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Prevention of Surgical Site Infection – Nurse Interventions

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Summary

Background: The aim of this study is to analyse nursing interventions in preventing infection in surgical wounds and to determine whether the nurses' education level influences adherence to infection prevention criteria in surgical wound care within the established patient safety culture.

Sample and Methods: We used a questionnaire developed by authors Saad Tarabichi and Javad Parvizi – SSI prevention practice items. We analysed responses from 110 nurses working in inpatient surgical departments of university and teaching hospitals in Slovakia.

Results: We found that the level of education of nurses influences adherence to proper handwashing technique, p = .000, influences the use of protective masks during surgical wound care, p = 0.027, but has no impact on monitoring and assessing surgical wounds, p = 0.67. Completing specialized studies does not influence adherence to aseptic procedures during surgical wound dressing changes, p = 0.73.

Conclusion: We recommend that nurses follow the criteria of nursing standards and guidelines for preventing SSI (Surgical Site Infection).

Keywords Infection, Surgical wound, Prevention, Nurses, Questionnaire SSI prevention practice items

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Introduction

The European Wound Management Association (EWMA 2002) recommends the assessment and evaluation of the wound, ensuring adequate moisture, and supporting epithelialization as the basic principle of the Anglo-Saxon concept under the acronym TIME (Schultz, Barillo, Mozingo, Chin 2024). T – Tissues, non-viable tissue – this refers to the removal of devitalized tissue – debridement. Chronic wounds require repeated debridement, unlike acute surgical wounds, which do not. I – Inflammation, suppression of inflammation and infection. In some cases, it is necessary to open the wound, perform surgical debridement, and ensure the proper drainage of wound exudate with appropriate drainage selection (Bukovčan, 2019) M – Moisture, moisture balance – every wound contains exudate, which can aid in wound healing by preventing desiccation of the wound bed, promoting cell regeneration, and providing nutrients (Holloway, Pokorná, Probst 2024). An optimal moist environment is recommended for wound healing; excessive fluid can lead to maceration of the wound edges and surrounding skin. E – Epithelialization, epithelialization – evaluating the wound edges is the final step in the wound healing process according to the TIME procedures. The goal is a healthy wound edge and the formation of clean granulation tissue at the wound base. Epithelialization begins at the edges of the wound, and epithelial islands form within the wound. The wound is strengthened by collagen fibers, and the scar gradually transforms into healthy pink tissue (Schultz, Barillo, Mozingo, Chin 2024). The goal of the TIME concept is to reduce

swelling, decrease exudate production, and lower bacterial load. Despite the recommendation for TIME for chronic wounds, it can be adapted for the treatment of acute surgical wounds, reducing treatment costs and duration. Ulrych (2020) mentions that one of the causes of infection in surgical wounds is nosocomial infections. Infections can lead to wound dehiscence and even necrosis (Brabcová 2021).

Nursing Interventions in Preventing Infection in Surgical Wounds

The culture of patient safety in the domain of "prevention of nosocomial infections" includes effective handwashing techniques, adherence to aseptic procedures, and the safe disposal of biologically contaminated materials. The nursing management of a patient in preventing infection in a surgical wound includes interventions such as wound assessment, critical evaluation of the wound, analysis of appropriate wound dressing, application of barrier nursing care principles, and ensuring the patient receives nutritional support. Wounds healing "per primam" are indicated for dry dressings using traditional dressing materials. If the wound is without secretion, it is appropriate to use special self-adhesive non-adherent dressings. To increase comfort and protect the wound, ointment compresses, or non-adherent meshes can be used, which help maintain flexible wound edges. These compresses are made of mesh netting and ointments and can be without any active ingredients. A second group includes compresses enriched with additional antimicrobial agents such as iodine-povidone or silver. They are applied directly to the wound and covered with sterile secondary dressings. The advantage is minimal trauma to the wound. Hydrogel dressings are suitable for poorly to moderately exuding wounds. Hydrocolloids are recommended for wounds in the granulation and epithelialization phases without signs of infection and support healing in an oxygen-free environment (Ren at al. 2024). Part of the wound treatment protocol includes the wound assessment: location, size, depth, shape and direction, secretion, and amount of exudate, wound characteristics, surrounding skin and edges, phase of healing, presence of drains and sutures, performed dressing changes, current wound condition, materials used, medications, and individual risk factors for the patient (Brabcová, 2021). Postoperative septic complications hinder and prolong the treatment process, particularly in elderly patients, and significantly increase its cost (Pobrotyn, 2020). Moreover, these complications negatively impact patients' functional status and independence (Wróblewska, 2018). Unfortunately, unlike many other infection-related health problems, postoperative infections cannot be effectively prevented through vaccination (Paplicki, 2020). Consequently, a traditional approach remains necessary, focusing on interrupting pathogen transmission pathways. Both education and fear of causing or experiencing an infection and its consequences can substantially influence the effectiveness of these preventive measures (Sus2o, 2022). The susceptibility of surgical sites to infections results from a complex interplay of seemingly unrelated factors, as is often the case in various fields of medicine (Waszczuk, 2008). Patients are also informed about the risks associated with surgical site infections (Drobnik, 2017), which is a crucial component not only of infection prevention but also of obtaining informed consent for surgical procedures (Trnka, 2017), especially for high-risk major surgeries (Sus2o, 2008). The COVID-19 pandemic has significantly altered hygiene habits among both hospital patients and healthcare personnel (Drobnik, 2021) to an extent unparalleled by other factors, including other epidemic infectious diseases such as influenza (Sus2o, 2021). Infection control, including the prevention of surgical site infections, has evolved into a systemic approach in recent decades and is legally supported by state regulations aimed at fulfilling the government's role in ensuring public health security (Paplicki, 2018). New information technology solutions are being implemented (Sus2o, 2017) to facilitate infection monitoring (Sus2o, 2008), document preventive measures (Sus2o, 2009), and enhance communication between healthcare providers responsible for postoperative wound care, particularly between hospitals and primary healthcare facilities (Trnka, 2010).

File and Methods

The risk of infection in a surgical wound is one of the most common postoperative complications. We analyzed the interventions of nurses in the prevention of surgical wound infections. We

focused on dependent variables such as adherence to hand washing techniques, use of sterile gloves, monitoring and assessment of the surgical wound, adherence to aseptic procedures during the dressing of the surgical wound, and the use of face masks during the treatment of the surgical wound. For the purpose of the thesis, with the authors' consent, Saad Tarabichi and Javad Parvizi, we used a sample questionnaire – Questionnaire SSI prevention practice items from the article Prevention of Surgical Site Infection: A Ten-Step Approach, focused on nursing practices and procedures that ensure the prevention of infection in wounds. The demographic part of the questionnaire tracks three independent variables: education, length of practice in the surgical department, and completion of specialized study. Each question was assessed on a Likert scale, offering four response options with the following score weights: never (0), rather not (1), rather yes (2), always (3). The questionnaire was anonymous, voluntary, and ethical principles of scientific research were followed.

The selection criteria for respondents included: active nursing practice in a three-shift system in a surgical department. Age, gender, and length of practice with no limitations, as well as willingness to cooperate by answering all the questionnaire's questions. In 2024, we approached 150 nurses via stratified sampling from university and faculty hospitals in Slovakia. We received 126 responses, of which 16 were excluded due to incomplete answers. We analysed 73.33% of the responses from the nurses approached. The data from the nurses' responses were analysed using the Shapiro-Wilk normality test – Royston Test. The null hypothesis that the data come from a normal distribution was rejected, indicating that the sample data have a non-normal distribution. To evaluate the relationship between two observed variables, we chose the non-parametric Chi-square test. The null hypothesis (H0) was set up with the assumption that there is no difference between the expected and theoretical results. Tests were evaluated at the significance level $\alpha = 5\%$. We used the Microsoft Excel software function CHISQ.TEST to calculate the p-value. The criterion for evaluating the data analysis was the statement: if the p-value is $< \alpha$, then we reject H0, and the differences between the expected and observed frequencies are statistically significant.

Characteristics of the Sample

The sample consisted of 57% nurses with a university degree and approximately 33% with a completed high school diploma. 45% of the total respondents had completed specialized studies, 13% were currently studying, and as many as 43% of the nurses had not started or completed specialized studies.

Table 1 Descriptive Characteristics of the Nurse Sample

Descriptive Category	Length of Practice
Average	**12,8 years**
Minimum	1 year
Maximum	45 years
Mode	3 years
Median	10 years
Variance	102,78
Standard deviation	10,14

Results

We analysed the patient safety culture through the indicator: the application of independent competencies by Slovak nurses in preventing infection during the dressing of a surgical wound. We based our approach on the EBN principle (evidence-based nursing) and specifically on the SSI Guidelines and clinical standardized procedures valid in Slovakia. Procedurally, we focused on the risk analysis of wound infection development, influenced by factors before the surgery, and during and after the dressing of the surgical wound. We evaluated the nurses' responses and calculated a risk score for the nursing interventions. The variation range of the achieved score can range from a minimum of 0 (indicating risks to patient safety culture in the evaluated area) to a score of 300 (indicating the strengths of the patient safety culture).

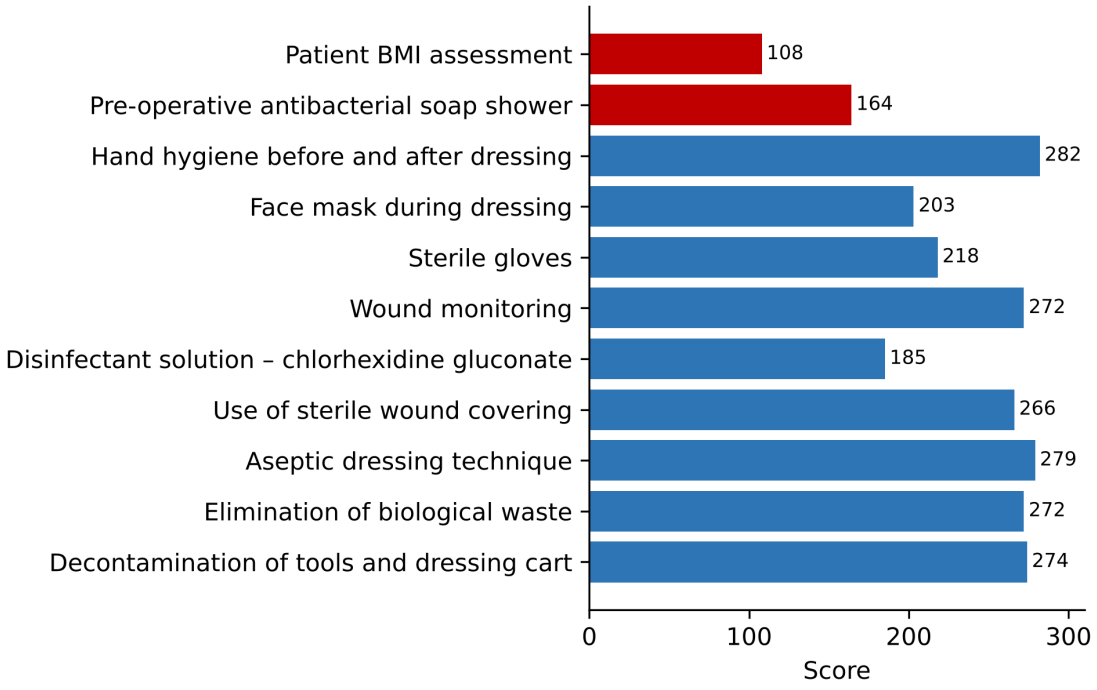
The lowest score of 108 was achieved for the item "assessment of the patient's BMI," meaning nurses perform it only sporadically. The priority intervention for infection prevention in surgical wounds identified by the nurses was the intervention "hand hygiene and disinfection by the nurse before and after dressing change," with a score of 282. The nurses identified the strong points of patient safety culture as the interventions

"aseptic technique for wound dressing," with a score of 279, and "decontamination of equipment and dressing trolley," with a score of 274.

Table 2 Nursing Interventions in the Prevention of Surgical Wound Infection

Category / Score	Never (0)	Rather No (1)	Rather Yes (2)	Always (3)	Score
Preoperative Preparation					
Patient BMI assessment ↓	28%	45%	18%	9%	108
Pre – operative antibacterial soap shower	16%	30%	28%	26%	164
Pre-dressing Preparation					
Hand hygiene before and after dressing ↑	-	-	18%	82%	282
Face mask during dressing	3%	26%	36%	35%	203
Dressing Process					
Sterile gloves	4%	20%	30%	46%	218
Wound monitoring	-	2%	24%	74%	272
Disinfectant solution for the wound – chlorhexidine gluconate	9%	22%	44%	25%	185
Use of sterile wound covering	1%	2%	27%	70%	266
Aseptic dressing technique	-	-	21%	79%	279
Post-dressing Procedures					
Elimination of biological waste	-	2%	24%	74%	272
Decontamination of tools and dressing cart	-	1%	24%	75%	274

Graph 1 Nurses' intervention scores in preventing infection in surgical wounds



Nurses' responses in the categories "never" and "rather not" signal a risk and weak points in the established safety culture system. Nurses who do not implement these interventions put the patient at risk of infection. The dominance of responses in the categories "rather yes" and "always" indicates

that nurses consider interventions for preventing infection in surgical wounds during nursing care to be significant and have become a routine part of their work. The resulting scores of the assessed categories, which are dominant in positive evaluative statements, confirm the application of the EBN principle, specifically the Guidelines for SSI and clinical standardized procedures in practice.

The nurses' responses to the analysed variables were compared with independent variables using the Chi-square test. We found that the nurses' level of education influences adherence to proper handwashing technique, $p = 0.000 < \alpha = 0.05$, which confirms the validity of the statement for the sample, but it has no effect on the monitoring and assessment of the surgical wound, $p = 0.67$. The deviations between the measured and theoretical values resulted from chance, indicating no dependency between the two monitored indicators. Completion of specialized studies has no effect on adherence to aseptic procedures during surgical wound dressing, $p = 0.73$. We confirmed in the surveyed sample of surgical nurses that the highest level of education influences the use of protective face masks during surgical wound care, $p = 0.027 < \alpha = 0.05$.

Discussion

Infection prevention in surgical wounds (SSI) is an independent competency of nurses, even in Slovakia. The issue we addressed was analysed within the nursing practice of university and teaching hospitals. From the SSI Guidelines, we analysed selected preventive interventions by nurses based on the results of the project in terms of ensuring the process, structure, and outcome criteria of clinical standardized procedures valid in Slovakia.

In our project, we found that the least frequently performed intervention, with a score of 108, was the "assessment of the patient's BMI." We found that the most frequently performed intervention, with a score of 282, was the "nurse hand hygiene and disinfection before and after dressing."

In the next part of the survey, we focused on the impact of education on adherence to proper hand hygiene techniques and the assessment of surgical wounds. We found that the nurses' level of education influences adherence to proper handwashing technique, $p = 0.000 < \alpha = 0.05$, but education has no effect on the assessment of surgical wounds, $p = 0.67$. The study focused on hand hygiene technique show that the major barriers for not practicing the appropriate technique of wound dressing are time-consuming procedure, heavy workload, lack of adequate staff to assist in dressing procedure and lack of sufficient supplies (Sijimol 2021).

The use of face masks by the team during dressing wound should be mandatory to prevent infection. Marsons (2021) recommends the use of face masks by all staff during surgical procedures to protect both the patient and the staff. There are two reasons for staff to wear surgical masks: firstly, to protect surgical sites from microorganisms transferred from the faces and respiratory tract of scrubbed staff and, secondly, to protect health care professionals from sprays and splashes of patients' blood and body fluids during surgery. SSI contribute to the increase in the burden of both patients and health care systems by increasing the length of hospitalisation, the cost of care, mortality and morbidity. Since surgical masks were introduced as a preventive practice for SSI, over a hundred years ago, they have been used to provide a physical barrier between the mouth and nose of health care personnel and surgical wounds of patients (Ogo N, Foran P 2020). In our study, we focused on the relationship between wearing a face mask during wound dressing and the nurses' level of education. We confirmed in the surveyed sample of surgical nurses that the highest level of education influences the use of protective face masks during surgical wound care, $p = 0.027 < \alpha = 0.05$.

A very important intervention is knowing how to properly assess a surgical wound. There are tools to describe SSI using objective criteria. These include the ASEPSIS (Additional treatment, the presence of Serous discharge, Erythema, Purulent exudate, and Separation of the deep tissues, the Isolation of bacteria, and the duration of inpatient Stay) scoring system, which was created to assess wounds Campwala (2019).

Obesity is considered a risk factor for surgical site infection (SSI). In our study, nurses assigned the lowest score in the preoperative preparation category – 108, among the categories observed. Several studies examining the impact of body mass index (BMI) on the risk of SSI have demonstrated a

trend of increasing SSI risk with higher BMI. This increase is most notable in surgeries involving "clean wounds," with the relative risk of SSI for morbidly obese patients being up to 7 times higher than for patients with a normal BMI (Meijs et al., 2019). Further analyses also showed that BMI was significantly positively associated with a higher risk of SSI. Risk estimates indicated that an increase of 5 BMI units was associated with a 13% increased risk of SSI (Abdelaziz, 2021). The preoperative shower with antibacterial soap was another category monitored in preoperative preparation. Our respondents achieved the second-lowest score in this item – 164. This simple intervention, which is within the nurse's responsibility, can significantly reduce the risk of SSI. A preoperative bath with 4% CHG is effective in preventing SSI because 4% CHG is bactericidal, bacteriostatic, and remains on the skin for a long time, reducing bacterial colonies by nine times and increasing the skin's ability to act antiseptically for a longer period (Prayugo et al. 2022).

A very significant competency of nurses is the dressing of surgical wounds. Preparation for the dressing, the dressing itself, and the processes following the dressing significantly influence SSI. As many as 66% of our respondents reported using a chlorhexidine solution in alcohol. Its effectiveness has been confirmed by several studies. In adult patients undergoing surgery of any wound classification, skin preparation using 2.0-2.5% chlorhexidine in alcohol is the most effective method for preventing SSI (Jalalzadeh et al. 2024).

Conclusion

Nurses play a pivotal role in preventing SSIs. Their responsibility includes implementing evidence-based practices, adhering to infection control guidelines, and maintaining a high standard of care to minimize infection risks by applying infection control practices, assessing patient risks, and educating both patients and staff. Adherence to evidence-based guidelines and standardized procedures in clinical practice is essential to ensure the highest level of care and reduce the incidence of SSI.

Study Limits

The study's limitations include the purposive selection of respondents restricted to nurses from university hospitals, the smaller sample size, and the fact that nurses were contacted electronically. Based on the above, our results are valid for the sample and can be considered pilot. For analysis prevention of surgical site infection, we suggest increasing the sample, and futher analyzing solved problem.

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