

# Antibiotic Resistance – A Threat to Public Health – A Review

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## ABSTRACT

Antibiotics which served as life saver during world war has emerged as a threat . In the 21st century, antimicrobial resistance (AMR) has become one of the serious threats to global health. The inappropriate use of antibiotics in both medical and dental practices speeds up the rise of resistant microorganisms. Dentistry plays a major role in community antibiotic prescriptions, making up about 7–10% of total outpatient antibiotic use in several healthcare systems. This study aimed to review the literature on antibiotic resistance as a public health threat. A systematic search was conducted across major biomedical databases up to 2024. Cross-sectional and observational studies assessing antibiotic prescribing and AMR awareness in dentistry were included. Inappropriate antibiotic prescribing was found in multiple regions, especially in developing countries. Knowledge gaps regarding antibiotic resistance mechanisms and stewardship principles were evident among dental practitioners and students. Inappropriate antibiotic prescribing in dentistry is a major contributor to antimicrobial resistance. Strengthening antimicrobial stewardship programs and promoting evidence-based prescribing are essential.

**Keywords:** Antimicrobial resistance, AMR in dentistry, Stewardship, antibiotics, public threat

## INTRODUCTION

There was a breakthrough in the field of medicine when Alexander Flemming introduced Penicillin. It was a life saver during world war II. But on later days resistance evolved. In the 21<sup>st</sup> century, people started using antibiotics often and in some regions they are available over the counter, leading to misuse and inappropriate consumption. Antibiotics, now a days are used like any other common drug without knowing the exact spectrum of action and duration of action and the exact course to be taken (1,2). Such misuse significantly contributes to antimicrobial resistance (AMR) (2). According to the World Health Organization (WHO), antimicrobial resistance is the ability of microorganisms to survive exposure to antimicrobial drugs that were previously effective against them (3). AMR poses a critical threat to global health, food security, and development (3). Global surveillance data indicate that resistant infections are associated with increased morbidity, mortality, and

healthcare costs (4). Microorganism started to resist to the action of antibiotics as Darwin stated Survival of the fittest. Healthcare professionals, including dentists, contribute to the development of AMR (5). Dentists account for approximately 7–10% of outpatient antibiotic prescriptions in several countries (6). While antibiotics are essential for managing odontogenic infections with systemic involvement, many dental conditions such as irreversible pulpitis and localized periapical abscesses can be effectively treated with operative measures alone (7). Previous research demonstrates that dentists frequently deviate from evidence-based prescribing guidelines (8). Broad-spectrum antibiotics are often preferred over narrow-spectrum alternatives, increasing selective pressure on oral microbiota (9). International health organizations emphasize the urgent need for antimicrobial stewardship in dentistry (3,10,11). This study aimed to study the antibiotic resistance that is evolving as a threat to public health and need for awareness program among dentists.

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## MATERIALS AND METHODS

A review was conducted by analysing various articles published on reputed journals. Studies evaluating antibiotic prescribing patterns and antimicrobial resistance awareness among dental practitioners and students were included. Databases searched included PubMed, Scopus, Google Scholar, Cureus, Bioinformation, IJDR, IJPI, and WJARR.

## RESULTS

### 3.1 Antibiotic Prescribing Patterns

Across included studies, amoxicillin was the most commonly prescribed antibiotic, often combined with clavulanic acid (13,14). Metronidazole was frequently used as adjunctive therapy (13).

Antibiotics were prescribed for conditions such as:

Irreversible pulpitis (7)

Localized periapical abscess without systemic signs (7)

Routine dental extraction (8)

Postoperative prophylaxis without clear indication (16)

These practices conflict with established clinical guidelines (7). A scoping review confirmed widespread inappropriate prescribing in dentistry across multiple countries (8).

### 3.2 Oral Microbiome and Resistance Mechanisms

The oral cavity contains complex biofilms capable of harboring resistant bacterial strains (17). Repeated exposure to antibiotics such as amoxicillin alters oral microbiota and increases resistant strains (18). Rising resistance has been documented among bacteria isolated from odontogenic infections (19). These findings highlight the need for rational prescribing practices (9).

### 3.3 Knowledge and Awareness of AMR

Although practitioners demonstrate general awareness of AMR (14), their understanding of resistance mechanisms and stewardship strategies varies (15). Among dental students, awareness depends on clinical and pharmacological training (15). Educational interventions and stewardship

programs significantly improve prescribing behavior (20).

### 3.4 Factors Influencing Inappropriate Prescribing

Key contributing factors include:

Patient expectations for antibiotics (13)

Defensive prescribing practices (5)

Lack of awareness of updated guidelines (7)

Over-the-counter antibiotic availability in some regions (1)

## DISCUSSION

This review confirms that inappropriate antibiotic prescribing remains prevalent in dentistry worldwide (8). Despite increased global awareness of AMR (3), clinical practice often does not align with evidence-based recommendations (7). Overuse of broad-spectrum antibiotics increases selective pressure within oral biofilms (9,17). The WHO AWaRe classification recommends prioritizing “Access” group antibiotics and minimizing “Watch” agents to reduce resistance (21). International antimicrobial stewardship initiatives emphasize prescription audits, clinician education, and regulatory frameworks (10). Surveillance studies demonstrate that structured interventions significantly reduce unnecessary antibiotic use (22). Integrating antimicrobial stewardship training into undergraduate curricula and continuing dental education is essential (20).

### Clinical and Public Health Implications

Antibiotics should not replace definitive operative treatment (7). Clear systemic involvement must be present before prescribing antibiotics. Narrow-spectrum agents should be preferred in accordance with WHO recommendations (21). Dental education programs must incorporate antimicrobial stewardship training (20). National surveillance systems should monitor dental antibiotic prescriptions (22).

## LIMITATIONS

Most included studies were cross-sectional and questionnaire-based (13–15). Self-reported prescribing patterns may introduce response bias. Geographic concentration of studies may limit generalizability.



## CONCLUSION

Antimicrobial resistance is one of the most serious public health challenges today. Dentistry, as one of the major contributors to community antibiotic prescriptions, has a vital role in addressing this crisis. This systematic review shows that inappropriate antibiotic prescribing continues to be common across various regions, especially for dental issues that can be managed with definitive procedures. The ongoing preference for broad-spectrum antibiotics and divergence from evidence-based guidelines increase selective pressure in oral biofilms, promoting resistance development and spread. Although there is general awareness of antimicrobial resistance among dental practitioners and students, meaningful changes in prescribing behavior require structured antimicrobial stewardship programs, ongoing professional education, and incorporating stewardship principles into educational curricula. Effective measures must occur on multiple levels. Clinically, antibiotics should only be prescribed when there is clear systemic involvement and when operative treatment is insufficient. At the educational level, dental schools need to enhance training in pharmacology, microbiology, and evidence-based prescribing. At the policy level, regulatory bodies should implement monitoring systems and encourage adherence to the WHO AWaRe framework. To preserve antibiotic effectiveness for future generations, immediate, coordinated, and ongoing actions are necessary. Dentists must shift from being contributors to antimicrobial resistance to becoming leaders in antimicrobial stewardship. Following guidelines, raising awareness, and practicing responsible prescribing are crucial to safeguarding global health and maintaining effective antimicrobial therapy.

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