ORIGINAL ARTICLE

Clinical Staff's Perception and Practice of Point-Of-Care Testing of Acutely-Ill Children and Adolescents at a Referral Hospital in Southern Nigeria

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ABSTRACT

Background: Point-of-care tests (POCTs) can shorten the time taken to arrive at definitive diagnoses in many paediatric illnesses including surgical disorders. Therefore, POCT is a veritable tool in the investigation and management of acutely-ill children in emergency departments (EDs). **Objective:** To evaluate the perception, practice and determinants of point-of-care testing by clinical staff attending to acutely-ill children and adolescents in our centre. **Methods:** This study adopted a cross-sectional design. Data were collected with a semi-structured questionnaire. Participants' overall perception of POCT adequacy was assessed on a 100mm uncalibrated visual analogue scale (VAS). Frequency of POCT device usage and actual point-of-care testing in the preceding 24 hours were documented. Inferential analysis assessed factors influencing participants' perception. P-value < 0.05 was considered significant. **Results**: Altogether, 134 healthcare workers participated in the study; they were mainly from the Children Emergency Room 39 (29.1%), Medical Emergency department 30 (22.4%) and Surgical Emergency department 22 (16.4%). Their mean (SD) age was 33.2 (6.3) years. A majority 98 (85.2%) of them agreed that POCT shortens the time-to-diagnoses in their patients. POCTs recently used in the EDs were pulse oximeter 91 (67.9%), glucometer 85 (63.4%), urinalysis 52 (38.8%) and malaria rapid diagnosis test (mRDT) 43 (32,1%). Professional cadre significantly influenced POCT perception and usage (p=0.02). Participants' overall VAS score on POCT adequacy in the EDs was satisfactory (63.0±24.4) and similar in both gender (t =1.780; p= 0.078). **Conclusion:** Point-of-care testing is favourably perceived and practiced in the evaluation of acutely-ill children and adolescents. There is a need to improve the availability of POCTs in paediatric acute care setting.

Keywords: Point-of-care testing, perception, practice, clinical staff, children, emergency

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Date Submitted 28th July 2024
Date Accepted 20th December 2024
Date Published online 30th December 2024

Access this article online

QuickResponse Code

website:www.bornomedicaljournal.com

DOI: 10.31173/bomj.bomj_2427_21

Introduction

Point-of-care testing (POCT) can shorten the time taken to arrive at definitive diagnoses in many paediatric illnesses including surgical disorders.[1,2] Acutely-ill patients including children and adolescents constitute a high proportion of patients who require POCTs especially in countries with young populations, and they often present late in health facilities in developing settings.[3] This is often due to multi-factorial delays at household, community and hospital levels;[4] this often contributes to the increased morbidity and mortality rates in developing countries.[5,6] It is pertinent to modify or overcome various factors contributing to these delays in the populace by improved health education, easy access to healthcare services and enhanced coverage of health insurance schemes. Nonetheless, emergency preparedness, shortened time to diagnosis and relevant testing to guide clinical decisions are necessary for improved

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outcomes of acutely-ill children after arrival in health facilities.[7]

Therefore, POCT is a veritable tool in the evaluation and management of acutely-ill children in emergency departments, with a wide range of POCT devices such as those functioning via a non-invasive route (pulse oximeter, bilirubin meter), urine test strips (urinalysis strip, pregnancy test strip) and invasive routes such as capillary blood samples (for blood gas analysis, mRDT).[8-10] POCT devices' mechanisms of action differ depending on the nature of the test but refraction of infrared light, oxidative-reductive reaction, antigen-antibody reactions and colour-matching are common underlying principles of POCTs.[11-14] These principles are similar to those used in main laboratories for gold-standard tests. More advanced POCTs exist, for detection of special enzymes and assays like D-dimers, beta-hCG, and biosensors for inborn errors, such as hexokinase and glucose dehydrogenase anomalies.[15]

The usefulness of POCTs has been highlighted as their ability to shorten 'time to diagnose', improve clinical decision making, enhance patient monitoring and overall outcomes.[1,10] Asha et al.[16] in Sydney found that POCT significantly shortening the time required to diagnose with improved cost-effectiveness. Nijman et al.[17] in the Netherlands reported similar findings, with bedside C-reactive protein (CRP) test reducing the length of stay in CHER by 19% after accounting for other factors. Bonner et al.[18] in USA similarly found that POCT improves both the quality of care and overall outcomes of acutely-ill children, while Whitney et al.[19] in USA provided evidence that POCT reduced the cost of treatment of critically ill children. In 2023, Baldeh et al.[20] concluded that there is a need to improve on the availability of POCTs and standard of practice in sub-Saharan Africa. The effective establishment of the REASSURED criteria, especially in low-and-middle-income countries (LMICs) is also of major importance for accurate and effective POCT.[21]

Considering the foregoing and the user-friendliness of POCTs, they should be used in routine clinical care of patients in all settings. However, there is a paucity of data on the utility of POCT in acutely-ill children and adolescents in our locale. This study seeks to evaluate the actual practice of point-of-care testing by healthcare workers attending to acutely-ill children and adolescents in our centre. We also assessed the perceived impact of POCT on their clinical practice, and tested the hypothesis that modifiable factors influence frequent use of POCT by the participants.

Methods

Study Area:

Study location: The study took place in the Children Emergency Room (*CHER*), Surgical Emergency, Medical Emergency, Triage, Obstetrics & Gynaecology Emergency units at the University of Benin Teaching Hospital (*UBTH*), in southern Nigeria. The study period was between May and June 2023.

Study design: This study adopted a descriptive, cross-sectional design.

Subjects: The participants were resident doctors, house officers, Nurses and Paramedics working in the emergency departments (EDs);

Inclusion criteria: All clinical health workers in the emergency department who are POCT users.

Exclusion Criteria: Health workers in the emergency departments who do not use POCT devices on patients in the EDs based on their job descriptions (e.g. ward assistants).

The **Sample Size Determination:** The minimum sample size was determined using the Fisher's formula for cross-sectional study:[22]

A total of 134 healthcare workers were recruited during the study period.

Sampling Technique: Purposive sampling was done; all eligible healthcare workers who consented to the study were consecutively recruited until the minimum sample size was attained.

Data Collection: Data was collected using a semi-structured questionnaire comprising sub-sections on biodata, respondents' perception of POCT, use of POCT amongst children and adolescents, and overall rating of POCT in the various emergency units. Construct validity of the instrument was ascertained following independent reviews by a chemical pathologist and a paediatrician with expertise in POCTs. Participants' perception of POCT usefulness in children was assessed on a 4-point Likert scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). The perception score for each item was derived from the mean score of the participants. A mean score less than 2.5 was rated as inadequate while a mean score of 2.5 and over was rated adequate. Their overall perception of the adequacy of POCT was also assessed on a 100mm uncalibrated visual analogue scale (VAS).

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Statistical Analysis: The data was analyzed using SPSS version 26.0 statistical software for Windows (*IBM, Armonk, N.Y., United States*). Frequencies and percentages were calculated for the socio-demographic features and other categorical variables. Mean scores were computed for the variables assessing participants' perception of POCT on each sub-scale. Reverse scoring was not applied to any item on the sub-scale. Adequate perception was defined with a cut-off point of 2.5; significant difference between weighted mean scores and VAS scores was tested using Student t-test between participants' subgroups. Chi-square was done to detect significant difference between proportions. The level of significance of each test was set at $p < 0.05$.

Ethical consideration: This study was done as part of a larger study that audited point-of-care testing at the institution; ethical approval was obtained from the Health Research Ethics Committee (HREC) of the University of Benin Teaching Hospital (ADM/E22/A/VOL.VII/148301138). Verbal consent was obtained from the study participants. All questionnaires were coded (*without names*) to ensure confidentiality. No invasive procedures or financial inducement was involved in this study.

Results

Baseline Characteristics of the Participants

Altogether, 134 healthcare workers participated in the study; 55 (41.0%) were nurses, followed by resident doctors 45 (33.6%), house officers 17 (12.7%), paramedics 16(11.9%) and a medical officer 1 (0.7%). The leading age groups amongst the participants were 30-39 years 60 (44.8%) and 20-29 years 47 (35.1%); mean age of the participants was 33.2±6.3 years. A majority of the participants were females, 93 (69.4%); while 41 (30.6%) were males. Thirty-nine (29.1%) of the participants were from the Children Emergency Room, 30 (22.4%) from Medical Emergency department, 24 (17.9%) from Obstetrics & Gynaecology Emergency unit, 22 (16.4%) from Surgical Emergency department and 19 (14.2%) from the Triage.

Perception of Point-of-care Tests

A majority 98 (85.2%) of the participants stated that POCT shortens the time to arrive at definitive diagnoses in patients seen at the emergency departments (ED). Also, most 99 (86.1%) of the participants disagreed with the statements that 'POCT increased the duration of stay" in the ED, 'POCT not being cost-effective' 80 (69.6%) and that 'POCT results are more accurate than main laboratory results' 91 (79.1%). Further details of participants' perception scores of statements on POCT utility in the ED are shown in Table 1.

Table 1: Healthcare Workers' Perceptions of Point-of-care Tests

Statements on POCT	Healthcare Workers' perception			
	SD/D	SA/A	Mean	SD
POCT shortens the 'time interval to correct diagnose'	17(14.8)	98(85.2)	3.22	0.85
POCT results are more accurate than lab results	91(79.1)	24(20.9)	2.15	0.73
POCT increases 'duration of stay' in emergency dept	99(86.1)	16(13.9)	1.63	0.85
POCT are not cost-effective	80(69.6)	31(27.0)	1.98	0.95
Weighted Mean score (SD)			**2.25**	**0.85**

POCT =Point-of-care Tests; A =agree, SA =strongly agree, D =disagree, SD =strongly disagree

Practice of Point-of-care Testing

Table 2 shows the frequency of point-of-care testing in children and adolescents in the preceding 3 weeks. The most used POCTs in the ED were pulse oximeter 91 (67.9%) and glucometer 85 (63.4%). This is followed by urinalysis 52 (38.8%) and malaria rapid diagnosis test (mRDT) 43 (32,1%). In the preceding 3 weeks, about two-thirds (73.1%) of the participants have neither used a transcutaneous -bilirubinometer, a blood gas analyser 93 (69.4%), nor a pregnancy test strip 80 (59.7%). Further information on the regularity of POCT use among the participants is shown in Table 2.

Distribution of point-of-care testing of children and adolescents across the various emergency wards that participated in the study is shown on Table 3a while Table 3b shows POCT usage in the preceding 3 weeks based on the different professional cadres of the participants. The use of malaria RDT, Glucometer and pregnancy test strips was similar among them but other POCTs were used by significantly different proportions of the participants during the period.

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More medical and nursing staff than paramedics used pulse oximetry (p= 0.26) and urinalysis (p = 0.027). In addition, more nurses and house officer than other cadres of participants used bilirubinometer (p= 0.041)

Table 2: Frequency of Point-of-care Testing of Children and Adolescents

Point-of-care Test	Frequency of use in the preceding 3 week			
	None	Rarely	Sometimes	Always
Malaria RDT (mRDT)	62(46.3)	12(9.0)	17(12.7)	43(32.1)
Glucocheck /Glucometer	21(15.7)	6(4.5)	22(16.4)	85(63.4)
Pulse oximetry (pulse oximeter)	27(20.1)	2(1.5)	14(10.4)	91(67.9)
Urinalysis (Combi strip)	35(26.1)	10(7.5)	37(27.6)	52(38.8)
PT strip (pregnancy test)	80(59.7)	30(22.4)	17(12.7)	7(5.2)
Bilirubinometer (transcutaneous)	98(73.1)	27(20.1)	4(3.0)	5(3.7)
Blood gas analyser (ABG device)	93(69.4)	26(19.4)	5(3.7)	10(7.5)

Table 3a: Frequency of Point-of-care Testing of Children and Adolescents by Participants' Wards in the preceding 3 weeks

Point-of-care Test	Ward				
	Surgical Emerg. n(%)	Medical Emerg n(%)	Triage n(%)	O&G Emerg n(%)	CHER n(%)
Malaria RDT (mRDT)	12 (52.2%)	9 (30.0%)	21 (60.0%)	4 (50.0%)	24 (77.4%)
Glucocheck / Glucometer	18 (78.3%)	21 (70.0%)	30 (85.7%)	7 (87.5%)	31 (100.0%)
Pulse Oximetry (Pulse Oximeter)	15 (65.2%)	20 (66.7%)	29 (82.9%)	7 (87.5%)	31 (100.0%)
Urinalysis (Combi Strip)	14 (60.9%)	20 (66.7%)	27 (77.1%)	5 (62.5%)	28 (90.3%)
PT Strip (Pregnancy Test)	10 (43.5%)	5 (16.7%)	17 (48.6%)	6 (75.0%)	15 (48.4%)
Bilirubinometer (Transcutaneous)	8 (34.8%)	3 (10.0%)	14 (40.0%)	4 (50.0%)	7 (22.6%)
Blood Gas Analyser (ABG Device)	9 (39.1%)	7 (23.3%)	14 (40.0%)	5 (62.5%)	6 (19.4%)

Table 3b: Frequency of Point-of-care Testing of Children and Adolescents by Participants' Cadre in the preceding 3 weeks

POCT	Resident Doctors	Medical Officers	House Officers	Nurses	Paramedics	Chi-Square	p-value
Malaria RDT (mRDT)	25 (55.6%)	0 (0.0%)	9 (52.9%)	31 (56.4%)	7 (43.8%)	2.020	.732
Glucocheck /Glucometer	35 (77.8%)	1 (100.0%)	17 (100.0%)	49 (89.1%)	11 (68.8%)	8.688	.069
Pulse oximetry	34 (75.6%)	1 (100.0%)	17 (100.0%)	46 (83.6%)	9 (56.3%)	11.087	.026*
Urinalysis (Combi strip)	32 (71.1%)	1 (100.0%)	15 (88.2%)	44 (80.0%)	7 (43.8%)	10.942	.027*
PT strip (pregnancy test)	14 (31.1%)	0 (0.0%)	7 (41.2%)	29 (52.7%)	4 (25.0%)	7.347	.119
Bilirubinometer	6 (13.3%)	0 (0.0%)	5 (29.4%)	22 (40.0%)	3 (18.8%)	9.983	.041*
Blood gas analyser	7 (15.6%)	0 (0.0%)	7 (41.2%)	25 (45.5%)	2 (12.5%)	14.316	.006*

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Report of point-of-care testing in the Preceding 24 hours

Table 4 shows participants' reports of point-of-care testing of children and adolescents within the preceding 24hours. The mean age of the children tested was 6.9± 5.3 years. About two-thirds 45 (64.3%) of the children tested were male. Pulse oximetry, glucose check and mRDT were the commonest POCTs done in the preceding 24hours.

Table 4: Report of Point-of-care testing of children and adolescents in the preceding 24 hours

Point-of-care testing of children and adolescents	Frequency, n	Percentage (%)*
Use POCT in a child in the proceeding 24 hours		
Yes	70	52.2
No	64	47.8
Age of the children investigated with POCT		
< 5 years	34	48.6
≥ 5 years	36	51.4
Sex of the children investigated with POCT		
Male	45	64.3
Female	25	35.7
Types of POCT done in the proceeding 24 hours		
Blood Gas Analysis	1	1.4
Glucometer check/ random blood glucose	21	30.0
Malaria Rapid Diagnostic Test (mRDT)	14	20.0
Urinalysis	12	17.1
Pulse oximetry	32	45.7

**Computed with a denominator of 70 (Yes) for child's age, sex and type of POCT; some participants used ≥1 POCT in the preceding 24 hours*

Perceived Adequacy of Point-of-care Testing

Over a half of the participants 77 (57.5%) rated their satisfaction with POCT use in the ED above average (>50mm on VAS). Also, about one-third 49 (36.6%) of the healthcare workers rated their satisfaction with point-of-care testing as excellent (>70mm on VAS). Their overall VAS score regarding perceived adequacy of POCT in ED was 63.0± 24.4, and it was not significantly influenced by gender ($t = 1.780$; $p = 0.078$) as shown in Table 5. Also, participants' age and recent use of POCT on a child in the ED were not associated with a high perception of POCT adequacy. However, their perceived adequacy of POCT significantly varied with their job status with nurses expressing higher level of satisfaction than other participants ($p < 0.05$; Table 6).

Table 5: Healthcare workers' overall perceived adequacy of point-of-care testing

Perceived Adequacy	Frequency, n	Percentage (%)
VAS score (mm)		
<50	57	42.5
>50	77	57.5
<70	85	63.4
>70	49	36.6
VAS by Gender	Mean*	SD
Male	56.79	21.798
Female	65.90	25.220
Total	62.95	24.44

*VAS= Visual analogue scale (100mm); *Student t-test* ($t = 1.780$; $p = 0.078$)

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Table 6: Factors associated with Perceived Adequacy of Point-of-care Testing

Factors	VAS<70	VAS>70	χ^2	p-value
Status				
Nurses	12 (31.6)	26 (68.4)	10.079	0.02
Others	41(64.1)	23 (35.9)		
Resident doctors	25 (67.6)	12 (32.4)	5.668	0.017
Others	28 (43.1)	37 (56.9)		
Residents	25 (67.6)	12 (32.4)	10.511	0.05
Nurses	12 (31.6)	26 (68.4)		
Others	16 (59.3)	11 (40.7)		
Age group (years)				
<30	31(66.0)	16(34.0)	0.199	0.656
>30	54(62.1)	33(37.9)		
Sex				
Male	28(68.3)	13(31.7)	0.602	0.438
Female	57(61.3)	36(38.7)		
Used POCT in the last 24 hours?				
Yes	40(57.1)	30(42.9)	2.500	0.114
No	45(70.3)	19(29.7)		

Discussion

This study shows majority of the participants believe that point-of-care-testing (POCT) is advantageous in the acute care setting comparable to earlier reports[16-19]. Over two-thirds of participating staff confirmed that POCT shortens the time-to-diagnosis in the Children's Emergency Room (CHER) and the various Emergency Departments (EDs), consistent with reports by Olusegun et al.[24] in Nigeria, which showed that POCT ensures prompts diagnosis of patients presenting in Nigerian health facilities. Likewise, Prince et al.[25] in Kenya reported that POCT significantly shorten the time-to-diagnosis of children with acute bacteria sepsis. It is noteworthy that most of our participants agreed that POCT shorten the overall duration of stay in the ED. This is similar to findings by Singer et al.[26] in America and Goldstein et al.[27] in South Africa that patients evaluated with POCT had shorter duration of stay in the ED irrespective of their underlying diagnosis but there was no direct effect of POCT on outcome in the South African study. However, impacts of POCT on survival till hospital discharge was not sought in our study.

The cost-effectiveness of POCT was widely acknowledged by our participants. POCT has been shown to be a cost-effective intervention in clinical practices by several researchers.[19,28] Whitney et al.[19] in London and Goldstein et al.[27] in South Africa reported on the cost-effectiveness of POCT in their studies. This cost-benefit is particularly noticeable when a POCT is capable of measuring multiple parameters in a single test. Also, POCTs that use wet analytic methods can run multiple tests from one cartridge thereby reducing the unit cost per test.[29] This technique is often used in new generation blood gas analyzers.[30] The shortened duration of admission and cost-effectiveness associated with POCT can minimize the financial burden of healthcare on families, especially in LMIC's where out-of-pocket spending on healthcare can be catastrophic.[19,31] Nonetheless, our participants did not perceive POCT as superior to main laboratory tests in regards to accuracy and diagnostic capability of results obtained. This is consistent with prior research that found diagnostic accuracies of POCT and laboratory tests to be similar.[32] Hence, POCT can be reliably used to guide the management of patients as well as facilitate out-patient monitoring of medical disorders.[1,8]

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The most frequently used POCTs by our participants include glucometer, urinalysis and malaria rapid diagnosis test (MRDT) comparable with reports by Inaku et al.[23] in Calabar that glucose testing by hand-held glucometers and malaria testing by mRDT were often done in their EDs for acutely-ill children. Likewise, Ocheke et al.[33] in Cambodia highlighted the utility of urinalysis in the ED as a part of the initial evaluation of febrile children with suspected urinary tract infection, serving as a diagnostic means of starting treatment while awaiting more specific investigation results. The user-friendliness and high accuracies of these POCTs make them indispensable to clinicians and clinical practice as a whole. Nonetheless, blood gas analysis and percutaneous bilirubinometry are least performed by our participants, apparently due to the limited availability of the devices or cartridges required for the tests. Although they are pertinent in emergency care, advanced POCTs such as blood gas analyzers are rarely available in acute and critical units in resource-limited settings.[34]

The overall rating of adequacy of POCT in CHER and ED by our participants was above average (63.0mm on VAS). About a half (52.2%) of our participants have used POCT on a child in the preceding 24 hours. This confirms that POCT is an integral part of emergency care in our setting, comparable to reports in other climes.[16-18,26] We did not find any association between demographic characteristics of the participants and their perceived adequacy of POCT in the ED but professional cadre influenced overall POCT perception and usage among the participants. This is comparable to findings reported by Onovughakpo-Sakpa et al.[35] in Edo, Nigeria, which showed significant relationships between level of knowledge, hospital characteristics, availability of POCT devices and their utilization with regards to doctors. Similarly, Ihekoronye et al.[36] in Osun found that higher levels of education among community pharmacists was associated with more utilization of POCTs while gender, age and location did not affect POCT adequacy.

The strength of our study includes the assessment of the actual use of POCT by the participants in their recent practices. Although their responses may be influenced by a recall bias, the short interval of use being assessed mitigated this. The limitation of this study includes the lack of data on the outcome of children evaluated with POCT in the ED. Also, we did not explore patients or caregiver's satisfaction with POCT in the index study.

Conclusion

In conclusion, POCT is a proper tool in the evaluation of acutely-ill children and adolescents; it is favourably perceived by healthcare workers in emergency units. There is a need to improve the availability of POCTs in CHERs and EDs to enable prompt diagnosis and treatment of paediatric disorders. A multicentre study exploring factors influencing clinical staffs' satisfaction with POCT is desirable in our setting.

Conflict of Interests: The authors declare that they have no conflict of interests.

Authors' Contributions: Both authors were involved in the conceptualization and writing of the study protocol. Author EA facilitated data collection. MTA analyzed / interpreted data and wrote the initial draft of the manuscript; EA critically reviewed it. Both authors approved the final manuscript.

Funding: The authors received no financial support for the research, authorship, and/or publication of this article.

Availability of data and materials: The study data are available on request to the corresponding author

Acknowledgements: The authors thank the Senior Registrars in Children's Emergency Room (CHER) for facilitating data collection in the unit.

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Cite this Article as: Abiodun MT, Ayinbuomwan E. Clinical Staff's Perception and Practice of Point-Of-Care Testing of Acutely-Ill Children and Adolescents at A Referral Hospital in Southern Nigeria. **Bo Med J** 2023; 21 (2):189-197 **Source of Support**: Nil, **Conflict of Interest**: None declared

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