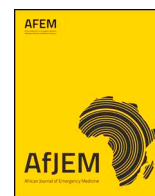




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Original article

## Paediatric Emergency Department preparedness in Nigeria: A prospective cross-sectional study

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## ABSTRACT

**Introduction:** Paediatric emergency medicine (PEM) is poorly developed in low and middle-income countries. The magnitude of challenges facing Paediatric Emergency Departments (PEDs) in Nigeria has not been well described. This study aimed to assess paediatric emergency care preparedness across PEDs in Nigeria.

**Methods:** This was a prospective cross-sectional study that utilized a self-administered questionnaire and a check list to assess three key domains (managerial, medication and equipment) in tertiary care PED facilities that were recruited across Nigeria. Preparedness scores and other institutional attributes were compared between zones and regions.

**Results:** Thirty-four tertiary-level PEDs across Nigeria were included. The mean number of patient visits over the 30-day period prior to data collection was 253.2 ( $\pm$  261.2). The mean (SD) managerial, medication and equipment performance scores of the included PEDs were 42.9% ( $\pm$  14.3%), 50.7% ( $\pm$  22.3%) and 43.9% ( $\pm$  11.8%) respectively. The mean (SD) total performance score was 46.9% ( $\pm$  15.3%). Only 13 PEDs had a total performance score of  $>$  50%. There was a statistically significant higher mean equipment score ( $p = 0.029$ ) in the Southern region ( $47.6 \pm 3.1$ ) compared to the Northern region ( $38.9 \pm 2.3$ ) of the country.

**Conclusions:** This study reports a global but remediable deficiency in emergency care preparedness amongst PEDs in tertiary care facilities in Nigeria. This study highlights the need for training of PED managers in basic and advanced life support and for the improvement in medication and equipment procurement across Nigeria.

## African relevance

- Nigeria had one of the highest global child mortality rates of 104.3 deaths per 1000 live births in 2016.
- Paediatric Emergency Medicine is a well-recognized subspecialty in high-income countries but is still largely under-developed in low- and middle-income countries (LMICs).
- Due to poorly developed health policies and lean healthcare funding, most Paediatric Emergency Centres in LMICs are deficient in equipment, medication and consumables.
- There is a need for further training staff as well as for an improvement in medication and equipment procurement across Nigeria.

## Introduction

Paediatric Emergency Medicine (PEM) is a medical subspecialty targeted at improving the management of children with potentially life-threatening illnesses or injuries [1]. PEM, though a well-recognized subspecialty in high-income countries, is still largely under-developed in low and middle-income countries (LMICs). Due to poorly developed health policies and lean healthcare funding, most of these facilities in LMICs are deficient in equipment, medication and consumables [2–7]. Emergency Departments (EDs) in most LMICs provide services for both children and adults [3].

Nigeria has a population of about 182,202,000, of which 50.4% are younger than 18 years [8]. Despite constituting only 1% of the global

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population, Nigeria contributes nearly 10% of the world's disease burden, caused mostly by preventable infectious diseases [9]. In 2016, Nigeria had one of the highest global child mortality rates of 104.3 deaths per 1000 live births [10]. Late presentation to the ED, delayed interventions, financial constraints, unavailability of life-saving equipment and inadequate support services all contribute to high paediatric mortality rates [4,11–13]. Furthermore, organized public pre-hospital emergency care services are not readily available in Nigeria [14].

Over 50% of deaths in PEDs occur within the first 24 h after admission [5,7,13]. A systematic review of studies conducted in 59 LMICs, showed that around one-tenth of deaths in Nigeria occurred in the ED, but only 17.6% ( $n = 18/102$ ) of EDs employed an emergency medicine specialist [3]. Overall unit performance and outcomes have been shown to be better at PEDs that are managed by emergency medicine specialists [4,15].

Research in PEDs across Nigeria has predominantly focused on the morbidity and mortality patterns of specific disease presentations [4,11–13]. Although a study of PED preparedness was recently conducted in the Southern region of Nigeria [5], no other study has evaluated national PED preparedness. Apart from periodic accreditation visits by relevant postgraduate medical colleges, there is no documented evidence of formal evaluation of PEDs across Nigeria.

This study aimed to assess the emergency preparedness (availability of skilled managers, medication and equipment) of PEDs across tertiary healthcare facilities in Nigeria. It is hoped that this baseline study will stimulate further research with the aim of developing national guidelines for improving paediatric patient outcomes.

## Materials and methods

This was a prospective cross-sectional questionnaire-based study that included tertiary-level PEDs in Nigeria. The Federal Republic of Nigeria is a LMIC with diverse cultures, languages and landscape. The country has a landmass of 923,768 km<sup>2</sup> and a population of over 182 million inhabitants. It is divided into two regions (North and South) which are further subdivided into six geopolitical zones. Each zone is further subdivided into states as follows: South-East (5 States), South-South (6 States), South-West (6 states), North-East (6 States), North-Central (6 States and the FCT) and North-West (7 States). Hence comprising 36 states plus the Federal Capital Territory [9].

The provision of healthcare in Nigeria is a tripartite function of the federal, state and local governments. Tertiary-level health care facilities include academic teaching hospitals, specialist hospitals and federal medical centres which are situated in urban cities of Nigeria and are predominantly administered by the Federal Ministry of Health. PEDs in Nigeria are based in tertiary healthcare facilities and are managed by paediatricians. There are 56 tertiary healthcare PED facilities in Nigeria. Thirty-six are located within university/specialist hospitals and 20 in federal medical centres. The volume of patient presentations at each of the PEDs is dependent on population density, patient complexity and patient acuity. Since PEDs in Nigeria are located in tertiary level care facilities, most PEDs have adopted strict triaging criteria, where patients fulfilling criteria for management in secondary and primary level care facilities are down referred [3,16–19].

Purposive sampling was utilized with the aim of recruiting 37 PEDs across Nigeria (one PED from each of the 36 states and one PED from the FCT). Twenty states had only one PED. All PEDs in these states were approached for study recruitment. There was > 1 PED in the remaining 16 states and the FCT. A simple random sampling method was utilized to select one PED from each of these 16 states and the FTC. In the event that the chosen facility was unable to participate, the random sampling procedure was repeated with the remainder of the facilities.

The questionnaire and checklist was adapted from the American Academy of Pediatrics (AAP) and International Federation of Emergency Medicine (IFEM) checklists [15,20–22]. Components of the questionnaire and checklist included: the number of patients that were

treated in the PED in the last 30 days prior to administration of the questionnaire, the number of patients admitted to the PED short-stay ward, the number of shift duties in the PED, the availability of various grades of doctors and nurses, qualifications of the HOD, nursing manager, doctors and nurses and the availability of recommended essential medications and equipment. A point score scale was devised from items in the three critical domains (managerial, medication and equipment) and used to assess performance of the PEDs. The item selection was based on a tool used in a similar study conducted in South Africa [23]. One point was awarded for each item in each of the 3 domains.

Ethical clearance for the study was granted by the Federal Ministry of Health of Nigeria (NHREC/01/01/2007–21/05/2017) and the University of Witwatersrand (HREC M 1700445). Permission to conduct the study and consent was obtained from the Chief Executive Officer as well as the physician head of department (HOD) and nursing manager of each of the participating hospitals. Data was collected by the primary investigator between 01 June 2017 and 31 January 2018. Relevant sections of the self-administered questionnaire were completed by the HOD and unit nursing manager (or designee) and retrieved upon completion. To determine the availability of medication and equipment (and complete the checklist), a formal inspection was conducted by the primary investigator in conjunction with the unit nursing manager. To ensure the maintenance of anonymity, hospital and staff identifying information were blocked out and replaced with a unique code on the questionnaire for each participating hospital.

Data were entered into an excel spreadsheet (Microsoft® Excel®) and thereafter exported to STATA version 14 (College Station, TX: Stata Corp LP) statistical software. Continuous variables were described using the mean and standard deviation or the median and interquartile range. Categorical variables were reported using frequencies and percentages. The independent *t*-test and one-way analysis of variance (ANOVA) were used to compare the means of normally distributed continuous variables. The Post hoc Bonferroni test was conducted when ANOVA was statistically significant. The Mann-Whitney *U* test and the Kruskal-Wallis test were used to compare the median of non-normally distributed continuous variables. The Pearson correlation coefficient was used to assess for linear relationships between continuous variables. The level of significance was set at  $\alpha < 0.05$  and confidence interval at 95%.

## Results

Of the target of 37 PEDs, 34, comprising 18 from the Northern region and 16 from the Southern region, were eventually recruited. Details of how the final study sample was achieved are described in Fig. 1.

The number of patient visits over the 30-day period prior to data collection ranged from 20 to 1500 with a mean (SD) of 253.2 ( $\pm 261.2$ ). The PEDs were sub-classified into low volume ( $n = 4$ , 11.8%) hospitals (< 100 patients/30 days), medium volume ( $n = 26$ , 76.5%) hospitals (100–500 patients/30 days) and high volume ( $n = 4$ , 11.8%) hospitals (> 500 patients/30 days). The number of patients admitted to each of the PEDs short-stay wards ranged from 16 to 320 with a mean (SD) of 116.4 ( $\pm 68.3$ ) patients. The low volume of patients managed in some PEDs is because 16 (47.1%) facilities have strict triaging criteria, where lower complexity/acuity patients are down referred to secondary and primary level care facilities.

All facilities had a paediatrician as HOD and a nursing manager at the time of the study, but only 18 (52.9%) of the PEDs had a dedicated HOD who was primarily based at the PED with no other clinical responsibilities outside of the PED. The remaining 16 (47.1%) PEDs were overseen by the HOD from the department of paediatrics. Most ( $n = 32$ , 94%) of the PEDs were managed by a HOD with a specialist/fellowship qualification in paediatrics. None of the HODs had a specialist/fellowship qualification in emergency medicine or a sub-specialty fellowship/certificate in Paediatric Emergency Medicine, while only two HODs

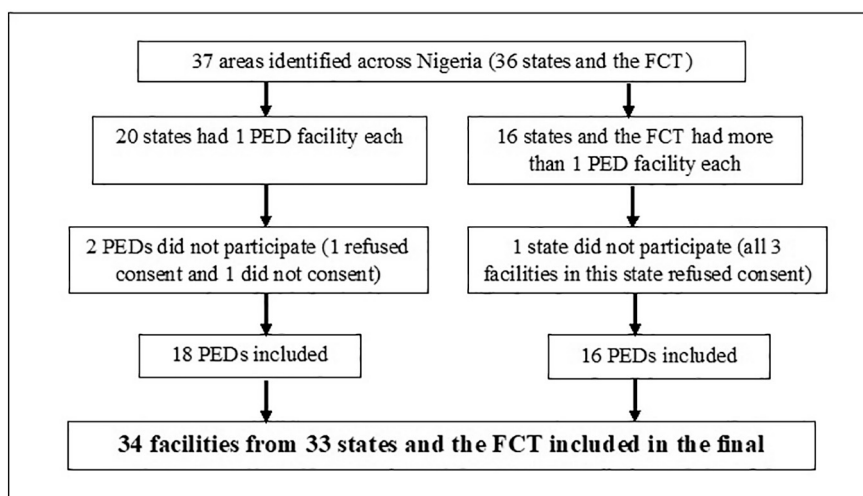


Fig. 1. Flow diagram describing the process in achieving the final study sample.

Table 1

Qualifications and training of HODs and nursing managers across the included facilities.

	Number of PEDs (n/%)
Qualifications of HODs	
MBBCh (or equivalent)	34 (100)
Fellowship in Paediatrics	32 (94.1)
Fellowship in Paediatric Emergency Medicine	0 (0)
Fellowship in Emergency Medicine	0 (0)
Additional related post graduate qualification	2 (5.9)
Refresher activities in the last year	
Paediatric conferences	13 (38.2)
Other continuing professional development activities	20 (58.8)
Current advanced life support courses	
Neonatal Resuscitation	2 (5.1)
Basic Life Support	10 (25.6)
Advanced Paediatric Life Support/Paediatric Advanced Life Support	16 (41.0)
Advanced Trauma Life Support	4 (10.2)
Nursing manager (n = 34)	
Qualifications of nursing managers	
Registered Nurse	34 (100)
Paediatric Nursing Training	27 (79.4)
Paediatric Emergency Nursing Training	4 (11.8)
Additional related post graduate qualification	0 (0)
Refresher activities in the last year	
Paediatric conferences	10 (29.4)
Other continuing professional development activities	14 (41.2)
Current advanced life support courses	
Neonatal Resuscitation	7 (20.6)
Basic Life Support	15 (44.1)
Advanced Paediatric Life Support/Paediatric Advanced Life Support	0 (0)
Advanced Trauma Life Support	0 (0)

(5.9%) had a master's qualification in emergency medicine. All 34 (100%) nursing managers were qualified as registered nurses, while 27 (79.4%) of them also had a qualification in paediatric nursing training. However, only 4 (11.8%) nursing managers had a qualification in paediatric emergency nursing training and none had any related additional qualifications. Attendance at refresher activities and completion of various advanced life support courses are described in Table 1. The majority of the HODs and nursing managers had not completed advanced life support courses.

The availability of various emergency medications at the included PEDs is described in Fig. 2. Besides adrenaline (n = 32, 94.1%),

furosemide (n = 31, 91.2%), dexamethasone (n = 31, 91.2%), hydrocortisone (n = 32, 94.1%), diazepam (n = 33, 97.1%), dextrose 10% or 20% (n = 34, 100%), normal saline (n = 34, 100%), ringers lactate (n = 34, 100%) and oxygen (n = 33, 97.1%), all of the other emergency medications were available in < 90% of PEDs. All 34 (100%) PEDs reported that staff were informed of the location of emergency medications in the PED and had pre-calculated charts and written formula to ensure correct dosing.

The availability of the equipment, consumables, hardware and other miscellaneous items at the included PEDs is described in Fig. 3. Of note, < 20% of PEDs had availability of a central venous catheter insertion set, intercostal drain set, intraosseous cannulation insertion set, fluid warmer, infusion pump set, umbilical vein catheter set, defibrillator and a neck collar. Also, < 10% of PEDs had a cricothyrotomy set, gum elastic bougie, laryngeal mask airway, PEEP valve, CPR board and blood gas analyser. None of PEDs had a colorimeter device, end-tidal carbon dioxide monitor, oesophageal detector device or a mechanical ventilator.

The mean (SD) managerial, medication and equipment performance scores of the included PEDs were 42.9% ( $\pm$  14.3%), 50.7% ( $\pm$  22.3%) and 43.9% ( $\pm$  11.8%) respectively. The mean (SD) total performance score was 46.9% ( $\pm$  15.3%). Only 13 PEDs had a total performance score of > 50%. There was a statistically significant higher mean equipment score (p = 0.029) in the Southern region (47.6  $\pm$  3.1) compared to the Northern region (38.9  $\pm$  2.3) of the country. With regards to the zones, there were differences in mean medication performance scores across the six geopolitical zones. Post hoc pairwise Bonferroni analysis showed that the South-South zone had a significantly lower mean score (27.5  $\pm$  10.84) compared to the South-East zone (63.8  $\pm$  17.15). Although there was an initial suggestion of a statistically significant difference in mean total scores between the 6 geopolitical zones (p = 0.0352), post hoc pairwise Bonferroni analysis did not identify any differences. Details of the above are described in Table 2.

Although a trend towards improvement was noted in the mean medication score from 30.0 (IQR 17.5–32.0) to 32.0 (IQR 17.0–47.0) and the mean equipment score from 40.5 (IQR 32.5–49.5) to 42.5 (IQR 37.0–50.0), there were no statistically significant differences in the mean medication (p = 0.2134) and mean equipment (p = 0.4266) scores between PEDs with and without a dedicated HOD (Table 2).

The correlation of the mean managerial, medication, equipment and total performance scores in the two regions as well as in each of the six geopolitical zones of Nigeria are described in Table 3. In both the North and South regions, the mean medication and equipment performance

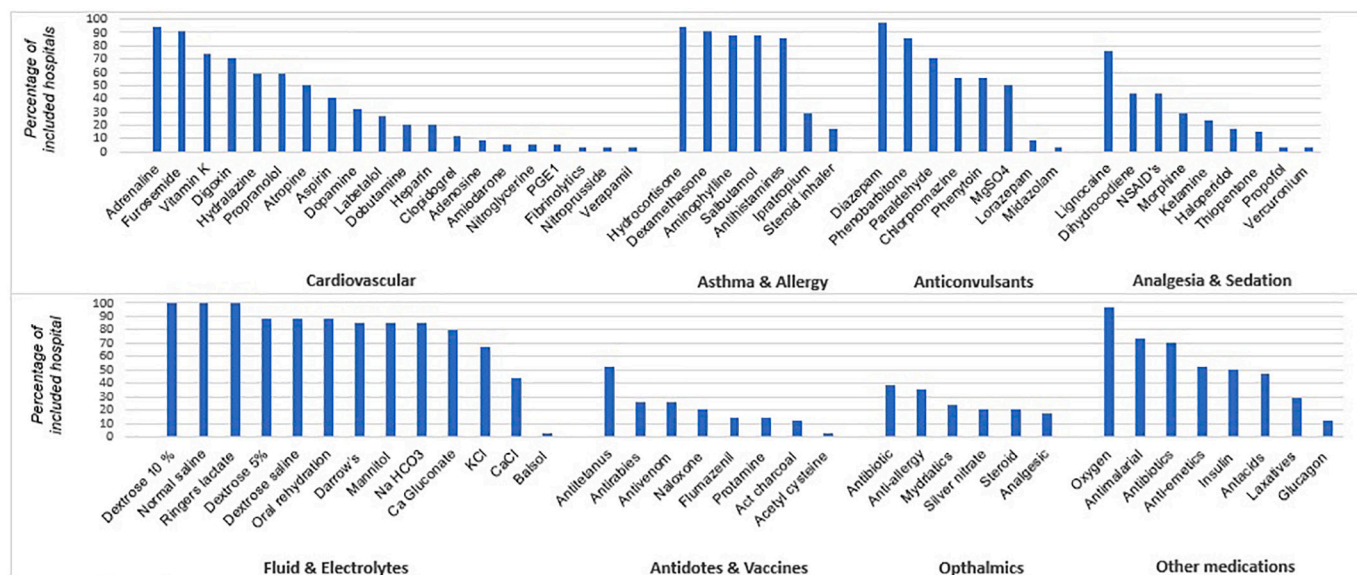


Fig. 2. Percentage of the thirty-four included Paediatric Emergency Departments that had availability of various medications. Medications have been categorized as follows: cardiovascular, asthma and allergy, anticonvulsants, analgesia and sedation, fluid and electrolytes, antidotes and vaccines, ophthalmics and miscellaneous.

scores correlated strongly with the mean total performance scores for the region. Also, the mean medication performance score correlated strongly and significantly with the mean equipment performance score in both the North ( $r = 0.76, p = 0.0003$ ) and South ( $r = 0.71, p = 0.002$ ) regions of the country. With regards to the six geopolitical zones, the mean medication score correlated significantly and strongly with the mean equipment score in the North-West ( $r = 0.92, p = 0.010$ ) and the South-East ( $r = 0.94, p = 0.017$ ) zones, while the mean managerial score correlated significantly and strongly with the mean equipment score in the South-West ( $r = 0.83, p = 0.043$ ) zone.

### Discussion

This study evaluated paediatric emergency care preparedness of tertiary-level PEDs recruited from all the six geopolitical zones in Nigeria. To our knowledge, this study is the first comprehensive nationwide evaluation of PED preparedness in Nigeria.

The presence of a dedicated coordinator in the PED should be the gold standard [4,15,20,21]. Studies have shown that the availability of a full-time paediatrician in the PED has been associated with an improvement in the quality of care [24]. However, our study showed that although a nursing manager was present in all the studied PEDs, only

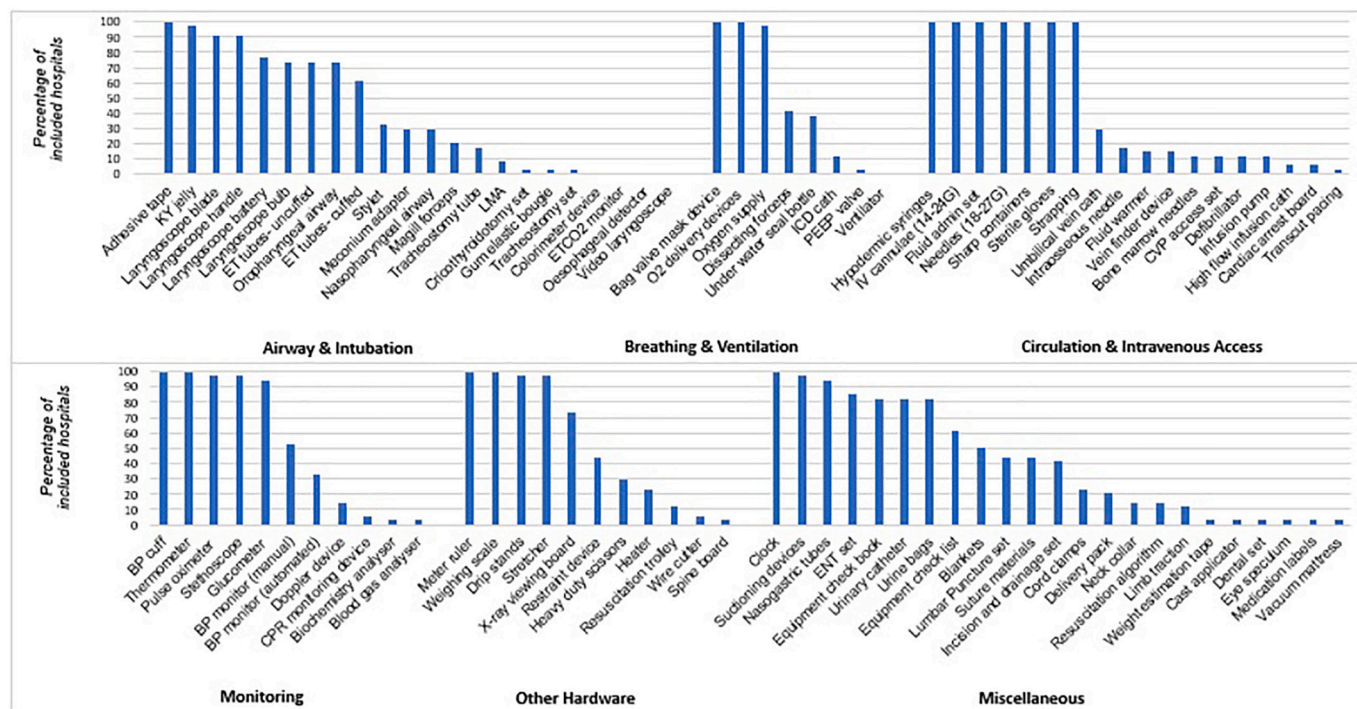


Fig. 3. Percentage of the thirty-four included Paediatric Emergency Departments that had availability of various equipment, consumables, hardware and other miscellaneous items. These have been categorized as follows: airway and intubation, breathing and ventilation, circulation and intravenous access, monitoring, other hardware and miscellaneous.

**Table 2**  
Comparison of the mean managerial, medication, equipment and total performance scores between the North and South regions as well as between the 6 geopolitical zones of Nigeria.

	Managerial Mean (SD)	Medication Mean (SD)	Equipment Mean (SD)	Total score (%) Mean (SD)
North region	2.8 (± 0.3)	26.8 (± 3.1)	38.9 (2.3)	50.1 (4.0)
South region	3.3 (± 0.2)	34.1 (± 4.1)	47.6 (3.1)	43.2 (3.1)
p-Value	0.217	0.166	0.029 <sup>a</sup>	0.195
North-Central zone	2.4 (0.98)	36.1 (10.76)	39.1 (7.56)	41.8 (9.19)
North-East zone	2.8 (1.79)	40.2 (17.66)	40.8 (12.11)	45.0 (14.06)
North-West zone	3.2 (0.98)	34.5 (21.36)	37.2 (11.82)	40.3 (17.51)
South-East zone	3.4 (0.89)	63.8 (17.15)	52.4 (20.11)	64.3 (19.57)
South-West zone	3 (0.71)	50.6 (12.28)	48.0 (4.53)	54.6 (8.20)
South-South zone	3.3 (1.21)	27.5 (10.84)	43.3 (8.10)	39.9 (9.99)
p-Value	0.6690	0.0084 <sup>a</sup>	0.2619	0.0352 <sup>b</sup>

<sup>a</sup> Post hoc pairwise Bonferroni test identified the difference to be between South-East and South-South.

<sup>b</sup> Post hoc pairwise Bonferroni test identified no differences.

<sup>\*</sup> Statistically significant difference.

about half (52.9%) of the facilities had a dedicated physician HOD. This result is marginally higher than a nation-wide web-based study in the USA that reported the availability of a nurse, physician emergency care coordinator or both in 59.3%, 47.5% and 42% of EDs respectively [25,26]. A systematic review that included 59 LMICs found that 28% of facilities had a dedicated physician HOD [3]. In contrast, rates of 70.4% and 100% were reported in Canada [27] and Britain [28] respectively.

Although there was a trend suggesting improved performance scores when a dedicated HOD was available in the included PEDs, the differences were not statistically significant. In contrast, the studies that were conducted in the USA [25] and Canada [27] reported that the presence of a paediatrician and nurse emergency care coordinator was associated with an improved likelihood of a PED having availability of all the recommended equipment and medications as well as a paediatric quality improvement process (adjusted relative risk, 4.11 [95% CI, 3.37–5.02]). In a similar study by Remick et al. [26], the presence of a paediatric emergency care coordinator was associated with an improvement in the quality of care. Similarly, in studies conducted in the USA [25] and Canada [27], the presence of a physician and nurse paediatric emergency care coordinator had a significant impact on paediatric emergency readiness, preparedness scores and adherence to emergency care guidelines.

**Table 3**  
Correlation of the mean managerial, medication, equipment and total performance scores across each of the 6 geopolitical zones of Nigeria.

	Managerial score		Medication score		Equipment score		Total score (%)	
	r	p-Value	r	p-Value	r	p-Value	r	p-Value
<i>Correlation between the two regions</i>								
North region								
Managerial score	1.00	1.000						
Medication score	0.13	0.64	1.00	1.000				
Equipment score	0.10	0.74	0.76	<b>0.0003<sup>*</sup></b>	1.00	1.000		
Total score (%)	0.15	0.58	0.95	<b>&lt; 0.0001<sup>*</sup></b>	0.90	<b>&lt; 0.0001<sup>*</sup></b>	1.00	1.000
South region								
Managerial score	1.00	1.000						
Medication score	-0.15	0.804	1.00	1.000				
Equipment score	-0.10	0.880	0.71	<b>0.002<sup>*</sup></b>	1.00	1.000		
Total score (%)	-0.60	0.284	0.88	<b>&lt; 0.0001<sup>*</sup></b>	0.88	<b>&lt; 0.0001<sup>*</sup></b>	1.00	1.000
<i>Correlation between the six geopolitical zones</i>								
North-Central zone								
Managerial score	1.00	1.000						
Medication score	0.05	0.91	1.00	1.000				
Equipment score	-0.17	0.719	0.69	0.084	1.00	1.000		
Total score (%)	0.24	0.606	0.28	0.541	-0.21	0.649	1.00	1.000
North-East zone								
Managerial score	1.00	1.000						
Medication score	-0.15	0.804	1.00	1.000				
Equipment score	-0.10	0.880	0.53	0.355	1.00	1.000		
Total score (%)	-0.60	0.284	0.81	0.097	0.44	0.464	1.00	1.000
North-West zone								
Managerial score	1.00	1.000						
Medication score	0.14	0.790	1.00	1.000				
Equipment score	0.08	0.876	0.92	<b>0.010<sup>*</sup></b>	1.00	1.000		
Total score (%)	-0.30	0.566	-0.60	0.206	-0.74	0.096	1.00	1.000
South-East zone								
Managerial score	1.00	1.000						
Medication score	-0.32	0.600	1.00	1.000				
Equipment score	-0.30	0.620	0.94	<b>0.017<sup>*</sup></b>	1.00	1.000		
Total score (%)	0.10	0.878	0.69	0.197	0.60	0.290	1.00	1.000
South-West zone								
Managerial score	1.00	1.000						
Medication score	0.64	0.169	1.00	1.000				
Equipment score	0.83	<b>0.043<sup>*</sup></b>	0.71	0.113	1.00	1.000		
Total score (%)	-0.58	0.224	-0.44	0.378	-0.34	0.509	1.00	1.000
South-South zone								
Managerial score	1.00	1.000						
Medication score	0.68	0.207	1.00	1.000				
Equipment score	-0.31	0.609	0.45	0.443	1.00	1.000		
Total score (%)	-0.46	0.434	-0.57	0.319	-0.13	0.835	1.00	1.000

<sup>\*</sup> Statistically significant difference.

In this study, only a handful of PED managers had additional training in PEM. Furthermore, our study revealed that the majority of HODs did not complete advanced life support training courses (88.2%) nor adequately attended continuing professional development (CPD) activities (58.8%). These poor compliances were even more pronounced amongst nursing managers. This pattern of limited professional development amongst nursing managers is similar to findings in other LMICs [3,5,17,29–31].

In line with reports from most LMIC settings [5,6,31–33], we found a below-average mean medication availability score (41.1%). However, some medications such as antimalarials, antibiotics, bronchodilators, anticonvulsants, intravenous fluids and oral rehydration solution were available in > 70% of the PEDs, possibly because of the high burden of infectious diseases in Nigeria [33]. Surprisingly, only 22 (64.7%) PEDs had an emergency drug list. This may potentially result in shortages of critical medications and delayed identification of expired medication in stock [34]. A paediatric emergency care essential drug list should be made available to all PEDs and a mechanism of closely monitoring availability and expiration of essential paediatric emergency drugs cannot be over emphasized.

The availability of equipment to manage the airway, breathing and circulation is vital [1]. The non-availability, malfunction and poor acquaintance with life-saving equipment and monitors have been associated with poor outcomes in emergencies [23]. This study found a below-average state of preparedness in terms of recommended equipment across the country, especially with regards to items that are required to confirm endotracheal intubation, manage dysrhythmias and initiate mechanical ventilation. Similarly, studies in other LMICs also reported poor availability of equipment in the ED [32,33,35].

In keeping with an earlier study that was conducted in Nigeria, the mean total performance score was 46.9% in this study, indicating that the majority of healthcare facilities failed to meet the minimum standard for delivering optimal health care service in Nigeria [33]. A study by Burt et al. reported that the volume of PED visits, the geographic region in which the ED is located and per capita income correlated strongly with each of the preparedness domains [16]. The reason for the unexpectedly low preparedness scores could be due to poor health financing, weaknesses in health administration, inadequate infrastructure, poor service delivery, household poverty and inefficient health care coverage [36].

In a study of primary health care emergency centres in South Africa, Adamson reported the availability of 62% of recommended emergency equipment, 80% of emergency drugs and 52.4% of emergency trolley items [23]. These indices were higher than what was obtained in this study, possibly because emergency medicine is a structured specialty in South Africa [21,37]. In paediatric verified EDs in the USA, preparedness scores of 68.9% and 89.6% were reported [25,26]. Weighting of internationally generated checklist to local epidemiology, workload and available resources may influence preparedness scoring. Hence, it is difficult to directly compare our study with other international studies.

The low-preparedness performance scores of the PEDs in this study calls for a focused effort by the federal government of Nigeria to adequately equip the nation's PEDs, encourage implementation of a periodic peer ranking system [38,39], support on-site accreditation visitations, implement emergency preparedness drills and establish a paediatric emergency medicine fellowship program.

We found that there were significant differences between mean medication scores as well as between mean total performance scores amongst PEDs across the 6 geopolitical zones of Nigeria. Our study found a better preparedness to deliver paediatric emergency care in the South-East zone of Nigeria followed by the South West zones as compared to the other four zones. Similarly, other studies evaluating the availability of medication, equipment and services in Nigeria found higher availability of medication and equipment in the southern states as compared to the north [33]. Internal displacement due to insecurity and insurgencies and high poverty rates in the northern part of the

country may have played a major role in the poor retention of highly skilled manpower in the northern part of the country [40].

There are several limitations to this study. Firstly, since aspects of the questionnaire were self-completed by managers, there is a risk of self-reporting bias. To mitigate this bias, respondents were contacted both telephonically as well as by e mail to verify their responses. Secondly, the scoring tool used was based on the AAP checklist that includes several items that may not be considered essential in resource poor settings. However, since there is no widely accepted guideline on minimum requirements in resource poor settings and, also to maintain uniformity and standardisation of results, we had decided to use the AAP tool. Thirdly, direct comparison of resources and equipment without consideration of workload and resources in randomly selected PEDs with varying number of patient visits may not be representative of care within their geographical region. Though we did not set out to measure level of care, workload or seasonal variation, effort was made to collect data within the same time frame and in similar settings (tertiary facilities). Fourthly, due to the relatively small sample size, this study may not be powered enough to assess certain relationships such as the effectiveness of a dedicated HOD on improving performance scores as well as regional differences. Nevertheless, we are confident that our study has highlighted major deficiencies relating to PED preparedness in Nigeria, thereby drawing the attention of policy makers to current issues.

## Recommendations

Based on our study finding, policymakers should focus on the allocation of resources to improve the state of PED services across the country. In addition, efforts should be channelled at developing national guidelines and checklists that are specific to the needs of the Nigerian paediatric population. Other recommendations include the implementation of a structured subspecialty training program in paediatric emergency medicine, rollout of compulsory advanced life support training courses for all PED staff, employing permanent HODs with training in paediatric emergency care and quality checks on the availability of medications as well as the functionality of equipment. In addition, the introduction of a peer ranking system for PEDs across the country may engender healthy competition and foster the delivery of quality care.

## Conclusion

This nation-wide study assessed the preparedness of PEDs in Nigeria to render quality emergency care to children with undifferentiated emergency presentations. Although our study showed that most PEDs in Nigeria had a paediatrician as HOD, the majority of HODs did not have emergency medicine related qualifications nor advanced life support certification. This together with deficiencies in the availability of medication and equipment depicts a state of poor preparedness. Efforts should be geared towards ameliorating this deficient state of preparedness of PEDs. In addition, poor access to quality healthcare and the skewed spatial distribution of facilities, medication, equipment and skilled manpower across the nation requires urgent attention.

## Dissemination of findings

Results from this study was shared with hospital and emergency department managers at the participating hospitals.

## Authors' contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: CE contributed 50%; AL contributed 30%; MM,

FM, GO and HK contributed 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

### Declaration of competing interest

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