nurse to doctor ratios, followed by Eastern and Western Africa (two countries each) with no representation from Northern Africa (Table 3).
The highest nurse to doctor ratios were in Sierra Leone (39.85), Eswatini (25.13) and Malawi (16.10) with Zimbabwe, Gambia and Congo all with nurse to doctor ratios of 15 < 16 (in descending order, Table S3b).

3.7.2. Most under-resourced (Q5)
Northern and Eastern (four countries each) Africa had the lowest nurse to doctor ratios, followed by Western and Central (one country each) Africa, and no countries from Southern Africa (Table 3). Madagascar (0.58), Algeria (1.22) and Equatorial Guinea (1.25) had the lowest nurse to doctor ratios (Table S3b).

3.7.3. Intermediate resourced (Q2-4)
Q2 nurse to doctor ratio had the most representation from Southern Africa (four countries), closely followed by Central Africa (three countries), then Western and Eastern (two countries) Africa with no representation from Northern Africa (Table 3). For Q3 nurse to doctor ratio, Western Africa was best represented (four countries), closely followed by Eastern Africa (three countries), Southern Africa (two countries), then Northern and Central (one country each) Africa (Table 3). For Q4 nurse to doctor ratio, Western Africa dominated (six countries), followed by a lagging Eastern Africa (two countries), and single representation each from Northern, Central and Southern Africa (Table 3).

3.8. Hospital bed availability
Hospital beds are a proxy for available healthcare, which is dependent on health worker resourcing to deliver health services. The number of hospital beds reflect the availability of in-patient services, and serve as an estimate for the level of health service delivery; however, there is no global standard of the density of hospital beds per 10,000 population (World Health Organization, 2019).

The hospital bed density in African countries in Q1 were higher than in Q2-5, higher in Q2 compared to Q3-5, and higher in Q3 compared to Q5 (Figure 4). Therefore countries in Q1 were
markedly better resourced for hospital beds, countries in Q1 and Q2 were better resourced than Q3-5, and countries in Q5 lagged countries in Q1-3 for hospital bed availability. Hospital bed availability per quintile (mean ± SD) was 27.18 ± 6.19 in Q1, 15.54 ± 2.44 in Q2, 9.09 ± 1.22 in Q3, 6.14 ± 1.07 in Q4, and 3.18 ± 0.98 in Q5 (Table S4).

3.8.1. Best resourced (Q1)
Eastern and Southern Africa (three countries each) had the most hospital beds followed by Central and Northern Africa (two countries each) and Western Africa (one country) (Table 4). Libya (37), Seycelles (36) and Mauritius (34) had the most hospital beds. Sao Tome and Principe, South Africa, Namibia, Tunisia, Comoros, Cabo Verde, Equatorial Guinea and Eswatini all had 20 < 30 hospital beds (in descending order; Table S4b).

Figure 4. Hospital beds (per 10,000 population) in African countries per quintile.
Table 4. Quintile distribution for hospital bed density: countries per region

| Region   | Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 | n  |
|----------|------------|------------|------------|------------|------------|----|
| Northern | 2 (18%; 33%) | 2 (15%; 33%) | 1 (9%; 17%) | 0 (0%; 0%) | 1 (9%; 17%) | 6  |
| Western  | 1 (9%; 7%)  | 0 (0%; 0%)  | 4 (36%; 27%) | 3 (43%; 20%) | 7 (64%; 47%) | 15 |
| Central  | 2 (18%; 22%) | 3 (23%; 33%) | 3 (27%; 33%) | 0 (0%; 0%) | 1 (9%; 11%) | 9  |
| Eastern  | 3 (27%; 23%) | 3 (23%; 23%) | 2 (18%; 15%) | 3 (43%; 23%) | 2 (18%; 15%) | 13 |
| Southern | 3 (27%; 30%) | 5 (38%; 50%) | 1 (9%; 10%) | 1 (14%; 10%) | 0 (0%; 0%) | 10 |
| n        | 11         | 13         | 11         | 7          | 11         | Total = 53 |

For each quintile (column), the number of countries per region are presented followed by the percentage of countries for that region in that quintile relative to the total number of counties in that quintile; then percentage of countries in that region compared to the total countries of that region.

3.8.2. Most under-resourced (Q5)
The overwhelming majority of Western Africa (8 of the 11 countries in Q5) had the least hospital beds (Table 4). Eastern (two countries), Central and Northern (one country each) Africa also had amongst the fewest hospital beds with no representation from Southern Africa for Q5 hospital beds (Table 4). Mali (1) and Madagascar (2) had the least hospital beds, followed by Ethiopia, Guinea, Niger and Senegal (all with 3 hospital beds; Table S4b).

3.8.3. Intermediate resourced (Q2-4)
For Q2 hospital bed availability, Southern Africa (five countries) dominated, followed by Central and Eastern Africa (three countries each), Northern Africa (two countries), and no representation from Western Africa (Table 4). For Q3 hospital bed availability, Western Africa dominated (four countries), followed by Central (three countries) and Eastern (two countries) Africa, and Northern and Southern Africa (one country each; Table 4). For Q4 hospital bed availability, Western and Eastern Africa (three countries each) were best represented, followed by Southern African (one country) with no representation from Northern Africa (Table 4).

4. Discussion
This article focuses on the distribution of health workers in Africa. Each of the 53 countries across the five African regions were categorized according to quintiles. Quintile distribution of the African countries allowed countries from all regions to be assessed. This helped to determine the levels health resourcing in Africa.

Africa has >22% of the global disease burden, access to ∼3% of health workers and <1% of global financial resources (World Health Organization, 2020). The regional disparities in health worker (i.e. doctors and nurses) and hospital bed resourcing (with doctor, nurse and hospital bed densities reflecting health resourcing) in Africa are evident. Northern Africa was the best resourced region for doctors, nurses and hospital beds, with Libya, in particular faring well with the highest density of doctors (Table S1b), nurses (Table S2b) and hospital beds (Table S4b). The rest of the African regions, viz. Western, Central, Eastern and Southern Africa, which represent SSA, lagged in health resourcing. However within a region, e.g., Southern Africa, there is decent health resourcing e.g., in South Africa and poor health resourcing e.g., in Malawi (relative to other African countries), that reflected intra-regional disparities.

4.1. Comparing African health resourcing to global standards
The global threshold of 23 doctors and nurses (or midwives) per 10,000 population (World Health Organization, 2006) was the minimum health workers required for providing healthcare, with a revised global minimum threshold of 44.5 health professionals per 10,000 population (World Health Organization, 2016a). Even the revised global minimum threshold for health workers may be inadequate given the variable health worker quantities, composition and quality of training required to offer broader and effective health services as countries strive to achieve Sustainable Developmental Goal 3, good health for all (GBD 2017 SDG Collaborators, 2018).
Further, health worker density and resourcing reflect the quantity of available healthcare and not the quality of healthcare (GBD 2017 SDG Collaborators, 2018). The best resourced African countries (Q1) were just about adequately resourced for doctors and nurses (on the threshold of 4.45); however, the quality of care may also vary, potentially limiting health service effectiveness and efficiencies. Therefore, despite meeting the global minimum threshold for health workers, the best resourced African countries are modestly equipped to deliver healthcare, and that level of care is still dependent on the quality of care offered. Even the next best resourced African countries (Q2) did not meet global health worker thresholds, revealing the massive divide in health worker resourcing in most of Africa (Q2-Q5), the dire situation, and the continental challenge for better resourcing for doctors and nurses. Resourcing levels for other healthcare workers should also be assessed in Africa. The number of health workers (quantity) is important to meet health demands, but even with a sufficient number of health workers, quality and effective health service delivery may not be realized. Thus it is critical to gear towards sufficient health worker resourcing while simultaneously ensuring that personnel are well trained with relevant skills for quality service delivery.

4.2. Comparing African health resourcing across quintiles

African countries in the first quintile (Q1) were well resourced compared to intermediate resourced (Q2-4) and under-resourced (Q5) African countries evident by the higher doctor and nurse densities, the nurse to doctor ratios, and hospital beds. Most of the Q1 countries were from Northern Africa revealing a departure from the lower levels of health resourcing in SSA. Some regional integration and planning for better health resourcing is necessary in Africa.

The nurse to doctor ratio reveals how many nurses are available per doctor. A high ratio reflects more nurses available for task shifting and sharing to help reduce the clinical load, particularly during high demand. However, there are some limitations. The nurse to doctor ratio can be skewed by over- and under-resourcing of nurses or doctors. Further, a high nurse to doctor ratio may reflect more nurse focused training, and conversely a low nurse to doctor ratio may reflect more doctor focused training. The highest nurse to doctor ratios were in Central and Southern African countries, which renders these countries suitable for some task shifting and sharing to nurses and midwives. Nurse-monitored antiretroviral therapy (ART) was found to be non-inferior to doctor-monitored therapy rendering task shifting and sharing appropriate (Sanne et al., 2010). Interestingly, Northern African countries populated Q5 for nurse to doctor ratio that may reflect a higher priority of doctor training relative to nurse training. This could be investigated at a country level. The number of nurses per 1000 doctors for a typical country is highest in Africa, partly because of the very low number of doctors per 1000 population in that region (World Health Organization, 2006). However, globally and in Africa, there is also heterogeneity among countries within regions.

4.3. Addressing the African health resourcing challenge

The shortage of doctors in Africa, especially in rural areas, has prompted task shifting towards nurses (and midwives) (Terry et al., 2012). Urgent immediate intervention is required to increase doctor resourcing in most African countries. Even relatively well resourced countries and regions in Africa (i.e. most Northern African countries) will benefit from more health resources and relevant quality training. Frequent training and relevant skills are critical for health workers in Africa, given their scarcity and the high levels of under-resourcing. A doctor training and skills program could be implemented at a continental level to increase the number of doctors particularly in the poorest resourced African countries (those in Q5). This should be complemented by nursing and other health worker training and skills programs to augment healthcare in Africa, to enable and scale up task shifting and sharing. Nurses (and midwives) represent the majority of the health workforce and are integral to health service delivery including disease prevention, detection and treatment (Baltzell et al., 2017; Cunningham et al., 2017) and should be supported by allied health workers to improve quality of care, despite pervasive under-resourcing. Communities should also be empowered to contribute to better health access and services for their benefit.
Investments in health worker education could be supported by funding posts in the health sector (Sheffler et al., 2018). Further, more health workers need to be trained in Africa; thus the existing health workforce should be deployed more effectively, by improving distribution and productivity, and prioritizing productivity efficiencies (Willcox et al., 2015). Health systems reinforcement should also include the training of non-professional (un- and semi-skilled) support and community health workers (Willcox et al., 2015). Given funding constraints in some African countries, cost-effective deployment of health workers is necessary (Willcox et al., 2015). For example, in Q5 and the lowest income African countries (e.g., in half of the Western African countries that populated Q5 for nurse density), nursing assistants could help with most health service deliveries for the poorest people and should therefore be trained and upskilled to improve the quality of essential services and primary healthcare (Willcox et al., 2015). In Africa, achieving an optimal health worker resourcing mix remains a barrier to health service delivery. Further, the health worker distribution, i.e. in urban and rural areas, and quality, i.e. level of training and experience (George et al., 2018) determine the quality and coverage of healthcare.

Hospital bed shortages have come to the fore during the Covid-19 pandemic. Many African countries have few hospital beds and are heavily under-resourced. In Western Africa (8 of the 11 countries were in Q5 with the least hospital beds), the hospital bed shortages need to be urgently addressed. Hospital bed density is an indicator for evaluating the level of health service (Zhou et al., 2020). Inadequate hospital resourcing limits the healthcare provision to patients (Sen-Crowe et al., 2021). Health workers and governments therefore need to cooperate and implement interventions for hospital bed expansion and provide critical resources, particularly due to surging and resurging Covid-19 (Sen-Crowe et al., 2021). The expansion of hospital bed capacity by transferring patients to offsite locations (e.g., university residences, hotels and underutilized commercial spaces) will enhance capacity and extend capacity to more patients (Barrett et al., 2020). These are some strategies for ensuring better patient services and outcomes, particularly during outbreaks when limited resources are under even greater strain. Given the pervasive under-resourcing of healthcare in Africa, people should value their health as an asset, take ownership of their health, and adopt preventative strategies as treatment may not be easily accessed and care may not be readily available. Coordinated programs for disease prevention will contribute to improving the quality of life for patients and help to relieve health systems (Cerf, 2021b), particularly in health under-resourced countries.

Although African countries and regions with the poorest health resourcing (Q5) should be prioritized for addressing their shortages, most of the African countries in Q2-4 were also under-resourced and need health resourcing reinforcement, when compared to global standards. In Africa, health under-resourcing thus presents a challenge at continental, regional and national levels. Therefore, intergovernmental initiatives to provide greater continental and regional healthcare coverage should be adopted and implemented for better health outcomes for Africans. This should be reinforced by national cohesion in health service delivery. The sharing of limited health resources will be challenging but presents an opportunity for greater continental partnership and cohesion that will foster development.

4.4. Implications for practice
The study identified lags in doctor, nurse and hospital bed availability and provide several insights for practice. There is an urgent need for (i) increasing the numbers (health worker quantity) and improving training and upskilling of doctors, nurses and allied health workers (health worker quality); and (ii) increasing the numbers and availability of hospital beds for better health resourcing in Africa. There was a paucity of doctors and nurses in many countries. Each country should therefore interrogate and strengthen their national, provincial (state) and district data to work towards increasing doctor, nurse and allied and community health worker training programs and clinical services to reach populations, as far as resources allow, while simultaneously improving the relevance and quality of training and skills of their health workforce. This will augment the health workforce thereby contributing to better health service delivery.
Concisely, health worker numbers need to be augmented, and simultaneously reinforced with relevant quality training and upskilling to improve health service delivery. This requires targeted interventions for implementation. Doctors should be adequately equipped with skills, infrastructure and medical supplies to provide decent healthcare. Nurses represent the majority of the health workforce, are integral to health service delivery, and should be utilized for task shifting and sharing with support from allied health workers and communities to improve quality of care; this can be better leveraged in countries with high nurse densities and nurse to doctor ratios. Allied and community health workers should also be incentivized to contribute to healthcare—this presents an opportunity to increase the health workforce and to develop skills to enhance critical mass is health. Quantitative and qualitative enhancement of health workers will ultimately improve health service delivery. Hospital bed availability was also low in most African countries; therefore strategies should aim to increase hospital beds in health facilities, utilize beds in non-hospital facilities when necessary (e.g., commercial properties) and reduce patients’ time in hospital beds; these initiatives will improve health access.

Optimal use of health resources can help to reduce morbidity and mortality. Each country has its own health resourcing challenges and disease burdens. Governments have a key role in enhancing health resourcing. The health resourcing data per country and region can inform governments. Governments can therefore support and integrate health planning, information, monitoring and reporting. Each country can develop health information dashboards to track disease patterns and respond by allocating their available health workers (i.e. those on shift or on call) to deliver adequate and decent healthcare. Knowledge should be shared across provinces, from district levels, and feed into national health information systems. At a facility level, patients’ data should be verified and tracked to ensure that the best possible health services (i.e. package of care) can be delivered, given the resources. Further, this can be developed and later feed into regional and even continental health databases and dashboards to ultimately enable a mobilized health workforce. A standardized African health workforce registry with a minimum dataset of indicators should be adopted by each country, shared per region and feed into a continental registry. These governmental initiatives can help to focus limited resources to improve health service delivery. Further assessments at national levels can help to improve practice by optimally allocating and utilizing health resources.

4.5. Conclusions

Most African countries are under-resourced and lag global standards for health resourcing. Africa has the potential to advance the health of its citizens through optimal, effective and efficient use of its limited health resources. Given the pervasive under-resourcing of health workers, focused efforts are required on relevant quality training, upskilling, and retaining doctors and nurses, improving their working conditions, and implementing task shifting and sharing (Cerf, 2018, 2021a) to semi and unskilled health workers, and hospital bed capacity needs to increase for better access, to ensure that decent health services are delivered.

Funding
The author(s) reported there is no funding associated with the work featured in this article.

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Disclosure statement
No potential conflict of interest was reported by the author(s).

Supplementary material
Supplemental data for this article can be accessed here.

Citation information
Cite this article as: Quintile distribution of health resourcing in Africa, Marlon E. Cerf, Cogent Medicine (2021), 8: 1997161.

References
African Union. (2019). African Union: Member states. Retrieved from September 2, 2019. https://au.int/en/member_states/countryprofiles
Boltz, K., McLemore, M., Shottell, M., & Rankin, S. (2017). Impacts on global health from nursing research. Am J Trap Med, 96(4), 765–766. https://doi.org/10.4269/ajtmh.16-0918
Barrett, K., Khan, Y. A., Mac, M. S., Ximenes, R., Naimark, D. M. J., & Sander, B. (2020). Estimation of covid-19-induced depletion of hospital resources in...
Ontario, Canada. CMAJ, 192(24), E640–E646. https://doi.org/10.1503/cmaj.200715

Bhatnagar, A., Scott, K., Govender, V., & George, A. (2018). Pushing the boundaries of research on human resources for health: Fresh approaches to understanding health worker motivation. WHO South-East Asia J Public Health, 7(1), 13–17. https://doi.org/10.4103/2224-3151.228422

Cerf, M. E. (2018). The sustainable development goals: Contextualizing Africa’s economic and health landscape. Glob Chall, 2(8), 1800014. https://doi.org/10.1002/gch2.201800014

Cerf, M. E. (2019). Sustainable development goal integration, interdependence, and implementation: The environment–economics–health nexus and universal health coverage. Glob Chall, 3(9), 1900021. https://doi.org/10.1002/gch2.201900021

Cerf, M. E. (2021a). Health worker resourcing to meet universal health coverage in Africa. International Journal of Healthcare Management, 14(3), 789–796. https://doi.org/10.1080/20479700.2019.1693711

Cerf, M. E. (2021b). Healthy lifestyles and noncommunicable diseases: Nutrition, the life-course, and health promotion. Lifestyle Med, 2(2), e31. https://doi.org/10.1002/lim2.31

Cunningham, C., Bysiewicz, P., Sepeku, A., White, L., Murray, B., Lobue, N., & Sawe, H. (2017). Developing an emergency nursing short course in Tanzania. Afr J Emerg Med, 7(4), 147–150. https://doi.org/10.1016/j.ajem.2017.08.002

GBD 2017 SDG Collaborators. (2018). Measuring progress from 1990 to 2017 and projecting attainment to 2030 of the health-related sustainable development goals for 195 countries and territories: A systematic analysis for the global burden of disease study. Lancet, 392(10159), 2091–2138. https://doi.org/10.1016/S0140-6736(18)32281-5

George, A. S., Campbell, J., Ghaffar, A., Abimbola, S., Abularub, R., Bhatnagar, A., & Witter, S. (2018). Advancing the science behind human resources for health. Human Resources for Health, 16(1), 35. https://doi.org/10.1186/s12960-018-0302-z

Gouda, H. N., Charlson, F., Sorsdahl, K., Ahmadzada, S., Ferrari, A. J., Erskine, H., & Whiteford, H. (2019). Burden of non-communicable diseases in sub-Saharan Africa, 1990–2017: Results from the global burden of disease study 2017. Lancet Glob Health, 7(10), e1375–e1387. https://doi.org/10.1016/S2214-109X(19)30374-2

Kurth, A. E., Jacob, S., Squires, A. P., Sloney, A., Davis, S., Stalls, S., & Portillo, C. J. (2018). Investing in nurses is a prerequisite for ensuring universal health coverage. The Journal of the Association of Nurses in AIDS Care: JNAC, 27(3), 344–354. https://doi.org/10.1016/j.jnac.2016.02.016

Liu, J. X., Goryakin, Y., Moeda, A., Bruckner, T., & Scheffler, R. (2017). Global health workforce labor market projections for 2030. Human Resources for Health, 15(1), 11.doi: https://doi.org/10.1186/s12960-017-0187-2

McDermid, M. (2019). Advocating for the health worker. Ann Glob Health, 85(1), 16. https://doi.org/10.5334/aogh.2461

Mugo, N. S., Dibley, M. J., Damundu, E. Y., & Alam, A. (2018). The system here isn’t on patients’ side—perspectives of women and men on the barriers to accessing and utilizing maternal healthcare services in South Sudan. BMC Health Services Research, 18(1), 10. https://doi.org/10.1186/s12913-017-2788-9

Sanne, J., Orrell, C., Fox, M. P., Connadie, F., Ives, P., Zeinacker, J., & Wood, R. (2018). Nurse versus doctor management of HIV-infected patients receiving antiretroviral therapy (CIPRA-SA): A randomised non-inferiority trial. Lancet, 376(9734), 33–40. https://doi.org/10.1016/S0140-6736(16)30894-X

Scheffler, R. M., Campbell, J., Cockett, G., Moeda, A., Liu, J., Bruckner, T. A., & Evans, T. (2019). Forecasting imbalances in the global health labor market and devising policy responses. Human Resources for Health, 16(1), S. https://doi.org/10.1186/s12960-017-0264-6

Sen-Crowe, B., Sutherland, M., McKenney, M., & Elkbuli, A. (2021). A closer look into global hospital beds capacity and resource shortages during the covid-19 pandemic. The Journal of Surgical Research, 260, 56–63. https://doi.org/10.1016/j.jss.2020.11.062

Terry, B., Bisanzo, M., McNamara, M., Dreifuss, B., Chamberlain, S., Nelson, S. W., & Hammerstedt, H. (2012). Task shifting: Meeting the human resources needs for acute and emergency care in Africa. Afr J Emerg Med, 2 (4), 182–187. https://doi.org/10.1016/j.ajem.2012.06.005

Willcox, M. L., Peersman, W., Daou, P., Diakité, C., Bojuniwe, F., Mubangizi, V., & Mant, D. (2015). Human resources for primary health care in sub-Saharan Africa: progress or stagnation? Human Resources for Health, 13, 76. https://doi.org/10.1186/s12960-015-0073-8

World Health Organization. (2006). The World Health Report 2006: working together for health. https://www.who.int/whr/2006/whr06_en.pdf?ua=1

World Health Organization. (2016). Working for health and growth: investing in the health workforce. Report of the High-level Commission on Health Employment and Economic Growth. http://apps.who.int/iris/bitstream/10665/250047/1/9789241511308-eng.pdf?ua=1

World Health Organization. (2018). The 2018 update, global health workforce statistics. Retrieved from https://apps.who.int/gho/data/node.main.HWFGDRP?lang=en

World Health Organization. (2019). Global health observatory visualizations. Indicator metadata registry. hospital beds (per 10 000 population). Retrieved from http://apps.who.int/gho/data/node.wrapper?mr?i=119

World Health Organization. (2020). World health data platform. Retrieved from https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GH0/medical-doctors

World Health Organization. (2016a). Global strategy on human resources for health: Workforce 2030. Retrieved from http://www.who.int/hiv/resources/global_strategy_workforce2030_14_print.pdf?ua=1

Zheng, S., Silwal, A., & Newhouse, D. (2019). Here are the top 10 Sub-Saharan African countries that have reduced poverty the most. World Bank. Retrieved from December 23, 2020. https://blogs.worldbank.org/opensdata/here-are-top-10-sub-saharan-african-countries-have-reduced-poverty-most

Zhou, W., Wang, A., Wang, X., Cheke, R. A., Xiao, Y., & Tang, S. (2020). Impact of hospital bed shortages on the containment of Covid-19 in Wuhan. International Journal of Environmental Research and Public Health, 17(22), 8560. http://doi.org/10.3390/ijerph17228560
