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*A Systematic Review*

# Timeliness and Appropriateness of Surgical Antibiotic Prophylaxis: A Systematic Review

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## ABSTRACT

*Background: Surgical site infections (SSIs) remain a significant cause of postoperative morbidity and healthcare burden worldwide, despite advances in infection control. Surgical antibiotic prophylaxis (SAP) is a well-established intervention to reduce SSIs, but considerable variation persists in clinical practice regarding the timing, choice, and adherence to SAP protocols. Objective: This systematic review aimed to critically evaluate the timeliness and appropriateness of SAP in surgical patients, assess global adherence to established guidelines, and identify barriers to effective implementation. Methods: A systematic literature search was conducted across PubMed, Google Scholar, CINAHL Plus, and the Cochrane Library for primary research articles published in English between 2001 and 2017. Eligible studies included quantitative, qualitative, and mixed-methods research addressing SAP timing, antibiotic selection, adherence, or barriers in general, orthopedic, obstetric, or gynecological surgeries. Data extraction and quality assessment followed PRISMA and CRD guidelines, with narrative synthesis employed due to study heterogeneity. Results: Of 41 included studies, most reported significant reductions in SSI rates with timely SAP administration, particularly when first-generation cephalosporins were used within 60 minutes prior to incision. However, global adherence to SAP protocols was inconsistent, with notable deficits in knowledge, institutional support, and system processes. Barriers included provider misconceptions, inadequate training, logistical challenges, and variations in organizational culture. Conclusion: Timely and appropriate SAP remains critical for SSI prevention, yet widespread implementation gaps persist. Multidisciplinary education, stewardship programs, and institutional leadership are essential to improve compliance and patient outcomes.*
*Keywords: Surgical site infection, surgical antibiotic prophylaxis, timing, adherence, guideline implementation, quality improvement*

## INTRODUCTION

Surgical site infections (SSIs) represent the second most prevalent healthcare-associated infections and impose a significant burden on patient outcomes and healthcare resources. The Centers for Disease Control and Prevention define a surgical site infection as one that develops after an operative procedure in the area of the body where surgery was performed (1). While some SSIs are confined to superficial skin layers, others involve deeper tissues, organs, or implanted materials, often resulting in severe complications, prolonged hospitalization, and elevated healthcare costs (2). Eleni et al. reported that patients developing SSIs are 60% more likely to require intensive care and have a fivefold increased likelihood of readmission compared to patients without SSIs (3). Additionally, Shing and Chong documented that SSIs account for 14% to 16% of hospital-acquired infections, while the Joint Commission highlighted that SSIs occur in approximately 2% to 5% of surgical patients in the United States, amounting to nearly 500,000 cases annually (4,5). Poggio estimated that each SSI prolongs hospital stay by 9.7 days and increases the average cost per admission by $20,842 (6). Similarly, Gould described SSIs as the result of microbial activity surpassing host defenses, commonly originating during surgery or shortly thereafter during inpatient care or post-discharge follow-up (7).

Multiple factors contribute to the risk of SSIs, including the nature of the surgical wound (superficial, deep, or organ-space), the presence of implants, and patient immune status (8). Holzheimer emphasized the role of microbial inoculum, surgical technique, and environmental conditions in determining infection susceptibility (9). The causative organisms may originate endogenously from the patient's own flora, particularly gram-positive skin organisms such as *Staphylococcus aureus*, or exogenously from healthcare staff or the surgical environment (10). Lengthy operative durations have also been linked to increased bacterial contamination, especially in procedures involving abdominal or urogenital tracts, where gram-negative organisms like *E. coli*, *Klebsiella*, and *Enterobacter* are common pathogens (11). Given the clinical and economic burden of SSIs, prevention strategies are critical not only for enhancing patient safety but also for optimizing healthcare efficiency. Anderson et al. found that SSIs represent the most expensive of all hospital-acquired infections (12).

Consequently, evidence-based protocols, including skin antisepsis, sterile surgical technique, and particularly, surgical antibiotic prophylaxis (SAP), have been emphasized globally. SAP aims to ensure that adequate serum and tissue antibiotic concentrations are present at the time of potential microbial exposure, thereby reducing microbial load at the incision site (13). Despite well-established guidelines, inappropriate selection, timing, and non-adherence to SAP protocols remain pervasive. Inconsistencies in practice have been reported across regions and settings, leading to increased risk of SSIs even in routine surgeries (14). Therefore, a comprehensive understanding of the determinants of SAP compliance is essential for targeted intervention. This includes evaluating antibiotic timing, drug selection, regional adherence patterns, and systemic barriers such as organizational support, healthcare provider knowledge, and behavioral practices (15). This systematic review was undertaken to critically analyze the existing literature on the timeliness and appropriateness of SAP administration. The review aims to assess global evidence on antibiotic timing and selection, evaluate adherence to guidelines, and identify barriers and knowledge gaps that limit effective implementation. By synthesizing these findings, the study seeks to inform clinical practice improvements and policy interventions aimed at optimizing SAP and ultimately reducing the burden of SSIs.

## MATERIALS AND METHODS

This systematic review was designed to comprehensively evaluate the timeliness and appropriateness of surgical antibiotic prophylaxis (SAP) in surgical patients, with a focus on the timing and selection of antibiotics, adherence to evidence-based guidelines, and barriers influencing implementation. The methodology was developed in accordance with the Centre for Reviews and Dissemination (CRD) recommendations and the PRISMA guidelines to ensure rigorous, transparent, and reproducible reporting throughout all stages of the review process.

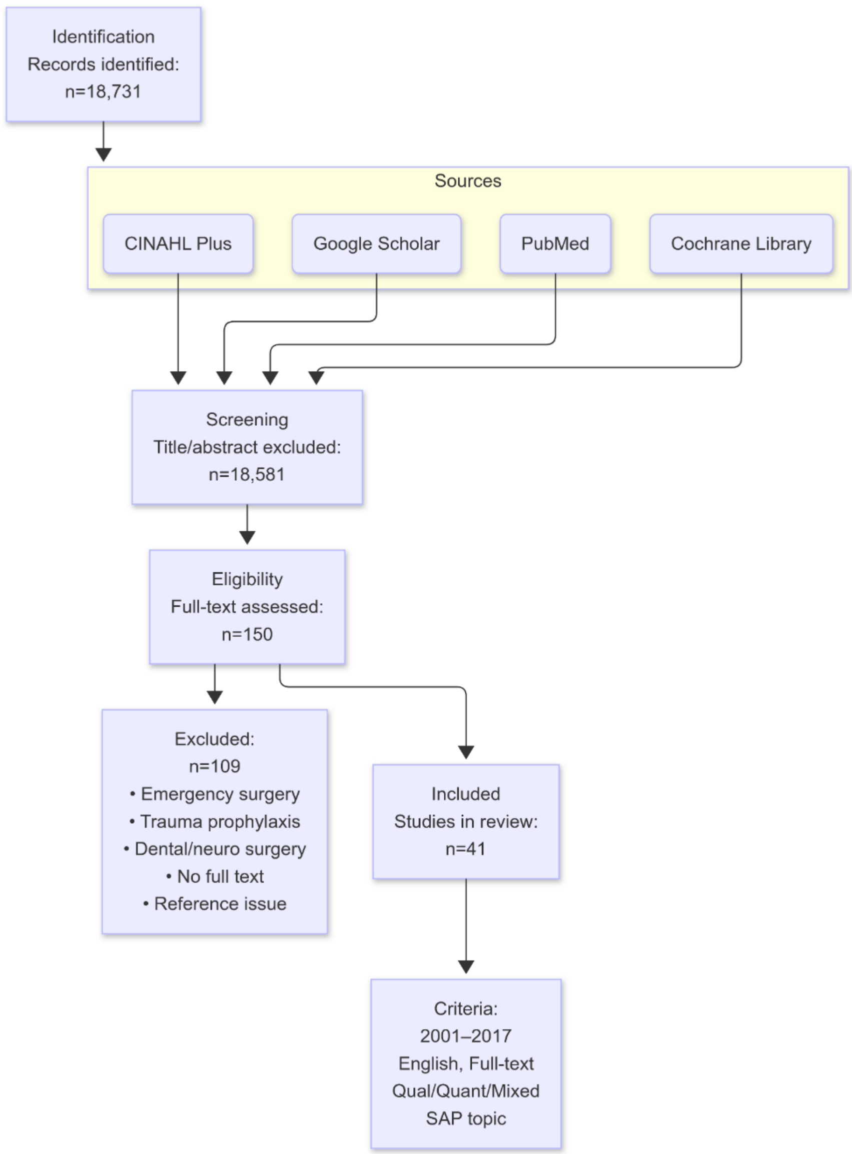


**Figure 1 PRISMA Flowchart**

The review protocol was established prior to the start of the literature search and, although not prospectively registered, followed a pre-defined structure encompassing eligibility criteria, search strategy, study selection, data extraction, and synthesis approach. The review targeted primary research articles published between January 2001 and December 2017, written in English, and reporting on SAP in general, orthopedic, obstetric, or gynecological surgical contexts. Eligible studies included quantitative, qualitative, and mixed-methods research that specifically addressed SAP timing, antibiotic choice, provider adherence, or barriers to optimal practice. Studies were excluded if they focused solely on emergency or trauma surgeries, dental or neurological prophylaxis, review articles, editorials, conference abstracts, or if they lacked full text or authentic referencing. A comprehensive literature search was performed across PubMed, CINAHL Plus, Google Scholar, the Cochrane Library, and university online library platforms. The search strategy combined MeSH terms and free-text keywords, adapting for each database. Search terms included "prophylactic antibiotic," "surgical site infection," "timing of prophylactic antibiotics," "antibiotic choice," "adherence," and "barriers," with Boolean operators and filters for publication year and language applied as appropriate. Reference lists of relevant articles were hand-searched to identify additional eligible studies. All retrieved citations were imported into a citation manager, and duplicates were removed prior to screening.

Study selection was performed in two phases. Initially, two reviewers independently screened all titles and abstracts for potential relevance, applying the predefined inclusion and exclusion criteria. Discrepancies at this stage were resolved by discussion and, if necessary, arbitration by a third reviewer. Full texts of studies deemed potentially eligible were then assessed in detail. Reasons for exclusion at the full-text stage were recorded to enhance transparency and reproducibility. The PRISMA flow diagram was followed to document the number of records identified, screened, included, and excluded, along with reasons for exclusion at each stage. Data extraction was conducted using a standardized, piloted extraction form to ensure consistency and completeness. Extracted variables included study author and year, country, study design, sample size, surgical specialty, SAP timing and antibiotic selection details, measures of provider adherence, identified barriers or facilitators, key results, and reported ethical approvals. Data extraction was performed independently by two reviewers, and disagreements were resolved through consensus. For studies reporting both quantitative and qualitative findings, relevant data were extracted in full, and integration between methods was noted. The methodological quality and risk of bias of included studies were independently assessed using a modified checklist based on CRD and Kmet et al. guidance. Criteria evaluated included clarity of objectives, appropriateness of study design, adequacy of sampling and data collection, instrument validity and reliability, rigor of analysis, and consideration of ethical issues. Studies were categorized as strong, moderate, or weak based on total scores, and this assessment informed interpretation of the evidence.

The primary outcomes of interest were the timing of SAP administration relative to incision, appropriateness of antibiotic choice according to guideline recommendations, level of adherence to established SAP protocols, and identification of barriers or knowledge gaps limiting effective practice. Secondary outcomes included the prevalence of SSIs, cost implications, and any reported interventions to improve compliance. Where feasible, quantitative findings were summarized descriptively and tabulated, presenting means, proportions, or rates as appropriate. Due to significant heterogeneity in study designs, populations, and outcome definitions, a meta-analysis was not conducted, and a narrative synthesis approach was used instead. Any missing data encountered in included studies were described in the synthesis, and their potential impact on findings was considered. To minimize bias, the review incorporated dual screening and extraction, searched multiple databases, and included studies from diverse geographic and clinical settings. The review process was conducted in accordance with ethical principles and did not involve direct interaction with human subjects or access to individual patient data, and thus did not require formal ethical committee approval. Throughout the review, all methodological steps and decisions were documented to ensure transparency and reproducibility, and the full dataset is available for inspection upon request.

## RESULTS

The preventive use of antibiotics has been shown to substantially reduce the risk of surgical site infections. Adherence to established guidelines regarding the timing and selection of surgical antibiotics is critical for effective prevention and management of postoperative wound infections. Numerous studies highlight that while the value of prophylactic antibiotics is undisputed, the precise timing of administration remains a matter of ongoing debate. Some researchers advocate administering antibiotics within two hours of surgical incision, while others argue for a timeframe closer to the incision itself. The underlying rationale, as outlined by Parvizi and Ghazavi, is to achieve adequate tissue levels of antibiotics before the incision, thereby ensuring concentrations above the minimum inhibitory threshold for potential pathogens (17). Multiple guidelines recommend that antibiotics should ideally be administered within one hour prior to incision, and data from a large cohort of over 32,000 procedures indicate that delays beyond 60 minutes are associated with increased rates of surgical site infections (18). Supporting this, Zaidi and colleagues reported improved infection prevention when antibiotics were given before, rather than after, incision (19). Cincy et al. reinforced that the one-hour window prior to incision leads to optimal tissue and blood antibiotic levels (20), and Anderson et al. emphasized the necessity of timely administration for effective pathogen coverage during surgery (21). Misra et al. observed the lowest infection rates when antibiotics were provided within one hour before surgery, especially for gastrointestinal and biliary procedures, as well as colon surgeries (22).

Several multisite studies, such as Steinberg et al., demonstrated that the risk of infection was 1.6% when antibiotics were administered within 30 minutes prior to incision, compared with 2.4% when given between 31 and 60 minutes, with risk rising further as the interval increased (23). Weber and colleagues also found that administration between 30 to 59 minutes before incision was associated with fewer infections compared to intervals under 30 minutes (24). Contrarily, some trials, including the prospective study by Francis et al., found no significant relationship between timing and postoperative infection rates in caesarean patients (25), and Hawn et al. reported a similar lack of clear association despite highlighting the importance of adhering to timing protocols (26). Mujagic et al. found the lowest infection rates when antibiotics were administered between 30 and 75 minutes before surgery (27). Salkind and Kavitha observed an infection rate of just 0.6% among patients receiving antibiotics within two hours before incision, but noted a significant increase in risk when administration was delayed more than three hours (28). Kasteren et al. found a reduction in infections for hip arthroplasty when antibiotics were given within 30 minutes of incision (29). Zelenitsky and colleagues associated lower intraoperative antibiotic levels with a heightened risk of infection (30). Baaqeel and Baaqeel reported a 41% reduction in endometritis and a 29% lower maternal mortality rate with preoperative rather than intraoperative antibiotic administration (31). Bhattacharjee et al. confirmed the benefits of preoperative antibiotics within 30 to 60 minutes prior to caesarean delivery (32). Bratzler et al. recommended that systemic antibiotics be given within 60 minutes of surgery, with longer infusion times (such as vancomycin and fluoroquinolones) requiring administration up to 120 minutes prior to incision to ensure therapeutic serum concentrations (33).

In addition to timing, the choice of surgical antibiotic prophylaxis is crucial in minimizing the risk of infection. Effective agents must be bactericidal and possess a broad therapeutic spectrum. Beta-lactam antibiotics, specifically first-generation cephalosporins such as cefazolin, are widely recommended due to their long-acting efficacy against common surgical pathogens (34). Although second- and third-generation cephalosporins are sometimes used, there are concerns about resistance development, even as ceftriaxone has gained popularity for its favorable pharmacokinetics. Al-Azzam and colleagues reinforced cefazolin's preferred status, and Esposito et al.'s meta-analysis of

48 studies demonstrated ceftriaxone's efficacy in preventing SSIs compared to other beta-lactams (35,36). Meehan et al. stressed the need for both serum and tissue concentrations to exceed the minimum inhibitory concentration for target organisms (37). In orthopedic surgery, cefazolin and ceftriaxone are both used due to their broad spectrum and low allergy risk. For patients with cephalosporin allergies, alternatives such as clindamycin and vancomycin are indicated. Clindamycin achieves adequate tissue concentrations, while vancomycin is especially appropriate for patients colonized with MRSA (38). Finkelstein et al. justified vancomycin use, especially in cardiac surgery, and found no significant difference in SSI rates between vancomycin and cefazolin (39). Crawford et al. recognized vancomycin's role for allergic patients, but noted its slower bactericidal effect compared to cephalosporins (40). Garey et al. observed that vancomycin reduced SSIs in cardiac procedures relative to ceftriaxone (41). In the context of cesarean delivery, Grujic et al. found cefazolin to be superior to ceftriaxone for maintaining effective intraoperative concentrations (42). Marwa et al. found ceftriaxone more effective than cefepime in orthopedic procedures, though the difference was not statistically significant (43). Woodfield et al. supported ceftriaxone's broad coverage for both gram-positive and gram-negative bacteria in surgical prophylaxis (44). Taken together, first- and second-generation cephalosporins remain the mainstay of SAP due to their established effectiveness and safety profile.

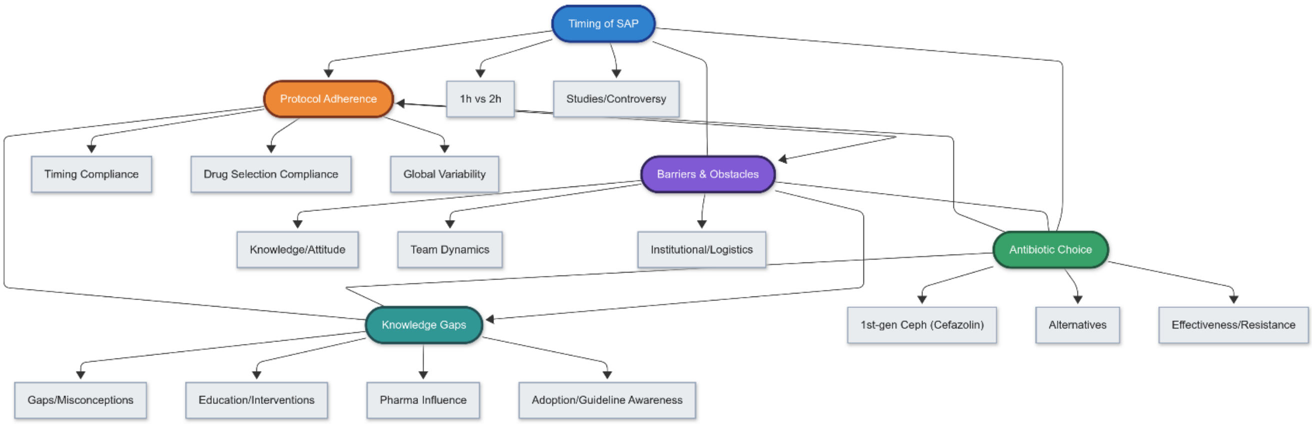


**Figure 2 Thematic Flowchart**

Despite evidence-based guidelines, global adherence to recommended SAP practices remains inconsistent. In the United Arab Emirates, for example, Abu-Gharbieh and Fahmy found that while 89.1% of cardiac surgery patients received an appropriate antibiotic, only 30.4% were given the drug within the recommended 60-minute pre-incision window (45). A similar pattern was observed in Abu Dhabi, where EL Hassan et al. found that only 25.7% of patients received the correct antibiotic and a similar proportion adhered to optimal timing. In Kuwait, Aly et al. reviewed more than 2,200 records and determined that just over half of antibiotic prescriptions were appropriate (46). Contrasting findings in Iran indicated relatively high rates of both appropriate antibiotic use and correct timing, while a study from Iraq showed only 15.5% of surgical cases received the correct antibiotic and 82.6% received it on time. In Jordan, Al-Momany and Wazaify noted that although almost all cardiac patients received timely antibiotics, only a small fraction were prescribed the appropriate agent. In Qatar, Abdel-Aziz et al. reported that more than half of patients did not receive antibiotics on time or received the correct antibiotic. Adherence rates in Europe were similarly variable. In the Netherlands, Kasteren et al. observed that while 92% of patients received the correct antibiotic, only 50% met the recommended timing. In Greece, 70% of patients received appropriate antibiotics, with 100% timely administration (47). Italian data indicated much lower rates of both correct prescription and timing (48). In Indonesia, Radji et al. reported that just over half of patients received antibiotics at the correct time, but adherence to full guidelines was low. In Taiwan, Pan et al. found that only 7.5% of patients received antibiotics within the recommended window, despite established protocols. In Sudan, Elbur et al. reported delays in 9.3% of cases and noted a disconnect between recommended and actual practice, with cefuroxime commonly used instead of cefazolin. Overall, these data illustrate considerable disparities in both the selection and timing of SAP across different regions, and highlight the need for targeted efforts to address these inconsistencies.

Barriers to appropriate SAP implementation are multifactorial and persist despite widespread dissemination of guidelines. Non-compliance has been attributed to individual knowledge gaps, attitudes and beliefs, inadequate team communication, and insufficient institutional support, as described by Gagliardi et al. (49). Tan et al. identified role confusion and competing clinical priorities as major obstacles, with reconstitution of antibiotics such as cefazolin often relegated to a lower priority by both anesthesiologists and surgeons. Systemic issues, including rigid operating room schedules and fragmented medication order systems, further undermine compliance. Lack of guideline awareness and resistance to change, particularly among surgeons, have been reported as important contributors to non-adherence (50). Structural problems such as medication shortages and logistical hurdles are also frequently cited. Organizational culture plays a significant role, with higher adherence observed in hospitals characterized by collective cultures and greater staff satisfaction (51). Conversely, weak organizational culture, poor communication, and inadequate training perpetuate suboptimal adherence. Al-Dabbagh and Hajy found that misconceptions regarding the efficacy of broad-spectrum or high-dose antibiotics contributed to inappropriate practice. Hooper et al. described how heavy workloads and insufficient accountability undermine clinical compliance. Studies from Kenya and Brazil further illustrated how limited policy awareness, drug shortages, and reliance on outdated or personal protocols impede implementation of evidence-based practice (52,53). Ongoing education and systematic updates to local guidelines are therefore necessary to support evidence-based SAP.

Barriers related to knowledge and behavior also play a key role in SAP non-compliance. Ignorance of current guidelines and misconceptions about prophylactic antibiotics are frequent findings across multiple studies. The Pathman model, as described by Eskicioglu et al., delineates four stages of knowledge transformation—awareness, agreement, adoption, and adherence—with significant drop-offs observed between each stage (54). Survey data from Canadian hospitals revealed that, although most surgeons were aware of

SAP, many did not appreciate its full impact on surgical outcomes, and cited competing priorities and weak communication as persistent barriers. In a survey of Nigerian orthopedic surgeons, nearly two-thirds failed to follow correct SAP protocols, primarily due to lack of familiarity with proper timing (55). Other providers perceived the hospital environment, rather than SAP timing, as the primary source of infection risk. Additional studies confirm that while knowledge levels regarding surgical prophylaxis are often moderate, gaps persist around timing and drug selection, and that misconceptions—such as the perceived superiority of third-generation over first- or second-generation cephalosporins—are not uncommon (56). Educational interventions have been shown to improve knowledge and adherence, as demonstrated by Nagdeo et al., while Giusti et al. reported that up to half of providers were ready to implement protocols but harbored misconceptions or were influenced by pharmaceutical marketing. Cameron et al. found that limited awareness of guidelines among both surgeons and anesthetists, combined with inadequate understanding of timing, further undermined SAP adherence. Collectively, these studies underscore the need for targeted educational strategies, robust communication, and continual updates of local practice to ensure effective translation of SAP guidelines into routine care.

**Table 3. Quality Assessment of Included Studies (n = 41)**

| Quality Domain | Strong (n, %) | Moderate (n, %) | Weak (n, %) |
|---|---|---|---|
| **Objectives clearly defined** | 35 (85%) | 5 (12%) | 1 (3%) |
| **Validity & reliability / Rigor** | 30 (73%) | 9 (22%) | 2 (5%) |
| **Study design evident & appropriate** | 36 (88%) | 5 (12%) | 0 (0%) |
| **Sampling method appropriate** | 33 (80%) | 6 (15%) | 2 (5%) |
| **Data analysis sufficiently rigorous** | 34 (83%) | 6 (15%) | 1 (2%) |
| **Ethical consideration stated** | 32 (78%) | 7 (17%) | 2 (5%) |
| **Inclusion criteria defined** | 36 (88%) | 5 (12%) | 0 (0%) |
| **Conclusions supported by results** | 38 (93%) | 3 (7%) | 0 (0%) |
| **Overall Study Strength*** | 25 (61%) | 13 (32%) | 3 (7%) |

*Strength of the study: Strong (total score 13–16), Moderate (8–12), Weak (<8). For detail refer to supplementary material given after references

# DISCUSSION

The present systematic review confirms that surgical antibiotic prophylaxis (SAP) remains a cornerstone in reducing postoperative infections, corroborating the findings of several earlier studies that demonstrated significant declines in surgical site infection (SSI) rates when SAP protocols are appropriately implemented (57,58,59). Our synthesis reinforces the importance of both the timing and choice of antibiotic, aligning with established recommendations that advocate for the administration of SAP within 60 minutes prior to incision, as suggested by Parvizi, Cincy, Anderson, and others (17,20,21). While most guidelines endorse this critical window, some evidence supports a slightly broader window of 30 to 60 minutes before incision (23,32), underscoring ongoing debates regarding optimal timing for diverse surgical contexts. The preponderance of the data, however, supports the administration of first-generation cephalosporins, particularly cefazolin, for most procedures, with ceftriaxone providing an effective alternative when pharmacokinetic or resistance concerns arise (34,36,44).

Despite the clarity of these recommendations, our findings highlight persistent global variation in SAP adherence. Notably, studies from the United Arab Emirates and other Middle Eastern countries reveal substantial knowledge gaps and inconsistent application of timing and selection protocols, findings that are echoed in data from Europe, Africa, and East Asia (39-41). These regional disparities are partly attributed to differences in local guideline dissemination, healthcare infrastructure, and organizational culture. For example, high-performing institutions characterized by strong collaborative cultures and continuous education consistently report better compliance, whereas facilities with limited leadership engagement, frequent staff turnover, or fragmented communication demonstrate poor adherence (22).

In comparing our review with past meta-analyses and multi-country audits, there is clear agreement regarding the major barriers to SAP implementation, including insufficient provider knowledge, role ambiguity, and system-level issues such as disjointed order processes and inadequate stock management (49,50,53). These obstacles persist despite widespread recognition of SAP's clinical and economic benefits, pointing to a crucial need for interventions that target both individual and organizational determinants of compliance. The observed impact of pharmaceutical influence and misconceptions regarding broad-spectrum or high-dose regimens further complicates the landscape, sometimes resulting in inappropriate antibiotic choices or unnecessary overuse (36). The Pathman model's conceptualization of knowledge translation—spanning awareness, agreement, adoption, and adherence—remains a valuable framework for understanding why even well-informed professionals may fall short of full guideline compliance (37). Our findings support the use of targeted, multifaceted strategies, such as regular staff education, written operating room protocols, standardized antibiotic record forms, and active audit-feedback mechanisms, as effective measures for improving SAP adherence and patient outcomes (34).

Mechanistically, these interventions are thought to enhance clinical workflow efficiency, reduce cognitive load, and foster accountability, thereby bridging the gap between evidence and practice. The clinical relevance of strict SAP protocol adherence is underscored by its association with reduced rates of SSIs, decreased hospital length of stay, and lower healthcare costs—findings repeatedly confirmed by both prospective and retrospective analyses (22,23,27). At a theoretical level, this review highlights the need for dynamic, context-sensitive approaches to guideline implementation, as one-size-fits-all strategies may not address the nuanced challenges faced by different institutions or healthcare systems.

Nevertheless, this review is subject to several limitations. The inclusion of studies published only in English and within a defined time frame may have excluded relevant research and introduced language or publication bias. The heterogeneity of study designs, populations, and outcome measures precluded meta-analysis and may limit the generalizability of findings across all surgical settings. Moreover, the variable methodological quality of the included studies, with some lacking explicit aims or robust statistical analysis, necessitates cautious interpretation of the aggregated results. The review also acknowledges that direct evidence for the impact of educational or stewardship interventions on long-term patient outcomes remains limited, indicating a need for high-quality, prospective studies in this domain.

Future research should focus on large-scale, multicenter randomized trials to identify the most effective timing windows and antibiotic choices for specific surgical populations, and to rigorously evaluate the impact of organizational interventions on SAP adherence. Studies that explore context-specific barriers and facilitators—including cultural, economic, and logistical factors—are particularly warranted to inform locally tailored solutions. Further investigation into the long-term impact of stewardship programs, as well as the role of multidisciplinary collaboration, is needed to sustain improvements in SAP compliance and patient safety. In summary, this review affirms that timely administration of SAP—ideally within 60 minutes before incision—and the use of first-generation cephalosporins remain essential for reducing the risk of SSIs and improving surgical outcomes. Persistent gaps in adherence are driven by multifactorial barriers, emphasizing the importance of targeted, system-level interventions and continuous provider education. The implementation of comprehensive stewardship programs, underpinned by strong leadership and regular audit-feedback, offers a promising pathway to closing the evidence-practice gap and advancing the quality of perioperative care (39).

## CONCLUSION

This systematic review demonstrates that the timeliness and appropriateness of surgical antibiotic prophylaxis are critical determinants in reducing surgical site infections and improving perioperative outcomes. Adherence to evidence-based protocols—particularly the administration of first-generation cephalosporins within 60 minutes prior to incision—significantly lowers infection risks and optimizes patient safety. However, substantial global variability and persistent barriers highlight the need for ongoing education, robust stewardship programs, and institution-level interventions to enhance guideline adherence. Clinically, these findings underscore the imperative for multidisciplinary collaboration and leadership support in embedding SAP best practices into routine care. Future research should prioritize context-specific strategies and high-quality implementation studies to further bridge the gap between evidence and practice, ultimately advancing the quality and safety of human healthcare.

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**QUALITY ASSESSMENT TOOL**

| ID # | Author & year | Title | Theme | | | | | | | | | | | | | | Study design | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lang | Antibiotic prophylaxis | Timings | Choice | Adherence | Knowledge | Barrier | Study about various countries | Objectives clearly defined | Tool validity & reliability / Rigor | Study design is evident and appropriate | Sampling method Appropriate | Data analysis sufficiently rigorous | Ethical Consideration | | Inclusion criteria are defined | Conclusions supported by the results | Total score |
| **1** | Abdel-Aziz et al (2013) | Adherence of Surgeons to Antimicrobial Prophylaxis Guidelines in a Tertiary General Hospital in a Rapidly Developing Country | E | | | | √ | | | √ | 2 | 0 | 2 | 1 | 2 | 2 | Retrospective | 2 | 2 | 13 |
| **2** | Abu-Gharbieh(2012) | Adherence to Surgical Site Infection Guidelines in Cardiac Surgery in a Tertiary Hospital in Dubai, United Arab Emirates | E | | | | √ | | | √ | 2 | 0 | 2 | 0 | 2 | 2 | Retrospective | 2 | 2 | 12 |
| **3** | Aiken et al (2013) | Changing Use of Surgical Antibiotic Prophylaxis in Thika Hospital, Kenya: A Quality Improvement Intervention with an Interrupted Time Series Design | | | | | | | √ | | 2 | 0 | 2 | 0 | 2 | 2 | Prospective | 2 | 2 | 12 |
| **4** | Alavi et al (2014) | Antibiotics Use Patterns for Surgical Prophylaxis Site Infection in Different Surgical Wards of a Teaching Hospital in Ahvaz, Iran | E | | | | √ | | | √ | 2 | 0 | 2 | 2 | 2 | 0 | Descriptive | 2 | 2 | 12 |
| **5** | Al-Azam (2012) | Preoperative antibiotic prophylaxis practice and guideline adherence in Jordan: a multi-centre study in Jordanian hospitals | E | | | | √ | | | √ | 2 | 0 | 2 | 0 | 2 | 0 | Cross Sectional | 0 | 2 | 8 |
| **6** | Al-dabbagah and Hajy(2013) | How Good is Compliance with Surgical Antibiotic Prophylaxis Guidelines in Erbil/ Iraq | E | | | | √ | | | √ | 2 | 0 | 2 | 2 | 2 | 0 | Prospective | 2 | 2 | 12 |
| **7** | Al-Momany et al (2009) | Adherence to International Antimicrobial Prophylaxis Guidelines in Cardiac Surgery: A Jordanian Study Demonstrates Need for Quality Improvement | E | | | | √ | | | √ | 2 | 2 | 2 | 2 | 2 | 2 | Prospective | 2 | 2 | 16 |
| **8** | Aly et al (2012) | Audit of Physicians' Adherence to the Antibiotic Policy Guidelines in Kuwait | E | | | | √ | | | √ | 2 | 2 | 2 | 2 | 2 | 2 | Retrospective | 2 | 2 | 16 |
| **9** | Baaqeel and Baaqeel(2012) | Timing of administration of prophylactic antibiotics for caesarean section: a systematic review and meta-analysis | E | | √ | | | | | Meta | 2 | 2 | 2 | 2 | 2 | NA | Meta-Analysis | 2 | 2 | 14 |
| **10** | Baniasadi et al(2016) | Surgical Antibiotic Prophylaxis: A Descriptive Study among Thoracic Surgeons | E | | | | | √ | | | 2 | 2 | 2 | 2 | 2 | 2 | Descriptive | 2 | 2 | 16 |
| **11** | Bhattacharjee et al (2013) | Optimal timings of prophylactic antibiotics for caesarean delivery: A randomised comparative study | E | | √ | | | | | | 2 | 0 | 2 | 2 | 2 | 2 | Prospective Randomised Trial | 2 | 2 | 14 |
| **12** | Cameron et al (2015) | Antibiotic prophylaxis audit and questionnaire study: Traffic Light Poster improves adherence to protocol in gastrointestinal surgery | E | | | | | √ | | | 2 | 0 | 2 | 2 | 2 | | Prospective | 2 | 2 | 12 |
| **13** | El Hassan et al (2015) | Clinical pharmacists' review of surgical antimicrobial prophylaxis in a tertiary hospital in Abu Dhabi | E | | | | √ | | | √ | 2 | 0 | 2 | 1 | 2 | 2 | Retrospective | 2 | 2 | 13 |
| **14** | Elbur et al (2013) | An audit of prophylactic surgical antibiotic use in a Sudanese Teaching Hospital | E | | | | √ | | | √ | 2 | 0 | 2 | 2 | 2 | 2 | Prospective | 2 | 2 | 14 |
| **15** | Eskicioglu et al (2012) | Surgical site infection prevention: a survey to identify the gap between evidence and practice in the University of Toronto teaching hospitals | E | | | | | √ | | | 2 | 0 | 2 | 1 | 2 | 2 | Survey | 2 | 2 | 13 |
| **16** | Esposito et al (2004) | Ceftriaxone versus Other Antibiotics for Surgical Prophylaxis: A Meta-Analysis | E | | | | | | | | 2 | 0 | 2 | 2 | 2 | NA | Meta-Analysis | 2 | 2 | 12 |
| **17** | Finkelstein et al (2002) | Vancomycin versus cefazolin prophylaxis for cardiac surgery in the setting of a high prevalence of methicillin-resistant Staphylococcal infections | E | | | √ | | | | | 2 | 0 | 2 | 2 | 2 | 2 | Double Blind Control Trial | 2 | 2 | 14 |
| **18** | Francis et al(2013) | Timing of prophylactic antibiotic at caesarean section: a double-blinded, randomised trial | E | | √ | | | | | | 2 | 0 | 2 | 2 | 2 | 2 | Prospective-Double Blinded | 2 | 2 | 14 |

 https://doi.org/10.61919/k21qsv37

| ID # | Author & year | Title | Theme | | | | | | | | | | | | | | Study design | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lang | Antibiotic prophylaxis | Timings | Choice | Adherence | Knowledge | Barrier | Study about various countries | Objectives clearly defined | Tool validity & reliability / Rigor | Study design is evident and appropriate | Sampling method Appropriate | Data analysis sufficiently rigorous | Ethical Consideration | | Inclusion criteria are defined | Conclusions supported by the results | Total score |
| **19** | Gagliardi et al (2009) | Factors influencing antibiotic prophylaxis for surgical site infection prevention in general surgery: a review of the literature | E | | | √ | | | | | 2 | 0 | 0 | 2 | 2 | NA | Scoping Review | 2 | 2 | 10 |
| **20** | Garey et al (2008) | Interrupted Time Series Analysis of Vancomycin Compared to Cefuroxime for Surgical Prophylaxis in Patients Undergoing Cardiac Surgery | E | | | √ | | | | | 2 | 0 | 2 | 2 | 0 | 2 | Prospective | 2 | 2 | 12 |
| **21** | Giusti et al (2016) | Surgical antibiotic prophylaxis in children: a mixed-method study on healthcare professionals' attitudes | E | | | | | √ | | | 2 | 0 | 2 | 1 | 2 | 2 | | 2 | 2 | 13 |
| **22** | Grujic et al (2010) | Preoperative Administration of Cephalosporins for Elective Caesarean Delivery. | E | | | √ | | | | | 2 | 0 | 2 | 2 | 2 | 0 | Prospective | 2 | 2 | 12 |
| **23** | Hawan et al (2013) | Timing of Surgical Antibiotic Prophylaxis and the Risk of Surgical Site Infection | E | | √ | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | Retrospective | 2 | 2 | 16 |
| **24** | Hooper et al (2015) | Surgical site infection—a population-based study in Australian adults measuring the compliance with and correct timing of appropriate antibiotic prophylaxis | E | | | | | | √ | | 2 | 0 | 2 | 2 | 2 | 2 | Care Tract Study | 2 | 2 | 14 |
| **25** | Kasteren et al (2003) | Adherence to local hospital guidelines for surgical antimicrobial prophylaxis: a multicentre audit in Dutch hospitals | E | | | | √ | | | √ | 2 | 0 | 2 | 1 | 2 | 0 | Prospective | 0 | 2 | 9 |
| **26** | Kasteren et al (2007) | Antibiotic prophylaxis and the risk of surgical site infections following total hip arthroplasty: timely administration is the most important factor | E | | √ | | | | | | 2 | 0 | 2 | 1 | 2 | 0 | Prospective | 2 | 2 | 11 |
| **27** | Khan et al(2006) | Current challenges in adherence to clinical guidelines for antibiotic prophylaxis in surgery | E | | | | √ | | | | 2 | NA | 2 | 2 | 0 | NA | Literature Review | 2 | 1 | 9 |
| **28** | Madubueze et al (2015) | Attitudes of Nigerian orthopaedic surgeons to the use of prophylactic antibiotics | E | | | | | √ | | | 2 | 0 | 2 | 2 | 2 | 0 | Observational | 2 | 2 | 12 |
| **29** | Marwa et al(2015) | Cefepime versus Ceftriaxone for perioperative systemic antibiotic prophylaxis in elective orthopaedic surgery at Bugando Medical Centre, Mwanza, Tanzania: a randomised clinical study | E | | | √ | | | | | 2 | 0 | 2 | 2 | 2 | 2 | Prospective - Randomised | 2 | 2 | 14 |
| **30** | Mujagic et al (2014) | Evaluating the optimal timings of surgical antimicrobial prophylaxis: study protocol for a randomised controlled trial'' | E | | √ | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | Randomized Control | 2 | 2 | 16 |
| **31** | Napolitano et al (2013) | Evaluation of the appropriate perioperative antibiotic prophylaxis in Italy | E | | | | √ | | | √ | 2 | 2 | 2 | 2 | 2 | 2 | Cross Sectional | 2 | 2 | 16 |
| **32** | Nddeo et al(2015) | Effects of an Educational Module in Rationalising Surgical Prophylaxis | E | | | | | √ | | | 2 | 0 | 2 | 1 | 2 | 2 | Interventional Study | 2 | 2 | 13 |
| **33** | Pan et al(2008) | Improvement in the Timing of Antibiotic Administration by Using a Prophylactic Antibiotic Record Form | E | | √ | | | | | | 2 | 1 | 2 | 2 | 2 | 2 | Retrospective | 2 | 2 | 15 |
| **34** | Putnam et al (2015) | Adherence to surgical antibiotic prophylaxis remains a challenge despite multifaceted interventions. Surgery | E | | | | | | √ | | 2 | 0 | 2 | 2 | 2 | 2 | Prospective | 2 | 2 | 14 |
| **35** | Radji et al (2014) | Evaluation of antibiotic prophylaxis administration at the orthopaedic surgery clinic of a tertiary hospital in Jakarta, Indonesia | E | | | | √ | | | √ | 2 | 0 | 2 | 1 | 0 | 0 | Cross Sectional | 2 | 2 | 9 |
| **36** | Tan et al (2006) | Exploring obstacles to the proper timing of prophylactic antibiotics for surgical site infections. Qual Saf Health Care | E | | | | | √ | | | 2 | 0 | 2 | 2 | 2 | 2 | Qualitative Survey | 1 | 2 | 13 |

| ID # | Author & year | Title | Theme: Lang | Antibiotic prophylaxis | Timings | Choice | Adherence | Knowledge | Barrier | Study about various countries | Objectives clearly defined | Tool validity & reliability / Rigor | Study design is evident and appropriate | Sampling method Appropriate | Data analysis sufficiently rigorous | Ethical Consideration | Study design | Inclusion criteria are defined | Conclusions supported by the results | Total score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **37** | Tourmousoglou et al (2007) | Adherence to guidelines for antibiotic prophylaxis in general surgery: a critical appraisal | E | | | | √ | | | √ | 2 | 0 | 2 | 1 | 2 | 0 | Prospective | 2 | 2 | 11 |
| **38** | Ukawa et al (2014) | Organisational culture affecting quality of care: guideline adherence in perioperative antibiotic use | E | | | | √ | | | √ | 2 | 2 | 2 | 1 | 2 | 0 | Retrospective | 2 | 2 | 13 |
| **39** | Weber (2008) | The timing of surgical antimicrobial prophylaxis | E | | √ | | | | | | 2 | 0 | 2 | 2 | 2 | 0 | Observational | 2 | 2 | 12 |
| **40** | Woodfield (2009) | A meta-analysis of randomised, controlled trials assessing the prophylactic use of ceftriaxone: a study of wound, chest, and urinary infections. World J Surg. | E | | | √ | | | | | 2 | 2 | 2 | 2 | 2 | NA | Meta-Analysis | 2 | 2 | 14 |
| **41** | Zelenitsky et al (2002) | Antibiotic Pharmacodynamics in Surgical Prophylaxis: An Association between Intraoperative Antibiotic Concentrations and Efficacy | E | | | √ | | | | | 2 | 0 | 2 | 2 | 2 | 0 | Prospective Randomized | 2 | 2 | 12 |

**SCORE KEY**

Yes (2) partial (1) No (0) Not Applicable (NA) Strength **of the study** (13-16 = Strong 8-12= Moderate less than 8 = weak)