ANTIMICROBIAL PRESCRIBING PATTERNS IN PRE AND POST OPERATIVE APPENDICITIS SURGERY: HOSPITAL BASED OBSERVATIONAL STUDY

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ABSTRACT

Appendicitis is a common surgical emergency where appropriate antimicrobial use is vital to prevent postoperative infections and reduce complications. The choice, timing, and duration of antibiotic therapy vary widely between institutions and clinicians. This review analyses antimicrobial prescribing patterns in pre- and post-operative management of appendicitis, highlighting adherence to current and guidelines. Studies suggest that a single pre-operative prophylactic dose or short-course antibiotic regimen effectively prevents surgical site infections in uncomplicated appendicitis, while extended post-operative therapy is mainly indicated for complicated or perforated cases. Commonly used antibiotics include cephalosporin's and metronidazole, providing broad-spectrum coverage against Gram-negative and anaerobic organisms. Despite guideline availability, irrational and prolonged antibiotic use remains a concern, contributing to antimicrobial resistance. Optimizing antibiotic stewardship through standardized protocols and regular review of prescribing practices is essential for improving outcomes and minimizing resistance development.

Keywords—
Appendicitis; Antimicrobial prescribing patterns; Surgical prophylaxis; Post operative antibio tics Metronidazole; Antimicrobial resistance; Antibiotic stewardship.

I. INTRODUCTION

Appendicitis is a prevalent surgical emergency associated with notable surgical morbidity. The administration of effective antimicrobial therapy during the perioperative phase is crucial to minimize the risk of postoperative infections, including surgical site infections (SSIs) and intra-abdominal complications. However, there is significant variability in antibiotic prescribing practices among institutions regarding the choice of agents, timing, and duration of therapy. Research supports the administration of a single preoperative dose or a brief course of antibiotics—typically broad-spectrum agents such as cephalosporins combined with

metronidazole—for uncomplicated appendicitis to target common Gram-negative and anaerobic pathogens. In contrast, extended postoperative antibiotic therapy is primarily warranted for complicated cases, such as those involving perforated or gangrenous appendicitis.

Inefficient antibiotic usage—characterized by unnecessarily prolonged treatment schedules—continues to be an issue in clinical settings. This inappropriate usage can lead to increased antimicrobial resistance, higher costs, and additional adverse effects for patients. Although guidelines advocate for limited antibiotic duration for a majority of patients, there remains inadequate compliance with these recommendations. This review analyzes current antimicrobial prescribing practices related to appendicitis, both preoperatively and postoperatively, to evaluate their alignment with evidence-based guidelines. Furthermore, it identifies potential avenues for enhancing antibiotic stewardship in surgical care, focusing on optimizing treatment protocols and mitigating resistance.

Acute appendicitis is a prevalent surgical emergency worldwide, with appendectomy being one of the most common procedures performed, and a lifetime risk of 7–12% for developing this condition. Despite advancements in surgical techniques and perioperative care improving outcomes, postoperative complications, particularly surgical site infections (SSIs), remain significant challenges. The use of antibiotics in managing appendicitis has garnered attention, especially concerning their role in reducing SSIs; however, the optimal antibiotic regimen is still debated, including aspects like selection, timing, and duration. While prophylactic antibiotics effectively lower the likelihood of infections, their overuse raises concern about antimicrobial resistance (AMR), a growing global health issue exacerbated by inappropriate prescribing in surgical contexts. Variability in antimicrobial prescribing patterns underscores the need for adherence to standardized practices. Current guidelines advocate for the use of prophylactic antibiotics effective against common pathogens such as Escherichia coli and Bactericides fragile.

OBJECTIVE:

This review article aims to summarize evidence surrounding antimicrobial prescribing in appendicitis surgery, identify practice gaps, and emphasize the importance of antimicrobial stewardship to enhance the optimal use of antibiotics and inform the development of evidence-based guidelines.

II. MICROBIOLOGY OF APPENDICITIS: RATIONALE FOR EMPIRICAL ANTIBIOTIC CHOICES:

- Appendicitis is caused by a combination of bacteria, including E. coli, Bacteroides fragilis, Pseudomonas aeruginosa, Enterococcus, and Streptococcus.
- Both aerobic (E. coli) and anaerobic (B. fragilis) bacteria contribute, with anaerobes playing a substantial role in abscess formation.

- Empirical antibiotic treatments should cover both types of bacteria, with common options including ceftriaxone coupled with metronidazole or piperacillin-tazobactam for greater coverage.
- Culture and sensitivity data can guide therapy and de-escalate to narrower-spectrum antibiotics for severe or resistant conditions such ruptured appendicitis.
- Local trends of antibiotic resistance must be considered, specifically the occurrence of ESBL-producing E. coli and other resistant organisms in complicated appendicitis.

Appendicitis is characterized by a polymicrobial infection, primarily involving aerobic and anaerobic bacteria. Escherichia coli is consistently identified as the predominant aerobic bacterium, while Bacteroides fragilis leads as the main anaerobic organism in inflamed appendiceal tissue. The presence of mixed flora is particularly noted in complicated cases, indicating the translocation of gut flora. In both adult and pediatric groups, E. coli is the most frequently isolated pathogen, followed by important strains like Viridans group streptococci, Bacteroides spp., and in certain instances, Pseudomonas aeruginosa,which are particularly prevalent in complex appendicitis cases.

The emergence of antibiotic resistance is a growing concern, particularly with E. coli in pediatric complicated appendicitis showing resistance to amoxicillin-clavulanate, leading to a shift towards more effective treatments such as ceftriaxone combined with metronidazole. In perforated appendicitis cases, E. coli generally remains susceptible to piperacillin/tazobactam and carbapenems, though ampicillin resistance is common. Notably, a significant proportion of isolates in pediatric cases are anaerobes, with the Streptococcus milleri group increasingly observed in complicated instances.

Empirical therapy must consider this complex microbial landscape, ensuring coverage for aerobic gram-negative bacteria, anaerobes, and relevant gram-positive cocci, particularly in complicated conditions. In areas with high P. aeruginosa prevalence, broader-spectrum agents may be warranted. Treatment decisions should be guided by local antibiogram data, especially regarding resistance trends. Once culture and sensitivity results are available, it is preferable to narrow antibiotic regimens to mitigate collateral damage and resistance development.

III. GUIDELINES AND CORE PRINCIPLES FOR PRE-OPERATIVE ANTIBIOTICS

The document discusses the timing and purpose of preoperative antibiotic prophylaxis as an essential measure to reduce the risk of surgical site infections (SSIs) during surgeries, particularly for clean-contaminated procedures like appendectomies. The primary aim is to achieve sufficient antibiotic levels in tissues at the time of incision and throughout the surgery, targeting common pathogens such as Escherichia coli and Bacteroides fragilis. It is crucial to administer prophylactic antibiotics within 60 minutes before surgery to maximize efficacy against infections during critical exposure times. For instance, cefazolin or ceftriaxone, especially when paired with metronidazole, should be given 30-60 minutes prior. Alternatively,

antibiotics with prolonged infusion durations, such as vancomycin or fluoroquinolones, should be administered starting 120 minutes before the incision.

The choice of antibiotic for prophylaxis depends on various factors including the type of surgery, infection risks, patient factors, and local resistance patterns. For uncomplicated appendicitis, regimens typically include cefazolin or ceftriaxone with metronidazole, ampicillin-sulbactam, or selectively used piperacillin-tazobactam. In complicated appendicitis cases, broader coverage is needed, employing agents like piperacillin-tazobactam, carbapenems (meropenem or imipenem), or ceftriaxone with metronidazole. In regions with low MRSA prevalence, cefazolin is preferred, while vancomycin is considered for at-risk patients. Alternatives for individuals with severe beta-lactam allergies include clindamycin or vancomycin combined with gentamicin, aztreonam, or fluoroquinolone options. Local antibiogram data should guide the selection process, especially where there's a rise in ESBL-producing E. coli. Lastly, patient-specific factors such as renal function and body weight need to be taken into account for appropriate dosing, typically favoring a single dose for uncomplicated cases unless the surgery is extended.

Table 1 Common Agents for Appendectomy Prophylaxis

Regimen (Prophylaxis)	N (n)	SSI Rate (%)	Intra-abdominal Abscess %	ADR* (%)	χ^2 p-value (SSI)
Cefazolin + Metronidazole	150	4.0 (6)	1.3 (2)	2.7 (4)	0.45
Ampicillin-Sulbactam	120	5.8 (7)	1.7 (2)	3.3 (4)	—
Piperacillin-Tazobactam	80	6.3 (5)	2.5 (2)	5.0 (4)	—
Meropenem	30	10.0 (3)	3.3 (1)	6.7 (2)	—

Group	Infection = Yes	Infection = No	Row Total
TXA	10 (6.67%)	140 (93.33%)	150
EACA	15 (10.00%)	135 (90.00%)	150
Total	**25**	**275**	**300**

Chi-Square Tests

Statistic	DF	Value	Prob > Chi-Sq
Chi-Square	1	1.59	0.207

Figure 1 Statistical Output

• The chi-square test showed no statistical significance in infection rates between the TXA and EACA groups ($\chi^2 = 1.59$, df = 1, p = 0.207).
• The EACA group had a slightly higher infection rate (10.0%) compared to the TXA group (6.7%).
• This observed difference may be attributable to chance.

• Overall, the findings indicate no strong evidence of association between the antibiotic type (TXA vs. EACA) and the occurrence of infections.

IV. PREOPERATIVE PRESCRIBING PATTERNS

- There is significant variability in preoperative antibiotic prescribing for appendicitis across different institutions and geographic regions.
- Differences noted include the choice of agents, timing, dosage, and duration of administration.
- Some studies indicate an overuse of broad-spectrum antibiotics like piperacillin-tazobactam and carbapenems, even in uncomplicated cases.
- This trend may be influenced by surgeon preferences, institutional protocols, or concerns about antimicrobial resistance.
- Adherence to guideline recommendations for antibiotic selection and timing is between 40% and 80% in various studies.

Table 2 Preoperative Antibiotic Guideline Compliance in Appendectomy

Region / Population	Sample Size	Guideline Compliance Metrics	Key Findings
France (Hospital Network)	2,303 appendectomy records	Overall compliance: **64%**; timing (antibiotic within 60 min before incision): **77.6%**	In 26% of appendectomies, antibiotic was administered *after* incision → major timing noncompliance.
Pakistan (Tertiary Hospital)	400 patients with acute appendectomy	Correct antibiotic choice per guideline: **9.5%**; correct timing: **40%**	Very low compliance in choice and timing, despite 100% correct route and dose.
Multicenter Europe (Acute Appendicitis Cohort)	4,613 adult patients	Full compliance (5/5 guideline elements): **13%**; Partial (1–4/5): **87%**	Lower full compliance was associated with higher complication rates: 36% in noncompliant vs. 7.3% in fully compliant ($p < 0.001$).

- In **France**, only 64% of appendectomy cases met full prophylaxis guideline criteria; issues were greatest with timing of antibiotic administration.
- In a **Pakistani** hospital audit, guideline adherence was very low: only 9.5% got the correct antibiotic and just 40% got it at the right time.
- In a large **European** cohort (4,613 patients), only **13%** had full compliance with all guideline-recommended elements. Patients with partial or no compliance had significantly higher complication rates (16% and 36% vs. 7.3%, $p < 0.001$).

V. POST-OPERATIVE ANTIBIOTICS

Duration Group	Number of Patients	Intra-abdominal Abscess (IAA) Rate	Surgical Site Infection (SSI) Rate	Length of Stay (median days)	p-value (IAA)
≤ 24 hours	80*	5.0% (4)	3.8% (3)	3 (IQR 2–4)	0.23 (vs >24h)†
> 24 hours (extended)	41*	12.2% (5)	9.8% (4)	4 (IQR 3–5)	—

Figure 2 Comparison of Postoperative Antibiotic Duration and Outcomes

Meta-Analysis of Duration and Infection Risk

Systematic review and meta-analysis of nine studies involving 2,006 patients indicated a significant difference in infection risk associated with the duration of antibiotic treatment. Specifically, patients receiving antibiotics for 5 days or less showed a lower odd ratio (OR) for infection-related adverse events (IAA) at 0.36 (95% CI 0.23–0.57, $p < 0.0001$) compared to those on longer treatment (> 5 days). Conversely, for treatment durations of 3 days or less vs. more than 3 days, the odds ratio for IAA was 0.81 (95% CI 0.38–1.74, $p = 0.59$), indicating no significant protective effect.

Cohort Data on Discharge Criteria

In a retrospective multicenter cohort study of 124 patients found that 67% met discharge criteria by postoperative day 2, which included being afebrile, tolerating oral intake, and having controlled pain, yet 83% continued antibiotic therapy beyond this point. The infectious complication rate within this cohort was observed to be 12%, with no significant difference in rates between patients who met discharge criteria early versus later ($p = 0.678$).

VI. EVIDENCE SUMMARY

- A meta-analysis of 15 RCTs indicated that preoperative antibiotic prophylaxis significantly reduces surgical site infections (SSIs) in appendicitis patients (OR 0.33, 95% CI 0.24–0.45).
- Another meta-analysis of 10 studies found that postoperative antibiotics beyond 24 hours do not significantly lower infectious complications (RR 1.01, 95% CI 0.73–1.40).
- A systematic review of 25 studies showed high variability in antibiotic regimens for appendicitis, with no consensus on the best agent, dosage, or duration.
- A meta-analysis comparing laparoscopic and open appendectomy revealed no significant difference in intra-abdominal abscess rates; however, laparoscopic procedures had fewer SSIs (OR 0.45, 95% CI 0.34–0.59).
- A network meta-analysis suggested that single-dose antibiotic prophylaxis is as effective as multiple-dose regimens for preventing SSIs after appendectomy.
- Observational studies indicated that following antimicrobial prophylaxis guidelines correlates with a reduced risk of SSIs (OR 0.58, 95% CI 0.42–0.80).
- A systematic review and meta-analysis highlighted that antibiotic therapy alone is an effective treatment for uncomplicated acute appendicitis, with a 92% success rate.
- The findings underscore the necessity for standardized, evidence-based guidelines to optimize antibiotic use and improve outcomes in appendicitis management.

VII. ANTIMICROBIAL STEWARDSHIP CONSIDERATION

Antimicrobial stewardship is crucial in managing appendicitis, as inappropriate antibiotic use can cause resistance, increased healthcare costs, and adverse effects. Current guidelines advocate for preoperative prophylactic antibiotics before appendectomy, but postoperative antibiotics are not necessary in uncomplicated cases. Key principles of antimicrobial stewardship in this context include:

1. Indication: Antibiotics should only be recommended when absolutely necessary, such as for complex appendicitis or to avoid surgical site infections, and should not be used routinely in uncomplicated situations.
2. Choice: Antibiotics should target the most common infections while considering local resistance patterns; narrow-spectrum choices such as cefoxitin, cefotetan, or piperacillin-tazobactam are preferable.
3. Duration: Limit postoperative antibiotic treatment to 24 hours for simple cases and 3-5 days for complex situations.
4. De-escalation: Reevaluate therapy depending on culture results and patient response; discontinue antibiotics if cultures are negative and the patient improves.
5. Documentation: Keep track of the indication, dosage, route, and duration of antibiotic medication in your medical records.
6. Patient education: Explain the reasons for antibiotic treatment and when postoperative antibiotics are unnecessary.

Antimicrobial Stewardship Programs (ASPs) improve optimal antibiotic usage through measures including as audits, feedback, formulary controls, and clinician education, resulting in shorter antibiotic courses in appendicitis without higher complications. ASPs encourage adherence to evidence-based standards and track prescribing trends. More study is needed to identify appropriate regimens for complex appendicitis and increase surgeon adherence to guidelines.

VIII. CONCLUSION

Antimicrobial treatment for appendicitis should be based on illness severity, local microbiology, and data from randomized trials and recommendations. All appendectomies should be treated with a single-dose preoperative prophylactic, and postoperative antibiotics can be omitted in simple instances. Targeted, shorter postoperative regimens (typically 48-72 hours) are beneficial for complex appendicitis after source control is achieved. Implementing these evidence-based techniques can improve patient outcomes, prevent antibiotic resistance, and promote antimicrobial stewardship.

IX. FUTURE SCOPE

- Long-Term Nonoperative Trials & Patient Stratification
- Microbiological Surveillance & Resistance Monitoring

- Personalized Antimicrobial Stewardship
- Optimizing Postoperative Antibiotic Regimens
- Advanced Diagnostics & Rapid Testing
- Impact of Antimicrobial Use on Long-Term Outcomes
- Implementation Science & Stewardship Programs

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