■ Review article

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Epileptic Disorders

Understanding the landscape of electrophysiology services for children in sub-Saharan Africa

Veena Kander[1], Joanne Hardman[2], Jo M. Wilmshurst[1,3]

[1] Department of Neurophysiology,
[2] Department of Education, University of Cape Town,
[3] Department of Paediatric Neurology, Red Cross War Memorial Children's Hospital, Neuroscience Institute, University of Cape Town, South Africa

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ABSTRACT

Objective. Incidence of epilepsy is greatest in infancy and childhood; this is especially evident in sub-Saharan Africa (SSA). The aim of this study was to understand access to electrophysiology services in SSA including which health practitioner performs and interprets paediatric electroencephalogram (EEG) studies as well as their training in paediatric EEG.

Methods. A web-based survey was sent to a cohort of health care practitioners who manage children with epilepsy in SSA. The questions addressed whether EEG was available to these health care practitioners, how the practitioners accessed EEG and who assisted interpretation of the study results. The survey was circulated (June-December 2019) to 305 participants from 32 African countries.

Results. A total of 73 (16 partial and 57 complete) surveys were returned from 18 countries. The respondents fell into two main categories: those with access to an EEG machine (44/73; 60%) and those without access to an EEG machine (29/73; 40%). For 32% (23/73), there was no dedicated technician and for 34% (25/73) no neurologist. Access to a neurologist resulted in the highest proportion of EEGs performed per annum. Of the respondents, 77% (56/73) agreed that there was a need for a paediatric apprenticeship in EEG skills. Qualitative data to justify need for paediatric EEG training was grouped into three themes: (1) "professional development"; (2) "better care"; and (3) "help paediatric patients and neurologists".

Significance. There is a lack of paediatric EEG training amongst doctors and technicians working with epilepsy in SSA. Expanding training beyond current capacity in SSA, for technicians and practitioners involved in EEG, is necessary.

Key words: EEG, sub-Saharan Africa, technicians, paediatrics, interpretation

Correspondence:
Veena Kander
Department of Paediatric Neurology,
5th Floor ICH,
Red Cross War Memorial Children's Hospital,
Klipfontein Road, Rondebosch,
Cape Town,
7700 South Africa
<veena.kander@uct.ac.za>

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Sub-Saharan Africa (SSA) has the highest burden of neurological diseases in the world, as illustrated by the high prevalence of people with epilepsy [1]. Infants and children have the highest incidence of epilepsy of all age groups, and this is especially evident in SSA [1]. Active and lifetime epilepsy prevalence burden in SSA ranges from active at 9 per 1000 population and lifetime at 16 per 1000 [2], and active childhood epilepsy in SSA is reported to range from 3.6 to 44 per 1000 children [3].

Whilst epilepsy is diagnosed on clinical grounds, performing an electroencephalogram (EEG), in conjunction with the clinical assessment, can assist and enhance the diagnosis, delineation of syndromes and the management of epilepsy [4]. This tool should be inexpensive and, with its high sensitivity and specificity, remains the most widely used test for neural function [5]. However, performing an EEG requires a specific set of skills especially when performed on children, where misinterpretation can easily occur. An inaccurately reported EEG can be as detrimental to a child as having no access to the tool at all [4]. Inaccurate implementation of the tool can be due to lack of both technique and knowledge of brain maturation and artefacts [4].

As gold standard, an EEG study should be performed by a neurophysiology technologist or EEG technician and interpreted by a specialist with formal training in epileptology. In high income countries, access to training from technician to specialist is readily available, whereas in SSA, even access to training as a technologist or technician is anecdotally very limited. Further, there is little data regarding the level of EEG training and knowledge in current neurophysiology services in SSA, especially for paediatric electrophysiology. In the African setting, clinicians have heavy clinical workloads and rarely have the capacity to work in a single area of specialisation *e.g.*, as an epileptologist or neurophysiologist. The practitioner performing the study should be able to highlight important findings which need acute interventions as well as providing the referring clinician with adequate information from the study to aid clinical assessment. Based on this, in centres lacking neurologists with electrophysiology training, establishing whether the practitioner performing EEGs (*i.e.*, the technician) has some clinical background beyond the technical ability to perform the study is important.

Methodology

We designed a 15-minute web-based survey consisting of 42 questions for health care practitioners who manage children with epilepsy in SSA (*supplementary figure 1*). The survey explored how the health care practitioners were able to access care for their patients with paediatric neurology conditions inclusive of how this related to EEG services in their country, with a special focus on paediatric electrophysiology. We used research electronic data capture (REDCap) from the University of Cape Town's (UCT) web applications, and this was widely circulated via the web (June-December 2019). Names of participants were collated from articles, internet searches, from across the African Paediatric Fellowship Program (APFP) alumni colleagues and from the Paediatric Epilepsy Training (PET) programs held across the African continent (Kenya/Uganda/Ghana/Tanzania). The target population totalled 311 participants from 32 African countries. The survey collected data on access to a neurologist, waiting times for EEG, number of EEG studies performed, personnel performing EEGs, their training experience (formal or informal), the type of practitioner interpreting paediatric studies and the usefulness of an apprenticeship in paediatric EEGs. The questions were mainly drop-down box options with a few open-ended questions, formatted to provide specific qualitative data for analysis. The aim of the study was to investigate and understand the extent and nature of access to electroencephalography studies in SSA, especially for paediatric patients. Also, the level of competence of the practitioner performing and interpreting the studies. In addition, we looked at an apprenticeship training programme that will focus on technicians to learn basic paediatric EEG interpretation for safe practice. The study was approved by the ethics committee of the UCT, Cape Town, South Africa (481/2018).

Statistical analysis

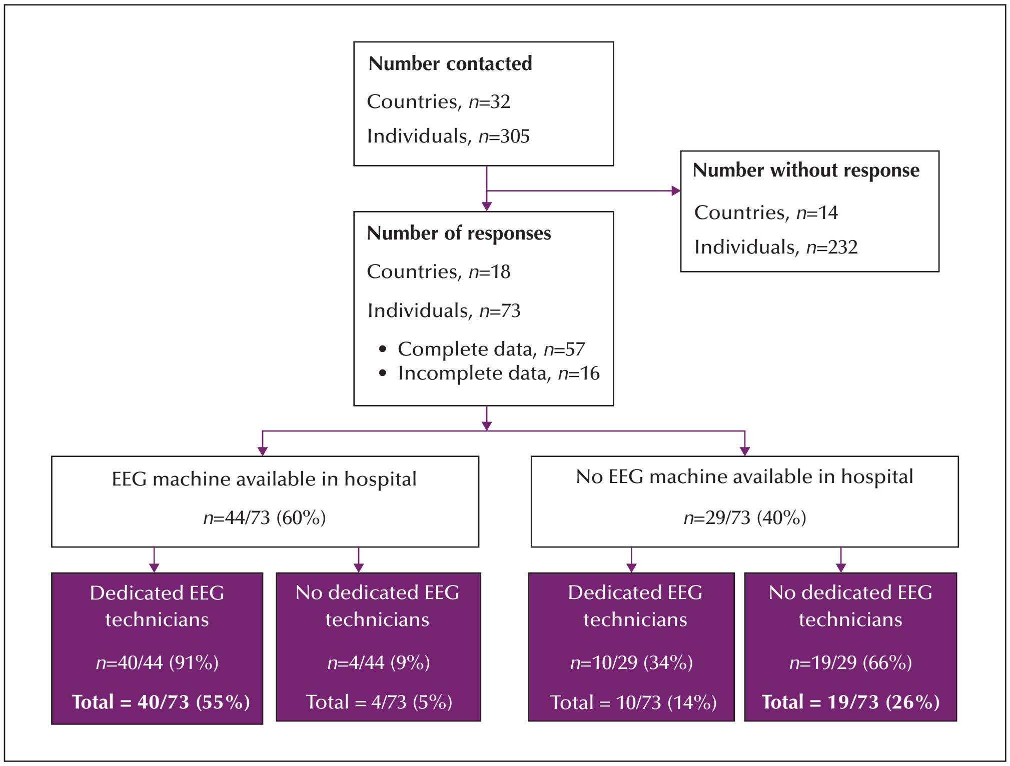
All survey data were exported from REDCap into "Stata 14.0 (StataCorp, College Station, TX)" for analysis and *p* values were obtained using chi square (X2) statistics. Qualitative data were analysed using thematic themes and comparison techniques.

Inclusion and exclusion criteria

Completed and partially completed questionnaires were included for analysis. Whilst the extent of partially completed questionnaires varied, we included those in which most of the critical questions were answered. Questionnaires with inadequately completed fields were excluded.

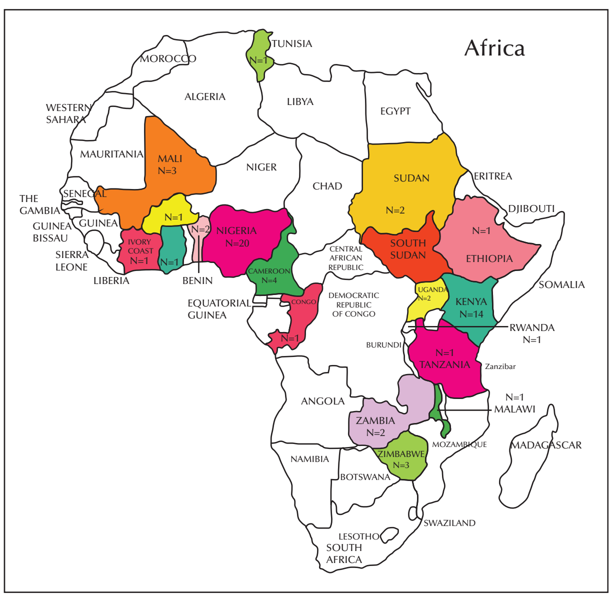
Results

Out of the 311 participants, six were removed owing to duplication and retirees from the field of practice. The survey was sent to 305 participants of whom 232 failed to complete. The survey was resent to non-respondents four times in the subsequent six months (June-December 2019). In total, 57 respondents successfully completed all fields of the survey. For the remaining 16, not all data fields were completed by the respondents, but sufficient data was captured to allow analysis of sub-sections. The combined 73 (16 partial and 57 complete) surveys were analysed from 18 countries which equated to 24% of the total participants who were sent the survey (*figure 1*). The 18 countries that responded, in line with world bank ratings, were 44% (8/18) from low- and 56% (10/18) from low-middle-income countries. The number of respondents from each country is presented in



■ **Figure 1.** Flow diagram of survey response.

figure 2, Nigeria had the highest number of respondents, followed by Kenya, and Ghana. Countries had respondents from across all levels of healthcare (primary/district/secondary/tertiary) and



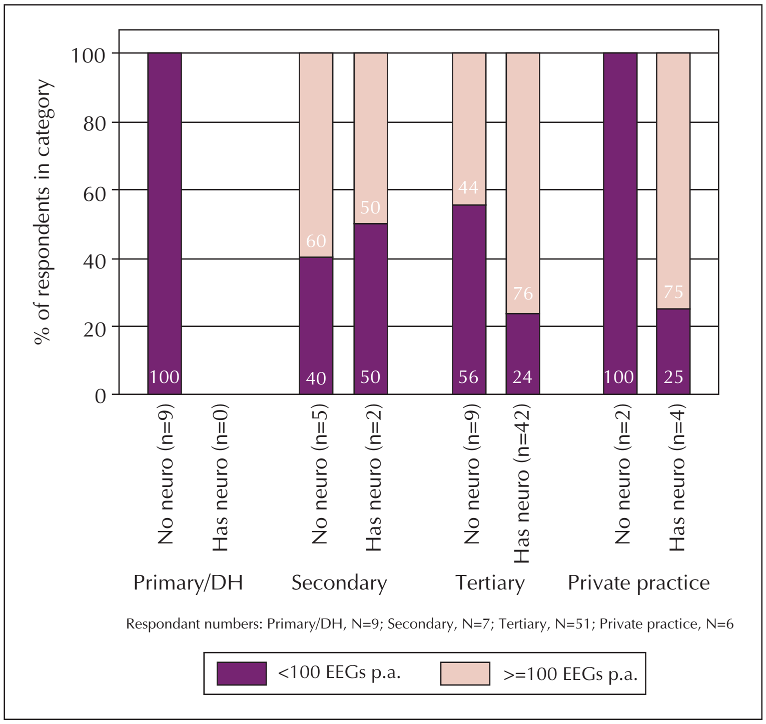
■ **Figure 2.** Participant countries represented.

private institutions (*figure 3*). EEG training was explored in South Africa previously and was not included in the data base [6]. The response from Tunisia was an outlier, as it is not part of SSA, however, as this participant was inadvertently included in the survey list after partaking in one of the PET courses, it was retained in the study as a useful comparison example of North versus SSA practice. There were no differences between practice in Tunisia compared to the countries of SSA. The 14 countries with no respondents had world ranking which ranged from low-, low-middle- to upper-middle-income countries (https://www.ilae.org/files/dmfile/World-Bank-list-of-economies-2020_web2.pdf).

The respondents fell into two main categories; those with access to EEG capacity and those unable to access this resource with or without a trained technician. This varied considerably and is illustrated in *figure 1*.

Access to EEG equipment and technicians

Of the respondents, 60% (44/73) had access to a service with EEG equipment and a neurologist, and 91% (40/44) of the EEG services that the respondents used had access to a technician as well. Of the 9% that lacked a dedicated technician, the EEGs were outsourced to the neurophysiology/adult and child neurology departments. The prior background details of the technicians



■ **Figure 3.** Bar graph showing annual burden of EEG requests according to availability of in-hospital neurologists within different levels of service delivery.

are documented in *table 1*. Of the 40% (29/73) who did not have on-site access to EEG equipment, 34% (10/29) could outsource to a technician to perform EEGs and 5/10 (50%) of this group who outsourced had access to a neurologist. Of the 5/10 respondents with no access to a neurologist, 3/5 came from primary or secondary hospitals and 1/5 was from a tertiary hospital and 1/5 from the private sector. The remainder (19/29) were unable to access either EEG equipment or personnel to perform the studies and had no access to a neurologist in 52% (15/29). The majority of these respondents came from primary or secondary hospitals, but 4/15 were based in a tertiary hospital. Only 14% (4/29) had access to a neurologist in this group.

Respondent characteristics against number of annual EEGs conducted (*supplementary table 1, supplementary figure 2*) and demographics of the group managing patients with epilepsy

There were discrepancies in the distribution of respondent ages by annual hospital EEG studies performed. Respondents from hospitals doing < 100 EEGs per year tended to be younger than those from hospitals doing 100 or more EEGs per year (*figure 3 and table 2*). For example, in the category in which less EEG studies were performed, only 10% of respondents were 45-54 years old (and 57% were 35-44 years old), compared to 37% (35-44 years old) and 37% (45-54 years old) of respondents in the higher EEG burden category. There was no statistical difference in the sex ratios of the respondents. The majority (40/73) were general paediatricians, and the remainder were adult neurologists (6), child neurologists (10), general physicians (2), general practitioners (1), psychiatrists (1), neuro-developmental specialist (1) and a few unknown (12). Of the above respondents, 70% (51/73) came from tertiary level hospitals. Only 66% (48/73) of the respondents had access to a neurologist in their hospital. Based on the annual EEGs undertaken, when compared to the availability of an in-house neurologist (*figure 3*), more EEGs per annum were yielded in the presence rather than absence of neurologists (25%) ($p<0.0001$). Respondents from primary level or district hospitals lacked in-hospital neurologists, and all reported requesting less than 100 EEGs per annum. Sixty percent of respondents from secondary-level hospitals lacking an in-hospital neurologist reported an EEG turnover of greater than 100 EEGs per year, compared to 50% of those in secondary-level hospitals with an in-hospital neurologist. The level tended to be slightly higher when an in-hospital neurologist was lacking (10% absolute difference, 60% vs 50%),

▼ Table 1. Employment and training characteristics of centres with one and two EEG technicians.

	Centre with one EEG technician (*n*=50)	**Centre with two EEG technicians (*n*=29)**
Pre-EEG training background of technician		
Nurse	16 (32%)	12 (41%)
Doctor	13 (26%)	8 (27%)
Physiology/EEG technician	9 (8%)	3 (10%)
Clerk	2 (4%)	5 (17%)
Other	2 (4%)	1 (3%)
No response	8 (16%)	0
Type of employment		
Full-time	35 (70%)	26 (90%)
Part-time	9 18%)	3 (10%)
Other	1 (2%)	0
No response	5 (10%)	0
Type of training		
Formal	22 (44%)	11 (38%)
Formal and informal	6 (12%)	5 (17%)
Only informal	15 (30%)	13 (45%)
No response	7 (14%)	0
Location of training		
Local	24 (48%)	21 (72%)
International	9 (18%)	3 (10%)
Combined, local and international	12 (24%)	5 (17%)
No response	5 (10%)	0
Duration of training		
< 3 months	10 (20%)	8 (28%)
3-6 months	10 (20%)	6 (21%)
7-12 months	8 (16%)	7 (24%)
> 1 year	14 (28%)	8 (27%)
No response	8 (16%)	0
Qualification obtained		
Certificate	23 (46%)	13 (45%)
Certificate & degree	1 (2%)	2 (7%)
Degree	1 (2%)	1 (3%)
Bachelor	2 (4%)	1 (3%)
Master	3 (6%)	1 (3%)
None	12 (24%)	12 (41%)
No response	8 (16%)	0

Formal training – a structured programme with a certificate on completion. Comparison was between all centres with technicians (*n*=50) and the subgroup who had two or more EEG technicians (*n*= 36/50), however, for some subsections, the questions were not completed in seven. Formal statistical analysis was undertaken for *n*=29.

Table 2. Characteristics of available EEG services.

Characteristic	Total respondents (*n*=73)	Annual EEGs ≥100 (*n*=43)	Annual EEGs <100 (*n*=30)	*p*
Level of service (location of respondent)				0.001
Primary level/district hospital	9 (12%)	0	9 (30%)	
Secondary level hospital	7 (10%)	4 (9%)	3 (10%)	
Tertiary level hospital	51 (70%)	36 (84%)	15 (50%)	
Private practice	6 (8%)	3 (7%)	3 (10%)	
EEG machine available in hospital				0.003
No	29 (40%)	11 (26%)	18 (60%)	
Yes	44 (60%)	32 (74%)	12 (40%)	
Department performing paediatric EEG in hospital				0.27
Adult/unspecified neurology	24/44 (54%)	19/32 (59%)	5/12 (42%)	
Paediatric neurology	15/44 (34%)	10/32 (31%)	5/12 (42%)	
Psychiatry	2/44 (5%)	2/32 (6%)	0	
Neurophysiology/technicians	3/44 (7%)	1/32 (3%)	2/12 (17%)	
Waiting time for EEG				0.16
<1 week	39 (53%)	27 (63%)	12 (40%)	
1-4 weeks	28 (28%)	12 (28%)	16 (53%)	
1-3 months	4 (5%)	3 (7%)	1 (3%)	
3-6 months	2 (3%)	1 (2%)	1 (3%)	
Number of annual EEGs				n/a
<100	30 (41%)	0	30 (100%)	
100-500	32 (44%)	32 (74%)	0	
500-1000	9 (12%)	9 (21%)	0	
>1000	2 (3%)	2 (5%)	0	
Who are the EEGs preformed on?				0.004
Adults	2 (3%)	1 (2%)	1 (3%)	
Children	6 (8%)	3 (7%)	3 (10%)	
Adults and children	42 (58%)	32 (74%)	10 (33%)	
No answer	23 (31%)	7 (16%)	16 (53%)	
Are there dedicated people to perform EEGs?				0.001
No	23 (31%)	7 (16%)	16 (53%)	
Yes	50 (68%)	36 (84%)	14(47%)	
Number of EEG technicians in the department				<0.0001
1 person	14/50 (28%)	5/36 (14%)	9/14 (64%)	
2 or more person's	36/50 (72%)	31/36 (86%)	5/14 (36%)	
Characteristics of primary person who reads and interprets paediatric EEGs	*n*=59	*n*=35	*n*=24	

Table 2. Characteristics of available EEG services (*continued*).

Characteristic	Total respondents (*n*=73)	Annual EEGs ≥100 (*n*=43)	Annual EEGs <100 (*n*=30)	*p*
Background of person				0.16
Adult neurologist	15 (25%)	12 (34%)	3 (12%)	
Paediatric neurologist	22 (37%)	13 (37%)	9 (38%)	
Psychiatrist	2 (3%)	1 (3%)	1 (4%)	
EEG technician	4 (7%)	1 (3%)	3 (12%)	
Combination of EEG technician and specialist	11 (19%)	7 (20%)	4 (17%)	
Other	5 (8%)	1 (3%)	4 (17%)	
Level of paediatric EEG training of the interpreter				0.06
< 3 months	6 (10%)	5 (14%)	1 (4%)	
3-6 months	17 (29%)	14 (40%)	3 (12%)	
7-12 months	9 (15%)	4 (11%)	5 (21%)	
> 1 year	20 (34%)	8 (23%)	12 (50%)	
Other	7 (12%)	4 (11%)	3 (3%)	

Values are presented as *n* (%), *p* values are based on the chi^2 test.
EEG: electroencephalogram; tech: technician

suggesting a tendency for requesting more EEGs for diagnoses. In both tertiary hospitals and private practice, an available in-hospital neurologist (vs not having an in-hospital neurologist) was associated with a greater number of EEGs performed; 44% vs 0% of respondents from tertiary hospitals reported > 100 EEGs per annum, and 76% vs 75% of respondents from private practices reported > 100 EEGs per annum. However, for in-hospital neurologists in tertiary and private practice, the absolute difference was only 1%. In 71% of cases (34/48), neurologists were managing adults and children with epilepsy, in 25% (12/48) only children and the remainder just adults. In the absence of a neurologist, a range of personnel provided neurology care which is documented in *supplementary table 1*. In this setting, the majority of children with epilepsy were seen by paediatricians, and a smaller percent by psychiatrists or medical officers with an interest in neurology.

Would an apprenticeship in paediatric EEG benefit the respondents' practice?

In total, 77% (56/73) were in an agreement for the need for an apprenticeship, 4% (3/73) stated that there was no need, and no response was given in 19% (14/73). The non-responders had access to a neurologist in 71% (10/14) of cases, and 29% had no access to a neurologist. Most of the non-responders came from tertiary hospitals (71%) and the remainder from private and primary/secondary hospitals.

The qualitative data with verbatim quotes was grouped according to the following three common themes:

- "professional development" (improve skill/enhance quality of interpretations). Of the participants, 48% (27/56) fitted into this theme e.g., "*as a paediatrician, I would be able to interpret EEGs for my patients and not rely on what the technician says which would help in the management of my patients*"; "*interpretation of paediatric and adult EEG is different, it will improve skills and interpretation*"; "*it would help with a proper EEG study and interpretation, helping ultimately to establish appropriate decision making*".
- "better care" (improve quicker diagnosis) accounted for 29% (16/56) e.g., "accurate classification of epilepsy which leads to treatment and good outcome"; "better interpretation of results, better care to paediatric patients"; "the person will be fully available for paediatric patients".
- "help paediatric patients and neurologists" resulted in 23% (13/56) of the responses, e.g., "the physiologist would be better able to flag paediatric EEG problems"; "quality of management of paediatric epilepsy would be improved if there are dedicated paediatric EEG services and personnel"; "it would increase expertise as an encephalographer and engender training of others".

A breakdown of the available EEG services is provided in *table 2*. As previously stated, 60% (44/73) of the respondents had access to EEG equipment within the respondent's hospital (p= 0.003). Paediatric EEGs were performed in a range of different locations; the majority were performed in an adult neurology department (54%), 34% in a paediatric department, and the remainder either within a psychiatry department (5%) or by EEG technicians (7%) in a neurophysiology facility. Most EEGs were performed within a week of the request. Breaking the data down further and looking at the turnaround time for undertaking EEG in the setting of access to a neurologist and an EEG machine (41/48), the results varied such that 77% (37/48) patients received an EEG within one month and 8% (4/48) waited longer. For 15% (7/48), for whom no EEG machine was present and the EEGs were outsourced, the EEG waiting times were also within a month. In the setting where no neurologist and no EEG machine (25/73) were available onsite, in 72% (18/25), surprisingly most of the EEGs were also performed within a month via outsourcing and only 8% (2/25) had longer waiting times. For the 20% (5/25) who had access to an EEG machine with no neurologist, the results were similar to the above. Only two clinicians, an adult neurologist from Sudan and a child neurologist from Cameroon, reported performing >1,000 EEGs per year, and the highest number of annual EEGs performed were between 100 and 500 in 44% of cases. The EEGs were statistically more likely to be performed on a combined adult and paediatric population rather than dedicated paediatric groups (p=0.004).

Respondents were significantly more likely to have access to someone who could perform EEGs for their patients (68% cases; p=0.001). In addition, they were significantly more likely to be associated with departments which had more than one technician (p<0.001). In the 32% who did not have access to a technician, the respondents were asked an open-ended question "*how can an EEG service be provided within their practice*"? The following three key themes emerged in response, with verbatim quotes: 43.5% alluded to "training" ("*good training programmes are lacking*"/ "*training technicians*") and 13% on "reporting" ("*interpretation not adequate for paediatric EEGs*"/"*paeds EEGs often get sent to another tertiary institution to have them read and interpreted*", and some stated "*district hospital*" which accounted for 4.5% ("*we always have to send to a tertiary centre in the big city, miles away for EEG to be done*"). The respondents were asked who read and interpreted their paediatric EEGs. Surprisingly, the group confirmed that this was done by paediatric neurologists in 37% followed by a range of other personnel. In terms of the level of paediatric experience, only 34% had > one-year experience in EEG training.

Table 1 provides the breakdown of the employment and training experience of centres with one EEG technician and centres with two EEG technicians. This table highlights their background prior to training, their type of employment, where and for how long they were trained, and lastly what qualification they received. Formal training in the one-EEG-technician category was more in demand versus informal training, whereas informal training for the two-EEG-technician category scored higher than formal training. Local training was popular for both categories, followed by a combination of local and international training.

Discussion

Surveys can be an effective way to gather information but can also be a burden to the receiver, as well as ending up in the spam folder. Despite resending the survey, only a quarter replied from 18/32 low-and low-middle-income countries in SSA and 24% of the invited participants (73/305). This figure still falls within a good net promoter score (NPS) survey response rate (https://www.genroe.com/blog/acceptable-survey-response-rate-2/11504). These countries have many specific challenges when it comes to the burden of epilepsy, especially when most individuals with epilepsy have onset during childhood [7, 8]. This survey provides useful insight into EEG services for epilepsy in SSA and the need for paediatric EEG training.

The responses confirmed that just over two thirds of the patients had access to neurologists, who saw mostly a combination of paediatric and adult patients. Access to a neurologist was also more likely in a tertiary (urban) than rural setting. Most children with epilepsy are treated by medical officers, paediatricians and psychiatrists, rather than specialist child neurologists. Access to an EEG service was available in a higher proportion than expected but this was when there was a neurologist available. A neurologist was statistically more likely to undertake more EEGs per year compared to services that lacked access to a neurologist. It is hoped that this reflects the clinical expertise of these neurologists to identify patients who would gain the most from such an investigation, which could answer clearly identified clinical questions, such as the differentiation between syndromes and ruling out non-epileptic cases. This was not the case in a study by authors in a centre where > 1,000 EEGs are performed per annum; paediatric neurologists requested more appropriate EEGs compared to paediatricians and non-specialists [9]. However, the survey did not capture how often the EEG studies resulted in a change in practice, nevertheless, this trend was also illustrated in another study by the authors [6]. Paediatric EEGs were performed by a spectrum of healthcare departments, mostly by adult care clinicians. Neurologists in SSA are scarce and even more so, paediatric neurologists [3, 8]. With the recommendation from the World Health Organisation of a minimum of one child neurologist per 100,000 population, it may take many years for SSA to have sufficient neurologists and paediatric neurologists to be equivalent to resource-equipped countries [10]. Hence alternate options to deliver health care are needed.

Overall, there was no difference in EEG waiting times between a neurologist and EEG machine onsite compared to no neurologist and no EEG machine in which the study had to be outsourced. However, in terms of paediatric EEGs, the survey could not address evidence for improved care, nevertheless, the verbatim quotes supported why paediatric apprenticeship training would be beneficial. Many centres had one or more technician who performed their EEGs and were employed fulltime. Various forms of training were present, and informal training (local) was preferred after formal and local training. In both the EEG technician groups, the training time for the majority was under a year and only a handful of technicians trained for greater than a year. Illustrating limited access to training, many people performing EEGs either had a certificate in isolation or lacked any qualification. Ideally, to perform EEGs, a science background is useful as the field requires technical skills as well as some knowledge in anatomy. Centres with two technicians can be more effective in yielding more EEGs per annum, and the combined expertise and teamwork supports a more competent practice. An EEG laboratory in SSA with one trained technician is a bonus, but two technicians is even more profound. This enables teamwork and multidisciplinary care, with retention and ongoing promotion of skills leading to better developed units and invested workers. Further, this permits higher patient turnover and improves centre expertise. In variance to practice in resourced settings, technicians in SSA could be more effective if qualified as a medical officer or nurse to aid case assessment. This would also target the burden of the clinical management of epilepsy in SSA.

There were no EEG services available for one third of the respondents. Respondents were asked to comment on "*how we can fill this void in their practice*"? Comments like "*training programmes*", "*the need for an EEG machine and reports are dependent on a neuro technologist*" are a few that stood out. District hospitals also tend not to be equipped with specialised equipment and many patients must travel long distances in order to be tested, often at a significant service fee. However, a small percentage had access to a technician outside their service to perform their EEGs as well as access to a neurologist. Although no EEG service was available, many still were in favour of having someone undergoing the apprenticeship.

Two thirds of the respondents reported that they were interested in an apprenticeship programme. Three frequent key themes re-occurred amongst the responses relating to professional development, better care for patients, and help for paediatric patients and neurologists. The overall response for why apprenticeship training was needed was to improve diagnosis and management for paediatric patients as well as improve skills both for doctors and technicians. An apprenticeship program has been developed as a sub-section of the African Paediatric Fellowship Program which trains Africans in Africa [8]. The APFP has been training paediatric neurologists since 2008 and offers a unique model for training, *i.e.*, it is cost effective, modelled on relevant training curricula, and leads to local retention and ongoing postgraduate support (https://theapfp.org). Currently, nine paediatricians have trained in paediatric neurology, inclusive of electrophysiology skills, via the APFP from: Kenya (2), Tanzania (1), Ghana (1), Uganda (1), Serra Leone (1), Nigeria (1) and Sudan (2). Three are currently in training in Kenya (2), Sudan (1) and Botswana (1) and will add to the above figures. Further paediatric trainees from Sudan (1), Uganda (1), Zimbabwe (1), Kenya (1), Nigeria (2) and Mali (1) are accepted to enter the program. This would also target the burden of the clinical management of epilepsy in SSA. In 2019, the authors ran a pilot project to support the training needs for a trainee from Kenyatta University, Department of Medical Physiology who was the APFP's first clinical technology fellow. With an MSc in Biotechnology, the fellow trained on-site for six months, based in the Neurophysiology Unit at Red Cross War Memorial Children's Hospital. He focused his skills on EEG interpretation and other critical elements of paediatric neurodiagnostics before returning home to Kenya in August to lead the neuro-clinical diagnostic team in their new University Teaching and Research Hospital. The neurophysiology/paediatric neurology team at the authors' training site supports in-house child neurology trainees based in Kenya who join the weekly meetings on EEG interpretation and will spend time in the department for study module attachments.

Overall, more training nodes are needed across Africa to improve healthcare workers' knowledge and to help elevate the burden of neurological disorders, especially epilepsy, in Africa.

Study limitations

Only a quarter of the respondents replied to the survey from half of the countries, which may have resulted in some bias with regard to the countries that elected to respond. If all countries had responded, a much broader insight into the needs for paediatric EEG training in SSA would have resulted. However, an NPS response rate above 20% is regarded as a good survey response rate. Of the countries that did not respond, only 5/14 were upper-middle and the rest were low- and low-middle-income countries (9/14). It is unknown whether the latter countries believed that the survey was irrelevant to them, due to their limitations treating patients with epilepsy. There was also some selection bias, as the survey was sent mostly to paediatricians (55%) who were intentionally targeted as the key care providers for children with epilepsy in Africa. Some of the above trained with the APFP program or visited the department for short-term training in paediatric neurology and EEG. Whilst this was a small proportion of the main group, these child neurology trainees often returned as the first specialist in their country and were truly insightful of the challenges and needs to access EEG in their setting. Most incomplete answers came from tertiary/academic hospitals. Some of the respondents may not have been able to answer all the questions, *i.e.*, those invested and interested in the field were more likely to respond.

Conclusion

This study addresses the lack of paediatric EEG access and knowledge amongst doctors and technicians working with children with epilepsy in SSA. Viable training models are needed to target the deficit of practitioners skilled in paediatric EEG in SSA. Examples, such as the APFP apprenticeship training programme, will focus on technicians, namely technology trained, nurses or medical officers, who would be taught a basic curriculum in EEG for paediatrics giving them the foundation to provide safe practice and interpretation of paediatric EEGs in SSA. The technicians would support newly qualified paediatric neurologists returning home to establish service delivery in their country and to provide good EEG paediatric practice. Cohesion with similar collaborative programs is needed to build a strong and sustainable workforce. ■

Supplementary material.
Supplementary data accompanying the manuscript are available at www.epilepticdisorders.com.

Ethical approval.
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