Annals of Clinical and Analytical Medicine

Prevention of Surgical Site Infections in Saudi Hospitals Based on the International Guidelines

Hadi Hamad Ali Almansour (1) *, Ibrahim Hussain M Al Zubayd (2), Abdullah Mubarak Hassan Al Faraj (3), Mohammed Jaber Ali Alnasaib (4), Mane Mahdi Alswar (5), Thabet Salem Alhazober (6), Suliman Saleh Hamad Alyami (7), Ibrahem Mohammad Saleh Al Hashel (8)

(1) Health Assistant, Urgent Care, Najran, Saudi Arabia.
(2) Nursing Specialist, Urgent Care, Najran, Saudi Arabia.
(3) Radiology Technician, Najran General Hospital, Saudi Arabia.
(4) Dental Assistant, Abasaud Healthcare Center, Najran, Saudi Arabia.
(5) X-ray Technician, Primary Health Centers, Najran, Saudi Arabia.
(6) Dental Technician, Hospital Najran Albalad, Najran, Saudi Arabia.
(7) Specialist in Health Services and Hospitals Management, Najran General Hospital, Saudi Arabia.
(8) Radiology Technician, Dahdah Primary Healthcare Center, Najran, Saudi Arabia.

Received 25/9/2023; revised 8/10/2023; accepted 16/12/2023

*Corresponding author

Abstract

Introduction: Surgical Site Infections (SSIs) remain a significant concern in healthcare, posing serious risks to patient safety and increasing healthcare costs. . In Saudi Arabia, the incidence of SSIs has been reported to be around 2-5%, varying by surgical procedure and hospital settings. This review aimed to evaluate the effectiveness of various interventions for the prevention of SSIs in the Saudi healthcare context.

Methods: In the initial phase of our systematic review, we conducted a thorough search of electronic databases, including PubMed, Embase, Scopus, and the Cochrane Library, up to September 2023, using carefully selected search terms to identify relevant literature on interventions for preventing Surgical Site Infections (SSIs) in Saudi hospitals. Inclusion criteria encompassed studies that investigated SSI prevention interventions aligned with international guidelines, while exclusion criteria eliminated studies unrelated to SSI prevention in Saudi hospitals, theoretical studies without empirical data, editorials, commentaries, and reviews, ensuring a rigorous and focused study selection process.

Results: The systematic review included six diverse studies focused on interventions for preventing Surgical Site Infections (SSIs) in Saudi hospitals, highlighting variations in sample size, intervention types, and effectiveness. Sample sizes ranged from 150 to 1,930 patients, reflecting the diverse healthcare settings in which SSI prevention strategies were implemented. Interventions, such as surgical hand antisepsis protocols, antimicrobial prophylaxis optimization, and controlled operating room ventilation, demonstrated varying degrees of effectiveness, with risk differences ranging from 4% to 16% and percentage reductions ranging from 5% to 20% across the studies. These variations underscored the context-specific nature of SSI prevention.

Conclusions: This systematic review examines interventions for preventing Surgical Site Infections (SSIs) in Saudi hospitals, revealing varying effectiveness among interventions and emphasizing the need for context-specific approaches guided by international guidelines. The findings offer valuable insights for healthcare practitioners and policymakers in Saudi Arabia, providing a foundation for evidence-based strategies to enhance patient safety and reduce SSIs.

Keywords: Surgical Site Infections, Interventions, Saudi Hospitals, International Guidelines, Patient Safety.

Introduction

Surgical Site Infections (SSIs) remain a significant concern in healthcare, posing serious risks to patient safety and increasing healthcare costs [1]. Globally, SSIs are among the most common healthcare-associated infections (HAIs), accounting for approximately 20% of all HAIs in hospitals. In Saudi Arabia, the incidence of SSIs has been reported to be around 2-5%, varying by surgical procedure and hospital settings [2]. This rate aligns with global trends but highlights the need for continual improvement in infection control practices. The impact of SSIs on patient outcomes and healthcare systems is profound. Patients with SSIs experience a length of hospital stay that is, on average, twice as long as patients without infections, and the mortality rate associated with SSIs is reported to be approximately 3% [3]. In the Saudi healthcare context, the economic burden is significant, with additional costs of SSI's. These statistics underscore the urgency of addressing SSIs effectively [2, 4].

Prevention strategies for SSIs are critical for enhancing patient safety and reducing hospital costs. International guidelines, such as those from the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), provide evidence-based recommendations for SSI prevention [5]. These include measures like proper surgical hand antisepsis, appropriate use of antimicrobial prophylaxis, and controlled operating room ventilation. In Saudi hospitals, adherence to these guidelines varies, and there is a lack of comprehensive data on the effectiveness of different preventive interventions. In Saudi Arabia, the challenges in preventing SSIs are compounded by factors such as varying compliance with international standards, differences in hospital resources, and patient-related factors like comorbidities [6]. A study indicated that is compliance with recommended SSI prevention measures in Saudi hospitals was around 70%, suggesting room for improvement. Moreover, the rate of antibiotic resistance in HAIs in Saudi Arabia, which stands at about 30%, further complicates SSI management and prevention, necessitating tailored strategies [7, 8]. Given the clinical and economic impact of SSIs and the need for effective prevention strategies in Saudi hospitals, this systematic review aimed to synthesize current research and practices. It aimed to evaluate the effectiveness of various interventions for the prevention of SSIs in the Saudi healthcare context, specifically focusing on the adherence to and implementation of international guidelines. By identifying successful practices and areas needing improvement, the review aimed to provide actionable insights for healthcare policymakers, administrators, and practitioners to enhance patient safety and care quality in Saudi hospitals.

Methods

In the first phase of our systematic review, we conducted a comprehensive search of electronic databases to identify relevant literature. The databases included PubMed, Embase, Scopus, and the Cochrane Library. We focused on studies published up until September 2023, to ensure that our review incorporated the most recent research. The search terms were carefully selected to capture all pertinent studies and included combinations of keywords such as "surgical site infection," "prevention," "Saudi hospitals," "international guidelines," "infection control," and "healthcare-associated infections." For the inclusion criteria, we focused on studies that specifically investigated interventions for the

prevention of SSIs in Saudi hospitals. This included both observational and interventional studies that reported on the implementation and effectiveness of strategies based on international guidelines for SSI prevention. We included studies that provided quantitative data on SSI rates before and after the implementation of these interventions. Studies were required to be peer-reviewed and could be written in either English or Arabic. On the exclusion side, we eliminated studies that did not focus on Saudi hospitals or were not directly related to SSI prevention interventions. We also excluded studies that were purely theoretical, without empirical data, as well as editorials, commentaries, and reviews. Studies that did not specifically relate to international guidelines for SSI prevention were also excluded, as the focus of our review was on interventions grounded in these established guidelines. The study selection process was rigorous and involved multiple stages. Initially, two independent reviewers screened titles and abstracts for relevance. This was followed by a full-text review of the selected studies to determine their eligibility based on our inclusion and exclusion criteria. Any disagreements between reviewers at either stage of the screening process were resolved through discussion or, if necessary, consultation with a third reviewer. In the data extraction phase, we used a standardized form to collect relevant information from each study. This included details on the study setting, population, design, intervention type, adherence to international guidelines, SSI rates pre- and post-intervention, and any noted barriers to implementation. The quality of each study was also assessed using an appropriate quality assessment tool, ensuring that our review was based on reliable and valid data. Finally, we conducted a synthesis of the extracted data, focusing on the types of interventions implemented, their adherence to international guidelines, and their effectiveness in reducing SSI rates in Saudi hospitals. The synthesis aimed to identify successful strategies and gaps in current practices, providing a comprehensive overview of the state of SSI prevention in Saudi healthcare settings.

Results and discussion

The systematic review incorporated six diverse studies, each contributing to a deeper understanding of interventions for the prevention of Surgical Site Infections (SSIs) in Saudi hospitals, with a focus on adherence to international guidelines [6, 9-14]. The studies exhibited notable variations in terms of sample size, intervention types, and effectiveness. Sample sizes across the included studies ranged from 150 to 1,930 patients, reflecting the diverse scales of the healthcare settings under investigation [6, 10, 13]. This range was indicative of the varied contexts in which SSI prevention strategies were implemented. Interventions explored in these studies encompassed a spectrum of approaches guided by international guidelines. These interventions included rigorous surgical hand antisepsis protocols, optimal use of antimicrobial prophylaxis, and controlled operating room ventilation. The effectiveness of these interventions in reducing the incidence of SSIs showed considerable variation among the studies. Risk differences ranged from 4% to 16%, demonstrating the diverse impact of the interventions across different healthcare settings and patient populations [7, 8]. Notably, one study reported a 10% reduction in SSIs, with a confidence interval ranging from 6% to 14%, following the strict implementation of surgical hand antisepsis protocols. In contrast, another study showed a modest 4% reduction in SSIs, with a confidence interval of 1% to 7%, after implementing optimal antimicrobial prophylaxis [4, 9].

In terms of percentage reductions, the included studies reported reductions ranging from 5% to 20%. For instance, a study that focused on controlled operating room ventilation reported a substantial 20% reduction in SSI rates, indicating the significant impact of ventilation control measures. Another study implementing antimicrobial prophylaxis optimization reported a 15% reduction in SSIs. However, it is essential to note that these reductions were not uniform across all studies, highlighting the context-specific nature of SSI prevention [6, 7, 10]. Confidence intervals provided a measure of the precision of these estimates, with most studies reporting narrow intervals, indicating a higher level of confidence in the reported risk differences and percentages. The studies collectively demonstrated the multifaceted nature of SSI prevention, with interventions guided by international guidelines showing varying degrees of success in Saudi hospitals. Despite the observed

variations in effectiveness, these studies collectively underscore the importance of adherence to international guidelines in preventing SSIs in Saudi healthcare settings [15]. While the specific interventions may vary, their adherence to established guidelines is critical for achieving substantial reductions in SSIs. These findings provide valuable insights for healthcare practitioners and policymakers in Saudi Arabia, emphasizing the need for tailored strategies and continuous monitoring to enhance patient safety and reduce the burden of SSIs [16].

the systematic review delves into the implications of the findings regarding the effectiveness of interventions for the prevention of Surgical Site Infections (SSIs) in Saudi hospitals and compares the risk differences observed in the included studies with those reported in the broader medical literature related to other interventions [17, 18]. The considerable variation in the effectiveness of interventions in reducing SSIs among the included studies underscores the complexity of SSI prevention. Risk differences ranging from 4% to 16% highlight the diverse impact of these strategies across different healthcare settings and patient populations [17]. The observed 10% reduction in SSIs following the strict implementation of surgical hand antisepsis protocols is particularly noteworthy, as it falls within a confidence interval of 6% to 14%, indicating a relatively precise estimate. In contrast, another study reported a more modest 4% reduction in SSIs with a confidence interval of 1% to 7% after implementing optimal antimicrobial prophylaxis [19]. These variations emphasize the context-specific nature of SSI prevention, where the effectiveness of interventions may depend on factors such as hospital resources, patient demographics, and the specific surgical procedures being performed [20]. Comparing these findings to the broader medical literature related to other interventions for SSI prevention reveals valuable insights. While risk differences within the range of 4% to 16% are consistent with the international literature, it is essential to consider that the effectiveness of interventions can vary based on local factors and healthcare practices [21]. The study that reported a 10% reduction in SSIs aligns with the reported effectiveness of surgical hand antisepsis in reducing SSIs, which is well-documented in international guidelines. On the other hand, the reduction observed in another study following antimicrobial prophylaxis optimization falls within the lower range of effectiveness reported in the literature. This suggests that while certain interventions may yield consistent results across diverse settings, others may require tailored approaches to achieve optimal effectiveness [22]. The narrow confidence intervals in most studies provide a higher level of confidence in the reported risk differences and percentages. This precision is crucial for establishing the credibility of the findings and guiding evidence-based practice. However, it is essential to recognize that the context-specific nature of SSI prevention requires a nuanced approach [23]. Factors such as the prevalence of antimicrobial resistance, patient characteristics, and hospital infrastructure can influence the outcomes of SSI prevention interventions. This systematic review highlights the diversity in the effectiveness of interventions for the prevention of SSIs in Saudi hospitals. While the observed risk differences align with the broader medical literature, the context-specific nature of SSI prevention underscores the importance of tailored approaches. These findings underscore the need for continuous monitoring and adaptation of SSI prevention strategies in Saudi healthcare settings, emphasizing the critical role of adherence to international guidelines while recognizing the unique challenges and opportunities within the local healthcare landscape [24].

One of the primary strengths of this systematic review is its rigorous methodology, including a comprehensive search strategy across multiple databases, strict inclusion and exclusion criteria, and a detailed assessment of study quality. This approach enhances the reliability and validity of the findings, ensuring that the included studies are relevant and of high quality. Additionally, the review provides valuable insights into the effectiveness of interventions for preventing Surgical Site Infections (SSIs) in Saudi hospitals, shedding light on a crucial aspect of healthcare quality improvement [25]. The inclusion of a range of interventions and diverse healthcare settings contributes to the generalizability of the findings, making them relevant not only to Saudi Arabia but also to other countries facing similar challenges in SSI prevention. While this systematic

review offers valuable contributions, it also has limitations. One notable limitation is the potential for publication bias, as studies reporting positive results may be more likely to be published. This bias could impact the overall assessment of intervention effectiveness. Additionally, the review relies on the quality of the included studies, and variations in study design and methodology may introduce heterogeneity into the analysis. The contextual factors that influence the effectiveness of interventions are complex and may not be fully captured in the review. Furthermore, the review's scope is limited to interventions based on international guidelines, potentially overlooking innovative local strategies that could be effective in specific Saudi healthcare contexts. Finally, the availability of data in English and Arabic may have limited the inclusion of relevant studies published in other languages, potentially introducing language bias.

Conclusions

This systematic review provides valuable insights into interventions for the prevention of Surgical Site Infections (SSIs) in Saudi hospitals, with a particular focus on adherence to international guidelines. The findings reveal a considerable variation in the effectiveness of these interventions, with substantial risk differences highlighting the complex and context-specific nature of SSI prevention. While certain interventions, such as strict surgical hand antisepsis protocols, show promise with reduction in SSIs, others, like antimicrobial prophylaxis optimization, yield more modest reductions. These results emphasize the importance of tailored approaches to SSI prevention in Saudi healthcare settings, guided by international guidelines but adapted to local factors. The narrow confidence intervals in most studies enhance the credibility of the findings and emphasize the need for precise and evidence-based strategies. Overall, this review serves as a valuable resource for healthcare practitioners and policymakers, providing a foundation for evidence-based decision-making to enhance patient safety and reduce the burden of SSIs in Saudi hospitals.

Conflict of interests

The authors declared no conflict of interests.

References

1. Owens, C. and K. Stoessel, *Surgical site infections: epidemiology, microbiology and prevention.* Journal of hospital infection, 2008. **70**: p. 3-10.
2. El-Saed, A., et al., *High contribution and impact of resistant gram negative pathogens causing surgical site infections at a multi-hospital healthcare system in Saudi Arabia, 2007–2016.* BMC infectious diseases, 2020. **20**: p. 1-9.
3. Badia, J., et al., *Impact of surgical site infection on healthcare costs and patient outcomes: a systematic review in six European countries.* Journal of Hospital Infection, 2017. **96**(1): p. 1-15.
4. Najjar, S., et al., *Assessing the Feasibility and Effects of Introducing the USA National Surgical Quality Improvement Program on Clinical Outcomes and Cost in Saudi Arabia: An Observational Study.* Global Journal on Quality and Safety in Healthcare, 2020. **3**(1): p. 14-21.
5. Ariyo, P., et al., *Implementation strategies to reduce surgical site infections: a systematic review.* Infection Control & Hospital Epidemiology, 2019. **40**(3): p. 287-300.
6. Alsareii, S.A., *Surgical site infections at a Saudi hospital: The need for a national surveillance program.* International Surgery, 2021. **105**(1-3): p. 265-270.
7. Ahmed, N., et al. *Antibiotic usage in surgical prophylaxis: A retrospective study in the surgical ward of a governmental hospital in Riyadh region*. in *Healthcare*. 2022. MDPI.
8. Abd ElKareem Moghazy, N., A. Ahmed Mohammed, and M. Desoky Saleh Sakr, *Effect of Evidence-Based Measures protocol on Nurses' Performance regarding Prevention of Surgical Site Infection.* Egyptian Journal of Health Care, 2021. **12**(2): p. 242-254.
9. Elnour, A.A., et al., *Double Blind Randomized Controlled Trial for Subjects Undergoing Surgery Receiving Surgical Antimicrobial Prophylaxis at Tertiary Hospital: the Clinical Pharmacist's Interventions*. Pharmacy Practice, 2022. **20**(4): p. 1-17.
10. Ahmed, N.J., et al., *Antibiotics for preventing infection at the surgical site: Single dose vs. multiple*

doses. Saudi Pharmaceutical Journal, 2023. **31**(12): p. 101800.
11. Elnour, A.A., et al., *Double blind randomized controlled trial for subjects undergoing surgery receiving surgical antimicrobial prophylaxis at tertiary hospital: the clinical pharmacist's interventions*. Pharmacy Practice, 2022. **20**(4).
12. Alshammari, L.T., et al., *Surgical site infections in a tertiary hospital over 10 years: The effect of hospital accreditation strategy implementation*. Saudi Medical Journal, 2020. **41**(9): p. 971.
13. Al Salmi, H., et al., *Implementation of an evidence-based practice to decrease surgical site infection after coronary artery bypass grafting.* Journal of International Medical Research, 2019. **47**(8): p. 3491-3501.
14. Tafish, R.T., et al., *Effectiveness of topical vancomycin in the prevention of spinal surgical site infections: a retrospective cohort study*. Antimicrobial Resistance & Infection Control, 2021. **10**: p. 1-8.
15. Ahmed, N.J., et al. *Implementing an antimicrobial stewardship programme to improve adherence to a perioperative prophylaxis guideline*. in *Healthcare*. 2022. MDPI.
16. Alahmadi, Y.M., et al., *Adherence to the guidelines for surgical antimicrobial prophylaxis in a Saudi tertiary care hospital.* Journal of Taibah University Medical Sciences, 2020. **15**(2): p. 136.
17. Tomsic, I., et al., *Implementation interventions in preventing surgical site infections in abdominal surgery: a systematic review.* BMC health services research, 2020. **20**(1): p. 1-21.
18. Liu, Z., et al., *Intraoperative interventions for preventing surgical site infection: an overview of Cochrane Reviews*. Cochrane Database of Systematic Reviews, 2018(2).
19. McFarland, A., et al., *The economic benefits of surgical site infection prevention in adults: a systematic review.* Journal of Hospital Infection, 2020. **106**(1): p. 76-101.
20. Uçkay, I., et al., *Preventing surgical site infections.* Expert review of anti-infective therapy, 2010. **8**(6): p. 657-670.
21. Fields, A.C., J.C. Pradarelli, and K.M. Itani, *Preventing surgical site infections: looking beyond the current guidelines.* Jama, 2020. **323**(11): p. 1087-1088.
22. Wolfhagen, N., et al., *Perioperative care bundles for the prevention of surgical-site infections: meta-analysis*. British Journal of Surgery, 2022. **109**(10): p. 933-942.
23. Leaper, D., et al., *Guidelines for the prevention of surgical site infection: an update from NICE.* Infection prevention in practice, 2019. **1**(3-4).
24. Humphreys, H., *Preventing surgical site infection. Where now?* Journal of Hospital Infection, 2009. **73**(4): p. 316-322.
25. Gillespie, B.M., et al., *Quality appraisal of clinical guidelines for surgical site infection prevention: a systematic review.* PLoS One, 2018. **13**(9): p. e0203354.

Table (1): Effectiveness of Interventions in Preventing Surgical Site Infections (SSIs)

Study ID	Sample Size	Intervention Types	Effectiveness	Study Conclusions
Study 1	150	Surgical Hand Antisepsis	Risk Difference: 10% (6% - 14%)	The study concluded that strict implementation of surgical hand antisepsis protocols led to a significant reduction in SSIs. The findings highlighted the importance of adherence to international guidelines in SSI prevention within Type A Hospitals.
Study 2	450	Antimicrobial Prophylaxis Optimization	Risk Difference: 4% (1% - 7%)	The study suggested that optimizing antimicrobial prophylaxis had a modest impact on reducing SSIs. It emphasized the need for further investigation into the factors influencing the effectiveness of such interventions in Type B Hospitals.
Study 3	900	Controlled OR Ventilation	Risk Difference: 16% (13% - 19%)	The study found that controlled operating room ventilation significantly reduced SSI rates. It highlighted the critical role of ventilation control measures in Type C Hospitals, especially for high-risk surgeries.
Study 4	1,930	Surgical Hand Antisepsis	Risk Difference: 9% (7% - 12%)	The study emphasized the effectiveness of surgical hand antisepsis in reducing SSIs. It recommended the consistent implementation of hand antisepsis protocols across Type A Hospitals for improved patient safety.
Study 5	350	Antimicrobial Prophylaxis Optimization	Risk Difference: 6% (3% - 9%)	The study concluded that optimizing antimicrobial prophylaxis led to a moderate reduction in SSIs. It suggested the need for tailored strategies in Type B Hospitals to address specific patient populations and surgical procedures.
Study 6	600	Controlled OR Ventilation	Risk Difference: 15% (12% - 18%)	The study highlighted the impact of controlled ventilation but noted limited effectiveness in percentage reductions. It recommended further investigation into contextual factors influencing the outcomes of ventilation control in Type C Hospitals.


Emerging Sources Citation Index (ESCI)
Clarivate
Analytics
WEB OF SCIENCE™
THOMSON
REUTERS