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## The Impact of COVID-19 on Neurosurgical Services in Africa

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■ **INTRODUCTION:** COVID-19 has affected the global provision of neurosurgical services. We sought to review the impact of COVID-19 on the neurosurgical services in Africa.

■ **METHODS:** A cross-sectional survey was distributed to African neurosurgeons seeking to review demographics, national and neurosurgical preparedness, and change in clinical services in April 2020.

■ **RESULTS:** A total of 316 responses from 42 countries were received. Of these, 81.6% of respondents were male and 79.11% were under the age of 45 years. In our sample, 123 (38.92%) respondents were in training. Most (94.3%) respondents stated they had COVID-19 cases reported in their country as of April 2020. Only 31 (41.50%) had received training on managing COVID-19. A total of 173 (54.70%) respondents were not performing elective surgery. There was a deficit in the provision of personal protective equipment (PPE): surgical masks (90.80%), gloves (84.80%), N95 masks (50.80%), and shoe covers (49.10%). Health ministry (80.40%), World Health Organization (74.50%), and journal papers (41.40%) were the most common sources of information on COVID-19. A total of 43.60% had a neurosurgeon in the COVID-19 preparedness team; 59.8% were concerned they may contract COVID-19 at work with a further 25.90% worried they may infect their family. Mental stress as a result of COVID-19 was reported by 14.20% of respondents. As of April 2020, 73.40% had no change in their income.

■ **CONCLUSIONS:** Most African countries have a national COVID-19 policy response plan that is not always fully suited to the local neurosurgery services. There is an ongoing need for PPE and training for COVID-19 preparedness. There has been a reduction in clinical activities both in clinic and surgeries undertaken.

### INTRODUCTION

On December 31, 2019, China reported a cluster of cases of pneumonia in Wuhan.<sup>1</sup> This was subsequently named coronavirus disease 2019 (COVID-19) and declared a global pandemic by the World Health Organization (WHO) on March 11, 2020.<sup>2</sup> The first case of COVID-19 in Africa was declared on February 14, 2020, in Egypt and, thereafter, South Africa has reported the highest number of cases at the time of preparing this paper.<sup>3</sup> Since then all African countries have reported COVID-19 cases.<sup>4</sup> The continent has had its fair share of infectious diseases outbreaks. This includes Ebola, Marburg virus, human immunodeficiency virus, and malaria. Lessons learned from these outbreaks have informed the African Centre for Disease Control (CDC)<sup>5</sup> and the national COVID response policy planning committee.

There is a growing recognition that there is an unmet global burden for surgical services.<sup>6</sup> The response to COVID-19 has been a time of reflection on what effects this would have in the short and long term in the ability to provide an expedient neurosurgical service in African countries (especially those in the sub-Saharan

#### Key words

- African neurosurgery
- Clinical practice
- COVID-19
- Demography
- Education
- Training

#### Abbreviations and Acronyms

**CAANS:** Continental Association of African Neurosurgical Societies  
**CDC:** African Centre for Disease Control  
**HCW:** Health care workers  
**PPE:** Personal protective equipment  
**WHO:** World Health Organization

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region) as the region has a low ratio of neurosurgeons per million of the population.<sup>7</sup> Many neurosurgical centers have been in practice less than 10 years and yet serve large patient populations spread over wide geographical areas.<sup>7</sup> There is a risk that overwhelmed health care systems would result in an erosion in efforts to improve provision of essential neurosurgical services.<sup>8</sup>

We sought to survey how Africa's neurosurgical community has been affected by COVID-19 in terms of working conditions and COVID-19 policy preparedness.

## METHODS

A 52-question cross-sectional survey was developed covering demographics, the local neurosurgical preparation, effects on training, and provision of personal protective equipment (PPE). It also covered changes in clinical practice and the economics as well as psychosocial effects on the individual surgeons. To standardize responses, we focused on effects during April 2020. Responses were anonymized. The survey was discussed by the Continental Association of African Neurosurgical Societies (CAANS) Administrative Council.

The CAANS COVID-19 survey was undertaken between April 16 and May 21, 2020. The survey was disseminated through the CAANS Secretariat, e-mails to African surgeons, and through social media (Twitter, WhatsApp, and Telegram). Every attempt was made to ensure at least 1 response was received from each African country thought to have a practicing neurosurgeon. The data was analyzed with simple descriptive statistics.

## RESULTS

### Demographics

A total of 316 responses were received, representing 42 out of 54 (77.78%) African countries (Table 1, Figure 1). No responses were received from 12 of these countries, although 11 out of these are believed not to have a neurosurgery service. These 12 countries have a combined population of 33.56 million (2.76%) relative to Africa's population of 1.216 billion. Of the respondents, 258 (81.60%) were male, 250 (79.11%) were younger than 45 years, with 123 (38.92%) currently undertaking training (Figure 2). Most of the respondents worked in a public institution (276; 87.30%) and most were located in an urban setting (293; 92.70%). In line with the relative young ages of the respondents, 78.20% had less than 10 years of neurosurgical practice. A total of 193 (62.02%) were qualified neurosurgeons, 35 (11.08%) were heads of department, 1 divisional head, 5 in private practice, 1 in medico-legal work, and 1 was retired. The other 145 held substantive consultant appointments inclusive of university appointments as Associate Professors (3). Nine of 35 (25.7%) heads of department were less than 40 years old.

A total of 269 (85.10%) of respondents stated they had a national neurosurgical society and 38 (12.00%) stated they had none.

### COVID-19 Effects as of April 2020

As at the time of the survey 298 (94.30%) of respondents were from 42 countries that had declared COVID-19 cases. Only 46 (14.60%) stated there were confirmed cases of COVID-19 within

**Table 1. Demographics Table**

Characteristic	All	Qualified Neurosurgeons	Trainees
Number of respondents	316	191 (60.44)	123 (38.9)
African Countries represented	42/54 (77.78)	41	23
Sex			
Male	258 (81.6)	161 (85.6)	95 (77.24)
Female	58 (18.4)	26 (13.8)	28 (22.76)
Age (years)			
<30	21 (6.6)	1 (0.52)	17 (13.82)
31–35	92 (29.1)	25 (13.09)	65 (52.85)
36–40	93 (29.4)	60 (31.41)	31 (25.2)
41–45	44 (13.9)	36 (39.56)	7 (5.69)
46–50	26 (8.2)	24 (12.57)	1 (0.81)
51–55	20 (6.3)	19 (9.95)	1 (0.81)
56–60	9 (2.8)	8 (4.19)	0
61–65	3 (0.9)	2 (1.05)	0
>65	8 (2.5)	5 (2.62)	
Region of practice			
Urban	293 (92.7)	178 (93.19)	103 (83.73)
Rural	23 (7.3)	13 (6.81)	10 (8.21)
Area of main practice			
Public	276 (87.3)	151 (79.06)	119 (96.74)
Private	40 (12.7)	36 (18.85)	4 (3.25)
Years of practice			
<5	175 (55.4)	67 (35)	104 (84.55)
5–10	72 (22.8)	55 (28.8)	17
10–15	28 (8.9)	27 (14.14)	1
15–20	16 (5.1)	16 (8.38)	0
>15	22 (7)	22 (11.52)	0
Retired	3 (0.9)	2 (1.05)	1
National Society			
Yes	269 (85.13)	161 (84.29)	105 (89.1)
No	38 (12.02)	26 (28.57)	11 (9)

Values are presented as n (%) or n/N.

their country's neurosurgical community, with 3 cases being the highest cases reported. Twelve (3.80%) of respondents representing 10 African countries stated there was a COVID-19 related death in their neurosurgical community (within their departments but not necessarily surgeons) compared with 260 (82.50%) who

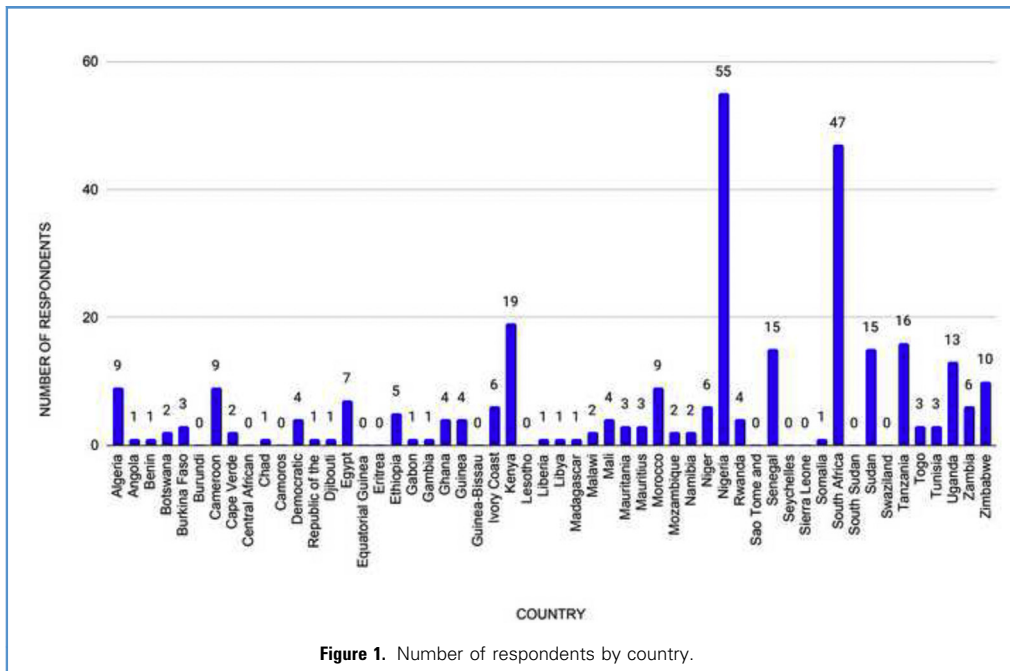


Figure 1. Number of respondents by country.

stated that at the time of the survey there were reported COVID-19 cases in the country as a whole.

As COVID-19 spread across the globe, many countries instituted national response plans, as corroborated by 296 (93.70%) of our respondents. However, only 52 (16.5%) of our respondents stated they had a specific COVID-19 neurosurgery

policy. Only 127 (40.20%) felt that the national COVID policy was suitable to their practice and a further 29.70% stating it was partially suitable (Figure 3). This is not surprising, as 33.50% of respondents representing 25 (43.60%) African countries stated there was a neurosurgeon in the COVID-19 preparedness team.

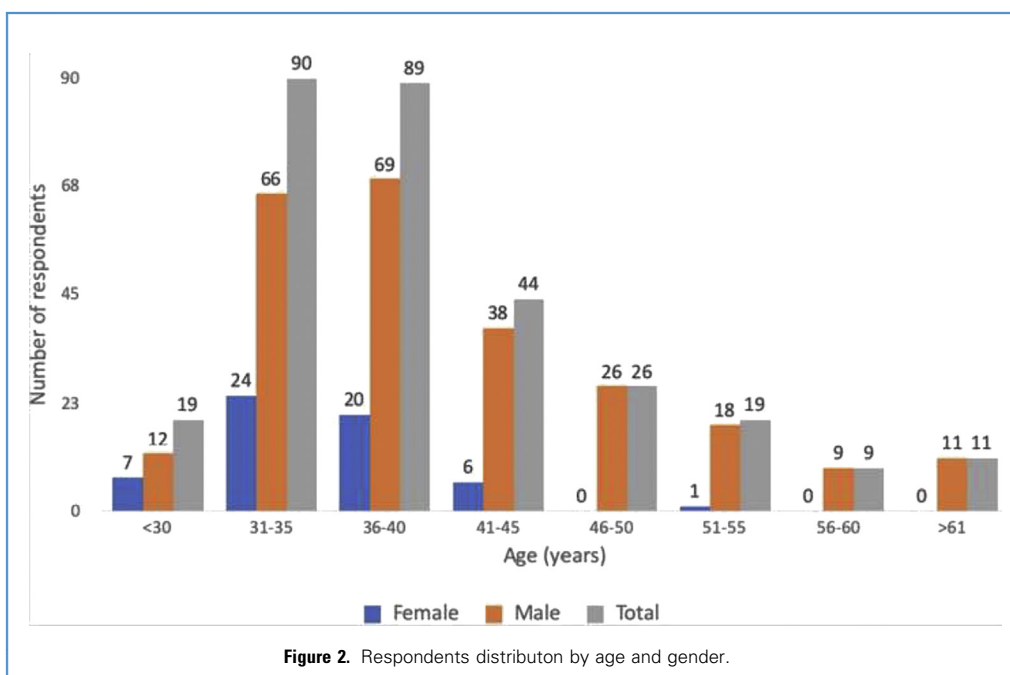
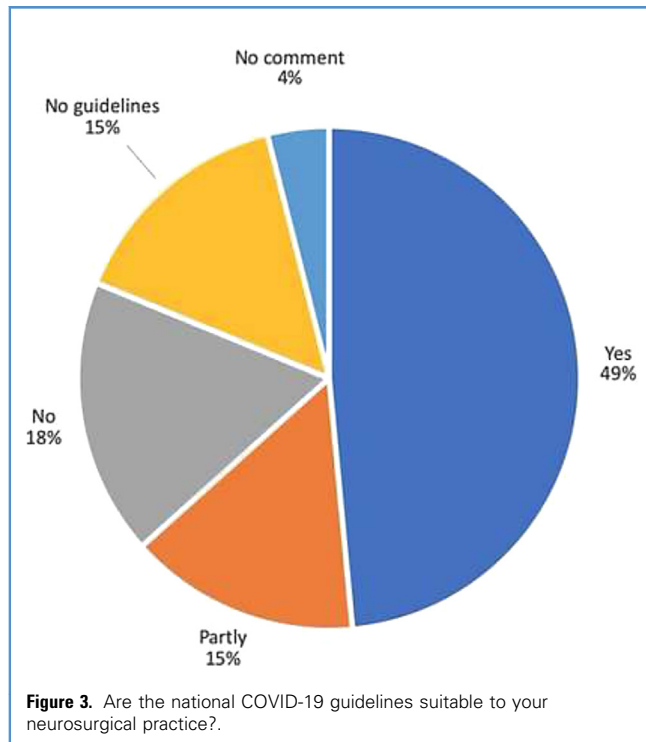


Figure 2. Respondents distribution by age and gender.



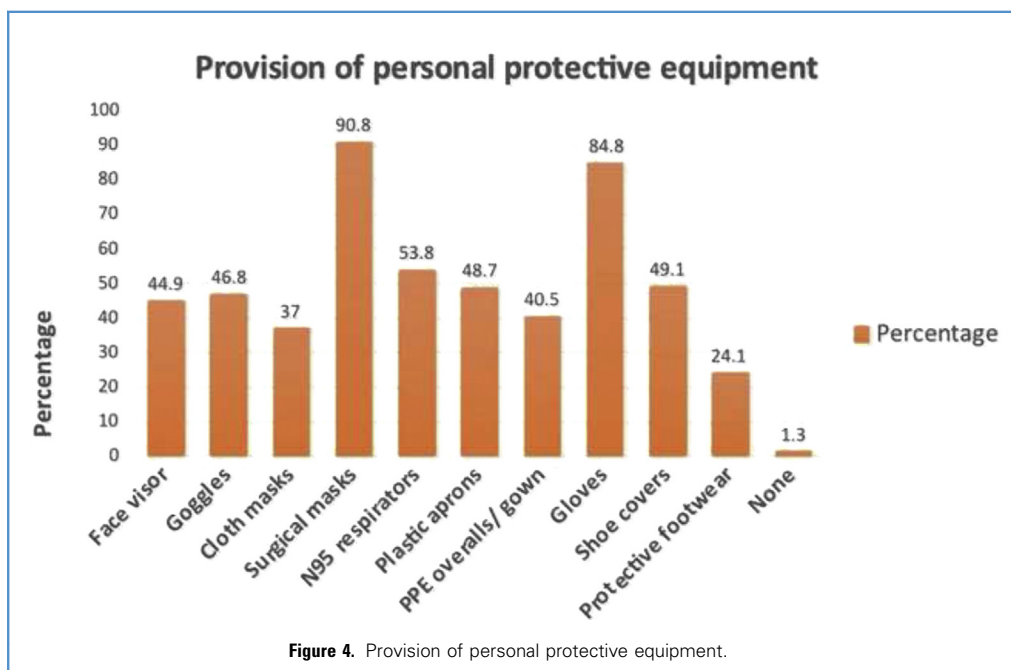
With regard to PPE, surgical masks were the most available to the respondents (287; 90.80%); followed by gloves (84.80%), N95 respirators (53.80%), plastic aprons (48.70%), eye protection (46.80%), shoe covers (49.10%), and gowns (40.50%). Of concern,

4 (1.30%) of the respondents stated they had no PPE available (Figure 4).

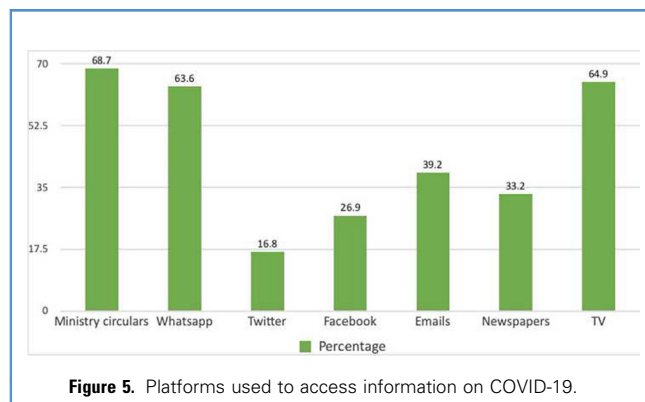
Only 131 (41.50%) had received training on managing COVID-19 patients and less than half (49.40%) had received training on how to wear PPE. At the time of the survey, the most commonly used platforms for accessing information on COVID-19 included Health Ministry circulars (68.70%), television (64.90%) and WhatsApp (63.60%) (Figure 5). The most commonly referenced resources were national health ministry guidelines (80.40%), WHO guidelines (72.50%), papers in various journals (41.10%), CDC guidelines (30.70%), and webinars (27.80%) (Figure 6).

**Clinical Practice**

A total of 173 (54.70%) respondents were not performing elective surgery in April 2020 due to COVID-19 (Table 2). The elective operative case load per clinician had reduced from a median of 5 (p25 = 3, p75 = 10) (Min. 0, Max. 40) to 1 (p25 = 0, p75 = 3) (Min. 0, Max. 40)—that is, to only 20% of previous workloads. Clinics have reduced by 83.3%; median weekly cases from 30 (p25 = 15 p75 = 40) (Min. 0, Max. 150) to 5 (p25 = 1 p75 = 14) (Min. 0, Max. 300). Emergency surgeries reduced by 40% from a median of 5 (p25 = 3 p75 = 10) (Min. 0, Max. 90) cases per week to a median of 3 (p25 = 1 p75 = 5) (Min. 0, Max. 30). Fifty-three (16.80%) respondents have had contact with COVID-19 positive patients and a further 21.8% treated patients suspected of having COVID-19 (patients never formally tested). Most of this exposure was in the emergency department (64, 20.30%), clinic (8.90%), or critical care areas (7.30%). COVID-19 screening for health care workers was only performed if there was clinical suspicion, as reported by 182 (57.60%) respondents. It is concerning to note that 17.1% of respondents worked in hospitals with no COVID-19 testing kits to test health care workers (HCW).







### Personal Well Being and the Socioeconomic Effects of COVID-19

More than half of the respondents (189; 59.80%) had concerns that they may contract COVID-19 in their line of work (Figure 7). Other concerns include a lack of training on how to manage COVID-19 (56%), a lack of PPE (53.60%), a lack of critical care access for their neurosurgical patients (44.3%), and financial worries (32.9%). Respondents were concerned that they may infect their family (82; 25.9%) and 45 (14.2%) acknowledged they had increased mental stress due to COVID-19.

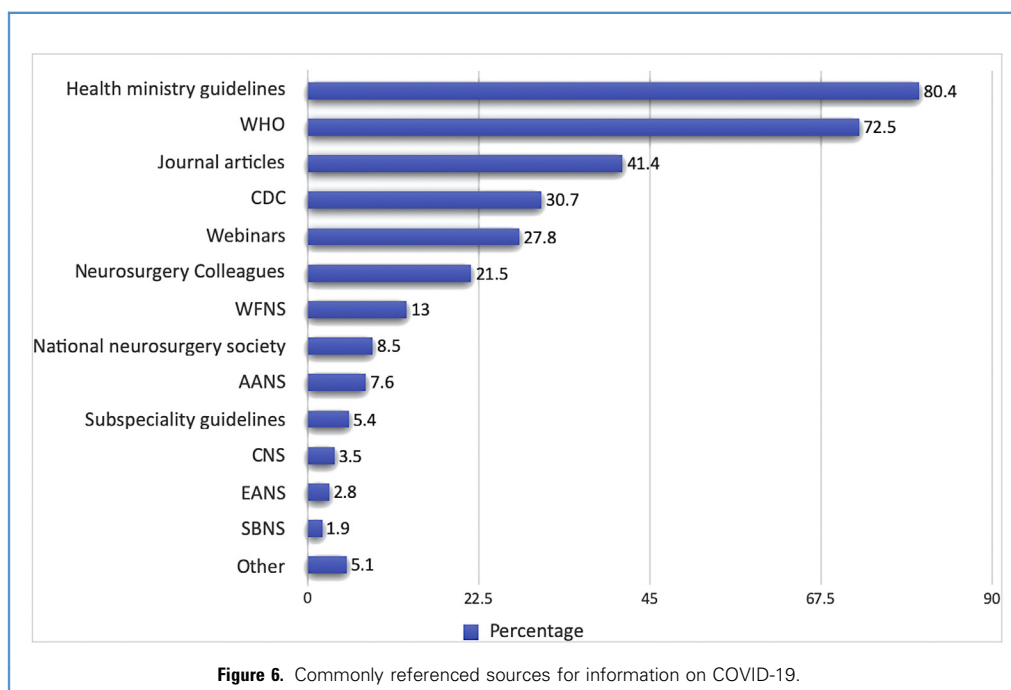
Increasing mobility in search of work or training opportunities meant that 35 (12.9%) respondents were stationed in a different country from their family. Travel restrictions due to COVID-19 restricted a further 71 (22.50%) who were not able to be with their families. For those fortunate to be with their families, 173 (54.80%) reported increased family time, with 89 (28.20%) stating

that this was due to reduced clinical commitments. A total of 37 (11.70%) reported reduced family time due to increasing work commitments. One fifth (62; 20.30%) reported no change in family time. Many respondents were separated from elderly relatives either due to travel restrictions (50; 15.80%) or by choosing to avoid visiting them due to concerns over the fear of infecting them with COVID-19 (102; 32.30%)

Almost one third (94, 29.70%) had a gross monthly salary of less than USD 1000, 91 (28.80%) earn between USD 1001 and 3000 per month, and 49 (15.5%) chose not to disclose their salaries. Thirty-nine (12.3%), who were mainly trainees, did not receive a salary. A total of 103 (44.3%) did not have a private practice. One quarter (25.3%) earned a gross income of up to USD 3000 per month from their private practice. A modest 45 (14.2%) chose not to disclose their private income. Most respondents (232; 73.4%) as of April 2020 had not had a change in their main salary income and 177 (56%) reported an unchanged private practice income.

### DISCUSSION

COVID-19 has proved to be an unparalleled global public health crisis. As of August 12, 2020, it had affected more than 213 countries globally, infecting 20,853,529 people and causing over 748,095 deaths.<sup>9</sup> The initial response was in containment of infection and providing supportive care to patients. In particular, there was a significant need to provide ventilators in anticipation of the surge of patients who would need mechanical ventilation. This resulted globally in the need to halt elective surgical cases, repurposing of all available spaces capable of providing critical care support and redeployment of health care workers to these areas. These efforts have been well documented in middle- and higher-income countries (American



**Table 2. Changes in Clinical Activities (% Respondents)**

Elective activities	Elective operations cancelled (75.30) Clinics cancelled (55.40) Clinic number of patients reduced (63.30) Telephone/online consults utilized (34.50) Masks worn in clinical environments (77.80)
Patients	Travel restrictions affect patients ability to present (48.40) Patients presenting late due to fear of contracting COVID-19 in hospital (34.80) All patients screened for COVID-19 (14.60) Patients for surgery screened for COVID-19 (10.40)
Hospital resources	Blood shortage (18.40) Shortage of neurosurgical supplies, e.g., external ventricular drains (12.00) Reduced bed capacity due to COVID-19 patients being admitted (12.00) Reduced bed capacity from sharing beds with other specialities (16.10) Staff redeployed out of the department (11.40) Staff recalled from academia (1.90)
Academic	Departmental academic meetings cancelled (61.70) No major ward rounds (36.40) National academic meetings cancelled (63.00)
COVID & HCW	Our institution has a testing/screening program for health care workers (38.60) There are plans to test HCW (11.10) Only HCW exposed to COVID-19 positive patients are tested (57.60) If exposed, the hospital recommends self-quarantine (41.10) If exposed, the hospital has designated/recommended quarantine centres (23.10) We pay for our tests (5.40) Testing kits are not available in our hospital (17.10)

Association of Neurological Surgeons, Italy, China, UK, India-Gupta<sup>10-12</sup> and also by College of Surgeons of East, Central and Southern Africa.<sup>13</sup> El-Ghandour et al.<sup>14</sup> surveyed 661 neurosurgeons from 6 continents (March 20 to April 3, 2020) and highlighted the reduction in clinical services coupled with the relative under-utilization of PPE.

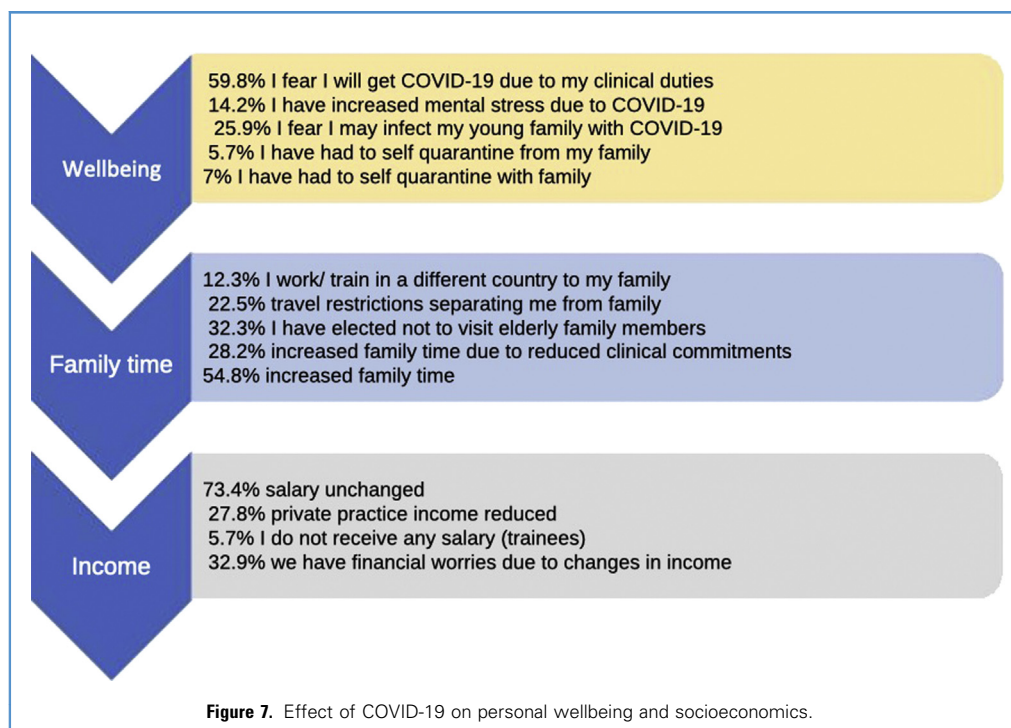
In our survey, although there was an involvement of neurosurgeons in national COVID-19 response plans in 25 countries polled, only 49% felt that their response plans were satisfactory for their neurosurgical services. Provision of PPE as well as training remain a challenge and this informs the fact that 59.8% were concerned they may contract COVID-19 while undertaking their clinical duties. HCW infection has been documented in other countries such as Italy,<sup>15</sup> where they made up 10% of infections. Many African neurosurgical units are small and relatively small numbers of staff infection can paralyze services. There needs to be frank discussions on HCW protection and provision of screening tests and appropriate quarantine support for those at risk. Simple measures can involve checking staff temperatures and drafting rotas to limit infection spread among HCW, as documented in Singapore.<sup>16</sup>

In line with other regions of the world, elective activities have been postponed. It is of concern that patients, out of fear of contracting COVID-19, were presenting late (34.8%) or struggling to get to hospital due to travel restrictions (48.4%). There are implications for patients depending on how long it takes for normal services to resume and if there is a subsequent surge in patient influx for institutions that are often operating at maximal capacity.<sup>8</sup> It is worthy of note that there are (or are likely to be) many non COVID-19 cases, such as brain tumors, that may have worsening morbidity and mortality due to suspension of elective surgeries and clinics. It is difficult to assess at present the magnitude of this as there are no African continental patient registries that can be used to provide this data.

It was encouraging to see that respondents came from 42 out of 54 (77.78%) African countries. The 12 countries not represented in our survey constitute less than 3% of Africa's population. That only 11 countries (that we believe) currently have no neurosurgeons, is testament to the rapid expansion of surgical training on the continent. To cope with the health and economic effects of COVID-19, many countries have rearranged their funding priorities and there is a risk of neurosurgical services becoming under resourced. Many African countries have to procure medical supplies from companies based in other continents that only have distributors on the continent. Twelve percent of our respondents reported shortages in neurosurgical supplies because of logistical challenges due to COVID-19 and there is a risk of this effect being exacerbated either due to logistics, local currency being devalued in the resulting economic downturn, reduced funds, or increase in cost of production—which can make it difficult for African countries to competitively purchase on the global market. Challenges in procurement for medical supplies to treat COVID-19 has led the African Union to establish a centralized medical supplies portal.<sup>17</sup> This is an exciting opportunity that can be leveraged to help aid in the procurement of surgical equipment in the future by enabling the region to centrally license and bargain for supplies. In the long run, initiatives to produce and develop surgical supplies on the continent need to be developed.

The mental well being of HCW is important as COVID-19 is likely to run a protracted course and have an effect on the delivery of medical services for months to come. We appreciated the candor of our respondents who reported increased mental stress and anxiety over their personal health and of their families (both young and elderly members) of contracting COVID-19. The reality of mortality in the neurosurgical community (19 neurosurgeons have died of COVID-19 as of June 2, 2020<sup>18</sup>) has resulted in increased psychological strain at a time when many are figuring out how to continue providing much needed surgical care. Many units are small with few surgeons and therefore the option of alternating clinical cover to give rest breaks may not be feasible for many of our respondents.

Although it is encouraging to note that most respondents did not have a change in their primary salary as of April 2020, there was a proportion who did not have a salary. This was largely residents. It is likely that many depend on spouses, family, or on the ability to do locum tenens or on-call shifts to supplement their income. A predicted global financial recession is likely to strain the ability of these doctors to support themselves. This group



comprised trainees who may then struggle to concentrate on their residency if they have to seek alternative financing.

### Strengths and Limitations of the Study

This is the most comprehensive survey of African neurosurgeons so far covering all but 1 of the countries with a practicing neurosurgeon. Utilizing social media and e-mails allowed for quick responses that could be easily collated. Given worldwide travel restrictions, the use of online platforms also enabled the authors (who represent all the WHO regions of Africa) to collaborate on every aspect of this study.

There is no central database of African neurosurgeons to enable direct e-mailing for surveys as well as to give accurate numbers of the neurosurgeons on the continent. Not all countries have a neurosurgical society with a secretariat that could be contacted and many of our respondents were not training or practicing in their countries of origin. It is therefore not possible at present to evaluate the response rate. A Young African Neurosurgeons Forum with an active database is being collated.

Relative to other continents, at the time of the survey, Africa was in the early phase of the COVID-19 infection spread. The responses are therefore likely to change as the pandemic spreads through the continent.

### CONCLUSIONS

This survey highlights that there is a growing presence of neurosurgery in most African countries. However, there is a need to

ensure that staff have the appropriate training and PPE to limit infections. The respondents sampled are young and have a bias to social media for dissemination of information; this should be exploited to ensure that all clinicians are kept abreast of scientific literature. The reduction of clinical activities will have an effect on training but there needs to be contingency plans for clinical service provision during the pandemic and also the projected surge of patients later on. There are weaknesses in Africa's medical supply chain for surgical supplies and blood, and clinicians need to look at how to modify their clinical practices accordingly.

### CRediT AUTHORSHIP CONTRIBUTION STATEMENT

**Muhammad Raji Mahmud:** Conceptualization, Methodology, Writing - original draft, Visualization, Project administration, Supervision. **Beverly Cheserem:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing - original draft, Visualization, Project administration. **Ignatius N. Esene:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing - original draft, Project administration. **Kazadi Kalangu:** Writing - review & editing, Project administration, Supervision. **Samuila Sanoussi:** Writing - review & editing, Supervision. **Aaron Musara:** Writing - review & editing, Supervision. **Nasser M.F. El-Ghandour:** Writing - review & editing. **Graham Fieggen:** Methodology, Investigation, Data curation, Writing - review & editing, Project administration, Supervision. **Mahmood Qureshi:** Methodology, Investigation, Data curation, Writing - review & editing, Project administration, Supervision.



## REFERENCES

1. Timeline of WHO's response to COVID-19. Available at: <https://www.who.int/news-room/detail/29-06-2020-covid-timeline>. Accessed July 16, 2020.
2. Coronavirus (COVID-19) events as they happen. Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>. Accessed July 16, 2020.
3. Coronavirus disease 2019 (COVID-19) – Africa CDC. Available at: <https://africacdc.org/covid-19/>. Accessed July 16, 2020.
4. Africa CDC. Available at: <https://africacdc.org/covid-19/>. Accessed July 16, 2020.
5. Kapata N, Ihekweazu C, Ntoumi F, et al. Is Africa prepared for tackling the COVID-19 (SARS-CoV-2) epidemic. Lessons from past outbreaks, ongoing pan-African public health efforts, and implications for the future. *Int J Infect Dis.* 2020;93:233-236.
6. Park KB, Johnson WD, Dempsey RJ. Global neurosurgery: the unmet need. *World Neurosurg.* 2016;88:32-35.
7. Punchak M, Mukhopadhyay S, Sachdev S, et al. Neurosurgical care: availability and access in low-income and middle-income countries. *World Neurosurg.* 2018;112:e240-e254.
8. Park KB, Kanmounye US, Lartigue JW. Global neurosurgery in the time of COVID-19. *Neurospine.* 2020;17:348-350.
9. Coronavirus disease (COVID-19). Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. Accessed July 16, 2020.
10. Kondziolka D, Couldwell WT, Rutka JT. Introduction. On pandemics: the impact of COVID-19 on the practice of neurosurgery. *J Neurosurg.* 2020. <https://doi.org/10.3171/2020.3.jns201007>.
11. Gupta P, Muthukumar N, Rajshekhar V, et al. Neurosurgery and neurology practices during the novel COVID-19 Pandemic: a consensus statement from India. *Neurol India.* 2020;68:246-254.
12. Weiner HL, Adelson PD, Brockmeyer DL, et al. Editorial. Pediatric neurosurgery along with children's hospitals' innovations are rapid and uniform in response to the COVID-19 pandemic. *J Neurosurg Pediatr.* 2020. <https://doi.org/10.3171/2020.4.PEDS20240>.
13. Ademuyiwa AO, Bekele A, Berhea AB, et al. COVID-19 Preparedness within the surgical, obstetric and anesthetic ecosystem in Sub Saharan Africa. *Ann Surg.* 2020;272:e9-e13.
14. El-Ghandour NMF, Elsebaie EH, Salem AA, et al. Letter: the impact of the coronavirus (COVID-19) pandemic on neurosurgeons worldwide. *Neurosurgery.* 2020;87:E250-E257.
15. Chirico F, Nucera G, Magnavita N. COVID-19: Protecting healthcare workers is a priority. *Infect Control Hosp Epidemiol.* 2020;41:1117.
16. Htun HL, Lim DW, Kyaw WM, et al. Responding to the COVID-19 outbreak in Singapore: staff protection and staff temperature and sickness surveillance systems. *Clin Infect Dis.* 2020;71:1947-1952.
17. COVID-19: African Union Chair, President Ramaphosa launches the Africa Medical Supplies Platform, Africa's Unified Continental Response to fight the pandemic. Available at: <https://www.tralac.org/news/article/14674-covid-19-african-union-chair-president-ramaphosa-launches-the-africa-medical-supplies-platform-africa-s-unified-continental-response-to-fight-the-pandemic.html>. Accessed December 2, 2020.
18. In memoriam: a memoir for our fallen "heroes" | Neurosurgery | Oxford Academic. Available at: <https://academic.oup.com/neurosurgery/article/doi/10.1093/neuros/nyaa314/5870597>. Accessed July 16, 2020.

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