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A Survey of Systemic Antibiotic Prescription Patterns Amongst Iraqi Dentists

Zaid A. Al Marah^a, Ali A. Abdulkareem^{b*}, Sarhang S. Gul^c,
Muhanad L. Alshami^a^a Faculty of Dentistry, Dijlah University College, Baghdad, Iraq^b College of Dentistry, University of Baghdad, Baghdad, Iraq^c College of Dentistry, University of Sulaimani, Sulaymaniyah, Iraq

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ABSTRACT

Objectives: The misuse of antibiotic prescriptions is a common behavior amongst dentists worldwide. Over-prescription of these agents is associated with multiple adverse effects and risk of developing bacterial resistance. The aim of this study was to assess systemic antibiotic prescription patterns amongst dentists in Iraq.

Methods: A questionnaire-based survey was conducted in dental centres distributed in 12 Iraqi governates. The questionnaire was composed of two main sections: The first was dedicated to collecting demographic and work-related information, and the second section included questions seeking details about antibiotic prescriptions for different oral and dental conditions.

Results: A total of 481 valid questionnaires were considered in the final analysis. The numbers of correct and incorrect patterns of prescribing antibiotics for different dental/oral conditions were almost equal (49.6% and 50.4%, respectively). Amongst independent variables investigated, qualification of the dentist and work domain were found to have significant associations with correct prescribing patterns (odds ratio, 1.166 and 1.197, respectively). The majority of dentists preferred amoxicillin as the first-choice antibiotic, followed by “Augmentin” (43.7% and 35.5%, respectively), whilst clarithromycin was the lowest on the list. Azithromycin was the most recommended antibiotic (55.9%) in cases of allergy to penicillin.

Conclusions: In general, antibiotics are prescribed for recommended conditions, but the prescription for nonrecommended conditions was also evident amongst Iraqi dentists. Correct pattern of antibiotic prescribing was significantly associated with specialists and those working in the academic field. Additionally, amoxicillin and its derivatives are the most preferred drugs.

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Introduction

The majority of oral and dental diseases are driven by the oral biofilm, and treatment to eliminate oral biofilm is generally provided via different procedures such as drainage, root canal treatment, scaling, and others.¹ In certain situations, antibiotic prescription is recommended as an adjunct to active dental treatment to control acute infection.^{2,3} Oral and dental

diseases that require mandatory prescription of antibiotics are limited, such as facial cellulitis, acute necrotizing gingivitis, reimplantation of teeth, and trismus.^{2,3} In addition, antibiotics are recommended in medically compromised patients who are at risk of experiencing infective endocarditis.³

The development of bacterial resistance as a consequence of unnecessary prescription of antibiotics, which might lead to a global crisis if neglected, is a problem that was recognised many decades ago.⁴ Since May 2015, the World Health Organisation (WHO) has been raising alarms in response to worldwide reports about the emergence of new bacterial strains resistant to the last-defense line of antibiotics.^{5,6} For

* Corresponding author. College of Dentistry, University of Baghdad, Medical City of Baghdad, Baghdad, Iraq.

E-mail address: ali.abbas@codental.uobaghdad.edu.iq (A.A. Abdulkareem).

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instance, approximately 23,000 deaths in the United States alone have been associated with bacterial resistance to antibiotics.⁷ In addition, inappropriate prescription of antibiotics could be associated with life-threatening conditions such as allergic reactions⁸ and increased potential for fatal opportunistic infections due to the suppression of the normal flora.^{9,10} Over-prescription of antibiotics by dentists has been reported in many countries in which antibiotics are inappropriately prescribed for certain diseases.¹¹⁻¹⁷ This situation is even worse in developing countries where there is a lack of clear guidelines for antibiotic prescription and dentists might prescribe antibiotics to fulfill patients' expectations without providing local treatment.¹⁸

The aforementioned literature suggests that over-prescription of antibiotics is a global issue amongst health care providers including dentists. However, the majority of studies about patterns and attitudes of dentists regarding antibiotic prescription were conducted in developed countries rather than developing countries.¹⁰⁻¹⁵ Furthermore, whilst patterns of antibiotic prescription have been investigated in countries neighboring Iraq, such as Jordan,¹⁹ Turkey,²⁰ and Kuwait,²¹ to the best of our knowledge, no study has been conducted on antibiotic prescription patterns in dental practice in Iraq. This suggests that the indications and problems associated with inappropriate antibiotic prescription have not been considered sufficiently in developing countries such as Iraq. Additionally, such studies could determine the gap in knowledge amongst both general and specialist dentists in developing countries and provide an opportunity to educate both dentists and patients. Thus, the aim of this study was to assess systemic antibiotic prescription patterns amongst dentists in Iraq.

Methods

Study design

This cross-sectional survey was conducted by using a questionnaire to assess antibiotic prescribing patterns amongst Iraqi dentists. The questionnaire was printed and mailed to randomly selected dental centres, governmental and private, and dental colleges distributed across 12 Iraqi governates. After completion, the questionnaires were mailed back to one of the authors. The distribution started in November 2019, and participants were asked to return the form within 2 to 3 weeks of receiving it; any forms returned after expiry of the collection period were excluded from the analysis. The study was approved by the ethics committee of the College of Dentistry, University of Baghdad (Ref. 1575 in 20/10/2019), and followed the guidelines in the Declaration of Helsinki for human studies.

Elements of the questionnaire and scoring methods

The questionnaire was adapted from previous studies^{14,17} and modified to fit the aim of this survey. The questionnaire consisted of open- and closed-ended questions that were divided into 2 sections. The first section was dedicated to collecting demographic and general information such as city, age, sex, graduation year, qualifications, workplace (health

sector or academic), work domain (rural or urban), and the number of patients treated per week. The second section was designed to gather data about antibiotic prescribing for selected common dental diseases, and participants were provided with a list of conditions that might potentially require an antibiotic prescription. This list included the following diseases where antibiotic usage is recommended: trismus, acute ulcerative gingivitis, reimplantation of teeth, infective endocarditis, and facial cellulitis.^{14,17,22-24} The list also included the following diseases/purposes for which antibiotics are not recommended: patient satisfaction, periodontitis, dental biofilm-induced gingivitis, acute pulpitis, dry socket, chronic apical infection, dental implant, sinusitis, pericoronitis, periodontal abscesses, and acute periapical infection.^{14,17,25-27} Participants were asked to determine for each of the listed items whether they would or would not prescribe antibiotics.

For each correct response in the prescription/nonprescription of antibiotics, a score "1" was given, whilst incorrect responses were given a score "0." Scores from all participants were pooled together to determine the total score for each studied variable to verify possible associations with antibiotic prescribing. In addition, details of the type, dose, and duration for each prescribed antibiotic were recorded as recommended by the Centers for Disease Control and Prevention.²⁸ The last part of this section included questions about whether the dentists were satisfied with the effects of antibiotics and which antibiotics they preferred as alternatives in the case of sensitivity to penicillin²⁵ (Table 1).

Sample size calculation and randomisation

The sample calculation was based on the total number of registered Iraqi dentists in 2019. The number of those dentists, together with their exact distribution across the different Iraqi governates, were officially provided to the authors by the Iraqi Dental Association.

The total number of registered dentists was 6,463, based on which the required representative sample to reject a null hypothesis at a 0.05 margin of error and a 95% confidence interval was calculated according to the following formulas:

Sample size = (distribution of 50%) / ((margin of error% / confidence level score)²)

Confidence level = 1.96 (for confidence level of 95%), margin of error = 0.05.

True sample = (sample size × population) / (sample size + population - 1)

The required sample size was determined to be 363 dentists (rounded up to 400)

A total of 800 questionnaire copies were printed, that is, double the calculated sample size, taking into consideration the dropout rate, which was estimated based on a previous pilot study. The questionnaires were distributed proportionally to the number of dentists in each city. The selection of sites within each governate was conducted randomly using the lottery method until the targeted number was achieved.

Table 1 – Survey questionnaire.

City:				
Age:				
Sex:	Male		Female	
Qualifications:				
Describe your workplace:	Health sector		Academia	
Where is your work domain?	Urban		Rural	
On average, how many patients do you treat per week?				
On average, how many times do you prescribe antibiotics per week?				
In which of the following situations would you prescribe antibiotics?				
Dental condition	Yes	No	Dose	Duration
Acute pulpitis				
Acute periapical infection				
Chronic apical infection				
Pericoronitis				
Cellulitis				
Periodontal abscesses				
Acute ulcerative gingivitis				
Dental biofilm-induced gingivitis				
Sinusitis				
Periodontitis				
Dry socket				
Trismus				
Reimplantation of teeth				
Infective endocarditis				
Dental implant				
Patient's satisfaction				
Do you always achieve the desired effect after prescribing the antibiotic(s)?	Yes	No		
In the case of sensitivity to penicillin, what alternative antibiotic do you usually prescribe?				
List of recommended/not recommended conditions (not shown to the respondents)				
Recommended: Trismus, acute ulcerative gingivitis, reimplantation of teeth, infective endocarditis, and facial cellulitis				
Not recommended: Patient satisfaction, periodontitis, dental biofilm-induced gingivitis, acute pulpitis, dry socket, chronic apical infection, dental implant, sinusitis, pericoronitis, periodontal abscesses, and acute periapical infection				

Statistical analysis

Demographic data were analysed in terms of mean, standard deviation, range, numbers, and proportions. Based on their calculated medians, clinicians' age, years of service, and number of patients seen per week were dichotomised into ≤ 28 and > 28 years, ≤ 3 and > 3 years, and ≤ 20 and > 20 patients, respectively. A Chi-square test was used to evaluate possible associations between each independent variable (age, sex, qualification, years of service, workplace, work domain, and number of patients seen weekly) and antibiotic prescription based on the total scores obtained from respondents. Furthermore, the dose and duration of each antibiotic prescribed for recommended and nonrecommended diseases were compared using a t test. A heat map was used to show the number of prescribed antibiotics for each disease, and a bar chart illustrated the frequency of antibiotic prescriptions and preferred alternative antibiotics to penicillin. The significance level was set at $P < .05$. All statistical analyses were performed using GraphPad Prism (version 8.4.0) software.

Results

The questionnaire was distributed amongst 800 randomly selected dentists. A total of 316 dentists did not return the questionnaire. A total of 481 (43.9% male and 56.1% female) dentists returned completed questionnaires, which were

included in the final analysis, whilst 3 incomplete forms were excluded. The average age of the participants was 30.8 ± 7.7 years, and their average service was about 5 years. The majority of participants were general practitioners (65.9%) working in the health sector (90.6%) and in urban areas (81.1%) (Table 2).

Further analysis showed that correct pattern of prescribing was significantly higher in association with specialists as compared to general practitioners ($P = .029$; odds ratio [OR], 1.166) and in those working in the academic field than in dentists working in the health sector ($P = .022$; OR, 1.197). Other variables did not show any significant association with the pattern of antibiotic prescribing (Table 2).

Although antibiotics are recommended for trismus, acute ulcerative gingivitis, and tooth reimplantation, these conditions were associated with the lowest preference of antibiotic prescriptions by the dentists ($n = 56$, 11.6%; $n = 197$, 41%; $n = 222$, 46.2%, respectively). On the other hand, most of the dentists indicated that they prescribe antibiotics for cellulitis ($n = 369$, 76.7%) and infective endocarditis ($n = 349$, 72.6%) (Figure 1). Regarding nonrecommended conditions, most of the dentists ($n = 381$, 79.2%) tend to prescribe antibiotics for acute periapical infection followed by periodontal abscess ($n = 311$, 64.7%). In addition, the lowest tendency to prescribe antibiotics was associated with patient satisfaction ($n = 47$, 9.8%) followed by periodontitis and dental biofilm-induced gingivitis ($n = 120$, 24.9% each). Responses of prescription of antibiotics for other conditions are illustrated in Figure 1.

Table 2 – Demographic (independent) variables of the dentists and their association with the antibiotic prescription pattern.

Variables		Range	Mean ± SD		
Age (years)		23-65	30.8 ± 7.7		
Range of graduation years		1988-2018			
Service period in years		1-31	4.6 ± 4.7		
Patients treated/week		5-130	29.7 ± 24.6		
Antibiotics prescribed/week		0-80	10.3 ± 11.4		
		No., %	Total score [†]	P value*	OR**
Age group	≤28	257, 53.4	2,113 (51.4)	.613	1.023
	>28	224, 46.6	1,821 (50.8)		
Sex	Male	211, 43.9	2,248 (52.0)	.068	1.088
	Female	270, 56.1	1,686 (49.9)		
Qualification	General practitioner [§]	317, 65.9	2,802 (55.0)	.029	1.166
	Higher degree	164, 34.1	579 (58.8)		
Workplace	Health sector [§]	436, 90.6	3,563 (51.0)	.022	1.197
	Academic	45, 9.4	400 (55.6)		
Work domain	Rural	91, 18.9	764 (53.0)	.232	1.072
	Urban	390, 81.1	3,210 (51.3)		
Service (years)	≤3	251, 52.1	2,368 (51.2)	.840	1.009
	>3	230, 47.9	1,566 (50.9)		
Patients seen/week	≤20	247, 51.4	2,022 (51.1)	.933	1.004
	>20	234, 48.6	1,912 (51.0)		
	Total	481, 100			

[†] Total scores obtained based on the correct responses concerning the prescription of antibiotics, frequency (%).

[§] Higher degree holders and academic personnel showed significantly higher correct pattern for antibiotic prescription than general practitioners and dentists in health sector respectively.

* Significant at $P < .05$ by Chi-square test.

** Odds ratio (OR) at 95% confidence interval.

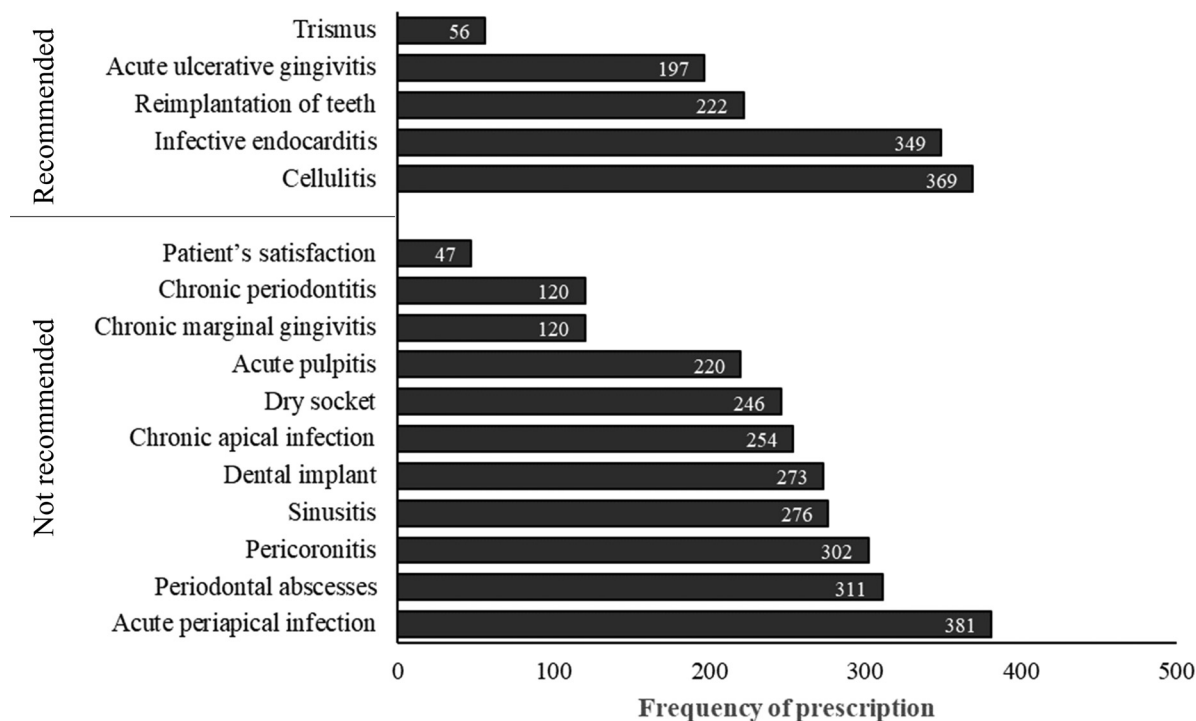


Fig. 1 – Frequency of antibiotic prescriptions for each condition. For nonrecommended diseases, the highest tendency to prescribe antibiotics was associated with acute periapical infection (n = 381, 79.2%), whilst the lowest was associated with prescription for the patient's satisfaction (n = 47, 9.8%). For recommended diseases, the majority of the dentists prescribed antibiotics for cellulitis (n = 369, 76.7%); however, trismus was not recognised by most of them (n = 56, 11.6%) as a condition that requires prescription of antibiotics.

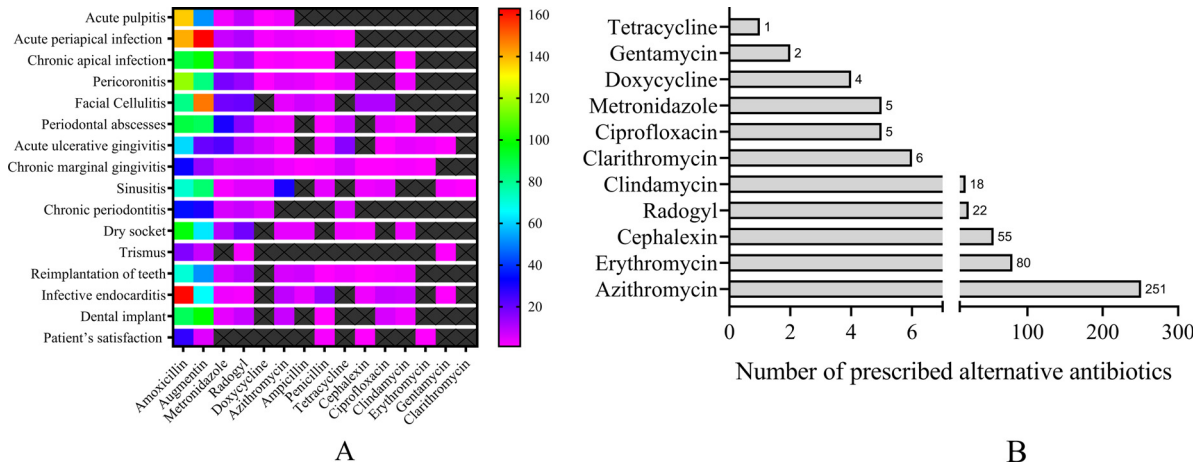


Fig. 2 – Antibiotic prescriptions for recommended and nonrecommended diseases: A, Preferences for antibiotic prescription. Color coding (scale on the right side of the figure) is used to differentiate how frequent every antibiotic (x-axis) is preferably prescribed by the dentists for each oral or dental disease/condition (y-axis). Blacked-out cells indicate nonprescription of antibiotics for certain diseases/conditions. B, Numbers of alternative antibiotics prescribed in the case of penicillin sensitivity.

A heat map was used to determine the frequency of each antibiotic prescription in all 16 situations. Amoxicillin and Augmentin were the most commonly prescribed (43.7% and 35.5%, respectively). For gentamycin and clarithromycin, the percentages were only 0.2% and 0.03%, respectively (Figure 2A). On the other hand, in the case of sensitivity to penicillin, azithromycin was the antibiotic most preferred by the dentists (55.9%), followed by erythromycin (17.8%) and cephalexin (12.2%). Finally, gentamycin and tetracycline (<1%) were the least preferred alternatives to penicillin (Figure 2B).

This study also compared the prescribed dose and duration for each antibiotic in recommended and nonrecommended situations. No statistically significant differences in the dose of antibiotics were identified except for amoxicillin, for which a higher dose was preferred ($P < .05$). Furthermore, no statistically significant differences were identified in the

duration of antibiotic prescriptions for recommended or nonrecommended situations apart from amoxicillin and metronidazole ($P < .05$) (Table 3).

Discussion

To the best of our knowledge, this is the first nationwide multicentre survey to investigate antibiotic prescription patterns amongst dentists in Iraq. The results obtained in this study showed that the preference of prescribing antibiotics by dentists was mainly directed towards recommended conditions. However, prescriptions for nonrecommended cases were also common. In general, amoxicillin, amoxicillin and clavulanic acid (Augmentin), or both were the most commonly prescribed antibiotics amongst Iraqi dentists.

Table 3 – Comparison of prescribed doses and durations of antibiotics between recommended and nonrecommended diseases.

Antibiotics	Dose (mg) (mean ± SD), range				Duration (days) (mean ± SD), range			
	Recommended		Not recommended		Recommended		Not recommended	
Amoxicillin	556.9 ± 277.4 ^a	250-2,000	501.3 ± 58.8	250-1,000	4.2 ± 1.6	1-8	4.5 ± 1.5 ^a	1-14
Ampicillin	500 ± 0.0	500	500 ± 0.0	500	5.1 ± 1.6	3-8	3.8 ± 1.4	2-7
Augmentin	632.7 ± 81.9	500-1,000	631.6 ± 85.6	500-1,000	4.9 ± 2.1	1-16	4.8 ± 1.4	1-8
Azithromycin	523.8 ± 109.1	500-1,000	495.2 ± 38.1	200-500	4.6 ± 1.8	1-7	4.1 ± 1.2	3-7
Cephalexin	533.3 ± 129.1	500-1,000	500 ± 0.0	500	4.5 ± 1.8	1-7	4.2 ± 1.1	3-5
Ciprofloxacin	505.9 ± 24.3	500-600	500 ± 0.0	500	4.5 ± 1.7	1-7	5.0 ± 1.6	3-7
Clindamycin	415.8 ± 130.2	300-600	290.0 ± 100.4	150-600	5.3 ± 1.5	3-7	5.3 ± 1.4	3-7
Doxycycline	208.3 ± 66.5	100-500	192.0 ± 103.8	100-300	5.0 ± 2.0	3-7	4.8 ± 1.4	3-7
Erythromycin	416.7 ± 144.3	250-500	375.0 ± 176.8	250-500	4.0 ± 1.0	3-5	4.0 ± 1.4	3-5
Gentamycin	400.0 ± 141.4	300-500	500 ± 0.0	500	2.7 ± 0.6	2-3	4.0 ± 1.4	3-5
Metronidazole	485.6 ± 58.9	200-500	493.6 ± 41.8	200-500	5.0 ± 1.8 ^a	1-7	4.2 ± 1.4	2-8
Penicillin	772.2 ± 414.2	100-2,000	607.1 ± 212.9	500-1,000	5.1 ± 3.2	1-14	4.2 ± 1.0	3-5
Radogyl	125.0 ± 0.0	125	125.0 ± 0.0	125	5.5 ± 3.1	3-17	4.7 ± 1.9	2-14
Tetracycline	407.9 ± 123.9	250-500	423.1 ± 117.7	250-500	5.5 ± 2.5	3-14	4.5 ± 1.4	3-7

^a Significant difference at $P < .05$ using a t test.

Inappropriate prescription of antibiotics for diseases that can be addressed by active dental treatment is common amongst dentists worldwide.¹³⁻¹⁷ Striking results obtained from a previous study showed that more than 80% of prophylactic antibiotic prescriptions in dental practice were unnecessary.²⁹ This is consistent with results from the current study, in which half of the participating clinicians indicated prescribing systemic antibiotics for conditions for which they are not required. For instance, dentists recommended antibiotics for diseases where the infection was merely of a pulpal location or confined to the gingiva, such as acute pulpitis and gingivitis, or localised infection, for example, dry socket (alveolar osteitis).^{30,31} A possible explanation for such antibiotic prescription is that it was given for prophylactic reasons as an attempt to eradicate infection during endodontic treatment. However, the use of prophylactic antibiotics is not well supported, and previous studies have shown weak or inconsistent results on antibiotic use in combination with endodontic therapy.³²⁻³⁴ Similarly, the use of antibiotics to control the infection or minimise the pain associated with dry socket is not based on the evidence.³⁵ For implant-associated surgeries, results from a systematic review of randomised clinical trials showed that the prescription of antibiotics for healthy individuals during placement of implants did not improve the clinical outcome.³⁶ On the other hand, the efficacy of prophylactic antibiotics for patients at risk for infective endocarditis due to congenital or acquired heart conditions is still unclear. Although recent guideline updates do not recommend an antibiotic regimen for these patients,³⁷ cardiologists oppose this, as they consider dental procedures as a potential source of infection.³⁸ Additionally, treatment of periodontitis is based on mechanical debridement, and the use of antibiotics has no additional benefit except for refractory periodontitis and what was previously known as aggressive periodontitis.^{27,39}

Different practice-related and demographic factors did not show any significant association with the pattern of antibiotic prescription except for the qualification and workplace. Unlike general practitioners, who are responsible for providing primary care for different dental conditions, specialists mostly deal with a limited range of referred cases and have more defined treatment plans. Additionally, dentists working in the academic sector are required to be cognizant of the latest updates in the dental field as part of their core teaching responsibilities. This could explain the higher association of correct patterns of antibiotic prescribing for recommended and nonrecommended conditions amongst the dentists working in academia than amongst their counterparts in the health sector. For the other variables, results were in agreement with a previous survey that indicated that factors such as age, sex, years of experience, and number of patients seen per week were not associated with the decision to prescribe antibiotics.¹² However, other studies have shown that these factors were significantly associated.^{11,15} This can be explained by the fact that different countries have different guidelines for dental practice, and the dentists have different educational backgrounds. In addition, these studies varied in their sample size, study and questionnaire design, interpretation of data, and analysis methods.

Most dentists prescribed amoxicillin and its derivative Augmentin as their drugs of choice for the majority of diseases, which is in line with previous studies.^{15,34} Metronidazole was ranked as the third most preferred drug for therapeutic or prophylactic purposes, despite the fact that its activity is limited to anaerobic Gram-negative bacteria.⁴⁰ Metronidazole is not suitable for most odontogenic infections, except for certain infections with predominant anaerobic microorganisms, such as necrotising ulcerative gingivitis.⁴⁰ Other antibiotics, such as clindamycin, erythromycin, and clarithromycin, were not as preferred despite their effectiveness, which could be due to the associated undesirable side effects.^{41,42} In the case of sensitivity to penicillin, the dentists identified azithromycin as the first drug of choice, followed by erythromycin, which is consistent with other studies.^{17,43} Consumption of these macrolides is known to be associated with gastrointestinal upset and other undesirable effects; however, dentists continued to prescribe them. This could be attributed to their previous successful experiences with these drugs. It seems that dentists tend to be overly cautious by prescribing broad-spectrum agents with minimal adverse effects; however, these broad-spectrum antibiotics increase the risk of bacterial resistance more than their narrow-spectrum counterparts.⁴⁴

The generally recommended duration by dentists for antibiotic intake is more than 3 days. Interestingly, the duration of amoxicillin use for diseases that did not require antibiotics was significantly longer than the duration for those for which antibiotics were necessary.⁴⁰ Normally, a longer duration of more than 10 days is indicated for those with immunocompromised conditions and disseminated infections, whereas, consistent with the results of this study, longer antibiotic prescription was recommended for diseases where prolonged antibiotic intake was not necessary.¹⁹ Another worrisome observation was related to the doses prescribed for different diseases, which were found to be random rather than the appropriate required dose. This random prescription of antibiotics could be attributed to the lack of clear guidelines from official institutions. Thus, dentists rely on knowledge gathered from various sources, or they follow other international guidelines. Even with proper knowledge and commitment to the guidelines, other nonclinical or social factors may still have influenced the dentists' antibiotic prescription patterns,³⁴ such as patient satisfaction. Additionally, the mindset of the patients, especially those in low socioeconomic groups, may cause them to consider the prescription of a long list of drugs as an indicator of the doctor's competency. Lack of knowledge about oral and dental infections, fear of the dental office environment, and inability to comply with the treatment schedule might explain patients' determination to obtain these drugs.

Since this was a questionnaire-based study, it has limitations observed in similarly designed studies, such as requiring the questions to be answered remotely rather than on a face-to-face basis, which may have affected the respondents' understanding of the questions and subsequent interpretation of the data. In addition, other variables that were not included in the current study, such as sources of information for antibiotic prescription or the patient's medical condition, might influence antibiotic

prescribing by dentists. Further, the dependence on the responses provided by the dentists represents a limitation of this study, since they may not have accurately reflected the prescriptions given to patients. Nevertheless, the large sample size and use of a mailing method rather than online questionnaires were reflective of the studied population and therefore represent strengths of the current study.

Conclusions

The majority of the dentists tend to prescribe antibiotics for recommended conditions, but antibiotic prescriptions for nonrecommended conditions were also common. In addition, qualification and workplace of the dentists showed significant associations with the correct pattern of prescribing. Amoxicillin and Augmentin were the most preferred antibiotics, whilst azithromycin was the first drug of choice in case of penicillin sensitivity.

Conflict of interests

None disclosed.

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