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# A Study on Effectiveness of Sterile Glove and Instrument Change at the Time of Abdominal Wound Closure to Prevent Surgical Site Infection.

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## ABSTRACT

**Background:** Surgical Site Infection (SSI) remains one of the most common and preventable post-operative complications in abdominal surgery. The change of sterile gloves and instruments before wound closure is a simple intraoperative intervention that may significantly reduce bacterial contamination of the wound. **Objectives:** To evaluate the effectiveness of changing sterile gloves and instruments at the time of abdominal wound closure in reducing SSI rates. **Methods:** A hospital-based prospective randomised controlled study was conducted at a tertiary care centre in West Bengal over a period of 12 months, enrolling 84 patients (42 in the study group and 42 in the control group) undergoing elective abdominal surgery. The study group underwent sterile glove and instrument change before wound closure, while the control group followed the standard operative protocol. SSI was assessed using the CDC criteria up to 30 days post-operatively. **Results:** The overall SSI rate in the study group was 9.5% as compared to 26.2% in the control group ($p=0.04$). Mean hospital stay was significantly shorter in the study group ($6.2 \pm 1.4$ days) compared to the control group ($8.7 \pm 2.1$ days; $p=0.001$). **Conclusion:** Changing sterile gloves and instruments prior to abdominal wound closure is a cost-effective and simple measure that significantly reduces SSI rates and shortens hospital stay.

***Keywords:*** *Surgical Site Infection, Sterile Glove Change, Instrument Change, Wound Closure, Abdominal Surgery, SSI Prevention.*

## 1. INTRODUCTION

Surgical Site Infection (SSI) is defined by the Centers for Disease Control and Prevention (CDC) as an infection that occurs within 30 days following a surgical procedure and involves the skin, subcutaneous tissue, or deeper anatomical layers at the site of incision. SSI constitutes approximately 20–25% of all healthcare-associated infections (HAIs) globally, and in developing countries such as India, the burden is disproportionately higher due to resource constraints, patient comorbidities, and varied surgical conditions[1].

In the Indian context, SSI poses a serious challenge not only in terms of patient morbidity and mortality but also in prolonged hospitalisation, increased antibiotic usage, economic burden on the patient's family, and strain on the healthcare system. Studies conducted across tertiary care hospitals in Eastern India suggest that SSI rates in general surgical wards range from 15% to 30%, considerably higher than the rates reported in developed nations[2].

The aetiology of SSI is multifactorial. Bacterial contamination of the wound site remains the primary cause, and the source of such contamination includes the patient's own skin flora, the environment of the operation theatre, the surgical team's hands, and critically, surgical instruments and gloves that may become contaminated during prolonged procedures[3][4]. Several studies have highlighted that the outer surface of surgical gloves, despite being sterile at the start of surgery, may accumulate bacteria from surrounding tissues, abdominal contents, and bowel flora during the course of an operation. This is particularly relevant in abdominal surgeries where exposure to gastrointestinal contents can significantly increase intraoperative microbial load[5].

The hypothesis that changing sterile gloves and instruments immediately before wound closure can reduce bacterial contamination at the incision site is both logically sound and supported by evidence from smaller studies. However, such evidence is still limited in the Indian population, and no large-scale study has been conducted at a tertiary care centre in West Bengal to validate this practice. The present study was, therefore, undertaken with the intent to generate regional evidence that can inform standard surgical practice in this part of the country.

## 2. OBJECTIVES

Primary Objective: To determine the effectiveness of sterile glove and instrument change at the time of abdominal wound closure in reducing the incidence of SSI.[6]

Secondary Objectives: To compare the duration of post-operative hospital stay between the study and control groups; to compare the occurrence of wound dehiscence, re-operation rates, and requirement of extended antibiotic therapy between both groups; and to document the sociodemographic profile of the study population.

## 3. METHODOLOGY

Study Design: This was a hospital-based, prospective, randomised controlled trial (RCT) conducted at the Department of General Surgery of a tertiary care centre in West Bengal, India.

Study Setting and Population: The study was conducted among patients admitted to the surgical ward who were posted for elective abdominal surgeries, including open appendicectomy, exploratory laparotomy, intestinal resection and anastomosis, and elective hernia repair.

Inclusion Criteria: Adult patients aged 18 years or above, undergoing elective open abdominal surgery, willing to provide written informed consent, and available for 30-day follow-up were included in the study.

Exclusion Criteria: Emergency surgeries, patients with pre-existing wound infections, immunocompromised individuals (HIV-positive, on corticosteroids, or undergoing chemotherapy), re-operative cases, and patients who declined consent were excluded.

**Sample Size Calculation**

The sample size was calculated using the standard formula for comparison of two proportions:

$$n = Z^2\alpha/2 \times [p_1(1-p_1) + p_2(1-p_2)] / (p_1-p_2)^2$$

Where: $Z\alpha/2 = 1.96$ (at 95% confidence interval), $p_1$ = expected SSI rate in control group = 25% (0.25) based on previously published data from similar tertiary care centres, $p_2$ = expected SSI rate in study group = 8% (0.08) based on literature estimates with intervention, and $p_1 - p_2 = 0.17$ (anticipated difference).

$n = (1.96)^2 \times [0.25\times0.75 + 0.08\times0.92] / (0.17)^2 = 3.84 \times [0.1875 + 0.0736] / 0.0289 = 3.84 \times 0.2611 / 0.0289 \approx 34.7$ per group

Rounding up and adding a 20% attrition allowance, the final sample size was fixed at 42 per group, making a total of 84 participants. This sample size provided 80% statistical power to detect the expected difference at 5% level of significance (two-tailed).

**Method of Sampling**

Simple random sampling was employed to allocate participants into two groups. Eligible patients were numbered sequentially, and allocation was done using a computer-generated random number table. Patients with odd random numbers were assigned to the Study Group (intervention), and those with even numbers were assigned to the Control Group. The surgical team performing wound closure was not blinded; however, outcome assessors evaluating SSI were blinded to group allocation (single-blind design).

**Intervention**

In the Study Group, immediately before abdominal wound closure, the operating surgeon and the scrub nurse changed their sterile gloves, and a fresh sterile set of instruments (needle holders, tissue forceps, and suture scissors) was provided. The peritoneum and fascial layers were then closed using standard techniques with the fresh gloves and instruments. The Control Group underwent wound closure with the gloves and instruments already in use throughout the surgery, as per the routine practice.

**Outcome Assessment**

SSI was assessed at 72 hours, Day 7, Day 14, and Day 30 post-operatively, as per the CDC definitions. Superficial SSI was defined as infection involving only the skin and subcutaneous tissue. Deep SSI involved the deep soft tissue, fascia, and muscle layers. Secondary outcomes included total post-operative hospital stay, wound dehiscence, need for re-operation, and need for extended antibiotic therapy.

**Statistical Analysis**

Data were entered and analysed using SPSS version 22.0 (IBM, USA). Categorical variables were expressed as frequencies and percentages; continuous variables were expressed as mean ± standard deviation (SD). Chi-square test was applied for categorical variables, and the unpaired Student's t-test was used for continuous variables. A p-value of less than 0.05 was considered statistically significant.

## 4. RESULTS

### 4.1 Sociodemographic Profile of Study Participants

A total of 84 patients were enrolled in the study — 42 in each group. The two groups were comparable in terms of age, gender, educational status, occupation, socioeconomic status, and body mass index (BMI), confirming adequate randomisation. The majority of participants (39.3%) were in the 31–45 years age group. Males constituted 58.3% of the study population. The maximum number of participants belonged to Class III socioeconomic status (32.1%) as per the Modified BG Prasad Scale. A majority of patients (51.2%) had a normal BMI. The detailed sociodemographic characteristics are presented in Table 1.

**Table 1: Sociodemographic Profile of Study Participants (n=84)**

| Sociodemographic Variable | Study Group (n=42) | Control Group (n=42) | Total (n=84) |
|---|---|---|---|
| **Age Group (years)** | | | |
| 18–30 Years | 14 (33.3%) | 13 (30.9%) | 27 (32.1%) |
| 31–45 Years | 16 (38.1%) | 17 (40.5%) | 33 (39.3%) |
| 46–60 Years | 08 (19.0%) | 09 (21.4%) | 17 (20.2%) |
| >60 Years | 04 (9.6%) | 03 (7.2%) | 07 (8.4%) |
| **Gender** | | | |
| Male | 24 (57.1%) | 25 (59.5%) | 49 (58.3%) |
| Female | 18 (42.9%) | 17 (40.5%) | 35 (41.7%) |
| **Educational Status** | | | |
| Illiterate | 08 (19.0%) | 09 (21.4%) | 17 (20.2%) |
| Primary Education | 12 (28.6%) | 11 (26.2%) | 23 (27.4%) |
| Secondary Education | 14 (33.3%) | 15 (35.7%) | 29 (34.5%) |
| Graduate & Above | 08 (19.1%) | 07 (16.7%) | 15 (17.9%) |
| **Occupation** | | | |
| Farmer / Labour | 18 (42.9%) | 17 (40.5%) | 35 (41.6%) |
| Housewife | 10 (23.8%) | 11 (26.2%) | 21 (25.0%) |
| Business / Service | 09 (21.4%) | 10 (23.8%) | 19 (22.6%) |
| Retired / Others | 05 (11.9%) | 04 (9.5%) | 09 (10.8%) |
| **Socioeconomic Status (Modified BG Prasad Scale)** | | | |
| Class I (Upper) | 05 (11.9%) | 04 (9.5%) | 09 (10.7%) |

| Sociodemographic Variable | Study Group (n=42) | Control Group (n=42) | Total (n=84) |
|---|---|---|---|
| Class II (Upper Middle) | 08 (19.0%) | 09 (21.4%) | 17 (20.2%) |
| Class III (Middle) | 13 (30.9%) | 14 (33.3%) | 27 (32.1%) |
| Class IV (Lower Middle) | 10 (23.8%) | 10 (23.8%) | 20 (23.8%) |
| Class V (Lower) | 06 (14.4%) | 05 (11.9%) | 11 (13.1%) |
| **Body Mass Index (BMI)** | | | |
| Underweight (<18.5) | 04 (9.5%) | 05 (11.9%) | 09 (10.7%) |
| Normal (18.5–24.9) | 22 (52.4%) | 21 (50.0%) | 43 (51.2%) |
| Overweight (25–29.9) | 11 (26.2%) | 12 (28.6%) | 23 (27.4%) |
| Obese (≥30) | 05 (11.9%) | 04 (9.5%) | 09 (10.7%) |

**BG Prasad Scale updated for 2023 consumer price index.*

### 4.2 Surgical Site Infection Outcomes

The overall SSI rate in the Study Group was 9.5% (4 out of 42 patients) as compared to 26.2% (11 out of 42 patients) in the Control Group. This difference was statistically significant (p=0.04). All SSI cases in the Study Group were superficial in nature (3 superficial, 1 deep), whereas the Control Group recorded a higher proportion of deep SSI cases.

The mean post-operative hospital stay was significantly shorter in the Study Group (6.2 ± 1.4 days) compared to the Control Group (8.7 ± 2.1 days), with a highly significant p-value of 0.001. No re-operation was required in the Study Group; however, 2 patients (4.8%) in the Control Group required re-operative intervention. Wound dehiscence was recorded in 1 patient (2.4%) in the Study Group versus 4 patients (9.5%) in the Control Group. The detailed outcome data are shown in Table 2.

**Table 2: Comparison of SSI Outcomes between Study and Control Groups**

| Outcome Parameter | Study Group (n=42) | Control Group (n=42) | p-value |
|---|---|---|---|
| SSI Rate (Overall) | 4 (9.5%) | 11 (26.2%) | 0.04* |
| Superficial SSI | 3 (7.1%) | 07 (16.7%) | 0.18 |
| Deep SSI | 1 (2.4%) | 04 (9.5%) | 0.16 |
| Mean Hospital Stay (days ± SD) | 6.2 ± 1.4 | 8.7 ± 2.1 | 0.001* |

| Outcome Parameter | Study Group (n=42) | Control Group (n=42) | p-value |
|---|---|---|---|
| Re-operation Required | 0 (0%) | 2 (4.8%) | 0.49 |
| Antibiotic Course Extended | 3 (7.1%) | 09 (21.4%) | 0.06 |
| Wound Dehiscence | 1 (2.4%) | 04 (9.5%) | 0.16 |

**Statistically significant ($p<0.05$). Chi-square test applied for categorical variables; unpaired t-test for continuous variables.*

## 5. DISCUSSION

The present study was undertaken with a clear clinical question: does the simple act of changing sterile gloves and surgical instruments immediately before abdominal wound closure reduce the incidence of Surgical Site Infection? The results of this study strongly support an affirmative answer to this question[7].

Our findings demonstrate a statistically significant reduction in overall SSI rates from 26.2% in the Control Group to 9.5% in the Study Group ($p=0.04$). This represents a clinically meaningful relative risk reduction of approximately 63.7%, which is not only statistically robust but also surgically relevant. The reduction in SSI is logically attributable to the decreased bacterial load introduced at the wound edges during closure, since gloves and instruments that have been in contact with abdominal viscera, bowel contents, and operative field throughout the surgery are likely to harbour a higher count of microorganisms by the time closure is commenced[8].

Several international studies have explored similar interventions with comparable outcomes. A landmark study by Tanner et al. demonstrated that gloves used during surgical procedures accumulate bacteria progressively over time, and that changing gloves at critical operative steps reduces contamination significantly. Likewise, Edwards and colleagues observed a statistically significant reduction in superficial SSI when instrument change was incorporated as a standard pre-closure step in colorectal surgeries. Our findings echo these international observations and extend them to the population of tertiary care patients in West Bengal, where the baseline SSI rates are notably higher due to factors such as malnutrition, comorbidities including diabetes mellitus, and a higher proportion of lower socioeconomic class patients[9].

The secondary outcome of mean hospital stay also demonstrated a highly significant difference, with the Study Group showing a reduction of approximately 2.5 days compared to the Control Group (6.2 vs 8.7 days, p=0.001). This finding has direct economic and operational implications for public hospitals in West Bengal, where bed turnover is a critical challenge. A shorter hospital stay also reduces the patient's exposure to nosocomial pathogens, thereby lowering the risk of secondary infections[10].

The absence of re-operations in the Study Group, in contrast to 2 cases (4.8%) in the Control Group, further underscores the clinical value of this intervention. Re-operations are associated with significantly higher morbidity, additional anaesthetic risk, and exponentially increased costs — all of which are critically important considerations in a resource-limited healthcare environment[11].

It is important to acknowledge certain limitations of this study. The sample size, though adequately powered for the primary outcome, was relatively small for subgroup analyses. The study was conducted at a single tertiary care centre, which may limit generalisability to smaller district hospitals or primary care settings. Additionally, the study was not double-blinded; while outcome assessors were blinded, the operating team was aware of the group allocation, which introduces a potential element of performance bias. Future multicentre trials with larger sample sizes, stratified by type of surgery and patient comorbidity, would further validate and strengthen these findings[12].

From a practical standpoint, the intervention is highly feasible and economically viable. The cost of an additional pair of sterile gloves and a fresh instrument set amounts to a fraction of the total operative cost, and is negligible when weighed against the cost savings of preventing even a single SSI in terms of extended hospitalisation, antibiotics, and wound care. This intervention can be standardised into operative checklists and incorporated into infection control protocols across government and private hospitals in West Bengal and other Indian states.

## 6. CONCLUSION

This study conclusively demonstrates that changing sterile gloves and surgical instruments immediately before abdominal wound closure is a simple, safe, and cost-effective intervention that significantly reduces Surgical Site Infection rates (from 26.2% to 9.5%; p=0.04) and shortens post-operative hospital stay. The intervention requires no specialised equipment or training and can be readily adopted as a standard practice in any surgical unit. Given the significant burden of SSI in Eastern Indian tertiary hospitals, we strongly recommend that this practice be incorporated as a routine

step in abdominal surgery protocols. Further multicentre randomised controlled trials across different surgical subspecialties are encouraged to build a stronger evidence base for national policy recommendations.

### 7.DECLARATION

**Conflict of Interest**: The authors declare no conflict of interest.

**Source of Funding**: The study received no external funding. It was conducted as a departmental academic research project.

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