

Original Article

Prescription patterns of antibiotics and awareness of antibiotic resistance among dental house surgeons, postgraduate students, and dental professionals – A cross-sectional descriptive survey

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ABSTRACT

Objectives: Exposing a patient to unnecessary antibiotics increases the risk that antibiotics will fail for that patient when required, thereby increasing the risk of antibiotic-resistant bacteria spreading to the patient's family, friends, and other contacts. The study aimed to investigate the antibiotic prescribing habits of dental professionals, house surgeons, and postgraduates.

Material and Methods: The questionnaire consisted of 20 multiple-choice and two open-ended questions, organized into three main sections, which were explicitly investigated.

Results: Among the participants, 33.2% were males, and 66.8% were females. The work experience of practitioners ranged from 2-10 years. Among the volunteers, 60.4% were academicians, 24% had a private practice, 10% were employed as private employees, and 5.6% were employed as government employees. 37.2% were house surgeons, 17.2% were general dentists, 23.2% were postgraduates, and 22.4% had specialty practice.

Conclusion: The consultation of guidelines for antibiotic prescriptions varies, emphasizing the need for a more consistent approach within the practitioner community. Various sources, including textbooks (30.4%) and pharmaceutical guidelines (24%), contribute to their knowledge of antimicrobial resistance.

Keywords: Antibiotics, Awareness, Dentists, Emergencies, Periapical diseases, Pulpal diseases, Resistance

INTRODUCTION

Antimicrobial resistance (AMR) is not a local concern but a pressing global issue. The overuse and misuse of antibiotics lead to the development of resistance by microorganisms, making infections caused by these organisms challenging to treat with common antibiotics. The resistant bacteria can spread quickly between individuals and across countries, making antibiotic resistance a global issue. The condition became risky because of increases in the rate of hospitalization, leading to higher medical costs and increasing mortality rates. Understanding how antibiotics are prescribed and the level of awareness among dental professionals is crucial in addressing this global issue by promoting responsible antibiotic use.

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During the pandemic, the spread of infections has become more widespread, and many infections did not even respond to the most prescribed antibiotics. According to the research, antibiotics taken by any patient can persist for up to 12 months in their microbiome. The bacteria may resist the causative drug and other drugs when a patient is exposed unnecessarily to antibiotics. Mainly, antibiotics were prescribed for a patient on demand or to be on the safe side; there is a risk of failure of antibiotics, especially when in need. The risk of antibacterial resistance slowly spreads to the patient's family, friends, and contacts. Before prescribing antibiotics, doctors must be aware of the chances of developing resistance in that patient and thus can reduce the spread into society.

Antibiotics, when used more frequently, can lead to their resistance. Dentists constitute 10% of medical personnel across the globe who prescribe antibiotics.^[1] Dentists prescribe antibiotics for almost every clinical scenario associated with pain.^[2] 80% of antibiotics prescribed for treating acute dental conditions were found unnecessary according to a UK-based study,^[3] and 80% of antibiotic use for prophylaxis was inappropriate according to research in the US.^[4] After assessing the studies and surveys on the usage of antibiotics, it is confirmed that the dental profession is also responsible for the increase in antibiotic resistance and thereby held responsible for putting their efforts into preventing the spread.

The present survey is a crucial tool in understanding how antibiotics are prescribed by dental house surgeons, postgraduates, and general and specialty practitioners. This study is paramount as it can help identify trends and practices in antibiotic use, which can contribute to the global efforts to tackle antibiotic resistance. By collecting data on antibiotic prescription patterns and awareness, the survey can find the trends in the overuse and misuse of antibiotics. This helps in creating awareness of antibiotic resistance and decreases the load of antibiotic use. Therefore, study aimed to investigate the antibiotic prescribing habits of dental professionals, house surgeons, and postgraduates, aiming to promote responsible antibiotic use in dental practice.

The objectives were as follows:

- To assess the attitudes toward prescribing antibiotics and, at the same time, AMR awareness
- To know the levels of awareness and knowledge of antibiotic resistance
- To evaluate areas of defect in knowledge and practices about antibiotic use
- To assess the patterns in indicating the antibiotics and their prophylactic use for systemic conditions
- To investigate the knowledge of misusing antibiotics
- To evaluate adherence to guidelines
- To identify educational needs.

MATERIAL AND METHODS

Study design

The present study aims to conduct an online and offline questionnaire survey of dentists in the Nellore Urban area, a region known for its diverse dental practices and patient demographics, from October 15 to November 15, 2023. The Nellore Urban area was chosen for its varied dental practices and patient demographics, which can provide a comprehensive understanding of antibiotic prescribing habits in different dental settings and patient populations.

Study participants

The participants were approached electronically and manually, and 250 participants were selected. The sample size is calculated using the formula.^[5]

Sample Size Formula = $[z^2 * p(1-p)]/e^2/1 + [z^2 * p(1-p)]/e^2 * N]$ Where,

- N is the population size
- z is the z-score
- e is the margin of error
- p is the standard deviation

Participation was voluntary and did not involve compensation. No personal health information or details were collected, participants' data were protected, and no inhumane questions or investigations were involved.

Data collection

The questionnaire, developed after a literature review by dental surgeons from different dental specialties, consisted of 20 multiple-choice questions and two open questions, which were sorted into three main sections, specifically investigating:

Participants' demographic features (their age and gender) and dental practice characteristics concerning their working experience (in years), dental setting (whether they worked in private practice alone, academician, or whether they were a public employee or a private employee), and their primary specialty for postgraduate students, and practitioners with M.D.S. degree (of oral surgery, endodontics, orthodontics, pediatric dentistry, periodontology, prosthetics/implantology, and others).

The following questions evaluated the antibiotic prescription habits of dentists:

How often do you prescribe systemic antibiotics?

Antibiotic therapy is prescribed mainly to treat bacterial infections. The duration of antibiotic therapy depends upon the type and severity of the infection to be treated and the

age of the patient. Antibiotic prophylaxis can even be given before diagnosis, as in empiric therapy. It should be aimed at the causative organisms. If this is not possible, a combination of penicillin with aminoglycoside and metronidazole would be the best option. The most common side effects noticed after antibiotic use include nausea, diarrhea, and even stomach upset.

Dentists' attitudes toward antibiotics and AMR awareness, whether they are aware of antibiotic resistance and how the organisms spread, how the infection caused by the microorganisms can be treated, dentists consult the guidelines for prescribing antibiotics, prescribing behavior regarding antibiotics and its relation to the development of antibiotic resistance, the main reason why antibiotics are prescribed without indication, and dentists' primary source of reference to access information on the topic of antibiotic resistance and antibiotic therapy. After collecting data, an appropriate statistical analysis was performed.

RESULTS

A student *t*-test was performed after data were retrieved from the responses obtained through Google Forms. Demographic results showed that 33.2% are males, and 66.8% of females [Figure 1] and most of the participants age was below 30 years [Figure 2] responded that the work experience of practitioners ranged from <2 years to 72.8%. 2–10 years of [Figure 3] work experience is 20.8%. 60.4% are academicians, and 24% have private practice [Figure 3]. 10.0% are working as private employees, and 5.6% are working as public employees. 37.2% were house surgeons, 17.2% were general dentists, 23.2% were postgraduates, and 22.4% had specialty practice [Figure 4]. The details are given in detail in Table 1.

The overall responses were explained in detail in Table 2. 59.6% answered that they prescribed antibiotics up to symptoms subsided, 23.6% prescribed antibiotics weekly, 6% of dentists never prescribed antibiotics, 5.2% prescribed antibiotics for every patient visit, 4.8% prescribed antibiotics every month, and 0.8% of dentists prescribed antibiotics annually [Figure 5]. For the question of the most common cause of prescribing antibiotics, 58% answered periapical abscess, 16% answered pulpitis, only 10.8% answered cellulitis, and 10% answered periodontal abscess. 3.2% answered pericoronitis and trauma 2%.

The third question is the most common therapy requiring antibiotic therapy, and 73.2% answered dental extraction. 12.4% answered root canal therapy [Figure 6]. The duration of antibiotics showed that 48.4% were prescribed antibiotics for 5 days, 37.6% were prescribed for 3 days, and 6.8% were prescribed for 7 days. 1.6% were prescribed antibiotics >7 days, 5.6% answered up to symptoms subsiding, 56.8% of participants [Figure 7] were prescribed amoxicillin and

clavulanic acid, and 42.8% were prescribed amoxicillin metronidazole, which is prescribed by only 0.4% [Figure 8].

Regarding the antibiotics prescribed for penicillin allergy, 36% answered cephalosporins, 25.6% answered clindamycin, and only 13.2% responded to macrolides [Figure 9]. They have noticed that the most common side effects [Figures 10 and 11] are gastritis 50.8%, nausea 23.6%, diarrhea 16.4%, allergy 5.6%, and vomiting 3.6%. 96.8% of dentists answered about antibiotic resistance, and 3.2% answered no [Figure 12]. For the question Antibiotic-resistant organisms transfer from person to person and animals to person and vice versa, 53.6% answered no, and 46.4% answered yes [Figure 13]. For diseases caused by these antibiotic-resistant microorganisms, 82.4% answered that they are challenging to treat. 17.6% answered that infections caused by antibiotic-resistant organisms are easily treatable [Figure 14].

Regarding the prescribing behavior of antibiotics and the development of antibiotic resistance, 62.8% answered yes, and 28% answered that they did not know [Figure 15]. 9.2% answered no. How often do dentists consult guidelines for prescribing antibiotics? 32.8% always answered, 34.8% usually answered, 29.2% responded occasionally, and 3.2% answered never [Figure 16].

The primary source consulted to obtain information on AMR and antibiotic administration: 30.4% answered textbooks, 24% answered scientific information from pharmaceutical

Table 1: Demographic details.

Demographics	Frequency	Percent
Gender		
Male	83	33.2
Female	167	66.8
Age		
< 2	182	72.8
2 – 10	52	20.8
11 – 20	10	4.0
21 – 30	5	2.0
> 30	1	0.4
Practice		
Private practice	60	24.0
Academician	151	60.4
Public employee	14	5.6
Private employee	25	10.0
Specialization	43	17.2
General dentist		
House surgeon	93	37.2
Postgraduate	58	23.2
M.D.S.	56	22.4
M.D.S: Master of Dental Surgery		

Table 2: Overall responses of study participants.

Questions	Frequency	Percentage
How often do you prescribe systemic antibiotic		
a. For every patient visit	13	5.2
b. Upto the symptoms	149	59.6
c. Weekly	59	23.6
d. Monthly	12	4.8
e. Annually	2	0.8
f. Never	15	6.0
The most frequent cause of prescribing antibiotics		
a. Pulpitis	40	16.0
b. Periapical abscess	145	58.0
c. Periodontal abscess	25	10.0
d. Cellulitis	27	10.8
e. Pericoronitis	8	3.2
f. Trauma	5	2.0
The most common therapy that requires antibiotics		
a. Oral prophylaxis	5	2.0
b. Root canal therapy	31	12.4
c. Dental extraction	183	73.2
d. Root planning	2	0.8
e. Periodontal surgery	20	8.0
f. Implant surgery	9	3.6
Duration of antibiotic therapy (days)		
a. 3	94	37.6
b. 5	121	48.4
c. 7	17	6.8
d. > 7	4	1.6
e. Till the symptoms subside	14	5.6
Most frequent antibiotics that you prescribe		
a. Amoxicillin	107	42.8
b. Amoxicillin+clavulanic acid	142	56.8
c. Metronidazole	1	0.4
Antibiotics that you prescribe for penicillin allergy		
a. Macrolides	33	13.2
b. Lincosamides	1	0.4
c. Fluoroquinolones	5	2.0
d. Cephalosporins	90	36.0
e. Metronidazole	15	6.0
f. Vancomycin	3	1.2
g. Clindamycin	64	25.6
h. Tetracycline	29	11.6
i. Don't know	10	4.0

(Contd...)

Table 2: (Continued).

Questions	Frequency	Percentage
The most common side effect you notice after antibiotic use		
a. Gastritis	127	50.8
b. Nausea	59	23.6
c. Vomiting	9	3.6
d. Diarrhoea	41	16.4
e. Allergy	14	5.6
Dentists know what antibiotic resistance is		
a. Yes	242	96.8
b. No	8	3.2
Antibiotic-resistant organisms transfer from person to person and animal to person and vice versa		
a. Yes	116	46.4
b. No	134	53.6
Diseases caused by these antibiotic-resistant microorganisms are		
a. Easily treatable	44	17.6
b. Difficult to treat	206	82.4
Do prescribing behavior antibiotics and the development of antibiotic resistance-related		
a. Yes	157	62.8
b. No	23	9.2
c. Don't know	70	28.0
How often do dentists consult guidelines for prescribing antibiotics		
a. Always	82	32.8
b. Often	87	34.8
c. Occasionally	73	29.2
d. Never	8	3.2
The primary source consulted to obtain information on antimicrobial resistance and antibiotic administration		
a. Textbooks	76	30.4
b. Forum on the internet	31	12.4
c. Scientific magazines	15	6.0
d. Consultation of guidelines	49	19.6
e. Direct communication with referring colleagues	19	7.6
f. Scientific information from the pharmaceutical guideline	60	24.0
The main reason why antibiotics are prescribed without indications		
a. Non-compliant patients	24	9.6
b. Uncertainty of clinical condition	38	15.2
c. To avoid occurrence of flare up and emergency dental visit	105	42.0
d. To reduce the patient's discomfort	83	33.2

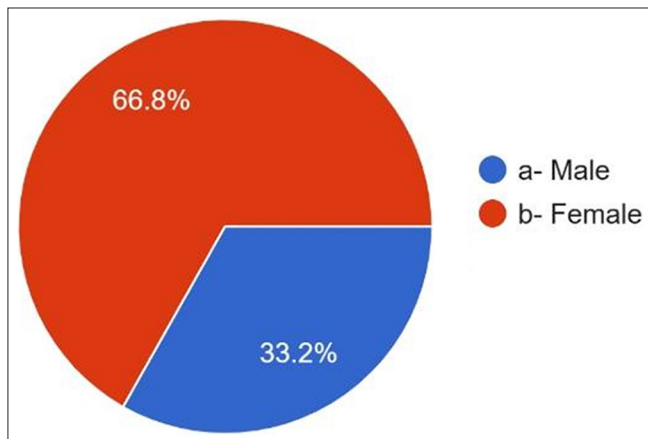


Figure 1: Gender distribution in the study.

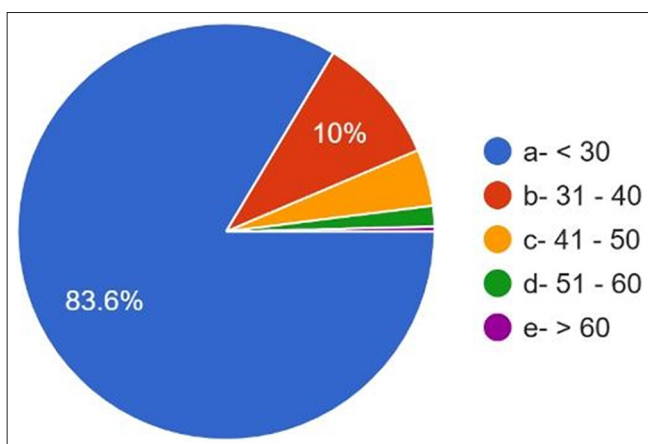


Figure 2: Range of age of the participants.

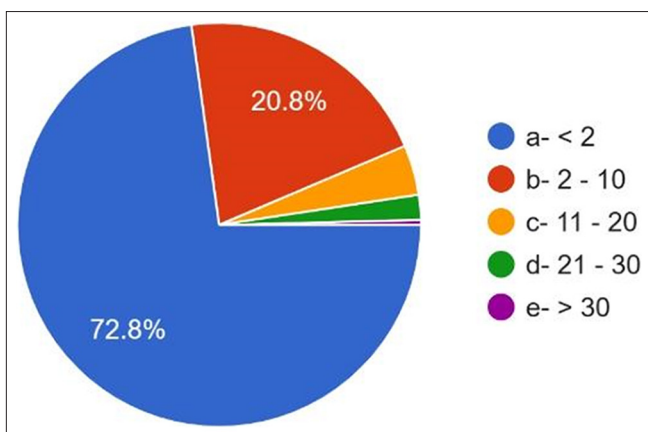


Figure 3: Working experience of Participant.

guidelines, 19.4% from consulting guidelines, 6% scientific magazines, and 10% from the internet [Figure 17]. For the main reason for prescribing antibiotics without indications, 42% answered to avoid complications [Figure 18]. 33.2% answered to prevent patient discomfort. For the question

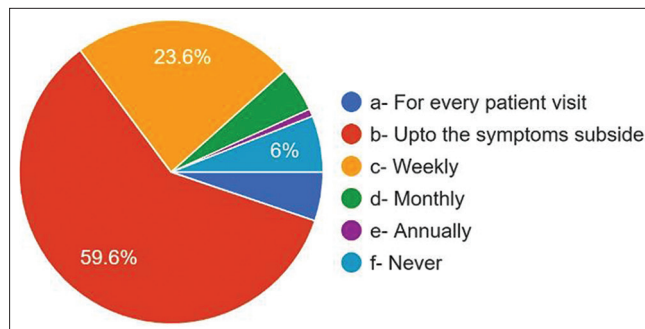


Figure 4: Frequency of prescribing antibiotics.

where the antibiotic prophylaxis was given, 30.8% answered immunocompetent healthy persons, 48.8% answered immunocompromised patients, 22% answered patients with rheumatoid arthritis, 26.8% responded to patients with replaced joints, patients with prosthetic heart valves in 55.56% [Figure 19].

DISCUSSION

A study by Khalil *et al.* uncovered a pressing issue: a single dose of amoxicillin can significantly increase resistant strains and disrupt normal oral microflora within a day. This rapid disturbance, reducing normal flora and causing a surge in resistant bacteria, underscores the urgent need for action in this area.^[6]

Many infections that several drug classes could successfully treat have acquired resistance. After exposure to antimicrobials, the microorganisms are subjected to selection pressure, where the resistant organisms are increased.^[6] They acquire fitness by having and exhibiting the resistance genes, which they tend to share with the rest of the microorganisms' poor infection control, environmental contamination, and geographical movement of infected humans and animals. There are reservoirs of resistance, including within humans and the local environments of hospitals and the community, as well as in animals and the farms and aquaculture environments, but also in water, soil, wildlife, and many other ecological niches due sewage waste pollution, pharma industrial waste, and manure run of from forms.^[7]

AMR is an ecological problem characterized by complex interactions between the microbial population, which is diverse, and the environment.^[8]

To help reduce antibiotic resistance, the World Health Organization (WHO) has introduced three classifications of antibiotics: the AWARE classification access, watch, and reserve.^[9] The access group includes antibiotics that offer the best therapeutic value while minimizing the potential for resistance.^[9] The watch group includes antibiotics that are more prone to selection for resistance. Antibiotics in

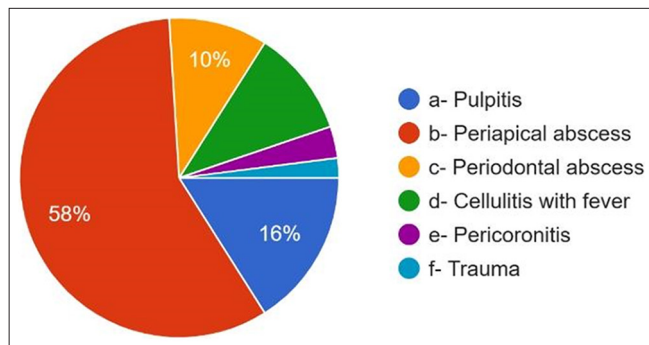


Figure 5: Most frequent cause for antibiotic prescription.

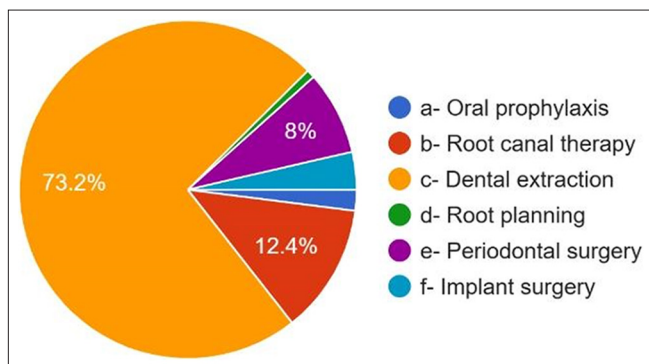


Figure 6: Most suitable clinical situation for antibiotic prescription.

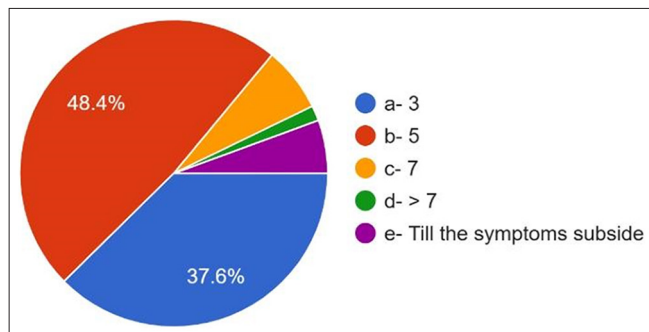


Figure 7: Duration of antibiotic therapy.

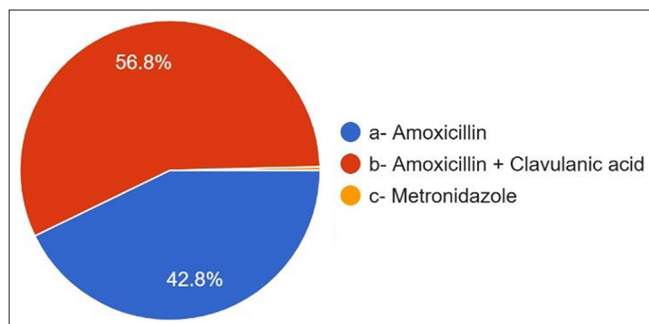


Figure 8: Most common antibiotics prescribed.

the watch group (such as erythromycin) should be the priority target for antibiotic stewardship programs to optimize use.^[10] The reserve group includes the “last resort” antibiotics, such as meropenem, reserved for treating infections because of multidrug-resistant organisms.^[11] Failure of antibiotics to treat effectively an infection in the mouth or elsewhere in the body (e.g., respiratory tract infection) or to provide prophylaxis before major surgery (e.g., joint replacement) can pose a life-threatening risk.^[12] For patients with dental infections, the spread of infection toward vital structures in the head and neck may occur rapidly. Optimizing antibiotic use by prescribing guidelines will improve everyone’s outcomes, especially for the most vulnerable.^[13] Dental infections are generally amenable to treatment by a dental procedure (such as tooth extraction) to remove the source of the infection without giving antibiotics. In the absence of infection, antibiotics are never appropriate for pain such as that associated with irreversible pulpitis.^[14] Dentists are surgeons skilled and equipped to diagnose and treat acute dental conditions during urgent appointments; access to dental, rather than medical, care for patients with acute dental conditions is essential. This growing problem of care provided in non-dental settings (such as hospital emergency departments) contributes to the overuse of antibiotics because the treatment provided is rarely definitive.^[15] Guidelines based on these principles while considering other relevant factors (such as antibiotic resistance patterns and access to high-quality antibiotics) sit at the heart of efforts to optimize antibiotic prescribing.^[16]

This questionnaire, which was developed based on guidelines provided by the WHO and the Indian Council of Medical Research, underscores dentists’ pivotal role in the fight against antibiotic resistance. These guidelines, designed to optimize antibiotic prescribing and improve patient outcomes, are crucial for dentists to adhere to.

Antibiotics should be prescribed in dentistry only when localized symptoms spread and cause symptoms like fever more significant than 35°C and cellulitis. However, for question 1, most participants, 59.6%, answered that they prescribe antibiotics to the symptoms subside. Most mild infections subside even if bacteria are frequently self-limiting and do not help reduce the occurrence of life-threatening illness.^[17]

Regarding the most frequent cause of prescribing antibiotics, 58% of participants answered peri apical abscess followed by pulpitis, periodontal abscess, cellulitis, and pericoronitis. However, abscesses with systemic involvement, cellulitis, and pericoronitis with systemic involvement are indicated for antibiotic use.^[18] 73.2 % of the dentists answered that dental extraction is the most common treatment. They prescribe antibiotics, followed by root canal therapy,

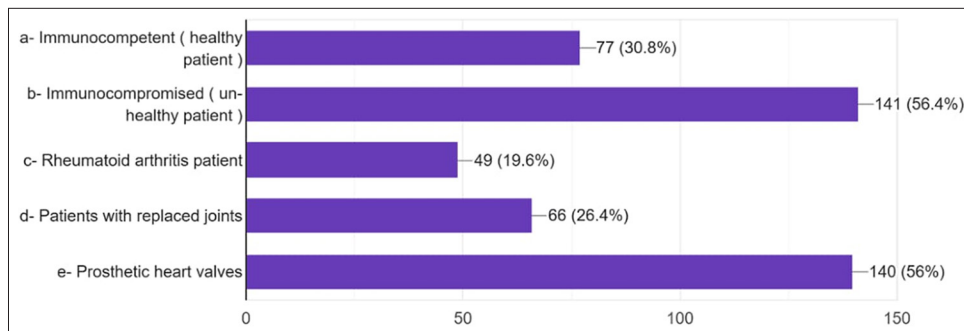


Figure 9: Percentage of Antibiotics prescription in various diseases.

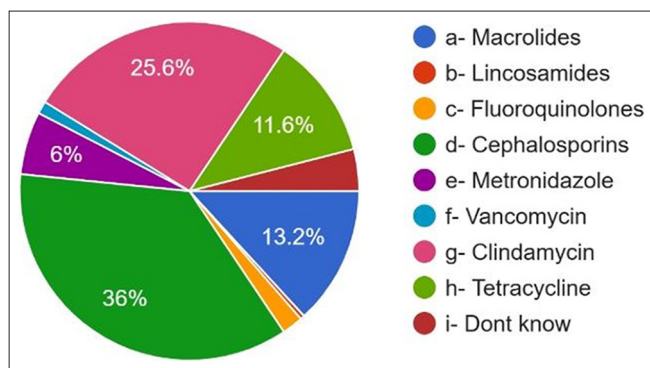


Figure 10: Antibiotics that prescribed in Penicillin allergy.

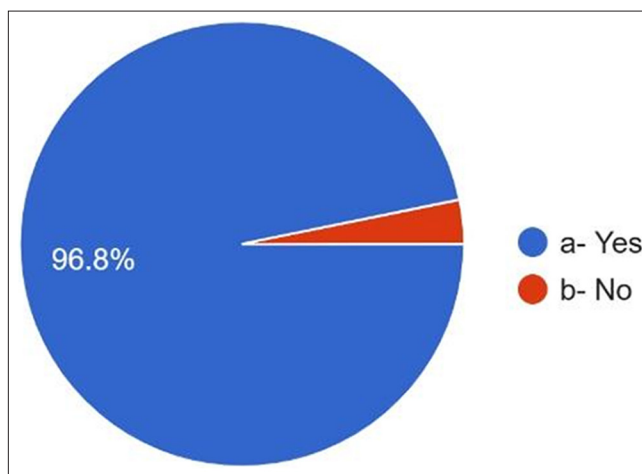


Figure 12: Whether aware about antibiotic resistance.

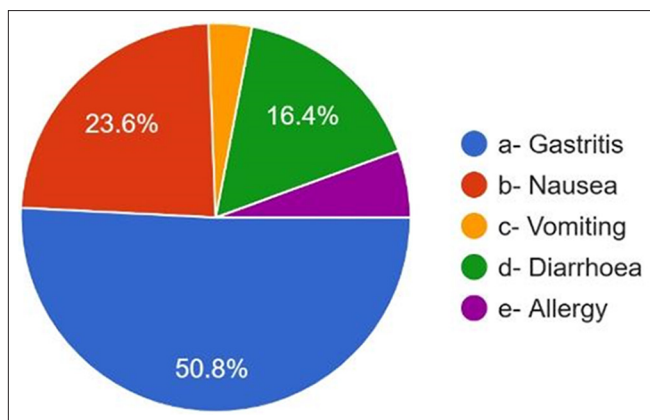


Figure 11: Most common side effect after antibiotic use.

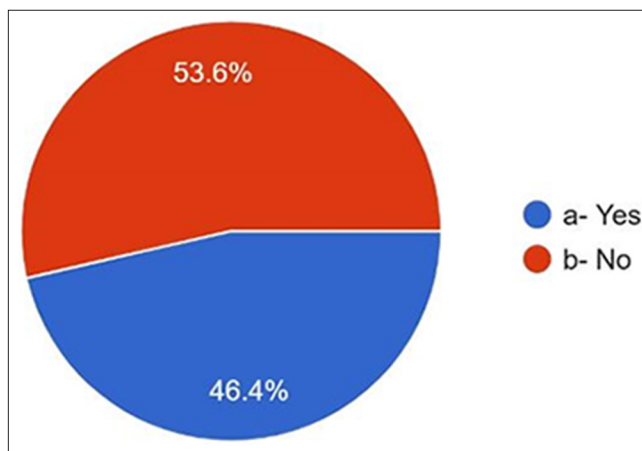


Figure 13: Transfer of antibiotic resistant organisms.

periodontal surgery, periapical surgery, implant surgery, oral prophylaxis, and root planning. However, previous studies have shown that most dental procedures do not require per-treatment antibiotic use or prevent the occurrence of complications.^[19] For the question course of antibiotic therapy, 48.4% of participants answered for 5 days, followed by 3 days and 7 days till the symptoms subside, but in most cases, 3 days are sufficient, followed by 5 days. The most common side effect observed was gastritis, followed by nausea, diarrhea, vomiting, and allergy. For the question, do the dentists know what antibiotic resistance is? 96.8%

of participants answered yes, but only 46.4% knew that antibiotic-resistant organisms transfer from person to person, animal to person, and vice versa. Diseases caused by microorganisms resistant to antibiotics are challenging to treat. 82.4 % of participants were aware of this, which might be life-threatening and require the development of newer antibiotics. Antibiotics that were prescribed wrongly

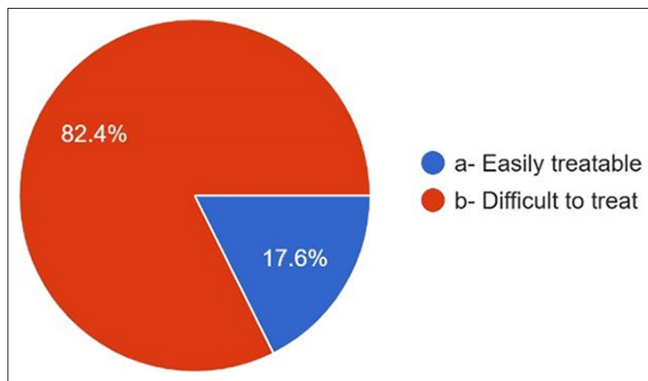


Figure 14: Ability of treating the diseases caused by antibiotic resistant microorganisms.

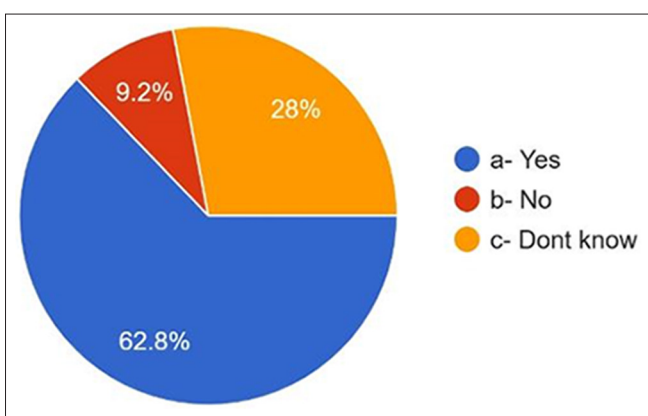


Figure 15: Relation between prescribing antibiotics and antibiotic resistance.

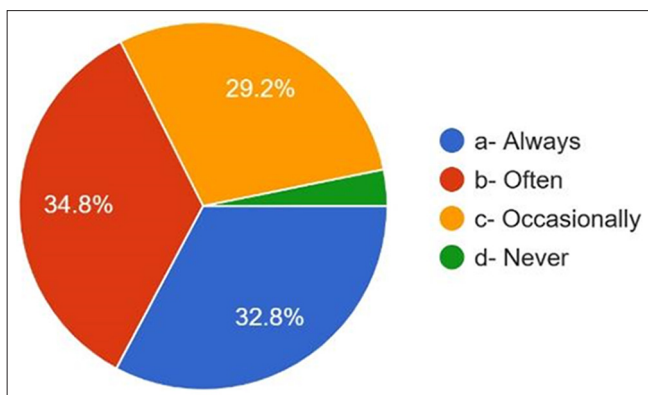


Figure 16: Referring guidelines for antibiotic prescription.

can also become a potent factor in increasing the resistance of bacteria.^[20] Treatment indication, choice of agent, and duration of antibiotic therapy are incorrect in 30–50% of cases. 30% to 60% of antibiotics prescribed in intensive care units are unnecessary and inappropriate. Incorrectly prescribed antibiotics have questionable therapeutic benefits and expose the patients to potential complications of antibiotic therapy. Sub-inhibitory and sub-therapeutic

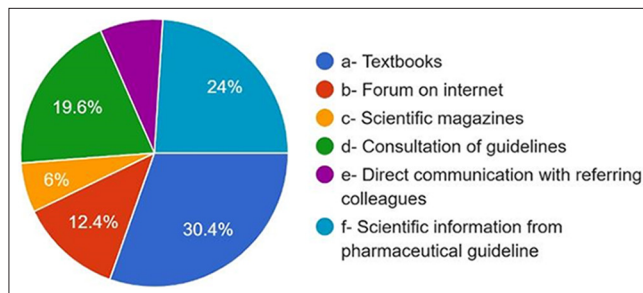


Figure 17: Main source of information.

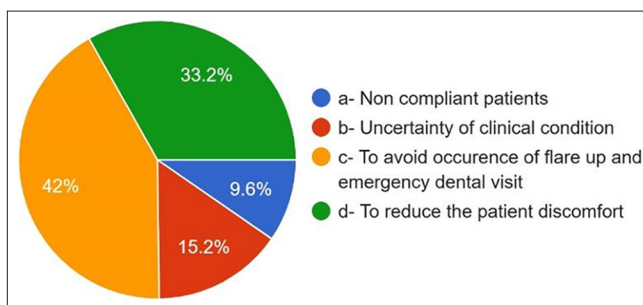


Figure 18: Main reason for prescribing antibiotics without any indication.

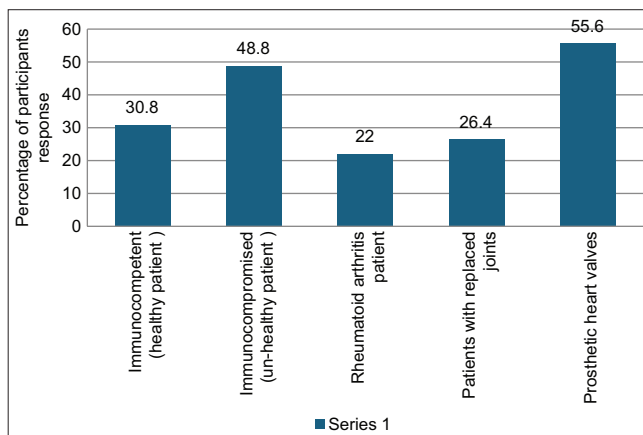


Figure 19: Antibiotic prophylaxis is given in (more than one option can be selected).

antibiotic concentrations can promote the development of antibiotic resistance by supporting genetic alterations, such as changes in gene expressions, horizontal gene transfer, and mutagenesis.^[21] Up to 10% of antibiotics prescribed in outpatient settings can be by dentists to treat oral and dental infections or prophylaxis of surgical procedures, of which a significant portion is unnecessary or inappropriate.^[22]

For the question, main source consulted to obtain information on AMR and antibiotic administration; 37.2% of general practitioners, 33.3% of interns, 27.6% of postgraduates, and 23.2% of specialty practitioners answered that they would

consult a textbook, 9.3% of general practitioners, 19.4% of interns, 24.1% of postgraduates, 23.2% of specialty doctors consulted guidelines to prescribe antibiotics. 25.6% of general practitioners, 23.7% of interns, 27.6% of postgraduates, and 19.6% of specialists' practitioners consulted information from pharmaceutical guidelines. The main reason antibiotics are prescribed without indications is that 55.4% of the specialist practitioners, 43.1% of postgraduates, 39.8% of interns, and 27.9% of general practitioners answered to avoid the occurrence of flare-ups and emergency visits. 37.2% of general practitioners, 29.0% of interns, 36.2% of postgraduates, and 33.9% of specialized practitioners prescribed antibiotics to reduce patient discomfort. Antibiotics are appropriate for inflammatory conditions, including periodontitis, irreversible pulpitis, and dry socket treatment because they cannot prevent severe complications and replace local surgical or non-surgical treatment.^[23,24]

Antibiotic prophylaxis is not needed in healthy, immunocompetent patients. It is contraindicated in severely immunocompromised patients, patients with prosthetic heart valves, patients with replaced joints, and patients with rheumatic fever. Dentists need to remember these indications before prescribing any drugs.

CONCLUSION

The study was conducted among dental house surgeons, postgraduate students, and dentists with varied experience levels, specializations, and gender distributions. After reviewing the study results, a few recommendations were suggested: Dental extraction is the most frequent therapy requiring antibiotic intervention (73.2%). The prescribing behavior analysis reveals a predominant trend of prescribing antibiotics until symptoms subside (59.6%), with periapical abscess being the most common reason (58%). There is no need to extend the duration of antibiotic prescription till the symptoms subside entirely, so it is recommended with a notable preference for a 5-day regimen (48.4%). Antibiotic choices predominantly favor amoxicillin and clavulanic acid (56.8%), and cephalosporins are the preferred alternative for those with penicillin allergies (36%).

The surveyed practitioners exhibit a high awareness of antibiotic resistance (96.8%), with a significant proportion acknowledging a connection between prescribing behavior and the development of antibiotic resistance (62.8%). The consultation of guidelines for antibiotic prescriptions, like Chemistry, Manufacturing and Controls guidelines, must be circulated within the practitioner's community. Various sources, including textbooks (30.4%) and pharmaceutical guidelines (24%), are also available, which can contribute to their knowledge of AMR. In prescribing antibiotics without clear indications, the primary motivations are to avoid complications (42%) and patient discomfort (33.2%).

Furthermore, antibiotic prophylaxis is notably standard for patients with prosthetic heart valves (55.56%). Although the participants know guidelines for prescribing antibiotics in a clinical scenario, they opt for higher antibiotics for longer than first-choice drugs out of fear of flare-ups, to avoid an emergency visit, or to increase patient comfort.

Ethical approval: The research/study approved by the Institutional Review Board at Institute Ethical Committee Narayana Dental College and Hospital (IEC\NDCH), number IEC/NDCH/2023/AUG-SEPT/P60, dated 09th September, 2023.

Declaration of patient consent: Patient's consent not required as there are no patients in this study.

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Conflicts of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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