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Evaluating the uptake and effect of Surgical Safety Checklist implementation in a rural hospital, Neno District, Malawi

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ABSTRACT

Background The WHO introduced the Surgical Safety Checklist (SSC) in 2008, which has been proven to enhance collaboration and patient safety before, during and after surgical procedures. However, the impact of using SSC has not been assessed in a rural setting in Malawi. We aimed to evaluate the uptake of SSC in Neno District, Malawi.

Methods We conducted a cross-sectional hospital-based retrospective chart review of 468 surgical cases from July 2021 to March 2022 in two hospitals in Neno District. We collected data using Excel and used R software for analysis. We used descriptive statistics to characterise the surgeries. We used χ^2 test and Wilcoxon signed-rank test to test the association between SSC use and independent variables. We fitted logistic regression to assess predictors of SSC use and complications.

Results Of 468 surgical cases, 92% (n=431) were done as emergency procedures. The median age was 23 years (IQR: 19–29) and 94% (n=439) were female. Overall, 38% of surgeries (n=176) used the SSC and of these, 98% were in emergency procedures. We found an association between the use of SSC and the age of the client (p=0.018), type of procedure, name of the procedure, healthcare worker cadre, time procedure performed and complications (p<0.001). However, no association was observed between SSC use and outcome (p>0.05). The odds of using SSC were higher in emergency surgeries, surgeries performed at night; however, they were lower among temporary employees and anaesthetists with a diploma (p<0.001). The odds of experiencing complications were 1.71 times greater when using SSC compared with surgeries without SSC (p=0.029).

Conclusions The use of an SSC in a rural area was promising, despite its fluctuating use and this needs programme improvement. Further studies are highly recommended to understand the fluctuation in the use of the SSC.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The WHO recommends the use of the Surgical Safety Checklist which has been shown to reduce postsurgical complications.
⇒ The Surgical Safety Checklist has shown to be effective in both developed and undeveloped countries, Malawi inclusive.
⇒ With limited resources in low and middle-income countries, the Surgical Safety Checklist has been shown to be a useful tool in reducing postsurgical complications.

WHAT THIS STUDY ADDS

⇒ This study shows that the Surgical Safety Checklist can be used in an emergency setting in rural areas as shown with a 98% usage in an emergency setting.
⇒ The usage of the Surgical Safety Checklist has key associations like time of the day, type of surgery and cadre of the service provider.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our findings inform the policymakers that it is possible to use the checklist in rural areas where surgeries are performed.
⇒ Policymakers should make a deliberate decision to make the Surgical Safety Checklist available all the time and providers should be trained on the use of the checklist.
⇒ Further qualitative research should be followed up to better understand why some cadres could not use the Surgical Safety Checklist despite the checklist being available.

INTRODUCTION

Surgery provides immediate and transformative treatment for many health conditions and will remain a key therapeutic strategy in all countries.[1 2] While surgery is performed in every community, wealthy and poor, rural and urban and in all regions with an estimated 234 million major surgical procedures performed annually,[3 4] it is also a major source of avoidable morbidity and mortality worldwide.[5 6] Recent studies have revealed a global surge in surgical procedures and indicated that

expanding access to surgeries in low and middle-income countries (LMICs) has the potential to avert 1.4 million fatalities and reduce the burden of 77.2 million disability-adjusted life years each year.[7] Estimates show that 28–32% of the global burden of disease can be treated with surgery, though a paradox remains as surgical procedures come with complications ranging from 3% to 16%.[8 9] Surgical site infection (SSI) is the most common postoperative complication providing a large health burden for healthcare providers and patients as it causes pain and suffering.[10] To reduce SSI, substantial improvements can be achieved by reducing variations in the reliability of surgical care processes.[11]

Although surgery undeniably prevents loss of life, it requires complex coordination of different health professionals and technologies and is associated with nearly two-thirds of in-hospital adverse events.[12] However, at least half of all surgical complications are avoidable.[13] Surgical checklists have been proposed to reduce surgical complications and increase the safety of surgical care. Several surgical checklists have been developed,[14] but the most widely known and implemented is the WHO-Surgical Safety Checklist (SSC).[14] The purpose of the SSC was to create a standardised framework to improve patient safety and reduce morbidity and mortality such as closing the patient with foreign bodies in the abdomen which is an avoidable error in the surgical setting resulting from potential deviations from best practice.[15]

The SSC is a visual aid that reminds users of important issues before and after surgery. The SSC comprises three components, 'sign-in', 'time-out' and 'sign-out', which are carried out when the patient arrives in the operating theatre, just before the surgical procedure starts and on completion of the procedure, respectively.[16] A second important feature of the SSC is combining checks for technical items (such as the administration of antibiotics and use of pulse oximeters) with non-technical items (such as team introductions and confirmations of procedures) whose principal purpose is to promote aspects of teamwork, communication and situational awareness.[17] The inclusion of the non-technical items in the checklist was influenced by research demonstrating an association between team practices (eg, communication behaviours) and improved safety processes and attitudes.[18]

Since its introduction in 2008, WHO-SSC has made a substantial impact in enhancing surgical safety and is associated with a reduction in surgical complications, morbidity and mortality rates worldwide.[19 20] The SSC has also increased awareness of the importance of communication and teamwork among surgical teams, leading to improved patient outcomes.[21] The use of the SSC has become a standard practice in many countries and has been implemented in various surgical settings, including limited resource settings.[22] While the uptake has been high, up to 75% in high-income countries, the uptake is as low as 20% in many LMICs.[23] One of the reasons for the low uptake is the lack of resources including human resources in working on the checklist. This lack of resource can hinder the adoption and effective use of surgical checklists in the LMICs.[24]

Malawi, a country in Southern Africa, grapples with healthcare resources including a shortage of trained health professionals, consumables and equipment.[19] However, implementation remains a problem. A study conducted at Kamuzu Central Hospital, a tertiary and referral facility, revealed challenges in the adoption of the SSC. The study showed that more than 90% of the theatre staff were familiar with the checklist with only one in four using it, indicating a gap between knowledge and practical implementation.[25] Similar findings have been reported in studies done in other countries where knowledge of the SSC does not translate to practical implementation.[26–28]

In Neno District, Lisungwi Community Hospital and Neno District Hospital started piloting the SSC to improve surgical care safety and decrease surgical complications from avoidable situations in July 2021. Currently, the checklist is being implemented in both obstetrics and general surgeries when performing emergency and elective surgical cases. There is still a paucity of literature regarding SSC implementation in Malawi with limited studies done in central hospitals which are located in urban settings and provide mainly specialist care.[19] Only a few studies have been done in rural areas/facilities and none in the Neno District.[27] Therefore, we aim to describe the pattern of surgical procedures conducted, the uptake of SSC, and measure the impact of SSC on surgical outcomes in rural hospitals in the Neno District. This research will help understand the pattern of the surgical checklist use in a resource-constrained country.

METHODS

Study design and setting

We used a retrospective chart review to assess the impact of the SSC use at Neno District Hospital and Lisungwi Community Hospital in Neno District, Malawi.

Neno is a rural district in the southwest part of the country with an estimated population of 150 000 in 2022.[29] The vast majority of people in Neno lack electricity, and more than 70% live on less than $1.90 per day.[29] Neno is a hard-to-reach area with some remote health facilities even harder to reach. There is no tarmac road in most parts of the area, making it even more difficult to access facilities during the rainy season.

There are 15 health facilities including two hospitals and 13 health centres that provide primary and secondary-level healthcare services in the district. Surgeries are conducted at the two main hospitals in the district: Neno District Hospital and Lisungwi Community Hospital. Both hospitals are Ministry of Health Malawi-owned hospitals and they are supported by a non-governmental organisation called Partners In Health (PIH)/Abwenzi Pa Za Umoyo. The two hospitals are similar in terms of infrastructure and service packages offered. Each hospital has one main operating theatre for major surgical procedures which in this context include general surgery,

obstetrics and gynaecology, and orthopaedics. Neno District Hospital has an additional smaller theatre for minor cases. About 70% of the procedures done in Neno are caesarean sections and almost 60% of all procedures are done as emergencies.

Implementation of SSC in Neno District

In 2019, a gathering of healthcare professionals from various surgical specialities, including surgical, orthopaedics, obstetrics and gynaecology, as well as theatre, was organised in response to the alarming incidence of post-surgical complications, notably SSIs. The purpose of this meeting was to brainstorm strategies to mitigate the occurrence of such complications. As a result, it was collectively decided to implement SSC as a preventative measure, which was subsequently supported and endorsed by the leadership of the health facilities.

Multiple efforts were undertaken to introduce the SSC into practice. First, the compelling evidence supporting the effectiveness of SSC was shared with all healthcare workers during the routine morning handover meeting. Educational activities were also conducted to empower the entire surgical team, including anaesthetists, clinicians and nurses, to use the SSC and to take the initiative in initiating its use.

To further reinforce the importance of SSC, prominent posters showcasing the checklist were printed and displayed in the main operating theatres of both hospitals, serving as a visual reminder to the entire team. Additionally, smaller A4-sized papers containing the SSC were printed and included in the patients' files, enabling surgeons to conveniently fill them out after each use.

At Neno District Hospital, a clinical officer with specialised education in obstetrics and gynaecology was designated with the responsibility of ensuring the utilisation of the SSC and the availability of A4 checklists in the patients' files. At Lisungwi Hospital, this responsibility was assigned to the anaesthetist. These initiatives were implemented to streamline the integration of SSC into routine surgical practices at both hospitals (figure 1).

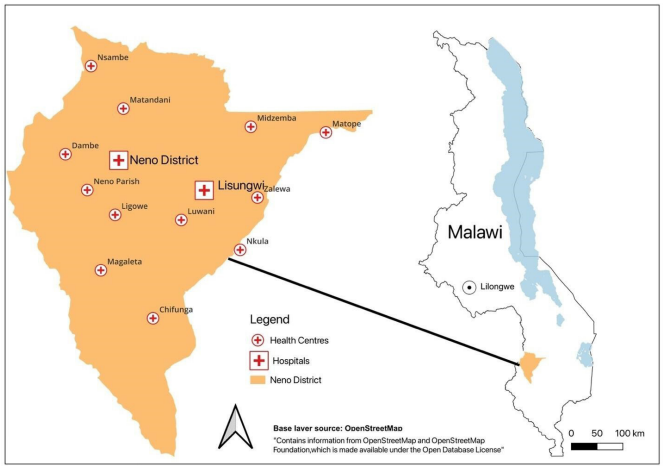

Figure 1 Map of Malawi and Neno District with hospitals. Map produced by MBA (mosaron@gmail.com)

The team set the target of increasing SSC use from 0% to 40% and reducing surgical complications by 10% in both hospitals by 6 months after its introduction.

Data collection

We developed a Microsoft Excel data collection tool based on the already collected variables in the surgical register. We collected patient identification numbers, site names categorised as Lisungwi or Neno District Hospital, age and sex of the cases in years. We further collected the date and time (start and end time) on which the procedure was done, the type of surgery, the name of the procedure, the team that conducted the procedures, complications of the procedures, the outcome of the procedure and whether SSC was used or not. We trained the research assistants on the common conditions and the medical terms used for 2 days. The data collection was conducted between April and May 2022. We conducted supervision and spot checks to ensure the quality of the data was not compromised.

Data analysis

We imported data from the Excel database to R software and used RStudio to clean and analyse the data. We used descriptive statistics such as counts and percentages for all categorical variables and median and IQR for all continuous variables. We used χ^2 test to test the association between SSC use and categorical variables and a Wilcoxon signed-rank test for continuous variables. Except for age, all variables were categorised: sex into male and female; type of surgery into elective and emergency; employer of the provider into Ministry Of Health (MOH), Partners In Health (PIH) or temporary; healthcare provider who conducted the surgery into doctor or clinical technicians/officers; anaesthetist cadre into anaesthetic clinical officers or anaesthetic technicians; name of procedure into caesarean section and other; complications into yes and no; time of the day into day and night; and outcome of the procedure into dead and alive. For all the variables associated with SSC use, we fitted bivariate and multivariable logistic regressions to determine the direction of the association.

RESULTS

The pattern of surgical procedures

During the 9 months, 468 surgical procedures were performed at the two hospitals. The median age was 23 years old (IQR: 19–29 years). The majority (n=94%, n=439) of procedures were performed on female patients. Nine out of 10 surgeries were emergency surgical procedures, with almost all emergency procedures being emergency caesarean deliveries (92%, n=430). Almost all procedures were performed by clinical technicians/officers (95%, n=444), with only 5% of the procedures performed by doctors. Anaesthetic technicians provided anaesthesia in 64% (n=300) of the cases, with the remainder provided by anaesthetic clinical officers. Most of the procedures were performed during the day (63%, n=268). Eighteen per

Table 1 Demographic characteristics and surgeries performed in Neno District (n=468)

Variable	n=468
Age of participants, median (IQR)	23 (19, 29)
Gender of participants, n (%)	
Female	439 (94)
Male	29 (6)
Type of surgery, n (%)	
Elective	37 (8)
Emergency	431 (92)
Employer of providers, n (%)	
MOH	272 (58)
PIH	140 (30)
Temporary	56 (12)
Healthcare worker cadre, n (%)	
Clinical officers/clinicians	444 (95)
Doctors	24 (5)
Name of procedure, n (%)	
CS	430 (92)
Other	38 (8)
Time of the day, n (%)	
Day	268 (63)
Night	160 (37)
Complications, n (%)	
No	372 (82)
Yes	82 (18)
Anaesthetist cadre, n (%)	
Anaesthetic clinical officer	168 (36)
Anaesthetic technician	300 (64)
Outcome of procedure, n (%)	
Alive	465 (99)
Dead	3 (1)

CS, caesarean section; MOH, Ministry of Health; PIH, Partners In Health.

cent (n=82) of the procedures had one or more complications reported, with three reported deaths (representing about 1% of all procedures) (table 1).

Uptake of SSC

Since the introduction of SSC, usage of the checklist steadily increased in the first 2 months and kept on fluctuating in the rest of the months. The post-2-month implementation median was 39.5% with an overall median of 37% in the study period (figure 2).

Of the 468 surgeries performed within the 9-month period, 38% (n=176) used SSC. In comparison to procedures where SSC was not used, SSC was more likely to be used for emergency caesarean deliveries, if the clinician performing the procedure was permanent, if the provider

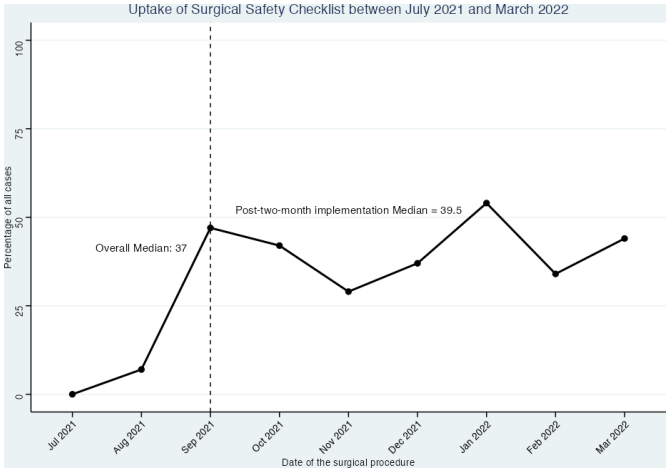

Figure 2 Uptake of SSC in Neno district between July 2021 and March 2022.

was a clinical officer/technician, if the anaesthetic clinical officer was involved and if the procedure was done during the day. We found an association between the use of SSC and complications (p=0.028) but none for outcome (p=0.053) (table 2).

Predictors of SSC use in Neno District

The odds of using SSC were 7.60 times higher in emergency surgeries compared with elective surgeries (OR: 7.60, 95% CI 2.68–31.9; p<0.001). However, after accounting for other variables, this effect diminished to 3.56 and was not statistically significant (adjusted OR (aOR): 3.56, 95% CI 1.12–15.8; p=0.052). Among temporary staff, the odds of SSC use were 70% lower compared with those employed by the Ministry of Health (OR: 0.30, 95% CI 0.13–0.62; p=0.002). Surgeries conducted during night-time were 2.65 times more likely to employ SSC than those performed during the day (OR: 2.65, 95% CI 1.78–3.98; p<0.001). Controlling for all covariates, the odds of SSC utilisation during surgeries conducted at night were 2.15 times higher compared with those during the day (aOR: 2.56, 95% CI 1.37–3.38; p<0.001). Among anaesthetists with a diploma, the odds of SSC use were 79% lower compared with those with a bachelor's degree (OR: 0.21, 95% CI 0.14–0.32; p<0.001). This effect remained consistent even when controlling for all variables, with 75% lower odds compared with those with a bachelor's degree (aOR: 0.25, 95% CI 0.16–0.40; p<0.001) (table 3).

The odds of complications were 1.71 times higher among SSC surgical procedures compared with non-SSC procedures (OR=1.71, 95% CI 1.06–2.77; p=0.029); but this effect lost statistical significance after adjusting for other factors (aOR=1.56, 95% CI 0.90–2.70; p=0.11), as shown in table 4.

DISCUSSION

Our study is one of the studies to examine the adoption of SSC in Malawi, and the second study to investigate SSC implementation in rural areas of the country.[25 27] We

Table 2 Surgical Safety Checklist uptake

Variable	Surgical Safety Checklist use		
	No n=292	Yes n=176	P value*
Type of surgery, n (%)			<0.001
Elective	34 (12)	3 (2)	
Emergency	258 (88)	173 (98)	
Employer of providers, n (%)			<0.001
MOH	167 (57)	105 (60)	
PIH	78 (27)	62 (35)	
Temporary	47 (16)	9 (5)	
Healthcare worker cadre, n (%)			<0.001
Clinical officers/clinicians	268 (92)	176 (100)	
Doctors	24 (8)	0 (0)	
Name of procedure, n (%)			<0.001
CS	254 (87)	176 (100)	
Other	38 (13)	0 (0)	
Time of the day, (n)			<0.001
Day	182 (72)	86 (49)	
Night	71 (28)	89 (51)	
Complications, n (%)			0.028
No	239 (85)	133 (77)	
Yes	42 (15)	40 (23)	
Anaesthetist cadre, n (%)			<0.001
Anaesthetic clinical officer	66 (23)	102 (58)	
Anaesthetic technician	226 (77)	74 (42)	
Outcome of procedure, n (%)			0.053
Alive	292 (100)	173 (98)	
Dead	0 (0)	3 (2)	

*Wilcoxon rank-sum test; Pearson's χ^2 test; Fisher's exact test.
CS, caesarean section; MOH, Ministry of Health; PIH, Partners In Health.

found the median usage rate of SSC after 2-month implementation was 39.5%, with an overall rate of 37% over the study period. Predominantly, female patients benefited from SSC during emergency surgeries compared with males. Permanent staff were more likely to use SSC compared with temporary staff. Additionally, we observed that the majority of clinical officers were using SSC, primarily during caesarean procedures. Furthermore, we identified an association between SSC use and complications, although no significant impact on surgical outcomes was observed.

The SSC adoption rate of 37% with variation within the months in our study is higher than what was reported at Kamuzu Central Hospital in Lilongwe, Malawi, where only 20% used it despite 90% of the surgical personnel being aware of SSC existence.[30] We observed an increased use of SSC within the first 2 months and a median of 39.5% after 2-month implementation. The variation in SSC use within the study period can be attributed to human resource which is still inadequate and this call for the balance between efficiency of time to assist more people with following SSC procedure. However, our findings also double what was reported at Yekatit Referral Hospital in Addis Ababa, Ethiopia, at the end of the follow-up period.[31] Similar findings have been documented in East Africa where SSC was only used by 25% of the anaesthetists in Kenya, with nobody using it in Burundi and Uganda.[28] Although our study did not investigate the reasons for the low adoption of SSC, studies conducted in Ghana and Zambia highlighted several factors that may contribute to this phenomenon. These factors included inadequate communication among healthcare teams, SSC not covering all perioperative risks, taking too long to complete, and poor attitude of team members towards questions and training status of professionals were significant drivers associated with low uptake of SSC.[23 26] Further studies should be conducted in Neno, Malawi, to uncover whether these factors are also present in the

Table 3 Bivariate and multivariable logistic regressions for SSC use

	Bivariate logistic regression			Multivariable logistic regression		
Variables	OR	95% CI	P value	aOR	95% CI	P value
Age	0.96	0.93, 0.98	**<0.001**			
Type of surgery						
Elective	Reference					
Emergency	7.60	2.68, 31.9	**<0.001**	3.56	1.12, 15.8	0.050
Employer of providers						
MOH	Reference					
PIH	1.26	0.84, 1.91	0.3	1.61	0.98, 2.64	0.059
Temporary	0.30	0.13, 0.62	**0.002**	0.60	0.25, 1.33	0.2
Time of the day						
Day	Reference					
Night	2.65	1.78, 3.98	**<0.001**	2.15	1.37, 3.38	**<0.001**
Anaesthetist cadre						
Bachelor's degree	Reference					
Diploma	0.21	0.14, 0.32	**<0.001**	0.25	0.16, 0.40	**<0.001**

Regression models for sex, healthcare worker cadre, name of the procedure and outcome were excluded due to perfect separation in the dataset. For example, all SSC use was on female, done by clinical officers/clinicians and was not caesarean.
p values that were significant are highlighted in bold.
aOR, adjusted OR; MOH, Ministry of Health; PIH, Partners In Health; SSC, Surgical Safety Checklist.

local context and identify any additional factors that may be unique to the area. Understanding the reasons behind low SSC adoption can inform targeted interventions to address barriers and improve the implementation of SSC in healthcare settings in LMICs where it has been shown that SSC adoption remains a challenge.[22]

Our study found that SSC is more frequently used during surgeries involving female patients, particularly in emergencies and caesarean sections. This pattern could be attributed to the higher number of surgeries performed on females, as a previous study showed that females account for 85% of all surgical patients, with obstetric cases constituting 75% of the total surgeries in Malawi.[32] Our results align with a previous study conducted at Jimma University Medical Center in Ethiopia, which reported a significantly lower utilisation rate of SSC in elective surgeries compared with emergency procedures, with a difference of 87.4%.[33] However, it is noteworthy that this finding is surprising, as elective surgeries generally allow for more time compared with critical, life-saving emergency procedures.

Table 4 Bivariate logistic regression for complications and SSC use

	Bivariate logistic regression		
Variables	OR	95% CI	P value
Surgical Safety Checklist use			
Complication not developed	Reference		
Complication developed	1.71	1.06, 2.77	<0.029

SSC, Surgical Safety Checklist.

In our study, the complication rates were higher where the SSC was used compared with where it was not. Our inconsistency use, competency of the healthcare workers and our skew towards caesarean section surgeries may help explain these findings. In addition, we did not separate the complications as immediately after an operation and those in subsequent days which may not be due to procedure but other possible reasons. Further, there could also be other confounders not explained in our study, for example, the cleanliness of the surgical room. A large study conducted in Canada did not find the impact of the checklist used as the complications developed were the same on both those who used or did not use it.[34] However, this is not in agreement with most studies conducted in LMICs as studies have shown that checklist use has a direct impact on the development of complications.[35] In Tunisia, the checklist use had a 60% prevention rate of complications in postsurgical cases.[36] This was also true with developed countries, as Baltimore, USA, reported a reduction in infection rate, with 43 infections avoided, 8 deaths prevented and $2 million saved in one hospital alone.[37] This suggests that SSC use does not guarantee the complication considering that other factors should be considered.

Our study revealed that anaesthetists holding diplomas were less likely to use SSC, while a higher proportion of clinicians showed a greater likelihood for SSC usage. This may be attributed to the fact that the Malawian health

system employs a greater number of clinicians at both primary and secondary healthcare facilities who perform surgical procedures. While we did not capture years of experiences for the team as well as seniority, studies suggest that these also play a role in the uptake of SSC.[26] Studies have shown that there is mostly inconsistent use of the checklist by all cadres in the health professions worldwide.[38] Similarly, in Switzerland, where the use of SSC was noted to be at 79%, SSC was being used by all cadres, including doctors and nurses.[39] However, the use of the checklist was not routine and a significant improvement in its uptake and compliance was advised. This suggests that adoption of SSC is a complex phenomenon that requires the coordination of the whole team.

Lastly, the usage of the SSC was higher during the night compared with the day in our study. This was different from a study conducted in Vienna, Austria, where the usage of the checklist was the same during the day and at night.[40] Our study had some limitations. It focused on the quantitative data and we did not have time to understand why the uptake of the checklist use was not consistent by the users themselves. Qualitative data could have helped us understand the knowledge and attitude towards the checklist use in theatres at a district level. Further studies should use a mixed-methods approach to better understand the perceptions of the healthcare workers towards the use of the checklist in the district and its impact on postoperative complications.

CONCLUSIONS

Our study demonstrates that implementation of the WHO-SSC is possible in a rural district. We found variation in the use even where adaptations were made to suit our environment, which can be attributed to several factors including human resources and perceived benefits. We conclude that there is an urgent need to make it available all the time and further user-friendly by training the whole team involved in theatre on its importance and implementation. The Ministry of Health Department of Quality Assurance needs to engage quality improvement teams and issue directives for the implementation of the WHO-SSC in the hospitals that conduct surgeries in both district and community hospitals.

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Contributors Conceptualisation: SK, CK. Design of the study: SK, CK. Data collection facilitation: SK, WN, IM, GC, SM, MBA. Data analysis: MBA, SK, CK. Manuscript draft: SK. Manuscript draft review: CK, MBA, HRZ, LT, IM, BDK, FM. SK acts as a guarantor in this project.

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Patient consent for publication Not applicable.

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