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Knowledge and application of the who safe surgical checklist amongst clinical medical students in a teaching Hospital in north-central, Nigeria: A quantitative analytical study

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Abstract
This checklist serves as a tool to enhance communication and teamwork among surgical teams, reducing the occurrence of adverse events during surgery. However, its implementation and utilization in some regions especially the LMICs in Africa present unique challenges. This study aimed to explore the knowledge and application of the WHO surgical checklist among clinical medical students in north -central zone of Nigeria. This was done via a single-blinded cross-sectional study among 186 penultimate and final-year clinical medical students at Bingham University Teaching Hospital, Nigeria. We found that 25.8% and 22.6% of the respondents had good and very good knowledge of the WHO Safe Surgical Checklist, respectively. About half of the respondents acquired their knowledge from the classroom alone, while the others were from class lectures and extracurricular activities. The most applied component of the surgical checklist was the sign-in (61.3%), followed by the sign-out (38.7%), while the time-out was the least (32.2%). While the general surgeons (36%) and the obstetricians and gynecologists (29%) were the most likely to adhere to the safe surgical checklists in their procedures, the orthopaedics surgeons were the least likely (3%). While the sign-in remains the most applied component of the checklist, with time-out being the least, we should know that each component has its safety potential.

Keywords: World health organization, safe surgical checklist, Nigeria, north-central, student

Introduction
Surgery is a crucial component of healthcare, with millions of surgical procedures performed worldwide every year. However, complications are common, resulting in significant morbidity and mortality. To improve patient safety, the World Health Organization (WHO) introduced the WHO Surgical Safety Checklist in 2008. This checklist serves as a tool to enhance communication and teamwork among surgical teams, reducing the occurrence of adverse events during surgeries. While the checklist has been widely adopted in many countries, its implementation and utilization in some regions especially the LMICs especially in Africa present unique challenges [1-3].

The WHO Surgical Safety Checklist: An Overview
The WHO Surgical Safety Checklist is a simple and effective tool designed to enhance patient safety during surgical procedures. It consists of three key phases: the Sign In, the Time Out, and the Sign-Out. Each phase focuses on specific tasks and communication points that are critical for ensuring patient safety. The checklist includes items such as patient identification, verification of the surgical site, confirmation of anaesthesia safety measures, and communication between team members. By systematically going through each item on the checklist, surgical teams can identify and address potential risks and prevent errors before, during, and after surgery. [1-4]

Fig 1: Showing the step-by-step components of the WHO Surgical Safety Checklist (SSC) [1].

Benefits of the WHO Surgical Safety Checklist

Although there are other Safe Surgical checklists, such as the Joint Commission Universal Protocol, Surgical Patients Safety System (SURPASS) Checklist and the I AM FOR SAFETY Checklist; that of the WHO is more widely recognized and gives you the time-out to stop and observe for possible errors in person, procedure and/or site. [2,5]

The implementation of the WHO Surgical Safety Checklist has been associated with significant improvements in patient outcomes [6]. Several studies have demonstrated a reduction in the rate of postoperative complications and mortality when the checklist is consistently utilized. For example, a study conducted in low and middle-income countries showed a 36% reduction in postoperative mortality after the checklist was implemented. Furthermore, the checklist has been shown to enhance teamwork, communication, and adherence to safety protocols among surgical teams [7].

The Application of the WHO Surgical Safety Checklist in Northern Nigeria

Despite the proven benefits of the WHO Surgical Safety Checklist, its application in Northern Nigeria faces various challenges. These challenges can be categorized into organizational barriers, cultural factors, and resource limitations.

Organizational Barrier

One of the primary organizational barriers to the effective implementation of the checklist is inconsistent training among surgical teams. Many healthcare facilities in Northern Nigeria lack standardized training programs for surgical staff, resulting in a poor understanding of the checklist's purpose and benefits. Moreover, the lack of ongoing training opportunities for rotating or newly hired staff impedes their ability to utilize the checklist effectively. Senior staff who have received training in the checklist often fail to share their knowledge with team members who have not undergone training, further hindering its implementation [8-9].

Cultural Factors

Cultural factors also play a role in the utilization of the WHO Surgical Safety Checklist in Northern Nigeria. In some instances, surgical teams may perceive the checklist as an unnecessary imposition or a deviation from traditional surgical practices. Resistance to change and a preference for established routines can hinder the adoption of the checklist. Additionally, hierarchical structures within surgical teams may discourage open communication and collaboration, making it challenging to implement checklist protocols that require active participation from all team members.

Resource Limitations

Limited resources, including equipment, staffing, and infrastructure, pose significant challenges to the application of the WHO Surgical Safety Checklist in Northern Nigeria. Many healthcare facilities in the region face shortages of essential surgical supplies, making it difficult to adhere to checklist items related to infection control and patient safety. Moreover, inadequate staffing levels and high patient volumes can create time constraints and increase the likelihood of checklist items being overlooked or rushed [10].

Strategies for Successful Implementation: Despite the barriers

to implementation, the WHO Surgical Safety Checklist can be effectively applied in Northern Nigeria with Comprehensive training programs, Cultivating a Culture of Safety, Adaptation to the local context, and appropriate resource allocation. However, of these, the most implementable strategy now is the Comprehensive training program.

Establishing comprehensive training programs that provide initial and ongoing education on the use of the checklist is crucial. These programs should be tailored to the specific needs of surgical teams in Northern Nigeria and should emphasize the importance of teamwork, communication, and patient safety. Regular refresher courses and training sessions should be provided to all staff, including new hires and rotating team members.

AIM

This study aims to explore the knowledge and application of the WHO safe surgical checklist in a Teaching Hospital in north central, Nigeria.

Methodology

The research was a single-blinded multistage descriptive cross-sectional epidemiological study. It utilized validated question tools that were distributed amongst clinical medical students at Bingham University Teaching Hospital in Jos, Plateau State; Nigeria. The study populations were the penultimate and final year clinical medical students at the time of this study.

Stages of the Sample Size Determination:

1. Through Simple Balloting Technique between the clinical and preclinical arms of the medical school. The clinical school of medicine was chosen.
2. The college of medicine at the school (clinical school) had an average of 2 batches each in the 4th year, 5th year and 6th year. Having a total of 615 students.

A. 2014/2015 – the number in class = 59
B. 2015/2016 – the number in class = 124
C. 2016/2017 – the number in class = 85
D. 2017/2018 – the number in class = 134
E. 2018/2019 – the number in class = 79
F. 2019/2020 – the number in class = 134

3. The penultimate (who had at least begun intermediate surgical posting) and final-year students were chosen for optimal surgical practical exposure. These were Batches A+B+C = 268 clinical medical students.
4. Using the Cochrane formula to calculate the sample size;

$$\frac{Z^2pq}{e^2}$$

e is the desired level of precision (i.e., the margin of error) = 0.05
p is the (estimated) proportion of the population which has the attribute in question = 0.5
q is 1 – p = 0.5
The z-value is found in a Z table = 1.96 for the 95th percentile.
Therefore;

$n_o = ((1.96)^2 (0.5) (0.5)) / (0.05)^2 = 385.$

For Small Sample corrections

$$\mathbf{N} = \frac{n_o}{1+\frac{(n_o-1)}{N}}$$

That's; N = 385 / (1 + (384 / 268)) = 158.25 Samples.
At the end of the study, we had 186 responses.

Inclusion Criteria

i. A clinical medical student at the College of Medicine and health sciences, Bingham University
ii. In either your penultimate or final year at the time of the study
iii. Have begun or completed your intermediate surgical posting (S_2)

Consent

Consent was sorted in the form of writing on each questionnaire without positive consent, no section of the questions was revealed or asked. No participant was compelled or further convinced to participate. No harm came directly or indirectly to any of the participants in this study. Their responses were treated with utmost confidentiality and were not used for any purpose other than that clearly stated on the questionnaire, that's for this study, only.

Result

Demographic distribution

Sex Distribution

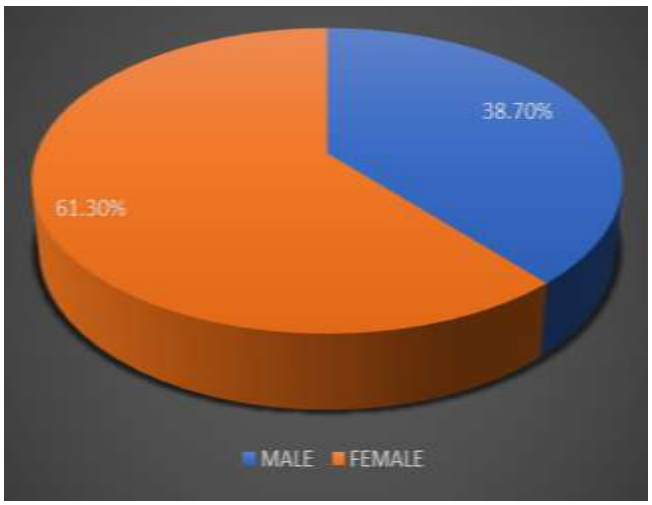

Fig 2: The Figure above shows the distribution of male and female respondents amongst the participants.

Table 1: The age ranges of the respondents ranged between 20 to 30 years of age, with a mean age of 25 years and a median age of 25 years.

Age data set	Frequency (f)	Percentage (%)
20	6	3.20
21	18	9.70
22	30	16.10
23	48	25.80
24	30	16.10
25	6	3.20
26	24	12.90
27	6	3.20
28	6	3.20
29	6	3.20
30	6	3.20

Surgical Exposure

No. of Surgeries observed. 64.5% (120) of respondents had witnessed less than 50 surgical procedures each. While 35.5% (66) of the respondents had witnessed more than 50 surgical

procedures Each. In total, they collectively had about 7, 212 surgical observation and/or assisting experience.

Knowledge of the who SSC

80.6% (150) of the respondents knew the WHO SSC. Whereas 19.4% (36) of them had not. For those who had heard about it, they had heard about it from school lectures and/or extracurricular activities (Table 2)

Table 3: Distribution showing sources from which the respondents acquired their knowledge of the WHO SSC.

Source of knowledge	Percentage
School and extracurricular activities	25.8%
School only	48.4%
Extracurricular/training only	6.4%

Understood the components of the checklist

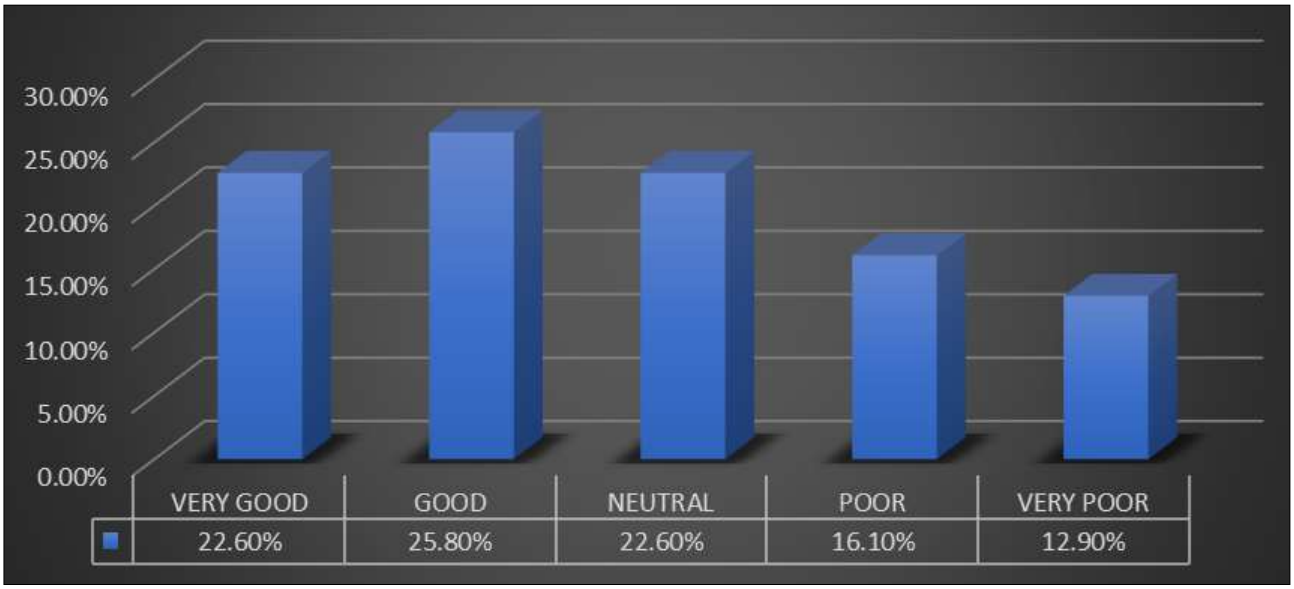

Fig 3: distribution showing the level of understanding of the various components of the safe surgical checklist.

Application of the who SSC

This was evaluated based on questions centred around general adherence, adherence per surgical unit and adherence to the various components.

A. The most frequently done component in your training Centre

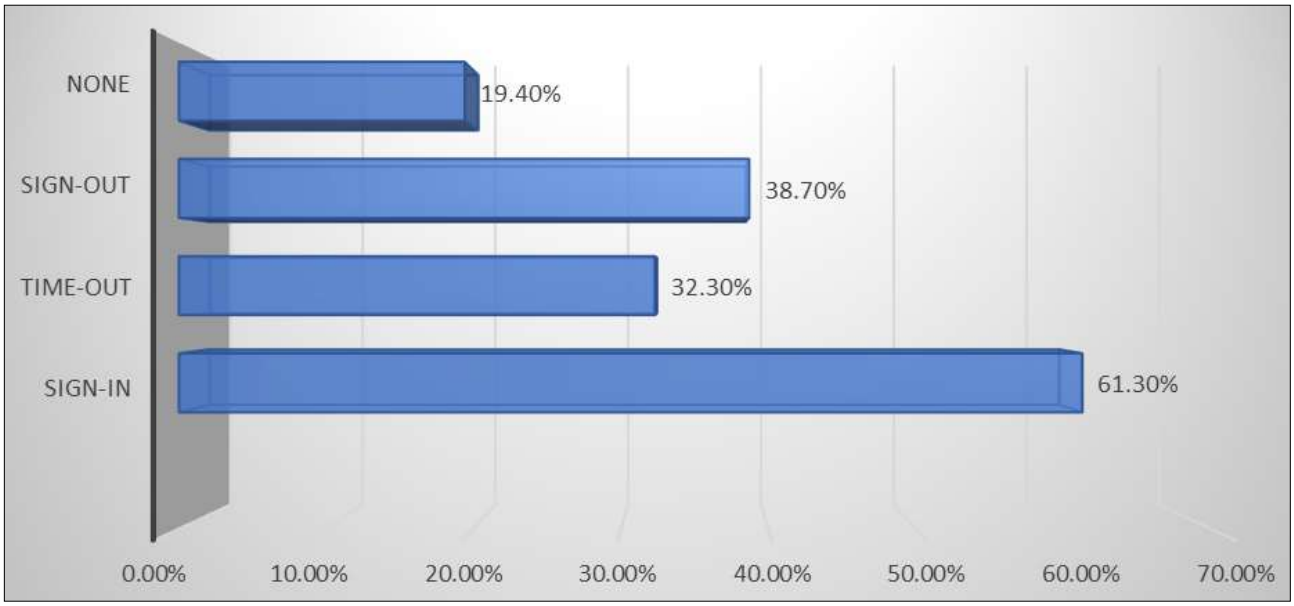

Fig 4: Distribution showing the most observed SSC component

B. Observed adherence based on surgical units

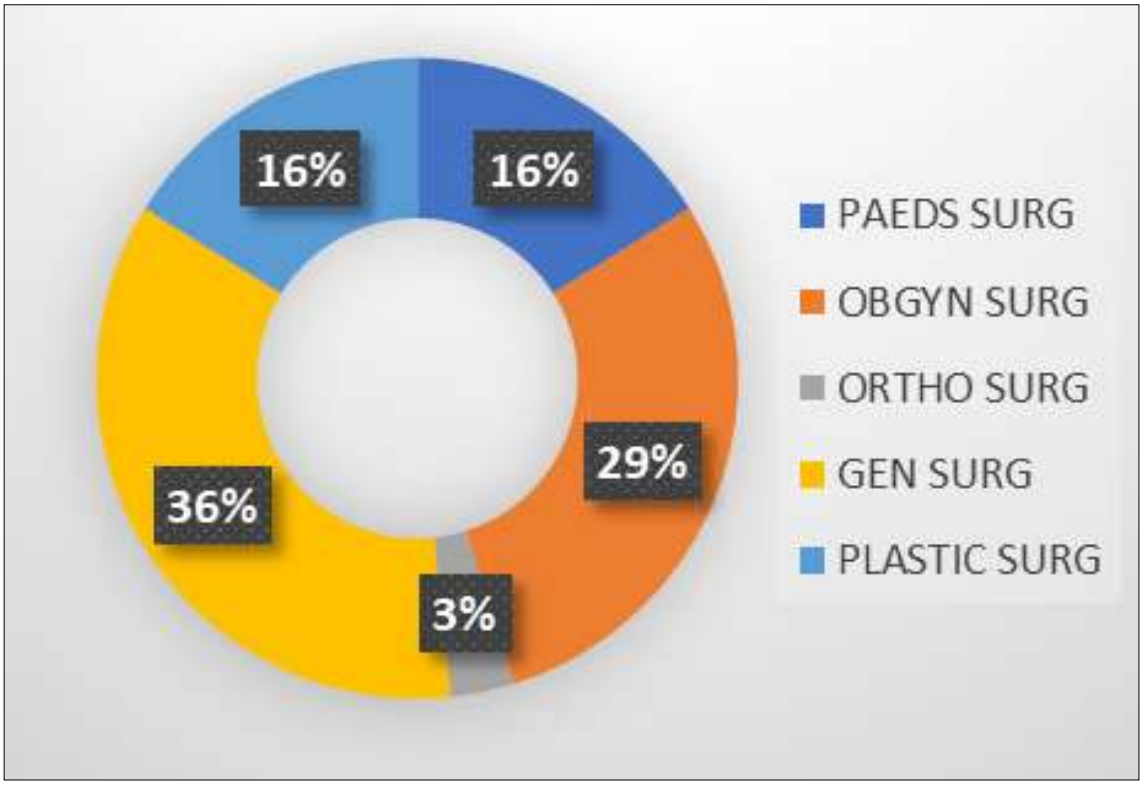

Fig 5: Distribution showing the most adherent surgical unit.

C. Adherence/application of the subunits under the sign-in component

Table 3: Showing the sub-unit distribution and their adherence to the Sign-In component as observed by the respondents.

S/N	SUB-UNITS OF THE SIGN-IN	Always	Most Times	Some Times	Rarely	Never
1.	Confirmation of the patient's name, surgery site, procedure and consent	71%	3.2%	16.1%	6.5%	3.2%
2.	Marking of the surgical site with an identifier (marker, etc)	6.5%	9.7%	19.4%	19.4%	45.2%
3.	Complete check of the anaesthesia machine and medications Before each surgery	25.8%	19.4%	35.5%	12.9%	6.5%
4.	Functional pulse oximeter	71%	12.9%	9.7%	0%	6.5%
5.	Assessment of allergy history	25.8%	9.7%	29%	9.7%	25.8%
6.	Blood and fluids availability with at least a wide bore IV line secured	83.9%	9.7%	6.5%	0%	0%

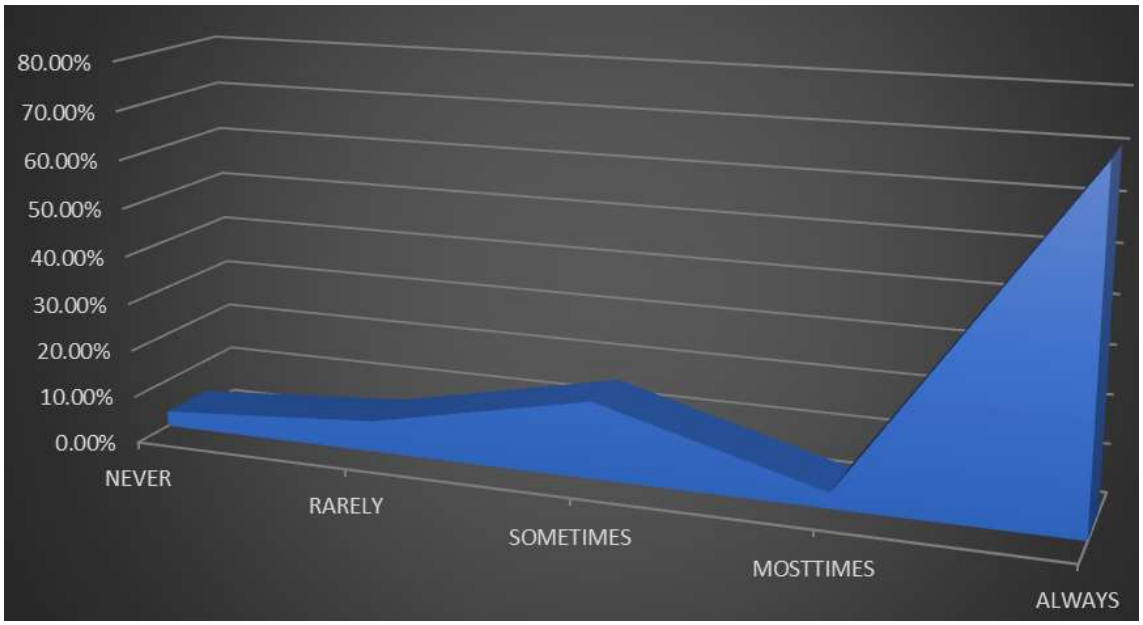

Fig 6: Confirmation of the patient's name, surgery site, procedure and consent

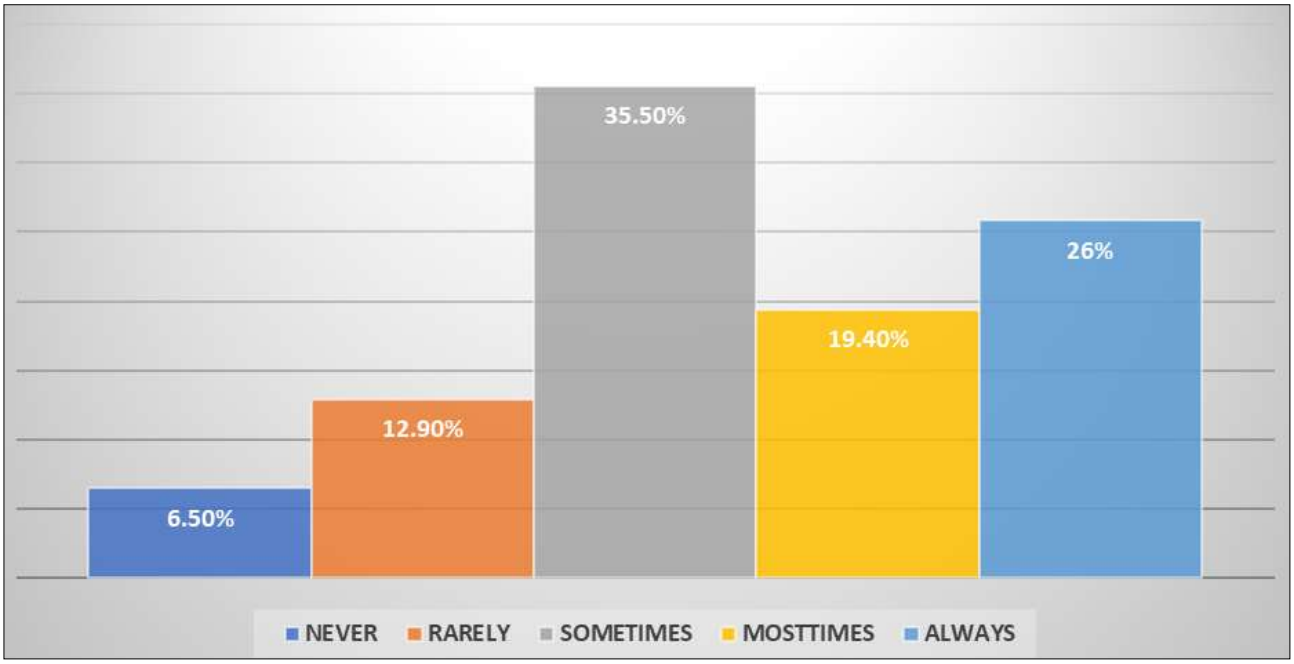

Fig 7: Complete check of the anaesthesia machine and medications Before each surgery

D. Adherence/application of the subunits under the time-out component

Table 4: Showing the sub-unit distribution and their adherence to the Time-out component as observed by the respondents.

S/N	Sub-units of the time-out	Always	Most times	Some times	Rarely	Never
1.	All surgical team members introduce themselves by name and role	0.0%	0.0%	12.9%	19.4%	67.7%
2.	Confirmation If antibiotics prophylaxis were administered in the last 60 minutes	6.5%	16.1%	35.5%	22.6%	19.4%
3.	Display of the essential radiological image of the pathology	3.2%	12.9%	22.6%	25.8%	35.5%

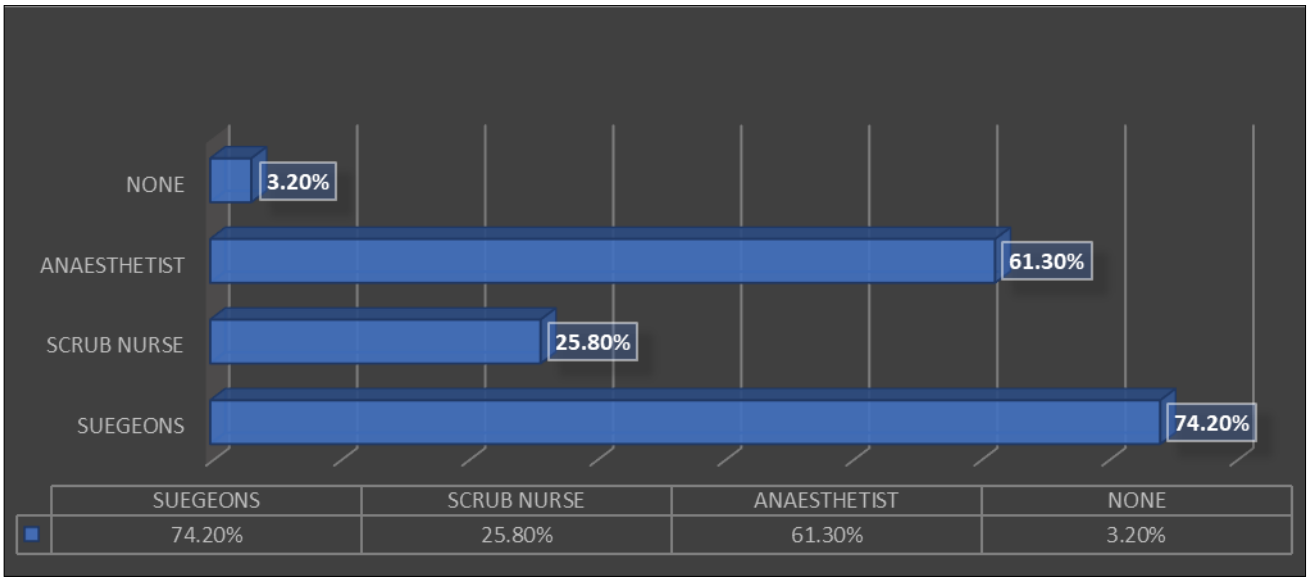

Fig 8: Showing the data distribution for the surgical staff who try to anticipate, prepare for and prevent critical events.

Adherence/application of the subunits under the sign-out component

Table 5: Showing the sub-unit distribution and their adherence to the Sign-out component as observed by the respondents.

S/N	Sub-units of the sign-out	Always	Most times	Some times	Rarely	Never
1.	The nurse verbally announces the name of the procedure	6.5%	6.5%	16.1%	32.3%	38.7%
2.	Nurse Complete counting of the instruments, sponge and needles used	67.7%	25.8%	0.0%	3.2%	3.2%
3.	Specimen labelling by Nurse	51.6%	16.1%	16.1%	3.2%	12.9%
4.	Discussions on If there were faulty equipment to be addressed noticed by the Surgeon or Nurse	9.7%	29.0%	32.3%	16.1%	12.9%
5.	Statements on the key concern for recovery and post-op management of the patient	48.4%	19.4%	12.9%	16.1%	3.2%

Discussion

The study aimed to explore the knowledge and application of the WHO Safe Surgical Checklist in a Teaching Hospital in north-central Nigeria. This was accomplished via a multistage descriptive cross-sectional study that was conducted amongst 186 respondents from the study population made up of clinical medical students in the penultimate and final years of their medical school training. Amongst the respondents, about 6 in 10 were females, while less than 4 in 10 were males (fig 2). Furthermore, the age range of the respondents was from 20 years to 30 years. Most of the respondents were 23 years of age (Table 1).

We needed to evaluate the surgical exposure of the respondents. We discovered that there was more than 7,000 surgical observation and assistantship experience collectively amongst the respondents. Using 50 observations as a benchmark, 64.5% (120) respondents had witnessed less than 50 surgical procedures each. While 35.5% (66) of the respondents had witnessed more than 50 surgical procedures Each.

Furthermore, we tried to evaluate their knowledge of the World Health Organization Safe Surgical Checklist. More than 8 in every 10 respondents knew the SSC. Also, while extracurricular activities were also a source via which this knowledge was gotten, class lectures on surgery were the most identified media of knowledge (Table 2). However, only about 25.8% and 22.6% of the respondents had good and very good knowledge of the components of the SSC, respectively (Figure 3).

To understand why this was so, we went further to study how the SSC is applied in their training institution. So, we evaluated how the SSC were applied at different levels, its general application, application per surgical unit and application of the various components. About 6 in every 10 surgeries carried out the sign-in component, almost 4 in 10 adhered to the sign-out component and about 3 in 10, had time-out. Also, almost 2 in every 20 surgeries did not carry out any component of the SSC (Figure 4). Furthermore, the general surgical team were the most likely to adhere to the SSC and its components, followed by the Obstetrics and gynaecological team. Whereas, the orthopaedics team were least likely to adhere to the SSC (Figure 5). In a study on the application of each of the SSC components, we evaluated each of the 3 components separately, that is the sign-in, time-out and sign-out.

In our study on the application of the sub-units that make up the sign-in component. We found that in more than 7 out of every 10 surgeries, they announced to confirm the patient's name, surgery site, procedure and if consent has been given. However, they hardly ever marked the surgical site with any identifier, as it was done in less than 1 in every 10 cases the respondents observed. Furthermore, in a quarter of cases, they carried out a complete check of the anaesthesia machine and the needed medications for the surgery. While the anaesthesia check may be excused since they may have done this in the morning when reporting to work for the day, the lack of medication cross-checks can be problematic. This will cause a lot of movements in the theatre from one section to the other, picking and delivering things, which may lead to accidents or infections, to mention but a few. Also, they made excellent checks of a working pulse oximeter and Blood pressure apparatus (71%), securing an IV access with a wide bore cannula, with blood and fluids available ahead of the surgery which is reconfirmed in the theatre out loud (83.9%). This is critical to the anticipation of and resuscitation in intra-op emergencies. However, assessment of allergic history is done in only about a quarter of cases. This may be because, in this region, most surgical facilities get the anaesthetists to go and evaluate the patients for surgical safety at the bedside, a minimum of 24 hours before the intended surgery (Table 3).

In our study into how they adhered to the time-out component, we concluded that this was met with way less enthusiasm than the sign-in. which was in keeping with Figure 4, which showed that the time-out component was the least observed as being carried out in the operating theatre. To begin with, surgical team members rarely introduced themselves by their names. This may be because they do not see this as important, in that they know each other well, working in the same health facility. Verbally confirming if prophylactic antibiotics were administered in the last 60 minutes was done in a bit more than 2 in 10 surgeries. But, the display of the essential radiological images of the pathology being operated on was done in less than 2 in 10 surgeries (Table 4). Nevertheless, the surgeons (74.2%) and Anesthetists (61.3%) often always try to anticipate, prepare for and prevent possible critical events intra-op (Figure 8).

Furthermore, when we evaluated the adherence to the sign-out component of the SSC as observed by the respondents, we discovered that; though it was better than that of the time-out, it was not as spontaneous nor frequent as that of the sign-in. a unique aspect of this section of the SSC is that it is almost wholly carried out by the theatre Nurses. A key sub-unit of this component is the Nurse having to verbally announce as a means of confirmation, the name of the procedure. As seen in our study this was very poorly done, with less than 2 in every 10 surgeries affirming this. Whereas, popular tasks like the scrub Nurse having to complete counting of the instruments, sponges and needles used were very commonly done, as seen in about 7 in every 10 procedures observed. Also, in a little over half of all the procedures the respondents observed, the specimen bottles were labelled by the nurses. Furthermore, in about half of all the procedures observed, the surgeon along with the peri-op team, made statements and inferences about key concerns for recovery and post-operative management of the patient(s) to get the best results. Yet, discussions such as ones that border around faulty equipment and intra-operative equipment noticed to be problematic that will need repairing were not so frequently carried out (Table 5).

It should be clear however that this may not be a complete pictorial representation of what may be found on the ground in the Institution being studied, the North-Central part of Nigeria or Nigeria as a whole. As JO Olatosi 2018 carried out a similar study from an Anaesthetist's point of view at the Lagos University Teaching Hospital, Nigeria and concluded that there was neat perfect knowledge and use of the surgical checklist in Nigeria. Especially in teaching hospitals. This study was conducted in the teaching hospital [11]. Hence, it is safe to say that this study reflects what examples the surgeons and surgical team openly lay for the clinical students learning under them to be followed. That is, what they were willing to do and hence teach their students in turn. The limitations of this study were in the fact that it was not a multicenter study, as such could not attest to the standard of operation in the region. Also, the study population were limited. Lastly, the study relied on data obtained via observation and not from the surgical staff primarily.

Conclusion

While we can say that the WHO SSC has been adopted at Bingham University Teaching Hospital where the study was carried out, we cannot say it has been fully adopted. The selective application of the checklist is due to organizational barriers and resource limitations. While the sign-in remains the

most applied component of the checklist, with time-out being the least, we should know that each component has its safety potential. Furthermore, the WHO Surgical Safety Checklist is a valuable tool for enhancing patient safety during surgical procedures. Its successful implementation in Northern Nigeria requires addressing the unique challenges posed by organizational barriers, cultural factors, and resource limitations. By investing in comprehensive training programs, cultivating a culture of safety, adapting the checklist to the local context, and allocating adequate resources, healthcare facilities in Northern Nigeria can improve surgical outcomes and reduce the incidence of adverse events. The WHO Surgical Safety Checklist has the potential to transform surgical care in the region, ensuring safer and more effective surgeries for patients in Northern Nigeria.

Recommendation

1. Adherence to the WHO SSC can help prevent common surgical errors that are detrimental to the life of the patient and the surgical staff. Every component is important in its own right.
2. It prevents preventable adverse outcomes and intra-operative complications while the patient is on the operating table. Hence, it should be taught regularly to health staff who are surgically inclined or reemphasized when lessons on safe surgical care are being thought. As safe surgical care starts even before a surgical incision is made.

Abbreviations

WHO – World Health Organization
SSC- Safe Surgical Checklist
LMICs- Lower- and Middle-Income Countries

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The Authors will like to acknowledge the efforts of all their teachers and colleagues over the years who have helped to shape them into safe surgical medical doctors.

To my Parents and Brothers, the foundation on which I stand. And to Prof. Dr-Med. Edwin Oseni-Momodu introduced me to the gospel of the WHO Safe Surgical checklist as a crucial bottleneck to safe surgery. Who always thrust me high into the sky, believing I could fly; though he never stopped to check if I had wings. Thank you. – D.D. OTOBO, MD**.**

Conflict of interest

The Authors declare no conflict of interests

Sponsorship

The author got no sponsorship in cash, kind, grant or wired transaction for this study from any sponsoring agency. The funds utilized were all internally sourced.

Authors contribution

Study design and literature review = ODD, EEM, AJ
Sample size determination, Data entry, and Data Analysis = ODD, AL, IAM
Result interpretation, Discussion and Conclusion = PHO, ODD, UPN, AA
Final review and correction = All authors

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