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## Unique triage methods in the paediatric emergency room of a low resource setting

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**Abstract:** *Introduction:* Despite its importance in emergency medicine, the practice of triage in low- and middle-income countries remains rudimentary, due to dearth of human and material resources, among other reasons.

*Subjects and methods:* In the Children Emergency Room of a teaching hospital, some nonclinical staff were intermittently deployed to coordinate patient traffic and provide brief first-contact triage on arrival. For this, they were internally trained in triage. The present study was aimed at assessing the value and accuracy of first-contact triage provided by nonclinical staff in a children emergency department of a tertiary hospital.

*Results:* Data of 45 patients seen during the period were obtained from the records of the triage officers and included their age, gender, presenting complaints and the findings of the paediatric assessment triangle. There was a statistically significant relationship between the triage ratings of the non-

clinical staff and the qSOFA / L-qSOFA scores obtained by the emergency room doctors, the time spent in CHER and the total duration of admission ( $R^2= 0.36 - 0.44$ ;  $p = 0.003$ ), ( $R^2= 0.23 - 0.28$ ;  $p = 0.018$ ) and ( $R^2= 0.33 - 0.40$ ;  $p = 0.007$ ) respectively.

*Conclusion:* This study shows that to a high degree, the nonclinical staff correctly categorized the severity of illness in the Paediatric Emergency Department of a tertiary level hospital, thus limiting undue tertiary delay in treatment and potential harm from such delays. Hence, the study exposes a potential source of human resources for paediatric emergency triage in LMICs where there is a dearth of professional medical personnel.

**Key words:** Triage, Children Emergency Room, Irrua Specialist Teaching Hospital, Paediatric Assessment Triangle, Paediatric Emergency Department, National Youth Service Corps

### Introduction

Triage, the preliminary assessment of patients to determine the disease severity,<sup>1-3</sup> is often weak in LMICs<sup>4,5</sup> where it is fraught with poor facilities, high disease burden, and shortage of human resources.<sup>4,7</sup>

In Nigeria, the emergency care is rudimentary, vulnerable and challenged with limitations in workforce, hospital capacity and financial hardship.<sup>8-10</sup> With the average child-to-paediatrician ratio of 157,878 : 1,<sup>11</sup> allotting triage to resident doctors as practiced in some hospitals<sup>12</sup> is not widely feasible.

Therefore, optimization of scarce resources is recommended,<sup>13,14</sup> for which purpose some nonclinical staff were trained to work as first-contact triage personnel in the Children Emergency Room of Irrua Specialist Teaching Hospital (ISTH). This study evaluated the value of this practice.

### Aims and objectives

#### Broad Aim

The study aims to evaluate the value of brief first-contact triage provided by nonclinical staff in the Paediatric Emergency Department (PED) of a tertiary level hospital.

#### Specific Objectives

The specific objectives of the study are to:

- i. determine the first-contact triage ratings of patients seen in the PED of a tertiary level hospital as assessed by nonclinical staff.
- ii. determine the disease severity of patients seen in the PED of a tertiary level hospital using their qSOFA/ LqSOFA scores, duration of emergency care and total duration of hospital admission.
- iii. determine the relationship between the triage ratings provided by nonclinical staff and the disease severity of patients.

## Materials and Methods

### *Study design and location*

The study was a retrospective observational study carried out in the children emergency room (CHER) of ISTH. The hospital is 358-bed facility owned and run by the Federal government of Nigeria. CHER is a 15-bed ward that receives paediatric medical and surgical emergencies (excluding trauma cases). It offers daily 24hr services inclusive of weekends and is manned by the CHER team of doctors and nurses. Other interns, resident doctors and consultants in the Paediatrics Department take clinical calls in CHER as well.

CHER receives children between the ages of one month to 16 years. Following emergency stabilization and initial treatment in CHER, most admitted patients are transferred to the Paediatric Surgical Ward, the Paediatric Medical Ward or the Lassa Isolation Ward for continuum of care. Patients who require emergency surgical intervention are however transferred to the surgical theatre directly from CHER while those requiring mechanical ventilation are transferred to the general ICU department that serves both the adult and paediatric populations of the hospital.

Between October 2021 to January 2023, National Youth Service Corps (NYSC)<sup>15</sup> members were intermittently deployed to CHER to coordinate patient traffic and provide brief first-contact triage on arrival, at periods when there was transient shortage of triage nurses in CHER. The NYSC program is a compulsory one-year duration of national service undergone by graduates of Nigerian tertiary institutions across the country.

The corps-members assigned to CHER had their disciplines in the social sciences, and their duties were restricted only to official working hours i.e. 8am to 4pm (excluding call hours, weekends, NYSC community development days and any other NYSC activity / training day). The deployment of NYSC staff to CHER occurred only when corps members were posted to the hospital which only occurred intermittently between October 2021 to January 2023

### *Ethics*

This study was carried out with the ethical approval of the hospital's health research ethical committee which complies with the modified Helsinki declaration of 1975.

### *Sampling method*

Total sampling method was used, as data was obtained only from the patients triaged by the NYSC staff during the period they had worked in CHER.

### *Triage procedure*

Upon arrival, the youth-corps members posted to CHER by the central hospital administration received orientation by the head doctor and head nurse of CHER. There-

after, they were introduced to basic concepts of triage as well as the different subdivisions of the emergency unit into which patients could be triaged according to the severity of their illness at presentation.

Specific trainings in the use of the Paediatric Assessment Triangle<sup>16</sup> as a triage tool (Appendix I), as well as red flag symptoms in children<sup>17</sup> were given to them thereafter. The choice of PAT was due to its validity in Paediatrics for identifying the most severe patients as a first step in the triage process.<sup>16</sup> In addition, it is simple to understand and easy to administer in comparison with other triage tools.

The training also included identification of red-flag complaints. Due to the epidemiology of disease in our locale, the red-flag complaints of interest were identified as breathlessness, drowsiness, convulsions, weakness and coma. The triage officers were neither required to conduct a physical examination nor record vital signs of the patients since they lacked both the license and expertise to do so.

Next, practical sessions / demonstrations were organized with patients in real-time, using the three-level triage scale<sup>18</sup>: category 1 / code red (immediate), category 2 / code yellow (urgent) and category 3 / code green (non-urgent). These trainings were done by the Consultant Emergency Paediatrician and the Head Nurse. The first week of their resuming work in CHER was used for this orientation and stepwise training in triage.

Following the tiered trainings and demonstrations, the NYSC staff were put to task under supervision, and corrections made as necessary. Thereafter, the NYSC staff carried out these duties on their own and documented their findings electronically. Due to the simplicity of the tools, the entire triage process was often completed very quickly and did not interfere with smooth delivery of emergency care.

Following triage, the patients were received by the emergency room nurses and doctors who proceeded with treatment, according to the existing routine CHER procedures. The vital signs check was done by the CHER nurses as is routine. Where there was a discrepancy between the triage categorization and the disposition of the patient, the emergency room nurse promptly transferred the patient to the relevant section of the emergency room for appropriate care by the doctors. As the entire emergency room was manned by the same doctors and nurses, it was an internal reallocation and did not require any special re-arrangement nor documentation.

### *Triage tools and categorization*

Using the Paediatric Assessment Triangle (PAT) and presenting complaints (which incorporated red-flag complaints), the triage officers categorized every patient into one of the three triage-level codes: code red, yellow or green. Identification of any red flag complaint by the NYSC staff qualified the patient for the red triage category. In addition, patients with 2 or more abnormal features in PAT were also graded as red.

Conversely, patients with one abnormal PAT item and

no red flag complaint were graded yellow while a completely normal PAT and no red flag complaint triaged the patient into the green zone. No scoring system was required of the triage officers when using the PAT and presenting complaints.

#### Severity classification by doctors in CHER

The scoring scale used in CHER is the quick Sequential Organ Failure Assessment (qSOFA)<sup>19</sup> tool or its modification, the L-qSOFA<sup>20</sup>. The qSOFA score is a bedside tool with increased specificity for mortality<sup>21,22</sup> and predicting organ dysfunction.<sup>23</sup> It is computed by assigning one score for each of 3 criteria (i) increased respiratory rate, (ii) altered mental status or (iii) decreased systolic blood pressure. A qSOFA score of 2 is regarded as suggestive of life-threatening organ dysfunction in the setting of suspected infection.<sup>24</sup> This standard cut off score of 2 was used in the current study to identify severe disease, permitting objective comparisons with the triage grading by the NYSC staff.

The L-qSOFA score on the other hand is a modification of the qSOFA score designed for use specifically in children due to its improved performance in children.<sup>20</sup> It makes use of four parameters namely: (i) increased respiratory rate, (ii) altered mental status (iii) increased pulse rate and (iv) prolonged capillary refill time. Similar to the qSOFA score, a score of 2 is considered as significant for critical care admission and mortality.<sup>24</sup> Since determining the capillary refill time in dark-skinned children may be difficult, and because active resuscitation and treatment are sometimes commenced before detailed examination is done in very ill patients, the capillary refill time is not always determined at admission in every patient in CHER. In such cases the qSOFA score was used to grade disease severity. However, where the capillary refill time was assessed at admission, the L-qSOFA score was used in preference over the q-SOFA score.

#### Patient flow

After receiving medical care in CHER, the patients were transferred to the definitive wards for completion of treatment. They had no further routine official interactions with the NYSC triage staff, and the latter also had no routine official dealings with the patients' case notes or records. Thus, the study was a blinded one. Details of the treatment from CHER through the wards until discharge were documented in the patients' case notes as is routine.

#### Data handling

Data was obtained from the electronic triage records of the NYSC staff as well as the patients' case notes. The data obtained from the case notes included the biodata and vital signs of the patient, presenting complaints documented by the doctors, capillary refill time, diagnosis, and qSOFA /LqSOFA scores, which latter served as indicators of disease severity.

The qSOFA / LqSOFA scores were interpreted thus:

- scores of 2 = severe disease
- a score of 1 = moderate disease
- a score of 0 = mild disease

Other indicators of disease severity also obtained from the patients' case notes was the duration of time spent in CHER as well as the total duration of hospital admission of each patient.

#### Statistical analysis

Data cleaning and analysis were done using the Statistical Package for Social Science (SPSS) version 25. Continuous variables such as age and duration of in-patient care were summarized using means and standard deviations. The duration of emergency care in CHER and the duration of hospital admission were further grouped to form categorical data. They were regarded as the outcomes.

Categorical variables such as gender, triage groups, presenting complaints (symptoms), diagnoses, duration of emergency care, total admission duration, the qSOFA and LqSOFA scores were expressed in frequencies and percentages, while regression and Chi square tests were used to determine the association between categorical variables. For all statistical tests of hypothesis, the level of significance was set at 0.05 and p values were reported.

## Results

A total of 45 patients were enrolled into this present study comprising of 28 (62.20%) males and 17 (37.80%) females. Their ages ranged between 1 month to 16 years with a mean age of 4.11 ( $\pm$  4.21) years. Table 2 shows the age groups of the patients according to gender. There was no statistical difference between the age groups of the patient when their gender was compared.

**Table 1:** Distribution of study population according to age group and gender

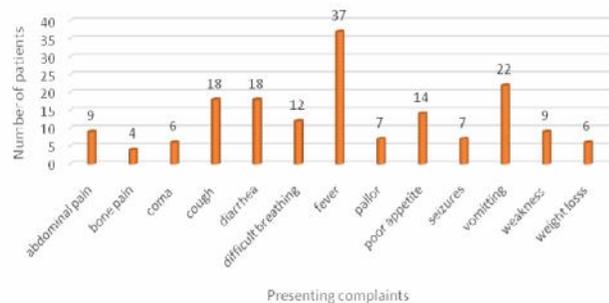
Age group	Male (%)	Female	Total	
Infant (1–12 mo)	9 (64.3)	5 (35.7)	14 (100.0)	
Toddler (>1 yr–3 yrs)	8 (80.0)	2 (20.0)	10 (100.0)	
Preschool (> 3 yrs–6 yrs)	4 (66.7)	2 (33.3)	6 (100.0)	$\chi^2 = 3.652$
School age (>6 yrs–12 yrs)	5 (41.7)	7 (58.3)	12 (100.0)	df = 4
Adolescent (>12 yrs–16 yrs)	2 (66.7)	1 (33.3)	3 (100.0)	p = 0.462
Total	28 (62.2)	17 (37.8)	45 (100.0)	

Majority (30, 66.6%) of the patients who consulted CHER were admitted and treated on in-patient basis. Fever was the most prevalent presenting complaint of the patients (37; 82.2%). Other presenting complaints included: vomiting (22; 49.0%), cough (18; 40.0%),

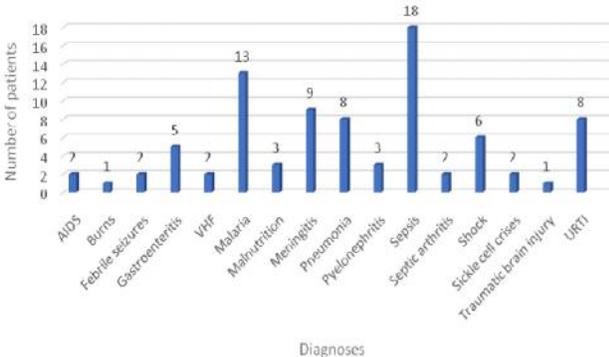
diarrhea (18; 40.0%), poor appetite (14; 31.1%), difficulty with breathing (12; 26.7%), abdominal pain (9; 20.0%), weakness (9; 20.0%), pallor (7; 15.6%), seizures (7; 15.6%), coma (6, 13.3%), weight loss (6, 13.3%), and bone pains, catarrh and headache, each with a frequency of 4 patients (8.9%) respectively. The symptoms are presented in Figure 1.

Figure 2 illustrates the diagnoses made in CHER. The most prevalent diagnoses were sepsis (18, 40%) and malaria / severe malaria (13, 28.9%). Other diagnoses included meningitis (9, 20%), pneumonia (8, 17.8%), upper respiratory tract infections (8, 17.8%), shock (6, 13.3%), gastroenteritis complicated by dehydration (5, 11.1%), pyelonephritis (3, 6.7%), malnutrition (3, 6.7%), viral hemorrhagic fever i.e. VHF (2, 4.4%), septic arthritis (2, 4.4%), status epilepticus (2, 4.4%), febrile seizures (2, 4.4%), sickle cell crises (2, 4.4%), AIDS (2, 4.4%), burns (1, 2.2%) and concussion injury (1, 2.2%).

**Fig 1: Prevalence of symptoms among the patients**



**Fig 2: Diagnoses in CHER**



**Table 2: The relationship between triage categories and SOFA scores**

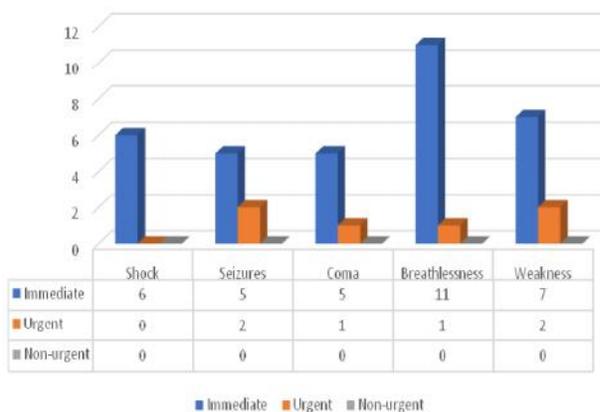
Triage categories	0 n (%)	qSOFA scores 1 n (%)	2 n (%)	Total N (%)	
Immediate	1 (3.4%)	7 (24.1%)	21 (72.4%)	29 (100%)	
Urgent	1 (9.1%)	5 (45.5%)	5 (89.1%)	11 (100%)	R <sup>2</sup> = 0.34 - 0.40 p = 0.016
Non-urgent	4 (20%)	0 (0%)	1 (20%)	5 (100%)	
Total	6 (13.3)	12 (26.7%)	27 (35.6%)	45 (100%)	

Majority of the patients (29, 64.4%) were triaged as red (requiring immediate care), 11 (24.4%) as yellow (requiring urgent care) and 5 (11.1%) as green (requiring non-urgent care). On the other hand, 27 (60%) of the patients had qSOFA / LqSOFA scores of 2, 12

(26.7%) had a score of 1 and 6 (13.3%) had a score of 0. As depicted in Table 3, comparison of the ratings was statistically significant, R<sup>2</sup>= 0.36 - 0.44; p = 0.003.

The red code allotted by the triage officers corresponded with certain clinical findings elicited by the clinicians. All (6 of 6; 100%) of the patients diagnosed with shock had been triaged into the red code zone, while 77.8% (7 of 9), 91.6% (11 of 12), 71% (5 of 7) and 83.3% (5 of 6) of patients with complaints of weakness, breathlessness, convulsions, and coma respectively were categorized into the red code zone. No patient with any of these symptoms was triaged in the nonurgent category. This is shown in figure 3.

**Fig 3: Triaga grading vesus clinical findings**



The patients in this study spent between 1 hour to three days in CHER with a mean duration of 23.3 (± 20.2) hours. On the other hand, the mean duration of total hospital admission was 4.2 (1- 13; ± 3.7) days. As depicted in table 4, there was a significant relationship between the triage ratings by the NYSC staff and the length of time the patients spent in the emergency department (R<sup>2</sup>= 0.23 - 0.28; p = 0.018) as well as the total duration of hospital admission (R<sup>2</sup>= 0.30 - 0.37; p = 0.013).

**Table 3:** The relationship between triage and duration of in-hospital care

Triage Categories	Time spent in CHER (hours)			Total N (%)	
	0 – 24 n (%)	25 – 72 n (%)	> 72 n (%)		
Immediate	8 (27.6)	20 (69.0)	1 (3.4)	29 (100.0)	
Urgent	5 (45.5)	3 (27.3)	3 (27.3)	11 (100.0)	
Non-urgent	4 (80.0)	1 (20.0)	0 (0.0)	5 (100.0)	R <sup>2</sup> = 0.23 - 0.28
Total	17 (37.8)	24 (53.3)	4 (8.9)	45 (100.0)	p = 0.018
Total duration of admission (days)					
	< 1 n (%)	1 – 3 n (%)	4 – 7 n (%)	>7 n (%)	Total N (%)
Immediate	7 (24.1)	0 (0.0)	14 (48.3)	8 (27.6)	29 (100.0)
Urgent	4 (36.4)	3 (27.3)	2 (18.2)	2 (18.2)	11 (100.0)
Non-urgent	4 (80.0)	0 (0.0)	0 (0.0)	1 (20.0)	5 (100.0)
Total	15 (33.3)	3 (6.7)	16 (35.6)	11 (24.4)	45 (100.0)
				p = 0.007	R <sup>2</sup> = 0.33 - 0.40

## Discussion

The present study shows a high admission rate of 66.6% in CHER. Similar findings were observed by Onubogu et al in Rivers State University Teaching Hospital where the admission rate in the Children Emergency Room was 54.9%.<sup>25</sup> These high admission rates may be due to the fact that teaching hospitals in Nigeria are referral centres for primary and secondary health facilities and thus, often receive the most ill patients.

The most common indications for emergency room visits in the present study were infectious diseases, a finding that is prevalent in tropical environments.<sup>26</sup> Similar observations were reported in other paediatric emergency units across the country including Sa'ad and colleagues in Maiduguri<sup>27</sup>, Agbesanwa and colleagues in Ekiti<sup>13</sup>, Kareem and colleagues in Owo<sup>28</sup>, Onubogu and colleagues in Port Harcourt<sup>25</sup>, and Enyuma and colleagues in Calabar<sup>11</sup>. Values as high as 80% of total admissions have been documented in some facilities<sup>28,29</sup> The high prevalence of infectious diseases in tropical environments has been explained as being due to biological and environmental factors that encourage high levels of biodiversity in hosts, vectors, and pathogens, as well as other social factors.<sup>24</sup>

The admitted patients in the present study spent between one to three days in CHER (with a mean time duration of 23 hours) before they were either discharged home or transferred to other units in the hospital. As there is no paediatric intensive care unit in ISTH, the children emergency unit doubles as a mini-intensive care unit by providing services like noninvasive ventilatory support, cardiac support with inotropes, exchange transfusions etc. Thus, the more critically ill a patient is, the longer their stay in CHER is likely to be. Accordingly, the present study uses the length of stay in CHER as an indicator of disease severity in the immediate phase, while the total hospital admission is considered indicative of overall disease severity and organ dysfunction.

Though developed for sepsis, the scope of the qSOFA score now transcends infections and sepsis as it is accurate when used for patients without sepsis.<sup>30</sup> These grading systems are designed for quick use by the bedside to grade disease severity and determine the risk of mortality in admitted patients.<sup>19</sup> Other authors have similarly used the qSOFA score in paediatric populations in Nigeria.<sup>30</sup> In the present study, two or more points on the qSOFA/ LqSOFA scales were interpreted as severe illness and at high risk of mortality, in keeping with the standard recommendation.<sup>19</sup>

Majority (60%) of the patients in our study had high qSOFA/ LqSOFA scores (2 or more points), similar to the study by Hassan et al<sup>31</sup> where 54.6% of their paediatric population had high qSOFA scores. Since both these centres are referral hospitals, it is understandable that their patient clientele would be skewed in favour of children with severe disease, thus accounting for the high qSOFA scores.

Unlike the findings of some studies<sup>30-32</sup>, the high qSOFA/ LqSOFA scores in our study were not associated with higher in-hospital mortality. Schlapbach et al<sup>33</sup> and Goulden et al<sup>34</sup> reported a similar discordance like our study. Thus, although high scores identified patients with severe illness in our study, such patients survived till discharge home.

This could be due to the timely intervention and intensive treatment administered to such severely ill children, which altered the disease trajectory. Indeed, timely intervention is identified as the hallmark of survival from severe disease caused by caused infections,<sup>19</sup> further emphasizing the invaluable importance of triage in the ED. However, larger studies are required to ascertain our finding.

Only the most basic triage tools were used in our study, the pediatric assessment triangle and the patient's presenting complaints. Authors report that the assessment of the initial PAT in triage, readily and reliably identifies high-acuity paediatric patients.<sup>35</sup> Furthermore, research reveals that abnormal PAT findings are an independent risk factor for ICU admission and longer stay in the Pediatric EmergencyDepartment.<sup>16</sup> In these studies

however, nurses administered the PAT in triage.

Unlike most other triage tools, a unique feature of the PAT is that it does not mandatorily require a thorough physical examination or the recording of vital signs. This implies that the PAT is usable by nonmedical persons. In our study, nonclinical NYSC staff were able to easily administer the PAT to patients on arrival of the latter at CHER. To the best knowledge of the researchers, ours is the first study where nonmedical staff were trained to administer a triage tool in Paediatrics.

It is a standard recommendation that triage tools must be targeted to the actual clinical environment where the tool will be used, particularly in low- income countries and rural, primary care settings.<sup>36</sup> As our CHER does not receive trauma patients, more complex trauma triage tools are not required. Thus, PAT suffices for basic triage in paediatric emergency departments, and this was demonstrated by our study.

Remarkably, our study found that the triage classification by the nonclinical staff showed a significant relationship with the qSOFA/ L-qSOFA scores of the patients, as well as the duration of admission in CHER and total hospital admission. This means that, to a high degree, the nonclinical staff correctly and promptly identified the degree of severity of the disease right at the point of presentation, thus determining the urgency of attention required to give sick children.

Furthermore, most of the patients that had the most severe findings during the subsequent reviews of the doctors (i.e. shock, dyspnea, lethargy, convulsions and coma), had earlier been triaged as requiring immediate care by the NYSC staff. As the doctors had had no prior knowledge of the triage categorization of the NYSC staff, this finding further buttresses the accuracy of the initial triage assessments of the staff.

The findings of our study are very relevant to the current situation in Nigeria. With an under-five mortality rate of 110.8 per 1,000 live births,<sup>37</sup> Nigeria still exhibits global deficiency in emergency care preparedness in the Paediatric Emergency Departments of tertiary care facilities.<sup>38</sup> It is particularly worrisome because due to their limited reserve and delicate physiology, sick children may deteriorate very quickly and without notice. Hence prompt and effective emergency care are pivotal to the survival of sick children.

And pivotal to successful emergency care is a reliable triage system. An inaccurate triage decision could prolong patients' waiting time to use the services, which potentially leads to adverse events.<sup>39</sup> This may contribute to the reason why over 50% of deaths in Nigerian PEDs occur within the first 24 hours after admission,<sup>11,38</sup> and brings to fore the importance of prompt, accurate and reproducible triage ratings in the emergency room. With a registered nurse to population ratio of 1 : 1,135<sup>40</sup> and a paediatrician to child ratio of 1 :157,878<sup>12</sup>, adequate staffing of PEDs with trained paediatric medical personnel is a long way from realization in Nigeria. In this regard, our study provides an invaluable exposé to the availability of yet unexplored human resources for

strengthening triage, emergency health systems and the health sector in general. Remarkably, this was achieved at little or no financial costs in our study.

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## Conclusion

Due to the dearth of health resources in Nigeria and other LMICs, innovative methods should be developed to address the unique needs of staffing in the health care systems in these settings, particularly the emergency systems. Our study provides evidential insight into a method of addressing this need and provides a basis for further research. It also exposes the PAT as an easy-to-use tool for paediatric emergency triage in PEDs. Overall, our study addresses a very topical challenge in the emergency health care systems of many countries globally and provides a tenable solution in keeping with evidence-based practice.

## Recommendations

Larger, multicenter studies should be conducted to document the value of locally training and deploying non-medical staff for triage in paediatric emergency systems and even adult Emergency Departments as well.

## Acknowledgements

The authors acknowledge the CHER head-nurse and NYSC staff who worked in CHER as triage officers during the period of this study.

## Limitations

The small sample size and the exclusion of call hours (and weekends) are identified as limitations.

## Author's contribution

Owobu Adaugo Chizoma: Concept, design, definition of intellectual content, literature search, clinical studies, acquisition of data, data and statistical analysis, manuscript preparation, manuscript editing and reviewing.

Ugadu Chukwuemeka: Clinical studies, acquisition of data, manuscript editing and reviewing.

Ugbeni Henrietta: Clinical studies, acquisition of data, manuscript editing and reviewing.

Akhaine Jesu-Oboh Precious: Concept, design, acquisition of data, manuscript editing and reviewing.

**Conflict of interest:** None

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