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Original Article

Reducing Post-Caesarean Section Infections Through Quality Improvement Interventions at Shyira District Hospital, Rwanda: A Pre–Post Study

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Abstract

Background: Surgical procedures are associated with significant risks of morbidity and mortality, particularly in low-resource settings. The World Health Organization (WHO) Surgical Safety Checklist (SSC) is proven to reduce surgical complications, yet its use has remained suboptimal in many hospitals. This study implemented and evaluated the introduction of the WHO SSC in Shyira District Hospital, Rwanda.

Methods: A pre–post intervention study was conducted from December 2016 to March 2017. Baseline assessment involved a retrospective review of patient files from major surgeries conducted between January and March 2015. Root cause analysis identified barriers to SSC use. Interventions included development of a policy and procedure for SSC use, Training of nurses, midwives, and cleaners on mattress disinfection, as well as training of operating theatre staff. Post-intervention evaluation assessed SSC utilization, completeness, and knowledge improvement among Maternity and theatre staff.

Results: Prior to the intervention, SSC utilization was 0%. Following implementation, utilization increased significantly to 74% (292/393 major surgeries, $p < 0.001$). Completion rates for "Sign In" and "Time Out" components reached 100%, while "Sign Out" completion reached 92%. Staff knowledge of the SSC improved from a mean score of 51% pre-intervention to 83% post-intervention ($p = 0.001$). Training coverage increased from 17% to 82% of theatre staff.

Conclusion: Introducing a structured policy and targeted training significantly improved SSC utilization, completeness, and staff knowledge. SSC implementation enhanced teamwork, communication, and peri-operative safety. Sustained supervision, continuous training, and leadership engagement are essential to maintain improvements.

Keywords: WHO Surgical Safety Checklist, patient safety, operating theatre, quality improvement, Rwanda, Perioperative care.

Introduction

Caesarean section (CS) is a vital surgical intervention in modern obstetric practice and is widely recognized for its role in preventing maternal and neonatal morbidity and mortality when appropriately indicated (World Health Organization [WHO], 2023). Globally, the use of caesarean delivery has increased substantially over the past two decades, reflecting both improved access to emergency obstetric care and changes in clinical decision-making (Betrán et al., 2021). Despite its benefits, CS is associated with a higher likelihood of postoperative complications compared with vaginal delivery, with surgical site infections (SSIs) representing one of the most common and clinically significant adverse outcomes (Wloch et al., 2023). These infections contribute to delayed recovery, extended hospital stays, increased healthcare costs, and, in severe cases, maternal mortality. The burden of post-caesarean SSIs is disproportionately concentrated in low- and middle-income countries, where healthcare systems frequently face limitations related to infrastructure, staffing, and availability of infection prevention and control (IPC) resources (Allegranzi et al., 2022). Recent global evidence indicates that SSI rates following caesarean section in these settings are considerably higher than those reported in high-income countries, largely due to preventable system-level factors such as inadequate hand hygiene facilities, unreliable water and soap supply, and insufficient environmental cleaning practices (Islam et al., 2023; Wood et al., 2024).

In sub-Saharan Africa, post-caesarean SSIs remain a persistent public health challenge and a major contributor to maternal morbidity. Studies conducted across the region consistently report elevated infection rates following caesarean delivery, highlighting ongoing gaps in the implementation of basic IPC measures within maternity services (Chu et al., 2022; Sibomana et al., 2024). Evidence from the region identifies poor compliance with hand hygiene protocols, limited access to clean water, and inadequate disinfection of patient care surfaces as key modifiable risk factors contributing to postoperative infections in district-level hospitals (Dyrkorn et al., 2021; WHO, 2023).

Rwanda has made substantial progress in improving maternal health outcomes through expanded access to institutional deliveries and emergency obstetric care. Nevertheless, postoperative infections following caesarean section continue to pose a concern, particularly in district hospitals serving predominantly rural populations.

Facility-based studies and national assessments have documented post-caesarean SSI rates comparable to those observed elsewhere in sub-Saharan Africa, suggesting persistent weaknesses in perioperative IPC practices despite broader health system improvements (Bizimana et al., 2023; Rwanda Ministry of Health, 2022). Shyira District Hospital, located in Nyabihu District in the Western Province of Rwanda, provides maternity services to a catchment population of more than 300,000 people. Review of routine hospital data revealed that in 2015 approximately 4.7% of women undergoing caesarean section developed postoperative infections. Although this prevalence is within the range reported in similar contexts, it represents a significant burden of preventable maternal morbidity. Internal assessments conducted at the facility identified critical gaps related to inconsistent availability of water and soap at maternity ward entry points, limited hand hygiene infrastructure, and the absence of standardized mattress disinfection procedures before patient admission and after discharge. In response to these identified gaps, the implementation of targeted, low-cost, and context-appropriate quality improvement interventions aimed at strengthening IPC practices was prioritized. This study was therefore undertaken to improve hand hygiene infrastructure, ensure reliable access to water and soap, and institutionalize routine mattress disinfection practices, with the overarching goal of reducing post-caesarean section infection rates in the maternity service at Shyira District Hospital.

Research Methods

Study Design

This investigation adopted a before-and-after quality improvement approach to examine changes in post-caesarean section infection rates following the introduction of targeted infection prevention and control (IPC) measures. By comparing outcomes from periods preceding and following the intervention within the same health facility, the design allowed assessment of intervention-related changes under routine clinical conditions.

Study Setting

The study was carried out at Shyira District Hospital, situated in Nyabihu District in Rwanda's Western Province. The hospital provides comprehensive maternal health services to a largely rural population estimated at over 300,000 individuals and serves as a referral facility for multiple surrounding health centers. The maternity unit comprises 24 inpatient beds, of which 11 are allocated to women recovering after caesarean section. Caesarean deliveries are performed regularly as part of emergency and elective obstetric care.

Study Population

The study included all women who delivered by caesarean section at Shyira District Hospital during the specified study intervals. The baseline period encompassed January to December 2015, while the post-intervention phase extended from December 2016 to March 2017. All eligible caesarean cases recorded during these periods were included to ensure comprehensive assessment of infection trends before and after the intervention.

Outcome Definition

The primary outcome was post-caesarean section infection, defined as any surgical site infection clinically identified during the inpatient postoperative period. Diagnoses were based on routine clinical assessments and were recorded in maternity ward documentation and infection prevention and control surveillance registers.

Description of Interventions

An institutional root cause assessment was undertaken by the hospital's Infection Prevention and Control team to identify factors contributing to post-caesarean infections. This assessment identified two key deficiencies: unreliable access to water and soap within maternity service areas, and lack of standardized mattress disinfection practices between patient use. In response, several corrective actions were implemented, including expansion of hand hygiene infrastructure through installation of additional tippy taps and soap dispensers at maternity entry points, provision of uninterrupted water and soap supplies in patient care areas, and capacity building of healthcare workers and cleaning staff on appropriate mattress disinfection procedures. To enhance continuity of the intervention, a train-the-trainer model was employed, enabling trained staff to disseminate skills and knowledge to peers.

Data Collection Procedures

Data were obtained retrospectively from existing hospital records, including maternity registers, Health Management Information System (HMIS) reports, and IPC monitoring tools. Indicators used to monitor intervention implementation included availability of water and soap at key service points and adherence to mattress disinfection protocols. The principal outcome indicator was the proportion of women developing post-caesarean infections.

Data Analysis

Collected data were entered into Microsoft Excel and subsequently analyzed using the Statistical Package for the Social Sciences (SPSS), version 20. Descriptive analyses were performed to summarize infection rates and IPC process indicators across study periods. Comparative analysis of infection rates before and after intervention was conducted using the chi-square test, with statistical significance defined as a p-value below 0.05.

Ethical Considerations

Approval to conduct the study was granted by UR-CMHS-Institutional Review Board and the management of Shyira District Hospital. As the analysis relied exclusively on routinely collected secondary data, informed consent was not required. Strict measures were taken to protect patient confidentiality, and all data were anonymized prior to analysis.

Results

During the baseline assessment in 2015, Shyira District Hospital recorded 316 caesarean deliveries, among which 15 postoperative infections were identified, yielding an infection rate of 4.7%. This finding reflected a considerable level of post-caesarean morbidity prior to the implementation of infection prevention interventions. In contrast, the post-intervention period from December 2016 to March 2017 showed a marked improvement. Of the 96 caesarean procedures performed during this interval, only two cases of post-caesarean infection were reported, corresponding to an infection rate of 2.08%. The comparison between the two periods indicates a substantial reduction in postoperative infection burden following the quality improvement measures.

Table 1. Post-Caesarean Section Infection Rates Before and After Intervention

Study period	Total caesarean sections (n)	Post-caesarean infections (n)	Infection rate (%)
Pre-intervention (2015)	316	15	4.7
Post-intervention (Dec 2016–Mar 2017)	96	2	2.08

Note: *This reduction was statistically significant ($\chi^2 = 11.03$, $p = 0.023$).*

Changes in Infection Prevention and Control Process Indicators

Assessment of infection prevention and control process indicators revealed substantial improvements following implementation of the quality improvement interventions. Prior to the intervention, water was available at only half of the maternity ward entry points, while soap availability was limited to 15%, indicating significant barriers to effective hand hygiene. In addition, no soap dispensers were installed, and mattress disinfection was not routinely practiced before patient admission or after discharge. Following the intervention, all assessed IPC indicators showed complete improvement. Water and soap availability at maternity entry points reached 100%, soap dispensers were fully installed and functional, and routine mattress disinfection was consistently performed before and after patient use. These changes demonstrate successful implementation of basic IPC measures and reflect strengthened environmental and hand hygiene practices within the maternity service.

Table 2. Changes in Infection Prevention and Control Process Indicators

IPC Indicator	Pre-intervention (%)	Post-intervention (%)
Water availability at maternity entry points	50	100
Soap availability at maternity entry points	15	100
Presence of soap dispensers	0	100
Mattress disinfection before/after patient use	0	100

Substantial improvements were observed across all measured IPC process indicators following implementation of the quality improvement interventions.

Trend in Post-Caesarean Section Infection Rates Before and After Intervention

Figure 1 illustrates the decline in post-caesarean infection rates from the pre-intervention period (4.7%) to the post-intervention period (2.08%), demonstrating the effectiveness of the IPC quality improvement interventions.

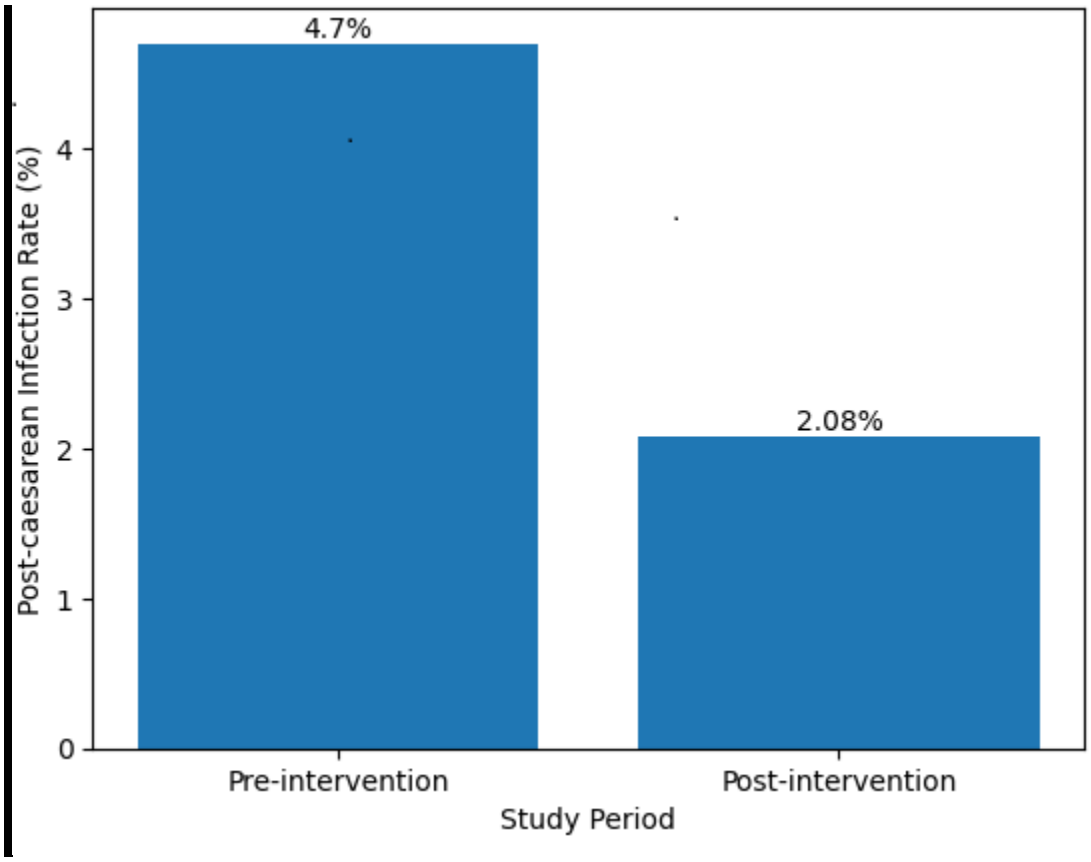

Figure 1. Trend in Post-Caesarean Section Infection Rates Before and After Intervention

Discussion

The present quality improvement initiative demonstrated a substantial decline in post-caesarean section infection rates following the introduction of targeted infection prevention and control (IPC) measures at Shyira District Hospital. The reduction from 4.7% to 2.08% indicates that strengthening foundational IPC practices within maternity services can lead to measurable improvements in postoperative maternal outcomes, even in settings with limited resources. Similar reductions have been reported in district hospitals across sub-Saharan Africa and

other low- and middle-income regions where focused improvements in hygiene practices and environmental sanitation were implemented (Dyrkorn et al., 2021; Sibomana et al., 2024).

In this study, analysis of pre-intervention conditions revealed that the elevated infection rate was primarily driven by facility-level and environmental deficiencies rather than patient-related or clinical factors. Inconsistent access to water and soap at maternity ward entry points, coupled with the absence of routine mattress disinfection, were identified as the principal contributors to infection risk. These findings are consistent with recent evidence indicating that inadequate hand hygiene infrastructure and poor environmental cleaning remain major determinants of healthcare-associated infections in maternity units across low-resource settings (Allegranzi et al., 2022; Islam et al., 2023). Addressing these gaps likely improved compliance with hand hygiene practices among healthcare workers, patients, and visitors, thereby reducing opportunities for pathogen transmission. In contrast to several recent studies conducted in sub-Saharan Africa, which emphasize clinical and obstetric risk factors such as emergency caesarean delivery, prolonged labour, maternal comorbidities, or timing of antibiotic prophylaxis, the present study did not identify these factors as major drivers of infection (Wood et al., 2024; Shacho et al., 2023). Instead, the root cause assessment suggested that clinical protocols, staff knowledge, and availability of essential equipment were largely adequate. This divergence highlights the importance of context-specific evaluations, as the relative contribution of infection risk factors may vary depending on baseline facility capacity and existing clinical practices.

Environmental hygiene, particularly mattress disinfection, emerged as a critical yet previously under-prioritized component of IPC within the maternity service. Patient mattresses and other high-contact surfaces are increasingly recognized as reservoirs for microorganisms capable of contributing to indirect transmission of infections in healthcare settings (Weber et al., 2022). While many studies primarily focus on hand hygiene and antimicrobial strategies, fewer have examined the role of mattress hygiene in obstetric care. The introduction of routine mattress disinfection before patient admission and after discharge in this study appears to have contributed meaningfully to the observed reduction in post-caesarean infections, supporting emerging evidence that targeted environmental cleaning interventions can substantially reduce healthcare-associated infections (Wood et al., 2024).

Compared with intervention studies that rely on resource-intensive approaches such as advanced antiseptic formulations or expanded antibiotic protocols the strategies implemented at Shyira District Hospital were simple, low-cost, and operationally feasible. This demonstrates that significant improvements in post-caesarean outcomes can be achieved through systematic reinforcement of basic IPC measures, provided they are supported by staff training, supervision, and routine monitoring. These findings reinforce the growing recognition that sustainable

reductions in surgical site infections depend not only on clinical interventions but also on strengthening health system processes and infrastructure at the facility level.

Overall, this study adds to the existing body of evidence by illustrating that locally identified, system-level IPC gaps rather than patient or procedural factors were the primary contributors to post-caesarean infections in this setting. By addressing these gaps through targeted quality improvement interventions, meaningful reductions in infection rates were achieved. These insights may inform similar initiatives in district hospitals across Rwanda and other comparable contexts, where optimizing basic IPC practices remains a critical pathway to improving maternal health outcomes.

Strengths and Limitations

A major strength of this study is its use of real-world hospital data and practical interventions that are easily scalable. However, the study has limitations, including the absence of a control group, differing observation periods, and reliance on routine clinical diagnosis of infection. These factors limit causal inference and generalizability.

Conclusion

The findings of this study indicate that the introduction of focused, cost-effective infection prevention and control (IPC) quality improvement measures was linked to a notable decline in post-caesarean section infection rates at Shyira District Hospital. Enhancements in essential IPC components including hand hygiene access, reliable provision of water and soap, and systematic mattress disinfection were successfully implemented within the existing resource framework and yielded observable improvements in maternal postoperative outcomes. These results emphasize that reinforcing basic IPC systems can significantly reduce preventable surgical infections in maternity services operating in resource-limited environments. Maintaining these improvements will depend on continuous oversight, sustained staff commitment, and integration of IPC monitoring into routine hospital practice. The experience from this study suggests that similar low-resource, context-specific interventions have the potential to strengthen the safety and quality of obstetric care in district hospitals throughout Rwanda and comparable settings.

Recommendations

To ensure continuity and expansion of the gains achieved, several actions are recommended. Ongoing supervision and regular assessment of IPC practices within maternity wards should be prioritized to promote consistent compliance and early identification of implementation gaps. Furthermore, standardized mattress disinfection procedures should be formally embedded within national IPC policies to address environmental contamination risks that are frequently underestimated in obstetric care settings. In addition, replication and scale-up of

comparable IPC quality improvement initiatives in other district hospitals should be considered, with appropriate adaptation to local contexts. Finally, future investigations should incorporate extended follow-up periods and more rigorous study designs, such as controlled or comparative studies, to better assess the long-term effectiveness and sustainability of IPC interventions on post-caesarean infection outcomes.

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Conflict of Interest

The researcher declares that there is no conflict of interest associated with the design, implementation, or publication of this study.

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