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Antibiotic prescription in the management of endodontic infections amongst Iraqi final-year undergraduate dental students

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Aim: This study aimed to examine the prescription of antibiotics for endodontic infections among undergraduate dental students. **Methods:** Two government Iraqi dental schools [(the University of Baghdad (UOB) (n=99) and University of Babylon (UB) (n=70)], and one private dental school [Osouldeen University College (OUC) (n=103)] were included in this survey study. A paper-based questionnaire composed of seven questions was distributed to students, and collected. A chi-square test was used for data analysis, and the level of significance was set at 0.05 (P=0.05). **Results:** A statistically significant difference (P<0.05) was identified between students' answers in the three dental schools regarding antibiotic selection for endodontic infections in which patients had no known allergies (P=0.001). In comparison to other dental schools, a statistically significantly higher proportion of respondents from UOB (32%) favored Azithromycin 500mg for treating patients with penicillin hypersensitivity (P=0.003). A high percentage of participants (62.1%) selected antibiotic prescription in cases with necrotic pulp and symptomatic apical periodontitis (with swelling and moderate/severe preoperative symptoms). However, there were no significant differences between the 3 dental schools (P>0.05). **Conclusion:** In conclusion, a significantly greater percentage of UB chose amoxicillin for the treatment of endodontic infection in patients with no medical allergies. Azithromycin 500mg was selected by UOB as the preferred option in patients who were sensitive to penicillin. Our findings support the need for the implementation of strategies to raise awareness of good antibiotic prescribing practices among dentists in Iraq.

Keywords: Anti-bacterial agents. Students, dental. Endodontics. Iraq.

Introduction

Antimicrobial resistance (AR) is one of the most significant threats to global public health[1]. Approximately, 400,000 infections and 25000 deaths were recorded as a result of persistent multidrug-resistant bacteria in Europe[2]. Consequently, by 2050, it is suspected that 10 million people will be killed annually if no action is taken against drug-resistant infections[2].

Gram-positive and gram-negative facultative anaerobes are the main reasons for endodontic infections[3]. Systemic antibiotics are usually prescribed for patients with endodontic infections as a prevention measure against the development of apical abscesses and to inhibit subsequent progression and persistence of infections[4]. This will lead to the increasing prescription of broad-spectrum antibiotics even in cases where antibiotics are not indicated, such as symptomatic irreversible pulpitis, necrotic pulps, and localized acute abscesses[4]. However, literature shows that immunocompromised patients with congenital immuno-deficiencies are encouraged to take antibiotics as a compensation for their compromised immune systems that cannot withstand the spread of microbial infections[4].

The AR of microorganisms may develop due to three main factors, including improper dosage, prolonged antibiotic treatment, and unnecessary antibiotic prescription[5]. According to the guidelines of the American Association of Endodontics (AAE), systemic indication of antibiotic prescription is only appropriate when there is a spread of infection characterized by fever, swelling, cellulitis, and lymphadenopathy[6].

Unfortunately, most general dental practitioners (GDPs) have shallow knowledge of prescription patterns to treat endodontic infections[7]. The majority of GDPs prescribe about 10% of all common antibiotics for endodontic infection treatment[8], which is considered very prevalent nowadays[9]. In recent literature, it has been noticed that some inappropriate prescriptions are undertaken by GDPs due to a lack of knowledge, social factors or traditional beliefs[10]. Therefore, undergraduate as well as postgraduate dental students should be equipped with sufficient knowledge to follow the prescription guidelines for systemic antibiotics in endodontic infections and frequent survey studies should be undertaken to evaluate current practices and ways to improve in instances of inappropriate prescription profiles.

Up to date, there is no congruous data for antibiotic prescription in endodontic infections amongst Iraqi-final year undergraduate dental students. This study aimed to determine the knowledge of final-year undergraduate dental students in three Iraqi dental schools in terms of prescribing antibiotics for patients with endodontic infections.

Materials and Methods

Ethical Approval

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

Preparation of the questionnaire

A one-page paper-based questionnaire that was adopted from previous studies[11,12] has been distributed. The questionnaire is composed of 7 questions (Figure 1). Three questions were related to the demographic information of the participants, such as age, gender, and dental school name. Two questions were related to the type of antibiotic used in the treatment of endodontic infections in an adult patient without and with medical allergy. One question was related to the duration of an antibiotic prescription. Another last question was related to the antibiotic indication for the following clinical situations:

1. Irreversible pulpitis; moderate to severe preoperative symptoms (Case 1).
2. Irreversible pulpitis with symptomatic apical periodontitis; moderate to severe preoperative symptoms (Case 2).
3. Necrotic pulp with asymptomatic apical periodontitis; no swelling, no/mild preoperative symptoms (Case 3).
4. Necrotic pulp with symptomatic apical periodontitis; no swelling; moderate/severe preoperative symptoms (Case 4).
5. Necrotic pulp with asymptomatic apical periodontitis; sinus tract present; no/mild preoperative symptoms (Case 5).
6. Necrotic pulp with symptomatic apical periodontitis; swelling present; moderate/severe preoperative symptoms (Case 6).

When the questionnaire was posted on the website, it was stated that this questionnaire is utilized for research.

The dental schools involved in the survey

The survey was undertaken at two government dental schools [University of Baghdad (UOB), University of Babylon (UB)], and one private dental school [Osouldeen University College (OUC)] from January 2019 to June 2019. A total of 446 students were invited to participate in the survey. Based on sample size calculation (https://www.surveymonkey.com/mp/sample-size-calculator/), a total of 211 participants are needed to participate in the survey (95% confidence interval and 5% margin of error). Two hundred and seventy-two participants contributed to this study (UOB =99, UB =70, and OUC =103). The response rate to the survey was 61% from all three dental schools.

Distribution and collection of the survey

Final year undergraduate dental students from those three Iraqi dental schools were invited to fill out a one-page paper-based questionnaire that was adopted from previous studies (Figure 1)[11,12]. The questionnaire was distributed by a representative from each dental school. Students were allowed to decline participation in the survey, and those that agreed were assured anonymity.

Age:

Gender: Male Female

University:

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	250 mg	500 mg	
• Amoxicillin + Clavulanic acid (Augmentin®)	625 mg	825 mg	1000 mg
• Clindamycin	150 mg	300 mg	
• Metronidazole (flagyl®)	250 mg	500 mg	
• Azithromycin (Zithromax®)	250 mg	500 mg	1000 mg
• Cephalexin (Keflix®)	250 mg	500 mg	

• Others:

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

• Clindamycin	150 mg	300 mg	
• Azithromycin	250 mg	500 mg	1000 mg
• Erythromycin	500 mg		
• Metronidazole	250 mg	500 mg	

• 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. (Case 1)

• Irreversible pulpitis with symptomatic apical periodontitis; moderate to severe preoperative symptoms. (Case 2)

• Necrotic pulp with asymptomatic apical periodontitis; no swelling, no/mild preoperative symptoms. (Case 3)

• Necrotic pulp with symptomatic apical periodontitis; no swelling, moderate/severe preoperative symptoms. (Case 4)

• Necrotic pulp with asymptomatic apical periodontitis; sinus tract present, no/mild preoperative symptoms. (Case 5)

• Necrotic pulp with symptomatic apical periodontitis; swelling present, moderate/severe preoperative symptoms. (Case 6)

Figure 1. Questionnaire used for the survey in this study

Statistical Analysis

SPSS version 24 was used to analyse the data. Categorical variables were described in terms of frequency and percentage. The difference in proportions explained by selected explanatory variables was tested with the chi-square test. The level of significance was set at 0.05 (P=0.05). Questionnaire internal consistency was assessed with Cronbach's alpha, which was between 0.7 and 0.81.

Results

Socio-demographic data of the study samples

Table 1 shows the gender distribution among the three dental schools. Two hundred and seventy-two participants were involved in this study (UOB =99 out of 186, UB =70 out of 116, and OUC =103 out of 143) with a response rate of 61%. About two thirds of the participants were female, while one-third were male with a mean age of 22 years old. The highest number of participants were from OUC (37.9%), followed by UOB (36.4%), followed by UB (25.7%).

Table 1. Socio-demographic data for the present study among 3 dental schools.

Variable		N	Percent (%)
Gender	Male	97	35.7
	Female	175	64.3
Dental schools	OUB	99	36.4
	UB	70	25.7
	OUC	103	37.9

Analysis of endodontic infection treatment for patients with no medical allergies

Figure 2 shows the drug of choice that was selected by students to treat adult patients with endodontic infections with no known allergies. The majority of the students selected amoxicillin 500 mg (32.7%) and amoxicillin + clavulanic acid 625 mg (32.4%) as the first choice of endodontic infection treatment. Amoxicillin 250 mg was listed as a second choice, in which was selected by (18.8%) of the participants. The other types of antibiotics included in the survey were selected by fewer participants, as shown same figure. Table 2 illustrates the comparison between the genders and dental schools in terms of antibiotic selection for endodontic infections in an adult patient without medical allergy. Table 2 showed that there was a significant difference (P value=0.001) between the responses of participants in the three dental schools regarding the choice of antibiotics for endodontic infections for patients without medical allergies, with UB (44.3%) coming in first, followed by the participants from OUC (40.8%), and finally the participants from UOB (16.2 percent).

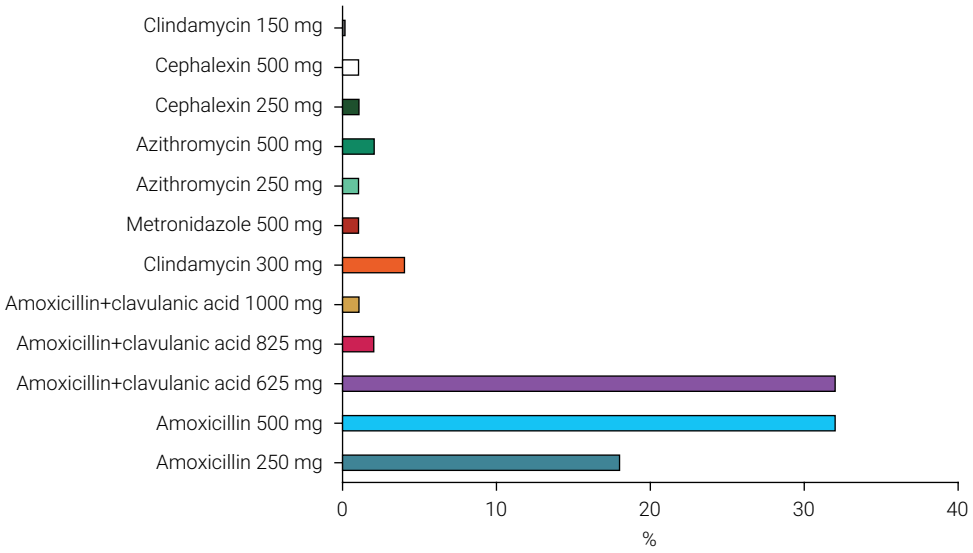

Figure 2. Descriptive analysis of antibiotics used in the treatment of endodontic infections in adult patients without medical allergy.

Table 2. Comparisons between the genders and dental schools in terms of antibiotic selection for endodontic infections in adult patients without medical allergy.

		Question 1				p-value
		Answer 1		Answer 2		
		N	%	N	%	
Gender	Male	73	75.3	24	24.7	0.037
	Female	110	62.9	65	37.1	
Dental schools	UOB	83	83.8	16	16.2	0.001*
	UB	39	55.7	31	44.3	
	OUC	61	59.2	42	40.8	

Answer 1:- Different type of antibiotics. Answer 2:- Amoxicilline 500mg. * P value for comparison of row percentage.

Endodontic infection treatment analysis for Penicillin sensitive patients

Figure 3 shows the selection of the most appropriate penicillin replacement for patients that are allergic to penicillin. The majority of participants chose azithromycin 500 mg (33.1%), while clindamycin 300 mg (22.8%) and erythromycin 500 mg (21.7%) were listed as second choice. According to Table 3, several antibiotic classes were recommended by students to patients who had penicillin allergies, where UOB had a significant higher percentage (32.3%) who selected Azithromycin 500mg compared with the other 2 dental schools, as shown in Table 3.

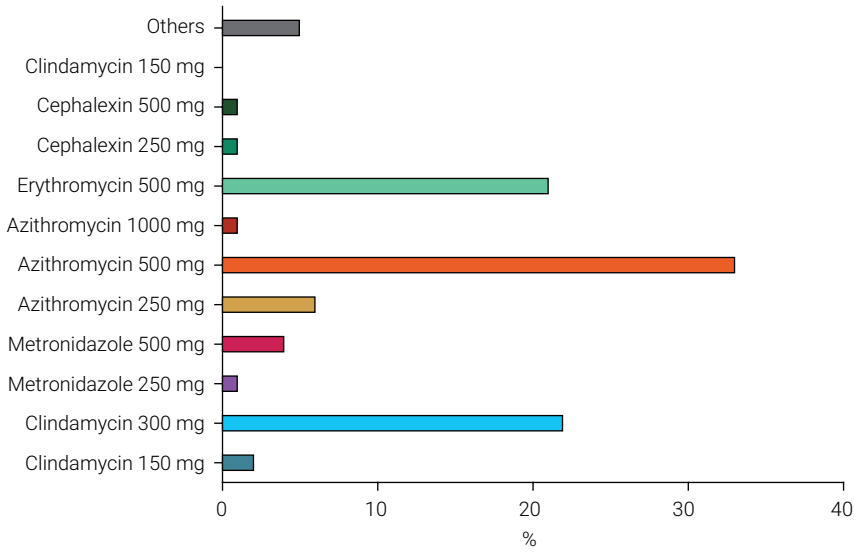

Figure 3. Descriptive analysis of antibiotic used in the treatment of endodontic infections in adult patients allergic to penicillin.

Table 3. Comparison between the genders and dental schools in terms of antibiotic selection for endodontic infections treatment in adult patients allergic to penicillin.

		Question 2				p-value
		Answer 1		Answer 2		
		N	%	N	%	
Gender	Male	74	76.3	23	23.7	0.072
	Female	136	77.7	39	22.3	
Dental schools	UOB	67	67.7	32	32.3	0.003*
	UB	63	90	7	10	
	OUC	80	77.7	23	22.3	

Answer 1: - Different type of antibiotic. Answer 2:- Azithromycin 500mg. * P value for comparison of row percentage

The suitable duration of antibiotic prescription upon endodontic infection

Figure 4 shows the appropriate duration of antibiotic prescription selected for endodontic infection. The majority of the participants selected 7 days as the first choice (36.4%), while 25.4% and 23.9% selected 5 and 3 days, respectively. Lesser percentages of participants selected other durations for antibiotic usage, as shown in the figure. There was a significant difference between the participants of the three dental schools (P =0.001), where the participants of UB (97.1%) and OUC (92.2%) were significantly higher in terms of selecting 7 days compared to the participants of UOB (79.8%), as shown in (Table 4).

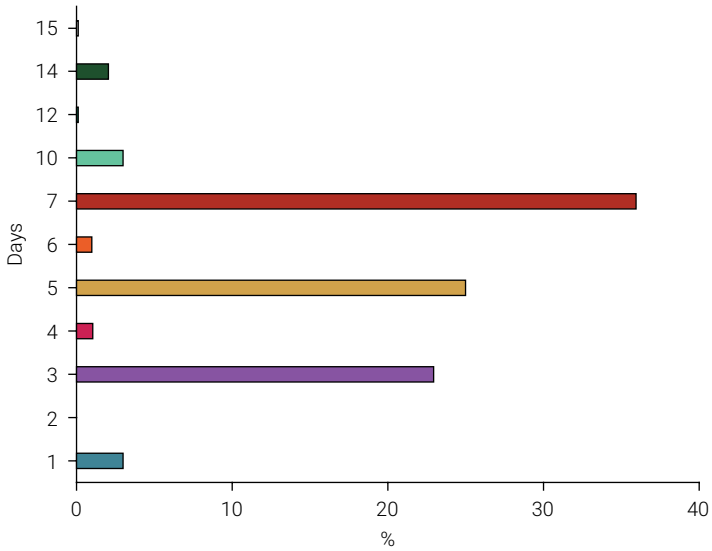

Figure 4. Descriptive analysis of the duration of antibiotic prescription for endodontic infections.

Table 4. Comparison between the genders and dental schools in terms of the duration of antibiotic prescription for endodontic infections.

		Question 3				p-value
		Answer 1		Answer 2		
		N	%	N	%	
Gender	Male	13	13.4	84	86.6	0.352
	Female	17	9.7	158	90.3	
Dental schools	UOB	20	20.2	79	79.8	0.001*
	UB	2	2.9	68	97.1	
	OUC	8	7.8	95	92.2	

Answer 1:- Different duration for treatment. Answer 2:- 3 to 7 days treatment. * P value for comparison of row percentage.

An antibiotic prescription profile in different clinical situations

Table 5 shows the antibiotic prescription for the six clinical scenarios. In the first clinical case, 28.3% of the participants indicated the use of antibiotics. A high percentage of participants (62.1%) selected antibiotic prescriptions in case 6 in comparison with other clinical cases.

Table 5. Descriptive analysis of the indicated antibiotics in six different clinical situations.

Question		N	%
Q4_1	Not indicated	195	71.7
	Indicated	77	28.3

Continue

Continuation

Q4_2	Not indicated	129	47.4
	Indicated	143	52.6
Q4_3	Not indicated	226	83.1
	Indicated	46	16.9
Q4_4	Not indicated	179	65.8
	Indicated	93	34.2
Q4_5	Not indicated	191	70.2
	Indicated	81	29.8
Q4_6	Not indicated	103	37.9
	Indicated	169	62.1

Discussion

Previous studies conducted in different countries have shown a lack of information and inappropriate antibiotic prescribing forms amongst dentists for endodontic infections[7,13]. Studies have demonstrated that it is essential to modify the antibiotic-prescribing practices of dentists to effectively control endodontic infections[14-16]. The information of dental students on the use of systemic antibiotics in pulp and periodontal infections should be improved by developing new strategies. Therefore, it is essential to identify the level of knowledge possessed by dental students on this particular subject. This is the first report examining Iraqi dental students' awareness of antibiotic usage on endodontic infections. Results revealed that the majority of Iraqi final-year dental students opted for the appropriate antibiotic for the treatment of endodontic infections, although there were still students that unsuitably specified antibiotics for clinical situations that do not really require a prescription of systemic antibiotics.

A total of 272 Iraqi final-year undergraduate dental students (97 male and 175 female) from 3 Iraqi dental schools located in Baghdad and Babylon cities participated in this survey, which is comparable to other similar surveys[17,18].

Our results showed that 18.8%, 32.7%, and 32.4% of respondents chose amoxicillin 250 mg, amoxicillin 500 mg, and amoxicillin+clavulanic acid 625 mg, respectively. UB and OUC were significantly higher compared with the participants of UOB in terms of amoxicillin prescription. This can be explained by the fact that antibiotic prescriptions at UOB are undertaken at the Endodontic department where postgraduate dental students receiving the cases have shallow knowledge of the current guidelines for antibiotic prescription in endodontic infections, whereas final-year undergraduate dental students at OUC and UB are directly supervised by their respective lecturer's specialist in the field of Endodontics. It is worth noting that the dental curriculum at Iraqi dental schools shows considerable variations in terms of the teaching profile and materials provided including textbooks and scientific publications in addition to guidelines and protocols followed for endodontic diagnosis and treatment procedures.

According to the Spanish Endodontic Society, the first-choice antibiotic for non-allergic patients is amoxicillin (44%) or a combination with clavulanate (42%)[19]. GPDs practising in Europe designated amoxicillin as the first antibiotic option for the treatment of endodontic infections[7]. Guzmán-Álvarez et al.[20] demonstrated that 78.9% of fourth-year undergraduate dental students have chosen amoxicillin as the first-choice drug for the management of odontogenic infections in one dental school in Mexico. In contrast, lesser percentages of amoxicillin prescriptions were noticed among final-year dental students in other regions[21]. One study showed that the second antibiotic of choice for non-allergic patients to penicillin (30.9%) is a combination of amoxicillin and clavulanic acid[22]. Thus, the first option for endodontic infections is the combination of amoxicillin + clavulanic acid, as an β-lactamase inhibitor[23].

β-lactam allergic patients were prescribed azithromycin 1000 mg and erythromycin 500 as the first antibiotics of choice[24], which is similar to our results, where final year dental students selected the same medication (UOB16 %, UB7% and OUC 23%). Endodontic specialists usually prefer clindamycin 300 mg as the first-choice antibiotic for patients who are allergic to penicillin[21]. Erythromycin and clindamycin are the two universally most commonly chosen antibiotics for the management of pulp and periapical infections[7]. *Streptococcus Viridans* and *fusobacterium streptococci* are commonly associated with odontogenic infections that cannot be treated by erythromycin[25]. Furthermore, erythromycin has a relatively high occurrence of gastrointestinal adverse effects (5-30%)[26]. This result corresponds with (ESE 2018) protocols that mention patients who are allergic to beta-lactam antibiotics may use clindamycin, clarithromycin, or azithromycin as an alternative treatment[27].

The final year dental students suggested 3-7 days, with 7 days being the most common (89.0%), as a typical duration for the antibiotic therapy, with substantial variances between the dental schools (P >0.05). According to AAE, amoxicillin 500 mg (3 times/day) is the desirable dose for adult patients, where 3 to 7 days are the recommended duration of antibiotic prescription[6]. Clindamycin (300 mg every 6 hours) is the most commonly chosen alternative for patients with a penicillin allergy. One study found that 99% of Italian students preferred 3–7 days as the duration for endodontic infection treatment[2]. It seems that there is confusion amongst dental students about the interval of antibiotic usage. One report has shown that endodontic infections have a fast commencement and short period of time, determining in 3 to 7 days, or less if the cause is cured or removed[5]. In addition, toxicity and/or allergy, and the risk of developing resistant microorganisms might be reduced with the short duration of therapy of antibiotics. The development of resistant microbial species might occur because of prolonged antibiotic usage or due to an insufficient dosage of antibiotics with narrow coverage of all microbial species[22].

In this study, the number of students proposing antibiotics for the 6 periapical and pulpal clinical cases confirms that the topic of antibiotic usage in endodontics should be included in the curriculum of dental schools. Our results demonstrated that a relatively high percentage of students would prescribe antibiotics in case 1 (28.3%) or case 2 (52.6%). Several reports[4,28] demonstrated that these two clinical scenarios can be treated without antibiotics as long as patients do not show symp-

toms of systemic involvement. In terms of antibiotic prescription, a low percentage for this clinical situation was found in Lithuania[29] and Belgium[30], whilst this percentage was higher in studies carried out in Iran (80.6%) and India (71.6%)[31,32]. As a general rule, pain reduction, percussion pain or the number of analgesic medications taken by patients with untreated irreversible pulpitis does not require antibiotic administration[33].

Results showed that 16.9% of students indicated the use of antibiotics in patients with case 3. A similar percentage (14%) has been reported in one study[21], while 31% of Spanish oral surgeons used to prescribe antibiotics in similar clinical situations[10]. Previous studies[4,28] reported that healthy individuals with this clinical condition do not require antibiotics; root canal treatment is sufficient to resolve the problem.

Our results also showed that 34.2% of students would recommend antibiotics to a patient with case 4. However, previous studies have described that this clinical situation requires only root canal treatment and in some cases, painkillers[4,28]. It is obvious that about one third of undergraduate Iraqi dental students had an inappropriate conception of antibiotic utilization in endodontic infection, which is relatively higher than survey studies[10,19].

The presence of asymptomatic apical periodontal diseases associated with the presence of a sinus tract is the 5th clinical case that is ideally indicated for root canal treatment without the use of antibiotics[7]. About one-third of dental students preferred antibiotic prescriptions in this circumstance, which is considered a high percentage. It seems that students require more attention to differentiate between acute and chronic infections of the periapical tissues. It is well-known that systemic involvement such as fever, malaise, as well as cellulitis and lymphadenitis require antibiotic prescriptions because such cases cannot be solely controlled by the immune system, and if left, may turn into a life-threatening situation[34].

The 6th case is pulp necrosis, symptomatic apical periodontal disease, swelling, and moderate/severe symptoms. Based on this survey, 62.1% of dental students prescribed antibiotics for this case. Undoubtedly, the existence of systemic involvement makes it necessary to use antibiotics in addition to endodontic treatment, incision, and drainage[7].

Results of this study showed that a large proportion of final-year undergraduate dental students are not aware of the scientific basis for prescribing antibiotics in endodontic infections. Thus, Iraqi dental schools are recommended to revise the guidelines for antibiotic prescriptions in the endodontic curriculum to provide students with more information about antibiotics and their proper use in endodontic infections. Worldwide, the contents and quality of medical and dental education systems provide limited focus on the principles of antimicrobial stewardship and resistance in terms of knowledge, attitude, and behaviour to medical or dental students[35]. There is a lack of studies, particularly in the Middle East, evaluating the efficacy of an educational syllabus on antibiotic prescribing for dental students[36]. It is essential to equip dental students with the necessary educational tools for analysing endodontic infections and ways to manage them with the aid of problem-based as well as case-based learning modules[18,37]. For instance, a

program-based module on antibiotic policy dealing with the history of infectious diseases and antibiotic guidelines should be followed, as it has been structured by one of the Netherlands universities[35]. Thus, Iraqi dental students need to be further educated in controlling the irrational outlooks and demands of patients as they leave dental school and go into a world where less-than-responsible prescribing is the norm.

In conclusion, among patients without medical allergies, a significantly higher proportion of UB respondents chose amoxicillin for the treatment of endodontic infection. UOB decided that Azithromycin 500 mg would be the best treatment for people who have penicillin sensitivity. Furthermore, in the first clinical case, 28.3% of the participants indicated the use of antibiotics. Therefore, results of the present study confirm the necessity of putting policies in place to increase Iraqi dentists' understanding of appropriate antibiotic prescription techniques.

Conflict of Interest

The authors declare no conflict of interest

Author Contribution

MMJ Al-Obaidi: concepts, design, literature search, data acquisition, manuscript preparation, manuscript editing, funding

EA Hadi: concepts, design, literature search, data acquisition, manuscript preparation

ZN Al-Talib: design, literature search, data acquisition, manuscript preparation

AM Daher: data analysis, statistical analysis

M Al-Adhami: data acquisition, data analysis, statistical analysis

HMA Ahmed: review and manuscript editing

All authors declare that they were actively involved in revising and approving the manuscript's final form.

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