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## Retrospective Study: Effectiveness of the Surgical Safety Checklist in Reducing Surgical Site Infections

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### ABSTRACT

**Introduction:** Surgical site infection (SSI) is one of the major challenges in healthcare, increasing patient morbidity and mortality. The global incidence of SSI has risen to 23.6 cases per 100 surgical procedures. Therefore, prevention and control of surgical site infections are essential patient-safety efforts. This study aims to evaluate the implementation of the Surgical Safety Checklist in relation to SSI occurrence at the hospital.

**Methods:** This research method A quantitative correlational research design was employed, utilizing a retrospective case-control approach. The study population comprised all patients who underwent surgery with indications of SSI, totaling 63 medical records, with total sampling conducted from January 2024 to April 2025. Data collection instruments included an observation checklist based on WHO guidelines and patient medical records.

**Results:** Data analysis using the independent t-test revealed a significance value of 0.00 ( $p < 0.05$ ), indicating a statistically significant difference in the mean incidence of SSI between groups with good and poor SSC implementation. Among the 63 patients diagnosed with wound dehiscence, the average onset of infection was 9 days postoperatively, with a mean surgical duration of 142 minutes.

**Conclusion:** The findings suggest that enhancing the quality of SSC implementation may serve as an effective strategy to reduce the incidence of HAIs in hospitals, particularly within central surgical installations. The results also underscore the importance of strengthening supervision, implementing preventive measures, and integrating the use of electronic medical records (EMR) to improve infection control and patient safety

**KEYWORDS:** Central Surgical Installation<sup>1</sup>; Healthcare Associated Infections<sup>2</sup>; Medical Records<sup>3</sup>; Surgical Safety Checklist<sup>4</sup>; Surgical Site Infection<sup>5</sup>.

### INTRODUCTION

Surgical site infection (SSI) remains one of the major challenges worldwide. This infection not only increases patient morbidity and mortality, but also makes the prevention and control of healthcare-associated infections (HAIs) a top priority to improve service quality and patient safety. Patient safety is a cultural aspect that must be implemented in hospitals. According to the International Patient Safety Goals (IPSG), key safety targets include correct surgical site, correct patient, and correct surgical procedure (1,2,3).

The global incidence of HAIs reaches 9 % or fewer than 1.40 million patients (4,5). In Indonesia, surveillance data from the Ministry of Health in 2022 showed an HAIS prevalence of 15.74 %, far above that of developed countries (4.8–15.5 %). In Bandung Regency, West Java, the HAIS rate is 57.6 % (6,7,8).

The most common HAIs in health-care facilities are ventilator-associated pneumonia (VAP), bloodstream infection (BSI), urinary tract infection (UTI), and surgical site infection (SSI). SSI is a leading cause of the high HAI burden in hospitals (9,10,11). Prevention of SSI has attracted particular attention from surgeons, infection-control specialists, and health authorities (12,13).

Worldwide, SSI incidence has risen from 1.2 to 23.6 cases per 100 surgeries. In Indonesia, SSI rates vary between 2 % and 18 % of all procedures (2, 14).

The SSC is seen as a remedy for socio-technical challenges in operating rooms, with most studies examining its clinical/economic impact, staff perceptions, and implementation barriers. Poor outcomes occur when context is ignored. Ethnographic data from an urban teaching hospital frames the SSC as a ritual comprising two versions: an improvised one and a scripted one (15). Consistent and proper use of the SSC is an important strategy for SSI prevention in operating rooms. Nevertheless, compliance and effectiveness differ across hospitals, influenced by resource availability and the prevailing safety culture.(16)

Numerous studies have shown that comprehensive, integrated SSC implementation lowers SSI rates and enhances patient-safety quality (17). Success, however, depends on factors such as training availability, safety culture, and robust documentation systems.

In the past five years, further evidence supports SSC effectiveness in decreasing infections and improving safety. A recent meta-analysis (18,19) reported a global SSC compliance of only 73 %. SSC use significantly reduces SSI, pneumonia, and other peri-operative complications, especially when integrated into adaptive hospital quality systems (20). Similar findings were observed in sub-Saharan African hospitals, where multimodal interventions combining SSC with infection-prevention protocols effectively lowered SSI rates (21).

Proper SSC implementation can reduce near-miss events, ensure equipment and medication readiness before procedures, and confirm patient identity and correct surgical site. SSC use is high worldwide, but implementation varies significantly. Tailored strategies are needed to address this variability (22). Consequently, repeated training and periodic audits are essential so that the checklist becomes fully internalised in the clinical work culture. Effective SSC implementation should target micro, meso, and macro levels. Future research must address barriers and use professional organisations to standardise SSC practices, thereby enhancing patient safety (23,24).

## METHOD

This type of study employs a quantitative research design with analytic correlation to examine the relationship between two variables, and it involves observation only without any intervention from the study subjects. The approach uses a case-control design to identify disease risk factors and disease occurrence. The cases in this study are patients suspected of having a surgical site infection (SSI). The research is conducted retrospectively (25, 26).

The population in this study comprises all patients who underwent surgery with an indication of SSI, numbering 63 patients over the period from January 2024 to April 2025. Sampling was performed by total sampling. This approach is appropriate when the population size is relatively small; in this study the sample consists of medical records of patients who underwent surgery at the Central Surgical Installation of X Hospital.

The instrument used was an observation sheet containing three phases: sign-in (7 statements), time-out (9 statements), and sign-out (5 statements), for a total of 21 statements. Observation was based on patients' medical records matched with SSI surveillance data for patients diagnosed with wound dehiscence by the Infection Prevention and Control (IPC).

Normality testing was performed using the Kolmogorov-Smirnov test, yielding a significance value of 0.200. Since the significance ( $0.200 > 0.05$ ), the data distribution can be considered normal, allowing the use of parametric tests, specifically the independent-samples t-test. Ethical approval was granted by Universitas Bhakti Kencana (Approval No. 152/09.KEPK/UBK/VI/2025).

## RESULTS

The research univariate data can be seen in Table 1.

**Table 1.** Respondent's Characteristics (n=63)

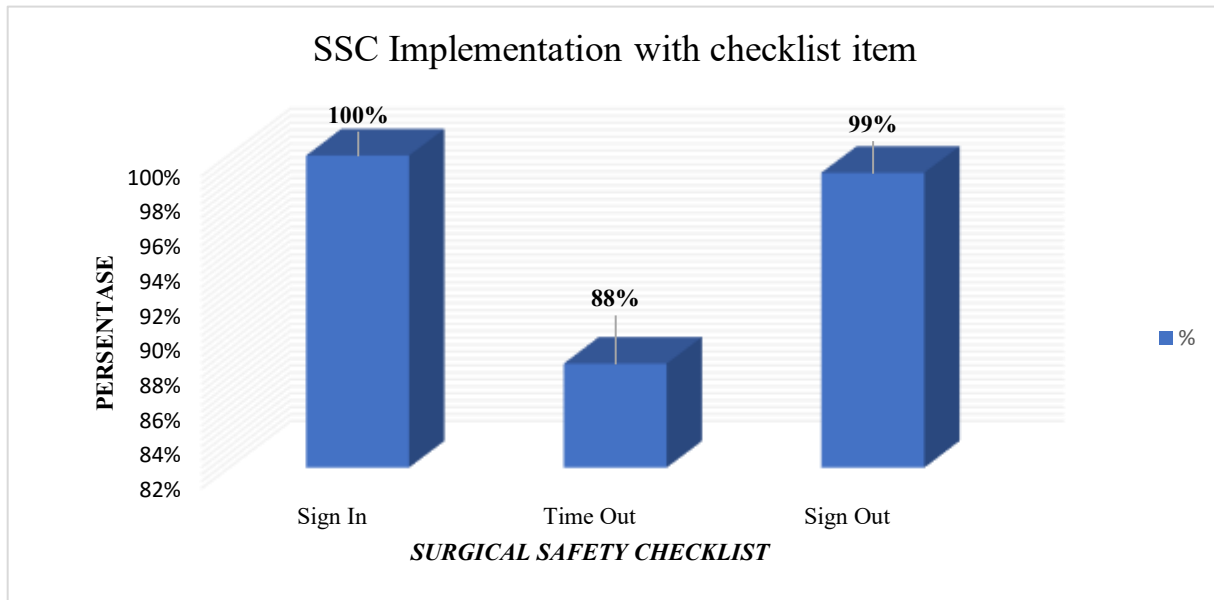
Characteristics	N	%
<b>Age</b>		
17-25 years	11	17,5
26-35 years	33	52,4
36-45 years	11	17,5
46-55 years	4	6,3
56-65 years	1	1,6
>65 years	3	4,8
<b>Body Mass Index (BMI)</b>		

18,5 – 22,9 (Normal)	3	4,8
23 – 24,9 (Overweight)	14	22,2
25 – 29,9 (Obesity I)	33	52,4
≥ 30 (Obesity II)	3	20,6
<b>ASA Physical Status</b>		
II	62	98,4
III	1	1,6
<b>Comorbidities</b>		
Hypertension	12	19
Diabetes Mellitus	11	17,5
Asthma	2	3,2
Hypertension and Pneumonia	1	1,6
None	37	58,7
<b>Previous Surgery</b>		
Yes	25	39,7
No	38	60,3
<b>Medication Use</b>		
Yes	23	36,5
No	40	63,5
<b>Surgical Procedure</b>		
Sectio caesarea (SC)	45	71,4
Hysterectomy	2	3,2
Extirpation	1	1,6
Cystectomy	2	3,2
Laparotomy	13	20,6
<b>Surgery Type</b>		
Minor	21	33,3
Moderate	29	46,3
Major	13	20,6
<b>Duration of surgery</b>		
< 1 hour	21	33,3
1-2 hours	29	46,0
>2 hours	13	20,6
<b>Classification of surgical procedure</b>		
Elective	34	54,0
Emergency (cito)	29	46,0
<b>Anesthesia Type</b>		
General anesthesia (GA)	44	69,8
Spinal anesthesia (SA)	19	30,2
<b>Post operative complications</b>		
PONV (post operative nausea & vomiting)	7	11,1
Shivering	11	17,5
PDPH (post dural puncture headache)	2	3,2
None	43	68,3
<b>Total</b>	<b>63 respondents</b>	<b>100%</b>

Source: Primary Data

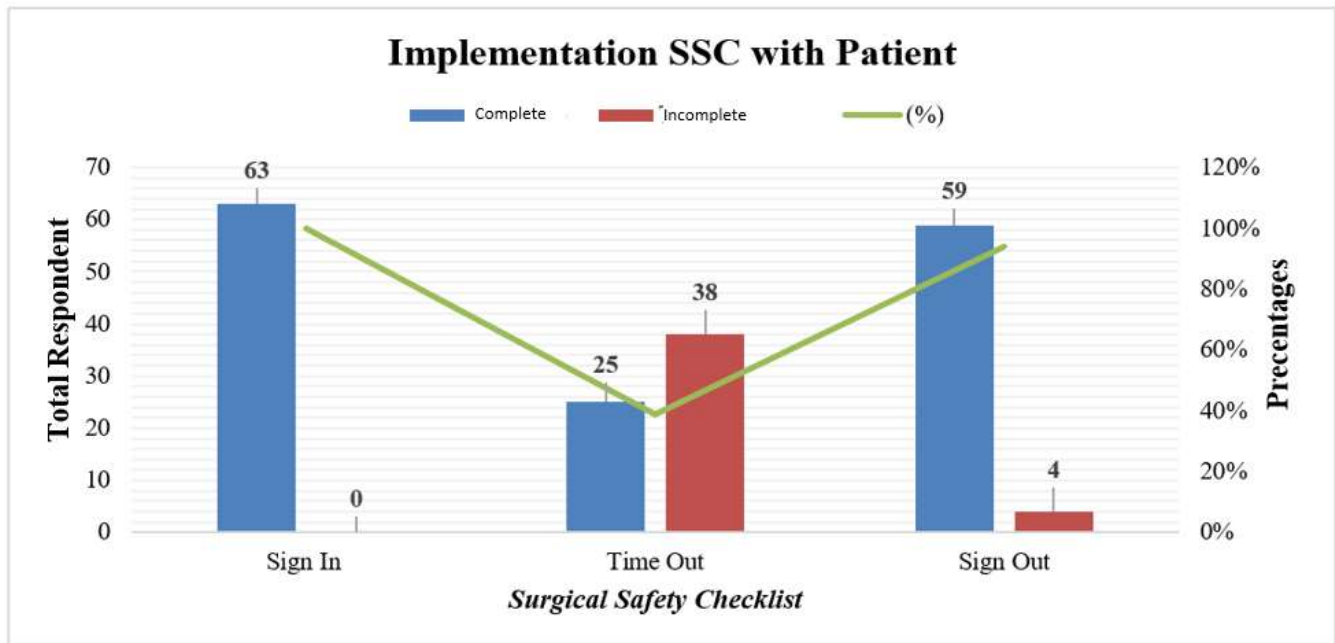
It was found that among the 63 patients with HAIs, specifically those with surgical site infection at X Hospital, the majority (52.4%) were aged 26–35 years (33 patients). Most also had a BMI of 25–29.9 (33 patients, 52.4%). Almost all (98.4%) were ASA class II (62 patients). Most had no comorbidities (45 patients, 71.4%), while 12 patients (19%) had hypertension. The majority had no prior surgery (38 patients, 60.3%) and did not use medication (40 patients, 63.5%). Most underwent cesarean section (45 patients, 69.8%). All patients (100%) had major surgery. The most common operation duration was 1–2 hours (29 patients, 46%). Elective surgeries accounted for 33 patients

(52.4%). Most received general anesthesia (44 patients, 69.8%) and did not experience postoperative anesthetic complications (43 patients, 68.3%).



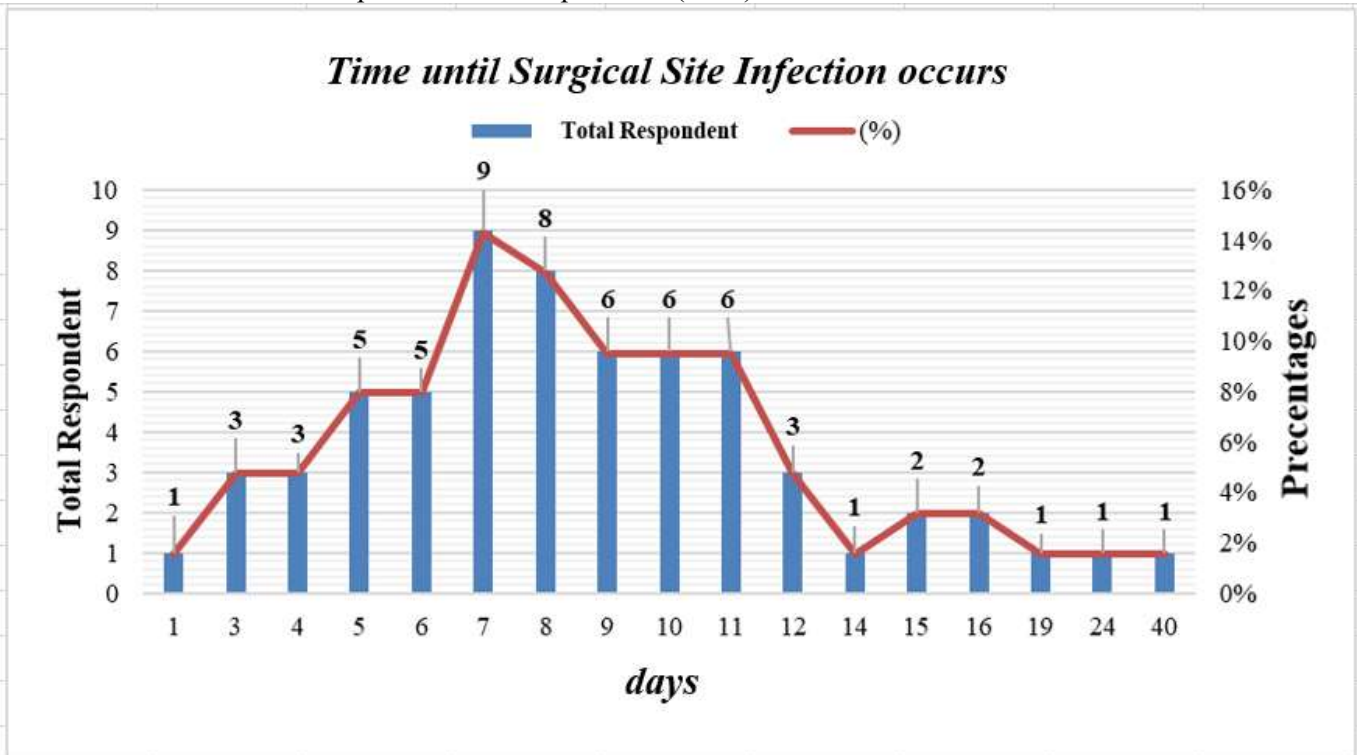
**Chart 1.** SSC Implementation with checklist item

Chart 1 shows that across all SSC phases, the number of checklist items with the highest implementation is observed in the Sign-In phase (100%). Meanwhile, the Time-Out phase (88%) has the lowest implementation of checklist items.



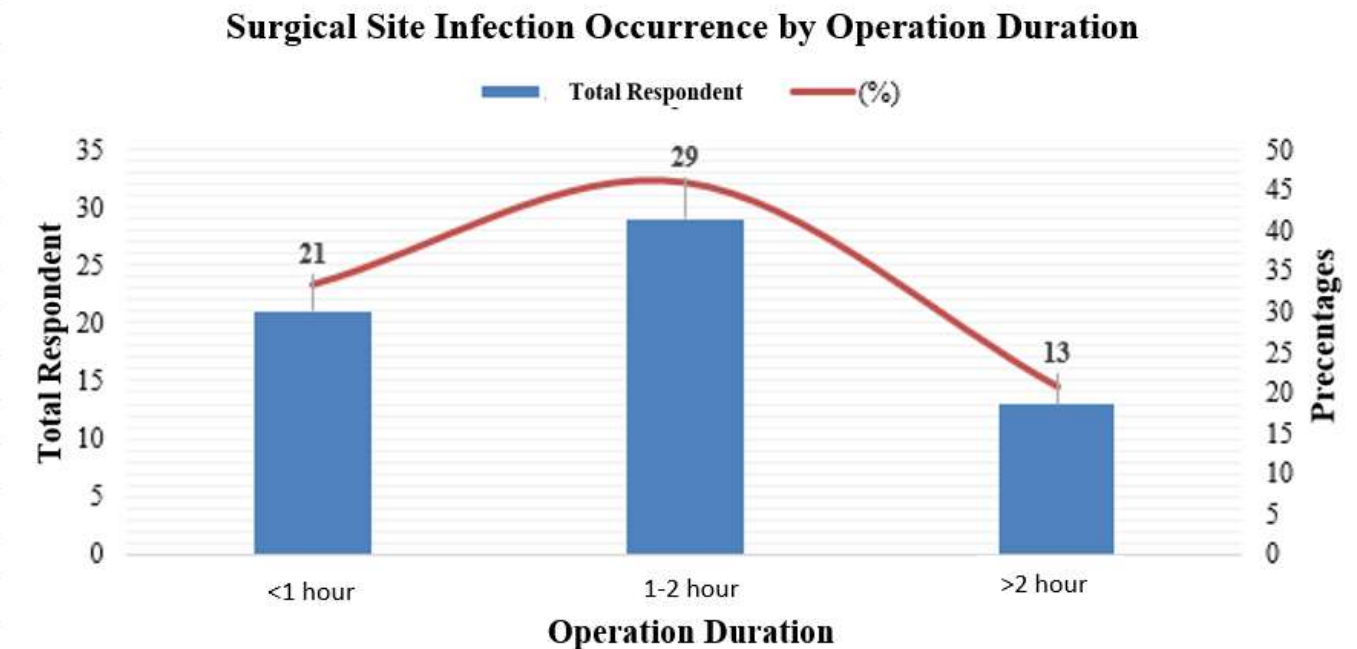
**Chart 2.** SSC Implementation by Respondents

Chart 2 shows that, regarding the completeness of SSC phases, the highest average number of respondents was observed in the Sign-In phase with 63 respondents (100 %). In contrast, the lowest average number of respondents was observed in the Time-Out phase with 25 respondents (39 %).



**Chart 3. Surgical Site Infection Occurrence by Operation Duration**

Chart 3 shows that the majority of respondents (14 %, 9 respondents) experienced infection within 7 days post-operatively.



#### Chart 4. Surgical Site Infection Occurance by Operation Duration

The chart shows that the majority of respondents (46.0 %, 29 respondents) underwent surgery lasting 1–2 hours, followed by 33.3 % (21 respondents) with a duration of less than 1 hour, and 20.6 % (13 respondents) with a duration longer than 2 hours. Correlation analysis using an Independent Samples t-test revealed a significance value of 0.000 (< 0.05), indicating a significant relationship between SSC implementation and the occurrence of HAIs. According to decision-making guidelines, when the Sig. (2-tailed) < 0.05, the null hypothesis ( $H_0$ ) is rejected and the alternative hypothesis ( $H_a$ ) is accepted. Consequently, it can be concluded that there is a statistically significant difference in means between SSC adherence and HAIs.

## DISCUSSION

### Surgical Safety Checklist (SSC)

Effective implementation of the Surgical Safety Checklist (SSC) has been proven to reduce Healthcare-Associated Infections (HAIs) in surgical patients, where consistent SSC application significantly reduced postoperative complications and infections. The SSC serves as a tool to ensure key patient safety steps are followed—from preoperative preparation, team communication during surgery, to postoperative evaluation. As a result, the risk of hospital-acquired infections can be significantly minimized (27, 28).

According to findings from expert interviews in the study (23), the implementation of SSC directly contributes to patient safety. Respondents reported that without strict adherence to the SSC, critical preventive actions such as counting surgical instruments and dressings are not systematically performed, thereby increasing the risk of postoperative complications. This indicates that without comprehensive SSC implementation, patients are exposed to risks arising from incomplete instrument or dressing verification, which significantly impacts patient safety (29),(1).

Low readiness for electronic anesthesia record completion especially in human resources, organizational support, and technology was found, alongside variability in EHR safety implementation: strong technically, weak clinically. The study provides a foundational understanding of EHR safety in public healthcare (29,30,31).

Integrating SSC with the Hospital Management Information System enables real-time monitoring of checklists, reduces documentation errors, and ensures all safety steps are fulfilled (27). Additionally, structured training such as in-house training through SSC socialization and simulation sessions exemplifies efforts to enhance team awareness and competence in SSC implementation. These training activities involve all surgical team members, including specialists, nurses, and ward supervisors, strengthening commitment to patient safety standards (23, 15).

This approach aligns with recommendations from recent studies emphasizing that SSC success heavily depends on active team involvement, coordination, and hospital management support (24), (32). With such measures, it is hoped that a culture of patient safety through SSC will take root in Indonesian healthcare settings, reducing surgical complications and mortality rates. (17,29)

This finding is consistent with literature reviews stating that compliance with SSC implementation has a positive impact on surgical patient safety across hospitals, where high compliance directly correlates with reduced complication and infection risks (33).

In summary, this study underscores the importance of SSC implementation as a strategy to prevent HAIs and improve surgical quality. Hospitals should continue strengthening SSC implementation through periodic training, structured monitoring and evaluation, and integration of information technology to maximize the benefits of SSC in reducing infection risks and enhancing patient safety. (12,16)

### Surgical Site Infections (SSI)

Based on research involving 63 surgical patients at the Central Surgery Installation of X Hospital, the majority of respondents were in the 26–35 years age group, classified as early adults. The majority of respondents had a Body Mass Index (BMI) in the Obesity I category, which has been identified as a major risk factor for Surgical Site Infections (SSI) (34–36).

This aligns with numerous studies indicating that key SSI risk factors originate from patient characteristics and surgical procedures. Although the 26–35 age group represents young adults with relatively strong immunity compared

to older individuals, they remain at high risk when combined with factors such as obesity/overweight, which impair wound healing due to poor tissue vascularization (37,38).

In terms of physical status based on the ASA Score classification, most respondents fell into the ASA II category, indicating patients generally have mild systemic disease without activity limitations. The ASA II status correlates with increased SSI risk due to organ dysfunction and compromised immune function (39,40).

Regarding surgical procedures, section caesarean procedures are classified as major surgeries with high SSI risk due to abdominal and uterine incisions, which are vulnerable to microbial contamination. The relatively long procedure duration of 1–2 hours also increases wound exposure to ambient operating room microbes, thereby potentially increasing SSI incidence (36, 38).

### Relationship Analysis

18 Data analysis revealed that the t-test yielded a significance value of 0.00 ( $p < 0.05$ ), leading to the rejection of the null hypothesis ( $H_0$ ) and acceptance of the alternative hypothesis ( $H_a$ ). This indicates a statistically significant difference in the mean incidence of Surgical Safety Infection between groups with good and poor SSC implementation. This evidence confirms that the quality of SSC implementation is closely linked to patient safety outcomes after surgery.

### Limitations and Cautions

27 The study's small sample size ( $n=63$ ) and cross-sectional design limit generalizability and prevent definitive causal inference. Reliance on subjective staff reports introduces potential reporting bias, while unaccounted variation in surgical complexity and a limited postoperative infection monitoring period (up to 7 days) may underestimate the true incidence of HAIs.

### Recommendations for Future Research

Future studies should adopt prospective cohort or randomized controlled trial designs to establish stronger causal evidence. Integrating the Surgical Safety Checklist (SSC) into electronic medical records (EMR) or hospital information systems (HIS) would improve data accuracy and real-time monitoring. Longer follow-up periods (up to 30–90 days) are essential to capture late-onset surgical site infections. Multicenter studies with larger, more diverse samples and qualitative methods to explore implementation barriers are also strongly recommended to enhance the validity and impact of findings across different healthcare settings.

### CONCLUSION

15 Good and standardized implementation of the Surgical Safety Checklist (SSC) significantly reduces the occurrence of HAIs, particularly surgical site infections. The main challenges lie in low awareness and inadequate documentation systems, which need to be addressed. Healthcare professionals are urged to improve compliance through training, hospitals must strengthen supervision and documentation using EMR, and future research is recommended to use a cohort approach for deeper analysis

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