



The Effectiveness of Implementing Bundle Surgical Site in Reducing Surgical Site Infections in Hospitals

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ABSTRACT:

Introduction: Surgical Site Infection (SSI) is a prevalent postoperative complication that contributes significantly to hospital-acquired infections, increased healthcare costs, and prolonged patient recovery. The implementation of evidence-based infection prevention protocols such as the Bundle Surgical Site (BSS) has been proven effective in reducing the incidence of SSI across various surgical procedures.

Objective: This study aimed to analyze the effectiveness of the Bundle Surgical Site (BSS) training in improving bundle adherence and reducing SSI risks among surgical healthcare personnel at hospital.

Methods: This quasi-experimental study involved 48 healthcare workers divided into two groups: an intervention group that received structured BSS training and a control group that only received routine education. Data were collected before and after the intervention to assess adherence to BSS protocols. The Wilcoxon test was used for statistical analysis with a significance level of $p < 0.05$.

Results

Before training, only 29.2% of the intervention group fully implemented BSS protocols, compared to 4.2% in the control group. Post-training, the intervention group's adherence significantly increased to 91.7%, while the control group improved modestly to 25.0%. The mean score of BSS implementation increased from 2.50 to 3.69 ($p = 0.000$), indicating a statistically significant improvement following the training.

Conclusions: Structured training on BSS protocols significantly enhances compliance among surgical healthcare workers. Incorporating regular BSS training into hospital quality improvement programs is recommended to improve surgical safety and reduce infection rates.

1. Introduction

Surgical Site Infection (SSI) is one of the most common complications following surgical procedures in hospitals. These infections not only increase the burden of morbidity and mortality, but also prolong hospital stays, increase healthcare costs, and reduce patients' quality of life. Globally, SSIs are reported to account for up to 20% of all nosocomial infections and can increase patient care costs up to threefold compared to patients without infectious complications [1,2]. Therefore, systematic, evidence-based prevention efforts are urgently needed to address this problem.

One strategy proven effective in reducing SSI incidence is the implementation of infection prevention bundles. Bundles are a collection of evidence-based interventions applied simultaneously and consistently to improve clinical outcomes. In the surgical context, a Surgical Site Infection Bundle (BSS) includes critical measures such as timely administration of prophylactic antibiotics, appropriate hair removal, skin antisepsis, intraoperative temperature control, glucose control, and adherence to aseptic standards during procedures [3-5]. Several international studies have shown that the integrated implementation of bundles can reduce SSI rates by more



than 40% in various types of surgery, including orthopedics, digestive surgery, and obstetric surgery [6,7].

However, the implementation of infection prevention bundles in hospitals is not always optimal. Factors such as lack of training, limited infrastructure, low compliance by healthcare workers with procedures, and weak support from hospital management often hinder implementation in the field. Previous research has shown that without training interventions or systematic audits, the level of bundle implementation tends to be low and varies across service units [8]. This underscores the need for a structured training strategy and strong institutional support to improve the effectiveness of BSS implementation.

In Indonesia, the implementation of the SSI prevention bundle still faces various challenges, particularly in regional hospitals with limited resources. Preliminary data from Dr. Loekmonohadi Hospital, Kudus, shows that the incidence of SSI remains above the national standard (<2%), while the bundle's implementation across various surgical procedures has not consistently reached 100%. This suggests that despite the availability of the protocol, implementation in the field has not been fully optimized, both in terms of technical aspects and the behavior of healthcare workers involved in surgical procedures.

2. Objectives

This study aims to analyze the effectiveness of implementing a surgical site infection prevention bundle on reducing the incidence of SSI at Dr. Loekmonohadi Hospital, Kudus, Central Java, Indonesia. Using a systematic training and observation approach, this study is expected to provide empirical evidence regarding the importance of bundle-based interventions as part of efforts to improve the quality of surgical services in the hospital.

3. Methods

The design of this study was a *Quasi-experiment* involving two groups, namely the experimental group and the control group. The experimental group was given training on Bundle Surgical Site procedures, while the

control group was only given counseling without training on Bundle Surgical Site procedures. This design aims to analyze the differences in the implementation of surgical site infection prevention protocols before and after Bundle Surgical Site training in surgical patients at Dr. Loekmonohadi Hospital, Kudus.

The population in this study were all health workers involved in the implementation of Bundle Surgical Site at Dr. Loekmonohadi Hospital, Central Java, Indonesia amounting to 48 people. All populations were used as samples. So the sample in this study amounted to 48 samples, then divided into 2 groups, namely the experimental group and the control group, each group consisting of 24 samples.

Data on the effectiveness of Bundle surgical site training were analyzed using the *Nonparametric Wilcoxon Test* using computer *software* with the SPSS application version 21 for Windows. This study has received ethical review approval from the Health Research Ethics Commission of Dr. Loekmonohadi Hospital with number 56/KEPK/I/2025

4. Results

Table 1. Frequency Distribution of Respondent Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Group	Intervention	24	50.0
	Control	24	50.0
Sex	Male	27	56.3
	Female	21	43.8
Age (years)	31–40	15	31.3
	41–50	26	54.2
	51–60	4	8.3
	61–70	3	6.2
Education Level	D4	3	6.3
	S1	35	72.9
	S2	10	20.8
Profession	Midwife	8	16.7



Variable	Category	Frequency (n)	Percentage (%)
Years of Service	Medical Doctor	10	20.8
	Nurse	30	62.5
	1–10	9	18.8
	11–20	31	64.6
	21–30	7	14.6
	31–40	1	2.1

Table 1 shows that the respondents in this study consisted of 48 healthcare workers evenly divided between the intervention and control groups (50% each). The majority of respondents were male (56.3 %) and were in the productive age range of 41–50 years (54.2%), reflecting a workforce with sufficient clinical experience. Most had a bachelor's degree (S1) at 72.9 % , with the dominant profession being nurses (62.5%), followed by doctors (20.8%) and midwives (16.7%). In terms of length of service, most had worked for 11–20 years (64.6 %), indicating that the respondents were generally healthcare workers accustomed to handling surgical procedures. These characteristics indicate that the respondents constitute a relevant and competent population in implementing infection prevention measures such as *the Surgical Site Bundle* in hospitals.

BSS Implementation Before Training

Table 2 Implementation of BSS Before Training Based on Respondent Groups

Group	BSS Implementation	
	Incomplete	Complete
Intervention Group	17 (70.8%)	7 (29.2%)
Control Group	23 (95.8%)	1 (4.2%)

Based on Table 2, it is known that the majority of the BSS implementation before training in both the intervention and control groups was incomplete. Each intervention group (70.8 %) while the control group (95.8%)

Implementation of BSS After Training

Table 3. Implementation of BSS After Training Based on Respondent Groups

Group	BSS Implementation	
	Incomplete	Complete
Intervention Group	2 (8.3%)	22 (91.7%)
Control Group	18 (75.0%)	6 (25.0%)

Based on table 3, it is known that the implementation of BSS after training, the proportion of complete participants in the intervention group (91.7 %) was greater than in the control group (25.0%).

Analysis of BSS Implementation Before and After Surgical Site Bundle Training

Table 4. Analysis of BSS Implementation Before and After Surgical Site Bundle Training

BSS Implementation	Mean	Z	df	p-value
Before Training	2.50			
		4,264	48	0.000
After Training	3.69			

Based on table 4 analysis of the level of BSS implementation before and after Bundle Surgical Site training, it is known that the p-value is $0.000 < 0.05$, which means there is a difference in the average level of BSS implementation before training (2.50) and after training (3.69), so Bundle Surgical Site training is effective in increasing the level of BSS implementation in Hospitals. In the intervention group, there was a significant increase from 29.2% (complete) to 91.7% (complete), while in the control group, the change was minimal from 4.2% (complete) to 25% (complete).

5. Discussion

The study results showed that before training, the level of implementation of the Surgical Site Bundle (BSS) was still relatively low, both in the intervention and control groups. Only 29.2 % of the intervention group and 4.2%



of the control group implemented the complete bundle. This finding reflects that without training and system strengthening, healthcare workers tend to be inconsistent in implementing all elements of the BSS. This gap aligns with previous research stating that compliance with infection prevention protocols is often influenced by knowledge, work habits, and minimal field supervision [4,5].

Following training, there was a significant increase in the level of BSS implementation in the intervention group, from 29.2 % to 91.7%. This demonstrates that training plays a crucial role in improving healthcare workers' understanding, skills, and commitment to comprehensively implementing BSS. This improvement reflects not only the success of knowledge transfer but also the effectiveness of practice-based training on changing clinical behavior. A similar study by Guerrero et al. (2021) also reported an increase in adherence to infection prevention protocols of up to 85% after the systematic implementation of bundled training [9].

This increase in BSS implementation can be explained through a behavioral theory approach. According to *the Health Belief Model*, healthcare workers will be more motivated to change their behavior if they understand the risks of SSI and believe that interventions such as BSS are effective in reducing these complications [10]. Furthermore, Bandura's *Social Cognitive Theory* explains that learning processes through observation, direct practice, and positive reinforcement, as implemented in training, can increase healthcare workers' self-efficacy in implementing preventive measures [11]. This increase also reflects that training is not only an educational instrument, but also a strategic tool for strengthening hospital quality control systems. Although the control group did not receive intensive training, compliance still increased from 4.2% to 25%, possibly due to environmental effects or general education that contributed to increased awareness of the importance of SSI prevention. However, this increase was not as significant as in the intervention group, confirming that structured and systematic training is more effective than a passive approach. Consistent with these findings, a study by Jakes et al. (2020) noted that successful bundle implementation is highly dependent on

training, management support, and the active involvement of the entire surgical team [12].

Overall, the results of this study confirm that BSS training has a significant positive impact on improving the implementation of infection prevention protocols in hospitals. Consistent and comprehensive implementation of the bundle has the potential to reduce the incidence of SSIs in various types of surgical procedures. BSS implementation training should be made part of a routine and structured program by hospital quality management and included in the clinical accreditation system as a key indicator of patient safety. Thus, this intervention will not only impact process improvements but also improve the final outcomes of healthcare services. [13,14]

6. Conclusions

The results of this study indicate that training in the implementation of *the Bundle Surgical Site* (BSS) significantly increased the level of compliance of healthcare workers in implementing surgical site infection (SSI) prevention protocols in hospitals. Before the training, only 29.2 % of respondents in the intervention group fully implemented the BSS, but this figure increased sharply to 91.7% after the training. In contrast, the control group that did not receive training only experienced a small increase from 4.2 % to 25%. This difference indicates that structured training plays a significant role in changing clinical behavior and the effectiveness of implementing evidence-based interventions in infection prevention.

Based on these findings, it is recommended that hospitals routinely implement BSS training as part of their quality improvement and patient safety programs, particularly in the operating room. Comprehensive BSS implementation should be a mandatory indicator in hospital accreditation processes and healthcare worker performance evaluations. Furthermore, regular oversight, monitoring of implementation, and integration of this policy into the hospital's risk management system are necessary to ensure the intervention remains sustainable and has a significant impact on reducing SSI incidence across various surgical procedures.



For further research, it is recommended that the evaluation of the implementation of *the Surgical Site Bundle* be conducted not only on the aspect of healthcare worker compliance, but also directly linked to the incidence of surgical site infections (SSIs) clinically. Longitudinal research with long-term observation will provide a more comprehensive picture of the bundle's effectiveness in reducing the incidence of SSIs. Furthermore, further studies can explore the inhibiting and supporting factors of BSS implementation in various types of hospitals, including private hospitals and health facilities with limited resources, to strengthen the generalizability of the results and the effectiveness of infection prevention policies nationally.

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