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Implementation of the WHO surgical safety checklist in resource-limited Somalia: a new standard in surgical safety

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Abstract

Background Surgical safety remains a critical global health concern, with complications from surgical procedures resulting in significant morbidity and mortality, particularly in low- and middle-income countries. The World Health Organization (WHO) Surgical Safety Checklist (SSC) has been shown to reduce surgical complications and mortality rates. However, its implementation and impact in resource-limited settings like Somalia remain understudied. This study aimed to evaluate the implementation of the WHO SSC in selected hospitals in Mogadishu, Somalia, and assess its impact on surgical safety practices.

Methods A pre- and post-intervention study was conducted in 15 randomly selected hospitals in Mogadishu, Somalia. The intervention involved a comprehensive training program on the WHO SSC for surgical teams. Data on hospital characteristics, surgical details, and adherence to the SSC were collected over two periods: pre-intervention (April 12th to May 4th, 2024) and post-intervention (May 12th to June 3rd, 2024). The primary outcome was the adherence to the SSC, categorized as good (>60%) or poor (≤60%). Descriptive statistics, McNemar's test, and binary logistic regression were used for data analysis.

Results Adherence to the WHO SSC significantly improved post-intervention, with 98.8% of surgical cases demonstrating good adherence compared to 37% pre-intervention ($p<0.001$). The mean adherence score increased from 51.6% (SD = 29.6) to 94.1% (SD = 8.2). Significant improvements were observed for most individual checklist items, including patient identity confirmation, surgical site marking, anesthesia machine checks, and pulse oximeter use ($p<0.001$). Team dynamics and communication also improved significantly post-intervention. Hospital type, size, years of service, funding source, surgical department, surgery type, urgency, and staff numbers were associated with checklist adherence pre-intervention.

Conclusion The implementation of a comprehensive training intervention significantly improved adherence to the WHO Surgical Safety Checklist in resource-limited hospitals in Mogadishu, Somalia. The findings highlight the feasibility and effectiveness of the SSC in enhancing surgical safety practices, team communication, and patient

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outcomes in challenging healthcare environments. Tailored implementation strategies, ongoing training, and cultural adaptation are crucial for the successful adoption of the SSC in resource-constrained settings.

Keywords Surgical safety checklist, WHO, Adherence, Implementation, Resource-limited settings, Somalia, Patient safety, Team communication

Introduction

Surgical safety remains a critical global health concern, with complications arising from surgical procedures resulting in significant morbidity and mortality [1]. Approximately 234 million major surgical procedures are performed annually worldwide, with nearly 7 million patients experiencing disabling complications and 1 million deaths occurring during or immediately after surgery [2]. Studies suggest that at least half of these adverse events are potentially preventable [3]. In response to this pressing issue, the World Health Organization (WHO) launched the "Safe Surgery Saves Lives" campaign in 2008, introducing the Surgical Safety Checklist (SSC) as a cornerstone initiative to globally enhance patient safety in operating rooms [4].

The WHO SSC is a 19-item tool designed to be used at three critical junctures during surgical procedures: before anesthesia induction (Sign In), before skin incision (Time Out), and before the patient leaves the operating room (Sign Out) [5]. The primary objectives are to improve team communication, ensure consistent care, and establish a culture of safety in surgical settings. Since its inception, numerous studies have demonstrated the efficacy of SSC in reducing surgical complications and mortality rates [6]. A landmark study published in the New England Journal of Medicine reported decreased death rates from 1.5 to 0.8% and inpatient complications from 11 to 7%, following SSC implementation across eight diverse hospitals worldwide [6].

Despite the proven benefits of the WHO SSC, its implementation and adherence remain challenging, particularly in low- and middle-income countries (LMICs), where resource constraints and cultural barriers often impede adoption [7]. Somalia, a country struggling with decades of conflict and a fragile healthcare system, exemplifies the complexities of implementing such safety measures in resource-limited settings [8]. The protracted civil war has severely damaged the country's medical infrastructure, leading to a critical shortage of healthcare professionals and essential medical equipment [9]. Consequently, surgical care in Somalia has been largely neglected, with the majority of studies focusing on infectious diseases, communicable diseases, and humanitarian emergencies [10].

In this context, evaluating the implementation of the WHO SSC in Somalia presents a unique opportunity to assess the effectiveness of the checklist in a challenging environment and identify strategies for improving surgical safety in similar settings. Previous studies have shown that the impact of SSC implementation can vary significantly based on local factors, including organizational culture, leadership support, and staff training [11, 12]. Therefore, an evaluation of the checklist's implementation in Somalia is crucial for understanding its potential benefits and barriers in a post-conflict resource-constrained setting.

This study aims to address this knowledge gap by conducting a pre-and post-intervention assessment of WHO SSC implementation in selected hospitals in Mogadishu., Somalia By examining checklist adherence rates, identifying factors influencing its use, and evaluating its impact on surgical team communication and patient outcomes, this research seeks to provide valuable insights into the feasibility and effectiveness of the SSC in Somalia's healthcare context. The findings of this study also have the potential to inform policy decisions and guide the development of tailored strategies for improving surgical safety in similar resource-limited environments across Africa and beyond.

Methodology

Study design and setting

This study employed a pre-and post-intervention design to evaluate the implementation of the World Health Organization (WHO) Surgical Safety Checklist (SSC) in 15 hospitals in Mogadishu, Somalia. Hospitals, which included General Hospitals, Specialty Hospitals, and Teaching Hospitals, were selected using a simple random sampling technique from a list of 69 hospitals in the city to ensure a representative sample. The selected hospitals varied in size, years of service, staffing level, and funding source.

Participants and intervention

The study population included all surgical procedures performed in the selected hospitals between April 12th and June 3rd' 2024. A comprehensive training program was designed and implemented to enhance the use of SSC. The training included practical demonstrations, interactive discussions, and the distribution of instructional materials. Surgical teams from participating hospitals received training, emphasizing the significance of each checklist item and providing strategies for effective implementation. The training sessions were conducted over one week, followed by a one-week dissemination period, in which the trained teams were responsible for training all relevant staff members within their hospitals. The trainees included scrub nurses, operative theater (OT) in charge, ward nurses, surgeons, and hospital management members in the training.

Data collection and analysis

Data were collected over two phases: Period I (pre-intervention), from April 12th to May 4th, and Period II (post-intervention), from May 12th to June 3rd. During both phases, a trained observer, who was a regular member of the surgical team (typically fulfilling the role of a scrub nurse), was present in the operating room to observe each surgical case and document adherence to the SSC. The observer performed their usual duties while also collecting data, ensuring that their presence did not disrupt or alter the routine practices of the team. By integrating the familiar observer into the surgical team, we minimized any potential influence on the team's behavior, thereby ensuring that the data collected accurately reflected the surgical teams' usual adherence to the checklist. Data collected included hospital characteristics, surgical details, and adherence to SSC across three phases: before anesthesia (sign-in), before incision (time-out), and before the patient left the operating room (sign-out).

Data analysis was performed using R programming (4.4.0). Descriptive statistics were used to summarize the characteristics of the hospitals and surgical cases. The primary analysis compared adherence to SSC before and after the intervention using the McNemar test. Cases with adherence of less than 60% were categorized as having poor adherence, whereas those with 60% or higher were categorized as having good adherence [13]. Binary logistic regression analysis was used to assess the association between checklist adherence and various hospital and surgical attributes. A significance level of 0.05 was set for all tests.

Results

Checklist adherence levels

Adherence to the WHO Surgical Safety Checklist (SSC) significantly improved after the training (Table 1). In Period I (pre-intervention), only 37% ($n=168$) of the surgical cases showed good adherence (>60%) to the checklist, with a mean adherence of 51.6% (SD=29.6). In contrast, during Period II (post-intervention), 98.8% ($n=336$) of the cases demonstrated good adherence, with a mean adherence of 94.1% (SD=8.2).

Table 1 Checklist Adherence levels

Levels	Frequency *n*(%)	Mean (SD)
Period I		
Good Adherence (>60%)	168 (37)	51.6±29.6
Poor Adherence (≤60%)	287 (63)	
Period II		
Good Adherence (>60%)	336 (98.8)	94.1±8.2
Poor Adherence (≤60%)	4 (1.2)	

Hospital and surgical case characteristics

Table 2 presents the characteristics of the hospitals and surgical cases in periods I and II. The distribution of hospital types, sizes, years of service, staffing levels, and funding sources was similar between the two periods. Gynecology was the most common surgical department (32.97% in Period I and 36.76% in Period II), followed by general surgery (23.96% and 27.06%, respectively). Most patients underwent major surgeries (78.46% and 75%, respectively). The proportion of elective surgeries was 51.87% in Period I and 55% in Period II (Fig. 1). Most surgeries lasted 1–3 h (67.47% and 64.71%), with a mean duration of 79.4 min (SD=40.7) in Period I and 77.4 min (SD=44.1) in Period II. The mean number of staff members in the operating room remained constant at five (SD=1) in both periods.

Checklist item adherence

Table 3 provides a detailed list of the checklist items.. Significant improvements ($p<0.001$) were observed for most items (Table 4). Patient identity confirmation increased from 44.6 to 97.9%, surgical site marking increased from 62.9 to 93.8%, anesthesia machines and medication checks improved from 66.2 to 94.7%, and pulse oximeter use increased from 89.9 to 99.7%. The allergy status confirmation rate increased from 58.7 to 98.2%. Risk assessments also improved significantly, with difficult airway risk assessment increasing from 64.8 to 68.5%, aspiration risk assessment rising from 64.8 to 68.5%, and risk of >500 ml blood loss assessment increasing from 31.9 to 63.2%. Team dynamics and communication were enhanced after the intervention: team member introductions increased from 31.2 to 95.9%, confirmation of patient information increased from 51.4 to 97.9%, antibiotic prophylaxis administration improved from 61.8 to 95.9%, and discussions of critical steps, duration, blood loss, and patient concerns all increased significantly from to 36–43% to over 97% ($p<0.001$). Adherence to the safety processes performed by nursing staff has also increased (Fig. 2). The equipment sterility confirmation rate increased from 82.9 to 99.7%. The essential imaging display rate increased from 69.0 to 83.8%. Verbal confirmation by the nursing team regarding the procedure name improved from 39.6 to 95.9%, instrument counts from 42.2 to 97.4%, specimen labeling from 74.1 to 93.2%, and equipment problem discussions from 41.1 to 97.9% ($p<0.001$).

Table 2 Comparison of Hospital and Surgical Case characteristics before and after WHO Surgical Safety Checklist training intervention

Variable	Period I		Period II	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Hospital Type				
General Hospital	281	61.76%	194	57.06
Specialty Hospital	79	17.36	41	12.06
Teaching Hospital	95	20.88	105	30.88
Hospital Size				
Large (> 500 beds)	83	18.24	73	21.47
Medium (100–500 beds)	222	48.79	113	33.24
Small (< 100 beds)	150	32.97	154	45.29
Years of Service				
Less than 10 years	242	53.19	208	61.18
10–30 years	38	8.35	20	5.88
More than 30 years	175	38.46	112	32.94
Mean ± SD	20.5 ± 18.3		18.3 ± 18.9	
Staffing				
Adequately Staffed	370	81.32	312	91.76
Understaffed	85	18.68	28	8.24
Funding				
Non-Profit Organization	110	24.18	39	11.47
Privately Funded	262	57.58	209	61.47
Publicly Funded	83	18.24	92	27.06
Department of Surgery				
ENT	81	17.8	68	20
General Surgery	109	23.96	92	27.06
Gynecology	150	32.97	125	36.76
Obstetrics	79	17.36	35	10.29
Orthopedics	28	6.15	12	3.53
Urology	8	1.76	8	2.35
Type of Surgery				
Major Surgery	357	78.46	255	75
Minor Surgery	98	21.54	85	25
Urgency of Surgery				
Elective	236	51.87	187	55
Emergency	219	48.13	153	45
Duration of Surgery				
Less than 1 h	143	31.43	113	33.24
1–3 h	307	67.47	220	64.71
More than 3 h	5	1.1	7	2.06
Mean ± SD	79.4 ± 40.7		77.4 ± 44.1	
Number of Staff in Operation				
Less than 5	162	35.6	132	38.82
More than 5	293	64.4	208	61.18
Mean ± SD	5 ± 1		5 ± 1	

Characteristics of hospital and surgical cases in Mogadishu, Somalia, before (Period I) and after (Period II) the WHO Surgical Safety Checklist Training Intervention. Table 1*displays the frequency and percentage of each characteristic for all the observed surgical cases across the 15 participating hospitals.*

Factors associated with checklist adherence

Table 5 presents the association between various hospital and surgical attributes and checklist adherence in Period I. Specialty hospitals (OR = 0.47, 95% CI: 0.28–0.79) and teaching hospitals (OR = 0.51, 95% CI: 0.3–0.88) had lower odds of good adherence compared to general hospitals. Medium (OR = 1.95, 95% CI: 1.1–3.46) and small hospitals (OR = 2.28, 95% CI: 1.25–4.15) had higher odds of good adherence compared to large hospitals. Hospitals aged 10–30 years (OR = 2.79, 95% CI: 1.38–5.63) and more than 30 years of service (OR = 3.36, 95% CI: 2.21–5.1) had higher odds of good adherence than those aged less than 10 years. Privately funded (OR = 0.18, 95% CI: 0.11–0.29) and publicly funded hospitals (OR = 0.5, 95%

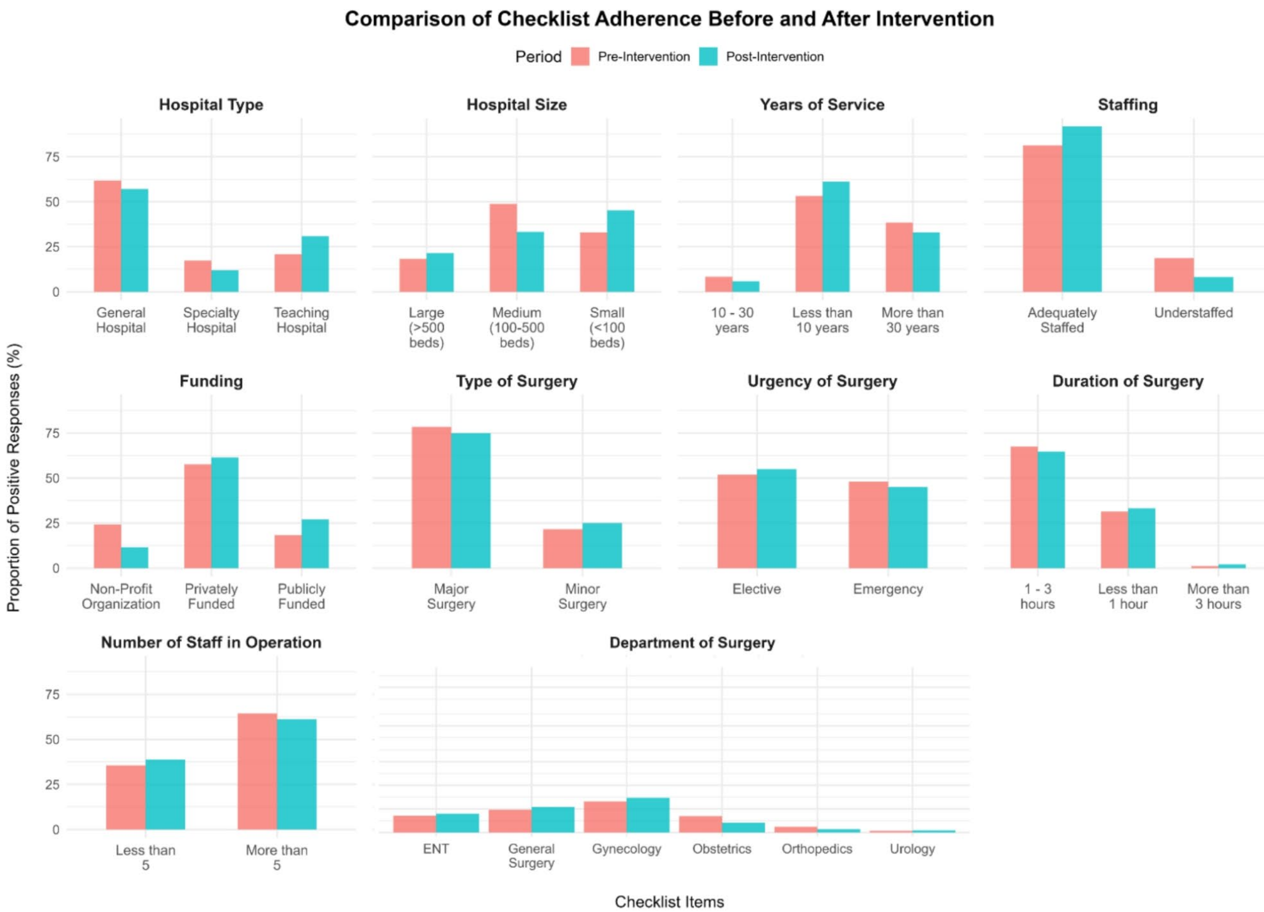

Fig. 1 Comparison of Key Variables Before and After Intervention

CI: 0.28–0.9) had lower odds of good adherence than non-profit organizations.

Gynecology (OR = 4.52, 95% CI: 2.37–8.62) and obstetrics departments (OR = 3.88, 95% CI: 1.9-7.901) had higher odds of good adherence. Minor surgeries had lower odds (OR = 0.26, 95% CI: 0.15–0.47) of good adherence compared to major surgeries. Emergency surgeries had higher odds (OR = 2, 95% CI: 1.36–2.94) of good adherence compared to elective surgeries. Cases with more than five staff members had higher odds (OR = 1.65, 95% CI: 1.09–2.48) of good adherence compared to those with fewer than five staff members.

Discussion

This study demonstrated that the implementation of a comprehensive training intervention led to a significant improvement in adherence to the WHO Surgical Safety Checklist in selected hospitals in Mogadishu, Somalia. The checklist compliance rates increased from 37% pre-intervention to 98.8% post-intervention, with the mean adherence score improving from 51.6 to 94.1%. Notably, the adherence rates for most checklist items also improved significantly. However, disparities in adherence were observed in the pre-intervention period based on hospital and surgery characteristics.

The significant improvement in checklist adherence post-intervention in this study aligns with the existing literature, underscoring the benefits of surgical safety checklists. A quality improvement project in Uganda found that the use of the WHO SSC increased from 7% in the pre-intervention phase to 92% in the intervention phase and remained elevated at 77% in the post-intervention phase [14]. This dramatic increase was achieved by implementing an educational intervention coupled with daily audits and feedback procedures. In England, a study showed a significant increase in checklist use from 7.9 to 96.9%, following an educational program aimed at increasing awareness and proper utilization [15]. These findings underscore the importance of robust implementation strategies, ongoing training, and cultural adaptation to ensure consistent and comprehensive utilization of the WHO SSC.

Notably, our study observed that adherence rates varied based on hospital type and surgical characteristics

Table 3 Detailed checklist items and descriptions for WHO Surgical Safety Checklist

Item	Description
Stage 1: Before Induction of Anesthesia (Sign in)	
item1	The patient confirmed his/her identity
item2	The patient confirmed the site of the procedure
item3	The patient confirmed the name of the procedure
item4	The patient confirmed consent
item5	The surgical site is marked
item6	The anesthesia machine and medication check is complete
item7	The pulse oximeter is on the patient and functioning
item8	The patient's allergy status is known and confirmed by the staff
item9	Patient's risk of difficult airway or aspiration is assessed with necessary equipment assistance available
item10	Risk of > 500 ml blood loss (> 7 ml/kg in children) is assessed with two IVs, central access, and fluids planned
Stage 2: Before Skin Incision (Time out)	
item11	Team members introduced themselves by name and role
item12	Patient's name, procedure, and incision site are confirmed by the surgical team
item13	Antibiotic prophylaxis has been given within the last 60 min
item14	The surgical team asked the surgeon about the critical or non-routine steps
item15	The surgical team asked the surgeon about the estimated duration of the case
item16	The surgical team asked the surgeon about the anticipated blood loss
item17	The surgical team asked the anesthetist about any patient-specific concerns
item18	Sterility, including indicator results, has been confirmed by the nursing team
item19	The surgical team asked the nursing team about any equipment issues or concerns
item20	Essential imaging for the procedure was displayed
Stage 3: Before Patient Leaves Operating Room (sign out)	
item21	The name of the procedure is verbally confirmed by the nursing team
item22	Completion of instruments, sponge, and needle counts is verbally confirmed by the nursing team
item23	Specimen labeling, specimen labels read aloud, including patient name, is verbally confirmed by the nursing team
item24	The nurse verbally confirmed whether there were any equipment problems to be addressed
item25	Discussion of key concerns for recovery and management of the patient is done by the surgeon, anesthetist, and nurse

during the pre-intervention period. General hospitals and major surgeries exhibited higher adherence than specialty and teaching hospitals or minor surgeries did. This finding is consistent with that of a study that found that compliance with the WHO Surgical Safety Checklist varied depending on the hospital and the implementation process [16]. Another study found significant variation in adherence to the checklist between hospitals [17]. This variation may be attributed to differences in organizational structure, resource availability, and the nature of surgeries performed in these hospitals [18]. For example, teaching hospitals often have more complex cases and a higher turnover of staff, which may contribute to lower adherence [19]. On the other hand, small hospitals, despite having fewer resources, might exhibit higher adherence due to more streamlined communication and closer-knit teams. Private hospitals may face different challenges compared to non-profit hospitals, such as prioritizing efficiency and cost-effectiveness, which might impact adherence to safety protocols [20]. Understanding these dynamics is crucial for tailoring interventions that address specific challenges faced by different types of hospitals.

Our study highlights significant improvements in adherence at different stages of the surgical procedure. During the "sign in" phase, items such as patient identity confirmation, surgical site marking, and anesthesia machine checks showed remarkable improvement. The "time out" phase saw increases in team introductions (from 31.2–95.9%) and discussions about critical steps and potential complications. Finally, in the "sign out" phase, adherence to items like instrument counts and specimen labeling also improved significantly. Several studies have found that compliance with surgical safety checklists varies across different stages of implementation and even within different sections of checklists [21, 22]. One study found that while the overall compliance rate for the checklist was 65% eight months after implementation, the 'Sign out' section was the most difficult to complete, being missed completely in 21% of cases [23]. Similarly, another study found that while compliance with the 'sign in' and 'time out' sections was high, 'sign out' was only observed in 2 out of 100 cases [24]. This difficulty with the 'sign out' section is likely because it is not linked to a specific event in patient management [22].

One of the key findings of our study was the substantial improvement in adherence to specific checklist items.

Table 4 Comparison of Checklist Adherence Rates (Period I and Period II)

Item	Period I		Period II		*P*-value*
	Yes (n %)	No (n %)	Yes (n %)	No (n %)	
Item1	203 (44.62%)	252 (55.38%)	333 (97.94%)	7 (2.06%)	< 0.001
item2	174 (38.24%)	281 (61.76%)	333 (97.94%)	7 (2.06%)	-
item3	166 (36.48%)	289 (63.52%)	333 (97.94%)	7 (2.06%)	-
item4	221 (48.57%)	234 (51.43%)	329 (96.76%)	11 (3.24%)	-
item5	286 (62.86%)	169 (37.14%)	319 (93.82%)	21 (6.18%)	-
item6	301 (66.15%)	154 (33.85%)	322 (94.71%)	18 (5.29%)	
item7	409 (89.89%)	46 (10.11%)	339 (99.71%)	1 (0.29%)	0.021
item8	267 (58.68%)	188 (41.32%)	334 (98.24%)	6 (1.76%)	< 0.001
item9	295 (64.84%)	160 (35.16%)	233 (68.53%)	107 (31.47%)	0.369
item10	145 (31.87%)	310 (68.13%)	215 (63.24%)	125 (36.76%)	< 0.001
item11	142 (31.21%)	313 (68.79%)	326 (95.88%)	14 (4.12%)	-
item12	234 (51.43%)	221 (48.57%)	333 (97.94%)	7 (2.06%)	-
item13	281 (61.76%)	174 (38.24%)	326 (95.88%)	14 (4.12%)	-
item14	175 (38.46%)	280 (61.54%)	338 (99.41%)	2 (0.59%)	-
item15	165 (36.50%)	287 (63.50%)	330 (98.21%)	6 (1.79%)	-
item16	176 (38.94%)	276 (61.06%)	331 (97.64%)	8 (2.36%)	-
item17	194 (42.64%)	261 (57.36%)	339 (99.71%)	1 (0.29%)	-
item18	377 (82.86%)	78 (17.14%)	339 (99.71%)	1 (0.29%)	-
item19	255 (56.92%)	193 (43.08%)	334 (99.11%)	3 (0.89%)	-
item20	314 (69.01%)	141 (30.99%)	285 (83.82%)	55 (16.18%)	-
item21	180 (39.56%)	275 (60.44%)	326 (95.88%)	14 (4.12%)	-
item22	192 (42.20%)	263 (57.80%)	331 (97.35%)	9 (2.65%)	-
item23	337 (74.07%)	118 (25.93%)	317 (93.24%)	23 (6.76%)	-
item24	187 (41.10%)	268 (58.90%)	333 (97.94%)	7 (2.06%)	-
item25	189 (41.54%)	266 (58.46%)	315 (92.65%)	25 (7.35%)	-

**The p-value obtained using McNemar's test indicates the statistical significance of the change in adherence rates pre- and post-training, with values less than 0.05 considered statistically significant. All p-values marked with a dashed line ("-") were less than 0.001.*

For example, patient identity confirmation increased from 44.6 to 97.9%, surgical site marking increased from 62.9 to 93.8%, and pulse oximeter use increased from 89.9 to 99.7%. These improvements are critical because they address fundamental safety checks that prevent common surgical errors. Similarly, the significant increase in anesthesia machine checks (from 66.2 to 94.7%) and allergy status confirmation (from 58.7 to 98.2%) highlights the role of SSC in ensuring comprehensive preoperative preparation. These findings are consistent with those of previous studies. A study conducted in Thailand reported that the use of a Surgical Safety Checklist improved verification of patient identity [25]. The same study reported that compliance was low for surgical site marking (only 19.4% of surgical sites were marked). Several studies have indicated a substantial improvement in the use of pulse oximetry following checklist implementation [26]. In Madagascar, increased pulse oximeter use was one of the three most significant practice changes observed after implementation of the checklist. Two hospitals even reported instances in which the pulse oximeter alerted clinical teams to desaturate patients, enabling timely intervention by the anesthetist [27].

Although our study did not specifically investigate complications and mortality rates due to resource constraints, the implementation of SSC is associated with a reduction in postoperative complications and mortality rates, reflecting an overall enhancement in patient safety outcomes. For instance, a study conducted in Chile demonstrated that implementing the WHO Surgical Safety Checklist led to a decrease in major complications from 11 to 7% and a reduction in mortality by 53% (from 1.5 to 0.8%) [28]. Studies have emphasized the significance of surgical safety checklists in minimizing surgical errors and complications [29, 30]. One Study found that the implementation of surgical safety checklists led to a decline in surgical complications from 19.9 to 12.4% ($P<0.001$) and shortened the average length of stay by 0.8 days ($P=0.022$) [31]. This underscores the sustained positive impact of checklists on patient outcomes.

In addition to improving adherence, SSC has been shown to enhance teamwork and communication among the surgical teams. A study reported that the use of an anesthesia pre-induction checklist improved information exchange, knowledge of critical information, and perception of teamwork and safety among anesthesia teams [32]. Our study observed similar improvements

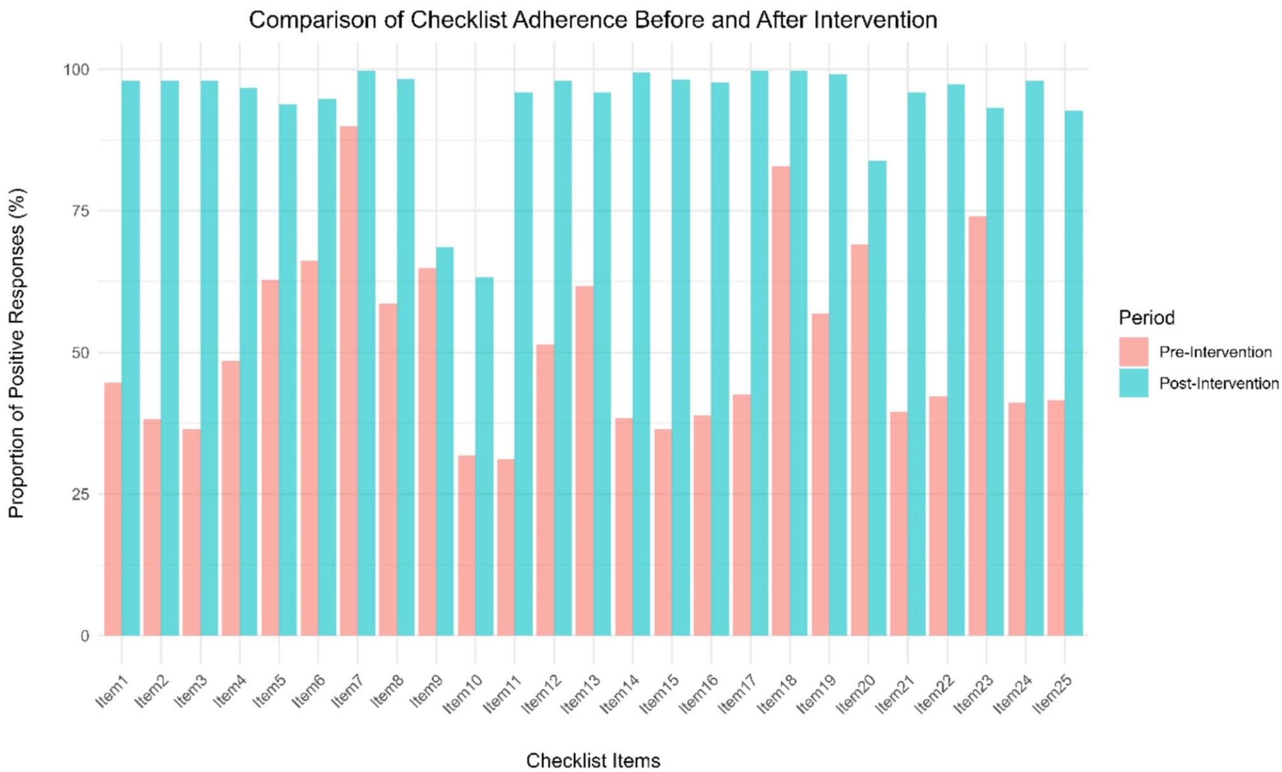

Fig. 2 Comparison of Key Variables Before and After Intervention

in team dynamics and communication, with significant increases in team member introductions and discussions on critical steps, duration, and anticipated blood loss. A study at a UK hospital focusing on orthopedic operations found that 77% of respondents believed that the checklist led to better communication among team members [15]. Similarly, in a study conducted at 13 hospitals in the USA, 73.6% of respondents indicated that the checklist helps prevent problems or complications during surgery, suggesting improved communication and adherence to safety protocols [24]. However, some studies have shown variations in how different surgical team members perceive the checklist's impact on communication. Research suggests that, while surgeons often report a more favorable view of improved teamwork and communication fostered by the checklist, other surgical team members, such as nurses and anesthesia providers, may not share the same level of perceived improvement [33]. This contrast underscores the importance of addressing potential communication gaps between surgeons and other team members to maximize the effectiveness of the checklist.

The findings of this study have several important practical implications. Effective implementation strategies are crucial for the successful adoption of surgical safety checklists [24]. The success of implementing SSC, including achieving compliance and realizing its benefits, is influenced by various factors, such as local resources, established practices, and staff attitudes. For instance, in a study conducted in both UK and African hospitals, resource limitations in African hospitals posed a significant challenge in implementing certain technical aspects of the checklist [34].Adapting the checklist to local contexts and considering specific challenges and resource constraints can further enhance its effectiveness.

The unique context of our study, conducted in a resource-limited setting, adds to the growing body of evidence supporting the efficacy of surgical safety checklists in diverse healthcare settings. The inclusion of various hospital types and surgical specialties in our study provided a comprehensive understanding of the impact of the checklist across different environments. However, despite these strengths, our study also faced limitations, such as potential observer bias and the lack of long-term follow-up. Future research should focus on conducting multicenter studies across different regions to provide a broader understanding of the impact of the checklist. Evaluating the long-term sustainability and impact of improved adherence on patient outcomes will offer insights into the lasting benefits of the intervention [35]. Additionally, exploring the factors influencing checklist adherence, such as hospital culture, staff attitudes, and resource availability, can inform strategies to enhance implementation [36]. Assessing the cost-effectiveness of surgical safety checklists is crucial, particularly in

Table 5 Association of Implementation Status of Various Hospital and surgery attributes of (period I

	Checklist Adherence		**OR(95%CI)**	***P*-value**
	Good Adherence	**Poor Adherence**		
Hospital Type				
General Hospital	121 (43.06%)	160 (56.94%)	1.00	
Specialty Hospital	22 (27.85%)	57 (72.15%)	0.47 (0.28–0.79)	0.004*
Teaching Hospital	25 (26.32%)	70 (73.68%)	0.51 (0.3–0.88)	0.016*
Hospital Size				
Large (> 500 beds)	20 (24.10%)	63 (75.90%)	1.00	
Medium (100–500 beds)	85 (38.29%)	137 (61.71%)	1.95 (1.1–3.46)	0.021*
Small (< 100 beds)	63 (42.00%)	87 (58.00%)	2.28 (1.25–4.15)	0.007*
Years of Service				
Less than 10 years	59 (24.38%)	183 (75.62%)	1.00	
10–30 years	18 (47.37%)	20 (52.63%)	2.79 (1.38–5.63)	0.004*
More than 30 years	91 (52.00%)	84 (48.00%)	3.36 (2.21–5.1)	< 0.001*
Staffing				
Adequately Staffed	134 (36.22%)	236 (63.78%)	1.00	
Understaffed	34 (40.00%)	51 (60.00%)	1.17 (0.72–1.9)	0.515
Funding				
Non-Profit Organization	69 (62.73%)	41 (37.27%)	1.00	
Privately Funded	61 (23.28%)	201 (76.72%)	0.18 (0.11–0.29)	< 0.001*
Publicly Funded	38 (45.78%)	45 (54.22%)	0.5 (0.28–0.9)	0.02*
Department of Surgery				
ENT	15 (18.52%)	66 (81.48%)	1.00	
General Surgery	31 (28.44%)	78 (71.56%)	1.75 (0.87–3.52)	0.117
Gynecology	76 (50.67%)	74 (49.33%)	4.52 (2.37–8.62)	< 0.001*
Obstetrics	37 (46.84%)	42 (53.16%)	3.88 (1.9–7.901	< 0.001*
Orthopedics	5 (17.86%)	23 (82.14%)	0.96 (0.31–2.93)	0.938
Urology	4 (50.00%)	4 (50.00%)	4.4 (0.99–19.62)	0.052
Type of Surgery				
Major Surgery	152 (42.58%)	205 (57.42%)	1.00	
Minor Surgery	16 (16.33%)	82 (83.67%)	0.26 (0.15–0.47)	< 0.001*
Urgency of Surgery				
Elective	69 (29.24%)	167 (70.76%)	1.00	
Emergency	99 (45.21%)	120 (54.79%)	2 (1.36–2.94)	< 0.001*
Duration of Surgery				
Less than 1 h	49 (34.27%)	94 (65.73%)	1.00	
1–3 h	119 (38.76%)	188 (61.24%)	1.21 (0.8–1.84)	0.359
More than 3 h	0 (0.00%)	5 (100.00%)	-	0.998
Number of Staff in Operation				
Less than 5	48 (29.63%)	114 (70.37%)	1.00	
More than 5	120 (40.96%)	173 (59.04%)	1.65 (1.09–2.48)	0.017*

resource-limited settings. Semel et al. (2010) highlighted the potential cost savings associated with the implementation of the SSC, suggesting that the checklist can be a cost-effective tool for improving surgical safety [37].

Conclusion

Implementation of a comprehensive training intervention significantly improved adherence to the WHO Surgical Safety Checklist in selected hospitals in Mogadishu, Somalia. The checklist compliance rates increased from 37% pre-intervention to 98.8% post-intervention, with the mean adherence score improving from 51.6 to 94.1%. The adherence rates for most individual checklist items also improved significantly, particularly in areas such as patient identity confirmation, surgical site marking, anesthesia machine checks, and pulse oximeter use. However, disparities in adherence were observed in the pre-intervention period based on hospital and surgery characteristics, with general hospitals and major surgeries exhibiting higher adherence than specialty and teaching hospitals or minor surgeries. This study highlights the importance of effective implementation strategies, ongoing training, and cultural adaptation to ensure consistent and comprehensive utilization of the WHO Surgical Safety Checklist.

Although the study did not specifically investigate complications and mortality rates, the implementation of the checklist has been associated with reductions in postoperative complications and mortality in other settings. The checklist also enhanced teamwork and communication among the surgical teams. Future research should focus on conducting multicenter studies, evaluating long-term sustainability and its impact on patient outcomes, exploring factors influencing checklist adherence, and assessing cost-effectiveness, particularly in resource-limited settings.

Author contributions

NID Conceptualized this idea. The study design was developed collaboratively by NID, AHE, AMA, MMA, MAO, MMH, and AOA. Material preparation, data collection, and analysis were performed by NID, AMA, MMA, and MAO. MMA analyzed and interpreted the data. The initial draft was composed by MMA, and all authors contributed to the writing, reviewing, and editing of the subsequent versions of the manuscript.

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Data availability

The Data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethical approval and consent to Participate

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of SIMAD University, Mogadishu, Somalia, as per the approval letter dated March 30, 2024, with reference number 2024/SU-IRB/FMHS/P055. In accordance with this approval, informed consent was obtained from all individual participants involved in the study. Participants were adequately informed about the study's objectives, their right to confidentiality, and their right to withdraw consent at any time without repercussions.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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