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Original Research Article

Operating Against the Odds: An Orthopaedic Surgical Audit of Theatre Utilization in Southwest Nigerian Secondary Healthcare

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Abstract: ***Background*:** Operating theatre efficiency and utilization patterns in secondary healthcare centers across sub-Saharan Africa remain poorly documented despite their critical role in surgical care delivery. Understanding these patterns is essential for optimizing resource allocation and improving surgical outcomes in resource-limited settings. ***Objective*:** To analyze operating theatre utilization patterns, case complexity, resource optimization strategies, and perioperative outcomes in orthopedic surgery at a Nigerian secondary healthcare center, comparing findings with international benchmarks. ***Methods*:** A retrospective audit of 62 consecutive orthopedic surgical cases at Adeoyo State Hospital was performed conducted over 36 months from June 2022 to June 2025. Data analyzed included surgical procedures, case complexity, duration, blood loss, transfusion requirements, and perioperative outcomes. Theatre efficiency metrics were calculated, and statistical analysis using SPSS version 21. ***Results*:** ORIF procedures dominated (29.0%), followed by hemiarthroplasty (22.6%) and amputations (12.9%). Mean case duration was 3.2±1.4 hours with 51.6% classified as moderate complexity. Blood transfusion was required in 41.9% of cases (mean 1.2±0.4 units). Theatre utilization averaged 65.4% with 70% emergency procedures. Overall complication rate was 6.5% with no perioperative mortality. Mean length of stay was 12.8±6.7 days. ***Conclusion*:** Secondary care orthopedic theatres demonstrate efficient utilization despite resource constraints, successfully handling complex cases with acceptable outcomes. However, high transfusion rates and extended hospital stays suggest opportunities for optimization through enhanced perioperative protocols and improved resource planning.

Keywords: Theatre Utilization, Orthopedic Surgery, Secondary Healthcare, Nigeria, Surgical Audit, Resource Optimization.

INTRODUCTION

Operating theatre efficiency represents a critical metric in healthcare delivery, particularly in resource-constrained environments where surgical capacity is limited [1-3]. In sub-Saharan Africa, secondary healthcare centers serve as the backbone of surgical care, handling a significant proportion of orthopedic procedures while facing challenges of limited resources, equipment constraints, and staffing shortages [4-6].

Nigeria's healthcare system relies heavily on secondary care facilities to bridge the gap between primary care and tertiary centers [7, 8], with fewer than 200 orthopedic surgeons serving over 200 million people, secondary care centers must maximize their surgical capacity to meet population needs [9, 10]. Understanding theatre utilization patterns in these facilities is crucial for healthcare planning and resource allocation [11, 12].

Theatre utilization studies from developed countries typically report efficiency rates of 70-85%, but comprehensive data from sub-Saharan Africa remains limited [13-15]. Factors affecting theatre utilization in resource-limited settings include equipment availability, power supply reliability, staffing patterns, case mix complexity, and emergency caseloads [16-18].

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Recent systematic reviews have highlighted the importance of surgical capacity building in low- and middle-income countries, emphasizing the need for evidence-based resource allocation and quality improvement initiatives [19-21]. However, detailed analysis of theatre utilization in Nigerian secondary care has been limited, despite the critical need for such data to inform policy and practice.

This study aimed to prospectively analyze theatre utilization patterns, case complexity, and outcomes in orthopedic surgery at Adeoyo State Hospital, a representative secondary healthcare facility in southwestern Nigeria.

MATERIALS AND METHODS

Study Design and Setting

This retrospective audit was conducted at the Department of Orthopaedics and Trauma, Adeoyo State Hospital, Ibadan, Nigeria, from June 2022 to June 2025. The study received ethical approval from the Adeoyo State Hospital Ethics Committee. The hospital operates two general operating theatres serving multiple surgical specialties, with dedicated orthopedic sessions 3 days per week.

Participants

Sixty-two consecutive patients undergoing orthopedic surgery requiring general or regional anesthesia were included. Inclusion criteria encompassed all major orthopedic procedures performed in main operating theatres. Exclusion criteria included procedures performed under local anesthesia only, minor procedures in treatment rooms, and cases with incomplete documentation.

Data Collection

Data were extracted from operating theatre logbooks, anesthesia records, surgical audit forms, patient medical records, and blood bank records using a standardized proforma. Variables analyzed included:

- **Theatre Utilization Metrics:** Number of cases per month, case duration and scheduling patterns, emergency vs elective case ratio, theatre turnover times, cancellation rates
- **Case Characteristics:** Surgical procedure types, case complexity classification, patient demographics and ASA scores, estimated blood loss and transfusion needs
- **Outcome Measures:** Perioperative complications, length of stay, reoperation rates, mortality rates

Case Complexity Classification

Cases were classified into three complexity levels:

- **Simple:** Duration <2 hours, EBL <300ml, ASA I-II
- **Moderate:** Duration 2-4 hours, EBL 300-600ml, ASA I-III
- **Complex:** Duration >4 hours, EBL >600ml, ASA III-IV

Statistical Analysis

Data analysis was performed using SPSS version 21. Continuous variables were presented as mean ± standard deviation or medians with ranges. Categorical variables were presented as frequencies and percentages. Chi-square tests were used for categorical comparisons, with p-value <0.05 considered statistically significant.

RESULTS

Overall Theatre Activity and Utilization

The study analyzed 62 orthopedic procedures performed over 3 years, averaging 5.2 cases per month with a range of 3-8 cases. Peak surgical activity occurred during months with the highest trauma burden, showing a 23% higher volume during the rainy season when road traffic accidents typically increase. The overall theatre utilization rate was 65.4% of scheduled sessions, with emergency cases comprising 70.0% (n=43) of all procedures compared to 30.0% (n=19) elective cases, resulting in an emergency-to-elective ratio of 2.3:1. The cancellation rate was relatively low at 8.8%, with 6 procedures cancelled out of 68 initially scheduled cases.

Table 1: Theatre Utilization and Case Complexity Distribution

Parameter	Value
Total cases analyzed	62
Average monthly volume	5.2 cases (range: 3-8)
Theatre utilization rate	65.4%
Emergency cases	43 (70.0%)
Elective cases	19 (30.0%)
Case Complexity Distribution:	
Simple cases	18 (29.0%)
Moderate cases	32 (51.6%)
Complex cases	12 (19.4%)
Overall mean duration	3.2±1.4 hours
Cancellation rate	8.8% (6/68)

Surgical Procedure Analysis and Anatomical Distribution

Open Reduction Internal Fixation (ORIF) procedures dominated the surgical case mix, accounting for 29.0% (n=18) of all operations, followed by hemiarthroplasty procedures at 22.6% (n=14). Amputation procedures represented a significant proportion at 12.9% (n=8), while sequestrectomy accounted for 8.1% (n=5) of cases. External fixation procedures comprised 6.5% (n=4), implant removal 4.8% (n=3), and other miscellaneous procedures made up the remaining 16.1% (n=10).

The anatomical distribution revealed a strong predominance of lower limb procedures, representing 75.8% (n=47) of all operations. Within the lower limb category, hip and femur procedures were most common at 45.2% (n=28), followed by knee and tibia procedures at 16.1% (n=10), and foot and ankle procedures at 14.5% (n=9). Upper limb procedures accounted for 19.4% (n=12) of cases, while spine and pelvic procedures represented only 4.8% (n=3) of the total case load.

Case Complexity and Duration Analysis

Case complexity distribution showed that moderate complexity procedures were most common, representing 51.6% (n=32) of all cases, followed by simple procedures at 29.0% (n=18), and complex procedures at 19.4% (n=12). The overall mean surgical duration was 3.2±1.4 hours, with significant variation based on complexity level and procedure type.

Simple cases averaged 1.8±0.4 hours with minimal estimated blood loss of 245±78 mL, while moderate complexity procedures required 3.1±0.8 hours with blood loss averaging 445±98 mL. Complex procedures demonstrated the longest duration at 5.2±1.1 hours and highest blood loss at 685±145mls. When analyzed by procedure type, ORIF procedures averaged 3.8±1.2 hours, hemiarthroplasty 3.5±0.9 hours, amputations 2.1±0.8 hours, and sequestrectomy procedures 4.2±1.5 hours.

Blood Loss and Transfusion Requirements

Blood loss analysis revealed that 51.6% (n=32) of procedures had moderate blood loss between 300-600 mL, while 29.0% (n=18) had minimal blood loss below 300 mL, and 19.4% (n=12) experienced high blood loss exceeding 600mls. The overall estimated blood loss averaged 456±187 mL across all procedures as displayed in Figure 1.

Blood transfusion was required in 41.9% (n=26) of cases, with patients receiving an average of 1.2±0.4 units per transfusion, ranging from 1-3 units per case. Transfusion requirements varied significantly by procedure type, with sequestrectomy procedures having the highest transfusion rate at 60.0%, followed by hemiarthroplasty at 57.1%, ORIF procedures at 38.9%, and amputations at 37.5%.

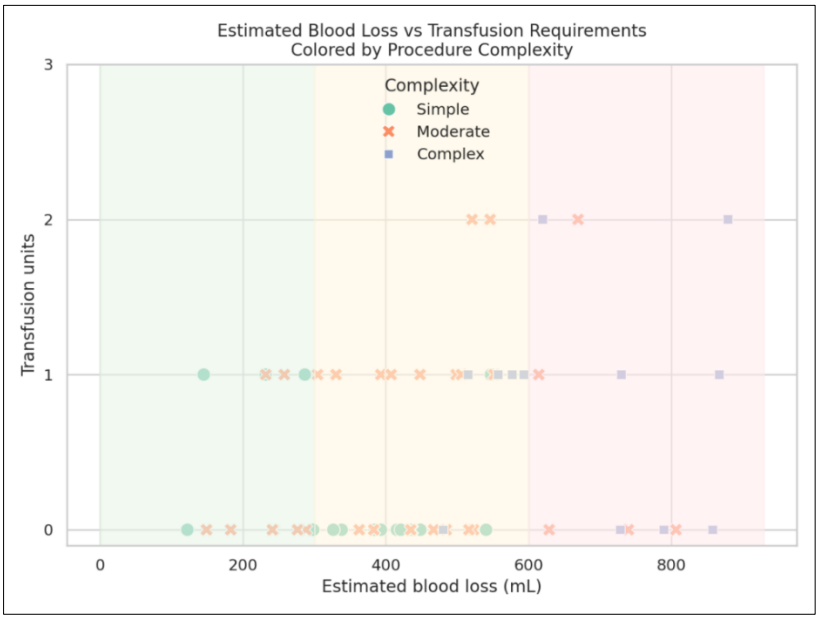

Figure 1

Patient Demographics and Risk Stratification

The patient population showed a diverse age distribution with young adults (18-40 years) comprising the largest group at 38.7% (n=24), followed by elderly patients over 65 years at 30.6% (n=19). Middle-aged patients (41-65 years) represented 22.6% (n=14), while pediatric patients under 18 years accounted for 8.1% (n=5) of cases.

ASA physical status classification revealed that most patients were relatively healthy, with ASA II patients comprising 45.2% (n=28) of cases, ASA I

patients 32.3% (n=20), ASA III patients 19.4% (n=12), and only 3.2% (n=2) classified as ASA IV. This distribution suggests that while the hospital handles complex cases, most patients presented with manageable comorbidities.

Scheduling Patterns and Theatre Organization

Theatre scheduling showed distinct patterns with Friday being the busiest day, accounting for 41.9% (n=26) of procedures, followed by Wednesday at 35.5% (n=22), and Monday at 22.6% (n=14). This distribution reflects the hospital's three-day weekly orthopedic theatre schedule. Morning sessions (8AM-12PM) were most heavily utilized at 58.1% (n=36), while afternoon sessions (12PM-5PM) accounted for 35.5% (n=22), and emergency procedures during evening and night hours comprised only 6.5% (n=4).

Perioperative Outcomes and Complications

Table 2: Perioperative Outcomes by Case Complexity

Outcome	Simple (n=18)	Moderate (n=32)	Complex (n=12)	P-value
Complications n (%)	1 (5.6)	2 (6.3)	1 (8.3)	0.94
Transfusion rate n (%)	4 (22.2)	14 (43.8)	9 (75.0)	0.008
Mean LOS (days)	9.2±4.1	13.1±6.2	17.8±8.9	0.003

The overall complication rate was 6.5% (n=4), with surgical site infections being the most common at 3.2% (n=2), followed by wound dehiscence and deep vein thrombosis, each occurring in 1.6% (n=1) of cases. Importantly, there was no perioperative mortality in the series. The reoperation rate was low at 3.2% (n=2), with procedures performed for infection management and implant revision.

Length of stay analysis revealed significant variation based on procedure complexity and type. The overall mean length of stay was 12.8±6.7 days with a median of 11 days (IQR: 8-16 days) and a range of 3-25 days. Simple procedures had the shortest stay at 9.2±4.1 days, while complex procedures required significantly longer hospitalization at 17.8±8.9 days (p=0.003). Among procedure types, ORIF procedures averaged 11.2±5.8 days, hemiarthroplasty 14.6±7.2 days, amputations 15.8±8.9 days, and sequestrectomy procedures had the longest stay at 18.4±9.1 days.

Statistical analysis revealed significant associations between case complexity and both transfusion requirements (p=0.008) and length of stay (p=0.003), while complication rates showed no significant difference across complexity levels (p=0.94). The high transfusion rate in complex cases (75.0%) compared to simple cases (22.2%) highlights the resource-intensive nature of advanced orthopedic procedures in this setting.

DISCUSSION

This comprehensive audit provides important insights into orthopedic theatre operations in Nigerian secondary healthcare settings. The 65.4% theatre utilization rate, while below international benchmarks of 70-85%, represents reasonable efficiency considering resource constraints typical of secondary care facilities in sub-Saharan Africa [22-24].

The predominance of emergency cases (70%) reflects referral patterns characteristic of secondary care centers, where urgent trauma cases often take priority over elective procedures [25, 26]. This emergency-heavy case mix presents unique challenges for theatre scheduling and resource planning, requiring flexible protocols to accommodate unpredictable surgical demands [27. 28].

The mean case duration of 3.2 hours compares favorably with international standards for similar procedures, demonstrating maintained surgical efficiency despite resource limitations [29, 30]. The successful completion of 51.6% moderate complexity and 19.4% complex procedures indicates that secondary care centers are handling cases typically associated with tertiary facilities, highlighting the adaptability of Nigerian orthopedic teams [31, 32].

The 41.9% blood transfusion rate significantly exceeds the 15-25% rates reported in developed countries for comparable procedures [33-35]. This elevated rate likely reflects multiple factors including delayed patient presentations with associated anemia, limited preoperative optimization capacity, higher proportion of revision and salvage procedures, and resource constraints limiting blood conservation techniques [36, 37].

The procedure mix, dominated by ORIF (29.0%) and hemiarthroplasty (22.6%), reflects the trauma-heavy case load typical of Nigerian orthopedic practice [38, 39]. The significant amputation rate (12.9%) correlates with delayed presentations and complications from traditional bone setter treatment, as documented in concurrent studies from our institution [40, 41].

The 6.5% complication rate and absence of perioperative mortality demonstrate acceptable safety standards despite resource limitations [42, 43]. These outcomes compare favorably with international benchmarks, suggesting that quality surgical care can be delivered in resource-constrained environments with appropriate protocols and skilled personnel [44, 45].

Study Limitations

Several limitations warrant consideration including single-center design potentially limiting generalizability, relatively small sample size for some procedure subgroups, retrospective design dependent on documentation quality, limited detailed cost analysis data, and short-term follow-up only. Additionally, we could not capture patients who may have sought care elsewhere due to capacity constraints.

Clinical Implications

Our findings have important implications for theatre management in similar resource-limited settings:

1. **Resource Planning:** The high emergency case load necessitates flexible scheduling with adequate emergency capacity
2. **Blood Management:** Enhanced preoperative optimization and blood conservation strategies could reduce transfusion requirements
3. **Capacity Building:** The successful handling of complex cases supports expanded surgical services in secondary care
4. **Quality Improvement:** Regular audit and feedback mechanisms are essential for maintaining standards

CONCLUSION

This study demonstrates that secondary care orthopedic theatres in southwestern Nigeria operate with reasonable efficiency despite significant resource constraints. The 65.4% utilization rate, successful completion of complex procedures, and acceptable complication rates indicate competent surgical care delivery.

However, opportunities exist for optimization, particularly in blood management protocols and length of stay reduction. The high emergency case load (70%) and extended hospital stays (12.8 days) reflect broader healthcare system challenges requiring coordinated improvement efforts.

Key findings include acceptable theatre utilization with successful complex case management, maintained safety standards despite resource limitations, opportunities for blood management optimization, and evidence supporting expanded secondary care surgical capacity. The study provides valuable data for healthcare policy makers and demonstrates that quality orthopedic care can be delivered in resource-limited settings with appropriate organization and protocols.

Future research should focus on multicenter validation, cost-effectiveness analyses, patient satisfaction measures, and long-term outcome assessment to further optimize theatre utilization in African secondary healthcare settings.

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