The impact of establishing a regional anesthesia block room on the perioperative journey at a major teaching hospital in Rwanda, 2025

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ABSTRACT

INTRODUCTION: Regional anesthesia offers important advantages over general anesthesia, including improved analgesia, fewer perioperative complications, and enhanced operating room (OR) efficiency. However, evidence on the implementation and impact of regional anesthesia block rooms (BRs) in low-resource settings remains limited. This study evaluated the effect of establishing a BR on perioperative efficiency at a tertiary teaching hospital in Rwanda.

METHODS: This quality improvement study employed a pre–post implementation design guided by the Plan–Do–Study–Act (PDSA) framework and reported in accordance with SQUIRE 2.0 guidelines. Conducted at Centre Hospitalier Universitaire de Kigali between May and October 2023, the study compared perioperative time metrics before and after BR implementation. Outcomes included peripheral nerve block (PNB) duration, time from PNB completion to incision, surgical duration, and post-anesthesia care unit (PACU) stay. Data were analyzed using descriptive statistics and inferential tests, with significance set at $p < 0.05$.

RESULTS: A total of 46 patients were included (20 pre-implementation, 26 post-implementation), with comparable baseline characteristics across groups. The introduction of the BR was associated with a significant increase in surgical time (88.4 ± 77.9 vs. 101.5 ± 37.3 minutes; $p < 0.05$), corresponding to a mean gain of 13.1 minutes per case. No significant differences were observed in PNB duration, PNB-to-incision time, or PACU length of stay. No complications related to regional anesthesia were reported.

CONCLUSION: The implementation of a BR in a resource-limited setting is feasible and improves OR efficiency without compromising patient safety. Scaling such interventions requires investment in workforce capacity, structured training, and improved perioperative coordination.

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INTRODUCTION

Regional anesthesia has become an essential component of modern perioperative care, particularly in obstetric, trauma, and orthopedic surgery, where it is associated with improved clinical outcomes and system efficiency [1–3]. Compared with general anesthesia, regional techniques reduce perioperative airway and respiratory complications, provide superior analgesia, shorten post-anesthesia care unit (PACU) stay, and enhance operating room (OR) efficiency [1,3]. These advantages are especially relevant in resource-limited settings, where optimizing efficiency and patient safety is critical.

In high-income countries, regional anesthesia services are well established, supported by dedicated regional anesthesia and acute pain management (RAAPM) training programs and the use of block rooms (BRs) to facilitate parallel processing of care [4]. A block room allows peripheral nerve blocks (PNBs) to be performed outside the operating room, thereby minimizing delays and improving workflow efficiency [5–7]. This model has been shown to reduce anesthesia-controlled time, improve patient flow, and increase surgical throughput [5,8].

In contrast, the adoption of structured regional anesthesia services in sub-Saharan Africa remains limited. Although progress has been reported in several countries including Ghana, Uganda, Rwanda, and Ethiopia, implementation is often constrained by shortages of trained personnel, inconsistent availability of consumables, and limited institutional support [8–10]. In Rwanda, while ultrasound-guided PNBs are increasingly practiced, their use remains inconsistent due to variability in expertise and resource availability.

At Centre Hospitalier Universitaire de Kigali (CHUK), a previous attempt to establish a block room in 2016 was unsuccessful due to staffing constraints, inadequate supplies, and limited local ownership. Importantly, block room models developed in high-resource environments are not directly transferable without contextual adaptation [11,12].

To address these gaps, a quality improvement initiative was undertaken to implement a context-adapted block room at CHUK. This study aimed to evaluate the impact of this intervention on the perioperative journey, specifically assessing its effect on efficiency within the Surgical Preparation Unit (SPU), operating room, and PACU. The findings provide context-specific evidence on the feasibility and effectiveness of block room implementation in a low-resource setting and may inform scale-up strategies in similar environments.

METHODS

Study Design

This study was conducted as a quality improvement project using a pre–post implementation design guided by the Plan–Do–Study–Act (PDSA) framework. Reporting followed the Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) guidelines [16]. The project was implemented over four phases between February and October 2023.

Study Setting

The study was conducted at Centre Hospitalier Universitaire de Kigali (CHUK), a tertiary referral and teaching hospital in Kigali, Rwanda, serving a population of over 6.2 million people. The hospital has approximately 513 beds and provides comprehensive medical and surgical services. The anesthesia department consists of 10 anesthesiologists and 10 rotating residents, supporting eight operating rooms and more than 10,000 surgical procedures annually. Regional anesthesia is performed by anesthesiologists and supervised residents.

Intervention and Implementation (PDSA Cycles)

Plan Phase (May–June 2023): Baseline perioperative workflows were assessed prior to implementation. In the standard process, patients requiring peripheral nerve blocks were transferred from the Surgical Preparation Unit (SPU) to the operating room, where blocks were performed after initiation of anesthesia monitoring and intravenous access. This workflow contributed to delays and inefficiencies within the OR.

Stakeholder engagement was conducted through a series of meetings involving hospital leadership, anesthesia and surgery department heads, nursing leadership, and pharmacy representatives. These discussions aimed to define roles, secure institutional support, and allocate space and resources for the block room. Baseline data on perioperative timelines were collected over eight weeks to inform process redesign.

Do Phase (July 2023): A dedicated block room was established within the preoperative holding area, equipped with two beds, monitoring devices, an ultrasound machine, and essential supplies for regional anesthesia. Preoperative assessment identified eligible patients for PNBs, and informed consent was obtained.

On the day of surgery, patients were transferred from the SPU to the block room, where standard ASA monitoring and intravenous access were established prior to performing and confirming successful nerve blocks. Patients were then transferred to the operating room for surgery, followed by routine transfer to PACU postoperatively. Process refinements included reallocating a non-physician anesthetist to PACU to facilitate patient flow and reduce discharge delays.

Study Phase (August–September 2023): Perioperative time metrics were prospectively collected using the same methodology as the baseline phase. These included timestamps for patient movement through SPU, block room, operating room, and PACU. Key outcome measures included: Peripheral Nerve Block (PNB) duration; time from PNB completion to surgical incision; surgical duration (incision to closure); and PACU length of stay.

Act Phase (September 2023 onward): Post-implementation evaluation identified areas for improvement, including the need for consistent staffing of the block room and improved scheduling coordination. Strategies under consideration include dedicated staffing models and enhanced surgical planning to optimize block room utilization.

Study Population

The study included all adult patients undergoing elective orthopedic surgery under regional anesthesia during the study period. Emergency cases and patients who declined consent were excluded.

Sample Size

A total of 46 eligible patients were included during the implementation phase (August–September 2023). The sample size was determined by feasibility constraints, including limited block room operational days and staffing capacity. Given that the intervention was delivered by two anesthesiologists working on alternating schedules, the risk of systematic selection bias was considered low. However, temporal variations in case complexity and resource availability may have introduced variability.

Data Collection and Analysis

Data were collected prospectively using standardized data collection forms and analyzed using STATA version 15.0 (StataCorp, USA). Categorical variables were summarized using frequencies and percentages, while continuous variables were described using means and standard deviations.

Comparisons between pre- and post-intervention periods were performed using the chi-square test for categorical variables and the independent t-test for continuous variables. Statistical significance was defined as a p-value < 0.05.

Ethical Considerations

Ethical approval was obtained from the CHUK Institutional Review Board (EC/CHUK/031/2023). Written informed consent was obtained from all participants prior to inclusion.

RESULTS

Participant Characteristics

A total of 46 patients were included in the analysis, with 20 patients in the pre-implementation group and 26 in the post-implementation group. There were no statistically significant differences in baseline characteristics between the two groups, indicating comparability. The mean age was similar before and after block room (BR) implementation (40.7 ± 17.2 vs. 42.9 ± 18.9 years; $p > 0.05$). The sex distribution was also comparable, with males accounting for 60.0% (n = 12) before and 57.7% (n = 15) after implementation ($p > 0.05$). The spectrum of surgical diagnoses was broadly similar across both groups, with upper limb fractures being the most common indications. Likewise, the types of regional anesthesia techniques performed did not differ significantly between groups ($p > 0.05$), with supraclavicular and interscalene blocks being the most frequently used approaches. No complications related to peripheral nerve blocks (PNBs) were reported in either period (0% vs. 0%) (Table 1).

Table 1: *Characteristics of patients undergoing regional anesthesia at CHUK before (N:20) and after (N:26) BR initiation*

Variable	Before BR (n = 20)	After BR (n = 26)	P-value
Age (years), mean ± SD	40.7 ± 17.2	42.9 ± 18.9	>0.05
Sex, n (%)			
Male	12 (60.0)	15 (57.7)	>0.05
Female	8 (40.0)	11 (42.3)	
Diagnosis, n (%)			
Radius fracture	4 (20.0)	4 (15.4)	>0.05
Humerus fracture	8 (40.0)	8 (30.8)	
Ulna fracture	1 (5.0)	1 (3.8)	
Forearm laceration	1 (5.0)	2 (7.7)	
Metacarpal fracture	1 (5.0)	2 (7.7)	
Finger injury	1 (5.0)	1 (3.8)	
Elbow dislocation	1 (5.0)	1 (3.8)	
Diabetic foot	1 (5.0)	1 (3.8)	
Leg ulcer	1 (5.0)	0 (0.0)	
Foot tumour	1 (5.0)	0 (0.0)	
Others*	0 (0.0)	6 (23.1)	
Regional anesthesia technique, n (%)			
Interscalene	7 (35.0)	8 (30.8)	>0.05
Supraclavicular	7 (35.0)	12 (46.2)	
Axillary	3 (15.0)	1 (3.8)	
Adductor canal / Popliteal	3 (15.0)	5 (19.2)	
Complications, n (%)			
Yes	0 (0.0)	0 (0.0)	>0.05
No	20 (100)	26 (100)	

Others#: ankle fracture, implant removal, arm tumor, crash injury of the arm

Perioperative Time Outcomes

The implementation of the block room was associated with a significant increase in surgical time available in the operating room. As seen in Table 2, mean surgical duration increased from 88.4 ± 77.9 minutes before implementation to 101.5 ± 37.3 minutes after implementation, representing a mean gain of 13.1 minutes per case ($p < 0.05$). In contrast, there were no statistically significant differences observed in other perioperative time intervals. The mean duration of PNB procedures remained comparable between groups (31.0 ± 12.3 vs. 32.7 ± 8.9 minutes; $p > 0.05$). Similarly, the time from PNB completion to surgical incision showed no significant change (28.75 ± 14.6 vs. 24.5 ± 11.1 minutes; $p > 0.05$). Postoperative recovery time in the PACU was also similar before and after the intervention (70.7 ± 34.9 vs. 67.2 ± 44.7 minutes; $p > 0.05$).

Safety Outcomes

No complications related to regional anesthesia were observed during either the pre-implementation or post-implementation periods. This finding suggests that the introduction of the block room did not compromise patient safety while improving operating room efficiency.

DISCUSSION

This study demonstrates that implementing a context-adapted regional anesthesia BR in a resource-limited tertiary hospital is feasible and associated with measurable improvements in operating room efficiency. Specifically, the intervention resulted in a statistically significant increase in surgical time available per case (+13.1 minutes), without compromising procedural duration, recovery time, or patient safety. These

Table 2: *Comparison of Perioperative Time Outcomes Before and After Block Room Implementation*

Outcome (minutes)	Before BR (Mean ± SD)	After BR (Mean ± SD)	P-value
PNB duration	31.0 ± 12.3	32.7 ± 8.9	>0.05
PNB completion to incision	28.75 ± 14.6	24.5 ± 11.1	>0.05
Surgical time (OR time)	88.4 ± 77.9	101.5 ± 37.3	<0.05
PACU stay	70.7 ± 34.9	67.2 ± 44.7	>0.05

BR=Block Room, OR = Operating Room, PNB = Peripheral Nerve Block, PACU = Post-Anesthesia Care Unit, SD=Standard Deviation. Surgical time was defined as the time in the OR controlled by the surgeon (Time from skin incision to completion of the final suture).

findings suggest that reorganizing perioperative workflows through parallel processing can yield meaningful efficiency gains even in constrained health systems.

The observed improvement in surgical time aligns with evidence from high-income settings, where block rooms have consistently been associated with reductions in anesthesia-controlled time and enhanced operating room throughput [5,13,14]. The principle underlying these gains, parallel processing of anesthesia and surgical preparation, allows non-operative tasks to occur outside the operating room, thereby maximizing its utilization [15]. Our findings extend this evidence to a low-resource context, demonstrating that similar efficiency benefits can be achieved despite limited infrastructure and workforce constraints.

However, unlike some studies that reported reductions in anesthesia-controlled time and turnover intervals, we did not observe significant changes in PNB duration or PNB-to-incision time. This finding is consistent with Eappen et al. [16], who reported that introducing a regional block team did not necessarily reduce anesthesia-controlled times in settings with pre-existing workflow inefficiencies. In our context, this may reflect persistent system-level constraints, including staffing limitations, variability in case complexity, and logistical coordination challenges. These findings underscore that while block rooms can improve certain aspects of efficiency, their full impact depends on broader system optimization.

Importantly, the absence of complications in both study periods reinforces the safety of regional anesthesia delivery within a structured block room model. This is consistent with established guidelines emphasizing the importance of appropriate monitoring, dedicated space, and trained personnel in maintaining safety standards [7,17]. The findings suggest that introducing efficiency-driven models does not inherently compromise care quality when implemented within a robust clinical governance framework.

A key contribution of this study lies in demonstrating the importance of contextual adaptation in implementing health system innovations. Previous attempts to establish a block room at CHUK were unsuccessful due to limited staffing, inadequate supplies, and lack of ownership, which are barriers similarly reported in other low-income settings [12,18]. In contrast, the success of the current initiative was underpinned by deliberate stakeholder engagement, iterative process refinement through the PDSA framework, and the identification of local clinical champions.

These findings highlight that implementation success in resource-limited settings is less dependent on infrastructure alone and more on governance, ownership, and workflow redesign. The ability to adapt global best practices to local realities is critical, particularly in environments where workforce shortages and competing priorities are pervasive.

The improvement in surgical efficiency observed in this study has important implications for health system performance in LMICs. In settings where surgical capacity is constrained, even modest gains in efficiency can translate into increased surgical throughput, reduced waiting times, and improved access to care. From a policy perspective, the findings support the integration of regional anesthesia services into broader surgical system strengthening strategies. However, the distribution of costs and benefits must be carefully considered. While the establishment of a block room may place additional demands on anesthesia departments, the benefits, such as improved operating room utilization and increased surgical output, are realized at the institutional level [19,20]. This underscores the need for coordinated institutional support and cross-departmental investment.

Furthermore, strengthening training pathways in regional anesthesia, including the development of structured rotations or fellowship programs, may enhance sustainability. Building local capacity is essential not only for maintaining block room functionality but also for scaling such interventions across other hospitals in Rwanda and similar contexts.

This study has several strengths. It represents one of the first evaluations of block room implementation in a sub-Saharan African setting and applies a structured quality improvement framework (PDSA) with standardized reporting (SQUIRE). The use of real-world data enhances the relevance of the findings for similar health systems.
However, several limitations should be considered. First, the study was conducted at a single center with a relatively small sample size, which may limit generalizability and increase the risk of type II error. Second, the short follow-up period may not fully capture the long-term impact of the intervention or its sustainability. Third, the absence of multivariable adjustment limits the ability to account for potential confounding factors, such as case complexity or provider variability. Finally, operational constraints, including inconsistent staffing of the block room, may have attenuated the observed effects.
Future research should focus on evaluating the long-term sustainability and scalability of block room implementation in similar settings. Larger, multicenter studies are needed to confirm these findings and explore additional outcomes, including cost-effectiveness, patient satisfaction, and training impact. There is also a need to investigate system-level interventions—such as workforce optimization, scheduling coordination, and integrated perioperative pathways—that may enhance the effectiveness of block rooms.

CONCLUSION

The implementation of a regional anesthesia block room at CHUK demonstrates that context-adapted perioperative innovations can improve operating room efficiency without compromising patient safety in resource-limited settings. While the magnitude of improvement was modest, the findings provide important proof of concept that workflow redesign can contribute to strengthening surgical systems in LMICs. Sustained impact will depend on continued investment in workforce capacity, institutional support, and system-wide optimization. To enhance impact and scalability, the following actions are recommended: establishing dedicated staffing models for block room operations to ensure consistency and maximize efficiency gains; strengthening training programs in regional anesthesia, including structured rotations and fellowships, to build sustainable local expertise; and improving surgical scheduling and coordination to cluster patients requiring regional anesthesia, thereby optimizing block room utilization.

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