Utilization and Completeness of World Health Organization Surgical Safety Checklist in a Tertiary Hospital in Nepal

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ABSTRACT

Background

The World Health Organization Surgical Safety Checklist (WHO-SSC) reduces surgical complications and morbidity; however, its utilization remains low in low- and middle-income countries.

Objective

To assess the utilization and completeness of a modified WHO Surgical Safety Checklist at a tertiary hospital in Nepal.

Method

A descriptive, observational cross-sectional study was conducted in 300 surgeries at Kathmandu Medical College Teaching Hospital (February to May 2024) following ethical clearance. Utilization and completeness of the modified WHO Surgical Safety Checklist (Pre-procedure check, Sign-in, Time-out, Sign-out) were observed passively. Data were analyzed using Microsoft Excel and SPSS v 20. Data were presented in numbers and percentages and Chi-square/ Fisher's exact test used for categorical variables. A p-value of < 0.05 was considered significant.

Result

WHO Surgical Safety Checklist was utilized in 48.7% of cases, with full compliance in only 8.7%. Utilization rate was seen to be 63% in the Pre-procedure check, while Sign-out was the least performed (29.3%). Highest utilization was seen in the General Surgery department, while the highest completion rate was seen in Neurosurgery (100%). Verbal confirmation (70.2%) was done more than written documentation.

Conclusion

Despite proven benefits, adherence to WHO Surgical Safety Checklist remains suboptimal. Targeted training and regular audits are essential to improve compliance and patient safety in resource-limited settings.

KEY WORDS

Completeness, Compliance, Utilization, WHO surgical safety checklist

INTRODUCTION

Evidence proves that a lack of surgical safety protocols can result in adverse events, affecting nearly 10% of surgical patients; half of which are preventable.[1,2] A study by the World Health Organization (WHO) showed that a simple surgical checklist used during major surgeries can decrease the incidence of related complications and mortality by one-third.[3]

WHO Surgical Safety Checklist (WHO-SSC) was introduced in 2008, to improve open communication between different surgical faculties. The checklist is performed at three points of time: Sign-in (before anaesthesia induction); Time-Out (before surgical incision), and Sign-out (before exiting the operating theatre).

Though proven to improve outcomes in the developed world, the utilization and completeness remain low in developing countries.[4] This study assessed the utilization and completeness of the WHO-SSC at a tertiary hospital in Nepal to identify gaps and improve surgical safety.

METHODS

A descriptive, observational cross-sectional study was conducted in the operating theatres (OTs) of Kathmandu Medical College Teaching Hospital (KMCTH) to assess the utilization and completeness of the WHO-SSC from February to May 2024. Following approval of the Institutional Review Committee (Ref: 0102024/06), major and intermediate surgeries being conducted at KMCTH were included in the study. Informed consent was taken. Minor surgeries and patients not willing to participate were excluded. The sample size was calculated based on a previous study where the proportion of utilization of the WHO-SSC was 93.5%.[5] Utilizing the formula, $n=z^2 X\ pq/e^2$, where n=sample size, z=1.96 at 95% confidence interval, p=proportion of surgeries where the WHO-SSC was used (0.935), q=1-p (0.065) and e=allowable error at 3%, a sample size of 260 was calculated. Considering a dropout of 15%, a sample size of 300 was finalized. A convenience sampling technique was used. WHO-SSC, which is a checklist consisting of 19 items, was observed by trained research assistants. To minimize potential biases, the operating room personnel were unaware of the observation.

Our hospital uses a modified WHO-SSC, which has a pre-procedure column filled by a nursing assistant before the patient is shifted to OT, in addition to the Sign-in, Time out and Sign-out of the standard WHO-SSC (Table 1). Details regarding the type of surgery and anaesthesia, nature of surgery (elective or emergency), time of operation, the position of the operation on the OT list, and the number of staff were also collected. We made the following observations:

1. Whether the WHO-SSC was performed

2. If yes, were all three parts (Sign-in, Time-out, Sign-out) performed?

WHO-SSC consists of 19 items divided into three domains: Sign-in (7 items), Time-out (7 items), and Sign-out (5 items). Sign-in is done before induction of anaesthesia in the presence of nurses and anaesthesiologists. Time-out and Sign-out are performed before skin incision and before the patient leaves the operating room respectively, with the whole team (nurses, anaesthesiologists, and surgeons).

3. Which team member initiated each part of the checklist

Following the end of the surgery, the post-operative patient charts were reviewed in the Post-Anaesthesia Care Unit (PACU) for any missing information. The checklist was deemed complete if it was filled out 80-100%. Data entry and statistical analysis were done in Microsoft Excel and Statistical Package for the Social Sciences Version 2 (SPSS Inc. Chicago, IL, USA). Data are presented in numbers and percentages. The utilization rate was the percentage of surgeries using WHO-SSC. Completion rates for individual checklist components were also calculated as percentages. The total completion rate was derived by dividing the performed checklist items (only Sign-in, Time-out, and Sign-out) by 19 for standardization. Chi-square or Fisher Exact test was used to calculate the statistical significance of categorical variables. Logistic regression models were developed to test the utilization of WHO-SSC according to the type of surgery or anaesthesia, department and the number of staffs available. Odds ratio (OR) and its 95% Confidence Interval (C.I.) was used to interpret the results. A p-value < 0.05 was considered statistically significant.

RESULTS

Three hundred surgeries were included in this study. Out of 300 observed cases, the WHO-SSC was utilized in 146 (48.7%) cases and not used in 154 (51.3%) cases, while full compliance with all the checklist components was seen only in 26 (8.7%) cases. Rest of the cases had either incomplete or no adherence at all. Most of the surgeries included in the study were elective cases, 279 (93%) with General surgery being the most common department (36.3%), followed by Urosurgery and orthopaedics (14% each), ENT (10%), and obstetrics and gynaecology (8.3%). Few surgeries in neurosurgery, paediatric-surgery, plastic-surgery, oromaxillofacial surgery, ophthalmology and gastromedicine (ERCP) were also included.

Pre-procedure verification was performed most of the time (63.3%). Among the three parts of the original WHO-SSC, compliance with Time-out was the highest (40.6%), followed by Sign-in (36.3%) and finally, Sign-out (29.3%) (Fig. 1).

Table 1. Modified WHO Surgical Safety Checklist sed in KMCTH

KATHMANDU MEDICAL COLLEGE PUBLIC LIMITED
Teaching Hospital
Department of Surgery
SURGICAL SAFETY CHECKLIST

AT WAITING HALL	BEFORE INDUCTION OF ANAESTHESIA	BEFORE SKIN INCISION	BEFORE LEAVING OPERATING ROOM
PRE-PROCEDURE	**SIGN-IN**	**TIME-OUT**	**SIGN-OUT**
Patient/ Patient's representative actively confirms with registered nurse •Identity Yes •Procedure and procedure site Yes •Consent Yes Site marked by person performing the procedure Yes N/A Registered nurse confirms presence of • History and physical examination Yes •Pre-anaesthesia assessment Yes • Diagnostic and radiologic test result Yes N/A • Blood products Yes N/A • Any special equipment, devices, implants Yes N/A	Patient has confirmed • Identity • Site • Procedure •Consent Site marked/ Not applicable Anaesthesia safety check completed? Is the pulse oximeter on patient and functioning? Does the patient have a known allergy? No Yes Difficult airway/aspiration risk? No Yes, and equipment/ assistance available Risk of >500 ml blood loss (7 ml/kg in children)? No Yes, and adequate intravenous access and fluids planned	Confirm all team members have introduced themselves by name and role Surgeon, Anaesthesia Professional and nurse verbally confirm Patient Site Procedure Anticipated critical events: • Surgeon reviews: What are the critical or unexpected steps? Operative duration? Anticipated blood loss? • Anaesthesia team reviews: Are there any patient-specific concerns? • Nursing team reviews: Has sterility been confirmed? Are there any equipment issues or any concerns? Has antibiotic prophylaxis been given within the last 60 minutes? Yes Not applicable Is essential imaging displayed? Yes Not applicable	Nurse verbally confirms: •The name of the procedure •That instrument, sponge and needle counts are correct •How the specimen is labelled (including patient name) •Whether there are any equipment problems to be addressed Surgeon, anaesthesia professional and nurse review the key concerns for recovery and management of this patient.

Patient name: ..... Age/Sex.....Diagnosis.....
Surgery.....Anaesthesiologist: ..... Nurse: .....

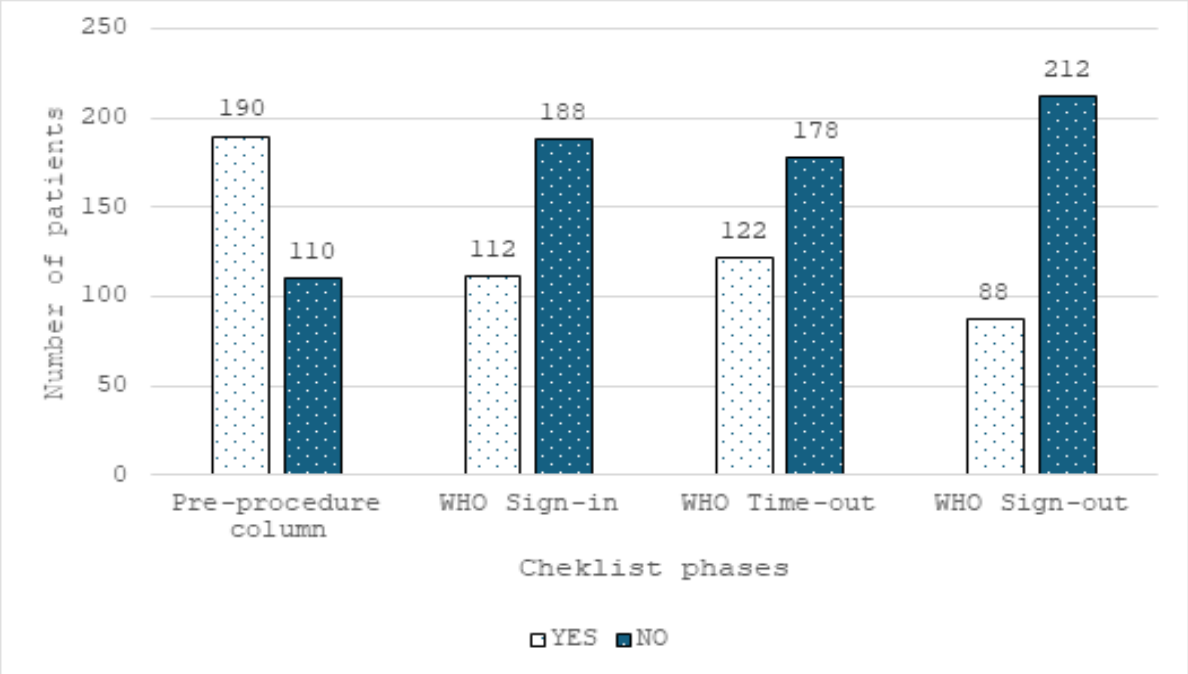

Figure 1. Utilization of individual phases of WHO-SSC

Utilization of checklist as per the type of anaesthesia, nature of surgery, department, position on the list and number of staffs have been shown in table 2. We found no statistically significant differences in WHO-SSC utilization across anaesthesia types (p=0.414). Similarly, utilization also had no significant association with the nature of surgery, (p=0.581), position on the day's list (p=0.608) and with the number of staff present in the OT (p=0.439). A highly significant difference in checklist utilization was seen across departments (p < 0.001). The utilization rate ranged from 0% to 100% with Neurosurgery, General surgery, and Urosurgery showing above average compliance.

Table 2. Utilization of WHO-SSC according to type of anaesthesia, surgery, department, position on the list and number of staff

Variables	Category	Utilization of checklist			p-value
		Yes (n=146) n (%)	No (n=154) n (%)	Total	
Type of anaesthesia	GA* with tracheal intubation	97 (51.1)	93 (48.9)	190	0.420
	GA* with LMA†	12 (57.1)	9 (42.9)	21	
	Subarachnoid block	29 (43.3)	38 (56.7)	67	
	Peripheral nerve blocks	8 (36.4)	14 (63.6)	22	
Nature of Surgery	Elective	137 (49.1)	142(50.9)	279	0.581
	Emergency	9 (42.8)	12 (57.2)	21	
Department	General surgery	75 (68.8)	34 (31.2)	109	<0.001
	Urosurgery	22 (52.4)	20 (47.6)	42	
	Orthopaedics	16 (38.1)	26 (61.9)	42	
	ENT	4 (13.3)	26 (86.7)	30	
	Obstetrics/ Gynecology	4 (16)	21 (84)	25	
	Plastic surgery	3 (20)	12 (80)	15	
	Neurosurgery	13 (100)	0 (0)	13	
	Paediatric surgery	8 (66.7)	4 (33.3)	12	
	Gastromedicine	0 (0)	6 (100)	6	
	Oro-maxillofacial surgery	1 (20)	4 (80)	5	
	Ophthalmology	0 (0)	1 (100)	1	
Position on the theatre list	First	74 (53.6)	64 (46.4)	138	0.608
	Second	35 (47.3)	39 (52.7)	74	
	Third	21 (42)	29 (58)	50	
	> Fourth	16 (44.4)	20 (55.6)	36	
Number of staff in OT	≤ 5	9 (45)	11 (55)	20	0.439
	> 5 to < 10	99 (45.4)	201 (54.6)	218	
	≥ 10	38 (61.3)	24 (38.7)	62	

Note: Data are presented as number (percentage). p-value calculated via Chi-square test/ Fisher's exact test. Abbreviations: *General anaesthesia; †Laryngeal mask airway

Regarding the initiator of the checklist, it was found that sign-in was mostly initiated by the anaesthesia residents, while Time-out and sign-out were conducted primarily by surgery residents and surgeons, respectively (Table 3). Among the times when it was performed, verbal confirmation (70.2%) was more common than written documentation. To be specific, Sign-in, Time-out, and Sign-out were done verbally in 60.3%, 68%, and 89% respectively.

Though the utilization of the WHO-SSC was seen in 146 (48.7%) cases, full compliance to the checklist was only in 26 (8.7%). Table 4 shows that Pre-procedure column, which should be filled before the patient is shifted to the OT was the most completely filled part, while Sign-out was the least completed part. The parameter mostly missed in the pre-procedure column was "Special equipment check". As for Sign-in, the most commonly missed factor was checking patient's consent and allergies, while for Time-out, team introduction and antibiotic confirmation were frequently missed. On the other hand, during Sign-out, the only thing most of the staff did were confirming the instrument and the sponge counts. The events caught by the use of WHO-SSC were preparation for a difficult airway in two cases and giving antibiotics in five cases.

Table 3. Initiator of the WHO-SSC

Variables	Anaesthesiologist n (%)	Anaesthesia resident n (%)	Surgeon n (%)	Surgery resident n (%)	Nursing staff n (%)	None n (%)
Sign-in	27 (9)	84 (28)	0 (0)	0 (0)	0 (0)	189 (63)
Sign-out	2 (0.7)	11 (3.7)	31(10.3)	78 (26)	0 (0)	178 (59.3)
Time-out	0 (0)	0 (0)	36 (12)	34 (11.3)	3 (1)	227(75.6)

Note: Data are presented as number (percentage)

Multivariable logistic regression analysis performed to see factors that were associated with the utilization of the checklist, showed department to be a significant predictor of utilization of WHO-SSC [adjusted Odds Ratio (aOR)=1.45, 95% CI 1.30-1.62, p < 0.001], indicating a 45% increased chance of utilization of the checklist as per the department (Table 5). The OR of 1.45 was statistically significant because the confidence interval did not include one. Regarding other factors in the analysis table, they were not statistically significant as the CI of all other factors include one. Though the aOR of "nature of surgery" was highest among the whole group, the CI includes one and hence, the association was not statistically significant. This was further strengthened by the p-value being more than 0.05.

Table 4. **Completeness of the WHO-SSC phases**

Variables of WHO-SSC	Filled	Incompletely filled	Not filled
	n (%)	n (%)	n (%)
Pre-procedure	170 (56.7)	20 (6.6)	110 (36.7)
Sign-in	108 (36)	4 (1.3)	188 (62.7)
Time-out	101 (33.7)	21 (7)	178 (59.3)
Sign-out	14 (4.7)	74 (24.7)	212 (70.6)
Note: Data are presented as numbers (percentages)			

DISCUSSION

This study evaluated the implementation of a modified WHO-SSC in our operating theaters across 300 surgeries, and our data shows a low utilization rate of 48.7%. The completion rate of the checklist was even lower at 8.7%. These findings reveal critical gaps in the utilization and completeness of the checklist, with significant disparities across departments and checklist components.

The overall utilization rate of 48.7% falls short of international standards as other studies have shown utilization rates of 70-93.5%.[5,6] Though our results align with a similar study conducted at the University of Gondar, Ethiopia, where the checklist was utilized in only 39.7% of the cases, the problem lies in the fact that this utilization rate is very low.[7] A study done in Pakistan by Hamza et al. found that though the compliance rate was low in the initial phase of the study, compliance with the checklist improved significantly in the second phase following an educational intervention.[8] This highlights the importance of training and education, whereby simple and cost-effective measures can greatly improve patient outcomes. According to the Lancet Commissions, five billion people in the world are devoid of affordable anaesthesia and surgical care, the bulk of which lies in developing countries.[9] The difference in quality of health care in developed and developing countries, for example, due to health care budgets, may affect surgical safety.[4] Hence, use of these simple tools like checklists becomes even more important in low-and-middle income countries (LMICs).

WHO-SSC is performed at three standard and critical time-points of surgery. In our study, Time-out was the most commonly performed, which was initiated by surgeons. Ambulkar et al. also found that surgeons were the initiators of WHO-SSC in 83.5% of cases.[10] Though Time-out was initiated by surgeons, we found that Sign-in was initiated by anaesthesia residents in most of the cases. Sign-out was the least performed among all. Similar results have been seen in other LMIC studies too and even in the developed world.[10-13] As Sign-out is done at the end of surgery, it may be incompletely filled due to tiredness or time pressure.[14] Another factor may be that Sign-out should be initiated by the nursing staff. However, in India and Nepal, the nurses do not assume a leading role, which has been termed "OR culture" by Ambulkar et al. In the present study, only 3 Sign-outs out of 300 were initiated by nurses.[10] This can be changed by education and regular training, which is a cost-effective way of improving patient safety and improving team engagement. In fact, the checklist ensures that all the team members, anaesthesiologists, surgeons and nursing staffs are on the same page at all times during the peri-operative period. Use of WHO-SSC can also bring about a cultural shift in OTs, as it can empower team members to speak up if they find problems during systematic checks, regardless of hierarchy.

Table 5. **Factors Associated with WHO Surgical Safety Checklist Utilization – Results of Multivariable Logistic Regression Analysis**

Variable	Adjusted Odds ratio [Exp (B)]	95% Confidence Interval	p-value
Department	1.45	1.30 to 1.62	<0.001*
Type of anaesthesia	0.93	0.77 to 1.12	0.427
Nature of surgery	1.55	0.55 to 4.36	0.410
Position on the list	1.27	1.00 to 1.61	0.054
Number of OT staff	0.97	0.85 to 1.12	0.710

Note: * Variables with significant association (p-value < 0.05)

A very concerning result of this study is the mere 8.7% full compliance of the WHO-SSC. It means that even when the checklist was initiated, important steps were omitted. Full compliance means going through all the three phases and having completion rate of 80-100% overall. Though individual completion rates of different phases are good, overall full compliance is low. Individual full compliance of Pre-procedure check, Sign-in, Time-out and Sign-out were 56.67%, 36%, 33.67% and 4.67% respectively in this study. This is in contrast with the compliance rate by Bajracharya et al. which are 55.4%, 47.9% and 56.9% respectively.[15] This may have been affected by the low utilization of the Sign-out phases. Incomplete and poor use of checklists can reduce the effectiveness of the WHO-SSC as completeness depends on proper communication between the medical professionals involved by reducing the risk of misunderstandings. So, using checklists without an appreciation of the mechanism of their benefit can be a potential threat to the safety of the patient.[12]

Higher adherence to performing the checklist was seen in Neurosurgery and General Surgery departments. In fact, departmental variation was the most important predictor of checklist use, which was strengthened by the multivariable logistic regression analysis done. This may be the reflection of differences in team dynamics and the way they perceive the relevance of the checklist. Targeted training and departmental audits can help us to address these problems. There was no association of utilization of checklist with anaesthesia type, nature of surgery and staffing number, proving these were not primary barriers to implementation of WHO-SSC in our center. General thoughts may hint at WHO-SSC being less used in emergency due to time constraints. But in this

study, though the nature of surgery showed a high OR, the association was not significant. It also had a wide CI (055-4.36) compared to the effect of department which had a tighter CI (1.30-1.62). This effect may have been seen as there were fewer emergency cases included in this study.

The study also found that verbal confirmation was more common than written documentation. Though the WHO states that verbal performance is adequate for checklist implementation, it may compromise standardization and accountability. Similar finding was also reported by Vivekanantam et al. who identified inconsistent documentation of the checklist as one of the key problems in LMICs.[4] Barriers to the use of checklist has also been studied, though we did not explore that side. According to Uprety et al. some common barriers to the use of checklist are lack of training, lack of experience an unwillingness of the personnel involved.[16]

This study has limitations. This is just a single center study and there may be potential observer bias. We also did not explore the underlying barriers that could have led to low compliance.

Compliance with the utilization and completeness of the checklist was found to be low, with significant departmental disparities. Sign-out phase was the least performed. Targeted training and regular monitoring should be provided to team members involved.

1. Compulsory training for all surgical staff

2. Regular audits

3. Focus on documentation of the checklist apart from verbal checks

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