DOI: 10.4274/gulhane.galenos.2025.00821
Gulhane Med J 2025;67(2):58-66

Patient knowledge and participation in preventing surgical site infections: an integrative review

Jukas Mirnoto[1,2], Andi Masyitha Irwan[3]

[1]*Hasanuddin University Faculty of Nursing, Department of Medical Surgical Nursing, Makassar, Indonesia*
[2]*Daya District General Hospital, Makassar, Indonesia*
[3]*Hasanuddin University Faculty of Nursing, Department of Gerontological Nursing, Makassar, Indonesia*

Cite this article as: Mirnoto J, Irwan AM. Patient knowledge and participation in preventing surgical site infections: an integrative review. Gulhane Med J. 2025;67(2):58-66.

Date submitted:
22.08.2024
Date accepted:
13.05.2025
Publication Date:
03.06.2025

Corresponding Author:
Andi Masyitha Irwan, PhD., RN., Hasanuddin University Faculty of Nursing, Department of Gerontological Nursing, Makassar, Indonesia
citha_ners@med.unhas.ac.id

ORCID:
orcid.org/0000-0002-4715-7668

Keywords: Surgical site infection, patient education, patient role

ABSTRACT

Awareness of health workers regarding the role of patients in decisions about surgical site infections (SSIs) is still lacking. Therefore, this study aimed to provide insight into patient knowledge and participation, and the role of health workers in involving patients in SSI prevention. Six online databases were searched for relevant studies, and this search identified ten articles. Findings highlight the importance of patient knowledge, awareness and active participation, as well as the critical role of healthcare workers in engaging and empowering patients to prevent SSIs. Therefore, adequate patient knowledge can increase patient participation in infection prevention, by educating them about the disease process and empowering them to monitor surgical wounds, use antibiotics, and make decisions related to preventing SSIs.

Introduction

Surgical site infection (SSI) is a potential complication of surgical procedures that can harm the patient. According to the Centers for Disease Control and Prevention (CDC) in the United States (US), there were around 110,800 cases of SSIs due to inpatient surgical procedures in 2015. In 2021, the CDC reported a 3% increase in the incidence of SSIs across all types of surgical procedures compared with that in the previous year (1). In Japan, nosocomial infection surveillance revealed that the incidence of SSIs in gastrointestinal surgery cases had reached 9.6% (2). Another article reported that the readmission rate within 30 days for patients with SSI was 51.94 per 100 procedures compared with an overall readmission rate of 8.19 per 100 procedures. This indicated that patients with SSI had a significantly higher risk of adverse outcomes than those without SSI (3). According to the World Health Organization (WHO), SSI is a common healthcare-associated infection (HAI) in low-and middle-income countries, affecting up to one-third of patients undergoing surgery. In high-income countries, such as Europe and the US, SSI remains the second most common type of HAI (4). Therefore, special attention should be paid to reducing post-surgery complications as part of patient safety to prevent SSIs (5).

SSIs occur in surgical sites after procedures and can range from infections in the skin to more severe infections that spread to the tissue beneath the skin, organs, or implanted material (6). The incidence of SSIs can be prevented by implementing the principles and guidelines for infection prevention from the beginning of surgery, through the intraoperative period, and into the postoperative period (4). As a healthcare professional, it is important to make every effort to prevent any possible infection incidence in a hospital setting (7).

The current SSI prevention strategies primarily focus on the role of health workers and the risk factors related to the surgical procedure (8). Although routine surveillance and standard prevention protocols have been established, active involvement of patients in the prevention of SSIs should also be considered because patient involvement can be beneficial (9). If patients do not actively participate in efforts to prevent SSIs, the risk of developing infections may increase, leading to extended hospital stays, a higher risk of death, and increased treatment costs (10). However, health workers often do not recognize the role of patients and caregivers in decision-making, including antibiotic administration, despite observational data highlighting its importance. Consequently, patients and caregivers are not routinely either involved or aware of opportunities to participate in decision-making regarding SSIs (11). Therefore, healthcare workers need to educate patients about preventing SSIs and involve them in decision-making.

Patient knowledge regarding SSI prevention includes a comprehensive understanding of preventive measures (12), proper wound care procedures (13), identification of signs of infection, and compliance with essential medical instructions to reduce the risk of SSIs (14). Good patient knowledge is expected to help patients participate in SSI prevention efforts, comply with treatment protocols, monitor their health conditions, report emerging symptoms, and collaborate with health workers in the decision-making process regarding effective preventive measures to reduce the risk of SSIs (10).

The results of previous reviews have identified that involving patients in the prevention of surgical wound infections can be effective. However, further research is needed to validate this strategy (8). A review showed that although patient education is considered an important strategy to reduce the incidence of SSI and improve patient safety, patient education regarding SSI, including hospital care, is still very low (15). In addition, another review found the lack of participation and low awareness among patients regarding the risk of infection associated with the health services they receive (16). However, none of these studies has thoroughly examined patient knowledge, participation, and the role of health workers in involving patients in SSI prevention. It is important to consider the overall picture of patient knowledge, patient participation, and the role of health workers in involving patients in preventing SSIs.

The aim of this integrative review was to provide an overview of scientific literature on patient knowledge, patient participation, and the role of health workers in involving patients in the prevention of SSIs. This review is anticipated to help patients and health workers in collaborating to prevent SSIs.

Methods

Research on patient involvement in SSI prevention has been widely conducted. This research specifically focuses on patient knowledge, patient participation, and the role of health workers, in involving patients in preventing SSIs. In this review, we specifically focused on examining:

a. Patients' knowledge about SSI prevention,

b. Patient participation in SSI prevention,

c. Role of health workers in involving patients in SSI prevention.

Search strategy

This study used Whittemore and Knafl's (17) integrative review method, which is similar to our previous studies of Cooper (18) (19-21), to increase its accuracy. Integrative reviews enable the synthesis of diverse research designs, thereby providing a comprehensive understanding of a phenomenon. To ensure the accuracy of article search, this review was conducted following the PRISMA 2020 guidelines (22).

A literature search was conducted across six databases online in December 2023. The keywords used for five of these databases (Scopus, PubMed, ClinicalKey, ProQuest, and CINAHL) were "patient knowledge," "patient participation," "patient engagement," "prevention," "reduce," "minimize," and "SSI." For the Garuda database, the keywords "patient knowledge," "patient participation," "patient involvement," "prevention," "reducing," and "SSIs" were used. Garuda is an Indonesian database recommended by the Indonesian Ministry of Education, Culture, Research and Technology.

The inclusion criteria were as follows: 1) articles published in English or Indonesian, 2) original research, 3) published within the last 10 years (between 2014 and 2023), 4) research focused on patient knowledge and patient participation in SSI prevention, and 5) studies involving research subjects aged 18 years and older. The exclusion criteria were as follows: 1) review studies, 2) studies focused on instrument development, and 3) unpublished research.

Data extraction and quality assessment

Article searching was initiated by entering keywords into the databases. The identified articles were then sorted to remove duplicates. Subsequently, articles that met the eligibility criteria were selected. Articles with full text available were carefully reviewed to see if they met the inclusion or exclusion criteria. The selected articles were then subjected to an integrative review process (Figure 1).

In integrative reviews, quality evaluation is not mandatory. However, conducting an assessment can support the interpretation of study results. Two authors assessed the selected articles to determine their appropriateness for inclusion and interpretation in the integrative review. The 10 selected studies were critically appraised for quality using an instrument created by Bowling (23). The ratings were recorded in a table using a scale of "Yes" "Not reported" and "Poor" for evaluation. The evaluation results were used to assess the quality of the selected articles (23). This quality evaluation approach was selected for its relevance in assessing both quantitative and qualitative studies. Based on the evaluation, all 10 studies were determined to be of high quality. Consequently, it was decided that the selected articles met the required quality standards for inclusion in the review (Table 1).

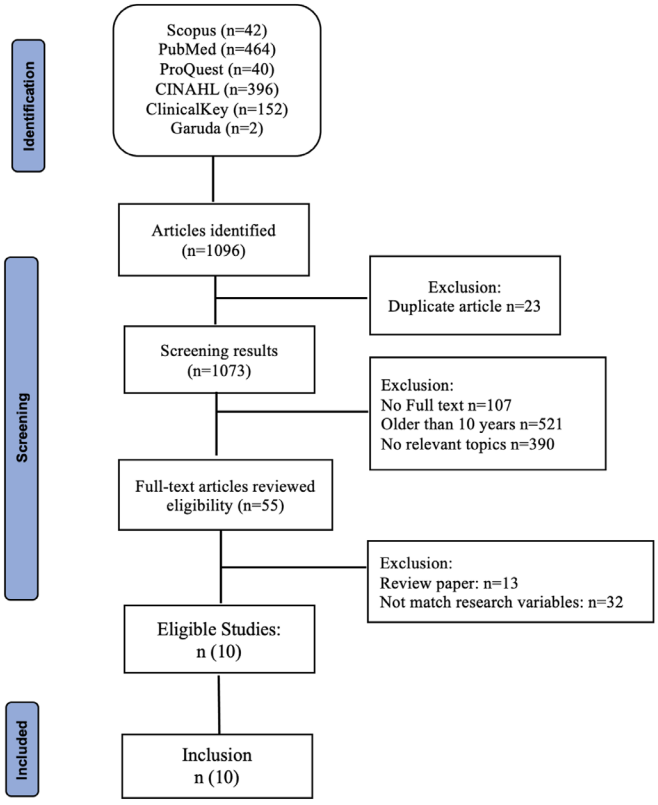

Figure 1. Prisma flow diagram

After quality evaluation, data analysis was conducted in several stages. First, the data were reduced by grouping, extracting, simplifying, and organizing the data into a framework, which was then analyzed sequentially (Table 2). Next, the data were compared and re-examined to reveal patterns, themes, and correlations. Similar data were regrouped, compared, and aligned. The final stage of data analysis involved verifying the data source to ensure its accuracy before drawing any conclusions.

Results

Ten articles were thoroughly examined and carefully synthesized to draw conclusions from research on patient knowledge, patient participation, and the role of health workers in involving patients in the prevention of SSIs. These 10 studies were conducted in various parts of the world, including the US (n=2) (13,24), Spain (n=1) (25), Nigeria (n=1) (26), Germany (n=1) (14), Brazil (n=1) (10), Japan (n=1) (27), Netherlands (n=1) (28), China (n=1) (29), South Africa (n=1) (11), and India (n=1) (11). These 10 articles comprised seven quantitative research articles and three qualitative research articles.

Table 1. Quality appraisal

Authors	Goals are clear explained	Study design explained	Appropriate research method	Adequate description, sample, and exclusion criteria	Ethics presented	Results are clearly reported	The results are in accordance with the study questions and literature	Limitations presented	Implications discussed	Value/level
Elia-Guedea et al. (25)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Oliveira et al. (10)	Yes	Not reported	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8/9 High
Sanger et al. (13)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Brisibe et al. (26)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Kawabata et al. (27)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not reported	Yes	8/9 High
Yao et al. (29)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Kluytmans (28)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Mullen et al. (24)	Yes	Yes	Yes	Poor	Yes	Yes	Yes	Yes	Yes	8/9 High
Nampoothiri et al. (11)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Voigt et al. (14)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High

Table 2. Data extraction

Author	Year/ Country	Research purposes	Method	Instrument	Sample/Setting	Patient knowledge	Patient participation	The role of healthcare workers in patient involvement
Nampoothiri et al. (11)	2023/ South Africa and India	To explore the impact of patient participation, understand cultural differences in care, and discuss antibiotic use	Qualitative (grounded theory approach)	Semi-structured interview	-/Specialist adult gastrointestinal and cardiovascular and thoracic surgery at a tertiary academic referral hospital in South Africa (site A) and India (site B)	The need to understand and acknowledge patients' knowledge and expertise in their own care, the potential benefits of face-to-face educational/ counseling sessions for patient education	Antibiotic decision making	1. Encourage patient involvement 2. Provide psychosocial support 3. Education about infection prevention and control
Sanger et al. (13)	2014/USA	To investigate the experience of surgical site infection patients regarding mobile applications as a solution to the problem of identifying and managing post-surgical wound complications	Qualitative	Surveys and semi-structured interviews	13/Two affiliated teaching hospitals, including an academic medical center and a level 1 trauma center, as well as two University of Washington general surgery clinics	1. Knowledge of wound care and monitoring after discharge from hospital 2. Not receiving adequate information or education 3. The patient's inability to process and retain the information provided.	Patients are actively involved by sharing their experiences and providing input on care practices after hospital discharge	Provision of accessible communication and timely responses to patient concerns, active involvement of patients in post-discharge care
Elia-Guedea et al. (25)	2017/ Spain	To assess the effectiveness of a series of simple preventive measures in reducing the risk of infection at the surgical site of the colon and rectum	Quantitative (comparative studies)	SSI's CDC Criteria	-/BClinico Hospital Colorectal Unit Universitario Lozano Blesa in Zaragoza	-	-	Increasing awareness through information and training sessions, ensuring appropriate administration of antibiotics, fostering teamwork
Brisibe et al. (26)	2014/ Nigeria	To assess the impact of implementing infection control policies on the knowledge, attitudes and practices of health workers	Quantitative (cross-sectional)	Semi-structured questionnaire derived from WHO, CDC guidelines and similar published studies	-/Caesarean section patients at the University of Port Harcourt Teaching Hospital and Braithwaite Memorial Specialist Hospital in Port Harcourt, Nigeria	-	-	Providing personal hygiene education before and after surgery

Table 2. Data extraction

Author	Year/ Country	Research purposes	Method	Instrument	Sample/Setting	Patient knowledge	Patient participation	The role of healthcare workers in patient involvement
Voigt et al. (14)	2022/ Germany	To investigate the level of interest and need for information on infection prevention and control among patients undergoing elective total endoprosthesis	Qualitative	Structured and standardized personal interviews	425/University Hospital Gottingen in Germany	The level of patient knowledge needs to be improved, with the great need for advice and information regarding infection prevention and control	The patient participation rate in this study was 38.4%, Empowering patients in infection prevention and control, which emphasizes the need for patients to receive appropriate advice and information	Empower patients by providing appropriate advice and information, tailored to their specific needs and conditions
Oliveira et al. (10)	2023/ Brazil	To analyze the perceptions of patients and health workers regarding patient participation in SSI prevention	Quantitative (cross-sectional study)	A questionnaire with a Likert scale format that covers various domains related to patient participation in SSI prevention for both patients and health workers	123/Postoperative patients and 92 healthcare professionals/two hospitals in São Paulo, Brazil	The patient's level of knowledge is emphasized as crucial in the prevention and control of SSI with a focus on understanding their role, acquiring knowledge, and developing skills for active participation	1. Active involvement, shared responsibility	1. Active communication with patients
							2. Patient collaboration in understanding and managing the perioperative process	2. Provide education
							3. Involves shifting from a passive role to an active collaborator	3. Support for patient participation
								4. Facilitate patient empowerment through training and innovative strategies

Table 2. Data extraction

Author	Year/ Country	Research purposes	Method	Instrument	Sample/Setting	Patient knowledge	Patient participation	The role of healthcare workers in patient involvement
Kawabata et al. (27)	2023/ Japan	To assess the impact of hospital participation in the JANIS program on SSI prevention	Quantitative (retrospective before-after observational study)	JANIS program, JANIS database, and standardized model infection ratio (SIR)	157.343/Acute care hospitals in Japan	-	-	1. Educate patients 2. Involving patients in infection monitoring programs to increase patient awareness and participation
Mullen et al. (24)	2017/USA	To investigate the impact of additional perisurgical nasal decolonization involving patients and surgical and nursing staff	Quantitative	Not specifically stated. Data was taken from patient records	1,073 patients/Orthopedic and surgical treatment centers	Use of antiseptics after discharge from hospital	Patient participation was high in nasal decolonization at 95% during the 15-month trial period	1. Actively encourage and systematically record voluntary self-decolonization 2. Encourage compliance with decolonization procedures
Kluytmans (28)	2023/ Netherlands	To develop an automated surveillance system for healthcare-associated infections to reduce the risk of post-surgical disease	Quantitative (case- control, studies cross-sections al and studies observational	-	5004 patients/hospitals in the Netherlands	Historical understanding and rediscovery of the impact of nasal transmission of *S. aureus* on post-surgical infections and implementation of preventive interventions and current practices regarding decolonization	Multicenter trials, as well as being recipients of intranasal applications perioperative	-
Yao et al. (29)	2021/ China	To understand the factors that influence patient participation behavior in the prevention and control of surgical site infections (SSI) in colorectal cancer patients	Quantitative (cross-sectional studies)	Survey questionnaire	580 patients/a gastrointestinal surgical ward at a university-affiliated tertiary hospital in shongqing, China	Level of awareness and understanding of SSI-related knowledge	Revealed that participation intention had the largest total effect among the factors influencing CRC patients' participation in SSI prevention and control behavior	1. Encourage patient participation 2. Support their involvement in medical services 3. Build trust 4. Facilitate health service decision making

JANIS: The Japanese Nosocomial Infection Surveillance, SSI: Surgical Site Infection, CRC: Colorectal Cancer, ASA: American Society of Anesthesiologists, USA: United States of America, WHO: World Health Organisation

Patient knowledge about preventing surgical site infections

Among the 10 articles analyzed, 7 discussed patient knowledge in preventing infections (10,11,13,14,24,28,29). The majority of the articles indicated that patients need knowledge (11,14) and understanding of the disease (14,29), wound care process (13), and the use of antibiotics (11) to prevent SSIs. This knowledge should be provided through information and education while the patient is in the hospital and even after they have been discharged and return home.

Patient participation in preventing surgical site infections

Seven of the articles included in this study explicitly mention the need for active participation of patients in efforts to prevent SSIs (10,11,13,14,24,28,29). Active patient participation can help prevent SSIs (11,27,28). This participation includes empowering patients (14), monitoring surgical wounds (13), changing passive roles to active collaborators (10), participating in the use of antiseptics and antibiotics, and taking an active role in decision-making for infection prevention and control (11).

Role of health workers in involving patients in preventing surgical site infections

Overall, the articles analyzed provide several methods for health workers to involve patients in SSI prevention. These include providing easily accessible communication (13), providing information and education (10,11,14,25-27), empowering patients (14), encouraging patient compliance with infection prevention protocols (24), and supporting patient involvement in decision-making regarding prevention and control of SSIs (11,13,27,29).

Discussion

This integrative review aimed to provide an overview of patient knowledge, patient participation, and the role of health workers in involving patients in preventing SSIs.

Patient knowledge about preventing surgical site infections

This review discusses the importance of educating patients about their illness, wound care, and infection prevention. According to the SSI prevention guidelines from the WHO (4), patients are motivated to learn about optimal medical practices and typically adhere to recommendations from health professionals. Research indicates that the patient's knowledge about hygiene, application of prophylactic antibiotics, and postoperative wound care can contribute to SSI prevention (26). Increasing patient knowledge can facilitate the implementation of infection prevention protocols by helping patients understand healthcare workers' efforts to prevent SSIs. Therefore, it is crucial for healthcare workers to educate patients about preventing SSIs.

Patient participation in preventing surgical site infections

Most studies included in this review emphasize the need for active patient participation in efforts to prevent SSIs. This active participation involves empowering patients, monitoring surgical wounds, and collaborating with patients to prevent and control SSIs. Although several SSI prevention guidelines (1,4,30) do not specifically mention the importance of patient participation in SSI prevention, recent studies have shown that patient participation in efforts to prevent SSIs can reduce the risk of infection, accelerate patients' recovery, lower treatment costs, and improve compliance with SSI prevention measures (10). Shifting the patient's role from passive to active participant alongside healthcare workers is crucial in efforts to prevent SSIs. Therefore, healthcare workers should strive to actively involve patients in SSI prevention.

Role of health workers in involving patients in preventing surgical site infections

In this discussion, the roles of health workers in involving patients in SSI prevention is analyzed. This includes providing adequate information and education, optimal communication between patients and healthcare workers, and involving patients in decision-making regarding procedures and strategies for preventing SSIs. It was noted that various SSI prevention guidelines (1,4,30) did not mention the role of healthcare workers in involving patients in SSI prevention. However, healthcare workers play a vital role in increasing patient involvement in efforts to prevent SSIs by utilizing educational strategies, such as conveying information through video and via pamphlets, to provide knowledge to patients before and after surgery. Emphasizing the importance of educating and informing patients about the evaluation of butyrylcholinesterase levels is crucial, as these levels have been shown to be associated with the risk of developing SSIs (31). In addition, providing training to healthcare workers is crucial to ensure that patients can be actively involved in perioperative patient care (10). The role of perioperative healthcare workers, which has so far been limited to preparing patients, medical equipment, and a sterile environment to prevent SSI, can be developed into a collaborative role with patients, to reduce morbidity and mortality due to surgical complications.

Implications

To prevent SSIs, it is important for patients to have good knowledge about infection prevention. This can increase patient participation alongside health workers, in implementing efforts to prevent SSIs. Patient knowledge can be enhanced by providing information and education as well as effective means of communication with health workers. This change can shift the role of the patient from a passive to an active, increasing the patient's participation and involvement in decision-making in

efforts to prevent infection. Active patient involvement can help health workers in their efforts to prevent SSIs.

Although this review has identified heterogeneous studies, there is still a lack of original research specifically focusing on patient knowledge and participation in preventing SSIs. More related original research articles are needed to address this gap. Furthermore, this review only considered studies published in English and the Indonesian language, so there may be relevant studies published in other languages that were not included.

Conclusion

This integrative review carefully analyzed various studies that examined patient knowledge, patient participation, and the role of health workers in involving patients in preventing SSIs. This review is fundamental in providing health workers with an overview of the importance of meeting patients' needs for knowledge about preventing SSIs through optimal education and communication strategies. Adequate patient knowledge can increase patient participation in infection prevention by empowering them to monitor surgical wounds, use antibiotics, and make decisions related to preventing SSIs. Healthcare workers can help involve patients in preventing SSIs by providing access to information and education, communicating effectively, empowering patients, and providing adequate support and motivation. Success in preventing SSI will in turn accelerate patient's recovery, lower treatment costs, and improve quality of life. This understanding will then help patients and health workers in developing appropriate strategies to prevent SSIs collaboratively.

Footnotes

Authorship Contributions

Surgical and Medical Practices: J.M., A.M.I., Concept: A.M.I., Design: J.M., A.M.I., Data Collection or Processing: J.M., A.M.I., Analysis or Interpretation: J.M., A.M.I., Literature Search: J.M., Writing: J.M.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. CDC. Surgical Site Infection Event (SSI). Natl Healthc Saf Netw. 2022;1-39. Last Accessed Date: 22.12.2023. Available from: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/ImportingProcedureData.pdf
2. Ohge H, Mayumi T, Haji S, Kitagawa Y, Kobayashi M, Kobayashi M, et al. The Japan Society for Surgical Infection: guidelines for the prevention, detection, and management of gastroenterological surgical site infection, 2018. *Surg Today*. 2021;51(1):1-31.
3. Bashaw MA, Keister KJ. Perioperative strategies for surgical site infection prevention. *AORN J*. 2019;109(1):68-78.
4. WHO. WHO Global guidelines on the prevention of surgical site infection. WHO Document Production Services, Geneva, Switzerland; 2018. Last Accessed Date: 22.12.2023. Available from: http://www.who.int/gpsc/ssi-prevention-guidelines
5. Harsul W, Irwan AM, Sjattar EL. The relationship between nurse self-efficacy and the culture of patient safety incident reporting in a district general hospital, Indonesia. *Clin Epidemiol Glob Heal*. 2020;8:477-481.
6. Anderson DJ, Podgorny K, Berríos-Torres SI, Bratzler DW, Dellinger EP, Greene L, et al. Strategies to prevent surgical site infections in acute care hospitals: 2014 update. *Infect Control Hosp Epidemiol*. 2021;35(6):605-627.
7. Amir H, Yusuf M, Syam Y, Irwan AM, Cahyani DD, Djalid NK, et al. Comparison between traditional and disposable bed baths in intensive care unit. *Eur J Clin Exp Med*. 2023;21(1):108-113.
8. Tartari E, Weterings V, Gastmeier P, Rodríguez Baño J, Widmer A, Kluytmans J, et al. Patient engagement with surgical site infection prevention: an expert panel perspective. *Antimicrob Resist Infect Control*. 2017;6:45.
9. Cox J, Douglas L, Wemmer V, Kaminsky K. The role of patient engagement in surgical site infection reduction: a process improvement project. *Adv Ski Wound Care*. 2023;36(11):599-603.
10. Oliveira MC, Dalcól C, de Carvalho REFL, Poveda VB. Patient participation in surgical site infection prevention: perceptions of nurses, physicians and patients. *Rev da Esc Enferm*. 2023;57:e20220459.
11. Nampoothiri V, Mbamalu O, Surendran S, Bonaconsa C, Pennel T, Boutall A, et al. The elephant in the room: exploring the influence and participation of patients in infection-related care across surgical pathways in South Africa and India. *Heal Expect*. 2023;26(2):892-904.
12. Calderwood MS, Anderson DJ, Bratzler DW, Dellinger EP, Garcia-Houchins S, Maragakis LL, et al. Strategies to prevent surgical site infections in acute-care hospitals: 2022 update. *Infect Control Hosp Epidemiol*. 2023;44(5):695-720.
13. Sanger PC, Hartzler A, Han SM, Armstrong CA, Stewart MR, Lordon RJ, et al. Patient perspectives on post-discharge surgical site infections: towards a patient-centered mobile health solution. *PLoS One*. 2014;9(12):e114016.
14. Voigt M, Schaumann R, Barre F, Mayr E, Lehmann W, Hawellek T, et al. Do patients need advice and information to prevent infections - results of a single centre structured survey. *Infect Prev Pract*. 2022;4(4):100237.
15. Hammoud S, Amer F, Lohner S, Kocsis B. Patient education on infection control: a systematic review. *Am J Infect Control*. 2020;48:1506-1515.
16. Mbamalu O, Bonaconsa C, Nampoothiri V, Surendran S, Veepanattu P, Singh S, et al. Patient understanding of and participation in infection-related care across surgical pathways: a scoping review. *Int J Infect Dis*. 2021;110:123-134.
17. Whittemore R, Knafl K. The integrative review: updated methodology. *J Adv Nurs*. 2005;52(5):546-553.

18. Cooper HM. Synthesizing research: a guide for literature reviews. SAGE PublicationsSage CA: Los Angeles, CA; 1989. Available from: https://www.amazon.com/Synthesizing-Research-Literature-Reviews-Applied/dp/0761913483

19. Iryanidar I, Kadar KS, Irwan AM. Readiness of nurses working in COVID-19 pandemic. *Int J Health Sci (Qassim)*. 2022;6(5):1639-1649.

20. Iryanidar I, Irwan AM. Stress and coping mechanisms in patients undergoing CABG: an integrative review. *Clin Epidemiol Glob Heal*. 2023;23:101388.

21. Ahmad SM, Irwan AM. Clinical simulation of complementary therapy in nursing education: an integrative review. *Afr J Nurs Midwifery*. 2022;24(2):11830.

22. Yao L, Zhang Y, Zhao C, Zhao F, Bai S. The PRISMA 2020 Statement: a system review of hospital preparedness for bioterrorism events. *Int J Environ Res Public Health*. 2022;19(23):16257.

23. Bowling A. Research methods in health: investigating health and health services. 4th. Maidenhead: McGraw-Hill Education; 2014.

24. Mullen A, Wieland HJ, Wieser ES, Spannhake EW, Marinos RS. Perioperative participation of orthopedic patients and surgical staff in a nasal decolonization intervention to reduce Staphylococcus spp surgical site infections. *Am J Infect Control.* 2017;45(5):554-556.

25. Elia-Guedea M, Cordoba-Diaz de Laspra E, Echazarreta-Gallego E, Valero-Lazaro MI, Ramirez-Rodriguez JM, Aguilella-Diago V. Colorectal surgery and surgical site infection: is a change of attitude necessary? I*nt J Colorectal Dis*. 2017;32(7):967-974.

26. Brisibe S, Ordinioha B, Gbeneolol PK. Knowledge, attitude, and infection control practices of two tertiary hospitals in Port-Harcourt, Nigeria. *Niger J Clin Pract.* 2014;17:691-695.

27. Kawabata J, Fukuda H, Morikane K. Effect of participation in a surgical site infection surveillance programme on hospital performance in Japan: a retrospective study. *J Hosp Infect.* 2024;146:183-191.

28. Kluytmans J. Prevention of surgical site infections: a personal odyssey. *J Hosp Infect.* 2023;138:85-88.

29. Yao L, Xiao M, Luo Y, Yan L, Zhao Q, Li Y. Research on the factors that influence patients with colorectal cancer participating in the prevention and control of surgical site infection: Based on the extended theory of planned behaviour. *Heal Expect.* 2021;24(6):2087-2097.

30. Verras GI, Mulita F. Butyrylcholinesterase levels correlate with surgical site infection risk and severity after colorectal surgery: a prospective single-center study. *Front Surg.* 2024;11:1379410.