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ORIGINAL ARTICLE

Knowledge of prescribing antimicrobials among Yemeni general dentists

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Abstract

Objective. Overuse of antimicrobial agents is closely related to an increase in bacterial resistance. A sound knowledge of appropriate prescribing of antimicrobials among health professionals is thus critical in combating the resistance. The objectives of this study were to assess the rationale for and patterns of antimicrobial prescriptions by general dental practitioners in Yemen. ***Material and Methods.*** A questionnaire containing 65 closed questions was used for this cross-sectional study and distributed to 280 dentists in the three major governorates in Yemen. The anonymously completed questionnaires sought answers to demographic questions and to questions on the therapeutic and prophylactic use of antimicrobial agents in dentistry. Correct and incorrect answers were defined according to information available in the current authoritative literature. Each correct answer was given a score of 1 while an incorrect answer scored 0. Thus, the total score had an attainable range from 0 to 65. Frequencies, means, and associations were assessed statistically. ***Results.*** Out of 181 collected forms (response rate 64.6%), 150 were appropriately completed and used for data analyses. Penicillins were the most frequently prescribed drugs (72%), followed by spiramycin (10%). It was found that up to 84% of practitioners were likely to prescribe an antimicrobial agent when there was no clinical indication for such a medication. Many respondents (70%) would consider antibiotics for at least one of the given non-clinical factors. ***Conclusions.*** The results suggest that dental practitioners in Yemen lack uniformity in the rationale for appropriate prescribing of antimicrobials to their patients. Consequently, to reduce overuse, there is an urgent need for the dental community in the country to be informed about evidence-based guidelines and the appropriate use of antimicrobial agents in clinical dental practice.

Key Words: *Antibiotics, general dental, prescription, Yemen*

Introduction

Resistance to antimicrobial agents is the ability of microbes to remain impervious to the inhibitory or lethal effects of these drugs and this has increased in conjunction with the ever widening use of antimicrobials in recent years. Thus, resistance to all antimicrobial agents was already noticed within the first couple of years after they were introduced in clinical medicine. The prevalence of resistant isolates and their level of resistance have reached a critical point, and alarming cases are increasingly being reported which are also a cause of concern to dentistry [1,2]. In addition, the continuous emergence of multiresistant species is reported from different parts of the globe and shows their ability to tolerate a panel of antibiotics and to cause serious mortality. This global problem is one of the biggest challenges facing public health today [3].

Bacterial resistance to antimicrobials is a result of a complex interplay of several factors [3,4]. The selective pressure exerted by widespread use of antimicrobial drugs is regarded as the driving force behind the evolution of microbial defense mechanisms. It has been shown, however, that a significant reduction in the use of antibiotics can be followed by a significant reduction in antimicrobial resistance and it is only through prudent and appropriate use of these drugs that their efficacy can be prolonged [5].

Misuse of antibiotics can be traced to the prescribers, patient compliance to prescriptions, and the drug sellers. Physicians' perceptions of patients' expectations might influence their prescription of antibiotics [6] and this is probably also the case with

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dentists. The few published studies on dentists' knowledge of antibiotic prescription have revealed that factors other than a sound knowledge might influence their prescription practices [7–10]. The misuse is more widespread when antibiotics are obtainable without prescriptions and where general knowledge and beliefs among the public are based on poor understanding [11]. Furthermore, many dental infections are mixed infections that provide an optimum environment for exchange of resistance determinants between bacterial species, thus resulting in even more resistance if combined with improper use of antimicrobials [12].

The prescribing of antimicrobials in dental practice is generally considerably less than that in medical practice [13,14]. However, in England and Scotland, dentists accounted for about 10% of all community prescriptions and in the USA, in the period 1995–97, for almost 9% of the most commonly used antimicrobial agents in Western countries [2,7]. Furthermore, antimicrobials are the most common medication prescribed by dental practitioners in developed [15] and developing countries [16]. Therefore, the contribution by dentistry to microbial resistance should not be neglected. In line with this, in 1999 the Féderation Dentaire International (World Dental Federation) Commission issued guidelines for appropriate use of antimicrobial agents to minimize development of resistance in dentistry [17]. Following other current guidelines and recommendations for therapeutic and prophylactic use of antimicrobial agents in immunocompetent [18,19] and immunocompromised [20,21] patients, will also contribute towards reaching this goal and subsequently will have an influence on combating resistance emergence.

Recently, we found a significantly higher prevalence of resistance to ampicillin and metronidazole among 18 selected oral microbes from Yemeni dental patients compared with those in Norway [22]. This finding prompted the current study, the aim of which was to assess the knowledge of general dental practitioners in Yemen in understanding the conditions for appropriate prescribing of antimicrobial agents to their patients.

Material and methods

Questionnaire

This cross-sectional questionnaire study was performed during the summer of 2004. The questionnaire comprised 65 close-ended questions. The questionnaire was identical to the one designed and first used by Palmer et al. [7] with the exception that the first three questions were omitted: 1) "Have you attended any postgraduate courses on antibiotic prescribing within the past two years?", 2) "Year of first dental degree", and 3) "Place of qualification".

The questionnaire sought answers to the following 11 parameters : (i) gender, (ii) age bands (21–30, 31–40, 41–50, 51–60, and above 61 years), (iii) clinical signs, (iv) antimicrobial treatment of dental infection (choice of antibiotic, dose and frequency used, and number of days treated), (v) non-clinical factors, (vi) choice of antimicrobial agent to dental infection in the case of patients allergic to penicillin, (vii) clinical conditions, (viii) treatment procedure with no relevant medical history, (ix) a relevant medical history, (x) antibiotic regimen used for prophylaxis with adult medically compromised patients (MCPs) not allergic to penicillin, and (xi) antibiotic regimen used for medically compromised patients allergic to penicillin. The categories of questions designated (iii), (v), (vii), and (viii) had various alternative answers (see Table II) and the respondents were asked to indicate "Yes" or "No" according to their opinion on each of these answers. Category (ix), "A relevant medical history", comprised 19 medical conditions (see Table III) that the respondents had to mark according to whether they thought prophylactic antibiotics were required or not.

A list of dentists was obtained from the databases of three pharmaceutical companies that operate in Yemen. Because there is no postal system in the country, the questionnaires were distributed by hand by one of the investigators (M.A-H.) to 280 dentists working in all the governmental as well as private dental clinics in the three major governorates (Sana'a, Aden, and Taiz). The purpose and importance of the study were explained to all recipients of the questionnaire. The questionnaires were collected later during a maximum of three different visits before a recipient was reported as a non-respondent.

Data analysis

Response rate and gender distribution were computed. Scores of knowledge were calculated by giving each correct answer a score of 1 while an incorrect answer scored 0. Thus, the total knowledge score of a questionnaire had an obtainable range from 0 to 65 based on information in guidelines, recommendations, and expert literature [18,19,23]. This authoritative information defined correct answers as follows: In the "Clinical signs" category, "Yes" would be a correct answer for elevated temperature and evidence of systemic spread, gross or diffuse swelling, difficulty in swallowing, and closure of the eye because of swelling. Similarly, "No" would be the correct answer for all answer alternatives in "Non-clinical factors" and "No relevant medical history". Of the 13 alternatives in "Clinical conditions", "Yes" is a correct answer only for cellulitis and acute ulcerative gingivitis. Regarding the need for prophylaxis in MCPs, the medical conditions considered to be the indications

Table I. Maximum possible scores, ranges, mean and standard deviation (SD) of scores, and respondents' level of knowledge of the five categories of questions in the questionnaire

Categories of questions	Maximum score	Range	Mean ± SD	Level of knowledge (%)
Clinical signs*	6	0–6	3.72 ± 1.03	Intermediate (62)
Clinical conditions*	14	0–14	3.25 ± 1.26	Poor (40)
Non-clinical factors*	5	0–5	5.99 ± 2.08	Intermediate (65)
Treatment procedure with no relevant medical history*	7	0–7	3.48 ± 1.40	Poor (49)
Relevant medical history**	19	0–19	6.50 ± 3.65	Poor (34)

*For details, see Table II; **For details, see Table III.

for antimicrobial prophylaxis are: previous bacterial endocarditis, prosthetic heart valves, ventricular septal defect, rheumatic heart disease, aortic stenosis, and radiotherapy to head and neck. Dental extractions, scaling, and polishing are the dental procedures requiring prophylaxis in MCPs.

The respondents were grouped according to the scores gained as having: 1) good knowledge (above 80% correct answers), 2) intermediate knowledge (between 50% and 80% correct answers), and poor knowledge (fewer than 50% correct answers). Average knowledge scores for the question categories (iii), (v), (vii), (viii), and (ix), respectively, were expressed as percentages and calculated by dividing the sum of the scores obtained by the sum of the maximum possible scores for the given category. Normal distribution of the data was checked, and the type of statistical test was chosen accordingly. For each of the categories of questions, the mean and the standard deviation were calculated. Significant differences with gender as a grouping variable were tested with the Mann-Whitney U-test. When age bands were used as grouping variable, the Kruskal-Wallis test was used for statistical computation. Differences with a p-value ≤ 0.05 were considered as statistically significant. All analyses were conducted using SPSS 12.00 for Windows.

Results

A total of 181 questionnaires were collected, giving a response rate of 64.6%. Of these, 150 had been properly completed and were analyzed. Sixty-six percent of the usable forms were submitted by males. The mean score was 28.9 with a standard deviation of 5.6. Test of significance (Mann-Whitney test, $p < 0.001$) showed a lower female mean score than male mean score (27.6, SD 4.6 and 29.57, SD 5.9, respectively). Group statistics using gender as a grouping test variable against the different

Table II. Distribution of respondents' "Yes" and "No" answers regarding clinical signs and conditions, non-clinical factors and no relevant medical history that require/do not require prophylactic antibiotics

Clinical signs	Yes/No	Non-clinical factors	Yes/No
1. Elevated temperature and evidence of systemic spread	115/35	1. Patient expectation of a prescription	22/128
2. Localized fluctuant swelling	102/48	2. Pressure of time and workload	36/114
3. Gross or diffuse swelling	135/15	3. Patient's social history	37/113
4. Unrestricted mouth opening	43/107	4. Uncertainty of diagnosis	42/108
5. Difficulty in swallowing	69/81	5. Where treatment has to be delayed	78/72
6. Closure of the eye owing to swelling	117/33		

Clinical conditions	Yes/No	No relevant medical history	Yes/No
1. Acute pulpitis	48/102	1. Extraction	
2. Acute periapical infection		a) routine	27/123
a) before drainage	105/45	b) surgical	135/15
b) after drainage	94/56	2. Apicectomy	139/11
3. Chronic apical infection	108/42	3. Root canal therapy	
4. Pericoronitis	126/24	a) preoperative	42/108
5. Cellulitis	117/33	b) postoperative	52/98
6. Periodontal abscess	124/26	4. Scaling and polishing	52/98
7. Acute ulcerative gingivitis	120/30	5. Restorative treatment	4/146
8. Chronic marginal gingivitis	81/69		
9. Sinusitis	123/27		
10. Chronic periodontitis	100/50		
11. Dry socket	102/48		
12. Trismus	49/101		
13. Reimplantation of teeth	114/36		

Table III. Relative distribution (%) of respondents according to their opinion on dental treatment and patients with medical conditions requiring antibiotic prophylaxis

Relevant medical conditions	Scaling and polishing (%)	Subgingival class II fillings (%)	Subgingival class V fillings (%)	Root canal therapy (%)	Extractions (%)	Impressions (%)	Seek specialist advice (%)
1. Diabetes mellitus	50.6	26	22.6	34.6	74.6	17.3	24
2. Hemodialysis patients	26.6	16.6	18	22.6	40.6	12	44
3. Hodgkin's disease	18.6	12.6	10	12.6	22.6	6	44.6
4. Aids	36	28.6	28	34	38.6	16	50.6
5. Patients on immunosuppressives	40	26	26	32.6	40.6	14	46.6
6. Autoimmune disease patients	16	8.6	8	14.6	26.6	4.6	46
7. Renal transplant patients	38	28.6	30	32	52	16.6	46.6
8. Head and neck irradiated patients	18	10	10	16	30.6	10.6	42.6
9. Patients with prosthetic joints	26.6	16.6	18	24	42.6	10	34
10. History of infective endocarditis	74.6	58.6	58.6	60	82.6	28.6	40
11. Cardiac valve prosthesis	64	52	50.6	54	78	22	42
12. Rheumatic heart disease	60	46.6	44.6	52	76.6	22.6	40.6
13. Aortic stenosis	32	26.6	26.6	31	44	14	52
14. Ventricular septal defect	34	28	26	36	48	14	52.6
15. Coronary bypass surgery	26.6	22.6	22.6	30.6	40	12	52.6
16. Rheumatic fever – no valvular dysfunction	30	22.6	22.6	26.6	40.6	12	44
17. Coronary heart disease	40.6	30.6	32.6	36	48	18	48.6
18. Pacemaker	26.6	22.6	22	26	34.6	12.6	48.6
19. Physiological/functional/innocent murmurs	14.6	14	12.6	18	26.6	8	48

categories revealed a statistically significant difference (Mann-Whitney test, $p \leq 0.00$) in the prescription of antibiotics in relation to clinical diagnosis. No significant difference was found among age-band groups (Kruskal-Wallis test). The ranges of scores in question categories with mean and standard deviation are presented in Table I. The table also shows the general knowledge of when it is appropriate or inappropriate to use antibiotics in the different parts of the questionnaire.

Penicillins were prescribed by 72% as the first drug of choice for treating dental infections, followed by spiramycin (10%). Three percent of the respondents prescribed erythromycin and lincomycin, 2% clindamycin and metronidazole, while other antimicrobial agents were prescribed by 5% of the respondents. Many respondents (70%) would consider antimicrobials for at least one of the given non-clinical reasons. Table II shows that elevated temperature and evidence of systemic spread, gross or diffuse swelling, closure of the eye because of swelling, and localized fluctuant swelling represent the main clinical signs taken by dentists to indicate the need to prescribe antibiotics to their patients. Approximately one-third of the respondents indicated that they would prescribe antimicrobials for patients with acute pulpitis, and around two-thirds would consider antimicrobials appropriate for chronic periodontitis and chronic apical infections.

Table III presents the respondents' opinions on dental treatment and patients with medical conditions requiring antibiotic prophylaxis. It reveals that a history of previous infective endocarditis, followed by cardiac valve prosthesis are the conditions that most respondents indicated as requiring antibiotic prophylaxis in all investigated treatment procedures. On the other hand, patients with autoimmune disease and Hodgkin's disease received little such attention.

Discussion

The questionnaire investigated the dentists' knowledge of therapeutic and prophylactic antimicrobial usage in clinical dentistry. This is the first study of its kind in Yemen. The knowledge of the respondents in some aspects was better than in others, but a general lack of uniformity and compliance with the expert literature [19,23,24] predominated. Palmer et al. [7] suggested that 29% of antimicrobial usage has no rational basis. Our findings revealed that the respondents would prescribe antimicrobials on the demand of patients or their social history, by 15% and 25%, respectively. Twenty-eight percent of the respondents would prescribe antimicrobials based on no diagnosis. This figure was found to be only 9% in England and Scotland [7] but reached 20% in a study conducted in Kuwait [9]. Lack of time and pressure of workload, with no clinical background had an influence on 24% of our respondents when prescribing antimicrobial agents. It is noticeable that a large number claimed they would not prescribe antibiotics after conservative treatment. However, 32% of them believed in the use of antibiotics in patients presenting with acute pulpitis, which is proven to be of no benefit at all in such cases [25]. The controversy between the two answers highlights the misconception of relating clinical observations and underlying pathological conditions.

The majority of chronic or even acute dental infections can be successfully treated by eliminating the source of infection, pulp extirpation, drainage of abscess, or tooth extraction without the need for antibiotics. Exceptions are when there is evidence of systemic involvement and gross, rapid, and diffuse spread of infection [19]. However, a large proportion of the surveyed Yemeni dentists indicated they would prescribe antimicrobial agents for treatment of several dental clinical conditions for which such drugs have no justification at all. For example, 72% and 54% would prescribe antibiotics for chronic apical infections and chronic marginal gingivitis, respectively. Routine use of antimicrobials by many respondents was illustrated by their treatment of dry sockets and pericoronitis, where evidence-based practice indicates local treatment alone as being sufficient [19]. However, in some clinical situations, e.g. pericoronitis with widespread infection or systemic involvement [26], prescribing antibiotics is justified. Such exceptional situations were not intercepted by our questionnaire. The general tendency of respondents to over-prescribe antimicrobials may be a consequence of lack of aseptic techniques, thus a "just in case" principle is practiced. This opinion would in itself be a justification for overuse of antibiotics, and such a practice is totally unacceptable because there is increasing evidence that it leads to a serious rise in bacterial resistance [27].

Our results indicate that penicillins are the family of antimicrobials that most dentists in Yemen would prescribe for treatment of dental infections. However, 10% would use a macrolide antimicrobial (spiramycin) as their first choice in such cases. This choice is difficult to explain and is not in line with the practice of dentists in other countries [10,28].

Participants scored better on clinical signs and symptoms and on non-clinical factors than they scored on prophylaxis in MCPs, suggesting that dentists need to extend their knowledge from just treating patients' teeth to treating patients with teeth. Prophylaxis in MCPs who receive dental treatment is not always a clear-cut matter, because different guidelines may have different recommendations and different regimens exist [23,29]. These differences may lead to controversy in a subgroup of medically compromised dental patients, e.g. MCPs

requiring placement of a rubber dam, in which antibiotic prophylaxis is mandatory according to the British Cardiac Society (BCS) guidelines, while they are neglected in the American Heart Association (AHA) guidelines [23]. Clinical judgment might also influence a dentist's decision on antimicrobial coverage in patients with a compromised immune system, such as AIDS and diabetic patients, who generally do not require such prophylaxis [23]. Furthermore, the same guidelines could be refused by one dental school and adopted by another in the same country, owing to the lack of convincing scientific background information [30]. These examples highlight the need for international guidelines that are generally agreed on and followed, as several different opinions might be a gateway to misuse.

Despite the domination of poor and low intermediate knowledge among respondents, a significant difference was found in the general knowledge between genders with regard to antimicrobial prescription in acute pulpitis, acute and chronic periapical infection, cellulitis, pericoronitis, periodontal abscess, acute ulcerative gingivitis, chronic marginal gingivitis, chronic periodontitis, sinusitis, and dry socket, in which females scored less than males. This favorable and advantageous male prescription pattern might be due to males being more confident than females. Or females, besides being introduced relatively recently to the labor force, might be more afraid of being accused of infection sequelae of dental treatment.

Our findings indicate that the scientific basis for prescribing antimicrobial agents was neglected by the majority of the respondents. This situation is not surprising as similar findings were reported among other health professionals in Yemen [31] and by general dental practitioners in other countries [7,9,10]. An exception is a study conducted in Norway some years ago [32]. Inferences from our study and similar studies raise questions about whether it is lack of, or ignorance of guidelines that lies behind antibiotics overuse. Such irrational use of antibiotics can be corrected by arranging an audit of clinical antibiotic prescription in dentistry, which is reported to improve general dental practitioners' attitudes to prescribing antimicrobials by, in some circumstances, 50% [33,34]. It is also worth mentioning here that general medical practitioners were found to prescribe more antibiotics and more broad-spectrum ones than did dentists when dealing with acute dental emergencies [35]. The use of antimicrobial agents will select for resistant isolates, and if this use is unnecessary, the situation will be worsened [5]. Nowadays it is not unusual to see an isolate with multidrug resistance or a "superbug" that does not respond to any antibiotic.

No official records indicate how many dentists there are in Yemen. However, we gained access to a list of all established governmental hospitals as well as private dental clinics. Dentistry is considered a relatively new professional discipline in this country, the first dental college having been established in 1994. Before that, dentists gained their degree abroad, mainly from eastern European countries and neighboring Arab universities. Yemeni dentists are not willing to reveal their professional identity by giving information about the place and year of their graduation; furthermore, no postgraduate courses on the prescribing of antimicrobials are offered to them in Yemen. On these bases, the first three questions in the original questionnaire of Palmer et al. [7] were omitted in our study.

One hundred and fifty usable forms out of 280 distributed (53.5% usable) and 181 collected (82.8% usable) forms were analyzed. This may raise questions about the representativeness of the data for Yemeni dentists in general and whether the non-respondents might have affected the study outcomes if they had responded. However, the demographic features of the non-respondents or of the 31 dentists that returned partially completed questionnaires yielded no new information, compared to the usable ones. In fact, investigating health workers' knowledge is considered a sensitive issue. This might partly explain the non-respondents' refusal to give information about their reasons for not complying, when further approached. It is probable that non-respondents might have an even poorer knowledge than those who responded. The low response rates among health practitioners are not uncommon [36]. We addressed the importance of the study and the study subjects were reminded at two subsequent visits, but not more than about two-thirds of them responded positively. This lack of responsiveness might be due to high workload, loss of the questionnaire, or even lack of interest [37].

In conclusion, our study is the first survey to date among Yemeni dentists. The findings, being representative of about 53.6% of all general dental practitioners in Yemen and studied in the light of the authoritative international literature in the field, indicate that too few Yemeni dentists have a good knowledge of antimicrobial indications and contra-indications. A consequence will be overuse of antimicrobial agents, which is most probably one explanation for the greater prevalence of resistant subgingival species among dental patients in Yemen, when compared with Norway [22]. Consequently, it is a matter of urgency that the dental community in Yemen is informed about the accepted current antibiotic prescription guidelines and the related evidence-based clinical practice. This is significant, since the implication of these recommendations will be one important step towards restricting the inappropriate use of antimicrobial agents in this country.

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