



## Antibiotic Prescription Knowledge of Dentists in Kingdom of Saudi Arabia: An Online, Country-wide Survey

<sup>1</sup>Esam Halboub, <sup>2</sup>Abdulaziz Alzaili, <sup>3</sup>Mir Faeq Ali Quadri, <sup>4</sup>Mohammed Al-Haroni  
<sup>5</sup>Mohammad Ibrahim Al-Obaida, <sup>6</sup>Nezar Noor Al-hebshi

### ABSTRACT

**Aim:** Dentists are probably contributing to the development of bacterial resistance to certain antibiotics. Campaigns to promote prudent use of antibiotics in dentistry are, thus, needed but require proper identification of dentists' knowledge gaps. The objective here was to comprehensively evaluate antibiotic prescription knowledge of dentists in Saudi Arabia.

**Material and methods:** A link to an online, previously validated questionnaire was emailed to 5199 dentists registered with the Saudi Dental Society. The questionnaire comprised 42 scorable items measuring antibiotics prescription knowledge in five different domains in addition to nonscorable questions regarding first-choice antibiotics and previous attendance of a course/workshop about antibiotic prescription. Each correct answer was given one mark. Mean scores were calculated as percentages and categorized as good (>80%), intermediate (60–80%), or poor (<60%).

**Results:** The response rate was 9.4%; however, only 373 (7.2%) fully completed the questionnaire. Around half of the participants (52%) reported prescribing amoxicillin/clavulanate as the first-choice antibiotic; 62% reported attending a course/workshop in the last 5 years. The average knowledge score was 69%, being highest for nonclinical indications (79%) and lowest for prophylactic use (56%). The worst per-item scores were noted for rheumatic heart disease (19%), trismus (28%), surgical extraction (30%), apicectomy (31%), and periodontal abscess (33%). Female dentists, dentists in governmental sector, and those with higher qualifications had significantly better knowledge.

**Conclusion:** The level of knowledge was hardly intermediate and several deficits were identified, indicating an urgent need for educational campaigns and provision of guidelines promoting rational use of antibiotics by dentists.

**Clinical Significance:** Irrational use of antibiotics by dentists can contribute to the problem of antibacterial resistance.

**Keywords:** Antibiotic resistance, Antimicrobial agents, Dentistry, Drug prescription, Knowledge.

**How to cite this article:** Halboub E, Alzaili A, Quadri MFA, Al-Haroni M, Al-Obaida MI, Al-hebshi NN. Antibiotic Prescription Knowledge of Dentists in Kingdom of Saudi Arabia: An Online, Country-wide Survey. *J Contemp Dent Pract* 2016;17(3): 198-204.

**Source of support:** The work was funded by the College of Dentistry, Jazan University.

**Conflicts of interest:** There are no conflicts of interest to declare.

### INTRODUCTION

Since their introduction, antibiotics have been successfully used in dental practice for management as well as prevention of infections.<sup>1</sup> However, there have been increasing reports about the overuse of antibiotics by dental practitioners and its contribution to the worldwide problem of antibiotic resistance.<sup>2-4</sup> Although the number of prescriptions written by dentists is not comparable to that by medical practitioners,<sup>5,6</sup> dentists'

<sup>1</sup>Department of Maxillofacial Surgery and Diagnostic Sciences College of Dentistry, Jazan, Kingdom of Saudi Arabia

<sup>2</sup>Jazan Dental Center, Ministry of Health, Jazan, Kingdom of Saudi Arabia

<sup>3</sup>Division of Dental Public Health, College of Dentistry, Jazan University, Jazan, Kingdom of Saudi Arabia

<sup>4</sup>Department of Clinical Dentistry, Faculty of Health Sciences UiT The Arctic University of Norway, Tromsø, Norway

<sup>5</sup>Department of Restorative Dental Sciences, College of Dentistry King Saud University, Riyadh, Kingdom of Saudi Arabia

<sup>6</sup>Department of Preventive Dentistry, College of Dentistry Jazan University, Jazan, Kingdom of Saudi Arabia

**Corresponding Authors:** Esam Halboub, Assistant Professor Department of Maxillofacial Surgery and Diagnostic Sciences College of Dentistry, Jazan University, PO Box: 114, Jazan 45142, Kingdom of Saudi Arabia, Phone: +00966 536293564 e-mail: mhalboub@gmail.com

Mohammad Ibrahim Al-Obaida, Associate Professor, Department of Restorative Dental Sciences, College of Dentistry, King Saud University, P.O. Box: 60169, Riyadh 11545, Kingdom of Saudi Arabia, Phone: +00966 504496211, e-mail: malobaida@yahoo.com

role in injudicious prescription of certain antibiotics is considerable.<sup>6</sup> In fact, around 7 to 11% of all common antibiotics, such as  $\beta$ -lactams, macrolides, tetracycline, clindamycin, metronidazole, etc., are prescribed by dentists.<sup>1</sup> This figure doubles when  $\beta$ -lactam antibiotics are considered alone.<sup>6</sup> In one study, prescription of metronidazole by dentists accounted for 40% of all metronidazole prescriptions.<sup>2</sup>

The potential for indiscriminate prescription of antibiotics by dentists is probably higher in certain countries, such as Kingdom of Saudi Arabia, in which dentists are legally entitled to prescribe antibiotics with little restrictions.<sup>7</sup> Therefore, there is an imperative need for educational campaigns that promote prudent use of antibiotics in dental practice.<sup>8</sup> However, for such campaigns to be effective, they need to be designed so as to target identified gaps in dentists' knowledge of proper use of antibiotics, which is why studies have been conducted for appraisal of antibiotic prescription knowledge of dentists in many countries around the world.<sup>9-14</sup> Five such studies have been carried out so far in Kingdom of Saudi Arabia.<sup>15-19</sup> These studies, however, involved single cities or regions of the country, targeted dentists in the private sector only, were limited to assessment of narrow aspects of the knowledge, e.g., only prophylaxis of endocarditis or use of antibiotics in endodontics, or/and failed to provide adequate details about the questionnaire, validation, and/or scoring.

The objective of the current study was, therefore, to perform comprehensive, multifaceted assessment of antibiotic prescription knowledge of dentists in both private and governmental sectors across Saudi Arabia.

## MATERIALS AND METHODS

A cross-sectional, anonymized questionnaire-based study was conducted between June and September 2015. A previously validated, shortened version<sup>20</sup> of the questionnaire designed originally by Palmer et al<sup>12</sup> was used. Apart from demographic and professional data, the questionnaire comprised scorable 42 questions assessing knowledge pertaining to indications of antibiotics use in five domains: clinical signs (six items); clinical conditions (13 items); nonclinical factors (five items); dental procedures in absence of relevant medical history (seven items) and extraction/periodontal treatment in presence of relevant medical conditions (11 items). Nonscorable items about first-choice antibiotic and previous attendance of a course/workshop on antibiotic prescription were also included. The questionnaire was transformed into an online version using Survey Monkey (<https://www.surveymonkey.com>).

An invitation-to-participate email with a link to the survey and a message introducing the purpose of the

study and assuring anonymity was sent to 7077 dentists registered with the Saudi Dental Society (SDS). To improve the response rate, an option to enter a draw for an iPad was included. The survey link was left open for 3 months, during which two reminder emails were sent. The study was conducted in compliance with the ethical principles included in the World Medical Association Declaration of Helsinki. The study was approved by Institutional Review Board (IRB), College of Dentistry, Jazan University.

The data were presented as frequencies and percentages as appropriate. Each correctly answered knowledge-related question was given a score of one. Total, per-domain, and per-item mean scores were calculated, transformed to percentages, and categorized as good knowledge (>80%), intermediate knowledge (60-80%), or poor knowledge (<60%). Mean scores were then checked for normality using Kolmogorov-Smirnov test. The distribution of the most commonly prescribed antibiotics by gender, work sector, and specialty was tested with chi-square test, while the differences in the knowledge score by the same factors were tested using independent t-test.

## RESULTS

Of the 7077 emails sent, 1878 bounced back, that is, only 5199 emails were delivered successfully to potential participants. As expected, the responses sharply peaked immediately after the original and each of the reminder emails. Eventually, 489 responses were received, that is, the response rate was 9.4%. However, only 373 respondents (7.2%) fully completed the questionnaire.

The demographic and professional characteristics of the respondents are presented in Table 1. More than half of them (56%) were males; 61%, general dental practitioners (GDPs); 58%, 25 to 35 years old; 63%, worked in the governmental sector, and 64% had <10 years of experience. Attending a lecture or a workshop on antibiotics prescription in the last 5 years as part of continuous education was reported by 62% of the respondents.

Nearly half of the participants (52%) reported prescribing amoxicillin with clavulanic acid for dental infections as the first choice (Table 2); penicillin/amoxicillin alone followed at 43%. The choice was not found to be affected by the gender or qualification of the respondents. However, use of amoxicillin with clavulanic was significantly more reported by dentists in private sector (65.4%) than dentists in government sector (45.3%,  $p < 0.001$ ).

Table 3 presents the correct answers and their rates for each of the items included in the questionnaire. Sixteen items (38%) scored "good"; seven (17%), "intermediate,"

**Table 1:** Characteristics of the respondents (n = 489)

Characteristics	Number	Percentage
<b>Gender</b>		
Male	276	56.4
Female	213	43.6
<b>Age group</b>		
25–34 years	285	58.3
35–44 years	135	27.6
45–55 years	53	10.8
≥ 55 years	10	3.3
<b>Specialties<sup>†</sup></b>		
General dental practitioner	300	61.3
Saudi board trainee <sup>‡</sup>	22	4.5
Specialist <sup>‡</sup>	110	22.5
Consultants <sup>‡</sup>	57	11.7
<b>Work sector</b>		
Government	308	63
Private	181	37
<b>Years of experience (N=485)</b>		
1–10 years	312	64.3
11–20 years	118	24.3
21–30 years	41	8.5
>30 years	14	2.9
<b>Attending a lecture or a workshop on antibiotics prescription as part of continuous education program</b>		
In less than 2 years	187	38.2
Between 2 and 5 years	118	24.1
More than 5 years ago	54	11
Never	130	26.6

<sup>†</sup>Based on Saudi Commission of Health Specialties; <sup>‡</sup>These subgroups were pooled together as “higher qualification” (HQ) in further analyses.

and 19 (45%), “poor.” The worst knowledge was observed for prophylactic antibiotic use for rheumatic heart disease (19%), surgical extraction (30%), and apicectomy (31%) as well as for therapeutic use for trismus (28%), periodontal abscess (33%), and pericoronitis (37%). The total and per-domain knowledge scores are summarized in Table 4. Overall, the knowledge was of intermediate level (69%). The best knowledge (nearly good) was observed in the nonclinical indications domain (79%), while the worst (poor) was reported for prophylactic use for extraction/periodontal treatment in presence of relevant medical conditions (56%). Knowledge in the clinical conditions domain was near intermediate (59%). Total and per-domain scores were found to be influenced significantly by all grouping factors: being a female dentist, working for the governmental sector, and having higher qualifications were associated with significantly higher knowledge scores.

## DISCUSSION

This is the first attempt to comprehensively assess antibiotic prescription knowledge of dentists across the Kingdom of

**Table 2:** Antibiotics reported as the first choice by the respondents (n = 414) stratified by gender, work sector, and specialty

Factor	Antibiotics prescribed			p*-value
	Penicillin or amoxicillin no. (%)	Amoxicillin with clavulanic acid no. (%)	Others no. (%)	
<b>Gender</b>				
Males	98 (41.4)	126 (53.2)	13 (5.5)	0.391
Females	79 (44.6)	93 (52.5)	5 (2.8)	
<b>Work sector</b>				
Government	132 (51.2)	117 (45.3)	9 (3.5)	<0.001
Private	45 (28.8)	102 (65.4)	9 (5.8)	
<b>Specialty</b>				
GDP	102 (40.8)	138 (55.2)	10 (4)	0.482
HQ	75 (45.7)	81 (49.4)	8 (4.9)	
<b>Years of experience (n=411)</b>				
1–10	121 (45.5)	134 (50.4)	11 (4.1)	0.061 <sup>†</sup>
10–20	44 (44)	49 (49)	7 (7)	
20–30	9 (25.7)	26 (74.3)	0 (0)	
>30 Years	2 (20)	8 (80)	0 (0)	
All (n=414)	177 (42.8)	219 (52.9)	18 (4.3)	

\*All analyses were by chi-square test unless indicated otherwise; <sup>†</sup>Fisher exact test; GDP: General dental practitioners; HQ: Higher qualification

Saudi Arabia. The survey targeted 5199 dentists registered with the SDS. However, despite sending two reminders and the motivation with a prize draw, the response rate was low (9.4%). The characteristics of the respondents may have been different from those of the entire target population in a way that influenced the results. Therefore, some over- or underestimation cannot be excluded, and generalization of the results should be done with caution.

Amoxicillin, a member of β-lactam antibiotics, is the most commonly prescribed antibiotic in dental practice worldwide.<sup>6,9-13,21-27</sup> In the current study, however, amoxicillin with clavulanic acid was reported as the first-choice antibiotic by 52% of the respondents, which is consistent with the findings by Iqbal<sup>19</sup> and Al-Harthi et al<sup>16</sup> for the North and West regions of the Kingdom respectively. A similar trend for prescribing a β-lactamase inhibitor has been reported in other parts of the world such as Turkey<sup>28</sup> and Czech Republic.<sup>29</sup> While this may be attributable to the emergence of β-lactamase producing oral bacteria,<sup>30,31</sup> it may simply be reflecting geographical variation in common prescription practices that are not influenced by bacterial resistance patterns. In Nigeria and India, e.g., amoxicillin and metronidazole are prescribed together as the first<sup>32,33</sup> or second-choice antibiotic.<sup>9</sup> In the present work, amoxicillin and metronidazole combination was not included as an option, which is one limitation of the study.

Work sector was the only factor that showed significant association with first-choice antibiotic in the current

**Table 3:** Correct answers and their rates to each of the questions in the five assessment domains

Term	Correct answer	Percentage	Term	Correct answer	Percentage
<b>Clinical signs<sup>†</sup></b>			<b>Nonclinical factors<sup>†</sup> – cont</b>		
1. Elevated temperature and evidence of systemic spread	Yes	89.1	4. Uncertainty of diagnosis	No	77.8
2. Localized fluctuant swelling	No	55.1	5. Where treatment has to be delayed	No	55.6
3. Gross or diffuse swelling	Yes	91.8	<b>Dental procedures in absence of relevant medical history<sup>‡</sup></b>		
4. Unrestricted mouth opening	No	84.8	1. Routine extraction	No	95.2
5. Difficulty in swallowing	Yes	46.1	2. Surgical extraction	No	30
6. Closure of the eye owing to swelling	Yes	82.6	3. Apicectomy	No	31.1
<b>Clinical conditions<sup>†</sup></b>			4. Root canal therapy (perioperative)	No	90.9
1. Acute pulpitis	No	63.6	5. Root canal therapy (postoperative)	No	85
2. Acute periapical infection before drainage	No	40.6	6. Scaling and polishing	No	98.9
3. Acute periapical infection after drainage	No	47.1	7. Restorative treatment	No	98.9
4. Chronic apical infection	No	68.4	<b>Extraction/periodontal treatment in the presence of relevant medical conditions<sup>‡</sup></b>		
5. Pericoronitis	No	36.7	1. Patients with prosthetic joints	No	50.7
6. Cellulitis	Yes	90.8	2. History of infective endocarditis	Yes	94.9
7. Periodontal abscess	No	33.1	3. Prosthetic cardiac valves	Yes	93.3
8. Acute ulcerative gingivitis	Yes	54.1	4. Rheumatic heart disease	No	18.8
9. Chronic marginal gingivitis	No	87.2	5. Aortic stenosis	No	51.2
10. Chronic periodontitis	No	75.8	6. Ventricular septal defect	No	42.4
11. Dry socket	No	61.1	7. Coronary bypass surgery	No	41.6
12. Trismus	Yes	27.5	8. Rheumatic fever without valvular dysfunction	No	52.8
13. Reimplantation of teeth	Yes	70.3	9. Coronary heart disease	No	46.4
<b>Nonclinical factors<sup>†</sup></b>			10. Pacemaker	No	52.5
1. Patient expectation of a prescription	No	91.1	11. Physiologic, functional, or innocent murmur	No	74.8
2. Pressure of time and workload	No	88.4			
3. Patient's social history	No	83.3			

<sup>†</sup>Therapeutic prescription; <sup>‡</sup>Prophylactic prescription

**Table 4:** Mean ± SD knowledge scores (%) in each of the five assessed domains by gender, work sector and specialty

Factors	Clinical signs <sup>†</sup> (n=414)	Clinical conditions <sup>†</sup> (n=414)	Nonclinical factors <sup>†</sup> (n=414)	Treatment procedure with no relevant medical history <sup>‡</sup> (n=373)	Relevant medical history <sup>‡</sup> (n=373)	Total (n=373)
<b>Gender</b>						
Male	73.63 ± 17.68	57.48 ± 15.06	77.97 ± 23.99	72.96 ± 16.68	55.4 ± 23.21	67.59 ± 11.84
Female	76.65 ± 17.61	61.19 ± 17.08	80.9 ± 22.85	79.43 ± 17.05	57.52 ± 22.79	71.39 ± 12.61
p*-value	0.086	0.02	0.21	<0.001	0.379	0.003
<b>Work sector</b>						
Government	76.81 ± 16.75	61.6 ± 15.71	80.08 ± 24.67	77.28 ± 16.28	58.57 ± 23.73	70.8 ± 12.51
Private	71.79 ± 18.8	54.88 ± 15.75	77.82 ± 21.5	73.01 ± 18.13	52.34 ± 21.24	66.44 ± 11.44
p*-value	0.005	<0.001	0.345	0.02	0.009	0.001
<b>Specialty</b>						
GDP	73.33 ± 17.48	56.12 ± 16.01	76.32 ± 24.76	73.84 ± 17.28	53.45 ± 23.37	66.89 ± 12.14
HQ	77.34 ± 17.79	63.56 ± 15.07	83.66 ± 20.81	78.57 ± 16.54	60.63 ± 21.87	72.6 ± 11.8
p*-value	0.024	<0.001	0.002	0.009	0.003	<0.001
Overall score	74.92 ± 17.69	59.07 ± 16.04	79.23 ± 23.52	75.72 ± 17.12	56.3 ± 23.02	69.21 ± 12.3
Level	Intermediate	Poor	Intermediate	Intermediate	Poor	Intermediate

\*Student's t test; <sup>†</sup>Therapeutic prescription; <sup>‡</sup>Prophylactic prescription; GDP: General dental practitioner; HQ: Higher qualification

study. Dentists in governmental sector were found to be more conservative about the use of amoxicillin with clavulanic acid as first-line antibiotic. This may be because dentists in the governmental are more likely to be attending continuous education. However, attending a lecture/course on antibiotics prescription, surprisingly, was not significantly associated with any differences in the choice of the first-line antibiotic, which is in contradistinction

with evidence from the literature emphasizing the importance of such training courses in improving antibiotic-prescribing practices of GDPs.<sup>8,12,13</sup> Another possible explanation is that a higher fraction of dentists in the governmental sector probably has postgraduate qualifications; indeed, 70% of dentists with postgraduate education included in our survey were practicing dentistry in the government sector (data not shown). Dentists' years

of experience showed close to significant association with the reported first-choice antibiotic; dentists with longer experience reported prescribing amoxicillin with clavulanic acid more frequently.

There is a very narrow space for prescribing antibiotics in dental practice. They are usually used in limited number of conditions/procedures for prevention of infection (prophylaxis) or as adjunct to primary treatment approaches as detailed by Palmer.<sup>34</sup> This increases the likelihood of prescriptions that represent overuse. The mean total knowledge score in the current study was 69%, suggesting that at least 30% of the prescriptions made by dentists in Kingdom of Saudi Arabia are not justified. Similar levels of knowledge were reported previously for dentists in Riyadh, Kingdom of Saudi Arabia (70%),<sup>17</sup> and in England and Scotland (68%).<sup>12</sup> A higher level was reported in Kuwait (78%)<sup>35</sup> but a lower level in Yemen (57%).<sup>36</sup>

The best knowledge was seen in the nonclinical factors domain, scoring an average close to "good" (79%). Antibiotic prescription when treatment has to be postponed was reported by 45% of the respondents, accounting for most of the drop in the average score of this domain. The scores for other items were mostly good. Comparatively, GDPs in England and Scotland<sup>12</sup> and Yemen<sup>36</sup> tended to unnecessarily prescribe antibiotics in these situations more frequently (their knowledge scores for this domain were 64.4 and 65% respectively). Knowledge regarding antibiotics prescription for dental procedures in the absence of relevant medical history scored second best (75.7%). This is higher than that scored by GDPs in Yemen (49%)<sup>36</sup> but lower than that scored by those in England and Scotland (84%).<sup>12</sup> The major aspect of knowledge deficit in this domain was in connection with the need of antibiotic prescription for surgical extraction and apicectomy procedures.

Knowledge pertaining to antibiotic prescription for clinical signs indicative of systemic involvement and/or spread of infections was also intermediate level (74.9%). Although this is higher than that reported for Yemeni (62%)<sup>36</sup> and Iranian dentists (65%),<sup>27</sup> it is lower than that reported for GDPs in England and Scotland (88%).<sup>12</sup> The main knowledge gaps in this domain were pertaining to unjustified prescription of antibiotics for localized fluctuant swelling, for which surgical drainage is the only required intervention, and underutilization of antibiotics in cases of difficulty of swallowing, for which adjunct antibiotic treatment is mandatory. Similar findings have been reported in other countries.<sup>10,27,35,36</sup>

The respondents' knowledge in clinical conditions domain was poor (59%), although a bit better than that reported for GDPs in England and Scotland (54%)<sup>12</sup> and in Yemen (40%).<sup>36</sup> There seems to be a high tendency

for unjustified prescription of antibiotics in conditions encountered frequently in dental practice. These include periapical infection, pericoronitis, periodontal abscess, dry socket, and even acute pulpitis. Such conditions in otherwise healthy patients are effectively treated by local surgical/mechanical intervention alone. Obviously, a great deal of antibiotic overprescription in dental practice is related to these clinical conditions.<sup>17,27,35</sup>

The worst knowledge score was in the domain of prophylactic antibiotic prescription for relevant medical conditions (56.3%). This is in agreement with a very recent study involving the same target population, that is, SDS-registered dentists, in which a score of 52.2% was obtained.<sup>15</sup> Similar level has been reported for Iranian GDPs (56%),<sup>37</sup> lower level (33%) for Nigerian dentists,<sup>38</sup> but a much higher level (81%) for Israeli dentists.<sup>39</sup> This indicates that a significant proportion of dentists in Kingdom of Saudi Arabia frequently prescribe antibiotics for conditions that do not pose risk of developing infective endocarditis, and are, thus, probably unaware of the latest guidelines for the prevention of infective endocarditis published by the American Heart Association.<sup>40</sup>

Female, government sector, and higher-qualified dentists in the current study were found to have significantly higher level of knowledge. The role of gender is a matter of controversy; contradictory results were reported elsewhere.<sup>15,21,36</sup> The role of postgraduate qualification is, however, well-established and unanimous.<sup>15,16,41,42</sup> As pointed above, dentists working in the governmental sectors are probably more influenced by continuous professional development (CPD) courses, availability of guidelines, and management of dental patients in the presence of specialists and consultants, which could explain why they had significantly higher knowledge than those working in the private sector.

## CONCLUSION

Dentists in Kingdom of Saudi Arabia have an intermediate level of knowledge on antibiotics prescription. There are, however, several aspects of poor knowledge that necessitate launching of educational campaigns and provision of guidelines for prudent use of antibiotics in dental practice.

## Acknowledgments

We are most thankful to the SDS for taking the task of sending the invitation and reminder emails to the registered members. We would like to thank Dr Yahiya Khobrani and Mahmoud Musrahy for their help with development of the online questionnaire.

## REFERENCES

1. Dar-Odeh NS, Abu-Hammad OA, Al-Omiri MK, Khraisat AS, Shehabi AA. Antibiotic prescribing practices by dentists: a review. *Ther Clin Risk Manag* 2010 Jul21;6:301-306.
2. Al-Haroni M. Bacterial resistance and the dental professionals' role to halt the problem. *J Dent* 2008 Feb;36(2):95-103.
3. Sweeney LC, Dave J, Chambers PA, Heritage J. Antibiotic resistance in general dental practice—a cause for concern? *J Antimicrob Chemother* 2004 Apr;53(4):567-576.
4. Cope AL, Chestnutt IG. Inappropriate prescribing of antibiotics in primary dental care: reasons and resolutions. *Prim Dent J* 2014 Nov;3(4):33-37.
5. Epstein JB, Chong S, Le ND. A survey of antibiotic use in dentistry. *J Am Dent Assoc* 2000 Nov;131(11):1600-1609.
6. Al-Haroni M, Skaug N. Incidence of antibiotic prescribing in dental practice in Norway and its contribution to national consumption. *J Antimicrob Chemother* 2007 Jun;59(6):1161-1166.
7. Ministry of Health. Ministry of Health Formulary Drug List. Health Minister Advisor of Capital Investments; Riyadh, Saudi Arabia 2012. p. 1-12.
8. Palmer NA, Dailey YM. General dental practitioners' experiences of a collaborative clinical audit on antibiotic prescribing: a qualitative study. *Br Dent J* 2002 Jul31;193(1):46-49.
9. Jayadev M, Karunakar P, Vishwanath B, Chinmayi SS, Siddhartha P, Chaitanya B. Knowledge and pattern of antibiotic and non narcotic analgesic prescription for pulpal and periapical pathologies: a survey among dentists. *J Clin Diagn Res* 2014 Jul;8(7):ZC10-ZC14.
10. Kohler M, Meyer J, Linder M, Lambrecht JT, Filippi A, Kulik Kunz EM. Prescription of antibiotics in the dental practice: a survey of dentists in Switzerland. *Schweiz Monatsschr Zahnmed* 2013;123(9):748-759.
11. Mainjot A, D'Hoore W, Vanheusden A, Van Nieuwenhuysen JP. Antibiotic prescribing in dental practice in Belgium. *Int Endod J* 2009 Dec;42(12):1112-1117.
12. Palmer NO, Martin MV, Pealing R, Ireland RS, Roy K, Smith A, Bagg J. Antibiotic prescribing knowledge of National Health Service general dental practitioners in England and Scotland. *J Antimicrob Chemother* 2001 Feb;47(2):233-237.
13. Skucaite N, Peciuliene V, Maneliene R, Maciulskiene V. Antibiotic prescription for the treatment of endodontic pathology: a survey among Lithuanian dentists. *Medicina (Kaunas)* 2010;46(12):806-813.
14. Tanwir F, Marrone G, Lundborg CS. Knowledge and reported practice of antibiotic prescription by dentists for common oral problems. *J Coll Physicians Surg Pak* 2013 Apr;23(4):276-281.
15. Al-Fouzan AF, Al-Shinaiber RM, Al-Baijan RS, Al-Balawi MM. Antibiotic prophylaxis against infective endocarditis in adult and child patients. Knowledge among dentists in Saudi Arabia. *Saudi Med J* 2015 May;36(5):554-561.
16. Al-Harathi SE, Khan LM, Abed HH, Alkreathy HM, Ali AS. Appraisal of antimicrobial prescribing practices of governmental and non-governmental dentists for hospitals in the western region of Saudi Arabia. *Saudi Med J* 2013 Dec;34(12):1262-1269.
17. Al-Huwayrini L, Al-Furiji S, Al-Dhurgham R, Al-Shawaf M, Al-Muhaiza M. Knowledge of antibiotics among dentists in Riyadh private clinics. *Saudi Dent J* 2013 Jul;25(3):119-124.
18. Al-Mubarak S, Al-Nowaiser A, Rass MA, Alsuwayed A, Alghofili A, Al-Mubarak EK, Ho A. Antibiotic prescription and dental practice within Saudi Arabia; the need to reinforce guidelines and implement specialty needs. *J Int Acad Periodontol* 2004 Apr;6(2):47-55.
19. Iqbal A. The attitudes of dentists towards the prescription of antibiotics during endodontic treatment in north of Saudi Arabia. *J Clin Diagn Res* 2015 May;9(5):ZC82-ZC84.
20. Al-Haroni MH, Skaug N, Al-Hebshi NN. Prevalence of subgingival bacteria resistant to aminopenicillins and metronidazole in dental patients from Yemen and Norway. *Int J Antimicrob Agents* 2006 Mar;27(3):217-223.
21. Garg AK, Agrawal N, Tewari RK, Kumar A, Chandra A. Antibiotic prescription pattern among Indian oral healthcare providers: a cross-sectional survey. *J Antimicrob Chemother* 2014 Feb;69(2):526-528.
22. Gonzalez-Martinez R, Cortell-Ballester I, Herraes-Vilas JM, Arnau-de Bolos JM, Gay-Escoda C. Antibiotic prescription in the treatment of odontogenic infection by health professionals: a factor to consensus. *Med Oral Patol Oral Cir Bucal* 2012 May 1;17(3):e452-e456.
23. Kandemir S, Ergul N. Grievances in cases using antibiotics due to orodontal problems and assessment of the need for antibiotics. *Int Dent J* 2000 Apr;50(2):73-77.
24. Murti A, Morse Z. Dental antibiotic prescription in Fijian adults. *Int Dent J* 2007 Apr;57(2):65-70.
25. Nabavizadeh MR, Sahebi S, Nadian I. Antibiotic prescription for endodontic treatment: general dentist knowledge + practice in shiraz. *Iran Endod J* 2011 Spring;6(2):54-59.
26. Ogunbodede EO, Fatusi OA, Folayan MO, Olayiwola G. Retrospective survey of antibiotic prescriptions in dentistry. *J Contemp Dent Pract* 2005 May15;6(2):64-71.
27. Vessal G, Khabiri A, Mirkhani H, Cookson BD, Askarian M. Study of antibiotic prescribing among dental practitioners in Shiraz, Islamic Republic of Iran. *East Mediterr Health J* 2011 Oct;17(10):763-769.
28. Kaptan RF, Haznedaroglu F, Basturk FB, Kayahan MB. Treatment approaches and antibiotic use for emergency dental treatment in Turkey. *Ther Clin Risk Manag* 2013;9:443-449.
29. Pipalova R, Vlcek J, Slezak R. The trends in antibiotic use by general dental practitioners in the Czech Republic (2006-2012). *Int Dent J* 2014 Jun;64(3):138-143.
30. Binta B. The prevalence of -lactamase-producing anaerobic oral bacteria and the genes responsible for this enzymes production in patients with chronic periodontitis. *Johannesburg: Witwatersrand*; 2014.
31. Kuriyama T, Absi EG, Williams DW, Lewis MA. An outcome audit of the treatment of acute dentoalveolar infection: impact of penicillin resistance. *Br Dent J* 2005 Jun25;198(12):759-763; discussion 4; quiz 78.
32. Azodo CC, Ojehanon PI. Antibiotics prescription in Nigerian dental healthcare services. *Odontostomatol Trop* 2014 Sep; 37(147):34-42.
33. Kumar KP, Kaushik M, Kumar PU, Reddy MS, Prashar N. Antibiotic prescribing habits of dental surgeons in hyderabad city, India, for pulpal and periapical pathologies: a survey. *Adv Pharmacol Sci* 2013;2013:537385.
34. Palmer NA. Revisiting the role of dentists in prescribing antibiotics. *Dent Update*. 2003 Dec;30(10):570-574.
35. Salako NO, Rotimi VO, Adib SM, Al-Mutawa S. Pattern of antibiotic prescription in the management of oral diseases among dentists in Kuwait. *J Dent* 2004 Sep;32(7):503-509.
36. Al-Haroni M, Skaug N. Knowledge of prescribing antimicrobials among Yemeni general dentists. *Acta Odontol Scand* 2006 Oct;64(5):274-280.

37. Ghaderi F, Oshagh M, Dehghani R, Hasanshahi R. Awareness of Iranian's general dentists regarding the latest prophylaxis guideline for prevention of infective endocarditis. *J Dent (Shiraz)* 2013 Mar;14(1):6-12.
38. Adeyemo WL, Oderinu OH, Olojede AC, Ayodele AO, Fashina AA. Nigerian dentists' knowledge of the current guidelines for preventing infective endocarditis. *Community Dent Health* 2011 Jun;28(2):178-181.
39. Zadik Y, Findler M, Livne S, Levin L, Elad S. Dentists' knowledge and implementation of the 2007 American Heart Association guidelines for prevention of infective endocarditis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2008 Dec;106(6):e16-e19.
40. Baltimore R. New recommendations for the prevention of infective endocarditis. *Curr Opin Pediatr* 2008 Feb;20(1):85-89.
41. Cherry WR, Lee JY, Shugars DA, White RP Jr Vann WF Jr. Antibiotic use for treating dental infections in children: a survey of dentists' prescribing practices. *J Am Dent Assoc* 2012 Jan;143(1):31-38.
42. Sivaraman SS, Hassan M, Pearson JM. A national survey of pediatric dentists on antibiotic use in children. *Pediatr Dent* 2013;35(7):546-549.