

Comparative Study of Medical Errors Among Healthcare Workers in Urban and Suburban Healthcare Settings in Edo State, Nigeria

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Abstract:

➤ *Background:*

Medical errors are a major global public health concern, leading to significant patient harm and economic losses. The distribution and determinants of these errors are influenced by the healthcare context, with urban and rural/suburban facilities facing distinct challenges. In Nigeria, patient safety remains under-researched, with little comparative data on medical errors across different settings. This study aimed to fill this gap by comparing the awareness, perception, prevalence, and determinants of medical errors among healthcare workers in urban and suburban facilities in Edo State, Nigeria.

➤ *Methods:*

A comparative descriptive cross-sectional study was conducted from October 2023 to March 2024 among healthcare workers in University of Benin Teaching Hospital (UBTH), an 860-bed tertiary facility in Benin City, and Igbinedion University Teaching Hospital (IUTH) with associated PHCs in Okada, a suburban community. A structured, pretested questionnaire adapted from WHO's Patient Safety Assessment Tool was administered to 485 participants (235 urban, 250 suburban). Data were analyzed using SPSS v25. Chi-square tests assessed associations, and binary logistic regression identified predictors of medical errors. A p-value < 0.05 was considered significant.

➤ *Results:*

Significant differences were found in sociodemographic characteristics, with urban facilities having more doctors and early-career professionals, while suburban facilities had more nurses and mid-career professionals. A positive perception of medical errors was significantly higher among suburban healthcare workers (57.9% vs. 42.1%; OR=4.85). However, the self-reported experience of committing (53.1% vs. 46.9%) and witnessing (53.6% vs. 46.4%) errors was higher in the urban facility. Urban workers more frequently reported communication and procedural errors, while errors were perceived as more "frequent" in urban settings. Key determinants like lack of training, equipment failure, and insufficient protocol standardization were more pronounced in suburban facilities. Logistic regression identified increasing age (OR=1.049, p=0.012) as a significant predictor of errors, and nurses were less likely to report errors compared to pharmacists (OR=0.303, p=0.001).

➤ *Conclusion:*

Medical errors are a significant challenge in both settings, but their nature and underlying factors differ. The urban tertiary center reported a higher frequency of errors linked to system complexity, while suburban facilities were more affected by systemic resource and training gaps. Interventions to enhance patient safety must be context-specific, focusing

on improving communication and procedures in urban areas and strengthening training, equipment, and standardized protocols in suburban areas.

Keywords: Medical Errors, Patient Safety, Healthcare Workers, Urban Health, Rural Health, Nigeria, Comparative Study.

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I. INTRODUCTION

➤ Background

Medical errors, defined as preventable failures in healthcare processes that may result in harm to patients, are a major public health concern worldwide. They encompass diagnostic mistakes, medication errors, communication lapses, procedural failures, and documentation inaccuracies.¹ The World Health Organization (WHO) estimates that unsafe care is one of the top ten causes of death and disability globally, with approximately 1 in every 10 patients experiencing harm while receiving hospital care.² Each year, nearly 2.6 million deaths occur across low- and middle-income countries (LMICs) as a direct consequence of unsafe medical practices and medical errors.

The economic burden is equally profound. In the United States, the annual cost of medical errors is estimated at over \$20 billion, while in LMICs, it is projected that the losses from unsafe care amount to trillions of dollars due to prolonged hospital stays, litigation, and loss of productivity.^{3,4}

The distribution of medical errors, however, is influenced by healthcare context. Urban facilities, although generally better equipped with advanced technology and specialist staff, often face system complexity, heavy patient loads, and communication breakdowns that predispose to errors.⁵ Conversely, rural or suburban facilities tend to struggle with chronic understaffing, inadequate training, lack of standard protocols, and limited equipment.⁶

In Nigeria, patient safety remains an underexplored domain, despite growing evidence of frequent errors in clinical care. Several studies reported that over 40 - 80% of healthcare workers admitted to committing a medical error in the previous year, with documentation and communication failures being among the most common types reported.^{7,8} Yet, little is known about how these patterns differ between urban and rural healthcare facilities, where differences in workload, staffing levels, and training opportunities are stark.

Comparative studies across settings are therefore crucial. While interventions such as electronic prescribing systems and advanced reporting mechanisms have shown promise in urban hospitals, rural health facilities may benefit more from structured training, improved staffing, and standardized operating procedures. Identifying context-specific risk factors will help policymakers design interventions tailored to the realities of both urban and rural environments.

This study was designed to fill this knowledge gap by conducting a comparative analysis of medical errors among healthcare workers in urban and rural settings. By highlighting differences in prevalence, perception, and predictors of errors, the study aims to provide evidence-based recommendations for improving patient safety and strengthening healthcare delivery in Nigeria.

II. MATERIALS AND METHODS

➤ Study Area and Duration

This study was conducted in selected urban and suburban healthcare settings in Edo State, Nigeria, between October 2023 and March 2024.

- Urban site (UBTH, Benin City): The University of Benin Teaching Hospital (UBTH), established in 1973, is an 860-bed tertiary healthcare facility with 23 clinical departments and about 3,870 personnel, including 696 doctors, 750 nurses, and 44 pharmacists. UBTH serves as a referral and training center for Edo and neighboring states (Delta, Ondo, Kogi, and Anambra), offering promotive, preventive, curative, and rehabilitative care.
- Suburban site (Okada community, Ovia North-East LGA): Okada is the headquarters of Ovia North-East Local Government Area, with a population of 153,849 (2006 census). The community is home to the Igbinedion University Teaching Hospital (IUTH), established in 1999, which provides tertiary care and training for medical students, alongside several primary health centers (Okada PHC, Iguiye, Isiuwa, Iyanomo, Oghobahon, and Ugbokun). The population is predominantly Bini, with farming and trading as major occupations.

• The Duration of the Study was Six Months, Including:

- ✓ Conceptualization and proposal development — 1 month
- ✓ Data collection and analysis — 3 months
- ✓ Final report writing — 2 months

➤ Study Design

A comparative descriptive cross-sectional study design was employed to assess the awareness, perception, prevalence, patterns, and determinants of medical errors among healthcare workers in urban (UBTH) and suburban (Okada/IUTH) settings.

➤ Study Population and Selection Criteria

The study population consisted of healthcare workers employed in the selected urban and suburban facilities.

- Urban: Doctors, nurses, pharmacists, and medical laboratory scientists at UBTH.
- Suburban: Doctors, nurses, pharmacists, medical laboratory scientists, community health officers, midwives, and CHEWs in Okada community.

• *Inclusion Criteria:*

- ✓ Healthcare professionals in the specified cadres who had worked for at least six months in the study site.
- ✓ Willingness to provide informed consent.

• *Exclusion Criteria:*

- ✓ Non-clinical staff or those outside the specified cadres.
- ✓ Professionals unwilling to participate or absent during the study period.

➤ *Data Collection and Management*

Data was collected using a structured, pretested, interviewer/self-administered questionnaire, adapted from the WHO Patient Safety Assessment Tool and previous studies on medical errors.

The instrument was pretested among 10% of the sample size in Usen community (Ovia South-West LGA), which shares similar demographic and healthcare characteristics with Okada. Feedback was used to refine clarity, validity, and reliability. Cronbach's alpha was used to test internal consistency of Likert-scale items ($\alpha \geq 0.7$ considered acceptable).

• *Data Management and Analysis:*

- ✓ Data was checked, coded, and entered into SPSS version 25.
- ✓ Descriptive statistics: frequencies, percentages, means, and standard deviations.
- ✓ Bivariate analysis: Chi-square tests.
- ✓ Multivariate analysis: Binary logistic regression was used to identify predictors of medical errors.
- ✓ Level of significance: $p < 0.05$.
- ✓ Results were presented using tables, charts, and prose summaries.

➤ *Ethical Considerations*

- Ethical approval was obtained from the Ethics and Research Committees of UBTH, Benin City, and IUTH, Okada.
- Administrative permission was granted by the management of both hospitals and PHCs.
- Written informed consent was obtained from each participant.
- Confidentiality and privacy were maintained by excluding names and securing data.
- Participation was voluntary, and respondents were informed they could withdraw at any stage without consequences.

III. RESULTS

➤ *Sociodemographic Characteristics of Participants (Table 1)*

A total of 485 participants were studied, of which 235 (48.5%) resided in urban areas and 250 (51.5%) in suburban areas. Age distribution showed a significant difference across locations ($\chi^2 = 63.701$, $p < 0.001$). A higher proportion of respondents aged ≤ 25 years resided in urban settings (56.2%), while those aged 31–40 years were predominantly from suburban areas (76.7% and 84.8% respectively).

Sex distribution was almost equal between both groups, with males constituting 48.4% of urban residents and 51.6% of suburban residents (OR = 0.99, 95% CI: 0.70–1.43, $p > 0.999$). Marital status showed a statistically significant difference ($\chi^2 = 20.134$, $p < 0.001$), as all divorced/separated participants were from suburban areas.

Professionally, doctors were mostly located in urban areas (86.4%), while nurses were predominantly in suburban areas (76.5%). Pharmacists were more evenly distributed. Years of experience also differed significantly ($\chi^2 = 139.279$, $p < 0.001$), with the majority of those with < 1 year experience residing in urban areas.

➤ *Perception of Medical Errors (Table 2)*

Perception of medical errors was significantly associated with place of residence ($\chi^2 = 36.309$, $p < 0.001$). Positive perceptions were more common in suburban areas (57.9%) compared to urban areas (42.1%), and individuals with positive perceptions were almost five times more likely to reside in suburban settings (OR = 4.85, 95% CI: 2.81–8.38).

➤ *Experience and Types of Medical Errors (Table 3)*

Residence significantly influenced participants' experience with medical errors. A higher proportion of urban residents reported committing medical errors (53.1%) compared to suburban residents (46.9%) (OR = 0.67, 95% CI: 0.47–0.96, $p = 0.036$). Similarly, more urban participants had witnessed medical errors (53.6%) compared to suburban participants (46.4%), and this was statistically significant (OR = 0.28, 95% CI: 0.16–0.47, $p < 0.001$).

Regarding the perceived frequency of errors, most suburban respondents reported errors as rare (61.2%), while the majority of urban participants described them as frequent (88.1%).

The most common type of error reported across both groups was medical errors (OR = 1.59, 95% CI: 1.06–2.38, $p = 0.025$). However, urban residents were more likely to report communication errors (59.6% vs. 40.4%) (OR = 0.24, 95% CI: 0.16–0.36, $p < 0.001$). Procedural errors were also significantly more common among urban participants (77.2% vs. 22.8%, $p < 0.001$).

➤ *Determinants of Medical Errors (Table 4)*

Several determinants were compared between urban and suburban participants. Inadequate staffing levels, high workload, and communication breakdown did not differ

significantly between groups. However, three factors showed statistically significant differences: lack of training and education on error prevention ($p < 0.001$), equipment failure ($p < 0.001$), and insufficient standardization of procedures and protocols ($p < 0.001$). Suburban participants consistently rated these factors higher, indicating that systemic issues may be more pronounced in suburban healthcare facilities.

➤ Logistic Regression Analysis (Table 5)

Multivariate logistic regression identified significant predictors of committing medical errors. Age was positively associated with errors (OR = 1.049, 95% CI: 1.011–1.089, $p = 0.012$), suggesting that increasing age slightly raised the likelihood of reporting an error.

Professional position was also a significant predictor. Compared with pharmacists, nurses had significantly lower odds of committing medical errors (OR = 0.303, 95% CI: 0.152–0.603, $p = 0.001$). Doctors showed higher odds (OR = 1.557), but this association was not statistically significant ($p = 0.146$).

Other variables, including sex, marital status, group (urban vs suburban), and years of experience, were not statistically significant predictors in the adjusted model.

Overall, the logistic regression model was significant ($\chi^2 = 62.057$, $df = 9$, $p < 0.001$), with Nagelkerke $R^2 = 0.203$, indicating that approximately 20% of the variance in medical errors was explained by the included predictors. The model correctly classified 67.5% of cases.

Table 1 Sociodemographic Characteristics of Participants

Variables	Residence		OR (95% CI)	χ^2	p-value
	Urban (n = 235) n (%)	Suburban (n = 250) n (%)			
Age group (years)					
≤25	77 (56.2)	60 (43.8)	-	63.701	<0.001*
26 – 30	76 (46.9)	86 (53.1)			
31 – 35	14 (23.3)	46 (76.7)			
36 – 40	7 (15.2)	39 (84.8)			
>40	61 (76.2)	19 (23.8)			
Sex					
Male	109 (48.4)	116 (51.6)	0.99 [0.70 – 1.43]	<0.001	>0.999
Female	126 (48.5)	134 (51.5)			
Marital Status					
Single	124 (44.9)	152 (55.1)	-	20.134	<0.001*
Married	84 (43.1)	111 (56.9)			
Divorced/Separated	0 (0.0)	14 (100.0)			
Profession^a					
Doctor	140 (86.4)	22 (13.6)	-	13.495	<0.001*
Nurse	28 (23.5)	91 (76.5)			
Pharmacist	60 (61.9)	37 (38.1)			
Years of experience					
<1	186 (71.5)	74 (28.5)	-	139.279	<0.001*
1-5	35 (71.4)	14 (28.6)			
>5					

^a Only the Professions Sampled in Both Studies were Compared,

*Statistically Significant

Table 2 Perception of Medical Errors

Variables	Residence		OR (95% CI)	χ^2	p-value
	Urban (n = 235) n (%)	Suburban (n = 250) n (%)			
Perception of medical errors					
Positive	168 (42.1)	231 (57.9)	4.85 [2.81 – 8.38]	36.309	<0.001*
Negative	67 (77.9)	60 (43.8)			

*Statistically Significant

Table 3 Experience and Types of Medical Errors

Variables	Residence		OR (95% CI)	χ^2	p-value
	Urban (n = 235) n (%)	Suburban (n = 250) n (%)			
Ever made a medical error					
Yes	137 (53.1)	121 (46.9)	0.67 [0.47– 0.96]	4.766	0.036*
No	98 (43.2)	129 (56.8)			
Ever witnessed a medical error					
Yes	214 (53.6)	185 (46.4)	0.28 [0.16 – 0.47]	24.179	<0.001*
No	21 (24.4)	65 (75.6)			
Perceived frequency of medical errors in workplace					
Rare	99 (38.8)	156 (61.2)	-	88.296	<0.001*
Occasional	32 (36.0)	57 (64.0)			
Frequent	104 (88.1)	14 (11.9)			
Common types of error					
Medical errors	160 (45.3)	193 (54.7)	1.59 [1.06 – 2.38]	5.080	0.025*
Communication errors	193 (59.6)	131 (40.4)	0.24 [0.16 – 0.36]	48.273	<0.001*
Equipment-related errors	91 (47.9)	99 (52.1)	1.04 [0.72 – 1.49]	0.039	0.853
Documentation errors	192 (49.6)	195 (50.4)	1.26 [0.81 – 1.97]	1.030	0.365
Procedural errors	88 (77.2)	26 (22.8)	0.19 [0.12 – 0.32]	49.284	<0.001*

*Statistically Significant

Table 4 Determinants of Medical Errors

Determinant	Urban Mean $\pm$ S.D	Suburban Mean $\pm$ S.D	t test	p-value
Inadequate staffing levels	4.35 $\pm$ 0.8	4.48 $\pm$ 0.9	1.703	0.089
High workload and burnout	3.91 $\pm$ 0.8	3.80 $\pm$ 1.0	1.369	0.172
Communication breakdown	4.00 $\pm$ 0.9	4.08 $\pm$ 0.8	1.075	0.283
Lack of training and education on error prevention	3.89 $\pm$ 1.0	4.38 $\pm$ 0.9	5.822	<0.001*
Equipment failure	4.14 $\pm$ 0.9	4.56 $\pm$ 0.7	5.790	<0.001*
Insufficient standardization of procedures and protocols	4.29 $\pm$ 0.8	4.43 $\pm$ 0.8	5.840	<0.001*

*Statistically Significant

Table 5 Logistic Regression Analysis of Factors Associated with Medical Errors

Variables	β coefficient	95% CI for Exp(B)	p-value
Group			
Urban	0.743	0.333 – 1.656	0.468
Suburban*	1		
Age	1.049	1.011 – 1.089	0.012**
Sex			
Male	0.886	0.535 – 1.469	0.640
Female*	1		
Marital status			
Single	0.900	0.157 – 5.155	0.906
Married	0.437	0.074 – 2.592	0.362
Divorced/Separated*	1		
Position			
Doctor	1.557	0.857 – 2.829	0.146
Nurse	0.303	0.152 – 0.603	0.001**
Pharmacist*	1		
Years of experience			
1–5 yrs	0.362	0.109 – 1.204	0.097
6–10 yrs	0.515	0.195 – 1.356	0.179
≥ 11 yrs*	1		

*Reference Category,

**Statistically Significant

IV. DISCUSSION

The study revealed significant differences in age distribution between urban and suburban healthcare workers. Younger professionals (≤ 35 years) were more concentrated in suburban areas, while those >40 years were predominantly in urban UBTH facilities. Sex distribution, however, showed no significant variation, consistent with previous findings that gender balance among healthcare workers is becoming more evenly distributed across Nigeria.⁹

Marital status showed statistically significant differences, with all divorced/separated respondents in suburban settings. Professional distribution highlighted that doctors were more likely to be in urban UBTH, while nurses were concentrated in suburban settings. This is similar to studies in sub-Saharan Africa where urban centers attract doctors due to better training and research opportunities, while suburban centers rely heavily on nursing staff for healthcare delivery.^{10,11}

Perception of medical errors was significantly higher among suburban healthcare workers compared to their urban counterparts. Suburban respondents were nearly five times more likely to hold positive perceptions. This may be linked to the closer community–patient relationship in suburban facilities and the growing emphasis on patient safety training in smaller hospitals. Similar trends have been reported in Ghana, where suburban health workers expressed stronger safety concerns due to limited resources and direct patient impact.¹²

The prevalence of self-reported medical errors was higher among urban respondents than suburban respondents. Likewise, witnessing of errors was much higher in urban UBTH compared to suburban settings, reflecting the higher patient turnover and system complexity of tertiary care centers.

The perceived frequency of errors differed significantly: errors were more often described as frequent in urban UBTH, while suburban facilities reported them as rare. This finding aligns with several studies which show that system complexity is a major driver of medical errors in tertiary institutions.^{13,14}

Error types also varied: medical and procedural errors were significantly more common in urban UBTH, while communication errors were disproportionately higher among urban workers compared to suburban. Interestingly, equipment-related and documentation errors did not differ significantly, suggesting these challenges are system-wide and not location-specific.

Key determinants were identified across both settings. Lack of training/education, equipment failure, and insufficient standardization of protocols were significantly more reported in suburban facilities. This suggests systemic weaknesses in training and equipment supply in suburban contexts. Conversely, inadequate staffing and burnout did not differ significantly, implying these are widespread challenges

in both tertiary and suburban settings in Nigeria, as shown in several studies which highlight the deficiencies in staffing and excessive work hours of medical professionals.^{15–17}

Logistic regression identified age and professional cadre as significant predictors. Older age was associated with increased odds of medical error, while nurses were less likely to commit errors compared with pharmacists. Doctors had higher odds of errors, although not statistically significant. Years of experience, sex, and marital status were not significant predictors in this study.

V. CONCLUSION

This comparative study demonstrates that medical errors are a significant challenge in both urban and suburban healthcare settings. The frequency of errors was higher in the University of Benin Teaching Hospital, reflecting the greater complexity and workload characteristic of tertiary centers. In contrast, healthcare workers in suburban facilities displayed a more positive perception of medical errors, suggesting heightened awareness of patient safety concerns.

The determinants of errors varied by setting: suburban facilities were more affected by inadequate training opportunities, frequent equipment failures, and weak standardization of clinical protocols, whereas urban facilities were more prone to communication and procedural errors arising from high patient turnover and system complexity. Furthermore, individual-level predictors played a role, with older health professionals and doctors being more likely to report medical errors, while nurses were less likely to do so.

These findings highlight the need for interventions. Strategies to reduce medical errors must take into account the unique realities of both urban and suburban healthcare environments, strengthening patient safety systems in ways that are responsive to context-specific challenges.

VI. RECOMMENDATIONS

➤ *Strengthen Patient Safety Training*

- Continuous professional development programs should be implemented, especially in suburban facilities where gaps in training were significant.
- Patient safety modules should be integrated into residency and nursing curricula.

➤ *Improve Equipment and Infrastructure*

- Governments and facility managers should prioritize the provision and maintenance of essential equipment in suburban health centers.

➤ *Enhance Communication Systems*

- Urban tertiary centers should deploy standardized communication tools such as SBAR (Situation, Background, Assessment, Recommendation) to minimize communication-related errors.

➤ *Address Staffing and Workload Challenges*

- Recruitment of additional staff and redistribution of workload is needed across both urban and suburban facilities.
- Burnout prevention strategies, including task-shifting and supportive supervision, should be prioritized.

➤ *Standardize Clinical Protocols*

- National and hospital-level guidelines should be enforced, particularly in suburban settings, to reduce variation in practice.

➤ *Promote Error Reporting Culture*

- Establish anonymous, non-punitive error reporting systems in both UBTH and suburban facilities to encourage early detection and prevention.

VII. LIMITATIONS OF THE STUDY

- Recall bias: Self-reported errors may be underreported or exaggerated, affecting prevalence estimates.
- Sampling limitations: The sites may not represent all contexts in Nigeria.
- Cross-sectional design: Limits causal inference; only associations could be determined.

Despite these limitations, the study provides critical comparative insights into medical errors in urban and suburban healthcare settings in Nigeria.

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