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Review Article

Efficacy of the pre-surgical chlorhexidine bath: integrative review

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Abstract

Background: surgical site infection appears in the surgical site or in the periphery, during the first 30 days after surgery. The prevention of this infection requires an adequate preoperative preparation.
Objetive: evaluate the efficacy of the pre-surgical bath with chlorhexidine in the pre-surgical preparation of the skin when compared with the pre-surgical bath with placebo.
Methods: this review was based on the question "What is the effectiveness of the pre-surgical bath with chlorhexidine versus pre-surgical bath with placebo in the pre-surgical preparation of the skin for the prevention of surgical site infection?". Inclusion and exclusion criteria, descriptors, boolean operators were defined and the search was performed in MEDLINE and CINAHL databases. Nine articles were included in the review.
Results: the pre-surgical bath with chlorhexidine for pre-surgical skin preparation alone is not significantly more effective when compared to the pre-surgical bath with placebo. Its effectiveness can be influenced by multiple factors that should be considered in the development of the surgical site infection.
Conclusion: the pre-surgical bath with chlorhexidine should not be an isolated intervention in the prevention of surgical site infection but should be combined with other interventions as recommended in the current guidelines.

Keywords: baths; chlorhexidine; surgical wound infection; perioperative care

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Introdution

A surgical site infection (SSI) is a healthcare-associated infection (HAI) that occurs in the surgical wound or periwound area during the first 30 days after surgery or 90 days after surgery if a prosthesis has been placed (Borchardt & Tzizik, 2018). This type of infection is one of the most common in surgical settings and is

responsible for up to 77% of deaths in patients who contract the infection (Anderson et al., 2014, as cited in Oliveira & Gama, 2018).

As indicated by the European Center for Disease Prevention and Control, SSIs represent a significant challenge to the quality of care provided to patients, particularly in Portugal. SSIs are among the most common HAIs) and are associated with prolonged hospital stays, additional surgical procedures, and increased morbidity, mortality, and health costs (Direção Geral de Saúde [DGS], 2022).

The risk of developing an infection is dependent on several intrinsic and extrinsic factors inherent to the patient undergoing surgery, including pre-existing infection, advanced age, obesity, diabetes, the duration of surgery, and asepsis (Kolasiński, 2018).

It is therefore imperative to prioritize the prevention of SSIs, given their status as a significant public health concern and a primary obstacle to the quality of care provided to patients because lower infection rates can help achieve health gains (Calouste Gulbenkian Foundation, 2015, as cited in Martins & Fernandes, 2019).

In accordance with Standard No. 020/2015 of the DGS, updated on November 17, 2022, the following interventions are to be implemented in an integrated manner to prevent SSIs: bathing with 2% to 4% chlorhexidine (CHX) on the day before surgery and the day of surgery (at least two hours in advance); performing surgical antibiotic prophylaxis, if indicated; screening for methicillin-resistant Staphylococcus aureus; avoiding trichotomy; maintaining normothermia during the perioperative period (body temperature values equal to or greater than 36 degrees Celsius); and maintaining normoglycemia during the surgical procedure and for the following 24 hours (capillary glycemia values at or below 180 milligrams per deciliter); maintaining peripheral oxygen saturation at or above 95%, along with adequate perfusion, both during the surgical process and in the postoperative phase; and adhering to aseptic dressing techniques (DGS, 2022).

It is therefore essential to implement a combination of basic measures to prevent SSIs, which include ensuring adequate preoperative preparation, using aseptic surgical techniques, administering antibiotic prophylaxis, and providing appropriate care throughout the perioperative period (Antimicrobial Resistance and Healthcare Associated Infection Scotland, 2018).

CHX is an antiseptic that effectively disrupts the membrane of bacterial cells. At low concentrations, CHX has a bacteriostatic effect, causing a change in the osmotic balance of the bacterial cell. At higher concentrations, it is bactericidal, precipitating the cytoplasmic contents of the cell. Its broad-spectrum activity includes gram-positive and gram-negative microorganisms, non-spore-forming bacteria, fungi, and viruses, including the human immunodeficiency virus (Edminston et al., 2013, as cited in Oliveira & Gama, 2018).

Preoperative bathing is a procedure performed before surgery to adequately prepare the patient. It is usually carried out with antiseptics to reduce bacterial colonization of the skin, which may be an effective method of preventing SSIs (Câmara et al., 2022).

In light of these considerations, a review question was formulated as follows: “What is the effectiveness of preoperative bathing with CHX compared to placebo in preoperative skin preparation for the prevention of SSIs?”.

The following objectives were defined: to synthesize the existing literature on the efficacy of preoperative bathing with CHX compared to placebo in preoperative skin preparation; to identify the optimal timing for preoperative bathing; to determine the concentration of CHX that is most effective in preventing SSIs; and to delineate the various methods of applying CHX in preoperative bathing.

It is important to clarify the concepts of preoperative bathing with CHX and placebo. A preoperative bath with CHX refers to any bath carried out in the period preceding surgery with an antiseptic solution

containing CHX to prevent SSIs. In contrast, a preoperative bath with a placebo refers to any bath carried out pre-surgery without any antiseptic solution.

Methodology review procedures

The principal objective of this integrative literature review (ILR) is to assess the effectiveness of preoperative bathing with CHX in comparison to placebo for preoperative skin preparation in patients undergoing surgical procedures for SII prevention, employing the Population - Intervention - Comparison - Outcomes - Study [PICO(S)] method.

The study population consisted of surgical patients who underwent a preoperative bath with CHX or a placebo as part of a strategy for preventing SSIs. The review included both quantitative primary research studies and secondary research studies.

In order to answer the aforementioned question and achieve the stated objectives, the following inclusion criteria were defined: articles comparing preoperative bathing with CHX with preoperative bathing with placebo; articles in which preoperative bathing with CHX is used in preoperative skin preparation; articles in which the target population is humans undergoing any type of surgery; articles written in Portuguese, English, and Spanish; articles with full text available; and both quantitative primary research articles and secondary research articles. Articles evaluating the effectiveness of a bundle of interventions were excluded based on their lack of relevance to the research question. No time limit was set for the selection of articles.

Once the research question, objectives, and inclusion and exclusion criteria had been formulated, the search process was initiated, including the selection of scientific databases. Keywords were selected based on the formulated review question: "Surgery," "Chlorhexidine," "Placebo," "Surgical Site Infection." No limit was set.

A preliminary search was initially conducted in the Health Sciences Descriptors (DeCS) database to define the empirical descriptors to be utilized. Two databases were then selected: MEDLINE and CINAHL. MEDLINE was accessed through the PubMed search platform, while CINAHL was accessed through the EBSCO search platform. The specific descriptors utilized in each database were the Medical Subject Headings (MESH) in MEDLINE and the Medical Headings (MH) in CINAHL. The empirical descriptors were identical in both databases. In addition to the aforementioned descriptors, the Boolean operators "AND" and "OR" were employed. To further refine the searches, additional limiters were employed, specifically "title/abstract" in MEDLINE and "Abstract" in CINAHL. Subsequently, the search expressions were defined for each database, as outlined in Table 1.

Table 1 Search strategies (MEDLINE and CINAHL)

MEDLINE Database
((((((((("surgery"[Title/Abstract]) OR ("surgical procedures"[Title/Abstract])) OR ("general surgery"[Title/Abstract]))) OR ((("General surgery"[MeSH Terms])) OR ("surgical procedures, operative"[MeSH Terms])))) AND ((((((((((((((("Preoperative Care"[Title/Abstract]) OR ("Surgical skin preparation"[Title/Abstract])) OR ("Preoperative skin preparation"[Title/Abstract])) OR ("Perioperative"[Title/Abstract])) OR ("Chlorhexidine skin preparation"[Title/Abstract])) OR ("Perioperative Nursing"[Title/Abstract])) OR ("Chlorhexidine gluconate bathing"[Title/Abstract])) OR ("Chlorhexidine

bath"[Title/Abstract])) OR ("Preoperative wash"[Title/Abstract])) OR ("Preoperative bathing"[Title/Abstract])) OR ("Preoperative shower"[Title/Abstract])) OR ("Preoperative Period"[MeSH Terms])) OR ("Perioperative Care"[MeSH Terms])) OR ("Perioperative Nursing"[MeSH Terms]))) OR ("baths"[MeSH Terms])) OR ("chlorhexidine"[MeSH Terms]))) AND (((((placebo[Title/Abstract]) OR ("soap"[Title/Abstract])) OR ("unmedicated soap"[Title/Abstract])) OR ("Placebo Effect"[Title/Abstract])) OR ("Placebos"[Mesh] OR "Placebo Effect"[Mesh]))) AND ((((("Surgical wound infection"[Title/Abstract]) OR ("Surgical wound infection prevention"[Title/Abstract])) OR ("Surgical wound infection incidence"[Title/Abstract])) OR ("Surgical site infection incidence"[Title/Abstract])) OR ("Surgical site infection prevention"[Title/Abstract])) OR ("Surgical wound infection"[MeSH Terms]))

CINAHL Database

(AB “surgical procedures” OR AB “surgery” OR AB “general surgery”))) OR MH "surgery, operative") AND ((AB "Preoperative Care" OR AB “Surgical skin preparation” OR AB “Preoperative skin preparation” OR AB “Perioperative” OR AB “Chlorhexidine skin preparation” OR AB "Perioperative Nursing” OR AB "Bath" OR AB "chlorhexidine gluconate bathing" OR AB "chlorhexidine bath" OR AB "preoperative wash" OR AB "preoperative bathing" OR AB "preoperative shower") OR (MH "Perioperative Nursing" OR MH "Practical Nurses" OR MH "Preoperative Care" OR MH "Skin Preparation, Surgical" OR MH "Preoperative Period" OR MH "Skin Preparation, Surgical" OR MH "Surgical Preparation (Iowa NIC)" OR MH ("Bathing and Baths") OR MH "Chlorhexidine")) AND ((AB placebo OR AB placebo effect" OR AB soap OR AB "unmedicated soap") OR ((MH "Placebo Effect") OR (MH "Placebos"))) AND ((((AB "Surgical wound infection” OR AB “Surgical wound infection prevention” OR AB “Surgical wound infection incidence” OR AB “Surgical site infection incidence” OR AB “Surgical site infection prevention”) OR ((MH "Surgical Wound Infection") OR (MH "Surgical Wound Care"))))))

A search on PubMed found 238 articles. After filtering by language, the total number of articles was 229. The CINAHL search obtained 24 articles, which remained the same after the language filter. This gave 253 articles. The results from both databases were exported to Mendeley®, where 34 duplicates were identified and removed, leaving 219 articles. The articles were then transferred to Rayyan®, a platform where two independent reviewers validated them individually and blindly. This process ensures the inclusion process is free from any influence. The next step was to review the titles and abstracts, which led to the exclusion of 197 articles, leaving 22 for a full analysis. After the examination and meticulous evaluation of the articles' content, 13 articles were excluded because they did not meet the inclusion criteria, resulting in a total of nine articles for this ILR. The following figure shows the research flowchart.

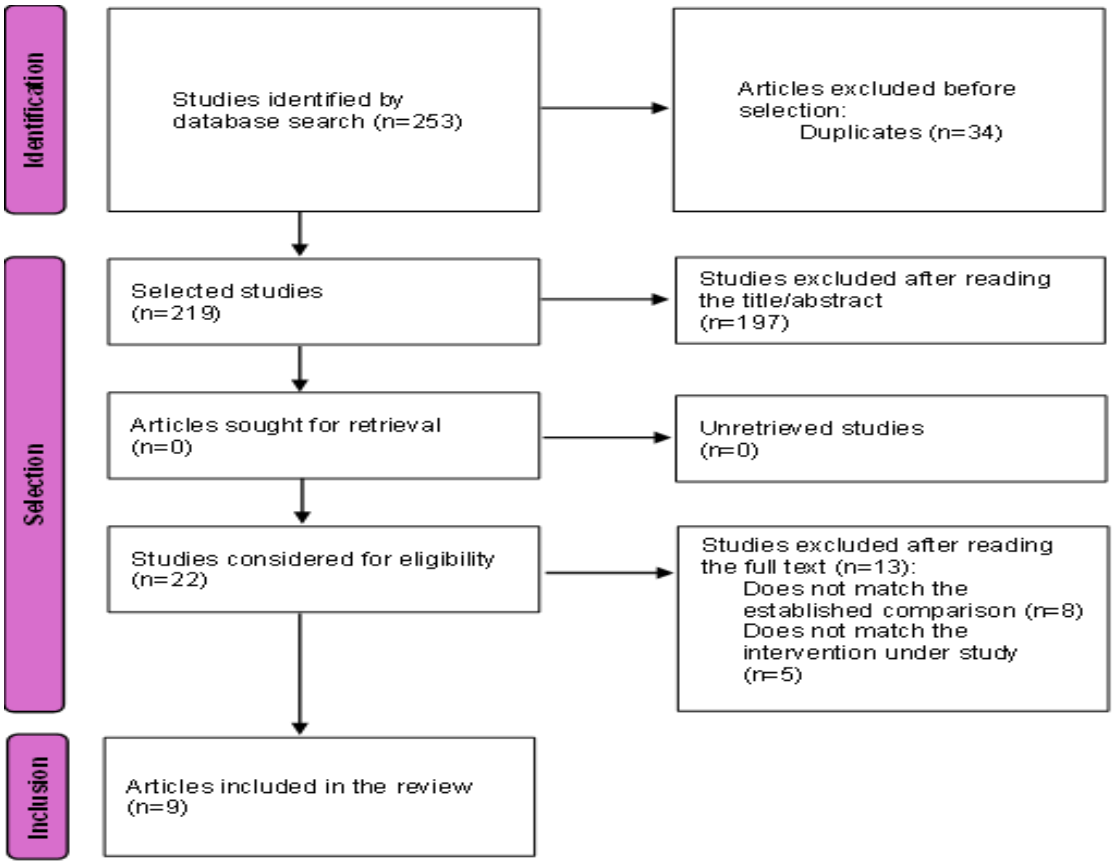

Figure 1 Flowchart of study selection

Results

In order to facilitate the systematic and organized presentation of the results, it was deemed pertinent to code the selected articles for this ILR (A1, A2, ..., A9), as illustrated in Table 2.

Table 2 Characteristics of selected articles

Coding	Title	Year of publication	Study design	Country
A1	*A comparison of pre-operative bathing with chlorhexidine-detergent and non-medicated soap in the prevention of wound infection*	1983	Randomized controlled trial	United Kingdom
A2	*Total body bathing with 'Hibiscrub' (chlorhexidine) in surgical patients: a controlled trial*	1983	Randomized controlled trial	United Kingdom
A3	*A comparison of the effects of preoperative whole-body bathing with detergent alone and with detergent containing chlorhexidine gluconate on the frequency of wound infections after clean surgery*	1988	Prospective randomized controlled study	Germany, Austria, Denmark, Italy, United Kingdom and Sweden

A4	*Preoperative whole-body disinfection--a controlled clinical study*	1988	Randomized controlled trial	United Kingdom
A5	*Meta-analysis of preoperative antiseptic bathing in the prevention of surgical site infection*	2006	Review with meta-analysis	European countries
A6	*Preoperative chlorhexidine shower or bath for prevention of surgical site infection: a meta-analysis*	2013	Review with meta-analysis	Several countries
A7	*Preoperative bathing or showering with skin antiseptics to prevent surgical site infection*	2015	Systematic literature review	Several countries
A8	*Preoperative bathing of the surgical site with chlorhexidine for infection prevention: Systematic review with meta-analysis*	2016	Review with meta-analysis	European countries
A9	*Antisepsia cutánea antes de la cirugía*	2018	Systematic literature review	Missing data

Article A1 is a randomized controlled trial involving 5536 patients undergoing surgery. The aim was to compare the efficacy between preoperative bathing with CHX and preoperative bathing with placebo in SSI prevention. In the experimental group, 92.6% of patients received one preoperative bath with CHX gel, and 7.4% received two or three preoperative baths, while in the control group, all patients received only one preoperative bath with placebo. There was a higher rate of SSIs in the experimental group than in the control group, 5.4% and 4.9%, respectively. However, the number of baths was not equal, which may have influenced the results and was a limitation of the study, so the authors did not consider this difference to be statistically significant (Ayliffe et al., 1983).

Article A2 is a randomized controlled trial designed to determine whether preoperative bathing with 4% CHX is more effective than preoperative bathing with a placebo in reducing bacterial flora and to determine the influence of preoperative bathing with 4% CHX on the development of SSIs. The sample consisted of 224 patients undergoing surgery, of whom 109 were part of the experimental group and underwent a preoperative bath with 4% CHX gel a few hours (unspecified) before surgery, and 115 were part of the control group and underwent a preoperative bath with placebo under the same conditions. The difference in SSIs recorded in both groups was only 1. There were 12 SSIs in the experimental group and 13 SSIs in the control group. The authors felt that the study sample was insufficient to meet the proposed objectives, but that the results suggested that bathing with CHX was more effective in reducing bacteria on the skin (Leigh et al., 1983).

Article A3 employs a randomized controlled study design, with a sample size of 2,458 surgical patients. Both groups underwent two preoperative baths: the experimental group received a 4% CHX sponge bath, while the control group underwent a placebo bath. The discrepancy in SSIs documented between the two groups was 0.04%, which prompted the authors to conclude that the observed difference was not statistically significant (Rotter et al., 1988).

Article A4 is a randomized controlled study that sought to ascertain whether there was a difference in the incidence of SSIs in patients who underwent a preoperative bath with CHX compared to those who underwent a preoperative bath with a placebo (either soap or solution). The study included a total of 2,015 patients undergoing surgery. The experimental group consisted of 689 patients who received two preoperative baths with CHX gel, while the control groups comprised 626 patients who received two preoperative baths with

placebo (soap) and 700 patients who received two preoperative baths with placebo (solution). The authors of this study concluded that the administration of two preoperative baths with CHX resulted in a 30% reduction in the incidence of SSIs because the experimental group exhibited a 9% SSI rate, while the control groups demonstrated rates of 12.8% and 11.7%, respectively (Hayek & Emerson, 1988).

Article A5 presents a meta-analysis of the evidence on the effectiveness of preoperative baths with antiseptics in reducing SSIs. This meta-analysis included six articles in which the intervention was to subject patients to two or three preoperative baths with 4% CHX, compared to patients who underwent two or three preoperative baths with a placebo (soap or solution). The authors did not consider the observed differences in SSI rates between the two groups to be statistically significant. In the comparison between the preoperative bath with 4% CHX and the placebo (solution), the incidence of SSIs was 9.2% and 10.1%, respectively. A comparison between preoperative bathing with 4% CHX and bathing with a placebo (soap) revealed an incidence of SSIs of 10.9% and 13.6%, respectively (Webster & Osborne, 2006).

Article A6 provides a meta-analysis of the evidence regarding the effectiveness of preoperative bathing with CHX in SSI prevention. A total of 16 articles were included in the meta-analysis, in which the interventions involved subjecting patients to one to three preoperative baths with CHX gel, in comparison to patients who underwent the same number of baths with a placebo. The authors reported a total of 149 SSIs and 188 SSIs, respectively, which they deemed not to be statistically significant (Chlebicki et al., 2013).

Article A7 is a systematic literature review comprising seven articles. Its objective was to synthesize the evidence on the effectiveness of preoperative bathing with antiseptics in SSI prevention. Patients were randomly assigned to receive either one or more preoperative baths with 4% CHX or one or more preoperative baths with a placebo (either a solution or soap). The incidence of SSIs was 9.1% in the group that underwent a preoperative bath with 4% CHX and 10% in the placebo (solution) group. The SSI rates for the preoperative bath with 4% CHX and the placebo (soap) were 10.9% and 13.6%, respectively. Consequently, the authors conclude that bathing with CHX does not result in a statistically significant reduction in the incidence of SSIs (Webster & Osborne, 2015).

Article A8 is a systematic literature review that includes eight articles. The objective was to synthesize the evidence on the impact of preoperative bathing with 4% CHX on SSI prevention in comparison to preoperative bathing with a placebo (solution or soap) in patients undergoing clean surgery. Patients were randomly assigned to receive one or three preoperative baths with 4% CHX gel, a placebo solution, or a placebo soap, and the SSI rates were compared. No statistically significant differences were observed between the preoperative bathing with 4% CHX and the placebo (solution) or between 4% CHX and the placebo (soap) (Franco et al., 2016).

Article A9 is a systematic literature review to delineate the main measures for preventing SSIs in preoperative skin preparation. A comparison was made between patients undergoing preoperative bathing with CHX and those undergoing preoperative bathing with a placebo (either solution or soap). The authors found no difference in the risk of SSIs when comparing the use of CHX with placebo, whether in the form of a solution or soap (Galleymore & Viera, 2018).

Discussion

The analysis of the selected articles indicates that preoperative bathing with CHX for preoperative skin preparation alone is not significantly more effective than preoperative bathing with placebo.

The findings of articles A1, A6, and A7 indicate that there is no compelling evidence to suggest that preoperative bathing with CHX alone has a positive influence on SSI rates. The authors of these articles highlight that CHX has a cumulative antibacterial effect on the skin, suggesting that its use in multiple baths may have resulted in a reduction in SSIs. This indicates that two or more preoperative baths may be more beneficial than a single preoperative bath. However, a potential limitation of article A1 is that the participants were only admitted the day before the surgery. Consequently, unless patients were instructed and provided with the necessary materials to perform the preoperative bath autonomously before the surgery, it was not possible to ascertain whether supervision became more challenging, which could influence the reliability of the results. The results of article A6 indicated a reduction in infections among patients who received two or more preoperative baths; however, the observed difference did not reach statistical significance. Article A7 underscores the superior methodological quality of the two largest experimental studies included in the review. These studies demonstrate that bathing with CHX does not result in a statistically significant reduction in SSI rates (Ayliffe et al., 1983; Chlebicki et al., 2013; Webster & Osborne, 2015).

In regard to the impact of CHX, the authors of article A2 posit that bathing with CHX is a more effective method for reducing bacteria on the skin, whereas the use of soap is a questionable preoperative procedure that increases bacterial counts (Leigh et al., 1983).

As evidenced by the findings of article A8, the use of CHX in bathing has been demonstrated to reduce bacterial colonization of the skin. However, few studies have been able to substantiate the efficacy of this intervention in preventing SSIs. The authors assert that the studies in the literature are methodologically inadequate and insufficient to demonstrate the benefit of the intervention (Franco et al., 2016).

None of the studies included in article A8 addresses the duration of CHX exposure on the skin during bathing. This omission may be relevant to understanding the antibacterial action of CHX on the skin and its subsequent influence on SII rates. For the intervention to be effective, it is recommended that bathing be carried out on at least two different occasions to ensure sufficient concentrations of CHX on the skin to eliminate the usual pathogens in surgical wounds. The authors (Franco et al., 2016) recommend further investigation into the induction of resistance in microorganisms by CHX.

In article A4, the authors concluded that performing two preoperative baths with CHX in preoperative skin preparation reduces the SSI rates by 30%. They also concluded that this antiseptic acts mainly on Gram-positive bacteria, a finding that was confirmed by the results, which showed that the main reduction was in Staphylococcus aureus infections (Hayek & Emerson, 1988).

These conclusions are consistent with the recommendations outlined in the DGS Intervention Toolkit for SSI Prevention, which advocates for two preoperative baths with 2%-4% CHX as an SSI prevention measure, the first bath on the night before the day of surgery and the second on the day of surgery at least two hours before the surgery, unless contraindicated (DGS, 2022).

In contrast, in article A3, participants were given two preoperative baths, with either CHX or placebo, and the authors found that the administration of two baths before surgery, with either CHX or placebo, resulted in similar infection rates (Rotter et al., 1988).

It is important to consider that the development of SSIs can be influenced by various risk factors (Galleymore & Viera, 2018). Several authors have highlighted that various factors that may contribute to the development of SSIs should be considered, including lack of supervision during bathing or low adherence to bathing instructions, age, type of surgery, length of surgery, trichotomy, number of baths, and volume of antiseptic used, and that nurses can intervene in some cases (Franco et al., 2016; Rotter et al., 1988; Galleymore & Viera, 2018).

It is therefore crucial to acknowledge that the efficacy of an antiseptic cannot be evaluated in a linear manner without considering all the extrinsic factors that may influence the SSI rate.

In addition to the lack of clear scientific evidence supporting the effectiveness of preoperative bathing with CHX in reducing SSIs, it is imperative to adhere to the current guidelines on this subject. In article A9, the authors underscore the significance of the guidelines on SSI prevention from a range of international institutions, including Cochrane, the World Health Organization (WHO), and the Centers for Disease Control and Prevention (CDC.) The WHO and the Cochrane Collaboration emphasize that there is no clear evidence demonstrating omsthe benefit of bathing with CHX over other products to prevent SSIs (Webster & Osborne, 2015; WHO, 2018). Furthermore, the CDC stipulates that a preoperative bath with either antimicrobial or non-antimicrobial soap should be performed at least one night before surgery.

Another objective of this ILR was to identify the optimal concentration of CHX for use in preoperative skin preparation to prevent SSIs. However, of the nine articles analyzed, only four mentioned the concentration of CHX used, and no article compared different concentrations. Therefore, it was not possible to answer this objective.

In conclusion, the limitations of this ILR include the fact that only two databases were used for the literature search, the fact that no gray literature was included, and the exclusion of articles that were not in Portuguese, Spanish, or English.

Conclusion

The ILR facilitated a comprehensive examination of the selected articles' findings, with a particular focus on the efficacy of preoperative bathing with CHX in preventing SSIs. The results enabled the research question and three of the initial objectives to be addressed: to evaluate the effectiveness of preoperative bathing with CHX compared to placebo in preoperative skin preparation; to identify the optimal times for preoperative bathing; and to identify the different methods of applying CHX in preoperative bathing. However, the objective of identifying the concentration of CHX used in preoperative skin preparation that is most effective in preventing SSIs was not met, as the articles selected lacked sufficient data to provide an answer.

SSI prevention is of significant importance in healthcare settings, as it can help reduce hospitalization times and healthcare costs, improve the quality of life for the general population, and, ultimately, achieve overall health gains. Prevention hinges on the implementation of a multifaceted approach, in accordance with the guidelines outlined in DGS Standard No. 020/2015, as updated on November 17, 2022, which includes the administration of preoperative bathing with 2%-4% CHX (DGS, 2022).

The analysis of the articles and existing literature on this topic suggests that bathing with CHX in preoperative skin preparation is not significantly more effective than preoperative bathing with a placebo. However, this intervention should continue to be implemented as recommended in the bundle of interventions for SSI prevention, which is interconnected with a set of interventions and not implemented in isolation.

Furthermore, it is important to consider the potential influence of various factors on the effectiveness of CHX bathing and, consequently, the development of SSIs, including patient age, type of surgery, duration of surgery, whether a trichotomy was performed, number of baths, and volume of antiseptic used.

Consequently, this nursing intervention should be implemented in conjunction with the other measures recommended by the current guidelines, as they not only reduce infection rates but also prevent them, thereby achieving health gains, namely shorter hospital stays and lower costs for the health system.

In short, it should be borne in mind that the development of SSIs can be influenced by multiple factors that must be taken into account and also that the effectiveness of preventing it does not depend on carrying out an intervention in isolation, but rather on carrying out a set of interventions in an interconnected way.

With this ILR, it was possible to verify that, although preoperative bathing with CHX is recommended, there is no clear evidence of its effectiveness when compared to preoperative bathing with a placebo, generating some controversy among the authors. Bearing in mind that most of the articles analyzed did not take into account factors that can influence the efficacy of bathing, it is proposed that future research should evaluate the efficacy of bathing with CHX compared to bathing with placebo in the prevention of SSIs where, in a controlled manner, the risk factors mentioned above are taken into account, in line with the reality of healthcare, where they are present. In this way, it would be possible to carefully infer whether or not the efficacy of preoperative bathing with CHX when compared to preoperative bathing with a placebo is statistically significant in the development of SSIs.

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