

Antibiotic prescription by general dental practitioners in the management of acute dentoalveolar infections

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أجريت هذه الدراسة لتقييم مستوى معلومات أطباء الأسنان العاميين حول استعمال المضادات الحيوية عند المرضى المصابين بالانتانات السنخية السنية الحادة. تم ارسال استبيانات الى عينة عشوائية مكونة من (٣٠٠) طبيب اسنان عام يعملون في القطاعين العام والخاص ويمارسون عملهم في مختلف محافظات الأردن. أجاب (٢٣٠) طبيب على الاستبيان بنسبة (٧٦,٧%). بينت النتائج ان المضاد الحيوي (Amoxycillin) مع أو بدون الـ (Metronidazole) هو اكثر المضادات الحيوية التي يقوم الأطباء بوصفها. المضادات الحيوية (Clindamycin و Lincomycin) تم وصفهم من قبل (٢٦,٥%) من الأطباء . أما في حالة المرضى الذين لديهم حساسية للبنسلين، فإن أكثر الأطباء قاموا بوصف المضاد الحيوي (Erythromycin) ويليها (Lincomycin و Clindamycin). فقط (١٧,٨%) من الأطباء الذين تم سؤالهم اخذوا عينات من الالتهابات السنية لمعرفة الزمرة الجرثومية المسببة والمضادات الحيوية المناسبة خلال فترة عملهم. كان هنالك اختلافات كبيرة بين الأطباء في نوعية المضادات الحيوية التي ينصحون بها واختلافات كبيرة أيضاً في الجرعات وعدد الأيام التي يجب على المريض ان يأخذ فيها الدواء. لوحظ ان الطبيبات و الاطباء حديثي التخرج و الأطباء الذين يعملون في المستشفيات والاطباء خريجي الأردن كانوا اكثر تماشياً مع الإرشادات المنصوح بها حالياً عند استخدام المضادات الحيوية.

Objective: This study was conducted to assess the level of knowledge of the general dental practitioners in the use of antibiotics for patients with acute dentoalveolar infections. **Materials and Methods:** A questionnaire was sent to a random sample of 300 general dental practitioners working in eleven governances in Jordan in order to survey their choice of antibiotic in the management of acute dentoalveolar infections. The responses were numerically coded and analysed. Frequencies were used to examine and describe the distribution of all the variables. **Results:** Responses were received from 230 (76.7%) general dental practitioners. Amoxycillin with or without metronidazole was the most frequently prescribed antibiotic. Lincosamides (clindamycin and lincomycin), were prescribed by 26.5% of the general dental practitioners. In patients allergic to penicillin, erythromycin was the most frequently prescribed followed by lincosamides. Only 17.8% of the general dental practitioners had taken microbiological samples for culture and sensitivity throughout their practice. There was a wide variety of dosage, frequency and duration for all the antibiotics prescribed. General dental practitioners who are female or young or working in hospitals and those graduated from Jordan were significantly more compliant with the current guidelines for antibiotic prescription. **Conclusion:** The results showed a lack of consistency in the rational use of antibiotics by the general dental practitioners with considerable variation in the recommended doses, frequencies and durations.

INTRODUCTION

The widespread concern about the increasing problem of antimicrobial resistance has emphasized the need for rationalization of antibiotic use in the treatment of infections.^{1,2} Although antibiotics, along with analgesics, are the most commonly prescribed medications by general dental practitioners (GDPs), little is known on the knowledge and understanding of GDPs concerning its use in everyday clinical practice. Recent studies have investigated the prescribing of antibiotics by GDPs in acute

dentoalveolar infections (ADAI) and have shown that the prescription of antibiotics in terms of dose, duration and choice of antibiotic is inappropriate and possibly increasing the worldwide problem of antimicrobial resistance.³⁻⁵

It has been suggested that availability of guidelines for GDPs in addition to improving undergraduate education and increasing the provision of postgraduate courses may encourage safe, effective, rational and economic use of antibiotics.⁶ The Faculty of General Dental Practitioners of the Royal College of Surgeons of England [FGDP (UK)] has recently published recommended guidelines for antimicrobial prescribing

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for dental practitioners.⁷ These guidelines were based on a review of all the available literature, best practice and consultation with many specialist dental societies. The aim of these guidelines is to rationalise, and thereby improve, the standards of prescribing by GDPs. In the case of ADAIs, the recommended guidelines were to identify the cause, to establish drainage and, where possible, to eliminate the cause of infection. In these guidelines, the recommended antibiotics, which were considered as an adjunct to treatment, are shown in Table 1. This study was carried out to assess the level of knowledge of GDPs in Jordan in the use of antibiotics for patients with ADAIs and to compare their prescription with the guidelines of the FGDP (UK).⁷

Table 1. Recommended antibiotics for ADAIs according to the guidelines of the FGDP (UK)⁷

Comments	Antibiotic	Dose	Frequency per day	Duration (days)
First choice	Amoxicillin	250 mg	3	Up to 5*
	or Amoxicillin	3g ¹		
	or Penicillin V	500 mg	4	Up to 5*
Anaerobic² +	Metronidazole	200 mg	3	Maximum 3*
Second choice	Metronidazole	200 mg	3	Maximum 3*
Third choice	Erythromycin	250 mg	4	Maximum 5*

¹Two doses, eight hours apart.

²If a predominately anaerobic infection is suspected or microbiologically proven, add to the above: metronidazole, 200 mg, three times daily (maximum three days).

*The guidelines recommend that patient should be reviewed in 2-3 days and if temperature is found normal and swelling is resolving, discontinue treatment.

MATERIALS AND METHODS

A questionnaire was devised to investigate general practitioners' knowledge of prescribing of antibiotics. This questionnaire was a modification of that described by Muthukrishnan *et al.*⁸ The GDPs were requested to state what antibiotic (s) they would normally use in case of an ADAI. They were asked to write down the antibiotic (s) they would

prescribe if they face a young, otherwise healthy, adult male patient as an emergency with an acute dental infection from a carious lower molar tooth. They were informed that the patient was mildly pyrexial, in severe pain and had a localised swelling on that side of the jaw with mouth opening restricted to 2 cms but that the patient could still swallow. Information was sought on the antibiotic dose, frequency and number of days that the practitioner would prescribe for the patient if he was not allergic to penicillin. The GDPs were also asked to state the antibiotic regime they would prescribe if the patient was allergic to penicillin. The next part of the questionnaire sought information on a number of non-clinical factors to determine if they have affected the GDPs' choice of the antibiotic prescribed. Specifically, questions were asked whether or not the cost of the antibiotic, availability in the nearby pharmacy, advertisement, effectiveness and previous experience with the drug, patient's preference of a specific antibiotic, or recommendations by consultants or colleagues would affect their antibiotic prescription. GDPs were also asked if they have ever taken a sample from a dental infection for culture and sensitivity to see the most effective antibiotic. Although the questionnaire was anonymous, respondents were requested to provide information about their age (banded in decades from 21-60 years), gender, work sector (private clinic, hospital), and place of qualification.

A random sample of 300 GDPs working in eleven governances in Jordan was generated from the Jordanian Dental Register – specialist practitioners were excluded. The questionnaires were mailed as part of a package which included a covering letter explaining the reasons for the survey and confirming anonymity, as well as a prepaid reply envelope. The responses were numerically coded and

entered into a Statistical Package for Social Science (SPSS Version 10) database and analysed. Chi-square tests were used to compare the number of patients in different subgroups and the associations between different factors. Differences at the 5% level were accepted as significant.

RESULTS

Of the 300 GDPs to whom the questionnaires were sent, 230 (76.7%) returned fully completed forms. The demographic and professional characteristics of the respondents are shown in Table 2. The antibiotics prescribed by the GDPs for adult patients with ADAIs who are not allergic to penicillin are shown in Table 3. Around 60% of the GDPs working in hospitals prescribed a combination of amoxicillin and metronidazole as their first choice and 15.1% of them used amoxicillin alone. In contrast, 36.9% of those working in private clinics used clindamycin or lincomycin, 21% used amoxicillin and 9.6% used a combination of amoxicillin and metronidazole. The compliance with the guidelines of the FGDP (UK) (Table 1) first choice of antibiotics (amoxicillin or penicillin ± metronidazole) is shown in Table 2. Female GDPs, young GDPs, GDPs working in hospitals and those graduated from Jordan were significantly more compliant.

Table 3 also showed the antibiotics prescribed in the presence of penicillin allergy. Erythromycin was the choice of 50% of the GDPs working in private clinics and of 71.2% of those working in hospitals. However, 30.5% of those working in private clinics used clindamycin or lincomycin compared with 15% of those working in hospitals. Metronidazole alone was used by only 2.2% of the GDPs. Amoxicillin or ampicillin was prescribed by 1.8% of GDPs for patients allergic to penicillin. The second choice (metronidazole) or

Table 2. Demographic and professional characteristics of participating GDPs and relationship to the guidelines of the FGDP (UK)⁷

Variables	n (%)	% Followed 1 st choice*	P**
Gender			
Males	159 (69.1)	42.8	0.02
Females	71 (30.9)	59.2	
Age (years)			
21-30	117 (50.9)	56.4	0.03
31-40	81 (35.2)	43.2	
41-50	24 (10.4)	29.2	
51-60	8 (3.5)	25.0	
Work sector			
Private clinic	157 (68.3)	33.8	<0.001
Hospital	73 (31.7)	78.1	
Place of qualification			
Jordan	92 (40.0)	60.9	0.007
Arab countries	40 (17.4)	50.0	
Eastern Europe	54 (23.5)	33.3	
Western Europe	5 (2.2)	20.0	
Asia	11 (4.8)	27.3	
Missing	28 (12.2)		

* % of GDPs who followed the first choice of antibiotics according to the FGDP (UK)⁷ guidelines for patients who are not allergic to penicillin.

** Of Chi-square

Table 3. GDPs first choice of antibiotic for ADAI.

In patients not allergic to penicillin			In patients allergic to penicillin		
Antibiotic	n	%	Antibiotic	n	%
Amoxicillin & Metronidazole	59	25.7	Erythromycin	130	56.5
Amoxicillin	44	19.1	Clindamycin	34	14.8
Lincomycin	37	16.1	Lincomycin	25	10.9
Clindamycin	24	10.4	Cephalosporin	12	5.2
Clindamycin & Metronidazole	10	4.3	Erythromycin & Metronidazole	10	4.3
Penicillin	7	3.0	Metronidazole	5	2.2
Cephalosporin	7	3.0	Tetracyclin	4	1.7
Augmentin & Metronidazole	7	3.0	Amoxicillin	2	0.9
Augmentin	6	2.6	Ampicillin	2	0.9
Cephalosporin & Metronidazole	6	2.6	Cephalosporin & Metronidazole	2	0.9
Erythromycin & Metronidazole	5	2.2	Lincomycin & Erythromycin	2	0.9
Ampicillin & Cloxacillin	4	1.7	Clindamycin & Metronidazole	1	0.4
Metronidazole	3	1.3	Metronidazole	1	0.4
Lincomycin & Metronidazole	3	1.3	Clindamycin & Erythromycin	1	0.4
Ciprofloxacin	2	0.9			
Penicillin & Lincomycin	1	0.4			
Amoxicillin & Lincomycin	1	0.4			
Ampicillin & Cloxacillin & Lincomycin	1	0.4			
Penicillin & Metronidazole	1	0.4			
Tetracyclin & Metronidazole	1	0.4			
Amoxicillin & Cephalosporin	1	0.4			

third choice (erythromycin) of antibiotics according to the guidelines of the FGDP (UK) was followed by 70% of female GDPs compared with 54.1% of males ($P=0.02$) and by 75.3% of GDPs working in hospitals compared with 53.3% of those working in private clinics ($P=0.001$). The use of the second or third choice of antibiotics showed no significant relationship with the age groups of the GDPs and their place of qualification.

Table 4 shows the dosages, frequencies and the length of the course of the most commonly prescribed antibiotics by the GDPs. Only those who indicated all the details (dose, frequency and duration) were included. There were wide variations for all the antibiotics. In case of amoxicillin, out of 84 GDPs, none used the recommended dose with correct frequency and duration and 83 (99%) prescribed double the recommended dose. Of the 84 GDPs, 15.5% prescribed amoxicillin for more than 5 days (6 to 12 days). Similarly, out of 74 GDPs who prescribed metronidazole, none used the recommended dose with correct frequency and duration and 50% prescribed at least double the recommended dose. Of the 74 GDPs, 96% prescribed metronidazole for more than 3 days (4 to 7 days). Only 4 out of 82 GDPs used erythromycin in the recommended dose, frequency and duration; around 60% prescribed double the recommended dose and 15.9% prescribed the antibiotic for more than 5 days (7 to 12 days).

The non-clinical factors influencing antibiotic prescribing are shown in Figure 1. Majority of the GDPs (95.7%) considered the effectiveness and previous experience with the drug as factors in determining their choice of the antibiotic they prescribed and almost two-thirds considered the cost of the antibiotic to be an important factor. The availability of the antibiotic in the nearby pharmacy was considered an important factor by 22.2% of the GDPs. The patients' preference was

taken into consideration by 6.1% of the GDPs. Only 17.8% of the GDPs surveyed ever took sample from a dental infection

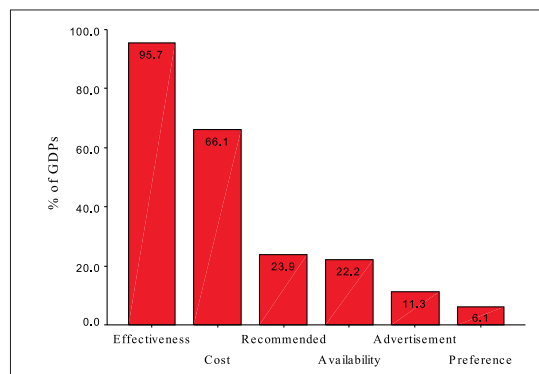


Fig. 1. Non-clinical factors that have affected GDPs' antibiotic prescribing.

Table 4. Dosage, frequency and length of course of the most commonly prescribed antibiotics¹

Antibiotic	Dosage X Frequency	No. days					Total	
		3	4	5	6	7		12
Amoxicillin	250 x 3	-	-	-	-	1	-	1
	500 x 3	1	3	32	4	4	1	45
	500 x 4	1	5	29	-	3	-	38
Clindamycin ²	150 x 3	5	3	11	-	2	-	21
	150 x 4	1	6	17	1	2	-	27
	300 x 3	-	1	2	-	-	-	3
Lincomycin	500 x 4	-	-	1	-	1	-	2
	150 x 3	-	-	3	-	-	-	3
	150 x 4	1	2	-	-	-	-	3
	300 x 4	-	-	1	-	-	-	1
	500 x 3	1	1	12	2	2	-	18
Metronidazole	500 x 4	1	1	-	-	-	-	2
	200 x 3	-	-	1	1	2	-	4
	250 x 3	1	3	14	1	2	-	21
	250 x 4	1	-	11	-	-	-	12
	400 x 3	-	-	2	-	1	-	3
	500 x 3	1	1	21	-	4	-	27
Erythromycin	500 x 4	-	1	4	-	2	-	7
	150 x 4	-	2	-	-	1	-	3
	250 x 3	-	-	3	-	1	-	4
	250 x 4	1	-	4	-	1	-	6
	400 x 2	-	-	2	-	1	-	3
	400 x 3	-	2	9	-	-	-	11
	400 x 4	-	2	4	-	-	-	6
	500 x 3	1	2	19	-	3	-	25
	500 x 4	-	3	14	-	4	1	22
800 x 3	-	-	1	-	1	-	2	

¹Only for GDPs who included in their prescriptions all the details (dose, frequency and duration). The recommended *Dental Practitioners' Formulary*⁶ doses and frequency are highlighted in bold.

²Clindamycin recommended dose: 150-300 mg.

for culture and antibiotic sensitivity of the causative microorganisms in their entire clinical practice.

DISCUSSION

GDPs should know when and what antibiotics to prescribe, for how long and in what dosage. This study showed a wide spectrum of antibiotics prescribed for patients with ADAIs with 12 different antibiotics given in 21 different prescriptions for patients who are not allergic to penicillin. As first choice recommendation by the FGDP (UK) guidelines,⁷ 44.8% of the GDPs surveyed used either amoxicillin alone or in combination with metronidazole in patients who are not allergic to penicillin. According to the guidelines of the FGDP (UK),⁷ metronidazole can be added to amoxicillin if there is suspicion that the ADAI is predominately anaerobic or it has been proven microbiologically. Although phenoxymethylpenicillin (penicillin V) with or without metronidazole can be used as first choice antibiotic in ADAI according to the FGDP (UK) guidelines⁷, this choice was chosen by only 3.4% of the GDPs surveyed. The use of penicillin is gradually reducing as recent studies have shown that the main isolates from dental abscess are a complex mixture of facultative and anaerobic bacteria, many of which are penicillin-resistant.¹⁰ In addition, none of the GDPs used the two-dose 3g amoxicillin regime recommended as one of the first choices in the FGDP (UK) guidelines.⁷ About one-third (33.3%) of the GDPs, particularly those working in private clinics, prescribed clindamycin or lincomycin, alone or in a combination with another antibiotic. According to the Dental Practitioners' Formulary⁹, these two antibiotics (the lincosamides) should not be used routinely for the treatment of dental infections because of their serious side-effects that include antibiotic-associated colitis, which may

be fatal in some patients. Moreover, lincosamides appear to be no more effective than penicillin against anaerobes and there may be cross resistance with erythromycin-resistant bacteria.^{9,11}

In response to the questions on the alternatives for patients who are allergic to penicillin, the overwhelming choice was erythromycin. Erythromycin is weakly active, bacteriostatic, antibiotic and it is not always as effective as penicillin. It has a high incidence of undesirable side effects such as nausea, vomiting, abdominal pain, diarrhoea and anorexia. In addition, resistance is a problem with erythromycin and can even develop during a course.^{12,13} Therefore, in the guidelines of the FGDP (UK),⁷ erythromycin is considered third choice in the management of ADAI. Recently, metronidazole is considered the best alternative to penicillin for the treatment of many dental infections in patients allergic to penicillin.^{9,14} Therefore, in the FGDP (UK) guidelines,⁷ metronidazole is the second choice in the management of ADAIs if penicillins can not be prescribed. In this study, only 2.2% of the GDPs used metronidazole alone for ADAIs in patients allergic to penicillin. Disappointingly, 1.8% of the GDPs prescribed amoxicillin or ampicillin for patients who are allergic to penicillin and 6.1% prescribed cephalosporins ignoring the information that about 10% of penicillin-sensitive patients will also be allergic to cephalosporins.⁹

In agreement with previous studies,^{4,8,15,16} antibiotics were poorly prescribed by GDPs in Jordan and there were considerable variations from the recommended frequencies and doses. In this study, GDPs tended to prescribe high doses of antibiotics, usually double the recommended doses. For example, in the case of amoxicillin, the vast majority of the GDPs surveyed prescribed 500 mg instead of the 250 mg recommended dose. Large doses of amoxicillin (500 mg) are not indicated in

ADAs as the absorption of this antibiotic in standard 250 mg amounts is adequate and therapeutically effective.¹⁷ There is increasing evidence that short courses of antibiotics, together with establishing drainage, are adequate for the resolution of ADAs. It is not, therefore, necessary for the majority of patients to complete a 5-day course of antibiotics.¹⁰ This is in keeping with the guidelines of the FGDP (UK)⁷ where patients should be reviewed in 2-3 days and, if temperature was found to be normal and swelling is resolving, the GDP should discontinue the use of the antibiotics. In this study, antibiotics were recommended by some of the GDPs surveyed for periods up to 12 days. This could be harmful by selecting resistant bacteria and abolishing the ability of the oral flora to resist colonisation of harmful micro-organisms, thereby leading to superimposed infections by multi-resistant bacteria and yeasts.¹⁸

The reason for such diverse antimicrobial prescription is unclear. Previous studies suggest that prescription is influenced by undergraduate and postgraduate education, publication and advertising.^{19,20} In this survey, the choice of the antibiotic by some GDPs was found to be affected by non-clinical factors such as the cost and the availability of the antibiotic in the nearby pharmacy, advertising and the patient's preference of a particular antibiotic. This study has also shown that female GDPs and young GDPs were more compliant with the current guidelines of the FGDP (UK).⁷ In addition, the compliance with the current guidelines was affected by the place of qualification. Graduates from Jordan and from other Arab countries were more compliant compared with those who graduated from Eastern Europe and Asian countries. GDPs working in private clinics were less compliant compared with those working in hospitals. Lincomycin and clindamycin were prescribed mostly by GDPs working in private clinics while amoxicillin and

metronidazole were prescribed mostly by GDPs working in hospitals. Perhaps the adoption of protocols for antibiotic prescription for acute dental infections in hospitals resulted in this better way of prescription.

The oral cavity is the habitat for a large number of microbial species, many of which and, often in combination, can cause dental infections.²¹ Consequently, it is recommended that GDPs should take microbiological samples, particularly in severe infections.⁹ However, in general practice, antibiotics are usually prescribed on an empirical basis and little use is made of diagnostic microbiology services.²² In this survey, only 17.8% of the GDPs ever took microbiological samples for culture and antibiotic sensitivity throughout their practice. Improving the availability of such services and providing training in their use, should be an integral part of a response to poor antibiotic prescribing.

The results of this study showed, considering the rapid development of antibacterial resistance, conscientious use of antibiotics is imperative for all GDPs practising in Jordan. GDPs should follow evidence-based protocols and guidelines in prescribing antibiotics for dentoalveolar infections. The guidelines on antibiotic recommendations and indications for use should be clarified at the undergraduate and graduate levels. Additionally, regular continuing dental education courses in the use of antibiotics are essential to disseminate information to practicing dentists particularly those working in private clinics and these courses should focus on non-Jordanian graduates and those who have been in practice for long time.

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