

REVIEW ARTICLE

Antibiotic Stewardship in Dentistry: Clinical Realities, Behavioural Drivers, and the Dentist's Role in Combating Antimicrobial Resistance: The Superbug Pandemic

Dr. Vennela Beera^{1*}

¹ BDS, Government Dental College, Hyderabad, India

* Author of Correspondence: Dr. Vennela Beera, BDS, Government Dental College, Hyderabad, India

Email: beeravennela@gmail.com

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ABSTRACT

Antimicrobial resistance (AMR) is a serious global public health emergency, undermining the effectiveness of modern medicine and driven largely by inappropriate antibiotic use in outpatient settings. Dentists account for approximately 7–10% of community antibiotic prescriptions in many countries. Routine dental procedures, such as simple extractions, can expose patients to infections that were previously manageable with antibiotics but are now more dangerous due to antibiotic resistance. Dental professionals operate at the intersection of surgical care and medication use, making prescribing decisions under complex clinical, behavioural, and systemic pressures. In dentistry, antimicrobial exposure often occurs in short, episodic courses creating a distinct ecological pattern of selective pressure compared with medical prescribing. This review examines the interaction between resistance mechanisms and dental prescribing behaviour and evaluates practical strategies to reduce unnecessary antibiotic use in routine practice. Dentistry has substantial potential to strengthen antimicrobial stewardship in outpatient care. Application of the World Health Organization AWaRe (Access, Watch, Reserve) classification can promote the use of narrow-spectrum antibiotics when indicated. In addition, reinforcing WASH (Water, Sanitation, and Hygiene) practices reduces preventable infections and supports stewardship efforts.

Introduction

A patient presenting for a routine dental extraction or a minor cut injury may now face significant risk due to bacterial resistance, a growing global health concern often described as a silent pandemic. These conditions that were once easily managed with antibiotics are becoming increasingly complex due to evolving antimicrobial resistance. AMR is a growing global challenge characterised by rising consumption and increasing bacterial adaptations. Millions of deaths are projected if present trends continue unchecked [1].

The discovery of antibiotics began in the mid-20th century with the Waksman platform, in which soil microorganisms were screened for compounds capable of inhibiting pathogenic bacteria [2]. This approach led to the identification of major antibiotic classes, including aminoglycosides, tetracyclines, and macrolides, which became foundational to modern medicine. However, discovery slowed as repeated screenings yielded previously identified compounds, and target-based drug design using genomics and synthetic chemistry failed to replicate nature's efficiency. Difficulties in penetrating bacterial cell walls and overcoming efflux mechanisms rendered many synthetic candidates ineffective, contributing to a diminishing pipeline and the emergence of resistant strains [2].

Community-based antibiotic prescribing is a major driver of resistance. In many countries, dentists account for nearly 7–10% of outpatient antibiotic prescriptions in many countries [3]. Dental treatment is primarily managed through operative intervention such as root canal therapy, incision and drainage, or extraction rather than systemic antibiotics [4]. However, prescribing decisions are frequently influenced by patient expectations, clinical uncertainty, and time constraints. Studies indicate that many parents expect antibiotics even when they are not clinically indicated [5].

Effective patient communication is crucial. Explaining why antibiotics may not be beneficial, highlighting operative treatment options, and prescribing antibiotics according to the WHO AWaRe framework which classifies antibiotics

into Access (first choice, narrow spectrum), Watch (high resistance risk), and. Reserve (last resort, critical use) categories are essential components of stewardship. In addition, maintaining proper WASH (Water, Sanitation, Hygiene) standards and sterile clinical environments reduces infection risk and limits unnecessary antibiotic exposure.

How Antibiotic Resistance Develops

Bacteria develop resistance through several mechanisms:

1. Horizontal gene transfer: Bacteria exchange genetic material through plasmids, transposons, and integrons, effectively sharing resistance instructions across species [6].
2. Enzymatic inactivation: Bacteria produce enzymes, such as beta-lactamases, that degrade antibiotic molecules before they can act [6].
3. Target modification: Alteration of antibiotic binding sites prevents drugs from attaching to their intended targets [6].
4. Efflux pumps: Bacteria remove antibiotics before lethal concentrations can accumulate inside the cell [6].
5. Co-selection: Environmental pollutants, such as heavy metals, such as mercury, cadmium, and lead, may co-select for resistance genes located on the same plasmids as antibiotic resistance genes, promoting resistance without direct antibiotic exposure [6].

In clinical settings, these mechanisms coexist within the same bacterial population, mainly in polymicrobial odontogenic infections where selective pressure is repeated.

Repeated antibiotic exposure favours the survival of resistant strains. Environmental contamination, pharmaceutical waste and agricultural antibiotic use, further accelerate the spread [7].

Misuse and overprescription in both hospitals and outpatient settings significantly accelerate resistance. Llor and Bjerrum (2014) highlight that many prescriptions for self-limiting conditions provide minimal clinical benefit while increasing resistance,

adverse drug reactions, and healthcare costs [8].

Globally, inappropriate antibiotic use remains common, particularly in low and middle-income countries. Use of fixed-dose combination (FDCs) antibiotics is high. Regulatory loopholes allow unapproved FDCs to circulate. In India, nearly 47% of private sector antibiotic consumption involves FDCs, many of which are irrational and combine incompatible drugs [9-11].

An imbalance in AWaRe classification use has also been observed, with lower use of narrow-spectrum antibiotics and higher reliance on broad-spectrum agents. Poor WASH infrastructure further increases infection burden and antibiotic demand. Regulatory reform, rational prescribing, and improved infection control are essential to reduce unnecessary antibiotic exposure [10-12].

Without regulating FDCs, guideline-based prescribing alone cannot adequately reduce inappropriate exposure.

Antibiotic Prescribing in Dental Practice

Inflammatory vs Infectious Conditions

Most dental pain, including irreversible pulpitis, is inflammatory rather than infectious in nature. Evidence shows that antibiotics do not reduce pain unless systemic infection is present. Definitive operative care remains the primary and most effective treatment [13]. Large studies confirm that inappropriate prescribing is influenced by clinician habits, patient expectations, time pressure, and systemic barriers [14].

For example, prescribing amoxicillin for irreversible pulpitis in the absence of systemic involvement remains common despite clear evidence that operative intervention resolves the pathology not antibiotics [13,14].

Postoperative and Prophylactic Prescribing

Routine antibiotic use after simple extractions is generally unnecessary. Delayed prescribing involves providing a prescription with instructions to initiate antibiotics only if symptoms worsen.

This strategy may reduce unnecessary antibiotic consumption while maintaining patient reassurance. Evidence indicates that routine antibiotic use following uncomplicated tooth extraction does not significantly improve outcomes in healthy individuals [15, 16].

Prophylaxis for infective endocarditis is recommended only for high-risk patients [17]. Despite established guidelines, practice variation persists.

Stewardship Guidance: MIND ME Approach

The MIND ME mnemonic supports rational prescribing [18]:

- M – Microbiology: Identify the likely causative organisms.
- I – Indications: Confirm that an antibiotic is genuinely required; operative management is preferred for localised dental infections.
- N – Narrowest Spectrum: Select the narrowest spectrum effective against the target pathogen.
- D – Dosage: Prescribe the correct therapeutic dose.
- M – Minimise Duration: Use the shortest effective treatment course.
- E – Ensure Monotherapy: Avoid unnecessary combination therapy unless clinically justified.

Applying MIND ME alongside AWaRe guided selection and strict WASH-based infection control practices allows dentists to optimise antibiotic use and enhance patient safety [18].

Global Trends and Stewardship Frameworks

Global antibiotic consumption continues to rise. Between 2016 and 2023, worldwide antibiotic use increased by 16.3% with projections indicating a 52.3% increase by 2030 [9,10,19]. The WHO AWaRe classification provides structured guidance for rational

prescribing [20].

Dentistry can contribute meaningfully by prioritising operative care, selecting narrow-spectrum antibiotics when clinically indicated, and reducing preventable infections through strong infection control practices.

Behavioural Drivers and Public Perception

Patient expectations and cultural norms significantly influence antibiotic prescribing practices. Although many individuals recognise antimicrobial resistance (AMR) as a serious issue, they often do not perceive their personal antibiotic use as contributing meaningfully to the problem.

Dentists play a critical role in aligning patient expectations with evidence-based care. This can be achieved by:

1. This can be achieved by clearly explaining the limitations and risks of antibiotics. Antibiotics do not alleviate pain in conditions such as irreversible pulpitis and cannot substitute definitive operative treatment. Patients should also be made aware of potential adverse effects, including gastrointestinal and allergic reactions, as well as the risk of contributing to resistance. Misunderstandings about what antibiotics can and cannot do are still common and often shape expectations in the clinic.
2. Encourage awareness of AMR as an individual clinical risk and a broader public health concern. Patients should understand that unnecessary antibiotic use may compromise the effectiveness of future treatments.

Clear and empathetic communication improves patients' satisfaction and reduces pressure to prescribe unnecessarily.

Managing Acute Dental Pain Without Unnecessary Antibiotics

Management of acute dental pain primarily involves prompt operative treatment, including root canal therapy, incision and drainage, or extraction.

Effective care includes adequate local anaesthesia, use of nonsteroidal anti-inflammatory drugs, clear explanation of diagnosis, and safety-net instructions for warning signs such as fever or progressive swelling.

Unnecessary antibiotic use increases the risk of adverse effects and adds financial burden [21]. Evidence-based operative and analgesic approaches reduce both drug exposure and healthcare costs.

Stewardship Strategies in Dentistry

Dentists can lead stewardship efforts through:

- Continuing professional education [22,23].
- Clear national prescribing guidelines [22,23].
- Medico-legal reassurance for evidence-based non-prescribing [22,23].
- Improved access to urgent care [22,23].
- Public campaigns aligned with dental messaging [22,23].
- Emphasising mechanical treatment over prophylactic antibiotics.
- Regulatory reform is necessary to ban irrational FDCs.
- Expanding the national list of essential medicines to standardise antibiotic use
- Implementing delayed prescribing protocols clinically, providing a prescription with instructions to wait 48 hours to see if symptoms resolve naturally.

Structured antimicrobial stewardship programs within dental settings have demonstrated effectiveness in reducing inappropriate prescribing while maintaining patient safety.

Conclusion

The introduction of antibiotics marked a transformative milestone in modern medicine; however, their effectiveness is increasingly threatened by antimicrobial resistance driven by overuse, environmental factors, and irrational drug combinations.

Dentistry plays a significant role in community antibiotic prescribing and has the potential to positively influence resistance trends. Implementation of evidence-based operative care, patient education, AWARe-guided prescribing, and robust infection control practices can significantly strengthen antimicrobial stewardship.

Addressing this challenge requires coordinated efforts, including regulatory enforcement, infrastructure improvement, and public education. Without intervention, inappropriate outpatient prescribing will continue to drive resistance. Structured stewardship strategies provide a critical opportunity to preserve antibiotic effectiveness for future generations.

Conflict of Interest

The author declares no conflict of interest.

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