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Effect of patient education on surgical site infections rates: a systematic review of the literature

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ABSTRACT

The present systematic review aimed to investigate the effectiveness of patient engagement through education and empowerment on surgical site infection (SSI) rates. Included studies involved adult patients undergoing surgical procedures with any educational intervention, aiming at patient engagement/empowerment, compared to no educational interventions or usual therapy. The information sources used were Web of Science, PubMed and Scopus, from 2013 until 2023. The Joanna Briggs Institute tool was used to assess the risk of bias, whereas our results were synthesized in a narrative form according to the research questions, due to the included studies' heterogeneity. A total of ten studies were included with 9236 participants all of whom were clinic patients. Eight studies included educational interventions as part of prevention bundles. All studies demonstrated a reduction on SSI rates, following the intervention, even though no study scored high on quality assessment. The findings highlighted the added value of patient education in conjunction with the application of prevention measures. Patient empowerment through education encourages active patient participation in their care, increases patient satisfaction and, ultimately, improves the quality of provided care. The need for more high-quality studies emerged, which will focus on patient engagement to further elucidate its role in SSI prevention.

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KEYWORDS
SSIs; patient education; wound infection; patient empowerment; patient engagement

Introduction

Surgical site infections (SSIs) comprise a threat toward the quality of the provided healthcare services globally, with their overall impact affecting mortality and morbidity. It has been estimated that they rank fourth amongst healthcare-associated infections (HAIs) in terms of health burden as measured in disability-adjusted life years (DALYs) [1]. Moreover, SSIs have been described as the HAI contributing the most to annual costs in the United States [2], mainly attributed to the prolonged length of hospital stay. The high rates of recurrent SSIs contribute to antibiotic overuse and subsequent antimicrobial resistance [3].

Even though the World Health Organization (WHO) issued Global Guidelines for the Prevention of SSIs [4], low adherence has been observed worldwide [5,6] with persisting high prevalence of such infections [7,8]. Additionally, these guidelines only focus on healthcare professionals (HCPs) role, excluding patient participation and engagement [4,9].

Patient engagement is attributed to four key concepts: personalization, access, commitment and therapeutic alliance. Personalization constitutes of the need to modify interventions based on each patient's specific requirements, including health literacy and cultural background. Access is the patient's ability to acquire resources and information, while commitment is the mental or emotional state that enables the patient to take advantage of the available resources. Therapeutic alliance refers to the connection between the patient and the healthcare provider that aims to achieve the patient's health goals [10]. Reference [10] defines patient engagement as the patients' desire and capability to actively choose to participate in their care in a way that is uniquely appropriate to them and in cooperation with their healthcare provider, in order to enhance the outcomes or experiences of care [10]. Patient engagement has been recognized as a substantial component of quality and safe health care, whilst increasing patient empowerment and satisfaction [11,12]. Engagement of patients can be achieved through interventions that involve the education of both patients and HCPs, by enabling the provision of feedback, and with their engagement for systems or services improvements [13].

The engagement of patients regarding SSIs prevention can be implemented through focused education

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and the implementation of prevention programs, including the preoperative avoidance and control of risk factors, as well as postoperative wound management education [14]. Organizational support and the application of evidence-based practices are prerequisites for the successful implementation of patient engagement and education [15]

Patient education has been proven to be a cost-effective measure for the management of chronic diseases [16], whereas its application on healthcare-associated infections has also been described as desirable by patients [17]. Patient education concerning HAIs has been assessed in a systematic review, the findings of which underline the lack of education for the prevention of HAIs [18]. Furthermore, of the 25 studies included in the aforementioned review, only two addressed patient education regarding surgical site infections. Both studies concluded that patient education regarding SSIs should be personalized and applied according to patient preferences in order to address patient's needs [19,20]. Additionally, when patients do not benefit from the appropriate education from their healthcare provider, they turn to other sources of information. To assess the understandability and actionability of online patient education materials regarding SSIs, Zellmer et al. used the PEMAT tool (Patient Education Materials Assessment Tool). The results of their study demonstrated that online information resources have low patient understanding and usefulness [21], further highlighting the need for the proper education of patients by their healthcare providers. Despite this evidence, a lack of studies evaluating the impact of patient engagement and education on SSIs exists.

This is the first review aiming to evaluate the effectiveness of patient engagement through educational interventions in adult patients undergoing surgery, in terms of reducing surgical site infections.

Methods

We followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guideline [22]. Criteria for included studies involved randomized or non-randomized trials, which included adult patients undergoing surgical procedures and had educational and/or empowerment interventions applied during the perioperative period, compared to usual care or with interventions other than the above. The primary outcomes included SSIs incidence. Length of hospital stay (LOS), mortality attributed to SSIs and postoperative intensive care unit (ICU) admission were also added. The study period was restricted to the past ten years in order to include only recent evidence and novel interventions regarding the education and empowerment of surgical patients. Restrictions applied concerned language – other than English, the pediatric population, and studies – other than randomized or non-randomized trials. Commentaries, editorials, letters to the editor and conference articles were also excluded.

Information sources

Studies were retrieved from Web of Science, PubMed and Scopus, whereas Clinical Trials.gov was searched for ongoing trials. Prospero was also searched for existing systematic reviews on the subject. The last search was conducted on December 15, 2023.

Search strategy

Search strategy was based on the study research question 'Do adult patients undergoing surgical procedures, benefit from perioperative education, compared to standard perioperative care in terms of decreased surgical site infections related events'.

The following terms were combined with Boolean operators in order to search all registries and databases: 'patient' OR 'perioperative patient' AND 'education' OR 'patient education' OR 'educational interventions' OR 'empowerment' OR 'engagement' AND 'Surgical Site Infection' OR 'SSI' OR 'surgical wound infections'.

Study selection

All studies from all databases were included in Covidence®, a web-based application for systematic reviews [23]. After the inclusion of all studies, duplicates were automatically removed and an eligibility assessment of the title and abstract was conducted by a reviewer followed by the full-text assessment of the remaining studies. A second reviewer would give a consensus on the first reviewer's judgment.

Data collection process

A data extraction template was created on Covidence®, and data were extracted directly by the first reviewer. The template was pilot-tested with the first three studies, and minor modifications were made to include all important data items. The second reviewer checked the extracted data, and consensus was achieved. Modifications to the initial template were the addition of the question of whether the intervention was part of a prevention bundle and the addition of the American Society of Anesthesiologists (ASA) score on population characteristics, as those were considered important variables.

Data items

Data extracted from each trial included the following: (1) Study characteristics, including study design,

funding sources and setting. (2) Population characteristics for both intervention and comparison groups, including eligibility criteria and type of surgery – tabulated according to Centers for Disease control and Prevention (CDC) categories, recruitment methods, as well as mean age and ASA score. (3) Intervention characteristics, based on the TIDieR checklist [24], which included data concerning what, who provided, how, where and when the intervention was administered. Moreover, it was stated whether the intervention was part of a prevention bundle or not. (4) Features of the comparator included whether it was a delay group, treatment as usual, baseline or other. (5) Outcomes description included the scales or tools used for the definition of SSIs and the timing of measurements. Secondary outcomes were also included with the same variables.

Study risk of bias assessment

The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for quasi-experimental studies [25] was used for assessing bias. The aforementioned tool examines internal validity in means of the temporal relationship of variables, selection bias, the presence of other exposures or treatments occurring in the same time with the intervention of interest, the inclusion of a control group, the implementation of multiple outcome measurements pre and post the intervention/exposure, the loss to follow-up between the comparison groups, the differences in outcome measurements, inter-raters reliability, and whether appropriate statistical analysis was used [25]. The results of the assessment were used for the results synthesis. The assessment was completed by two reviewers who worked independently. Any disagreements were solved by consensus, whilst a third reviewer served as a moderator.

Synthesis methods

A meta-analysis was planned for quantitative results. Due to the variation of interventions and population included in the selected studies, a meta-analysis was not feasible; therefore, a narrative review of the included studies has been selected for presenting the findings.

Results

Study selection

A total of ten studies were included in the review. The search from Web of Science, Scopus, PubMed and registries including ClinicalTrials.gov and Prospero yielded a total of 1378 citations, of which 221 were removed as duplicates. A total of 1157 studies were screened for title and abstract, excluding 1125. Of the remained 32 studies, we excluded 22 studies after the article review, as did not meet the inclusion criteria. The PRISMA flow diagram presents a summary of the study inclusion process (Figure 1).

Study characteristics

All ten studies included in the review were non-randomized experimental studies, published in English. Seven studies [26–32] were identified as quality improvement studies that were implemented in order to assess the effectiveness of interventions on SSIs.

The review included a total of 9236 participants, all of whom were clinic patients, whereas historic controls were used as baseline population for nine studies [26–34]. One study used treatment as usual to assess the effect of the intervention [35]. All but two studies [26,33] included educational interventions as part of prevention bundles.

Primary outcomes for seven studies [26–31,34] included SSIs as defined by the CDC criteria [36], whereas the same variable was included as a secondary outcome for two studies [33,35]. LOS was explored as the primary outcome for two studies [32,35]. Secondary outcomes included SSIs [33,35], cost-effectiveness of the intervention [27], compliance to bundle [31] as well as admission to ICU and noninfectious complications [30,32]. No studies emerged that included the effect of patient empowerment on SSIs. Table 1 describes the studies' main characteristics.

Risk of bias in studies

The JBI Critical Appraisal for Quasi-Experimental Studies tool was used to assess the quality for each of the included studies [25]. No study achieved to score in all items. Five studies [27,28,30,31,33] scored 6/8, which was the highest score. Reasons for reduced scores included the lack of a control group in all studies except one [35] and participants receiving similar treatment/care, other than the exposure or intervention of interest in eight studies [27–32,34,35]. The later was due to the educational intervention being part of prevention bundles. In one study [26], the outcome was not measured in a reliable way, as it was based on patient self-assessment. Moreover, in two studies, the method of the outcome measurement was not clear [29,35]. One study was assessed with remarkably low scores [29] as it only achieved scores for items 1, 2 and 7. Table 2 presents a summary of these assessments.

Results of individual studies

SSIs were reported to be lower in the intervention group in nine out of the ten studies included ($p \leq$

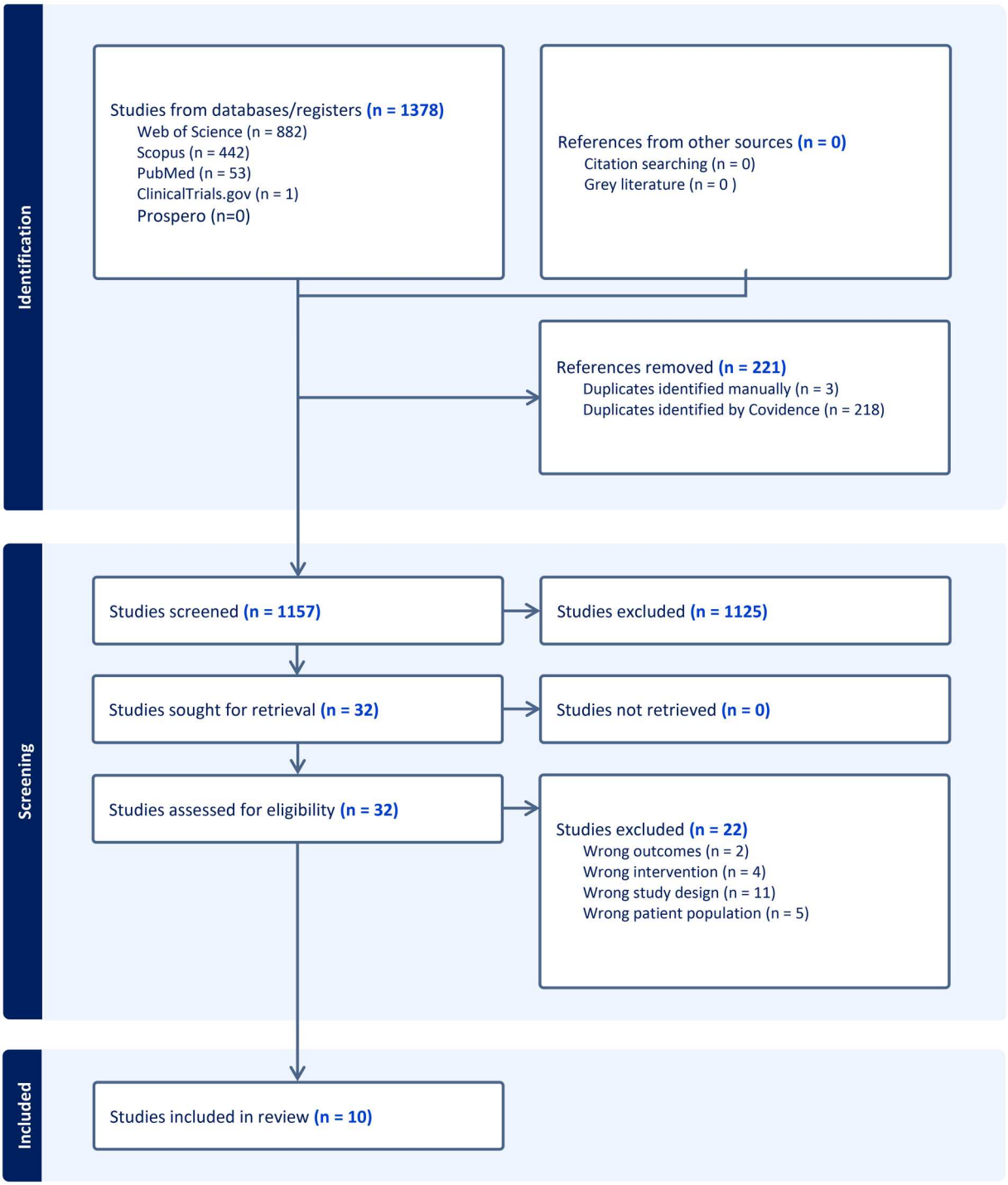

Figure 1. PRISMA flow diagram of included studies.

0,02). The remaining study also found lower rates of SSIs in the intervention group, although without statistical significance [35]. Only five studies reported the effect of the intervention in terms of odds ratio [27,28,30–32]. Summary statistics of the included studies are presented in Table 3.

Results of synthesis

Due to the heterogeneity of interventions and participants, a narrative descriptive summary of the findings is reported.

Of the ten studies included, six originated from the United States [26–30,35], one from India [31], one from Australia [32], one from the Philippines [34] and one from Canada [33]. All included studies enrolled clinical patients for participation.

The CDC criteria for SSI definition were used from 8 studies [26–31,33,35], whereas one study used the WHO definitions [34].

Half of the studies, involved gynecology associated surgeries, including cesarian section and operations for the treatment of gynecological malignancies [28–31,33]. Abdominal surgeries followed [26,27,32,34,35],

Table 1. Included studies characteristics.

Author (Year)	Country	Study design	Type of surgery	Total number of participants (I/C)	Intervention	Part of prevention Bundle	Comparator	Primary Outcomes	Secondary outcomes
[31]	India	QI	OVRY, HYST, XLAP	840 (217/624)	Patient education, dismissal with 4% chlorhexidine gluconate, and follow-up phone call from the institute	Yes	BL	SSI rates	Compliance to bundles, readmission due to SSIs
[26]	USA	QI	COLO, PLAST, GEN	115 (53/62)	Patient education on surgical site care and/or drain with use of written evidence-based material, standardized surgical site discharge kit including a mirror to assess the incision, canisters to empty drains, gauze/paper tape and 0.9% sodium chloride for wound cleansing if indicated	No	BL	SSI rates	Compliance to instructions
[28]	United States	QI	XLAP, OVRY	825 (190/635)	Patient education pamphlet, hand hygiene, dressing removal, 4% chlorhexidine gluconate showering after dressing removal, dismissal with 4% chlorhexidine gluconate, postoperative patient education on wound care and infection symptoms, and follow-up phone call.	Yes	BL	SSIs	N/A
[29]	United States	QI	CSEC	not mentioned – only post-intervention (1956)	1. Standardized one-page guide to help prepare patients for the day of surgery. 2. Shower with 4% chlorhexidine gluconate (CHG) antiseptic before admission for cesarean delivery and avoidance of lotions or other emollients after showering 3. Preoperative phone for instructions, and confirmation of arrival information, (NPO status and showering with the 4% CHG) 4. Before surgery: educational handouts, educational tool kit designed to help prepare patients for cesarean delivery, (web-based video program with information about the surgical process for cesarean delivery, what to expect after cesarean delivery, strategies for preventing SSIs, and answers to frequently asked questions about cesarean delivery.) 5. Before discharge: correct methods for cleansing their incision sites	Yes	BL	SSIs	-
[35]	United States	NRES	BILI, COLO, GAST, NECK	146 (76/70)	Bag with support items, instructions, and compliance log.	Yes	TAU	LOS, pulmonary complications, and readmission	SSIs
[33]	Canada	NRES	CSEC	209 (136/73)	Education regarding the removal of hair prior to cesarian section.	No	BL	Rate of hair removal	SSIs
[27]	United States	QI	XLAP, SB	787 (555/232)	Patient education handouts regarding signs and symptoms of SSIs, and a follow-up phone call to the patient 48–72 h after surgery with further SSI education and assessment.	Yes	BL	SSIs (overall rate)	Cost effectiveness of the bundled intervention

(*Continued*)

Table 1. Continued.

Author (Year)	Country	Study design	Type of surgery	Total number of participants (I/C)	Intervention	Part of prevention Bundle	Comparator	Primary Outcomes	Secondary outcomes
[30]	United States	QI	CSEC	3637 (667) (baseline) 796 (switch for iodine to CHG), 1098 (bundle initiation) 1076 (Bundle Maintenance)	Enhanced oral and written patient education on postoperative wound care (hand and body hygiene, avoidance of baths and occlusive dressings, signs and symptoms of wound complications and reiteration of the importance of completion of a course of nasal mupirocin for patients known to carry MRSA)	Yes	BL	SSIs defined as endometritis, sepsis, septic pelvic thrombophlebitis and/or wound infection	not infectious wound complications - breakdown, dehiscence, disruption, separation with drainage, seroma and hematoma
[32]	Australia	QI	THOR, XLAP, BILI, COLO, GAST, REC	370 (185/185)	Education topics: weight management, nutrition, post-op pain management, medication review, and smoking cessation	No	BL	LOS	Incidence of postoperative pneumonia, unplanned ICU intubation, prolonged mechanical ventilation (>48 h), hospital readmission and mortality.
[34]	Philippines	QI	XLAP	351 (187/164)	Patient education on wound care	Yes	BL	SSIs	N/A

QI: Quality improvement study, NRES: non-randomized experimental study; BILI: Bile duct, liver or pancreatic surgery; COLO: colon surgery; CSEC: cesarean section; GAST: gastric surgery; GEN: general surgery; HYST: abdominal hysterectomy; NECK: neck surgery; OVRY: ovarian surgery; PLAST: plastic surgery; REC: rectal surgery; SB: small bowel surgery; THOR: thoracic surgery; XLAP: Exploratory laparotomy I: intervention group; C: comparison group; BL: Baseline; TAU: treatment as usual; SSIs: surgical site infections; LOS: length of stay

combined with patients undergoing thoracic [32] or head & neck surgery [35]. The study by Cox et al also included patients undergoing plastic and general surgery [26].

The vast majority of studies provided the educational intervention as part of a prevention bundle for SSIs [27–32,34,35]. Education was delivered in a visual form and face to face. Visual education included educational pamphlets and handouts [27,28], a handbook with educational resources [32], an infographic with information regarding best practices for caring for a surgical wound with photos of SSIs warning signs [34], web-based videos [29], written instructions [26,30,35] and prompt messages on posters and in the hospital journal [33].

A follow-up phone call was introduced in four studies to enhance education and ensure compliance with the instructions given [27–29,31]. Studies that focused mainly on postoperative education stressed the importance of maintaining the surgical wound clean and recognizing early signs of infection [26–28,30,31,34]. The significance of preserving the best possible physical health prior to surgery [32,35] and adhering to preoperative instructions [29,33] was underlined in preoperative education. Six studies included a prevention kit that patients could take home in addition to the education provided [26,28,29,31,34,35].

All of the included studies reported a decrease in SSI rates; however, it was unclear whether this was the effect of the educational intervention alone or the combination of bundled interventions. The Ng et al. study [33] demonstrated a decrease in SSI incidence from 7.60 to 3.70 using only an educational intervention ($p < 0{,}001$). Cox et al. also illustrated a substantial decrease on SSIs for all three types of surgery described, without the educational intervention being part of a prevention bundle. Specifically, SSIs rates for colon, plastic and general surgeries declined from 3.4, 1.2 and 0.86 to 2.7, 0.5 and 0.33, respectively [26].

Discussion

This systematic review aimed to investigate the effectiveness of adult patients' education and empowerment on SSI rates. To the best of the reviewers' knowledge, this is the first systematic review to address this topic. All ten studies included in the review illustrated decreased SSI rates following the interventions, the majority of which were part of prevention bundles.

The studies focused on the frequency of infections following abdominal or gynecological surgeries, emphasizing the need for intervention, since these procedures present higher SSI rates [8,37].

In order to empower patients and promote their active participation in their care, education is essential. However, very few studies choose patient engagement through education as an infection control strategy,

Table 2. Results of JBI critical appraisal for quasi-experimental studies.

Author (year)	1.	2.	3.	4.	5.	6.	7.	8.	9.	Total score
[31]	YES	YES	YES	NO	YES	N/A	YES	YES	YES	6/8
[26]	YES	YES	NO	NO	NO	N/A	YES	NO	NO	4/8
[32]	YES	YES	YES	NO	NO	N/A	YES	YES	YES	5/8
[34]	YES	YES	YES	NO	YES	N/A	YES	YES	NO	5/8
[28]	YES	YES	YES	NO	YES	N/A	YES	YES	YES	6/8
[29]	YES	YES	YES	NO	UNCLEAR	N/A	YES	UNCLEAR	NO	3/8
[35]	YES	YES	YES	YES	YES	YES	YES	UNCLEAR	YES	7/9
[33]	YES	YES	NO	NO	NO	N/A	YES	YES	YES	6/8
[30]	YES	YES	YES	NO	YES	N/A	YES	YES	YES	6/8
[27]	YES	YES	YES	NO	YES	N/A	YES	YES	YES	6/8

Items:
1. Is it clear in the study what is the 'cause' and what is the 'effect'?
2. Were the participants included in any comparisons similar?
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?
4. Was there a control group?
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?
6. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?
7. Were the outcomes of participants included in any comparisons measured in the same way?
8. Were outcomes measured in a reliable way?
9. Was appropriate statistical analysis used?

despite its well-established role in this process. In a 2019 systematic review by Ariyo et al., aiming to summarize the implementation strategies for adherence to SSI prevention interventions, only 15 out of 125 studies focused on patient education and their role on SSI control [38].

Patient education can be carried out in the form of lectures, discussions, simulated games, computer technology utilization, written materials, audiotapes or videotapes. Moreover, education can be delivered verbally or through demonstration and role playing. Demonstration has been found to be the most effective method of patient education. Audiotapes, videotapes, written materials and lectures are more effective teaching strategies compared to verbal teaching and discussions. Furthermore, enhancing written materials with illustrations and writing in an easily comprehensible and straightforward manner can improve patient's educational outcomes [39].

Patient education in the selected studies was provided using visual aids and infographics, methods that have been found to be beneficial, based on patient's feedback in other studies [40]. Patient's preference on written over verbal instructions has been previously demonstrated and should be considered to encourage active patient participation [17]. In an effort to improve education, follow-up phone calls were included; however, prior research indicated that this practice was ineffective when patients received sufficient instructions while hospitalized [41]. Phone calls were also employed in a study to monitor and self-assess the surgical wound by the patients [26]. Even though self-assessment of SSIs can lead to timely intervention and the prevention of accompanying complications, it has been shown that it can result in misdiagnosis, thus necessitating confirmation from a healthcare professional [42].

A discharge kit was provided to patients in six studies [26,28,29,31,34,35] to facilitate evidence-based postoperative care. According to the model of Surgical Patient Engagement, proposed by Yun et al., patients need at least one of four drivers for their engagement, namely self-efficacy, transitional agency, resilience and enabling agency [43]. The provision of these medical supplies to postoperative patients enhances their agency, by enabling them to plan ahead and complete their self-care action, whilst education enhances their self-efficacy.

The majority of the studies implemented patient education as part of a prevention bundle [27–32,34,35]. Bundles are defined as the use of evidence-based interventions that can decrease the incidence of healthcare-associated infections when used collectively [44]. SSIs prevention bundles may include preoperative, intraoperative and postoperative measures, according to the recommendations from WHO [4] and the CDC [9]. The implementation of bundles has been recognized as an effective method for reducing SSIs [45,46]. However, despite their effectiveness, there have been reports of low adherence [6]. Reasons for noncompliance to SSIs care bundles include the complexity of the interventions, the lack of capacity of change, the lack of organizational support and the low acceptance from HCPs [47]. The included studies demonstrated a decrease in SSI rates when bundles and patient education were combined.

Through education, the patient is empowered to be actively involved in their care while promoting patient-centered care. Patient engagement necessitates HCPs to actively participate in patient education and information sharing. Health literacy and the development of skills such as the ability of patients to ask questions regarding their own health and understand the information provided are essential parts of shared decision-making and patient engagement leading to optimal patient care [48]. Organizations and management play a crucial role in fostering a culture that

Table 3. Summary statistics of included studies.

Study ID	Intervention	Comparison	*p*-value	OR	Lower 95% CI	Higher 95% CI
[31]	3,7	16,8	<0,001	0,19	0,09	0,39
[26]	2,7/0,5/0,33	3,4/1,2/0,86	NA	NA	NA	NA
[32]	2,16	7,56	0,02	0,27	0,06	0,88
[34]	9,7	28,8	NA	NA	NA	NA
[28]	1,10	6,00	0,01	0,17	0,04	0,7
[29]	0,60	4,1	NA	NA	NA	NA
[35]	14,00	22,00	Non-significant	NA	NA	NA
[33]	3,70	7,60	<0,001	NA	NA	NA
[30]	4,5	8,4	<0,01	0,51	0,34	0,76
[27]	7,40	12,50	0,01	0,56	0,37	0,85

supports patient involvement in both care and participatory decision-making, with a commitment to addressing health literacy [49].

Limitations

The present review had certain limitations that should be acknowledged. Firstly, the studies included were of low quality due to their design. The effect of education on SSI reduction was unclear due to the inclusion of bundled interventions. Nevertheless, the added value of patient education was apparent.

Secondly, the screening and data extraction was performed by a single reviewer followed by a second reviewer who gave consensus on the included studies. The lack of an independent review of the studies could lead to a risk of bias. Despite this, we believe that the results of the study were not influenced.

Implications for practice and further research

Despite the limitations presented, the findings suggest that patient education and engagement can contribute to the reduction of SSI rates. The majority of the included studies were quality improvement studies, investigating the results of the intervention on SSIs. Our study's findings highlighted the added value of patient education in conjunction with the application of prevention measures. Patient empowerment through education encourages active patient participation in their care, increases patient satisfaction and, ultimately, improves the quality of provided care. There is a need for more high-quality studies focusing on patient engagement to further elucidate its role in SSI prevention. Additionally, the importance of organizational and hospital management toward the implementation of policies to promote patient-centered care is evident.

Conclusion

Patient education constitutes an important asset in the battle to reduce surgical site infections as it can lead to desirable outcomes, especially when combined with evidence-based guidelines. There is a clear need for more high-quality studies to investigate the impact of patient education on patient empowerment and engagement to ultimately improve surgical site infection rates. This in turn will lead to the development of effective policies for the prevention of SSIs.

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