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Original Article

Implementation of the WHO Surgical Safety Checklist in the Operating Theatre of Masaka District Hospital, Rwanda: A Quality Improvement Project

Hospital, Rwanda: A Quality Improvement Project

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Abstract

Background: Surgical procedures are associated with a substantial risk of preventable morbidity and mortality, particularly in low-resource settings. The World Health Organization (WHO) Surgical Safety Checklist (SSC) has been shown to improve teamwork, communication, and surgical outcomes; however, its utilization remains suboptimal in many hospitals. This quality improvement project aimed to implement and evaluate the use of the WHO SSC in the Operating Theatre of Masaka District Hospital, Rwanda.

Methods: A pre–post intervention study was conducted. Baseline assessment involved a retrospective review of patient records for major surgical procedures performed between January and March 2016 to determine SSC utilization and completeness. A root cause analysis was undertaken to identify barriers to SSC use. Interventions included the development of a hospital policy and procedures for SSC implementation, provision of printed SSC tools, and targeted training of operating theatre staff. Post-intervention evaluation, conducted between January and March 2017, assessed SSC utilization, checklist completeness, staff knowledge, and trends in surgical incidents and post-surgical infections.

Results: At baseline, SSC utilization was 0%. Following implementation, SSC use increased significantly to 74% (292/393 major surgeries; $p < 0.001$). Completion rates reached 100% for the "Sign In" and "Time Out" components and 92% for the "Sign Out" component. Mean staff knowledge scores improved from 51% pre-

intervention to 83% post-intervention (p = 0.001), and training coverage increased from 17% to 82% of operating theatre staff. During the post-intervention period, the rate of post-surgical infections declined from 9% to 5%, and reported operating theatre incidents decreased from 4% to 2%.

Conclusion: The introduction of a structured policy, availability of checklist tools, and targeted staff training substantially improved WHO SSC utilization, completeness, and staff knowledge. Implementation of the SSC strengthened teamwork and communication in the operating theatre and was associated with reductions in surgical incidents and post-surgical infections. Sustained leadership support, continuous training, and routine supervision are essential to maintain and further improve surgical safety practices.

Keywords: Implementation, WHO Surgical Safety Checklist, , operating theatre, quality improvement, Rwanda,.

Introduction

Safe surgical care has emerged as a central priority in global health, particularly as conditions requiring operative management including trauma, malignancies, congenital disorders, and noncommunicable diseases continue to expand worldwide. Recent evidence highlights that surgical and anesthesia-related complications remain a significant contributor to preventable morbidity and mortality, underscoring the need for robust perioperative safety systems (Abbott et al., 2023). The World Health Organization (WHO) identifies the Surgical Safety Checklist (SSC) as one of the most effective tools for reducing operative risks, improving teamwork, and standardizing essential safety actions throughout the surgical process (WHO, 2021). Updated analyses demonstrate that consistent use of the SSC leads to substantial reductions in postoperative complications and mortality across a wide range of health-care settings (Haugen et al., 2019; Abbott et al., 2023).

These challenges are intensified in sub-Saharan Africa (SSA)**,** where surgical outcomes remain disproportionately poor compared to global averages. Findings from recent multicountry studies show that perioperative mortality in SSA is more than double the global rate, despite patients often being younger and presenting with fewer comorbidities (Biccard et al., 2018; Ademuyiwa et al., 2022). Limited surgical workforce capacity, inconsistent availability of essential equipment, and gaps in adherence to safety protocols contribute to these outcomes. Implementation of the SSC across SSA remains uneven, with facility-level barriers such as workflow constraints, insufficient training, and fragmented communication within surgical teams (Gyamfi et al., 2021; Livingston et al., 2020).

Across low- and middle-income countries (LMICs) more broadly, similar challenges persist. Recent systematic reviews emphasize that sustainable checklist adoption requires more than availability of the tool; it demands institutional commitment, regular supervision, and integration into routine practice (Aveling et al., 2022; Böhmer et al., 2021). Studies also indicate that when surgical teams internalize the SSC as part of their safety culture, its

impact on reducing complications becomes significantly stronger (Bhangu et al., 2021). Therefore, strengthening implementation fidelity remains a crucial priority for improving surgical outcomes in resource-constrained settings.

Within Rwanda**,** efforts to enhance surgical safety have been embedded within national hospital accreditation guidelines, which require universal use of the WHO SSC during all major surgical procedures. Masaka District Hospital, a public facility established in 2011 in Kicukiro District plays a central role in delivering surgical care to a catchment population of approximately 491,731 residents. The hospital provides a range of medical, maternal, neonatal, and surgical services and manages a growing volume of operative cases. In 2016, the hospital's Operating Theatre (OT) conducted 1,642 major surgeries**,** reflecting its critical function in regional surgical care. The OT comprises two operating rooms, a preoperative preparation area, sterilization and hand-washing facilities, and staff changing rooms. Given the complexity of its workflow, adherence to standardized safety procedures is essential to prevent perioperative complications such as wrong-site surgery, anesthetic incidents, and postoperative infections. However, an internal review conducted in 2016 revealed a substantial implementation gap: none of the 233 audited patient files contained a completed WHO SSC form**.** This absence places surgical patients at unnecessary risk and contradicts national accreditation requirements, while mirroring patterns seen in other LMIC facilities where checklist use has not yet fully transitioned into routine practice (Aveling et al., 2022; Gyamfi et al., 2021).

Considering global evidence showing the SSC's effectiveness, the high surgical risk profile in SSA, regional implementation challenges, and the documented non-use within Masaka District Hospital, this study was designed to introduce, operationalize, and assess the implementation of the WHO Surgical Safety Checklist in the hospital's Operating Theatre. The findings aim to support the integration of standardized safety practices and contribute to improved surgical outcomes within Rwanda's healthcare system.

Research Methods

Study Design

This project adopted a pre–post intervention design to evaluate changes in the use of the World Health Organization Surgical Safety Checklist (WHO SSC) in the Operating Theatre at Masaka District Hospital. The baseline assessment was carried out between March and April 2016. During this period, a multidisciplinary improvement team comprising surgeons, anesthetists, nurses, and midwives was organized to facilitate the intervention process. Baseline data were obtained by reviewing inpatient medical records of individuals who underwent major surgical procedures in the first quarter of 2016. These findings provided the initial measurement of the problem and informed the diagnostic phase of the project. Following the implementation of selected

strategies, the post-intervention evaluation was completed between January and March 2017. All activities were executed in accordance with a predetermined implementation timeline outlined in a Gantt chart.

Baseline Data Collection

Baseline data were gathered in April 2016 by examining all patient files associated with major surgeries completed between January and March of that year. The Quality Improvement Focal Person, the Head of the Archive Department, and the Head of the Maternity Department participated in the data retrieval process. A structured assessment tool was developed to determine whether the SSC had been used and, if present, whether its three major components Sign In, Time Out, and Sign Out were completed. Each of these components encompasses several safety checks essential for minimizing perioperative risk. Because every patient undergoing major surgery is expected to have a completed SSC attached to the surgical record, all eligible files for the three-month period were reviewed to establish the magnitude of checklist non-use.

Root Cause Analysis

A comprehensive root cause analysis was conducted to understand the underlying factors contributing to the absence of SSC use. A series of facilitated meetings involving Operating Theatre staff, surgeons, nurses, anesthetists together with the Quality Improvement officer were held to present baseline findings and solicit staff perspectives. The potential explanations identified during these discussions were evaluated alongside published evidence on common barriers to SSC implementation in similar settings. The research team summarized the identified causes using a fishbone (Ishikawa) diagram, which categorized contributing factors into four domains: people, environment, policies and procedures, and equipment. Verification of each potential cause was undertaken over approximately two and a half months through document review, staff interviews, and comparison with hospital administrative records. The analysis confirmed several root causes, including poor awareness of the checklist, lack of SSC-related training, absence of orientation for newly assigned theatre staff, lack of hospital guidelines governing SSC use, and non-availability of printed SSC forms.

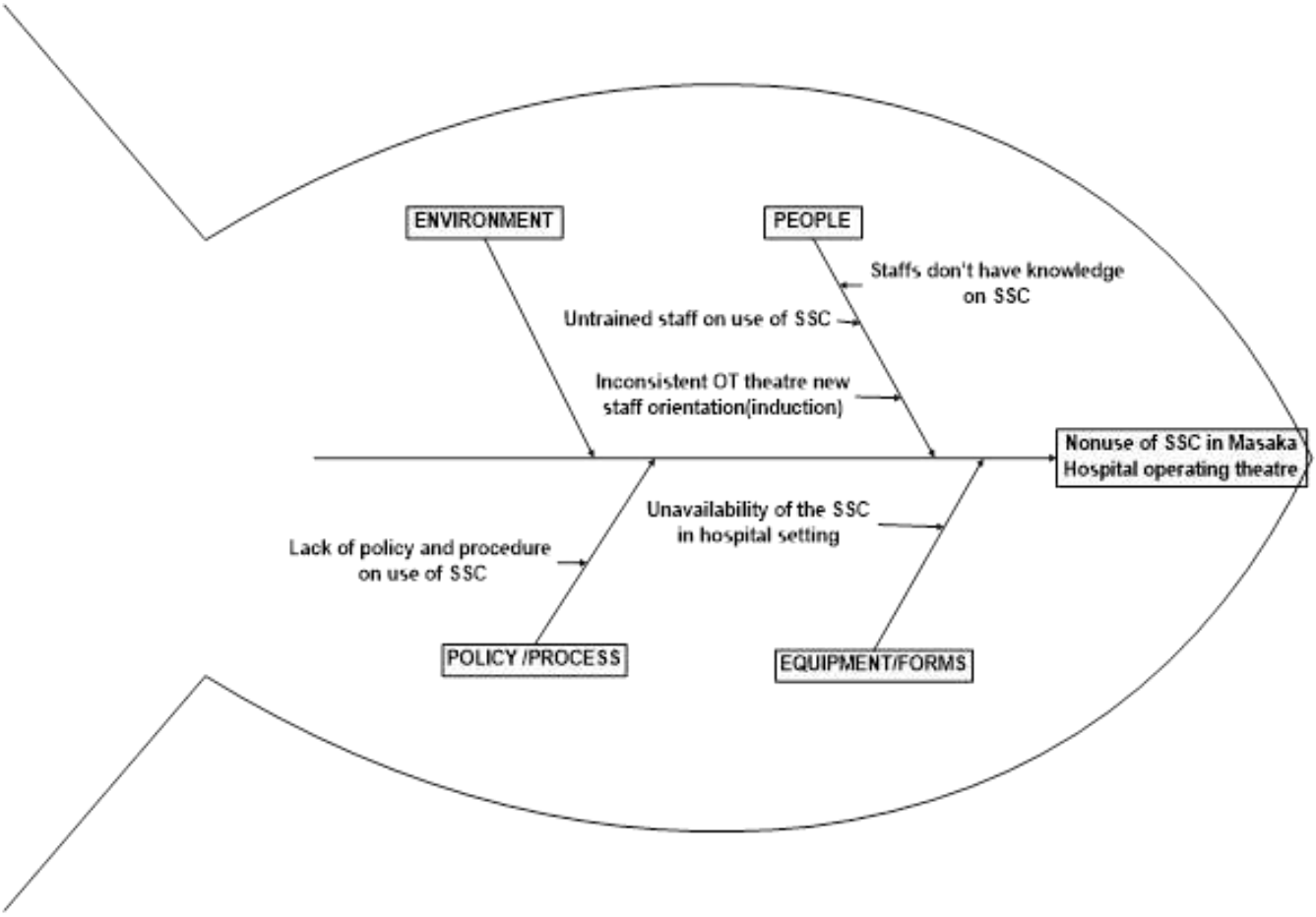

Figure 1.Fish bone illustrating the possible causes of nonuse of SSC in Masaka District hospital.

Verification of Causes

Before finalizing the root causes, the research team conducted a rigorous verification process. This involved collecting additional information for each suspected cause, validating records in the Human Resources and Logistics offices, and engaging staff to clarify discrepancies. Only causes supported by evidence were included in the final list, ensuring that the planned intervention would address actual not presumed barriers to SSC utilization.

Assessment of Knowledge on the Surgical Safety Checklist

To evaluate the level of knowledge among Operating Theatre staff, a modified questionnaire derived from WHO materials was administered. The instrument consisted of 10 closed-ended questions assessing understanding of the purpose, components, and correct application of the SSC. All 17 Operating theatre staff were eligible to participate, but only 12 were present during the data collection period. The questionnaire was designed to be self-administered to reduce response bias. Knowledge scores revealed marked deficiencies: most participants

performed poorly, with the majority scoring below 50%. These results demonstrated that knowledge gaps were a major contributor to the checklist's nonuse, further validating the need for targeted staff training.

Assessment of Training Status

The research team also assessed whether staff had previously received training on the SSC. This was accomplished using a tally sheet in which staff self-reported past training, followed by a review of their personnel files to confirm the information. Among the 17 Operating Theatre staff, only three each of them anesthetists reported having received SSC training at external institutions. None of these trainings were documented in personnel records, and the remaining 14 staff members had never been instructed on the use of the SSC. This finding reinforced the conclusion that the lack of training constituted a major barrier.

Orientation for Newly Assigned Staff

The study further examined whether new staff members assigned to the Operating Theatre had received formal orientation specific to their roles. Review of Human Resources documentation, complemented by staff interviews, revealed that none of the 14 individuals who joined the theatre after 2015 had undergone structured induction on SSC use or Operating theatre protocols. These staff members included nurses, doctors, and anesthetist technicians. The absence of orientation highlighted systemic challenges in integrating new personnel into the safety practices required in a high-risk environment such as the Operating Theatre.

Assessment of Hospital Policies and Procedures

To determine whether the institution had formal guidance governing SSC use, the research team reviewed the hospital's master list of policies and procedures and inspected the Operating Theatre for posted guidelines. No policy or procedural document addressing SSC use was identified. All interviewed staff confirmed that they had not encountered any official guidance on the SSC during their tenure at the hospital. This lack of policy-level direction emerged as a critical barrier to implementation.

Availability of the Surgical Safety Checklist

The availability of SSC forms was assessed by reviewing inventory lists in the Logistics and Printing Offices and confirming findings with Operating Theatre staff. The assessment showed that the WHO SSC was not included among hospital-approved forms, nor was it available in printed format within the theatre. This absence of physical tools constituted an operational barrier to checklist use.

Intervention Development and Implementation

After verifying the root causes, the team evaluated potential solutions based on feasibility, cost considerations, anticipated impact, and implementation timelines. Two key interventions were selected: development of a policy and procedure document governing SSC use, and implementation of routine staff training. A draft policy was created through consultative meetings with theatre staff and was subsequently reviewed by the hospital accreditation steering committee. After incorporating recommended revisions, the document received formal approval from hospital leadership. Once the policy was in place, staff training sessions were organized to ensure comprehension of the new guideline. Training was delivered through four sessions to accommodate shift schedules and involved didactic teaching, visual demonstrations, and role-play exercises. Training materials were distributed, and staff were notified in advance to ensure full participation.

Measures

The evaluation framework consisted of both outcome and process measures. Outcome indicators included the SSC utilization rate, defined as the proportion of major surgeries in which the SSC was used, the SSC completeness rate, defined as the proportion of required elements correctly filled, the rates of surgical infections and surgical incidents were evaluated to ascertain the impact of SSC utilization in OT Process indicators assessed whether a policy and procedure document had been established, the number of staff trained, and the improvement in staff knowledge between baseline and post-intervention assessments**.**

Data Analysis

Data for the utilization and completeness rates were extracted using the audit tool and entered into Microsoft Excel for preliminary processing before analysis in SPSS version 20. Staff knowledge scores were compiled in Excel and imported into SPSS for statistical testing. Comparisons between pre-intervention and post-intervention outcomes were conducted using Chi-square tests for categorical variables and independent (unpaired) t-tests for continuous variables. A significance level of $p = 0.05$ was applied.

Ethical Considerations

The study did not involve direct engagement with patients nor any alteration of clinical care. Approval to access patient records and implement the quality improvement activities was obtained from the hospital administration following ethical review. All data were handled confidentially, and identifying information was removed during analysis to maintain privacy.

Results

The primary purpose of this improvement initiative was to introduce the WHO Surgical Safety Checklist (SSC) into routine practice within the Operating Theatre at Masaka District Hospital, with an initial aim of raising utilization from 0% to at least 40%. The activities were executed as planned according to the project timeline, with leadership provided by a multidisciplinary group consisting of the researcher, the Operating theatre medical officer, the lead anesthetist, theatre nursing leadership, and the hospital Quality Improvement (QI) team. All theatre personnel were engaged throughout the implementation process, particularly after the root causes of checklist nonuse were clarified and corresponding action plans mainly training and introduction of formal policy were initiated.

4.1 Use of the WHO SSC

At the outset of the project, none of the surgical records reviewed contained the WHO SSC, resulting in a baseline utilization rate of 0%. Following three months of implementation (January–March 2017), the uptake of the checklist rose markedly. Out of 393 major surgical procedures performed during this period, 292 documented the use of the SSC, equivalent to a utilization rate of 74%. This increase was statistically significant ($p = 0.001$).

Table 1. Pre- and Post-intervention WHO Surgical Safety Checklist (SSC) Utilization Rates

Period	Total Major Surgeries	SSC Used	Utilization Rate (%)
Baseline (Jan–Mar 2016)	233	0	0%
Post-intervention (Jan–Mar 2017)	393	292	74%

Completion of the SSC

Assessment of the completeness of SSC forms involved checking each of the 19 checklist items across the three sections: Sign In, Time Out, and Sign Out. After implementation, both the Sign In and Time Out sections were fully completed in all reviewed cases (100%), representing a significant improvement from baseline when no SSCs existed ($p = 0.000$). The Sign Out section showed a slightly lower but still high completion level of 92%.

Table 2. Completeness of SSC Components After Implementation

SSC Component	Total Reviewed (n=292)	Completed (n)	Completion Rate (%)
Sign In	292	292	100%
Sign Out	292	268	92%

Knowledge of the SSC Among Staff

Knowledge scores improved substantially following the intervention. The average score rose from 51% before the intervention to 83% afterward (p = 0.001). Before implementation, knowledge distribution was skewed toward the lower ranges 17% scored below 25%, and 67% fell between 26% and 50%. After the intervention, no staff member scored below 50%; 14% scored between 50% and 75%, while 84% achieved scores of 75–100%. Detailed analysis of individual questions demonstrated improvements across all areas. For example, understanding of whether the SSC is equivalent to a Team Time Out increased from 42% to 100%, and knowledge about antibiotic prophylaxis timing rose from 83% to 100%. Awareness of the SSC's role in communication, error prevention, and documentation also increased markedly.

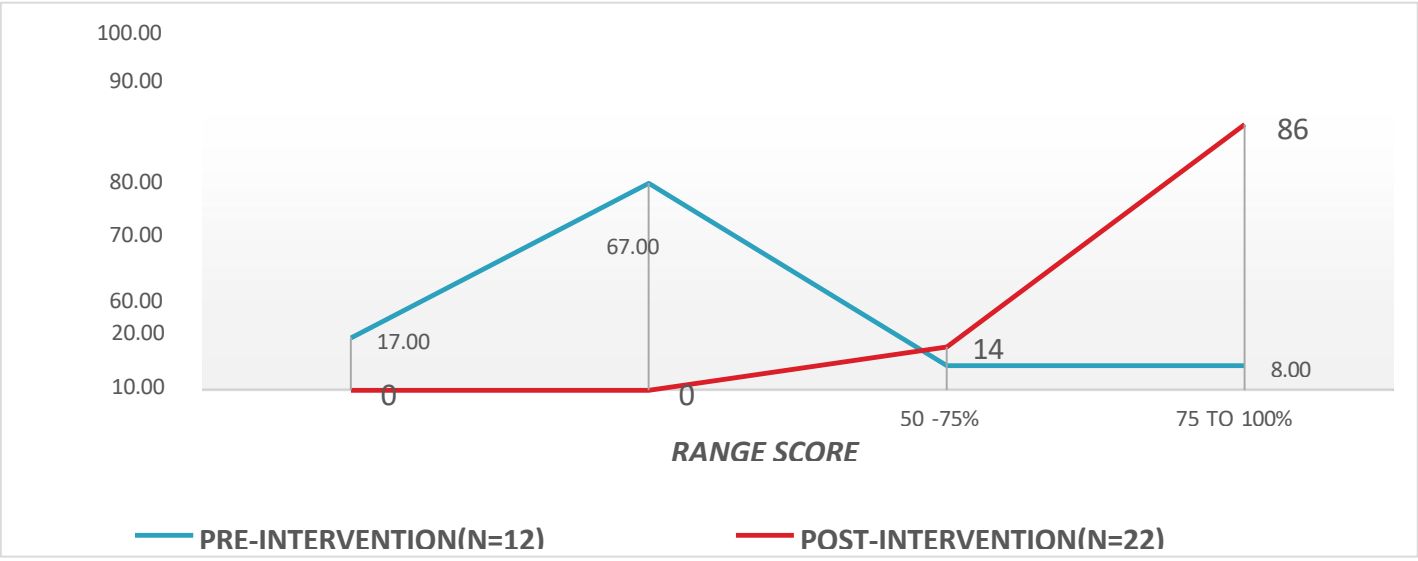

Figure 1. Graph comparing the knowledge performance on SSC pre and post intervention

Summary on Changes in Staff Knowledge of SSC Use Before and After Intervention

Following the intervention, staff knowledge of the WHO Surgical Safety Checklist increased substantially across all domains. Major improvements were recorded in understanding the checklist's purpose, including rises from 42% to 100% for identifying the SSC as a Team Time Out and from 33% to 95% for documenting swab counts. Knowledge related to preventing omissions and supporting inexperienced staff improved by 70 percentage points each (both $p < .001$). Awareness that the SSC is not used to assign blame increased from 0% to 92%. Although documentation-of-complications understanding rose from 8% to 41%, it remained the lowest-performing area.

Table 3. Summary on Changes in Staff Knowledge of SSC Use Before and After Intervention

WHO SSC Knowledge Item	Pre-intervention **Correct** Answers **(n = 12)**	Post-intervention **Correct** Answers **(n = 22)**	% **Change**	*p*-value
The WHO SSC is a synonym for a Team Time Out	5 (42%)	22 (100%)	+58%	.001
The WHO SSC does not require signatures from every team member	6 (50%)	20 (91%)	+41%	.021
The WHO SSC requires accurate documentation of the number of swabs used	4 (33%)	21 (95%)	+62%	.000
The WHO SSC applies to all surgical team members, not only surgeons	7 (58%)	22 (100%)	+42%	.001
The WHO SSC recommends giving antibiotic prophylaxis within 60 minutes before incision	10 (83%)	22 (100%)	+17%	.048
The WHO SSC is designed to assist inexperienced or newly assigned staff	2 (16%)	19 (86%)	+70%	.000
The WHO SSC is not intended to assign blame for mistakes	0 (0%)	20 (92%)	+92%	.000
The WHO SSC helps prevent accidental omissions during routine surgical processes	2 (16%)	19 (86%)	+70%	.000
The WHO SSC improves communication within the surgical team	8 (67%)	21 (95%)	+28%	.023
The WHO SSC may be used to document complications	1 (8%)	9 (41%)	+33%	.076

Staff Training Coverage

Prior to the start of the project, only 3 out of 17 theatre staff (17%) had ever participated in SSC training. By the end of the intervention, 82% had received structured, hands-on training led by the researcher and previously trained staff. The training package included demonstrations, role plays, and discussion sessions.

Table 4. Increase in Staff Trained on WHO SSC

Training Status	Staff (n = 17)	Percentage (%)
Trained pre-intervention	3	17%
Trained post-intervention	14	82%
Total trained after project	**17**	**100%**

Development of Policy and Procedure

A formal policy document detailing the expectations and processes for SSC use was drafted collaboratively with theatre representatives and the QI team. After review and endorsement by the accreditation committee, the policy was approved by hospital leadership and disseminated to all relevant departments.

Discussion

The introduction of the WHO Surgical Safety Checklist (SSC) at Masaka District Hospital led to a marked shift in perioperative practices, demonstrating how coordinated quality-improvement strategies can transform clinical behavior in a relatively short timeframe. Moving from complete nonuse to a utilization rate of 74% within three months highlights the powerful effect of combining structured training, formal policy endorsement, and active leadership engagement. Similar outcomes have been observed in other low-resource environments, where well-supported SSC initiatives have produced rapid improvements in adherence (Abbott et al., 2023; Livingston et al., 2020). The near-universal completion of the *Sign In* and *Time Out* phases suggests that once staff understood their roles and had access to clear tools, integration of the checklist into daily workflow occurred smoothly. The *Sign Out* component displayed slightly lower compliance than the initial checklist stages, a pattern also reported in other LMIC studies. End-of-procedure pressures, including fatigue, workflow disruptions, and competing demands, commonly result in incomplete documentation at this final stage (Aveling et al., 2022; Haugen et al., 2019). Continued emphasis on reinforcing the value of the postoperative pause, coupled with supervisory follow-up, may help to close this gap over time.

The improvement in staff knowledge was particularly striking. Average scores increased from 51% before the intervention to 83% afterward, indicating that the educational sessions were effective in strengthening understanding of SSC principles and application. Evidence suggests that interactive teaching such as simulation, demonstration, and reflective discussion contributes significantly to sustained behavioural change in surgical teams (Gyamfi et al., 2021; Hauge et al., 2020). Enhancing comprehension is crucial, as staff who appreciate the rationale behind the SSC are more likely to maintain high levels of adherence. Participants also reported improvements in communication and team cohesiveness during surgical procedures. These observations correspond with literature describing the SSC as both a safety instrument and a communication framework that supports shared situational awareness and reduces preventable errors (Bhangu et al., 2021; Abbott et al., 2023). Although this study did not formally assess clinical outcomes, routine hospital data collected during the project period pointed to a reduction in perioperative mortality, a trend consistent with multicountry evaluations showing that SSC use lowers postoperative complications and deaths (Biccard et al., 2018). However, not all indicators reflected improvement. Surgical site infection (SSI) rates remained relatively unchanged despite checklist implementation. This is unsurprising, as SSI prevention depends on multiple system-level factors such as sterilization practices, antibiotic stewardship, operating-theatre ventilation, and postoperative wound care that extend beyond checklist use alone (Ademuyiwa et al., 2022). This finding underscores the need for a broader infection-control strategy if reductions in SSI are to be achieved.

Challenges Encountered

Implementation efforts were shaped by several contextual and operational constraints. Training schedules were disrupted by emergency procedures and competing clinical duties, while staff rotations and external engagements reduced the number of personnel available for training at any given time. Language limitations also affected comprehension for some staff members, as training videos and reference materials were primarily in English. High staff turnover and frequent cross-departmental transfers hindered continuity, necessitating repeated orientation efforts. Variability in motivation and time availability, especially for training held after official working hours, further constrained participation.

Strategies to Address These Challenges

Future cycles of SSC implementation would benefit from integrating SSC orientation into the onboarding of every new member of the theatre team and from developing multilingual and context-appropriate training tools. Embedding the SSC into routine job expectations—rather than positioning it as an added task—could help normalize its use. Institutional support is essential; allocating protected training time, providing oversight, and incorporating SSC adherence into supervisory mechanisms may help sustain gains. Addressing staffing gaps and

workload management may also minimize disruptions to both training and implementation efforts (Böhmer et al., 2021).

Lessons Learned

This project underscored the value of a multidisciplinary approach in quality-improvement initiatives. The diverse expertise of the team allowed for solutions that were both practical and contextually relevant. Ongoing education emerged as a critical element for sustaining momentum, particularly in settings with frequent personnel changes. Additionally, the development and endorsement of a formal SSC policy helped create institutional alignment, clarifying expectations and reinforcing leadership commitment. These insights echo global evidence indicating that successful SSC uptake depends on cultural and organizational readiness, not merely the presence of a checklist (Aveling et al., 2022; Livingston et al., 2020).

Study Limitations

The study's emphasis on process outcomes such as utilization, compliance, and knowledge limits the ability to draw conclusions about long-term clinical effects. The short follow-up period further restricts assessment of sustainability. Accessing archived files proved difficult and occasionally incomplete, affecting data retrieval accuracy. Training sessions were at times interrupted by clinical emergencies, resulting in inconsistent attendance. Moreover, limited protected time for QI activities challenged uniform engagement across all theatre staff.

Conclusion

The implementation of the World Health Organization Surgical Safety Checklist in the Operating Theatre of Masaka District Hospital demonstrated that structured quality improvement interventions can significantly enhance surgical safety practices in a low-resource setting. The introduction of a formal policy, combined with targeted staff training and the availability of checklist tools, led to substantial improvements in checklist utilization, completeness, and staff knowledge. These changes strengthened team communication and coordination during surgical procedures and were associated with reductions in operating theatre incidents and post-surgical infections. Although rapid gains in compliance were achieved, sustaining and building on these improvements requires ongoing institutional commitment. Continuous supervision, regular refresher training, and integration of the checklist into routine clinical workflows are essential to maintain high adherence. Leadership engagement and accountability mechanisms remain critical to reinforcing a culture of safety. While the checklist alone cannot address all determinants of surgical outcomes particularly surgical site infections—it represents a foundational component of broader patient safety and quality improvement efforts. Scaling up and sustaining effective implementation of the WHO Surgical Safety Checklist has the potential to contribute meaningfully to improved perioperative care and patient outcomes in similar resource-constrained healthcare settings.

Recommendations

To strengthen the implementation and long-term use of the WHO Surgical Safety Checklist, hospitals should formally integrate the SSC into institutional policy frameworks and ensure its consistent application across all major surgeries, supported by regular refresher training within ongoing professional development programs. New Operating Theatre personnel should receive structured orientation on safety protocols from the outset, while hospital leadership must actively promote SSC adherence by providing protected time for training and incorporating SSC performance into supervisory and evaluation processes. Implementation efforts should also be supported by practical logistical measures, including flexible scheduling, facilitation of training sessions, and reliable availability of printed checklist forms. Future implementation cycles would benefit from longer evaluation periods to assess sustainability and potential effects on core outcomes such as postoperative complications, perioperative mortality, and hospital stay duration, alongside improvements in archiving and the exploration of digital platforms for checklist management. Further research should examine both the clinical and economic implications of SSC adoption at Masaka District Hospital, investigate behavioral and organizational factors that influence sustained checklist use, and evaluate the effectiveness of SSC implementation in settings where the tool has recently been introduced to inform broader national or regional scale-up strategies.

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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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