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## Review Article

# Is the unregulated prescribing of antimicrobials in dentistry a key catalyst for antimicrobial resistance?

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## ABSTRACT

Antibiotics are essential for treating infections in routine dental practice. Their applications range from abscesses and pericoronitis to post-operative extraction, root canal therapy, space infections, and implant placements. However, unregulated, and uncontrolled antibiotic prescriptions to patients result in significant short- and long-term consequences, one of which is Antimicrobial Resistance (AMR). The growing threat of AMR is worldwide and is further turning into a pandemic monster. In times like these, it is often valid to ask whether unregulated antimicrobial prescription in dentistry is an important factor contributing to AMR. This article aims at answering this question along with providing necessary evidences and strategies to curb this issue in the landscape of dentistry.

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## 1. Introduction

Antibiotic prescriptions in dentistry make up 7 to 10% of total prescriptions in healthcare.<sup>1</sup> However, research suggests that 90% of these included antibiotics as their first line of treatment.<sup>2</sup> Lack of sufficient guidelines and awareness among dental practitioners, as well as non-clinical factors such as market pressure, patient pressure, fear of failure of current therapy, and so on, frequently lead to antimicrobials being prescribed for a regular dental evaluation.<sup>3</sup> A study in conducted in Turkey found that 20% of the dental practitioners prescribed antibiotics just for a routine dental examination.<sup>1,4</sup> This overuse on a frequent basis can lead to development of resistant strains of bacteria which are entirely ineffective to various therapies and can have detrimental effect on patients' overall health in the long term. This is where susceptibility to AMR comes into

play, with dentists gradually contributing to it as well as reprimanding their patients' health.

## 2. Discussion

### 2.1. The role of antibiotics in dental practice

Antibiotics are used extensively in dental practice to prevent and cure bacterial infections. Their use is indicated when oral bacterial invasions involve systemic involvement, such as odontogenic infections, abscesses, or space infections.<sup>3</sup> Antibiotics are also commonly used as a preventive measure in dental surgeries, including extractions and implant placements. They are significant in immunocompromised patients or those with pre-existing systemic conditions such as prosthetic heart valves or previous infective endocarditis.<sup>5,6</sup> Furthermore, antibiotics are used to treat post-operative infections or when there is a substantial risk of contamination during dental treatments.

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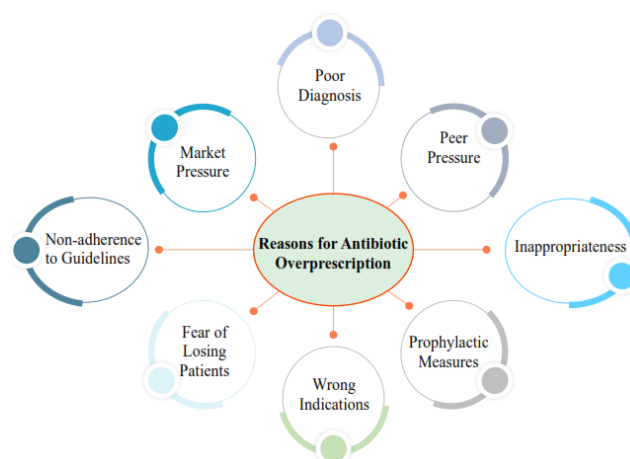
Penicillin, such as Amoxicillin and Ampicillin continue to be first-line antibiotics due to their efficiency against the prevalent oral microbiota, which includes species of *Streptococcus* and *Actinomyces*.<sup>7</sup> Clindamycin is a preferred choice for patients with penicillin allergies because of its broad spectrum of action, notably against anaerobic bacteria. Other options include azithromycin and clarithromycin, which are macrolides, and metronidazole, which is frequently coupled with penicillin for increased anaerobic coverage in severe infections.<sup>8</sup> Doxycycline and tetracycline are commonly used in periodontal therapy because of their efficacy against *Aggregatibacter actinomycetemcomitans* and their ability to inhibit matrix metalloproteinases.<sup>9</sup> Cephalosporins such as cephalexin, are sometimes advised where broader coverage is required. However, they are used with caution due to cross-reactivity with penicillins.<sup>4</sup> Antibiotic overuse and overprescription in dentistry settings significantly contribute to antimicrobial resistance. As a result of the growing concern about this worldwide issue, the function of antibiotics in dentistry has come under scrutiny.

## 2.2. Uncontrolled antibiotic prescriptions: A growing threat

In wealthy nations, antibiotic prescriptions account for over 7% to 10% of total antibiotics in healthcare.<sup>1</sup> The unregulated prescription of antibiotics in dentistry has arisen as a significant concern, particularly considering its contribution to antimicrobial resistance. Recent studies show that a significant number of antibiotic prescriptions in dentistry practice are not evidence-based. Estimates indicate that up to 80% of these prescriptions are redundant or inappropriate. Dentists gave antibiotics for various acute and chronic dental conditions that did not require antibiotic treatment in the first place and when local measures such as draining the infection, removing the pulp, or extracting the tooth were sufficient.<sup>1,10</sup> Inappropriate antibiotic prescription is not limited to India; it is a global issue, with research suggesting that dentists in both wealthy and developing countries fail to follow evidence based antimicrobial prescription. In a study conducted in Turkey, approximately three-fourths of the analyzed prescriptions showed inappropriate antibiotic usage, as existing guidelines and meta-analyses did not support antibiotic use for dental caries or diseases of the pulp and periapical tissues.<sup>4</sup> These irrational practices may also be due to their inattentive or careless behaviour since the rationale for antibiotic indication in one-fifth of prescriptions was a dental examination, which did not explicitly recommend antibiotic treatment.<sup>4</sup> This was exacerbated by increasing prescription rates for various antibiotic classes under uncertain indications. Studies have demonstrated an overall trend in Turkey towards amoxicillin + enzyme inhibitor use, with this medication being the most

chosen antibiotic for each of the diagnoses established by dentists in the study. This conclusion was consistent with dentists' preferences in Belgium and Spain, as opposed to the meagre rates of amoxicillin + enzyme inhibitor prescription in Norway and Wales.<sup>10</sup>

Despite appearing to provide significant efficacy, the predilection for broad-spectrum antibiotics in most nations may not be reasonable and is frequently inappropriate. A review found many non-clinical reasons, such as fear of losing patients, time constraints, training skills (uncertain diagnosis, incomplete therapy), and pressure from the patient on one side and market pressure from pharmaceutical corporations on the other, as leading dentists are increasingly prescribing antibiotics for non-clinical reasons<sup>1</sup>. A recent umbrella review of the global population revealed similar characteristics related to antibiotic prescribing in acute dental diseases, including a "just in case" strategy to avert significant complications, peer pressure from patients, and the impact of workload.<sup>1</sup> The trainers' lack of expertise regarding the proper use of antibiotics for dental diseases raises concerns about the quality of education provided to dental students as well. Antibiotic prescription rates for specialist qualified dentists (MDS) were lower than for general dental practitioners (BDS).<sup>1</sup> This indicates that awareness of appropriate antibiotic prescription should start in undergraduate training itself. Future interventions should align undergraduate curricula with current guidelines and promote antimicrobial stewardship. This indiscriminate use of antibiotics in dental treatment is especially alarming because it not only reduces their efficacy but also jeopardizes public health by contributing to Antimicrobial Resistance (AMR). This issue requires strict adherence to evidence-based prescribing practices, increased education for dental professionals, and the implementation of reliable antimicrobial stewardship programs to ensure antibiotics are used appropriately and effectively in dental care.



**Figure 1:** Reasons for antibiotic overprescription

### 2.3. *The relationship between antibiotic misuse and AMR*

Antibiotic misuse causes significant development of antimicrobial resistance (AMR). Evidence suggests that the repeated use of antibiotics whether through overprescription, wrong dosages, or situations where they are ineffective, causes microorganisms in the body to acquire resistance.<sup>11</sup> Repeated exposure over time, combined with additional factors such as antibiotic pollution, direct or indirect communication via human-animal contact, poor hygiene, and filthy facilities, offers an ideal environment for resistant bacteria to propagate, thrive, and multiply. This causes susceptible bacteria to die off resulting in the global threat known as AMR.<sup>10</sup>

One of the most important causes of antibiotic overuse, leading to AMR, is excessive antibiotic exposure. Antibiotics kill (or limit the growth of) bacteria that are susceptible to them, but bacteria that are unaffected by them continue to thrive. This selection mechanism affects more than only infection-causing microorganisms. Antibiotics influence the entire microbiome (also known as 'good bacteria'), causing an imbalance that can have major consequences on an individual's overall health and well-being.<sup>10</sup> Thus, antibiotic-resistant infections are associated with prolonged hospital stays, increased healthcare expenses, the requirement for more expensive and broader spectrum antibiotics, and poorer clinical outcomes.<sup>12</sup>

Other ways include the rate of antibiotic prescription. A systematic review indicated that India's prescription rate is significantly higher than 45.8% in England and 57.4% in Germany.<sup>1</sup> The higher the prescription rate, the greater the likelihood of antibiotic overuse, which leads to increased resistance. Several non-clinical reasons, such as fear of losing patients, time constraints, training skills (uncertain diagnosis, incomplete treatment), pressure from patients, and market pressure from pharmaceutical companies, all lead dentists to prescribe antibiotics outside clinical indications.<sup>1,11</sup> Although purchasing antibiotics over the counter is banned, a survey discovered that self-medication for dental problems was prevalent in India.<sup>13</sup> The perception of inadequate access to healthcare, chronic nature of the sickness, and having more than two symptoms, all increased the possibility of using over-the-counter medication. This indicates decreased awareness and increased susceptibility to AMR.<sup>1</sup>

Drug-resistant bacteria do not respect boundaries and can be found all over the world.<sup>4</sup> Everyone is at risk of getting infections that do not respond to antibiotics. Antibiotic resistance jeopardizes modern medicine, which relies on antibiotics for cancer treatments, organ transplants, and as pre- and post-op therapy.<sup>10</sup> Ensuring antibiotics use when necessary is therefore very critical in decreasing AMR.

### 2.4. *The impact of antimicrobial resistance on effective dental therapy*

Antimicrobial resistance (AMR) has a substantial and multifaceted impact on dental care, compromising infection management and overall patient outcomes. AMR hampers the treatment of dental infections by reducing the efficacy of routinely used antibiotics, resulting in longer and expensive therapy.<sup>12</sup> AMR dramatically reduces the efficacy of conventional antibiotics like amoxicillin, clindamycin, metronidazole etc. Resistant forms of bacteria, such as Streptococcus and Staphylococcus species may render these antibiotics ineffective resulting in persistent or recurrent infections despite appropriate treatment<sup>10</sup>. Furthermore, the presence of resistant microorganisms often calls for a more complex and extended treatment approach. When first-line antibiotics fail, dentists may need to use second or third-line antibiotics, which are more expensive and have greater potential for toxicity. In some circumstances, a longer course of therapy may be necessary, raising the risk of side effects and eventually affecting patient compliance. Patients who have infections with resistant organisms inevitably experience persistent pain, discomfort, and functional restrictions. The prolonged duration of symptoms and the necessity for more extensive therapies can have a detrimental effect on patients' quality of life, limiting their ability to engage in daily activities. Diseases that are resistant to regular medicines may spread beyond the oral cavity, resulting in systemic involvement such as bacteraemia or sepsis.<sup>14</sup> This is especially concerning for immunocompromised people or those with underlying health issues, as resistant infections can lead to severe systemic consequences and increased morbidity.<sup>12</sup> Even prophylactic measures before major surgeries are unsuccessful when the immune system is already impaired.

The economic burden of AMR is significant. The need for more expensive antibiotics, longer treatment durations,<sup>15</sup> and additional diagnostic tests to guide therapy can all considerably raise healthcare expenses.<sup>11,12</sup> As a result, managing treatment failures and complications often demand additional resources such as follow-up visits, hospitalizations, and surgical interventions, which further escalates the cost.

### 2.5. *Strategies to curb antibiotic overprescription in dentistry*

Dentists have been targeted by several AMS interventions due to their role in unnecessary antibiotic prescribing.<sup>1</sup> Implementing preventive measures to address the unregulated prescriptions causing resistance, in dentistry, necessitates a structured approach involving different stakeholders. International agencies such as the Centres for Disease Control and Prevention (CDC) have developed policies for appropriate antimicrobial agent use in health

care.<sup>15</sup> The CDC published Core Elements of Outpatient Antibiotic Stewardship, which include:<sup>2,15</sup>

1. Committing to optimize antibiotic prescribing.
2. Implement at least one policy or action to improve practice.
3. Monitoring antibiotic prescribing patterns and providing feedback to providers.
4. Provide education and expertise.<sup>2</sup>

The Infectious Diseases Society of America (IDSA),<sup>16,17</sup> World Health Organisation (WHO)<sup>18</sup> and the Society for Healthcare Epidemiology of America (SHEA)<sup>17</sup> offers guidelines regarding the application of AMS strategies in outpatient settings, including audits, clinician feedback, and education.<sup>2</sup> A multinational, multidisciplinary team created metrics to measure antibiotic use in outpatient settings, which can then be used to track and manage antibiotic prescribing. This is a rapidly expanding field, and dental practitioners have several options for dealing with AMS.<sup>2</sup>

Other recommendations include cooperating with pharmacists and other healthcare experts, involving the entire dental team in the solution and giving adequate training and mentorship to build a methodical approach to AMR caused by overprescription.<sup>1</sup> Measures for tracking are advised in order to provide objective feedback and the opportunity to alter the intervention. Validated metrics for assessing the quantity of antibiotic use in outpatient settings have been created, such as the number of prescriptions per defined population or the number of prescriptions and physician visits.<sup>2</sup> Other recommendations include providing educational tools for dentists and patients, promoting collaboration between national organizations such as the American Dental Association (ADA) and other dental associations, and integrating national prescribing recommendations into dental software so that practitioners can easily access them. In the United Kingdom, the Dental AMS Toolkit is an AMS software explicitly designed for dentists.<sup>2,19</sup> This toolkit was introduced in 2016 and created in collaboration with a diverse group of publics, private, and academic stakeholders, including professional associations (Faculty of General Dental Practice [UK] and British Dental Association). The UK toolkit provides patients with instructions about the correct usage of antibiotics, audit tools, education, and training for dentists on antibiotic use and the prevention of infections.<sup>2,19</sup> On the diagnostic front, considering the potential of recommending patients for penicillin allergy delabelling<sup>20</sup> can also help mitigate inappropriate prescription of drugs and increase patient safety. Similarly, implementing standardized infection control policies throughout dental clinics and providing ongoing training for dental personnel on infection control methods for example sterilization measures will help to reduce the prime factor of risk of infection.<sup>2,10</sup> By applying these strategies, the dental profession may considerably

reduce antibiotic overuse which majorly links to the global battle of AMR.

### 3. Conclusion

Antibiotic misuse is a serious issue that, in the long run, contributes strongly to Antimicrobial Resistance (AMR). This resistance acquired against certain species renders antibiotics ineffective in dental therapies. Dentists and their unregulated and over-prescription of antimicrobials in dentistry are a significant contributor to this. Incorrect diagnosis, wrong indications, not adhering to the given guidelines, peer pressure, market pressure, and 'just-in-case' prophylactic measures all lead these specialists to overprescribe antibiotics, thereby contributing to the global threat of AMR. This not only extends the duration of ongoing treatment of patients but also involves different lines of treatment, an even greater use of broad-spectrum antibiotics, prolonged symptoms and increased hospital stays. This has a substantial effect on patient's finances and most importantly, mental health due to increased distress caused by overprescription. As a result, the current system seems inappropriate and requires stringent guidelines and monitoring to limit the occurrence of AMR in the population. A combination of education, regulation, and collaboration at all healthcare system levels, towards unregulated antibiotic prescription will extensively reduce AMR and its further occurrences in the times to come.

### 4. Ethical Approval

Compliance with ethical standards.

### 5. Conflict of interest

No conflict of interest to be declared.

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None.

### 7. Acknowledgement

None.


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