Knowledge regarding antibiotics and antibiotic resistance amongst public and medical professionals

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ABSTRACT

Antimicrobial resistance (AMR) is a global burden on health and a threat to development and well-being. The World Health Organization (WHO) declared that the AMR is one of the 10 top global public health problems threatening humanity. The purpose of this study was to evaluate how well clinical dental students, working dentists, pharmacists, and the general public in Ras Al Khaimah (RAK), United Arab Emirates, knew and understood the use of antibiotics and antibiotic resistance. This is a descriptive cross-sectional study. Participants were 278 individuals, including clinical year dental students, interns, and dentists (n=134), RAK private pharmacists (n=50), and the general public outpatients (n=92), who had recently taken antibiotics, were given both an electronic and a physical copy of a pre-tested and pre-validated questionnaire, where each survey measures a different variable. Descriptive and analytical statistics were included in the data. Of the 278 questionnaires that were distributed, 258 were completed (response rate: 92.8%). One of the main reasons given by 16% of patients was self-medication with antibiotics for toothaches. Antibiotics were typically recommended by dentists to treat pain (34%) and facial edema (47%). 22% of pharmacists were requested to dispense antibiotics without a prescription, which is a sizable percentage. The participants were aware of the pattern in antibiotic prescriptions, but self-medication and non-surgical pain management frequently contributed to excessive antibiotic prescriptions based solely on antibiotic efficacy. The general population needs to be exclusively made aware of the risks posed by antibiotic resistance.

Keywords: Antibiotics, Bacterial resistance, Self-medication, Knowledge, Dental management

Introduction

Antimicrobial resistance (AMR) raises the healthcare burden and costs on a worldwide scale. According to the World Health Organization (WHO), AMR is one of the top ten global public health problems. According to the worldwide study, AMR alone caused 1.27 million fatalities in 2019, more than HIV/AIDS or malaria, and 4.95 million deaths were related to antibiotic-resistant illnesses [1]. The improper overuse or misuse of antibiotics, frequently without medical justification, with potentially serious negative effects on health is responsible for the development of drug-resistant pathogens. Furthermore, the cost of AMR is another economic burden that the communities need to bear. Long-term illness not only raises the likelihood of death and disability, but also causes patients to stay longer in the hospital, necessitates the use of more expensive medications, and strains their financial resources. It is crucial to maintain the

availability of effective antimicrobial drugs to help modern medicine treat a wide range of infections, including those used in major surgery and cancer chemotherapy [2].

Odontogenic infections are multi-microbial which includes gram-positive and gram-negative bacteria. Antibiotic therapy has been in use for many decades to control various infectious diseases. In dental practice, antibiotics are either prescribed for prophylactic or therapeutic use. Prophylactic antibiotics are mainly prescribed to prevent potential complications involving the prevention of the spread of space infections and potential endocarditis [3].

Antibiotics are ideally to be used along with surgical therapy to treat various dental infections [4]. Alexander Fleming in 1945 addressed in his lecture "It is not difficult to make microbes resistant to penicillin in the laboratory by exposing them to concentrations not sufficient to kill them, and the same thing has occasionally happened in the body" [5]. Dental practitioners prescribe almost 10% of all antibiotics [6]. The recent WHO data on the worldwide ratio of antibiotic consumption indicated Romania to be leading in antibiotic consumption [7]. The reason for assimilating data on antibiotic consumption is the fact that in life-threatening situations antibiotics become less effective due to antibiotic resistance [8]. Research findings demonstrated that antibiotic resistance is a natural phenomenon, probably predating the current clinical use of antibiotics [9, 10]. Resistant strains can spread rapidly among hospitalized patients. Inappropriate prescription of antibiotics and the over-counter availability in some countries without prescriptions have contributed to the increase in antibiotic resistance rate. Many other factors include self-medication by patients and lack of awareness regarding antibiotic resistance [8, 11]. Many studies have been conducted on the inappropriate use of antibiotics in dental practice in Western countries and Asia [12, 13]. Most of the studies revealed that the irrational use of antibiotics, yet for a longer duration is highly prevalent in the communities. Furthermore, uncertainties existed regarding the indications for antibiotic use. Sarwar *et al.* observed in their study that the majority of participants (95%) were positive for multidrug-resistant bacteria [14]. As a result, treatment for those in Pakistan who have infectious diseases like tuberculosis, acute respiratory tract infections, and malaria is more challenging [14]. Many awareness programs such as "antimicrobial stewardship" (AMS) were introduced but failed to reach the community levels. Therefore, community pharmacists need to educate the communities regarding AMS programs. Therefore, one of the key causes of the development of bacterial resistance is incorrect diagnosis, inappropriate use of antibiotics, and antibiotic dosing [14].

Antibiotics, on the other hand, are often misused in a variety of contexts across the world, compromising patient safety and increasing the acquisition and transmission of antimicrobial resistance (AMR). Inappropriate antibiotic usage is characterized by inappropriate antibiotic selection, dosage, timing, and/or mode of administration, as well as duration [15].

This study aimed to determine the knowledge and awareness of antibiotics and antibiotic resistance amongst clinical dental professionals including clinical year dental students, working dentists, pharmacists in private establishments, and patients in the local community of the Ras Al-Khaimah emirate, United Arab Emirates (RAK, UAE).

Materials and Methods

Design, setting, and sampling
This is a non-representative, descriptive, cross-sectional, questionnaire-based study carried out in the health sciences university, RAK between November 2020 and June 2021 by using a convenience sampling technique.

Inclusion and exclusion criteria
The present study included participants of the interns and dental clinical years from the health sciences university in RAK, practicing dentists, Pharmacists working in the emirates of RAK, and outpatients attending the same health science university. Clinical year students, interns, dental practitioners, pharmacists, and outpatients from other emirates, UAE were excluded from the study.

Instrument
An adopted, valid, and reliable survey was used to meet the purpose of this study. The study questionnaire was modified from three previously used surveys [16-18]. The questionnaire consists of 3 sections; section A comprises 20 items formulated for outpatients, section B contains 23 items, developed for clinical year students, interns, and practicing dentists, and Section C includes 16 items, specifically tailored for practicing pharmacists. The age range of all participants was 18 to 70 years. The survey was split into three sections because the dentists, interns clinical year students, outpatients, and pharmacists were from the same community.

Ethical consideration
The present study conforms to the principles embodied in the Declaration of Helsinki. The study protocol was reviewed and approved by the University research and ethical committee and the Ministry of Health, UAE before data collection; Ref# RAKMHSU-REC-079-2021/21-UG-D and MOHAP/REC2021/10-2021-UG-P respectively. A consent form was obtained from all participants who met the inclusion criteria. Participants were free to withdraw at any time without giving explanations and personal identification was not requested to retain information confidentiality.

Data collection
Both electronic (Google form) and hard copies versions of the pretested and validated questionnaires comprising closed-ended questions related to antibiotic use and resistance for the three sections (A, B, and C) were prepared or printed. Informed consent was embedded in both versions of the questionnaires. The online questionnaire link and hard copies were

emailed/distributed to the targeted subjects according to the convenience of the subjects.

The data was collected in about 3 months.

Statistical analysis

The data were analyzed statistically using Statistical Package for Social Science (SPSS) (version 26) software. The data included descriptive statistics to find out percentages and frequencies and analytical statistics to compare dependent and independent variables. The p-values and 95% confidence ranges were presented. Statistical significance was determined by the p-value (p 0.05). Descriptive statistics were used to present demographic data. The p-value for age, gender, prerequisite, and familiarity differences was determined using multivariate linear regression. The link between pharmacists and dentists in terms of the number of days for prescribing antibiotics was assessed.

Results and Discussion

Responses of dentists, interns, and clinical year students

Out of 134 links and hard copies of the questionnaire distributed/emailed to the clinical year students, interns, and practicing dentists, 116 subjects responded, achieving a response rate of 86.5%. About 35% of the respondents were males and 65% were females. The majority (91%) of the respondents were <30 years of age and few dental practitioners with less than 5 years of clinical experience. The major respondents were clinical year students, while a small percentage were general practitioners (83%, 17%) respectively. From the responses, it was observed that the main source updated information was obtained by practicing doctors from the continuing dental education programs and conferences (49%), followed by the scientifically published literature (25%), **(Table 1)**. The most prescribed antibiotic by the respondents was amoxicillin (57%) in non-allergic patients [plain amoxicillin (47%) or amoxicillin with clavulanic acid (10%)]. Amoxicillin in combination with Metronidazole was preferred by 42% of the respondents as the first choice **(Figure 1)**.

Table 1. Responses of the practicing dentists, interns, and clinical year dental students			
Questions	Choices	Frequency	Percentage
Qualification	Dentists	12	10%
	Interns	3	3%
	Clinical year students	101	87%
Gender	Male	41	35%
	Female	75	65%
Age	Bellow 30	106	91%
	Above 30	10	9%
Years of practicing dentistry	<5	102	88%
	5-10	7	6%
	11-15	0	0%
	>15	7	6%
Practice type	Private practice	3	3%
	Academic institution	12	10%
	Hospital dentistry	3	3%
	Health center	2	2%
	University student	96	83%
Knowledge What is the most common antibiotic you prescribe?	Amoxicillin	54	47%
	Amoxiclav	12	10%
	Amoxicillin + Metronidazole	49	42%
	Ofloxacin + Ornidazole	0	0%
If a patient is allergic to penicillin, which antibiotic do you usually prescribe?	Erythromycin	26	22%
	Clindamycin	75	65%
	Azithromycin	9	8%
	Others	6	5%
What is the minimum number of days for prescribing antibiotics?	3	42	36%
	5	43	37%
	7	31	27%
	10	0	0%
What is the most common determinant for prescribing antibiotics?	Facial swelling	55	47%
	Pain relief	39	34%
	Unavailable appointment for several weeks	0	0%

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	Patient satisfaction/parent	2	2%
	Prophylactic (before extraction)	18	16%
In which of the following conditions would you prescribe antibiotics?	Reversible pulpitis	20	17%
	Irreversible pulpitis	14	12%
	Localized dentoalveolar abscess	25	22%
	Localized dentoalveolar abscess with draining fistula	17	15%
	Facial cellulitis	38	34%
For which infection are antibiotics prescribed?	Fungal infection	8	7%
	Viral infection	12	10%
	Bacterial infection	96	83%
Is self-medication with antibiotics by patients to treat dental problems responsible for antibiotic resistance?	Yes	100	86.2%
	No	16	13.7%
Do you think antibiotic resistance can be prevented?	Yes	54	46.5%
	No	62	53.4%
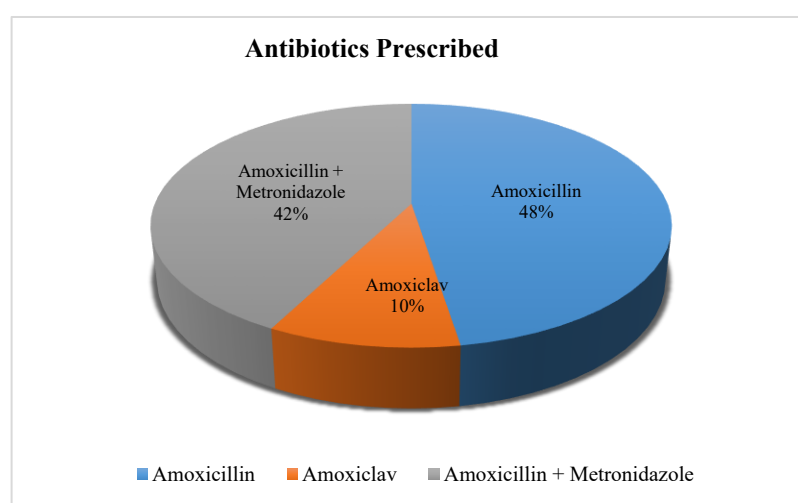
Figure 1. More commonly prescribed antibiotics among non-allergic patients

Response for awareness regarding the drug of choice for patients allergic to penicillin, was clindamycin (65%), erythromycin (22%), followed by azithromycin (8%). Results from the current study's respondents' minimal length of antibiotic therapy was (37%), while many respondents administered antibiotics for at least three days. (36%) and a minimum of 7 days by 27%. A substantial number (83%) of the respondents believed that antibiotics are for the treatment of bacterial infections, 10% chose viral infection, and 7% chose fungal infection. The main reasons cited for prescribing antibiotics were facial swelling (47%), prophylactic before extraction (16%), and pain relief (34%). Choice of a particular brand (41%) was observed in prescriptions followed by the popularity of the brand (37%). The statistics of this study from various aspects point towards an over-prescription of antibiotics. Mitral valve prolapses with regurgitation (7%), tooth intrusion (7%), tooth extrusion (5%), lateral luxation (9%), a subluxation (57%), and rheumatoid arthritis (12%), reversible pulpitis (17%), irreversible pulpitis (12%), restricted dentoalveolar abscess with (15%) and lacking draining fistula (22%) are some of the frequently cited causes. **(Table 1)**.

Most of the respondents believe that self-medication caused leads to antibiotic resistance (83%). A considerable number (34%) of the respondents fear the loss of patients if antibiotics are not prescribed. Many of the practitioners (91%) take the antibiotic cost into account before prescribing and 40% consider patients' preferences. More than half of the respondents (53%) believe that antibiotic resistance cannot be prevented and 47% think that the resistance can be prevented. Only 67% of the respondents keep themselves updated before the use of antibiotics. The majority of responders (99%) concur that antibiotic resistance is a rising issue **(Table 1)**.

The coefficients table provides the necessary information to predict the Dentist- Antibiotic prescription need for the management of oral diseases statistically significantly to the model (by looking at the "Sig." column). Gender, age, and year of experience "Unstandardized Coefficients" B = 0.26, -0.27, and 0.32 respectively. To sum up, the result of linear regression revealed that gender, age, and year of experience level are not a significant factor for Antibiotic resistance factors $p>0.05$ **(Table 2)**.

Table 2. Dentist- Antibiotic prescription needed for management of oral diseases.				
Independent variables	B	SD	Sig	95% Confidence interval
Gender	0.260529	0.196469069	0.1875197	0.649-0.128
Age	-0.27281	0.455501758	0.5504348	0.629-1.175
Years of experience	0.321386	0.399276776	0.422571	0.469-1.112

$p < 0.05$, significant

Responses of pharmacists

Fifty questionnaires were emailed/distributed randomly to pharmacists in the RAK emirate, and all responded to the survey. Sixty-eight percent of the respondents were males and 32% were females. Pharmacists above 30 years age group constituted the highest proportion (56%) while the age group less than 30 years formed 44%.

Forty-two percent of the subjects had experience <5 years and 26% had 5−10 years of experience **(Table 3)**. When knowledge about antibiotics is considered, all participants (n=50) gave answers to the eleven queries about their understanding of antibiotics. Thirty-nine (78%) of the participants agreed that antibiotics are useful for bacterial infections, and 20% thought useful for viral infections. Fifty-eight percent of the participants agreed; "The 'natural flora' of the human body can be killed by antibiotics," **(Table 3)**. When participants were asked about the factor that contributes the most to antibiotic resistance, 76% agreed that long duration results in antibiotic resistance, and 24% chose a low dose. Sixty-six percent of the participants agreed that they educate the patients on the use of antibiotics and antibiotic resistance, 26% choose sometimes and 6% choose they do not. Only 70% communicate with prescribers if they are not sure about the appropriateness of an antibiotic prescription **(Table 3)**. Seventy-eight percent of pharmacists dispense antibiotics on prescription with complete clinical information. When the participants were asked if they dispense antibiotics for a longer duration than prescribed by the physician, 84% chose no, 8% stated sometimes and another 8% chose yes. Five percent of the respondents agreed to stop taking antibiotics before completing the course if symptoms improve **(Table 3)**. Seventy percent agreed that an overdose of antibiotics could lead to antibiotic resistance and 28% disagreed. Eighty-six percent agreed antibiotic resistance could be prevented. When participants were asked if they dispense antibiotics without a prescription on patient demand, 22% chose yes, 68% marked no and only 2% chose sometimes. Ninety-four percent of the participants follow MOH guidelines for antibiotic dispensing. Seventy-two percent admitted that they ask patients about their knowledge of prescribed antibiotics and usage practices **(Table 3)**.

Table 3. Responses of Pharmacists to the questionnaire.			
Questions	Choices	Frequency	Percentage
Gender	1=Male	34	68%
	2=female	16	32%
Age	1=less than 30	22	44%
	2=more than 22	30	60%
Years of practicing	1=<5	21	42%
	2=5-10	13	26%
	3=10-15	9	185%
	4=>15	7	14%
What is the minimum number of days for prescribing antibiotics?	1=3	19	38%
	2=5	17	34%
	3=7	13	26%
	4=10	1	2%
	5=30	0	0%
In your opinion, which factor contributed the most to antibiotic resistance?	1=low dose	12	24%
	2=long duration	38	76%
For what treatment are antibiotics prescribed?	1=fungal infection	2	4%
	2=viral infection	10	20%
	3=bacterial infection	39	78%
Do you educate patients on how to use antibiotics and resistance-related issues?	1=yes	33	66%
	2=no	3	6%
	3=sometime yes	14	28%
Do you communicate with the prescriber if you are unsure about the appropriateness of an antibiotic's prescription?	1=yes	35	70%
	2=no	7	14%
	3=sometime yes	8	16%

Do you dispense antibiotics for a duration longer than prescribed by physicians at the patient's request?	1=yes	4	8%
	2=no	42	84%
	3=sometime yes	4	8%
Do you dispense antibiotics on prescription with competing clinical information?	1=yes	39	78%
	2=no	8	16%
	3=sometime yes	3	6%
If symptoms of the patient improve before completion of a full course of antibiotic therapy, do you think the patient can stop taking medication?	1=yes	25	50%
	2=no	23	46%
	3=sometime yes	2	4%
Do you think antibiotics can kill the normal flora of the human body?	1=yes	29	58%
	2=no	13	26%
	3=sometime yes	8	16%
Do you feel an overdose of antibiotics can lead to resistance?	1=yes	38	76%
	2=no	8	16%
	3=sometime yes	4	8%
Do you search for additional clinical information (drug interaction, ADRs, allergy) before deciding to dispense the prescribed antibiotics?	1=yes	45	90%
	2=no	4	8%
	3=sometime yes	1	2%
Do you think antibiotic resistance can be prevented?	1=yes	43	86%
	2=no	6	12%
	3=sometime yes	1	2%
Are you following different guidelines for general and dental problems?	1=yes	36	72%
	2=no	13	26%
	3=sometime yes	1	2%
Do you dispense antibiotics without a prescription on patient demand?	1=yes	11	22%
	2=no	34	68%
	3=sometime yes	5	10%
Are you following the MOH guidelines for antibiotic prescription?	1=yes	47	94%
	2=no	1	2%
	3=sometime yes	2	4%
Are you aware of antibiotic resistance?	1=yes	46	92%
	2=no	2	4%
	3=sometime yes	2	4%

The Coefficients table provides the necessary information to predict the pharmacist factors that contribute to the most antibiotic resistance statistically significantly to the model (by looking at the "Sig." column). Gender, age, and year of experience level "Unstandardized Coefficients" B = 0.146, 0.022, and 0.041 respectively. To sum up, the result of linear regression revealed that gender, age, and year of experience level are not significant factors for antibiotic resistance factors **(Table 4)**.

Table 4. Pharmacists- Factors contribute the most to antibiotic resistance.				
Independent variables	**B**	**SD**	*Sig*	**95% confidence interval**
Gender	0.146401	0.146255123	0.3220658	0.44-0.148
Age	0.022673	0.148656137	0.8794423	0.321-0.276
Years of experience	0.04149	0.075559523	0.585593	0193-0.11

p< 0.05, significant

Responses of outpatients

Out of the 92 respondents, 64% were female and 36% were male. Most of the participants (80%) were urban residents, of whom 50% were below the age of 30 years, and 49% were above.

When participants were asked what approach, they took when having a toothache, 67% chose a dentist and 16% opted to take self-medication. Forty-seven percent used paracetamol for toothache and 22% used antibiotics when they had a toothache **(Table 5)**.

Fifty-four percent agreed to self-medication with antibiotics at any time in life and 24% had self-medication with antibiotics last month. When participants were asked if they complied with physician recommendations, 30% agreed and (70%) disagreed. Only 32% of the respondents returned to the dentist after completing the antibiotic course and the majority (68%) did not. Fifty-two percent of patients demand antibiotics for dental infections and 39% for common cold infections. Only 32% of the

patients had awareness regarding the adverse effects of Antibiotic consumption and 55% were unaware. The majority of responders believed that antibiotic therapy should last no longer than seven days. Awareness of antibiotic resistance amongst the participants was 59%. Many participants (51%) agreed that antibiotic resistance should be limited by reducing antibiotic usage **(Table 5)**. A considerable number (46%) of the participants agreed that every toothache doesn't need antibiotics.

When participants were asked if antibiotics could damage other body systems, 43% said yes and 42% had no clue. The majority of the respondents stopped taking antibiotics once they felt better and only 17% stopped once their physician or pharmacist told them to stop. Eighty percent believed antibiotic resistance is due to insufficient knowledge about the use of antibiotics, 59% were aware of the definition of antibiotic resistance and 40% were unaware.

Table 5. Responses of the outpatients

Questions	Choices	Frequency	Percentage
Age	< 30	46	50%
	>30	46	50%
Sex	Male	33	36%
	Female	59	64%
Place of residence	Rural	18	18%
	Urban	74	80%
Nationality	Afghanistan	16	17%
	Bangladesh	8	9%
	Egypt	2	2%
	India	15	16%
	Jordan	1	1%
	Nigeria	3	3%
	Pakistan	18	20%
	Philippines	8	9%
	Poland	1	1%
	Poland	3	3%
	Syria	1	1%
	Sri Lanka	6	7%
	Sudan	3	3%
	UAE	4	4%
	Yemen	2	2%
	Zimbabwe	1	1%
When you have a toothache, to whom do you appeal?	Dentist	58	63%
	Specialist	6	7%
	Pharmacist	13	14%
	Self-medication	15	16%
What do you use for a toothache?	Paracetamol	43	47%
	Brufen	22	24%
	Antibiotics	20	22%
	Home remedy	7	8%
Self-medication: a) Have you ever self-medicated yourself with antibiotics?	Yes	50	54%
	No	42	46%
b) Have you self-medicated yourself with antibiotics last month?	Yes	25	27%
	No	67	73%
c) Compliant with the physician's recommendation regarding the antibiotic treatment.	Yes	28	30%
	No	64	70%
d) Do you return to the dentist after the antibiotic treatment?	Yes	29	32%
	No	63	68%
e) Do you request antibiotic treatment for a dental infection?	Yes	48	52%
	No	44	48%
f) Are you interested in asking for information about the prescribed antibiotic?	Yes	53	58%
	No	39	42%
g) Do you request antibiotic treatment for a common cold infection?	Yes	36	39%

	No	56	61%
Answer the following questions by YES, NO, or I don't know: a) Do you believe that the antibiotics you will receive might contribute to antibiotic resistance?	Yes	41	45%
	No	15	16%
	I don't know	36	39%
b) Do you think the antibiotics you will receive may cause a future problem for the medical practice?	Yes	22	24%
	No	22	24%
	I don't know	48	52%
c) Do you think it is better to take fewer antibiotics than those prescribed?	Yes	47	51%
	No	19	21%
	I don't know	26	28%
d) Do you think missing an antibiotic dose contributes to antibiotic resistance?	Yes	26	28%
	No	29	32%
	I don't know	37	40%
e) Do you believe that not every toothache needs antibiotics?	Yes	42	46%
	No	19	21%
	I don't know	31	34%

The lack of awareness amongst the public played a vital role in the unreasonable usage of antibiotics. Our study observes that despite the stringent policies and rules on antibiotic prescription 54% stated that they have taken self-medication with antibiotics in the past 1 year and 27% in the last month.

Our study indicates that the most common antibiotics that were consumed were Clindamycin, Amoxicillin, and Ampicillin to treat insignificant indicators, for example, sore throat, fever, cough, and dental infection for less than 7 days **(Table 6)**. In the current study, 52%, took antibiotics to treat dental infections, 39% for flu-related infections, and 17% for throat infections, even though sore throat and the common cold are due to viral infections.

Table 6. Number of days for prescribing antibiotics

Chi-square	3 days	5days	7-10days	Total
Dentist	0.009208	0.027423	0.00631953	0.042951134
Pharmacist	0.021363	0.063622	0.01466131	0.09964663
Total	0	0		0.185548898

$p < 0.05$, significant

Antibiotic resistance is due to the bacterial genetic changes that make antibiotics ineffective. This is attributed to a lack of knowledge about when to use antibiotics and for how long to take them. A key component of strategies for addressing this global One Health issue is increasing public awareness of antibiotic resistance [19, 20]. In dentistry, antibiotics are often used to treat prophylaxis, local infections, focal infections, nonodontogenic infections, and odontogenic infections. A comprehensive set of guidelines should be developed to prevent issues, such as bacterial resistance, due to the prescription of unnecessary antibiotics. In-depth guidelines are important since only around 12% of dentists appropriately and sufficiently administer antibiotics [16, 21, 22]. Our study assessed the awareness of practices related to antibiotic prescriptions and usage among clinical dentistry students, practicing dentists, pharmacists, and patients in the RAK community. The questions were based on those in previous surveys developed in the USA and Spain [17, 18, 23, 24]. The overall response rate of the current study was 86.5%, thus higher than other reported survey responses [7, 25, 26].

Long courses of antibiotic therapy compromise the commensal flora, leading to resistance to microbial colonization. Chronic infections of teeth requiring endodontic treatment may require a broad-spectrum activity drug such as amoxicillin, when inappropriately prescribed in healthy individuals, would cause antibiotic resistance problems [26]. Generally, the results of the present study, which are based on the knowledge of antibiotic prescription amongst the participants, are in line with similar studies conducted in the USA and India. The latter studies revealed that amoxicillin was prescribed by 27.5% of members of the American Association of Endodontists (AAE) [17, 27, 28]. According to our findings, amoxicillin plus metronidazole is the second-most common antibiotic recommended (42%). A similar study conducted in the UAE dentist population had a similar finding with amoxicillin as the choice but few preferred amoxicillin with clavulanic acid as a combination, which was like the survey conducted in Spain [29, 30]. In Europe too, amoxicillin was found to be the most frequently prescribed antibiotic [31, 32]. Our findings show that the antibiotic of first preference in subjects allergic to penicillin is clindamycin (65%). Similar findings were reported in previous studies conducted in the USA and in Spain [16-18, 23, 27]. In another study, the most common antibiotic prescribed to people with penicillin allergies was erythromycin [4]. Azithromycin has been used as an alternative drug in patients allergic to penicillin, but it is limited in oral infection usage, as even with a single course around 82%

of oral *Streptococcus* spp. Turn resistant to macrolides [33]. Probably, the best antibiotic of choice for a patient allergic to penicillin is clindamycin, although it has a low serious risk of pseudomembranous colitis development [34, 35]. Normally, treatment of odontogenic infections requires an average of 5 to 7 days of antibiotic therapy; nevertheless, treatment of severe infections or immunocompromised patients' therapy can be of a longer duration owing to reduced immunity. As a rule of thumb, antibiotic therapy should be extended for 3 days after the patient's symptoms have been resolved [17]. A minimum of three days' worth of antibiotics were prescribed, according to 36% of participants in the study. To decrease antibiotic resistance, patient compliance is crucial. It is a habit of many patients to stop taking the prescribed drug once the initial symptoms are resolved and our finding in this study is no exception (62%). Our research showed that pharmacists were knowledgeable about antibiotics. Though 26% of respondents were ignorant that antibiotics may kill the normal flora of the human body, and 20% of participants were uninformed that antibiotics are ineffective against viruses, more than 60% of participants correctly answered all the questions. The majority of participants knew that while antibiotics cannot kill viruses, they can kill bacteria. The results of this study are comparable to those of Eurobarometer's report, in which 58% of the participants thought that antibiotics could kill viruses [36]. Participants in our study were aware of the Ministry of Health Guidelines for the Prescription of Antibiotics, and the majority of them thought that they were important for improving patient care. Understanding incentives is important for both developing novel intervention strategies and avoiding improper antibiotic administration practices [37]. According to our research, 22% of community pharmacists provided antibiotics under specific conditions without a prescription, which is comparable to findings from Saudi Arabia and China [38, 39]. Studies suggest that providing antibiotics without a prescription could result in financial gain [40, 41]. It is imperative to investigate the relationship between the financial advantages and the present dispensing methods. Other studies demonstrated that pharmacists agreed to introduce a team advising on antimicrobial prescribing [39, 42]. According to a survey conducted in Ethiopia, more than half of pharmacists collaborated with other medical experts 16% of the participants reported frequently prescribing antibiotics for lengthier periods than the doctors had intended [43]. Another study has also seen 28% of the respondents admit that they dispensed antibiotics for a longer duration than prescribed by physicians [37]. Undoubtedly, significant efforts are required to guarantee better adherence to the instructions for dispensing antibiotics. Self-medication was also considered more significant in causing Antibiotic resistance [44, 45]. The cause of the self-medication was antibiotics that were left over from a previous valid prescription or that were purchased without a prescription [46, 47].

According to our survey, 68% of antibiotics were taken beyond the doctor's advice. We found no differences in the overall use of antibiotics between young people, adults, and the elderly (p= 0.35, p=0.33). This was true for both age group and gender. In other studies, there were significant differences between the usage of antibiotics between older and younger patients [9]. In order to obtain the necessary knowledge on how to use antimicrobials properly, antibiotic resistance, and side effects, patients should ask their healthcare practitioners for assistance if necessary. Patients should be aware that antibiotics should only be used on prescription and as recommended by the physician. They should also return any unused antibiotics to pharmacies and regional collection facilities and refrain from using antimicrobials that have not been prescribed for them [48]. The appropriate use of antimicrobials is essential for reducing and preventing antimicrobial resistance [49, 50]. One of the main drawbacks of self-administered surveys is the bias resulting from variations in participant recall accuracy or completeness, as well as from under- or over-reporting of knowledge. This data represents only one Emirate out of the seven Emirates. The uniqueness of this study relates to the fact that this is the only study in the UAE that has correlated antibiotic knowledge amongst the clinical students, interns, doctors, outpatients, and pharmacists who dispensed medication to the outpatients within the community.

Conclusion

The emerging need to educate all regardless of clinical year students and practicing doctors, about community patients is mandatory to prevent antibiotic resistance amongst communities. Our study found that not only do patients use antibiotics for pain relief injudiciously, but they also manage to procure them even though stringent guidelines are in force. Unfortunately, doctors also prescribe antibiotics as a quick remedy, where it should be used as an adjunct along with the surgical intervention. The study establishes the crucial requirement to increase public, dental, and community pharmacists' understanding of the use of antibiotics to decrease antibiotic resistance. In order to possibly perceive any overdue educational needs, it is necessary to understand knowledge, attitudes, and behaviors about the usage of antibiotics.

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