




Knowledge and Attitudes Towards Antibiotic Prescribing Among Dentists in Sudan

AbdelRahman Murtada Ramadan¹, Omer AbdelKariem Al Rikaby², Osama Abdalla Abu-Hammad³, Najla Saeed Dar-Odeh⁴

¹College of Dentistry, Taibah University, Al-Madinah Al-Munawarah, Kingdom of Saudi Arabia.  0000-0002-5008-9395

²Faculty of Pharmacy, University of Medical Sciences and Technology, Khartoum, Sudan.  0000-0002-4700-1292

³College of Dentistry, Taibah University, Al-Madinah Al-Munawarah, Kingdom of Saudi Arabia and School of Dentistry, University of Jordan, Amman, Jordan.  0000-0002-3416-165X

⁴College of Dentistry, Taibah University, Al-Madinah Al-Munawarah, Kingdom of Saudi Arabia and School of Dentistry, University of Jordan, Amman, Jordan.  0000-0002-6577-2373

Author to whom correspondence should be addressed: Professor Najla S. Dar-Odeh, College of Dentistry, Taibah University, Al-Madinah Al-Munawarah, Saudi Arabia. Phone: +00966 592231888. E-mail: najla_dar_odeh@yahoo.com.

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Abstract

Objective: To evaluate antibiotic prescribing practices of dentists working in a major teaching hospital in Sudan, and to assess the need for establishing education programmes to enhance dentists' awareness of antibiotic use. **Material and Methods:** A cross-sectional study was carried out by distributing an anonymous self-administered questionnaire to a convenience sample of dental practitioners at major teaching hospital in Khartoum/Sudan. The questionnaire investigated knowledge and attitudes of participants in relation to antibiotic prescribing in dental practice. **Results:** One hundred out of 135 dental practitioners working at the hospital participated in the survey with 48 males and 52 females. Most of the participants (N=44) did not specify their preferable drug reference, while 32 participants specified British National Formulary, and the practice was significantly associated with a higher professional rank ($p<0.001$). Metronidazole was the most frequently cited antibiotic for dentofacial infections (N=73) and Acute Necrotizing Ulcerative Gingivitis (N=56), while amoxicillin was the most frequently cited antibiotic for dento-alveolar infections and infective endocarditis prophylaxis (N=88 and N=47, respectively). **Conclusion:** Undergraduate, as well as postgraduate courses, are required in Sudan to provide up-to-date orientation on antibiotic use, and to increase awareness of dentists about antibiotic prescribing.

Keywords: Drug Prescriptions; Anti-Bacterial Agents; Focal Infection, Dental.

Introduction

Dentists deal with various infections in the orofacial region and their sequelae [1,2]. Most of these infections are bacterial infections originating in the dental pulp, and less frequently in the periodontal, and salivary tissues. Operative intervention in the form of dental fillings, root canal treatment, scaling, root planning, extraction or abscess drainage is considered the gold standard for treatment [3].

In certain situations operative intervention is not applicable or contraindicated, hence, the need for an antibiotic prescription may arise. Indications for antibiotic prescribing in dentistry are, however, limited; facial cellulitis [4], bacterial sialadenitis, necrotizing ulcerative gingivitis pericoronitis and certain forms of periodontitis [5,6] are considered the most representative examples of indicated clinical conditions for therapeutic antibiotic prescribing in dentistry.

Unfortunately, studies have shown that since the discovery of antibiotics, dentists in different parts of the world have contributed to the calamity of antibiotic abuse in the form of inappropriate prescribing for non-indicated clinical conditions [7], or worse, prescribing for social or non-clinical situations [8]. The latter trend is evident among dentists working in developing countries in particular [9]. Antibiotics abuse is not without cost. Antibiotic resistance has increased markedly over the past decade. An estimated 23,000 deaths and 2 million illnesses in the United States annually have been attributed to antibiotic resistant strains [10]. Furthermore, antibiotics use can be associated with allergy, anaphylaxis, gastrointestinal disturbances, as well as other side effects [11]. In children, complications are worse; diabetes, obesity, asthma, allergy, gastrointestinal disturbances and developmental tooth abnormalities have all been reported in children due to antibiotic abuse [12-15]. A closer look at epidemiological studies on prescribing practices shows that twice as much research was conducted in developed countries like the United Kingdom, when compared to developing ones, where few studies were conducted with the main finding of inappropriate antibiotic dental prescribing practices [16,17]. This indicates the importance of this study as it collects data from an under-researched area of developing countries.

Prophylactic antibiotic use, on the other hand, has been considered for a wide variety of conditions, with infective endocarditis (IE) being the indication that has the most well-established guidelines. In this particular condition, the protocol of antibiotic prescription is being updated on a periodic basis, and guidelines are available for all dentists [18]. There are two authorities worldwide that put the recommendations for antibiotic regimes, and indicated clinical conditions; the American Heart Association (AHA) and the National Institute for Health and Care Excellence in England and Wales (NICE). Before March 2008, patients at risk of IE were prophylactically given a single oral dose of 3 g amoxicillin or 600 mg clindamycin one hour prior to specified dental procedures [19]. Due to the associated risks of antibiotic use, a new recommendation was issued in March 2008 by NICE stating that antibiotic prophylaxis before invasive dental procedures should stop [20], in contrast to the AHA who still recommends antibiotic prophylaxis for individuals at risk of developing this infection after invasive dental procedures [21].

The current study was conducted to evaluate antibiotic prescribing practices of dentists working at the Khartoum Dental Teaching Hospital (KDTH); a major teaching hospital in Khartoum, Sudan, to investigate the dentists' knowledge and awareness of rational antibiotic prescribing practices both therapeutically for oral and dental conditions and prophylactically in cases prone to IE. The study also aimed to evaluate the need for establishing education programs or courses to enhance dentists' awareness of antibiotic use.

Material and Methods

Study Design and Data Collection

A cross-sectional study was carried out by distributing an anonymous self-administered questionnaire to a convenience sample of dental practitioners at KDTH during July 2011. The questionnaire was obtained by modifying the questionnaire used in a previously published study to make it appropriate for this topic [22].

A pilot study was carried out on ten volunteer dentists working at KDTH and was repeated after ten days. Whenever a subject gave a different answer to a specific question, he/she was interviewed, and when necessary the question was modified to rule out misunderstanding. The process was repeated until there was a full agreement between responses of each volunteer.

A briefing was given to the practitioners regarding the nature of the study, and the procedure of completing the questionnaire was explained. Verbal consent was obtained from the dental practitioners who were willing to participate, and a written consent followed the verbal consent at the time of distribution of questionnaires. Inclusion criteria were: dental practitioners working at KDTH of all professional ranks and both genders. Dental practitioners who did not give their consent to participate were excluded from the study.

The questionnaire was composed of closed-ended questions on demographic details of age, sex, professional rank, year of graduation; attendance of educational courses on antibiotic prescribing in the past two years; clinical indications for antibiotic prescribing; and types of antibiotics. Participants were advised to avoid referring to reference materials while completing the questionnaire.

At the time of the survey, 135 dental practitioners were working at the hospital. A sample size of 100 participants was determined to provide 95% power of study using an expected frequency of 50%, and a confidence limit of 5%, (Epi Info Software, Centers for Disease Control and Prevention, Atlanta, GA, USA).

Statistical Analysis

Descriptive statistics and frequencies were used to describe the results. Cross tabulation with Chi-square statistics was used to explore associations between participants' responses and their demographics. Professional demographics were divided into the following groups; year of graduation (<2007, ≥2007), and professional rank: senior (consultant, specialist, and registrar), and junior

(medical and house officers). The p-value was set at <0.05 . The statistical software programme Statistical Package for the Social Sciences (SPSS) version 21 was used for the data analysis.

Ethical Aspects

The ethical approval was obtained from the Ethical Review Board of the University of Medical Sciences and Technology (UMST), Khartoum, Sudan.

Results

A total number of 100 out of 135 practitioners at KDTH participated with 74.1% response rate. Table 1 describes the participants' drug prescribing reference of choice and its significance of association with demographics. Drug reference was statistically significantly associated with graduation year ($p=0.005$) and professional rank ($p<0.001$) as new graduates referred more to senior practitioners while older graduates mostly referred to British National Formulary (BNF).

Table 1. Participants' preferable drug prescribing reference and significance of association with socio-professional factors.

Variables	N	BNF	Dental National Formulary	Other References	Senior Practitioners	p-value
Graduation Year						
<2007	33	54.0%	15.2%	6.1%	24.2%	0.005
≥2007)	67	21.2%	13.6%	10.0%	54.5%	
Professional Rank						
Seniors	25	72.0%	12.0%	4%	12.0%	0.000
Juniors	75	18.9%	14.9%	10.8%	55.4%	
Attendance of Antibiotic Activity						
Yes	30	46.7%	13.3%	6.7%	33.3%	0.237
No	70	26.1%	14.5%	10.1%	49.3%	
Gender						
Male	48	40.4%	10.6%	8.5%	40.4%	0.423
Female	52	25.5%	17.6%	9.8%	47.1%	

BNF: British National Formulary.

Table 2 shows the therapeutic antibiotics chosen by participants to treat dentoalveolar, dentofacial and Acute Necrotizing Ulcerative Gingivitis (ANUG). It also shows the prophylactic antibiotics chosen by participants for prophylaxis against IE. Metronidazole was the most frequently cited antibiotic for dento-facial infections and ANUG, while amoxicillin was the most frequently cited antibiotic for dento-alveolar infections.

Table 2. Number of respondents choosing different types of therapeutic antibiotics for various oral-maxillofacial infections and prophylactic antibiotics to infective endocarditis.

Antibiotics	Den-alv	Den-fac	ANUG	IE	Cumulative Antibiotic Use for All Conditions
Metronidazole	87	73	56	7	223
Amoxicillin	88	47	18	47	200
Amoxicillin-Clavulanic Acid	31	51	10	19	111
Clindamycin	12	9	4	5	30
Penicillin V	3	5	6	3	17

Erythromycin	8	3	1	0	12
Tetracycline	3	0	8	0	11
Cephalosporin III	7	1	1	0	9
Doxycycline	2	1	6	0	9
Ciprofloxacin	2	3	1	0	6
Azithromycin	0	3	1	0	4
Cephalexin	1	0	1	0	2
Ampicillin	1	0	1	0	2
Cephalosporin II	0	0	1	0	1

Den-alv: Dentoalveolar Infections; Den-Fac: Dentofacial Infections; ANUG: Acute Necrotizing Ulcerative Gingivitis; IE: Patients at Risk to Infective Endocarditis.

Table 3 shows participants' decisions to prescribe antibiotics for the various oral conditions, as well as relevant attitudes on antibiotic prescribing among the various demographic groups. A trend for overprescribing antibiotics was noticed since the majority of participants prescribe antibiotics for dental abscess, periodontal abscess, pericoronitis, and dry socket. On the hand hand, most participants would not prescribe antibiotics for patients in pain or upon patients' expectations. Most participants would also discuss with their patients antibiotics' side effects.

Table 3. Various responses to indications for antibiotic prescribing among the different demographic groups.

Participants' Decisions	Graduation Year		Professional Rank		Attendance of Antibiotics Courses		Gender	
	<2007 %	≥2007 %	Seniors %	Juniors %	Yes %	No %	Male %	Female %
Dental and Periodontal Abscess								
Yes	97.0	92.5	96.0	93.3	100.0	91.4	93.6	94.2
No	3.0	7.5	4.0	6.7	0.0	8.6	6.4	5.8
p-value	0.380		0.627		0.098		0.898	
Pericoronitis								
Yes	84.8	73.1	72.0	78.7	70.0	80.0	78.7	75.0
No	15.2	26.9	28.0	21.3	30.0	20.0	21.3	25.0
p-value	0.191		0.493		0.276		0.661	
Post Extraction / Surgical Procedure								
Yes	75.8	68.7	72.0	70.7	76.7	68.6	68.1	75.0
No	24.2	31.3	28.0	29.3	23.3	31.4	31.9	25.0
p-value	0.462		0.899		0.414		0.446	
Dry Socket								
Yes	63.6	44.8	48.0	52.0	53.3	50.0	46.8	53.8%
No	36.4	55.2	52.0	48.0	46.7	50.0	53.2	46.2%
p-value	0.076		0.729		0.760		0.484	
Patient in Pain								
Yes	18.2	10.4	24.0	9.3	16.7	11.4	14.9	11.5
No	81.8	89.6	76.0	90.7	83.3	88.6	85.1	88.5
p-value	0.280		0.059		0.475		0.622	
Chronic Periodontitis								
Yes	48.5	32.8	48.0	34.7	46.7	34.3	48.9	28.8
No	51.5	67.2	52.0	65.3	53.3	65.7	51.1	71.2
p-value	0.130		0.234		0.242		0.040*	
Prophylaxis								
Yes	87.9	79.1	84.0	81.3	93.3	77.1	87.2	76.9
No	12.1	20.9	16.0	18.7	6.7	22.9	12.8	23.1
p-value	0.283		0.764		0.053		0.184	

Patient Expectation								
Yes	9.1	9.1	8.0	6.7	3.3	8.6	6.4	7.7
No	90.9	90.9	92.0	93.3	96.7	91.4	93.6	92.3
p-value	0.565		0.821		0.347		0.800	
Trauma								
Yes	90.9	73.1	80.0	78.7	90.0	74.3	85.1	73.1
No	9.1	26.9	20.0	21.3	10.0	25.7	14.9	26.9
p-value	0.040*		0.887		0.077		0.144	
Do you follow any antibiotic prescription protocol?								
Yes	37.5	25.4	45.8	24.0	43.3	23.2	29.8	29.4
No	62.5	74.6	54.2	76.0	56.7	76.8	70.2	70.6
p-value	0.215		0.041*		0.043*		0.968	
Ask patient for history of antibiotic use?								
Yes	100.0	93.8	100.0	94.5	96.7	95.6	100.0	92.0
No	0.0	6.2	0.0	5.5	3.3	4.4	0.0	8.0
p-value	0.146		0.232		0.804		0.048*	
Do you discuss the main side effects of antibiotic with your patients?								
Yes	77.4	64.1	79.2	64.8	82.1	62.7	82.6	56.2
No	22.6	35.9	20.8	35.2	17.9	37.3	17.4	43.8
p-value	0.189		0.190		0.063		0.006**	
Usually, after you drain, abscesses do you request an antibiotic sensitivity tests?								
Yes	39.4	22.7	58.3	18.7	34.5	25.7	45.7	31.5
No	60.6	77.3	41.7	81.3	65.5	74.3	54.3	68.5
p-value	0.083		0.000**		0.378		0.000**	
If you request an antibiotic sensitivity test do you prescribe any antibiotic before the test results?								
Yes	66.7	82.1	52.0	85.3	23.3	17.1	61.7	90.4
No	33.3	11.9	48.0	9.3	3.3	4.3	34.0	5.8
p-value	0.019*		0.000**		0.546		0.002**	

*Statistically significant; **Highly statistically significant; When percentages do not add to 100%, this is because of non responses.

A number of 63 participants preferred the use of age for calculating pediatric antibiotic dose, while the rest preferred the use of weight for calculating the dose. There was no statistically significant difference between demographic characteristics and calculation methods ($p>0.05$).

Discussion

The study was conducted at the KDTH, a major teaching hospital in Sudan that recruits more than a hundred dentists of different professional ranks and receives approximately 9100 dental patients per month.

Most participants specified the British National Formulary (BNF) followed by the Dental Practitioners Formulary (DPF) and their senior mentors as their drug prescribing references. A minority did not specify their reference for drug prescribing which may indicate either uncertainty regarding the prescribing references, or overconfidence. It was noticed that graduation year and professional rank were the only demographics that had a highly statistically significant association with the drug reference where new graduates, and junior staff expectedly referring to senior staff, while older graduates and senior staff referring to the BNF. This finding suggests the need for

continuing educational courses for the junior staff. This is further confirmed by the finding that significantly more senior than junior staff stated that they follow a specific antibiotic prescribing protocol.

Metronidazole was the most frequently cited antibiotic by participants specifically for dentofacial infections and ANUG. Amoxicillin alone or less frequently in combination with clavulanic acid was also a favorite choice. Due to the spectrum that metronidazole covers, it is typically indicated for anaerobic infections like ANUG and pericoronitis [23], and similar infections caused by strict anaerobes [24]. A number of antibiotics are cited to a lesser degree by participants, and these include clindamycin, penicillin V, erythromycin, and tetracycline. Clindamycin is clinically effective in oral infections. However, its use may be complicated by pseudomembranous colitis, anaphylaxis, Sweet's syndrome and myelosuppression [25-27].

The use of erythromycin in dental infections has shown a declining popularity mainly because of the increasing erythromycin resistance in *Streptococcus pyogenes* that was observed in the 1990s, and in some parts of the world, this resistance peaked in the early 2000s [28,29]. Within the Eastern Mediterranean region, recent studies reported that 62.5% of *Enterococcus faecalis* isolated from the oral cavity [30], and 77% of *Streptococcus viridans* were susceptible to erythromycin [31]. Surprisingly, ANUG which is one of the few strong indications for antibiotics in dental practice has had less positive responses than the other two clinical situations. On the other hand, some non-indicated clinical conditions were cited like dry socket and chronic periodontitis.

Most participants would not prescribe antibiotics for pain only or for patients expecting antibiotics. Prescribing antibiotics for pain relief was shown to be one of the forms of antibiotic overuse in a study conducted in the USA [32]. Patient expectation has also been considered one of the social factors that initiate an antibiotic prescription by dentists, especially so in developing countries where the cultural norm is to satisfy needs of family and friends [22].

Gender differences in prescribing were noticed in a number of aspects. Significantly more male practitioners would prescribe for chronic periodontitis, which suggests that female dentists prefer periodontal instrumentation to antibiotic prescribing. Periodontal disease is common among humans [33], and a recent survey among periodontists found that a substantial proportion of approximately 50% prescribed antibiotics [34]. The male participants in the current study gave better responses than females regarding taking the history of antibiotic use, discussing side effects of antibiotics with their patients, requesting sensitivity testing after abscess drainage and prescribing empirical antibiotics.

Dental and Medical University education in Sudan mainly follows the British curricula, and since most of the participants graduated before 2007, perhaps that is why they still prefer prophylactic antibiotic prescribing against IE. According to the guidelines, one of the following antibiotics is recommended and is chosen according to individual patients' conditions; amoxicillin, ampicillin, cefazolin, ceftriaxone, cephalixin, clindamycin, azithromycin, and clarithromycin [21]. Surprisingly, some participants mentioned metronidazole, amoxicillin/clavulanic acid and penicillin

V. It was not the aim of this study to investigate dentists' attitudes in prescribing to patients with prosthetic joints, however, similar to the guidelines suggested for prophylaxis against IE, the most recent guidelines recommend against routine prophylactic antibiotics before dental procedures in immune-competent, prosthetic joint patients [35].

As for pediatric antibiotic prescribing most participants would consider the child's age in prescribing, and a smaller proportion would consider body weight. According to the BNF, the doses for children are based on body weight or the age range (first month, up to 1 year, 1-5 years, and 6-12 years). None of the demographics investigated has a statistically significant association with the rule for calculating pediatric dosage, which indicates that participants have a similar scientific background in pediatric prescribing.

The study has limitations. This was single-center study. Although this hospital is a major teaching hospital, a multi-center study might have yielded a more valid results. Also, the study was based on self-perceived data. Results would be more accurate if they were retrieved from documented sources like patients' records or pharmacy records to report the actual prescribing practices of all dentists working in this particular hospital.

Conclusion

There are some shortfalls in the knowledge of the participants regarding clinical indications and choice of antibiotic. Undergraduate, as well as postgraduate courses, are required in Sudan to provide up-to-date orientation on antibiotic use. It is recommended that the concerned dental association in Sudan make these courses obligatory by linking these courses with required continuing medical education points that are necessary to renew the practicing license.

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References

- [1] Dar-Odeh NS, Al-Beyari M, Abu-Hammad OA. The role of antifungal drugs in the management of denture-associated stomatitis. *Int Arab J Antimicrob Agents* 2012; 2(1):1-5. <https://doi.org/10.3823/705>
- [2] Al-Humaidi SF, Dar-Odeh NS, Alnazzawi A, Kutkut A, Hudieb M, Abu-Hammad O. Volatile sulphur compounds in exhaled air of dental students smoking the waterpipe: A nested case control study. *Minerva Stomatol* 2017; 66(4):157-62. <https://doi.org/10.23736/S0026-4970.17.04061-4>
- [3] Dar-Odeh N, Fadel HT, Abu-Hammad S, Abdeljawad R, Abu-Hammad OA. Antibiotic prescribing for Oro-facial infections in the paediatric outpatient: A review. *Antibiotics* 2018; 7(2):E38. <https://doi.org/10.3390/antibiotics7020038>
- [4] Dar-Odeh NS, Othman B, Bahabri RH, Alnazzawi AA, Borzangy SS, Fadel HT, Alolayan AB, Abu-Hammad OA. Antibiotic self-medication for oral conditions: Characteristics and associated factors. *Pesqui Bras Odontopediatria Clin Integr* 2018; 18(1):e3890. <https://doi.org/10.4034/PBOCI.2018.181.27>

- [5] 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; 32(7):503-9. <https://doi.org/10.1016/j.jdent.2004.04.001>
- [6] Moloney J, Stassen LFA. Pericoronitis: Treatment and a clinical dilemma. *J Ir Dent Assoc* 2009; 55(4):190-2.
- [7] 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 Diagnostic Res* 2014; 8(7):ZC10-4. <https://doi.org/10.7860/JCDR/2014/9645.4536>
- [8] Oberoi SS, Dhingra C, Sharma G, Sardana D. Antibiotics in dental practice: How justified are we. *Int Dent J* 2015; 65(1):4-10. <https://doi.org/10.1111/idj.12146>
- [9] Al-Haroni M, Skaug N. Knowledge of prescribing antimicrobials among Yemeni general dentists. *Acta Odontol Scand* 2006; 64(5):274-80. <https://doi.org/10.1080/00016350600672829>
- [10] Centers for Disease Control and Prevention. Antibiotic resistance threats in the United States. Available at: <http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf>. [Accessed on June 01, 2018].
- [11] Norris P, Chamberlain K, Dew K, Gabe J, Hodgetts D, Madden H. Public beliefs about antibiotics, infection and resistance: A qualitative study. *Antibiotics* 2013; 2(4):465-76. <https://doi.org/10.3390/antibiotics2040465>
- [12] Ferguson J, McEwen J, Al-Ajmi H, Purkins L, Colman PJ, Willavize SA. A comparison of the photosensitizing potential of trovafloxacin with that of other quinolones in healthy subjects. *J Antimicrob Chemother* 2000; 45(4):503-9.
- [13] Droste JH, Wieringa MH, Weyler JJ, Nelen VJ, Vermeire PA, Van Bever HP. Does the use of antibiotics in early childhood increase the risk of asthma and allergic disease? *Clin Exp Allergy* 2000; 30(11):1547-53.
- [14] Yallapragada SG, Nash CB, Robinson DT. Early-life exposure to antibiotics, alterations in the intestinal microbiome, and risk of metabolic disease in children and adults. *Pediatr Ann* 2015; 44(11):e265-9. <https://doi.org/10.3928/00904481-20151112-09>
- [15] Hong L, Levy SM, Warren JJ, Dawson DV, Bergus GR, Wefel JS. Association of amoxicillin use during early childhood with developmental tooth enamel defects. *Arch Pediatr Adolesc Med* 2005; 159(10):943-8. <https://doi.org/10.1001/archpedi.159.10.943>
- [16] Adeyemo WL, Oderinu OH, Olojede ACO, Ayodele AOS, Fashina AA. Nigerian dentists' knowledge of the current guidelines for preventing infective endocarditis. *Community Dent Health* 2011; 28(2):178-81.
- [17] Lalloo R, Solanki G, Ramphoma K, Myburgh NG. Antibiotic-prescribing patterns of South African dental practitioners following tooth extractions. *J Investig Clin Dent* 2016; 8(4): e12247. <https://doi.org/10.1111/jicd.12247>
- [18] National Institute for Health and Clinical Excellence. Prophylaxis against infective endocarditis: antimicrobial prophylaxis against infective endocarditis in adults and children undergoing interventional procedures. Available at: <https://www.nice.org.uk/guidance/cg64>. [Accessed on January 9, 2018].
- [19] Thornhill MH, Lockhart PB, Prendergast B, Chambers JB, Shanson D. NICE and antibiotic prophylaxis to prevent endocarditis. *Br Dent J* 2015; 218(11):619-21. <https://doi.org/10.1038/sj.bdj.2015.496>
- [20] National Institute for Health and Clinical Excellence. NICE Clinical Guidelines, No. 64. Prophylaxis against infective endocarditis: antimicrobial prophylaxis against infective endocarditis in adults and children undergoing interventional procedures. London; 2008. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK51789/>. [Accessed on January 9, 2018].
- [21] Allen U. Infective endocarditis: Updated guidelines. *Can J Infect Dis Med Microbiol* 2010; 21(2): 74-77.
- [22] N. S. Dar-Odeh et al. Prescribing Antibiotics for pediatric dental patients in Jordan; knowledge and attitudes of dentists. *Int Arab J Antimicrob Agents* 2013; 3(3):1-4. <https://doi.org/10.3823/736>
- [23] Seymour RA, Hogg SD. Antibiotics and chemoprophylaxis. *Periodontol* 2000 2008; 46:80-108. <https://doi.org/10.1111/j.1600-0757.2008.00246.x>
- [24] Herrera D, Alonso B, de Arriba L, Santa Cruz I, Serrano C, Sanz M. Acute periodontal lesions. *Periodontol* 2000 2014; 65(1):149-77. <https://doi.org/10.1111/prd.12022>

- [25] Morales MP, Carvalho AP, Espinosa KA, Murillo EE. A young man with myelosuppression caused by clindamycin: A case report. *J Med Case Rep* 2014; 8:7. <https://doi.org/10.1186/1752-1947-8-7>
- [26] Kandula S, Burke WS, Goldfarb JN. Clindamycin-induced Sweet syndrome. *J Am Acad Dermatol* 2010; 62(5):898-900. <https://doi.org/10.1016/j.jaad.2009.03.050>
- [27] Bulloch MN, Baccas JT, Arnold S. Clindamycin-induced hypersensitivity reaction. *Infection* 2016; 44(3):357-9. <https://doi.org/10.1007/s15010-015-0826-2>
- [28] Shulman ST, Bisno AL, Clegg HW, Gerber MA, Kaplan EL, Lee G, Martin JM, Van Beneden C. Clinical practice guideline for the diagnosis and management of group A streptococcal pharyngitis: 2012 update by the Infectious Diseases Society of America. *Clin Infect Dis* 2012; 15;55(10):1279-82. <https://doi.org/10.1093/cid/cis847>
- [29] Huang C, Lai J, Huang I, Chen P, Wang H, Shiau Y, Cheng Y, Hsieh L, Chang S, Lauderdale TY. Epidemiology and molecular characterization of macrolide-resistant *Streptococcus pyogenes* in Taiwan. *J Clin Microbiol* 2014; 52(2):508-16. <https://doi.org/10.1128/JCM.02383-13>
- [30] Salah R, Dar-Odeh N, Abu Hammad O, Shehabi AA. Prevalence of putative virulence factors and antimicrobial susceptibility of *Enterococcus faecalis* isolates from patients with dental diseases. *BMC Oral Health* 2008; 8:17. <https://doi.org/10.1186/1472-6831-8-17>
- [31] Abu-zineh RF, Dar-odeh NS, Shehabi AA. Macrolide resistance genes and virulence factors of common viridans *Streptococci* species colonizing oral cavities of patients in Jordan. *Oral Health Dent Manag* 2015; 14(6):337-41.
- [32] Sivaraman SS, Hassan M, Pearson JM. A national survey of pediatric dentists on antibiotic use in children. *Pediatr Dent* 2013; 35(7):546-9.
- [33] Gu Y, Lee H, Napolitano N, Clemens M, Zhang Y, Sorsa T et al. 4-methoxycarbonyl curcumin: A unique inhibitor of both inflammatory mediators and periodontal inflammation. *Mediators Inflamm* 2013; Article ID 329740. <https://doi.org/10.1155/2013/329740>
- [34] Froum SJ, Weinberg MA. An Evaluation of Antibiotic Use in Periodontal and Implant Practices. *Int J Periodontics Restorative Dent* 2015; 35(4):481-7. <https://doi.org/10.11607/prd.2488>
- [35] Sollecito TP, Abt E, Lockhart PB, Truelove E, Paumier TM, Tracy SL, Tampi M, Beltrán-Aguilar ED, Frantsve-Hawley J. The use of prophylactic antibiotics prior to Dental procedures in patients with prosthetic joints: Evidence-based clinical practice guideline for dental practitioners-a report of the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc* 2015; 146(1):11-16.e8. <https://doi.org/10.1016/j.adaj.2014.11.012>