

Short Communication



# Self-Reported Practices of General Dentists in Antibiotic Prescription for Endodontic Treatments in Southeastern Iran

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## Abstract

**Background:** Antibiotic resistance is a major global health concern that highlights the importance of appropriate antibiotic use in dental practice. In endodontic infections, antibiotics are not routinely indicated and should be prescribed only in specific clinical conditions. However, studies have shown that inappropriate prescription by dentists is still common. This study aimed to assess the self-reported practices of general dentists regarding antibiotic prescription during endodontic treatments in Kerman, Iran.

**Methods:** This cross-sectional study was conducted among general dentists practicing in Kerman, Iran. A self-administered questionnaire was designed to evaluate dentists' knowledge and practices related to antibiotic prescription for endodontic infections. The questionnaire was validated, and its reliability was confirmed before data collection. It consisted of two subdomains: the type and method of antibiotic administration and antibiotic prescribing across different clinical conditions. Data were analyzed using SPSS software (version 26; IBM Corp., Armonk, NY, USA). Descriptive statistics as well as Chi-squared and independent t-tests were used for analysis, and the significance level was set at  $P < 0.05$ .

**Results:** A total of 76 general dentists participated in the study. Only 33.2% of the participants were aware of antibiotic prescription guidelines, and 22.5% had read them. The mean total score of the questionnaire was 7.61 out of 14. Amoxicillin was the most commonly prescribed antibiotic. Most dentists (88.2%) prescribed antibiotics for 3–10 days, while 11.8% continued antibiotic therapy until two days after symptom resolution. Correct prescription of metronidazole was reported by only 10.7% of participants. No significant association was found between work experience and the total or subdomain scores.

**Conclusion:** The findings indicate deviations from recommended guidelines and inappropriate antibiotic prescribing in several clinical situations. Enhancing dentists' awareness of antibiotic prescription guidelines and providing continuing education programs may improve prescribing practices and help reduce the risk of antibiotic resistance.

**Keywords:** Endodontics, Antibacterial Agents, Drug Prescriptions, Dentists, General Practice, Iran

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## Introduction

In the last decade, many studies have been conducted on antibiotic prescription due to the importance of antibiotic resistance. Antibiotic resistance is currently the biggest danger to development, food security, and global health, according to the World Health Organization (WHO).<sup>1</sup> To avoid the emergence of antibiotic-resistant bacteria, it is crucial to use antibiotics carefully.<sup>2</sup> Appropriate antibiotic prescribing should follow evidence-based national and local clinical practice guidelines, when available.<sup>3</sup>

Appropriate antibiotic prescribing means antibiotics are only prescribed when needed, the right antibiotic is selected and prescribed at the right dose and for the right duration. Antibiotics are not routinely necessary in endodontic treatment, according to Longman<sup>4</sup> and Segura-Egea.<sup>5</sup> However, they may be used therapeutically as an adjunct

when there are signs of infection, like swelling or fever.<sup>4,5</sup>

Antibiotic overuse and misuse among dentists is substantial, with dentists prescribing around 10% of total antibiotics consumed.<sup>6,7</sup> It is revealed that dentists prescribe antibiotics for infection prophylaxis before dental procedures, but many of these prescriptions are unnecessary.<sup>7</sup> Also, it is reported that about 7–11% of antibiotics are prescribed by dentists and 30–50% of antibiotics that are prescribed or used are unnecessary.<sup>8–10</sup>

Certain medical conditions increase the risk of complications from odontogenic infections, warranting antibiotic prophylaxis. These include infective endocarditis, prosthetic heart valves, recent joint replacements, or immunocompromised patients.<sup>4,5</sup> Penicillin VK, alone or with metronidazole, is typically effective for most endodontic infections.<sup>5</sup> However, amoxicillin, with



or without clavulanic acid, is preferred due to better absorption and fewer side effects.<sup>5</sup> While bacteria are the primary etiological factor in pulpal and periapical disease progression,<sup>11,12</sup> routine antibiotic use is not indicated and may promote resistance.<sup>5</sup>

Recently, studies have been conducted in Iran to improve public health awareness, implement rational guidelines for antibiotic use, and increase dentists' knowledge and prescription methods. Vessal et al. (2011) observed inappropriate prescribing of antibiotics by dental practitioners, with over 40% prescribing antibiotics when not required.<sup>13</sup> Knowledge gaps regarding antibiotic prescriptions during endodontic treatment were identified by Nabavizadeh et al. (2011), emphasizing the need for further education and updated guidelines.<sup>14</sup> Kia et al. (2012) revealed polypharmacy, overuse of antibiotics, and prescription errors among dental prescriptions.<sup>15</sup> Additionally, Emad et al. (2020) found a prevalence of self-medication with antibiotics among dental outpatients ranging from 42.6% to 64% across different cities.<sup>16</sup> The common reasons for self-medication included severe pain, previous self-medication experiences, and high costs of dental visits.

Although there have been studies regarding the prescription of antibiotics in Iran, based on our searches, the method of prescribing antibiotics in endodontic treatment has not been investigated. The present research aimed to determine the self-reported practice of general dentists in prescribing antibiotics in endodontic treatments in Southeastern Iran.

## Materials and methods

### Study Design and Ethics

This cross-sectional study was conducted in Kerman, Iran. The Research Committee at Kerman University of Medical Sciences approved the study (Ethical code: IR.KMU.REC.1400.516).

### Study Population and Participants

The target population was general dentists in Kerman city, Iran. The inclusion criteria for this study were general dentists practicing in Kerman who were willing to participate in the study and had completed the questionnaire. Dentists who did not complete the questionnaire or provided incomplete responses were excluded from the analysis. In addition, dental specialists and dentists who were not actively practicing at the time of the study were not included.

### Sample size calculation and sampling

The sample size calculation was determined based on the expected proportion of correct responses to the questionnaire. During the pilot stage of the questionnaire, it was estimated that the proportion of correct answers would be approximately 20%. Using this estimated proportion as the expected value, a sample size of 77 participants was calculated to estimate the expected proportion with a 10% absolute precision, 95% confidence level, and accounting

for a 20% dropout rate.

The city of Kerman was divided into two areas based on the municipality regions. In each region, a random sample was selected according to the number of clinics and private offices of general dentists.

### Data Collection

In this study, data were collected using a self-administered questionnaire with closed-form questions. The first part of the questionnaire included demographic information, and the second part included questions assessing the level of awareness and performance of the studied community about prescribing antibiotics in the treatment of endodontic infections. The second part has two subdomains: the type and method of antibiotic administration and the prescribing of antibiotics in different conditions. Possible questions and answers are shown in [Tables 1 and 2](#).

To evaluate face validity, the questionnaire was reviewed by an expert panel consisting of seven endodontic specialists from the Department of Endodontics at Kerman Dental School and one epidemiologist. The experts assessed the clarity and comprehensibility of each item using a four-point scale (1 = unclear, 2 = somewhat clear, 3 = clear, and 4 = very clear). Ratings of 1 and 2 indicated inadequate clarity, while ratings of 3 and 4 indicated acceptable clarity.

Content validity was assessed using the Content Validity Index (CVI). Each item was rated on a four-point scale ranging from 1 (not relevant) to 4 (highly relevant). Ratings of 1 and 2 were considered irrelevant, whereas ratings of 3 and 4 were considered relevant. The CVI values for the questionnaire items ranged from 0.85 to 0.93.

Reliability of the questionnaire was evaluated using the test-retest method. The questionnaire was completed by 20 general dentists with a two-week interval, and the intra-class correlation coefficient (ICC) was calculated. The ICC values ranged from 0.76 to 0.88.

Each correct answer in the questionnaire received a score of 1, and each incorrect answer received a score of 0, resulting in a total possible score ranging from 0 to 14.

The questionnaires were distributed to general dentists practicing in Kerman, and participants were asked to complete and return them within one week. If a questionnaire was not returned, the researcher followed up in person. Participants who did not return the questionnaire after two follow-up visits were excluded from the study. At the end of the study, the latest guideline for antibiotic prescription in dental treatments was provided to the participants.

### Statistical Analysis

The percentage of answers to the questions, as well as the mean and standard deviation of the obtained scores, were calculated. For statistical analysis, the Chi-squared test was used for qualitative variables, and the t-test was used for quantitative variables. Data were analyzed using SPSS software (Version 26.0; IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated, and the Chi-squared test and independent t-test were used to assess associations

**Table 1.** Answers to questions about duration, type, and dose of antibiotic prescription

| Question                                                                                                                                                                                                                      | Correct answer |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| How long do you usually prescribe antibiotics for a patient?<br>(3 days/5days/7 days/10 days/until the symptoms disappear/Up to two days after symptoms disappear)                                                            | 9(11.8%)       |
| Which of the antibiotics is your first choice in dental infections?<br>(Amoxicillin/Amoxicillin+metronidazole/Metronidazole/Penicillin/Clindamycin/Co-amoxiclav/Cephalexin)                                                   | 61(80.2%)      |
| Which of the antibiotics is your first choice for teeth that have been extracted and replaced after trauma?<br>(Amoxicillin/Amoxicillin+metronidazole/Metronidazole+Penicillin/Clindamycin/Co-amoxiclav/Cephalexin Macrolide) | 29(38.1%)      |
| Which dose of metronidazole antibiotic do you prescribe? (Metronidazole 250 mg every 6 hours/Metronidazole 500 mg every 6 hours/<br>Metronidazole 250 mg every 8 hours /Metronidazole 500 mg every 8 hours)                   | 8(10.5%)       |

**Table 2.** The answers to questions about prescribing or not prescribing antibiotics in different conditions

| Conditions                                                                                                                                                                                                                                                                                                                                         | Correct answer |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Reversible pulpitis with moderate to severe pain/Irreversible pulpitis with moderate to severe pain/Irreversible pulpitis with moderate to severe pain and swelling and systemic symptoms/Acute apical periodontitis with moderate to severe pain/Chronic apical periodontitis/<br>Chronic apical periodontitis and swelling and systemic symptoms | 43(56.5%)      |
| Pulp necrosis/severe pain on percussion/extensive radiolucency around the root of the tooth                                                                                                                                                                                                                                                        | 42(55.6%)      |
| Insomnia for 3 nights due to toothache/previous unsuccessful root canal treatment/having a lesion around the root of the tooth/severe<br>pain when gently touching the tooth/moderate to severe mobility                                                                                                                                           | 40(52.4%)      |
| Severe tooth pain with a history of taking painkillers/extensive crown decay/no lesion around the root of the tooth/complete anesthesia<br>was not obtained during the treatment, and the tooth has severe pain.                                                                                                                                   | 57(75%)        |
| Diabetic patient/mild to moderate toothache/no pain and loose on touch/pus coming out of the gums.                                                                                                                                                                                                                                                 | 46(24.6%)      |
| Systemic conditions are healthy/lower first molar teeth are necrotic and painless/swelling inside the mouth and the floor of the mouth has<br>increased due to swelling.                                                                                                                                                                           | 47(61.6%)      |
| The tooth is necrotic and needs root canal treatment/moderate pain along with the lesion around the root of the tooth/the patient is<br>unable to carry out the treatment for a week due to travel.                                                                                                                                                | 40(52.4%)      |
| Previous inappropriate root treatment/lesion around the root/no pain on palpation/local swelling in the buccal vestibule next to the tooth                                                                                                                                                                                                         | 42(55.1%)      |
| Proper root canal treatment was done 3 days ago/There is no previous lesion/The tooth is extremely sensitive to touch and percussion/<br>Spontaneous pain that is unaffected by painkillers/No occlusion interference.                                                                                                                             | 65(86.1%)      |
| The tooth has been removed from the mouth due to trauma/the patient is systemically healthy/the tooth is in the socket/the tooth pulp has<br>been removed.                                                                                                                                                                                         | 49(64.9%)      |

between variables. The statistical significance level was set at  $P < 0.05$ .

## Results

Out of a total of 77 dentists entered in the study, 76 dentists completed and returned the questionnaire. Among all the participants in the study, 38.2% of them were women, 67% of them had less than 10 years of work experience, and, on average, they examined and treated 20 patients daily. A total of 62 people (81.5%) of the participants stated that they knew about the publication of the guideline related to antibiotics, but only 42 people (22.5%) had read it.

The results showed that in the questions regarding the duration, type, and dose of antibiotic prescription, only 80% of individuals answered correctly to the question “Which of the antibiotics is your first choice in dental infections?” while for the other questions, a maximum of 38.1% of individuals answered correctly (Table 1). In the section on antibiotic prescription scenarios, at least 50% of participants answered correctly to all questions, except for the scenario involving a diabetic patient with mild to moderate toothache, no pain upon touch, and pus coming out of the gums (Table 2).

The average score of self-reported practice was  $7.61 \pm 0.06$  (possible range 0 to 14). The scores of the two subdomains of the type and method of prescribing antibiotics ( $P = 0.651$ ,  $P = 0.251$ ) and prescribing antibiotics in different conditions ( $P = 0.781$ ,  $P = 0.430$ ), as well as the total score of the questionnaire ( $P = 0.153$ ,  $P = 0.341$ ), had no significant

relationship with gender and work experience. Finally, 59.1% of the studied subjects prescribed antibiotics for all emergency patients, and 11.3% of them never prescribed antibiotics for the treatment of emergency patients.

## Discussion

The findings of the present study indicate a moderate level of knowledge and practice among general dentists regarding antibiotic prescription for endodontic treatments. The mean total score was 7.61 out of 14, corresponding to approximately 54% of the maximum achievable score. This suggests that, overall, participants demonstrated an average level of adherence to recommended guidelines, with considerable room for improvement. The practice score of general dentists was at an intermediate level. More than half of them prescribed antibiotics for all emergency patients, and a significant number of them administered antibiotics for incorrect durations. Only a small number of general dentists reported having studied the guidelines for the prescription of antibiotics in cases of endodontic infections.

In this research, most general dentists opted for amoxicillin as their primary choice for treating dental infections. This preference aligns with the recommendations outlined in the guidelines for prescribing antibiotics in endodontics by both the American Association of Endodontists and the European Society of Endodontists (AAE and ESE). These guidelines advocate for beta-lactam antibiotics, such as penicillin and amoxicillin, as the first-line treatment.<sup>17, 18</sup> Amoxicillin stands out as the most frequently prescribed

antibiotic for dental infections.<sup>19,20</sup> It boasts efficacy against endodontic pathogens,<sup>21, 22</sup> particularly when compared to penicillin. Amoxicillin exhibits greater influence on anaerobic gram-negative bacteria, superior absorption through the digestive tract, and a longer half-life.<sup>23</sup> These attributes contribute to its frequent prescription in these cases.

In a study conducted by Parirokh et al. (2023), the objective was to ascertain the percentage of patients successfully treated with amoxicillin alone and evaluate the need for additional antibiotics.<sup>24</sup> Their findings indicated that 52.69% of endodontic infection cases were treated with amoxicillin alone, without requiring a second antibiotic. Consequently, initiating a two-drug regimen from the outset would result in unnecessary antibiotics being prescribed to 52.69% of patients. Conversely, Kakoei et al. (2007) reported that in 70% of cases, dentists prescribed a combination of amoxicillin and metronidazole as the initial drug treatment.<sup>23</sup>

The excessive prescription of antibiotics, often due to insufficient dentist knowledge, patient requests, and the desire to provide optimal treatment without considering side effects and costs, has contributed to the emergence of antibiotic-resistant microbes that were previously susceptible.<sup>3,25</sup> In this study, 11.8% of surveyed individuals were prescribed antibiotics until two days after the patient's symptoms subsided, while 88.2% were prescribed antibiotics for a duration ranging from 3 to 10 days.

The ideal duration for antibiotic treatment is the shortest period until symptomatic improvement is observed. Antibiotic treatment should cease once symptoms have abated and clinical recovery is evident. Since most acute dental infections resolve within 3 to 7 days, shorter treatment durations reduce the risk of antibiotic resistance, toxicity, or allergic reactions.<sup>25</sup> Consequently, patients should be re-evaluated two or three days after initiating treatment to determine whether to continue or discontinue the antibiotic. If there is an improvement, the antibiotic can be continued for an additional two to three days after symptom resolution.<sup>17, 26</sup>

In the study by Parirokh et al. (2020), the average duration of amoxicillin prescription ranged from two to four days, while patients requiring additional adjunct treatment received antibiotics for an average of five to six days.<sup>24</sup> Other studies, such as Segura-Egea et al. (2010) in Spain,<sup>26</sup> Bolfoni et al. (2018) in Brazil,<sup>25</sup> and Salvadoria et al. (2019) in Italy, reported average antibiotic prescription durations of seven days and 5.48 days, respectively.<sup>22</sup>

Lacey et al. (1983) highlighted that using amoxicillin for seven days could lead to an increase in resistant species (23). Therefore, patient monitoring should be prioritized, and long-term, unnecessary antibiotic use should be avoided. Decisions regarding the duration of treatment should be made on a case-by-case basis, considering the drug regimen and individual patient needs.<sup>27</sup>

In this study, 38.2% of respondents correctly selected amoxicillin as the first-choice antibiotic for teeth that had been extracted and reinserted, while 61.8% provided

incorrect answers. The use of systemic antibiotics after reinsertion is recommended to prevent infection-related complications and reduce the occurrence of inflammatory root resorption.<sup>28</sup> Amoxicillin and penicillin are preferred due to their effectiveness against oral flora and low complication rates. Doxycycline, with its antimicrobial and anti-inflammatory properties, is a suitable option. However, the risk of permanent tooth discoloration must be considered when administering tetracycline systemically to young patients. Tetracycline or doxycycline is generally not recommended for those under 12 years old.<sup>29</sup>

The study revealed that only 10.7% of subjects correctly prescribed metronidazole at the recommended dose and frequency (500 mg every 6 hours), while 89.3% deviated from these guidelines. Metronidazole possesses antibacterial properties and inhibits nucleic acid synthesis, making it effective against anaerobic microorganisms. In cases where progressive dental infections do not respond to antibiotics, clinicians may consider adding oral metronidazole to the first-line therapy or discontinuing the initial treatment and prescribing oral amoxicillin/clavulanate to enhance the effectiveness against gram-negative anaerobic organisms.<sup>30</sup>

Regarding prescribing antibiotics in response to specific conditions, 56.1% of participants in the study administered antibiotics correctly in cases of swelling and systemic symptoms (e.g., fever, lethargy), while 43.9% prescribed antibiotics in unnecessary situations. This finding corresponds with research by Fleming-Dutra et al. (2016), which reported that 30% to 50% of antibiotic prescriptions were unnecessary. Furthermore, 33.2% of surveyed individuals were aware of guidelines related to antibiotic prescription, but only 22.5% had read them.<sup>31</sup> Awareness and adherence to antibiotic prescription guidelines significantly improved participants' scores in terms of the type and method of antibiotic prescription, as well as their overall questionnaire scores. Nonetheless, Kakoei et al. (2007) noted that in certain situations, such as acute pulpitis, chronic periapical lesions, and marginal gingivitis, antibiotics were prescribed irrationally.<sup>23</sup> In a study by Iqbal et al. (2015) in northern Saudi Arabia, dentists' attitudes toward antibiotic prescription during root canal treatment were investigated. The findings emphasized the importance of providing dentists with training in the scientific basis of antibiotic prescription for root canal treatment and the need to adhere to current antibiotic prescribing guidelines.<sup>30</sup>

It is worth noting that research in the field of antibiotic usage should be conducted periodically. This is especially crucial due to the risk of indiscriminate antibiotic use leading to the emergence of antibiotic-resistant species. Over time, the efficacy of studies about the type and administration methods of antibiotics may become time-dependent, underscoring the importance of regular updates and reevaluation.

This study has several limitations that should be considered when interpreting the findings. First, the study was conducted among general dentists in Kerman, and the results may not be generalizable to other regions of Iran

or to specialists. Second, the sample size was limited by the number of dentists available and willing to participate, which may have reduced the statistical power to detect associations. Third, the data were collected through a self-administered questionnaire, which is subject to self-report bias and may not fully reflect actual clinical practices. Additionally, the study assessed knowledge and self-reported practices rather than directly observing prescribing behavior in real clinical situations. Future studies with larger and more diverse samples, as well as observational designs, are recommended to verify and expand upon these findings.

## Conclusion

The findings of this study showed that the knowledge and self-reported practices of general dentists in Kerman regarding antibiotic prescription for endodontic infections were at a moderate level, with several deviations from recommended guidelines. These findings highlight the need to improve dentists' awareness of and adherence to evidence-based guidelines through continuing education programs to promote rational antibiotic use.

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## Authors' Contribution

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## Competing Interests

The authors declare that they have no competing interests.

## Consent for publication

Not applicable.

## Ethical Approval

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Research Council of Kerman University of Medical Sciences (Ethical code: IR.KMU.REC.1400.516).

## Data Availability Statement

The data that support the findings of this study are available from Kerman University of Medical Sciences, but restrictions apply to their availability; they were used under license for the present study and are therefore not publicly available. Upon reasonable request and with permission of the Kerman University of Medical Sciences, the data will be available from the corresponding author.

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