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ANTIBIOTIC RESISTANCE AND MODERN STRATEGIES OF RATIONAL ANTIBACTERIAL THERAPY IN ODONTOGENIC INFECTIONS

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ABSTRACT

Background: Odontogenic infections are predominantly polymicrobial and are associated with a substantial burden of unnecessary antibiotic exposure. Objective: To critically synthesize contemporary evidence on antimicrobial resistance in odontogenic infections and develop a source-control-first framework for rational antibacterial prescribing. Methods: A focused narrative evidence synthesis was conducted using published clinical guidelines, peer-reviewed systematic reviews, observational research and the 2025 WHO surveillance report. No original patient-level dataset was available. Results: The reviewed evidence consistently prioritizes definitive dental intervention, drainage and removal of the infectious source over routine systemic antibiotics for localized disease. A 2026 systematic review of 37 studies reports increasing variability in susceptibility, notably for clindamycin, while emphasizing the value of local microbiological surveillance. Antibiotic treatment is indicated for spreading infection, systemic involvement and selected high-risk presentations. Conclusions: Rational management requires clinical severity assessment, prompt source control, cautious empiric selection using local guidelines, early reassessment and culture-guided modification in complicated cases. Published resistance estimates should not be extrapolated directly to Bukhara without local antibiograms.

Keywords: odontogenic infection; antibiotic resistance; antimicrobial stewardship; dental abscess; source control; clindamycin; antimicrobial susceptibility; rational prescribing.

INTRODUCTION

Odontogenic infections arise from dental pulp, periodontal tissues or pericoronal structures and range from localized inflammatory lesions to rapidly progressive infections of the fascial spaces. Their microbial ecology includes oral streptococci and anaerobic species, with pathogen composition influenced by anatomical location, prior antimicrobial exposure

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and disease severity. Because the odontogenic focus often contains necrotic tissue and poorly perfused collections, antibiotics cannot reliably replace drainage, endodontic management or extraction when these measures are clinically indicated. At the same time, indiscriminate antibacterial prescribing exposes patients to drug-related complications, encourages selection of resistant organisms and may delay definitive intervention [1–3].

Antimicrobial resistance is an expanding health-system challenge. The WHO Global Antibiotic Resistance Surveillance Report 2025 describes broad international resistance trends, although its surveillance estimates do not directly quantify resistance in odontogenic infections [4]. Dentistry has a specific stewardship responsibility because antibiotics are frequently prescribed for pain or localized swelling even when procedural treatment is the principal intervention. The present article aims to integrate microbiological findings with evidence-based clinical decision making, highlighting the conditions in which systemic therapy is justified and identifying gaps in local susceptibility data relevant to Central Asian settings.

LITERATURE REVIEW

The evidence-based American Dental Association guideline found negligible or uncertain benefit from antibiotics for most pulpal and periapical pain conditions in immunocompetent adults and recommended prioritizing definitive conservative dental treatment. Systemic involvement, such as fever or malaise, changes the risk-benefit balance and justifies adjunctive antibiotic therapy alongside urgent dental intervention [1]. The Scottish Dental Clinical Effectiveness Programme likewise advises drainage and elimination of the source as initial measures and reserves antibiotics principally for spreading or systemic infection, with a review ideally at approximately three days [2]. These recommendations relate to defined clinical populations and must not be applied without adjustment to immunocompromised patients or deep-space infections.

A 2022 scoping review of prospective and experimental investigations identified 21 studies involving 1,506 patients and described substantial heterogeneity in resistance across aerobic and facultative anaerobic organisms [5]. A more recent 2026 systematic review examined 37 eligible studies, comprising 10 prospective and 27 retrospective investigations, and reported concerns about penicillin-class susceptibility in some settings and notable clindamycin resistance; treatment recommendations were conditioned by severity, allergy assessment and local susceptibility profiles [6]. A separate analysis of 740 cases over 12 years further underlines the value of linking resistance data with real clinical outcomes rather than relying solely on in-vitro susceptibility [7].

A systematic review of treatment duration emphasizes that antibiotic courses should be determined by infection severity, the completeness of source control and response to treatment rather than habitually extended [8]. These studies support a stewardship model in which the immediate task is to classify clinical risk, provide procedural care and prescribe the narrowest effective regimen when antibiotics are genuinely required. Differences between recommendations for localized ambulatory infection and severe hospital-managed infection should be explicitly maintained.

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MATERIALS AND METHODS

This work is a structured narrative review with an applied clinical decision framework, not a prospective clinical trial or a systematic review with PRISMA-compliant screening. Source materials were selected for relevance to odontogenic infection, bacterial resistance, antimicrobial prescribing and emergency dental care. Priority was given to peer-reviewed guidelines and systematic reviews, followed by clinical observational analyses. Key sources comprise the American Dental Association guideline, SDCEP prescribing guidance, the 2025 WHO surveillance report and selected reviews published in 2022–2026 [1–8]. Evidence was summarized qualitatively by clinical presentation, need for procedural source control, microbial susceptibility considerations, reassessment and escalation. Published numbers were reproduced only when explicitly reported; no patient outcomes, pooled resistance rates or statistical significance estimates were generated for the present author.

A conceptual decision pathway was developed by translating convergent recommendations into steps that can be evaluated in a subsequent local clinical audit. The pathway is not a validated prediction rule. For a future observational investigation, relevant outcomes would include the proportion of visits resulting in an antibiotic prescription without a guideline-supported indication, documented definitive treatment, need for re-intervention, 72-hour clinical reassessment, microbiological sampling in complicated infections and prescription changes after culture results. No ethics approval or patient enrollment is claimed for the current literature-based manuscript.

RESULTS

The synthesis yielded four consistent findings. First, prompt treatment of the dental source is the principal intervention for localized odontogenic infections; systemic antibacterial therapy is not routinely indicated for uncomplicated localized pulpal or periapical pain in otherwise immunocompetent adults [1,2]. Second, spreading cellulitis, fever, malaise, deep fascial-space involvement or other systemic warning signs require urgent evaluation, source control and appropriately selected antibiotics, with hospital-based treatment when clinically necessary. Third, resistance patterns differ by organism, geography, clinical setting and previous antibiotic exposure, making a single universal susceptibility estimate unsuitable for individual practice. Fourth, early reassessment and short, response-guided courses can reduce avoidable antimicrobial exposure [2,6,8].

Clinical presentation	Primary management	Antibiotic decision
Symptomatic pulpitis or localized periapical pain	Definitive dental treatment and analgesia as appropriate	Generally not recommended in immunocompetent adults
Localized drainable abscess without systemic illness	Drainage and treatment/removal of the source	Usually unnecessary when definitive care is available; assess access and progression risk
Spreading swelling,	Urgent drainage/source	Indicated as adjunct; use

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cellulitis or systemic involvement	control and clinical severity assessment	local guideline and patient factors
Deep-space infection, airway concern or sepsis	Emergency surgical/medical referral and monitored treatment	Hospital-directed therapy, microbiological sampling where feasible

Table 1. Evidence-aligned clinical decision categories, adapted conceptually from published ADA and SDCEP guidance [1,2]. This is not a drug-prescribing protocol.

The updated systematic review by Schmid and colleagues provides a transparent illustration of the evidence base: of 37 included studies, 10 were prospective and 27 retrospective [6]. Figure 1 displays this published study-design distribution; it does not represent a new literature search by the present author. Because observational designs predominate, the reported resistance patterns must be interpreted with attention to referral bias, differences in sampling and laboratory methods, and the severity of patients included.

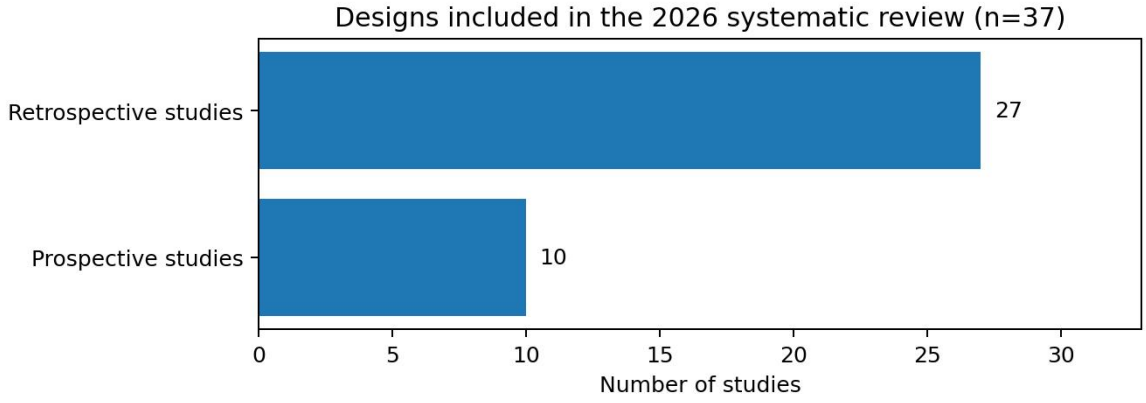


Figure 1. Published study designs in Schmid et al. (2026): 10 prospective and 27 retrospective studies, n=37 [6].

Antibiotic-related consideration	Evidence-based interpretation	Stewardship response
Penicillin-class agents	Susceptibility depends on species and local resistance; narrow-spectrum options remain relevant in selected uncomplicated cases	Follow local guidance, documented allergies, severity and prior exposure
Amoxicillin/clavulanate	Broader coverage may be useful in selected complicated situations, but is not automatically necessary	Avoid routine escalation when narrower treatment suffices
Clindamycin	Clinically important resistance and adverse-	Do not use automatically for an unverified penicillin-

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	effect concerns; C. difficile risk	allergy label
Metronidazole	Active against many obligate anaerobes but insufficient alone for all mixed infections	Use in appropriate combinations only when indicated
Culture and susceptibility testing	Most useful in severe, recurrent, unusual or nonresponding infections	Obtain appropriate samples when feasible and adjust treatment

Table 2. Qualitative synthesis of antibacterial selection considerations [1,2,5,6]. No local antibiogram was supplied.

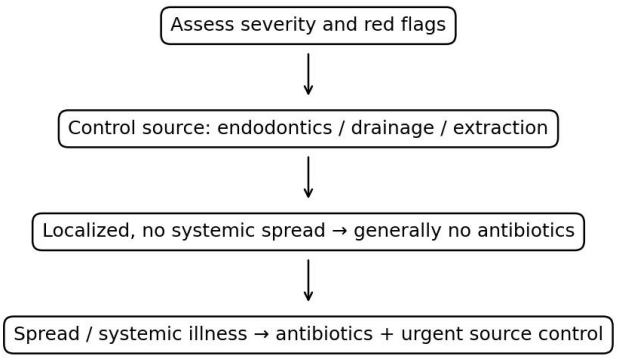


Figure 2. Conceptual source-control-first management pathway. Adapted from the principles of ADA and SDCEP guidance [1,2]; not validated in a local cohort.

DISCUSSION

The central implication of the synthesis is that antimicrobial stewardship in dental practice begins with diagnosis and procedural decisions, rather than with drug selection. A localized infection may persist when the underlying necrotic pulp or abscess cavity is not addressed, regardless of the selected antibiotic. Conversely, routine prescribing after adequate source control in the absence of systemic disease offers limited benefit and increases treatment burden. Contemporary clinical recommendations therefore distinguish definitive dental treatment from adjunctive antimicrobial therapy and emphasize timely reassessment if symptoms fail to improve [1,2].

The microbiology of odontogenic infections complicates empirical treatment because aerobic and anaerobic organisms can coexist within a single lesion. Susceptibility datasets disproportionately reflect severe hospitalized cases where sampling is performed; these populations cannot serve as straightforward proxies for uncomplicated community

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dentistry. The 2026 systematic review highlights clinically relevant resistance, including concerns about clindamycin, but its conclusions should not be interpreted as universal percentages for Uzbekistan [6]. A locally maintained antibiogram and cooperation between dental surgeons and microbiology laboratories would facilitate more defensible empirical choices and monitoring of changing susceptibility over time.

Penicillin allergy represents a further practical challenge. An unverified allergy label may lead clinicians toward broader or less suitable alternatives. Detailed assessment of the reaction history, and formal evaluation where appropriate, can help distinguish true immediate hypersensitivity from nonspecific adverse effects. Severe infections also require consideration of host factors such as diabetes, immunosuppression, inability to swallow, dehydration and airway compromise. These factors influence the urgency of referral and monitoring and make uniform outpatient antibiotic rules inappropriate.

The proposed management pathway could be assessed locally through an audit of dental records, including the documented diagnosis, severity, source-control procedure, indication for antibiotics, choice and duration of therapy, allergy history, early reassessment and escalation. A subsequent prospective study might assess the association between guideline implementation and reductions in potentially unnecessary prescribing while monitoring treatment failure and safety outcomes. Such research should preregister its endpoints, record potential confounders and obtain appropriate ethical approval before any patient data are collected.

The limitations of this review are substantial: it is a selective narrative synthesis without duplicate screening, quality scoring or meta-analysis; no original microbiological samples or patient outcomes were available; and findings originate in varied geographic and care settings. The diagrams are respectively a visualization of published study counts and a conceptual clinical workflow, not new treatment effects. Nevertheless, a careful separation of indication, source control, resistance-informed selection and follow-up provides a coherent foundation for rational clinical practice and a prospective regional research program.

CONCLUSION

Rational antibacterial therapy for odontogenic infections requires an integrated approach based on clinical severity, definitive elimination of the infectious source and judicious adjunctive antibiotic use. For most localized pulpal and periapical conditions in immunocompetent adults, procedural dental management is preferred over routine systemic antibiotics. Antibiotic treatment becomes appropriate when infection spreads, systemic illness develops or other patient-specific risk factors indicate a need for escalation. Because resistance is heterogeneous, prescribing decisions should follow current local guidance, with culture-directed modification in complicated or nonresponding cases. A structured local audit and prospective microbiological surveillance are needed before any quantitative claims can be made about resistance prevalence or treatment effectiveness in Bukhara.

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