

# Operation type and phase specific compliance with WHO surgical safety guidelines checklist at the mother and child hospital

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## ABSTRACT

The surgical safety checklist (SSC) is a recognized tool for enhancing patient safety by reducing surgical complications and mortality. While its benefits are well established, effective implementation depends on consistent adherence by the medical team. This study examined the relationship between surgical procedure type and team compliance with SSC in the central operating room of a maternal and child hospital in Yogyakarta. Using a quantitative cross-sectional design, data were collected from 65 observed operations out of 148 total procedures, including elective and emergency cases. Compliance was evaluated in three SSC phases: sign-in, time-out, and sign-out. Correlation was analyzed using chi-square tests. The results showed no significant relationship in the sign-in phase ( $p = 0.195$ ), but significant correlations were found in the time-out ( $p = 0.004$ ) and sign-out ( $p = 0.011$ ) phases. Overall, a significant association was identified between type of surgery and SSC compliance ( $p = 0.006$ ). This study concludes that SSC compliance remains suboptimal, particularly in the initial phase. Elective procedures demonstrated higher compliance than emergency cases. Strengthening a culture of safety and promoting interdisciplinary training are essential strategies to improve SSC adherence and elevate surgical care quality.

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## 1. INTRODUCTION

Surgical procedures are a fundamental component of modern healthcare; however, preventable perioperative adverse events continue to contribute substantially to global morbidity and mortality [1]-[4]. According to the Lifebox Foundation [5], over 300 million surgical procedures are performed each year globally, and a significant portion of these are still associated with preventable safety incidents. Consistent implementation of the World Health Organization (WHO) surgical safety checklist (SSC) has been shown to significantly reduce surgical complications and postoperative mortality. In response to this, WHO developed the WHO SSC, a structured perioperative safety protocol covering sign-in, time-out, and sign-out phases, designed to minimize surgical errors, improve team communication, and enhance patient safety [2], [6], [7].

Despite strong evidence supporting the effectiveness of the SSC, adherence remains inconsistent across healthcare settings, with notable variation between checklist phases [2], [8], [9]. Despite its proven benefits, SSC adherence varies across hospitals. Observational multicenter studies in Switzerland report high

overall compliance but frequent incompleteness in specific phases, particularly sign-out [1], [8], [10]-[12]. A recent systematic review of SSC implementation in LMICs observed that even when penetration (use of the checklist) is relatively high, the fidelity and completeness of checklist execution often remain suboptimal.

Several organizational and contextual barriers, including limited training, weak safety culture, and time pressure, have been reported to hinder consistent SSC implementation [13]-[16]. In several studies, surgical teams reported challenges, particularly in completing all phases of the checklist, with frequent omissions in time-out and sign-out items [17], [18]. Observational data from perinatal and obstetric settings suggest that elective (scheduled) surgeries tend to have better checklist completion compared to emergency surgeries, where time pressure, unpredictable workflows, and team composition variability may lead to lower SSC compliance; a survey of surgical team members in gynecological and obstetrical operations further supports that team awareness and perceptions directly impact adherence in such specialized settings [8], [19], [20]. These challenges are particularly relevant in maternal and child hospitals, where emergency obstetric procedures such as cesarean sections are common and operational urgency is high [21]-[24].

Although the effectiveness of the WHO SSC in reducing surgical complications and mortality has been well documented, most existing studies focus on overall compliance or clinical outcomes without examining compliance patterns across individual checklist phases. In addition, limited evidence compares phase-specific SSC compliance between elective and emergency procedures, particularly within maternal and child hospital settings where operational urgency and obstetric risk are prominent. Consequently, there is a lack of context-specific evidence describing how surgical urgency influences compliance at each SSC phase (sign-in, time-out, and sign-out), despite these phases representing distinct safety checkpoints.

## 2. METHOD

This study employed an analytic observational design with a cross-sectional approach to examine the association between surgical procedure type (elective versus emergency) and surgical team compliance with the WHO SSC. The study was conducted at a maternal and child hospital in Yogyakarta, Indonesia, between December 2016 and January 2017. The study population comprised all surgical procedures performed during the study period (148 cases). A total of 65 surgical procedures were included using an accidental sampling technique, whereby all eligible and observable surgeries were selected. The minimum sample size was determined using a proportion-based calculation, resulting in a minimum requirement of 65 observations. The independent variable was the type of surgical procedure, classified as elective or emergency according to operating theatre standards. The dependent variable was compliance with the WHO SSC, assessed across three phases: sign-in, time-out, and sign-out. Compliance was defined as the complete execution of all required items within each phase. Data were collected through structured non-participant observation using an observation sheet adapted from the WHO SSC and aligned with institutional standard operating procedures. Checklist items included patient identification, anesthesia safety checks, surgical site confirmation, team communication regarding critical events, instrument counts, documentation verification, and postoperative planning. Each item was recorded dichotomously as performed or not performed. Observations were conducted by trained observers who monitored each procedure throughout the perioperative process without interfering with clinical activities. Data analysis consisted of univariate analysis to describe surgical characteristics and SSC compliance distribution, followed by bivariate analysis using the chi-square test to assess the association between procedure type and compliance at each SSC phase. Statistical significance was set at  $p < 0.05$ . Ethical approval was obtained from the relevant institutional ethics committee. All observations were conducted anonymously, and no identifiable patient or staff information was recorded.

## 3. RESULTS AND DISCUSSION

The study observed a total of 65 surgical procedures, of which 36 (55.4%) were elective and 29 (44.6%) were emergency, indicating a modest predominance of scheduled operations in the sample. Procedures were heavily dominated by cesarean sections, which accounted for 55 of the 65 cases (84.6%); the remainder comprised appendectomy, myomectomy, cystotomy, salpingectomy, and circumcision Table 1 and Table 2. This case-mix with a large proportion of obstetric surgery frames the interpretation of checklist adherence and operational pressures within the perioperative environment.

In the sign-in phase, 23 procedures (35.4%) were fully compliant, with no statistically significant difference between emergency and elective surgeries ( $p = 0.195$ ) (Table 3). In contrast, the time-out phase demonstrated higher overall compliance (67.7%), with elective procedures showing significantly greater compliance than emergency procedures ( $p = 0.004$ ) (Table 4). The lowest compliance was observed during the sign-out phase, where only 27.7% of procedures met full compliance criteria; elective procedures again demonstrated significantly higher compliance compared with emergency cases ( $p = 0.006$ ) (Table 5).

Overall, these findings indicate that time-out is the most consistently implemented SSC phase, while sign-in and particularly sign-out remain vulnerable to incomplete execution, especially during emergency procedures.

Table 1. Distribution of surgical types

Surgical type	Frequency	Percentage
Emergency	29	44.6
Elective	36	55.4
Total	65	100.0

Table 2. Distribution of surgical procedures performed

Procedure category	Frequency	Percentage
Appendectomy (App)	2	3.1
Lupus salpingectomy (Lupusco)	1	1.5
Cystotomy	1	1.5
Myomectomy (Mioma)	2	3.1
Cesarean section	55	84.6
Circumcision	1	1.5
Total	65	100.0

Table 3. Chi-square test: correlation between type of surgery and compliance with SSC in the sign-in phase

Type of surgery	Compliant		Non-compliant		p-value
	Frequency	Percentage	Frequency	Percentage	
Emergency	13	20	16	24.6	0.195
Elective	10	15.4	26	40	
Total	23	35.4	42	64.6	

Table 4. Chi-square test: correlation between type of surgery and compliance with SSC in the time-out phase

Type of surgery	Compliant		Non-compliant		p-value
	Frequency	Percentage	Frequency	Percentage	
Emergency	14	21.5	15	23.1	0.004
Elective	30	46.2	6	9.2	
Total	44	67.7	21	32.3	

Table 5. Chi-square test: correlation between type of surgery and compliance with SSC in the sign-out phase

Type of surgery	Compliant		Non-compliant		p-value
	Frequency	Percentage	Frequency	Percentage	
Emergency	3	4.6	26	40	0.006
Elective	15	23.1	21	32.3	
Total	18	27.7	47	70.3	

This study demonstrates that compliance with the WHO SSC varies by checklist phase and differs according to the type of surgical procedure. The results indicate that the time-out phase achieved the highest level of compliance, whereas the sign-out phase showed the lowest adherence. Significant associations between procedure type and compliance were observed in the time-out and sign-out phases, with elective procedures demonstrating higher compliance than emergency procedures, while no statistically significant difference was identified during the sign-in phase.

The observed pattern of higher compliance during the time-out phase and lower compliance during the sign-out phase is consistent with findings reported in prior studies. Systematic and narrative reviews have shown that SSC implementation is often uneven across phases, with time-out more consistently performed than sign-in or sign-out, and overall checklist completeness frequently remaining below optimal levels despite formal adoption [25], [26]. These findings support the interpretation that checklist fidelity, rather than mere availability, varies across perioperative stages.

The lack of a significant difference in sign-in compliance between elective and emergency procedures suggests that pre-induction safety checks are relatively standardized and consistently applied

across procedure types in the study setting. In contrast, the significantly lower compliance observed during the sign-out phase—particularly in emergency procedures highlights a phase-specific vulnerability. This finding aligns with previous observational studies reporting that checklist items related to postoperative verification and team communication are more likely to be incomplete, especially under conditions of time pressure or workflow transition [27], [28].

The significantly higher compliance observed in elective procedures during the time-out and sign-out phases is also consistent with prior evidence indicating that scheduled surgeries allow more predictable team composition and procedural flow, which facilitates systematic checklist execution. Studies conducted in both low and middle-resource settings have similarly reported lower checklist completeness in emergency procedures, attributing these differences to contextual and operational factors rather than lack of checklist awareness [28], [29]. Conversely, reports from settings with sustained training, leadership engagement, and audit–feedback mechanisms demonstrate that higher and more consistent compliance can be achieved when checklist implementation is actively supported [30].

The predominance of cesarean sections in the present study provides important context for interpreting these findings. With obstetric procedures accounting for the majority of observed cases, the results primarily reflect compliance patterns within maternal and child surgical services. Previous studies focusing on obstetric and emergency cesarean procedures have reported similar challenges in maintaining checklist completeness, particularly during phases occurring outside the immediate pre-incision period [8], [26]. This consistency across studies supports the relevance of the observed phase-specific compliance gaps.

From a practical perspective, the findings indicate that improving SSC effectiveness requires targeted attention to phases with persistently low compliance, especially sign-out. Prior implementation studies emphasize that leadership involvement, focused team training, and routine monitoring are key strategies for improving checklist fidelity [1], [3], [31]. The phase-specific deficits identified in this study suggest that such strategies may be most effective when directed toward reinforcing sign-out execution, particularly in emergency procedures.

Several limitations should be considered when interpreting these results. The relatively small sample size and the predominance of obstetric procedures limit generalizability to other surgical specialties. Additionally, the cross-sectional observational design allows identification of associations but does not permit causal inference. Nevertheless, the consistency of the observed compliance patterns with findings reported in multiple independent studies supports the robustness of the results. Overall, this study provides empirical evidence that SSC compliance is phase-dependent and influenced by procedure type, with elective surgeries demonstrating higher adherence during key phases. These findings underscore the importance of phase-specific and context-sensitive approaches to strengthening SSC implementation in maternal and child surgical settings.

#### 4. CONCLUSION

This study shows that compliance with the WHO SSC varies by phase and is influenced by surgical urgency. Time-out demonstrated the highest adherence, whereas sign-in and sign-out were frequently incomplete. Significant differences between elective and emergency procedures were identified in the time-out and sign-out phases, with higher compliance in elective surgeries, while no significant difference was observed in the sign-in phase. The study contributes phase-specific evidence from a maternal and child surgical setting dominated by cesarean deliveries, highlighting that emergency contexts are particularly vulnerable to omissions at key safety checkpoints. These findings indicate that implementation efforts should prioritize strengthening sign-in and sign-out execution, especially during emergency procedures, through focused workflow integration and team accountability. This study is limited by its single-center design, small sample size, and procedure concentration. Future multicenter and interventional studies are needed to evaluate strategies that improve phase-specific compliance and sustain checklist fidelity across different surgical contexts.

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C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

## CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

## DATA AVAILABILITY

The datasets generated and analyzed during the current study are not publicly available due to institutional confidentiality policies but are available from the corresponding author on reasonable request.




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


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