

KNOWLEDGE AND PATTERNS OF ANTIBIOTIC PRESCRIPTION AMONG DENTAL PRACTITIONERS IN HAIL, SAUDI ARABIA

Hazza A. Alhobeira^{1a}, Juma Alkhabuli^{2b*}, Maleeha Fraih^{1c}

¹Department of Restorative Dentistry, College of Dentistry, University of Hail, Hail, Kingdom of Saudi Arabia

²Basic Medical and Dental Sciences Department, RAK College of Dental Sciences (RAKCODS), RAK Medical and Health Sciences University, Ras Al Khaimah (RAK), United Arab Emirates

^aPhD, MDentSci, MRDI, BDS, Assistant Professor, Head, Vice Dean

^bBDS, MDentSci, MFDS RCPS (Glasg), FICD, PhD, Chairperson

^cBDS, General Dental Practitioner

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ABSTRACT

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Introduction: Presence of various bacterial strains resistant to antibiotics is a genuine issue to medical professionals. Unjustified over prescription of antibiotics by dental practitioners (DP) is well recognized. The aim of this study was to explore the knowledge and patterns of antibiotic prescription and related antibiotic resistance among dental surgeons working in Hail, Saudi Arabia.

Methodology: A questionnaire was distributed to 150 DP working in the district of Hail, Saudi Arabia. The questionnaire sought answers to the common dental conditions for which antibiotic would be prescribed. The possible contributing factors in development of antibiotic resistance were also sought.

Results: Out of the 150 questionnaires sent out 101(67%) were filled in by the DP. About 85% were males and 15% were females. Most of the DP would prescribe antibiotics for elevated temperature (86.1%), diffuse swelling (75.2%) and swelling causing eye closure (90.1%). Antibiotic prescription would be considered for pericoronitis, cellulitis and trismus by 68.3%, 89.1% and 40.6% of the DP respectively. However, 55.4% would prescribe antibiotics for fluctuant localized swelling, 75.2% to reduce postoperative complications and 73.3.8% for surgical extraction.

Generally, amoxicillin was the most preferred drug of choice, and nearly 36% of the DP preferred amoxicillin-clavulanate in treatment of cellulitis. About 67% thought that the widespread use of antibiotics was the main contributing factor in development of antibiotic resistance.

Conclusion: Despite of the moderate knowledge of DP, a substantial percentage continue to prescribe antibiotics indiscriminately and irrationally. The results reveal that further work and efforts are required to acquaint the DP of the risk of unjustified antibiotic use and bacterial-resistance development.

Keywords: antimicrobial, dental practitioner, use of antibiotics, bacterial resistance.

1. Introduction

Antibiotic therapy is playing major role in treatment of various infectious diseases. There is no doubt that the safe use of systemic antibiotics has improved the quality of life dramatically and increased life expectancy for millions of people worldwide.

Despite the crucial benefits of systemic antibiotics, there has been an explosion in the number of bacteria that have become resistant to several drugs in use. In fact, not the antibiotics per se is the offender, as they remain one of the most powerful biological armaments against ailments caused by microbial infection. Nevertheless the inappropriate and irrational use of the antibiotics resulted in catastrophic situation attributed to development of bacterial strains resistant to a wide range of antibiotics.

Furthermore, use of antibiotics for self-medication

has been documented in general population in various developing and developed countries.¹ Several studies have demonstrated high prevalence of self-medication with antibiotics among medical and non-medical students.² The misuse of antibiotics is of risk to both the individual and the community at large as it leads to increased risk of adverse effects and emergence of bacterial resistance.³ Among the many factors that contribute to misuse of antibiotics is the liberal dispensing of antibiotics by pharmacists without prescription.

The flora of the oral cavity is comprised of diverse range of microorganisms including bacteria, fungi and protozoa. However, a small percentage of these microorganisms can be isolated by the conventional culture technique. Recently, the use of molecular biological methods demonstrated many novel phylotypes that cannot be recognized by

*Corresponding author:

Associate Professor Dr. Juma Alkhabuli, BDS, MDentSci, MFDS RCPS (Glasg), FICD, PhD, Chairperson, Basic Medical and Dental Sciences Department, RAK College of Dental Sciences (RAKCODS), RAK Medical and Health Sciences University, Ras Al Khaimah, RAK, P.O.Box 12973, United Arab Emirates, Tel/Fax: +97172222593/2269, e-mail: juma@rakmhsu.ac.ae

conventional techniques.⁴

Dentists prescribe medications for the management of several oral conditions, mainly orofacial infections.⁵ Since most human orofacial infections originate from odontogenic infections⁶ prescribing antibiotics by dental practitioners has become an important aspect of dental practice. Thus, antibiotics account most medicines prescribed by dentists.⁷ Dentists prescribe between 7% and 11% of all common antibiotics (betalactams, macrolides, tetracyclines, clindamycin, metronidazole).⁸ For instance, in the United Kingdom, dentists accounted for 7% of all community prescriptions of antimicrobials.⁹ On the other hand, the National Center for Disease Control and Prevention estimate that approximately one-third of outpatient antibiotic prescriptions are unnecessary.¹⁰ Antibiotic prescribing may be associated with unfavorable side effects ranging from gastrointestinal disturbances to fatal anaphylactic shock and development of resistance. The increasing resistance problems of recent years are probably related to over- or misuse of broad-spectrum agents such as cephalosporins and fluoro-quinolones.¹¹ We have now entered an era where some bacterial species are resistant to the full range of antibiotics presently available, with the methicillin-resistant *Staphylococcus aureus* being one of the most widely known example of extensive resistance.⁷

Understanding the enemy is the best way to win the battle. Thus, the rational choice and use of antimicrobial agents begins with the knowledge of the microorganisms most likely responsible for the common dental infections.

It is well known that the oral microbial flora is dynamic and subject to changes continuously throughout life. In dentistry antibiotics are mainly used to manage or prevent spread of odontogenic infection. Other uses; may include prophylaxis against infective endocarditis, selected joint surgery and in conditions related to systemic diseases, such as diabetes mellitus. Hence, the number of dental conditions that need use of systemic antibiotics remain limited. In fact, most of the dental emergencies, including acute dental pain need only local intervention.¹² Pain associated with acute pulpitis for example is not a justification for antibiotic therapy. The latter should be reserved for more serious conditions associated with evidence of systemic spread.¹³

The literature shows strong evidences that the dental surgeons have immensely contributed to antibiotic abuse and development of bacterial resistance.¹⁴⁻¹⁶ Several authors have widely examined the multiple factors related to improper prescription of antibiotics including but not limited to uncertainty or failure of making definite diagnosis, lack of knowledge of adverse reactions, over-prescription, self-medication, and lack of time for immediate treatment (convenience) or inability to find out the causative agent.¹⁷⁻²¹

The rationale behind carrying out this preliminary study is the increasing number of dental patients who are unnecessarily prescribed antibiotics. In developed countries, not a single dose of antibiotics can be obtained without prescription,

whereas in developing countries, including Middle East region, except narcotics, most of drugs including antibiotics are obtainable without prescription from any community pharmacy.

Despite of the available reports on the rationale use of antibiotics by the practicing dental surgeons in Saudi Arabia, the available information are still inadequate. Therefore, our objectives are to explore the knowledge and attitude of the dental surgeons practicing in Hail towards antibiotic therapy and its resistance.

2. Methodology

The study has obtained approval from the Research Ethics Committee, University of Hail, reference No.(H-2016-051).

In the current study, a validated self-administered questionnaire used by Alkhabuli et al.²² in a similar study was utilized to collect information from the practicing dental surgeons in district of Hail, Saudi Arabia. A hundred and fifty questionnaires were printed and distributed randomly to the practicing dentists including general dental practitioners (GDPs), specialists and consultants working in various sectors, such as government hospitals, private clinics and dental centers and were recollected after 10 days. In addition to the demographic information, the questionnaire inquired about the clinical and non-clinical parameters including symptoms and treatment modalities related to their patients, which dictates the dental practitioner's decision of prescribing antibiotics.

The practitioners were asked how would they assess the various clinical signs and symptoms such as pain, fever, swelling, limitation of mouth opening, difficulty in swallowing and closure of eyes due to swelling in prescribing antibiotics.

Dental surgeons may prescribe antibiotics for conditions other than infection, just to mention few, delay of treatment, convenience, social background and prevention of post-operative complications.

Moreover, the participants were requested to provide their opinion and judgment about prescribing antibiotics for specific clinical conditions, such as acute and chronic pulp diseases related to dental caries, gingivitis, periodontal abscesses, routine extraction and surgical extraction as well as tooth replantation and trismus.

The questionnaire also investigated the favored antibiotics by the dental surgeons in cases of cellulitis, periapical infection, pericoronitis, apicectomy, trismus and other dental infections. The suggested antibiotics were amoxicillin, amoxicillin-clavulanate (such as Augmentin), erythromycin, metronidazole, tetracycline and cephalosporin. In addition, the study sought the participants' opinion about the factors contributing to development of antibiotics resistance. These factors are the wide use of antibiotics particularly the broad-spectrum antibiotics, poor access to culture and sensitivity

tests, inappropriate duration, lack of guidelines and patients' demand and expectations.

In this study, all descriptive data were projected as frequencies and percentages and compared using chi-squared test, while quantitative data were presented as means and standard deviations (SD) and compared using t-test.

3. Results

A hundred and one completed questionnaires were considered valid. Any questionnaire with missing or insufficient data were excluded. The response rate was 67%. Males represented 85.1% of the respondents, while females represented 14.9%. The demographic and professional characteristics of the respondents are shown in Table 1. Most of the participants were general practitioners or interns (66.3%), specialists (30.7%) and only a few were consultants (3%). Nearly 60% of the participants practiced dentistry for more than 5 years.

Indications for antibiotic prescription in relation to the clinical signs and symptoms and general considerations by the practicing dental surgeons are demonstrated in Table 2. Most of the dental practitioners would prescribe antibiotics if there is a sign of fever (86.1%), swelling causing eye closure (90.1%) or diffuse swelling (75.2%).

A considerable percentage would prescribe antibiotics for a localized fluctuant swelling (55.4%). Patients presented with difficulty in swallowing would be given antibiotics by 56.4% of the participant dental surgeons. A significant percentage (52.2%) of dental practitioners would prescribe antibiotics postoperatively to prevent potential complications. In cases where the diagnosis is inconclusive or a decision to postpone the treatment has been taken, 44.6% and 75.2% of the participants would prescribe antibiotics respectively.

Table 3 demonstrates the patterns of antibiotic prescription by the participants for the clinically diagnosed conditions. The table reveals diverse variation among the respondents. The respondents would consider antibiotic therapy for pericoronitis, cellulitis and trismus by 68.3%, 89.1% and 40.6% respectively. A large percentage of the respondents (73.4%) would still prescribe antibiotics for surgical extraction, whereas 34.7% of the respondents would consider the same for routine extraction. Treatment of dry socket by antibiotics is a choice of 48.5% of the respondents. Acute periapical infection and acute pulpitis both are considered for antibiotic therapy by 57.4% and 38.6% of the respondents, respectively.

Dental infection may be manifested as maxillary sinusitis. About 67% of the dental professionals would prescribe antibiotics for such conditions. Substantial percentages of dental surgeons (70.3%) and (60.4%) would use antibiotics in treatment of periodontal abscesses and ulcerative gingivitis, respectively. Nearly 52% of the respondents are inclined to use antibiotics in

treatment of chronic periodontitis. About 89% of the respondents would prescribe antibiotics for cellulitis and 68.3% for pericoronitis cases. Patients with trismus would be prescribed antibiotics by approximately 41% of the dental surgeons. Post root canal treatment apical surgeries are common procedures. Antibiotic therapy is considered for apicectomy by 65.3% of the respondents. A considerable percentage of dental surgeons (61.4%) would prescribe antibiotics for root canal surgery postoperatively, whereas 41.6% would do the same preoperatively.

Less than 24% of the dental surgeons would probably prescribe antibiotics for scaling and polishing, direct pulp capping and indirect pulp capping cases. Antibiotic therapy is considered by 56.4% of the respondents in case of teeth replantation.

Table 4 indicates the motivation for using certain antibiotics in treatment of specific clinical conditions. Out of the 6 listed antibiotics, amoxicillin remains the drug of choice in management of all clinical conditions. Probably, amoxicillin-clavulanate is the second drug of choice after amoxicillin in treatment of cellulitis. The respondents are not inclined to use a combination of antibiotics in their routine dental treatments. The table shows that tetracycline and cephalosporins were scarcely prescribed by the dental surgeons.

The study has assessed the dental practitioners' opinions regarding the contributing factors in development of antibiotic resistance (Fig. 1). More than 65% of the respondents thought that wide spread use of antibiotics is a very important contributing factor in development of antibiotic resistance. Inappropriate antibiotic course duration was rated as the second among the very important contributing factors.

Moreover, about 52% of the respondents thought that use of broad spectrum antibiotics and lack of

Table 1. Demographic and professional characteristics of practicing dental practitioners.

Variable	n (%)
Gender:	
Male	86 (85.1)
Female	15 (14.9)
Age (years):	
20-29	28 (27.7)
30-39	35 (34.7)
40-49	32 (31.7)
50-59	06 (05.9)
Professional rank:	
General practitioner/Intern	67 (66.3)
Specialist	31 (30.7)
Consultant	03 (03.0)
Years in practice:	
< 5 years	41 (40.6)
> 5 years	60 (59.4)

Table 2. Antibiotic prescription patterns among dental practitioners for selected clinical signs, symptoms and general considerations.

Conditions	Number of dental practitioners (%) who responded "yes"
Elevated temperature + evidence of systemic spread	87 (86.1)
Localized fluctuant swelling	56 (55.4)
Gross or diffused swelling	76 (75.2)
Unrestricted mouth opening	39 (38.6)
Difficulty in swallowing	57 (56.4)
Closure of the eye due to swelling	91 (90.1)
Convenience (e.g. prophylaxis against foreseen complication, patient's demand)	45 (44.6)
Patient's social background (e.g. patient's economic condition, expectations, occupation etc.)	38 (37.6)
Prevention of post-operative complication	76 (75.2)
Delay of treatment	35 (34.7)
Uncertain diagnosis	26 (25.7)

prescribing guidelines are no less of significance. Nearly 36% of the respondents thought that antibiotic brand promotion by the pharmaceutical companies is an important contributing factor in antibiotic resistance development. About 27% of the practicing dental surgeons thought prescribing antibiotics on patients' demand is of less or no significance in development of antibiotic resistance.

4. Discussion

Antibiotic overuse among dental practitioners is a global concern and it seems progressing rapidly causing problems to the health care and community settings.

Unfortunately, many practitioners are still prescribing antibiotics inappropriately and indiscriminately for no valid cause.²⁵ Most of the conditions presented to the dentist are primarily due to inflammation of the pulp causing pain and discomfort. Thus, these conditions are treated by local intervention rather than prescribing antibiotics. The use of antibiotic in cases of chronic inflammatory periodontitis per se is also not indicated. Generally, systemic antimicrobial therapy should be reserved for conditions where the debridement is difficult to achieve or where there is a sign of local spread, and for patients suffering from systemic debilitating illnesses.

Although, similar studies have been conducted in Saudi Arabia,²⁶⁻²⁸ Hail district was not explored. It is worth to further investigate and find out the changes in the antimicrobial therapy trends among dental practitioners.

In the current study, only approximately 15% were females and this probably reflects the predominance of males in this profession.

A substantial percentage of the surveyed candidates were general practitioners or interns and these are the main dental working force in the community. Almost 60% of the respondents have experience more than 5 years. Nevertheless, long experience is not necessarily associated with updated knowledge on antibiotic therapy.

Alkhabuli et al.²² found that the practitioners with less than 5 years' experience had better knowledge on antibiotic and prescribing guidelines compared to those practicing for more than 5 years.

In principle, elimination of source of infection is the primary approach for any odontogenic infection. Therefore, where possible, incision and drainage of abscesses should be instituted immediately and antibiotics are basically adjunct and prescribed in the light of the presented clinical signs and symptoms.

Fever is a response of the host defense against microbial invasion, which further instigate an immune reaction. About 86% of the participants would prescribe antibiotics for patients presented with elevated temperature. These figures are in line with the previous regional studies.^{20,29,30} Facial cellulitis, commonly associated with periapical infection spread that may extend beyond midface causing eye closure is obviously another condition which mandates use of antibiotics. Over 90% of the surveyed practitioners are aware of the seriousness of the condition and the need for immediate antibiotics cover. In fact, the previous two conditions represent fundamental bases of infection spread and its sequel, which are known to all medical professionals. Therefore, lower percentages of agreement would be unacceptable. In contrast, it is alarming to see significant percentages of practicing dentists who would still prescribe antibiotics if they were unconfident of the diagnosis or on patients' request. This tendency of antibiotic abuse is not uncommon and well documented.^{20,29} Such practices of antibiotic abuse are unjustified and the dental surgeons should be aware of the unforeseen effects on long run.

It seems to be that management of localized fluctuant swelling is still confusing among dental practitioners including specialists. Although, primarily drainage of such abscesses is what is needed, over 55% of the respondents tend to prescribe antibiotics. However, no differences were

Table 3. Clinically diagnosed conditions for which dental practitioners would prescribe antibiotics.

Conditions for antibiotic prescription	Number of dental practitioners (%) who responded "yes"
Acute Pulpitis	39 (38.6)
Acute periapical infection	58 (57.4)
Chronic infection	63 (62.4)
Periodontal abscess	71 (70.3)
Acute ulcerative gingivitis	61 (60.4)
Chronic marginal gingivitis	34 (33.7)
Chronic periodontitis	52 (51.5)
Pericoronitis	69 (68.3)
Cellulitis	90 (89.1)
Sinusitis	68 (67.3)
Dry socket	49 (48.5)
Trismus	41 (40.6)
Routine extraction	35 (34.7)
Surgical extraction	74 (73.3)
Apicectomy	66 (65.3)
Root canal surgery pre-operative	42 (41.6)
Root canal surgery post-operative	62 (61.4)
Scaling and polishing	24 (23.8)
Restorative treatment (fillings with composite, etc.)	24 (23.8)
Replantation of teeth	57 (56.4)
Deep caries without pulpal involvement (indirect pulp capping)	20 (19.8)
Direct pulp capping	17 (16.8)

found between the specialists and the general practitioners in prescription patterns of antibiotic therapy for this condition.

Difficulty in swallowing and mouth opening restriction are common signs of fascial spaces infection and spread and may end up with serious complications. About 56.4% would prescribe antibiotics for cases associated with difficulty in swallowing. In other regions of the world, probably the dental surgeons are more aware of these conditions thus higher percentages were noticed.^{22,31}

Fascial spaces are poorly vascularized and antibiotics may not reach the deepest zone of the infection. Consequently, these conditions require thorough surgical intervention as sole antibiotic therapy is unlikely to clear the infection.

Unfortunately, antibiotic is still injudiciously prescribed. It seems that around 45% of the dental surgeons would prescribe antibiotic for cases where definitive diagnosis could not be made. Surprisingly, such unjustified antibiotic prescription has been reported in developed countries survey as high as in our study, and in countries where the use of drugs is much better controlled.^{31,32} Nevertheless, a recent survey from the United Arab Emirates revealed much lower percentage (16.6%).²² In the current study, almost 45% of the respondents are likely to dispose their patients under antibiotic cover if the treatment

could not be completed or differed. Obviously, this is unethical and unjustified approach.

It is a common practice to see dental surgeons prescribing antibiotic post-operatively to prevent unanticipated complication. Although this remains baseless, a substantial percentage of the surveyed candidates (75.2%) would cover their patients with antibiotics after surgical procedure. More specifically, patients undergoing apicectomy procedure for example would be prescribed antibiotics by 65% of the dental practitioners. In fact, if the procedure is performed under aseptic and atraumatic condition infection of the oral soft tissues as a complication is seldom. A comparative study of clindamycin prophylaxis and placebo in prevention of postoperative infection in endodontic surgical procedures showed no differences.³³

Surgical extraction of impacted teeth is invariably followed by a course of antibiotics. Salako et al.²⁰ reported that as high as 89.3% of the respondents would prescribe antibiotics for surgical extraction. In the current survey, the percentage is to some extent comparable (73.4%). There has been long contentious discussion about the benefits of using antibiotics postoperatively. Recent studies deemed use of antibiotics in post-surgical extraction unnecessary.^{34,35} In another study by Lodi et al.³⁶ despite no differences were found between antibiotics and placebo surgical extraction groups

Table 4. Preferred antibiotics for selected clinical conditions by dental practitioners

Conditions	Number of dental practitioners (%) who preferred one or more of the antibiotics mentioned in the received questionnaire						
	Amoxicillin	Amoxicillin-clavulanate	Erythromycin	Metronidazole	Tetracycline	Cephalosporins	More than one antibiotic
Periapical infections without penicillin allergy	54 (53.5)	27 (26.7)	14 (13.9)	6 (5.9)	0 (0)	0 (0)	0 (0)
Dental infections without penicillin allergy	62 (61.4)	23 (22.8)	12 (11.9)	3 (3.0)	1 (1.0)	0 (0)	0 (0)
Pericoronitis	36 (65.6)	25 (24.8)	19 (18.8)	18 (17.8)	0 (0)	3 (3.0)	0 (0)
Cellulitis	46 (45.5)	36 (35.6)	6 (5.6)	6 (5.6)	1 (1.0)	6 (5.9)	0 (0)
Apicectomy	61 (60.4)	26 (25.7)	9 (8.9)	3 (3.0)	2 (2.0)	0 (0)	0 (0)
Trismus	56 (55.4)	23 (22.8)	14 (13.9)	2 (2.0)	4 (4.0)	2 (2.0)	0 (0)

in terms of swelling, trismus or fever outcomes, the authors thought a small percentage may be benefited from antibiotics. However, antibiotics are encouraged for patients undergoing contaminated, long-duration surgery.³⁷

Etiology of alveolar osteitis, also known as dry socket, is multifactorial in origin and its incidence is low.^{38,39} Nearly 49% of the respondents would prescribe antibiotics to patients suffering from dry socket. There is no sound evidence to support the notion that dry socket is a complication caused by infection, therefore, antibiotics are of no value in curing the condition.⁴⁰

A quite sensible percentage (56.4%) of dental practitioners would prescribe antibiotics for replantation of teeth. Systemic use of antibiotics for such conditions has been questioned and the clinical studies do not recommend such regime, as no value was achieved. Nevertheless, immersing the avulsed teeth in antibiotic solution, such as tetracycline has been advocated. Experimental studies however, revealed some positive benefits and this is the reason behind its current recommendation by the scholars of dental traumatology.^{41,42}

The most worrying malpractice is the unjustified overuse of antibiotics in conditions related to pulp pathology. The only therapy needed for these cases is local clinical intervention. In periodontal conditions, except those associated with abscess, most of the cases require local management. A percentage like 52% of the respondents who are motivated to prescribe antibiotics for chronic periodontitis cannot be underestimated. On the other hand, consideration of antibiotic therapy for pericoronitis by 68.3% is acceptable. Nonetheless, mild to moderate pericoronitis without signs of spread can be treated effectively by normal saline irrigation avoiding systemic antibiotic therapy. Necrotizing ulcerative gingivitis is caused by anaerobic microorganisms and warrants specific antibiotic therapy. About 64.4% of the dental practitioners would prescribe antibiotics treatment of such conditions, though the management should emphasize on local debridement and antimicrobial mouth rinses, and systemic

antibiotics should be reserved for cases associated with signs and symptoms of infection spread.

Antibiotic therapy for odontogenic sinusitis was considered by 67% of the dental practitioners. Because of the vicinity of upper apices of posterior teeth to the floor of maxillary sinus, there is no doubt of potential odontogenic infection spread. However, diagnosis of such cases needs to be meticulous to avoid unnecessary or overuse of antibiotics.

Cellulitis is a serious acute condition and warrants systemic antibiotic. As nearly as 90% of dental practitioners would prescribe systemic antibiotics to avoid further complications. Trismus is the hallmark of a masticatory space infection or infection in the anterior compartment of lateral pharyngeal space and about 41% of the respondents opted to prescribe antibiotics. Both cellulitis and sever trismus are considered as serious medical conditions, therefore, proper diagnosis and management including referrals are crucial.

On the other hand, it is very painful to see a considerable percentage (34.7%) of the surveyed dental surgeons would still prescribe antibiotics for normal extraction, acute periapical infection (57.4%) and for acute pulpitis (38.6%). These conditions need immediate intervention rather than systemic antibiotic therapy. Many dental surgeons believe that antibiotics reduces acute pulpal pain. Nevertheless, there is insufficient evidence to support this concept.⁴³ Use of antibiotics for various apical pathology are still high and would be considered by more than 60% of the respondents. The available evidence does not provide clinicians with reliable and proper guidelines for treating periapical lesions,⁴⁴ therefore, use of antibiotics in such conditions is questionable.

Unfortunately, many dental practitioners would still prescribe antibiotics for simple dental procedures, such as restorative treatment, pulp capping, scaling and polishing, and the current percentages are higher compared to those reported by Alkhabuli et al.²²

When a question regarding antibiotic preference

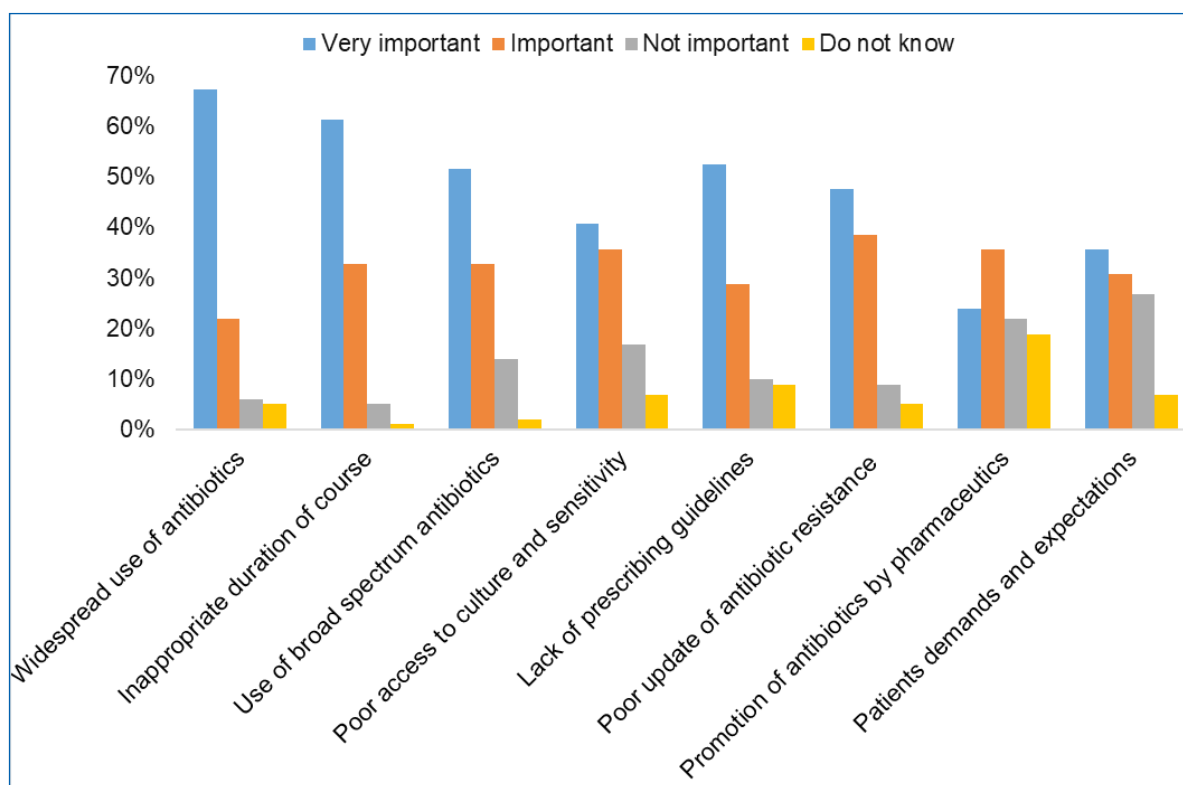


Figure 1. Percentages of dental practitioners' assessment of factors contributing to antibiotic resistance.

was raised, amoxicillin remained the most commonly used antibiotic in treatment of odontogenic infection for non-penicillin allergic patients (Table 4). Amoxicillin-clavulanate was the second drug of choice after amoxicillin, particularly in treatment of cellulitis. Clindamycin is also a good alternative drug for penicillin allergic individuals. In this study, erythromycin would barely be prescribed by the dental surgeons.

The predominant microorganisms involved in odontogenic infections are the viridans streptococci and the anaerobic bacteria, such as: *Prevotella*, *Peptostreptococcus*, *Porphyromonas* and *Fusobacterium*. Some recent studies demonstrated that many oral bacterial isolates showed resistance to erythromycin and questioned the benefit of this antibiotic in the treatment of severe orofacial infection.⁴⁵ Some authors believe that erythromycin is a historical antimicrobial drug in treatment of odontogenic infections and no more exists on the list of the antibiotics to be prescribed for such infections.⁴⁶

Metronidazole is one of the drugs of choice in treatment of pericoronitis, however, only 18% of the practitioners would recommend its use and a similar percentage was reported by Salako et al.²⁰ Metronidazole is only effective against anaerobes. Therefore, it should be used in infections where anaerobic strains are expected.⁴⁷

Tetracycline and cephalosporins were the least prescribed antimicrobials. Cephalosporins are not the first-line of treatment of odontogenic infection.⁴⁶

Therapy with more than one antibiotic is not uncommon, particularly in treatment of periapical

infection, cellulitis and trismus cases. Odontogenic infection is mostly a mixture of facultative and anaerobic microorganisms. Therefore, combination of antibiotics is advocated in certain conditions.

Most of the antibiotics used by the dental practitioners are broad spectrum in nature and this enhances the prevalence of antibiotic resistance. It is interesting to see that some dental practitioners, Norwegian dentists for example, rely on narrow spectrum antibiotics and their prescription is conservative and relatively low compared to physicians.⁴⁸

Antimicrobials drug resistance is a critical issue for dental professionals. Out of the eight-listed potential contributing factors, widespread use of antibiotics was rated as the most important factor in developing antibiotic resistance (65%). This is followed by the inappropriate duration of antibiotic course and use of broad spectrum antibiotics in order. More than 50% of the respondents thought lack of prescribing guidelines is another significant factor. Despite the inconsistency, recently several guidelines have been published,⁴⁹⁻⁵² but lack of follow up and updates by the dental practitioners is unfortunately the prevailing scenario.

About 41% of the surveyed dental surgeons thought poor access to culture and sensitivity test is another factor. Dental clinics rarely send samples from patients to microbiological laboratory for cultures and antimicrobial susceptibility testing. However, a vast recent retrospective study of odontogenic infections revealed no significant change in the microbiological picture over the last 3-4 decades,⁵³ and therefore, the current

antibiotic therapy regimes are adequate to clear such infections. However, it should be beard in mind that in cases presented with severe infections threatening life and vital structures, cultures and antibiotic susceptibility testing should be performed.

The practitioners also thought that the other factors, such as antibiotic promotion by manufacturer companies and patients' demand and expectation play role in the problem and should not be taken lightly.

5. Conclusion

The current survey of the dental practitioners of Hail district, Saudi Arabia, reveals moderate level of knowledge towards the use of antibiotics and development bacterial resistance. The dental professionals' responses demonstrate variation in the rational prescription of antibiotics for various dental conditions, indicating the lack of compliance with the general antibiotic guidelines and good practices. For all dental conditions amoxicillin

remained the most commonly prescribed drug. Widespread of antibiotic use and inappropriate duration of course were thought the most important contributing factors in development of antibiotic resistance. Statistically, there were no differences in antibiotic prescription by practitioners' qualification or gender. Development of antibiotic resistance is a worldwide problem and the dental professionals are accountable for a substantial stake in this conundrum. Therefore, there is a lot of effort awaited from the dental community to increase the awareness of antibiotic resistance problem and reduce the burden.

Author contributions

Equal contribution to the paper.

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Hazza A. ALHOBEIRA

PhD, MDentSci, MRDI, BDS
Assistant Professor and Consultant in Restorative Dentistry
Vice Dean, College of Dentistry, University of Hail
Kingdom of Saudi Arabia



CV

Dr Alhobeira obtained his BDS from King Saud University (KSU), Saudi Arabia in 1993 and worked as a GP up to 1997 in Specialized Dental Centre. He was appointed as director of the Hail Dental Centre & supervisor of the Dental Services in the Hail Region between 2006-2008. He obtained his MDentSci in 2000, and PhD & MRDI in 2004 from Leeds Dental Institute, UK. His main research interest is in Dental Biomaterials. He has authored several works in this field. Dr Alhobeira also worked as Director & Distinguished Examiner of the Saudi Board in Restorative Dentistry, Hail from 2008-2011. In 2012, he joined the University of Hail as Assistant Professor and took multiple academic posts in the college; currently, he is the Vice Dean of the Dental College in the University of Hail, Kingdom of Saudi Arabia (KSA).

Questions

The National Center for Disease Control and Prevention found that many of the out-patient antibiotic prescriptions are unnecessary. What is this percentage?

- a. 1/4;
- b. 2/3;
- c. 1/2;
- d. 1/3.

What is the percentage of antibiotic prescription in cases where definitive diagnosis could not be made?

- a. 45%;
- b. 55%;
- c. 35%;
- d. 25%.

Which of the following statements is FALSE?

- a. Most of the antibiotics used are broad spectrum;
- b. Antibiotics are of no value in dry socket treatment;
- c. Post-surgical extraction antibiotic cover is essential;
- d. Use of antibiotic in treatment of periapical pathology is baseless.

The most contributing factor in development of antibiotic resistance is the:

- a. Self-antibiotic medication;
- b. Widespread use of antibiotics;
- c. Lack of prescription guidelines;
- d. Poor access to culture and sensitivity test.

