

Antibiotic Prescription Patterns during Endodontic Infection among Iraqi Dentists

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Abstract

This study aims to examine the antibiotics prescription in endodontic infections amongst dentists. The questionnaire was carried out by asking 149 Iraqi dentists to fill out an online form, which was sent to them through several social media platforms. The paper-based questionnaire composed of seven questions was distributed to dentists. A statistically significant difference ($P < 0.05$) was identified among dentists with different years of experience in terms of antibiotic prescription among patients with endodontic infection. Surprisingly, when asked to decide on the correct prescription suitable for patients without medical allergy, 51.68% selected the wrong prescription as the answer and 48.32% selected the correct one. While for the patients with medical allergies, there was a significant difference ($P < 0.05$) among dentists who have many years of experience who selected the best answer in terms of the antibiotic prescription for allergic patients. The endodontic infection can be treated by cleaning the root canal system to remove the intracanal infection. However, over-prescribed antibiotics are still prevalent without any rational justification and antibiotic abuse is spreading globally leading to microbial antibiotic resistance.

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Introduction

The pain of odontogenic issue is the most significant condition of patients visit dental clinics.¹ Operative procedures such as nonsurgical root canal and dental filling are the conditions that can be managed conventionally.¹ Additionally, the administration of systemic antibiotics is not necessary in all endodontic cases, where it can be managed by debridement of the pulp space and proper obturation and sealing of the pulp space of the oral environment.² However, systemic manifestations and diffuse swelling are conditions where the antibiotic can be prescribed to patients.^{3, 4} Similarly, acute apical abscess associated with systemic involvement can be managed by

systemic antibiotics, based on the European Society of Endodontology.⁵

Gram-positive and gram-negative bacteria are the main source of endodontic infection⁶, where the prescription of broad-spectrum antibiotics is typically required. Basically, in recent years, there was an increase in the numbers of resistant strains which were sensitive to different types of antibiotics.⁷

According to World Health Organization, the unsuitable use of antibiotics in humans and animals might aggravate the spreading of antimicrobial resistance which is a principal threat to global public health.⁸ Also, excessive antibiotic use led to the rise of antibiotic-resistant bacteria, such as *Clostridium difficile* and carbapenem-resistant Enterobacteriaceae, which were identified as a threat to the healthcare system in the U.S.⁷ It was reported that thousands of deaths each year occurred due to multidrug-resistant infections.⁹

Therefore, if no action is taken, drug-resistant infections will kill 10 million people yearly by 2050.¹⁰

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Normally, an endodontic infection can be controlled by amoxicillin, as a preferred antibiotic among dentists.^{1, 11} Previous reports showed that around 40% of UK dentists propose antibiotics three times weekly, while another 15% recommend antibiotics every day.¹² Past numerous studies have shown that antibiotics prescription amongst dentists is similar to many other medical specialties. Overall about 10% of the antibiotic prescriptions were done by dentists and were the fourth-highest antibiotics prescriber in the U.S.^{13, 14}

It has been identified recently that clinical guidelines were not followed by dental practitioners, where some authors have summarized that there was insufficient information among dental practitioners regarding appropriate and effective prescription.¹⁵ Thus, the awareness of the quality of prescription should be evaluated and monitored through a survey among dental practitioners.

In the literature view, there were no reports about the antibiotic treatment patterns among Iraqi practitioners in terms of endodontic infections. Therefore, the goal of the study is to monitor antibiotic prescribing patterns for endodontic infections among Iraqi practitioners based on their years of experience.

Materials and methods

Ethical Approval

The study was approved by the Medical Ethics Committee, School of Dentistry-University of Baghdad (Reference Number: REF247MEC).

Preparation of the questionnaire

A one-page paper-based questionnaire that was adopted from previous studies^{16, 17} had been distributed to the dental practitioner. The questionnaire was composed of 7 questions (Fig. 1). Three questions were related to the demographic information of the participants such as age, gender, and years of experience. The other two questions were regarding the type of antibiotic used in the treatment of endodontic infections in an adult patient with or without medical allergy. One question was related to the duration of antibiotic prescriptions, and the last one was related to the antibiotic indication to the following clinical situations: -

- 1) Irreversible pulpitis; moderate to severe preoperative symptoms.

- 2) Irreversible pulpitis with symptomatic apical periodontitis; moderate to severe preoperative symptoms.
- 3) Necrotic pulp with asymptomatic apical periodontitis; no swelling, no/mild preoperative symptoms.
- 4) Necrotic pulp with symptomatic apical periodontitis; no swelling, moderate/severe preoperative symptoms.
- 5) Necrotic pulp with asymptomatic apical periodontitis; sinus tract present, no/mild preoperative symptoms.
- 6) Necrotic pulp with symptomatic apical periodontitis; swelling present, moderate/severe preoperative symptoms.

Distribution and collection of the survey

Iraqi dentists were asked to complete an online questionnaire (google forms), which was sent to them through multiple social media platforms. The list of dentists (n=149) was obtained from different sources such as social media, friends as well as colleagues. After responding to the questionnaire, the Iraqi dentist's registration number was recorded to avoid any data duplication. The survey was conducted from September 30, 2019, to March 3, 2020.

Statistical analysis

A database was made for additional analysis using Excel (Microsoft Corp., Redmond, WA, USA). The data were described using frequency and percentage. The total number of each question were considered for the analysis. Data were entered and analysed using SPSS V.24. The proportional difference was confirmed with a chi-square test. The P-value was set as the significant level 0.05.

Results

Gender

Table 1 demonstrates gender distribution in this study where 43.62% of the subjects were male, while 56.38% of the subjects were female.

Years of experience

The dentists in this study were categorized into three groups, based on their clinical experience after graduation. This categorization is clearly shown in Table 2.

Number of males	% of male	Number of females	% of female
65	43.62	84	56.38

Table 1. Demographics: Gender.

Years of experience	No. of dentists	% of dentists
< 1 yr	50	33.56
1-10 yr	58	38.93
> 10 yr	41	27.52

Table 2. Years of experience for the dentists.

		Incorrect		Correct		P
		n	%	n	%	
Gender	Male	36	24.16	29	19.46	0.426
	Female	41	27.52	43	28.86	
	Total	77	51.68	72	48.32	
Years of experience	< 1	26	17.45	24	16.11	0.686
	1-10	32	21.48	26	17.45	
	> 10	19	12.75	22	14.77	
	Total	77	51.68	72	48.32	

Table 3. Antibiotic prescription for patients without medical allergy.

		Incorrect		Correct		P
		n	%	n	%	
Gender	Male	52	34.90	13	8.72	0.600
	Female	70	46.98	14	9.40	
	Total	122	81.88	27	18.12	
Years of experience	< 1	45	30.20	5	3.36	0.001
	1-10	52	34.90	6	4.03	
	> 10	25	16.78	16	10.74	
	Total	122	81.88	27	18.12	

Table 4. Antibiotic prescription for patients with medical allergy.

Antibiotic prescription for patients without medical allergy

The dentists' selection for their drugs of choice in the treatment of non-allergic patients for the six clinical cases is demonstrated in Figure 2. It clearly shows that many dentists chose Amoxicillin 500 mg in the treatment of case No. 1. While other dentists chose Augmentin 625mg or Amoxicillin 500mg for clinical case No. 1 as well. However, a small number of dentists chose other antibiotics listed in the questioner for the treatment of the different clinical cases. Surprisingly, 51.68% of dentists gave an incorrect answer (They selected other types of antibiotics) and 48.32% gave a correct answer (Amoxicillin 500) regarding the antibiotic prescription (Table 3). Statistically, there were no significant differences among gender and dentists with different years of experience in terms of antibiotic prescription during endodontic infection (Table 3).

Antibiotic prescription for patients with medical allergy

The results showed that the majority of dentists chose metronidazole (500 mg) Azithromycin (500 mg & 250 mg), Erythromycin

(500 mg), and clindamycin (300 mg) especially for clinical case No 1 in patients with a medical allergy for endodontic infection treatment, as shown in (Figure 3). However, a small number of dentists chose Azithromycin (500 mg) Erythromycin (500 mg), and clindamycin (300 mg) for clinical case No. 2 as a treatment. Table 4 shows that there was a significant difference (P<0.05) between dentists who have many years of experience who selected the best answer in terms of the antibiotic prescription for allergic patients.

		Incorrect		Correct		P
		n	%	n	%	
Gender	Male	3	2.01	62	41.61	0.200
	Female	1	.67	83	55.70	
	Total	4	2.68	145	97.31	
Years of experience	< 1	0	.00	50	33.56	0.084
	1-10	1	.67	57	38.26	
	> 10	3	2.01	38	25.50	
	Total	4	2.68	145	97.31	

Table 5. Duration of antibiotic prescription.

		Incorrect		Correct		P
		n	%	n	%	
Gender	Male	62	41.61	3	2.01	0.748
	Female	81	54.36	3	2.01	
	Total	143	95.97	6	4.2	
Years of experience	< 1	50	33.56	0	.00	0.179
	1-10	55	36.91	3	2.01	
	> 10	38	25.50	3	2.01	
	Total	143	95.97	6	4.2	

Table 6. Antibiotics prescription for the clinical six cases.

Age: Gender: Male Female

Years of experience: < 1 1-10 > 10

1. Which is the first type of antibiotic used in the treatment of endodontic infections in an adult patient without medical allergy? (Please encircle your answer)

-Amoxicillin 250mg 500mg

-Amoxicillin + Clavulanic acid (Augmentin®) 625 mg 825mg 1000mg

-Clindamycin 150mg 300mg

-Metronidazole (flagyl®) 250mg 500mg

-Azithromycin (Zithromax®) 250mg 500mg 1000mg

-Cephalexin (Keflix®) 250mg 500mg

-Others:

2. If the patient has a sensitivity to penicillin, which type of the antibiotic used in the treatment of endodontic infections

-Clindamycin 150mg 300mg

-Azithromycin 250mg 500mg 1000mg

-Erythromycin 500mg

-Metronidazole 250mg 500mg

-Others:

3. Determine the duration of antibiotic prescription: ----- days

4. The antibiotics are indicated in which of the following situations? (Indicate your choice by √)

---Irreversible pulpitis; moderate to severe preoperative symptoms

---Irreversible pulpitis with symptomatic apical periodontitis; moderate to severe preoperative symptoms

---Necrotic pulp with asymptomatic apical periodontitis; no swelling, no/mild preoperative symptoms

---Necrotic pulp with symptomatic apical periodontitis; no swelling, moderate/severe preoperative symptoms

---Necrotic pulp with asymptomatic apical periodontitis; sinus tract present, no/mild preoperative symptoms

---Necrotic pulp with symptomatic apical periodontitis; swelling present, moderate/severe preoperative symptoms

Figure 1. Questionnaire used for the survey in this study.

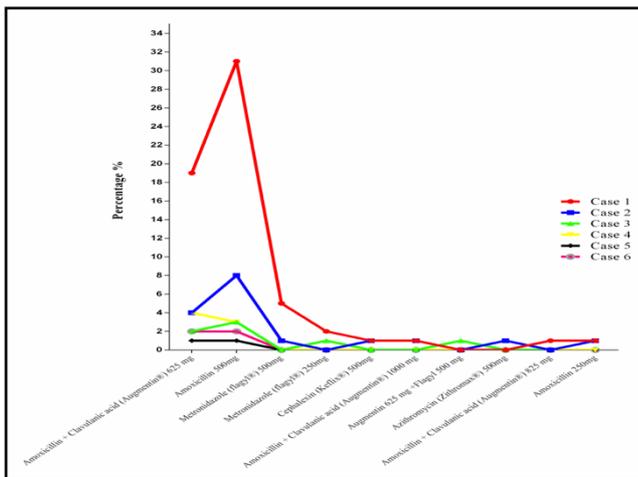


Figure 2. Antibiotic indication in Non-allergic patients.

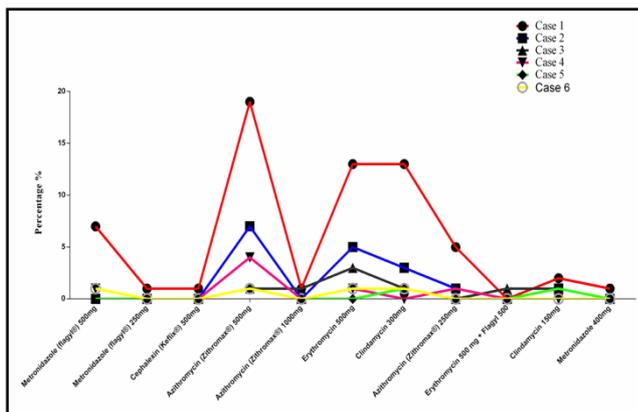


Figure 3. Antibiotic indication in allergic patients.

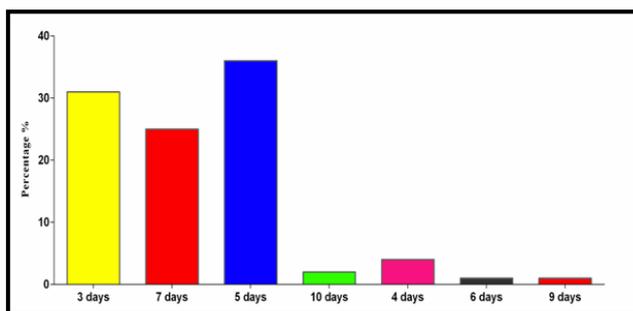


Figure 4. The optimal duration of antibiotic prescription.

Duration of antibiotic prescription

Figure 4 shows that most dentists selected 3-7 days duration for antibiotic prescription upon endodontic infection. Their answers were considered correct if they did choose the duration for antibiotic treatment between 3-7 days, where the majority of dentists made a correct choice for the antibiotic prescription duration (Table 5). The same table

also shows that there were no statistical differences ($p>0.05$) between the dentists' gender and years of experience regarding their answers about the duration of antibiotic prescription.

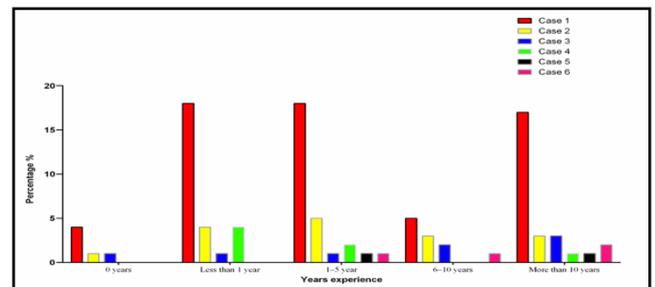


Figure 5. Antibiotic indication based on experienced years for the 6 clinical cases.

Antibiotic prescription in six clinical cases

Figure 5 provides a general demonstration of antibiotic prescription for the six clinical cases, with respect to the years of experience for participating dentists. It was observed that the number of antibiotic prescriptions will grow as the years of experience of the dentist increase. Furthermore, the majority of dentists prescribed antibiotics for the first clinical case in the study regardless of their years of experience. Moreover, many dentists with different years of experience chose to prescribe an antibiotic for the second clinical case. While a few decided to prescribe an antibiotic for the other cases. Unfortunately, the results showed that the majority of dentists (95.97%) in this study made an incorrect decision in prescribing antibiotics, as it was shown in Table 6. Interestingly, there was a significant difference ($P>0.05$) among dentists with different years of experience in terms of antibiotic prescription among patients with endodontic infections.

Discussion

Unsuitable usage of antibiotic medication results in microorganism resistance. It also contributes in transferring the resistance genes from antibiotic-resistant to antibiotic-susceptible microorganisms increasingly.⁷ Infectious diseases morbidity and mortality can be increased because of quick antibiotic resistance development. Dental practitioners contribute to resistant bacterial strains if they prescribe the

use of antibacterial drugs inappropriately, based on the British Society for Antimicrobial Chemotherapy.^{18, 19} In addition, antibiotic-resistant microorganisms can also be developed if the duration of therapy and prophylaxis are improper.¹⁸ Thus, the antibiotic prescription pattern in Iraq must be identified to learn whether the Iraqi dentists need further education. Antibiotics prescription is dependent on well-defined indications in cases of infections of endodontic origin. Symptomatic apical periodontitis with localized swelling in a healthy patient and without systemic involvement does not require systemic antibiotic therapy. In such cases, incision, drainage, with conventional root canal treatment can effectively prevent the spread of infection.²⁰ Antibiotics can be prescribed to prevent the spread of infection in special clinical cases related to progressive diffuse swelling and systemic involvement, including fever, malaise, and lymphadenopathy, as well as in medically compromised patients.¹⁷

Concerning the antibiotic therapy duration upon endodontic infection, our results showed that most dentists prescribed antibiotic treatment from 3 to 7 days for an endodontic infection. Our findings were similar to previous research, which reported that the sufficient control of infection should be between 3-7 days, however, the patients should be followed up after 2 to 3 days, to decide whether to stop or continue the treatment.²¹

Based on our results, the first-choice antibiotic for non-allergic patients is amoxicillin 500mg followed by Amoxicillin + Clavulanic acid (Augmentin®) 625 mg. The findings of our study were analogous to previous reports conducted in Lithuania²⁰ and Brazil²², which identified that amoxicillin is the most prescribed antibiotic for those non-allergic patients. Similarly, several studies revealed that the dentists selected Amoxicillin as the first choice administration.²³ Endodontic infection can be treated by Amoxicillin as a moderate-spectrum beta-lactam antibiotic. Nevertheless, beta-lactamase-producing bacteria can be produced by the same infection, so the amoxicillin effectiveness is reduced. Additionally, our result also showed that Amoxicillin + Clavulanic acid (Augmentin®) 625 mg was the second choice of antibiotic in non-allergic patients. According to^{24, 25} who stated that the combination of Amoxicillin with clavulanic acid is a broader spectrum of action, where it can

treat the developing resistant bacteria. Furthermore, the ideal choice for endodontic infections was either amoxicillin alone, or combined with clavulanic acid, taking into consideration the correct dosage and the proper duration.²⁶

Our results also revealed that most dental practitioners chose Azithromycin (Zithromax®) 500 mg, Erythromycin 500mg, and Clindamycin 300mg as the first choice of antibiotic for allergic patients, according to AAE.^{3, 27} Based on²⁶ the recommended antibiotic treatment for allergic patients are clindamycin, clarithromycin, or azithromycin. It is found that the broadest spectrum of microorganisms found in the mouth might be eliminated by Azithromycin and erythromycin. Iranian²⁸ and Indian dentists^{29, 30} also preferred these kinds of drugs specifically for penicillin-allergic patients. However, azithromycin and erythromycin were not a good choice for *Fusobacterium* and *Prevotella* strains during dental alveolar infections.²⁸ Similarly, another study showed that Clindamycin is a broad-spectrum antibiotic among dental practitioners for allergic patients.³¹ Former studies also found that erythromycin is an excellent choice in patients allergic to penicillin of endodontic diseases.³²

Necrotic pulp with symptomatic apical periodontitis; swelling present, moderate/severe preoperative symptoms was the case where most dental practitioners have chosen to treat with antibiotics. Previous research showed that this clinical case needed antibiotics as well as root canal treatment incision and drainage.^{5, 33} Approximately, most of the dentists (96%) prescribed antibiotics for this case. It is identified that systemic antibiotics should be prescribed as well as endodontic treatment to eliminate any spread of infection.^{5, 26, 33}

On the other hand, the second choice was irreversible pulpitis with symptomatic apical periodontitis; moderate to severe preoperative symptoms which required antibiotic treatment. Our results were similar to the former report which revealed that 2-4% of dentists indicated antibiotics for pulpitis treatment.^{20, 34} Also, antibiotics treatment was indicated by 50% of the Spanish Endodontic Society for acute apical periodontitis without swelling, associated with necrotic pulps.³⁵ A higher percentage of dentists prescribe antibiotics for pulpitis.^{23, 36} One report mentioned that 6.7% of practitioners prescribed

antibiotics for irreversible pulpitis cases which were less percentage compared with other reports³⁷ The contrasting results regarding irreversible pulpitis and the risks of antibiotic abuse may be due to the knowledge of general dental practitioners and might be improved. To prevent postoperative infection in endodontic surgical procedures, systemic antibiotics might be not effective during necrotic pulp and localized endodontic infections after adequate debridement and drainage.³⁸ However, one previous report revealed that only 30% of respondents prescribed antibiotics for symptomatic patients with necrotic pulp and chronic apical abscesses.³⁹ The previous study showed that 42% of respondents selected antibiotics, where the guidelines of antibiotic prescription were neglected.⁴⁰ Similarly, 30% - 71% of respondents proposed antibiotic prescription in this case.^{41, 42} A low percentage (12% and 22%) of dentists prescribe antibiotics in this case.²³ Thus, in this case, it was not recommended to treat it with antibiotics.⁵ It was concluded that antibiotic prescription does not support endodontic disease unless the infection is spread systemically or the patients are febrile.⁴³

Another study was on necrotic pulp with asymptomatic apical periodontitis; sinus tract present, no/mild preoperative symptoms. It was stated previously that this case can be treated with nonsurgical root canal and analgesics⁵ Similar to our results, former studies illustrated that 37% and 25% of dentists prescribe antibiotics in this case.⁴⁴ Furthermore, 21%-60% of respondents prescribed antibiotics in this case.^{35, 41} Moreover, a high percentage of dentists in European countries and other continents preferred to prescribe antibiotics in this situation.⁴³ It was demonstrated that necrotic pulp and irreversible pulpitis were not recommended to be treated by antibiotics.^{33, 45} In contrast to our study, this clinical situation was prescribed with antibiotics by 31% of Spanish oral surgeons' respondents.⁴¹

Irreversible pulpitis is considered a vital pulp without any symptoms involved systemically. Several studies proposed no antibiotics for this case⁵ However, such reports prescribed antibiotics for this case which were 12% and 22% of dentists.⁴⁴

It was identified that 53% of the respondents prescribed antibiotics in necrotic pulp, acute

apical periodontitis with no swelling. Also, it was stated that 22% of dental professionals proposed antibiotics in necrotic pulp with apical periodontitis and a sinus tract. Additionally, 86% and 71% of dental respondents prescribed antibiotics in irreversible pulpitis and necrotic pulp, acute apical periodontitis with no swelling respectively. Approximately, 60% of respondents proposed antibiotics for necrotic pulps with chronic apical periodontitis and a sinus tract case. In one study conducted in Turkey, it was found that 22% of dentists prescribed antibiotics for patients with acute apical periodontitis, and 41% of dentists prescribed antibiotics for patients with acute apical abscess⁴⁶ However, 74% of Turkish dentists prescribe antibiotics unnecessarily.⁴⁷ Also, 46% of Croatian dentists prescribe antibiotics in pulpitis cases and 80% prescribe for apical abscesses.⁴⁸

Our results also demonstrated that there was no significance in terms of antibiotic prescription among female and male practitioners or based on their experiences. This result was similar to the previous study.⁴⁹ Nevertheless, other studies have shown that more experienced practitioners were inclined to suggest antibiotics more often than younger practitioners.^{20, 50} Similarly, antibiotic prescriptions were more prescribed by younger dentists in root end surgery and necrotic pulps with chronic apical periodontitis, indicating that they might have insufficient experience in this field. A study conducted in Kuwait demonstrated that professional dentists with more experience have prescribed antibiotics for pain management more often as compared to younger dentists.¹¹

Conclusions

In conclusion, an endodontic infection can be treated primarily by cleaning and shaping the root canal system to remove the intracanal infection upon root canal procedure. Nevertheless, over-prescribed antibiotics are still ongoing without any rational justification. In the past and present time, antibiotic usage can enhance the oral microflora antibiotic resistance when used for all diseases. Antibiotic abuse is spreading globally leading to microbial antibiotic resistance.

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Declaration of Interest

The authors report no conflict of interest.

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