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# Dentists' Awareness of Antibiotic Stewardship and Their Willingness to Support Its Implementation: A Cross-Sectional Survey in a Dental School

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## ABSTRACT

**Objectives:** Antibiotic overuse is highly reported among dentists worldwide. An antibiotic stewardship programme has been shown to be effective for decreasing the number of unappropriated antibiotic prescriptions. The goal of this survey was to assess dentists' awareness of antibiotic stewardship and their willingness to implement changes accordingly.

**Methods:** A structured questionnaire was developed and distributed to dentists at a university hospital with different levels of experience. It included questions regarding antibiotic prescription habits, antibiotic stewardship knowledge and willingness to implement changes in such a programme.

**Results:** Overall, 256 dentists participated in the survey. Among them, 16.4% (95% confidence interval: 12.1%–21.5%) reported awareness regarding antibiotic stewardship. Awareness levels were higher among specialists (28.3%) and increased with experience. Most dentists in this study reported willingness to improve their antibiotic prescribing practices. The mean willingness score was 8.78 (standard deviation: 1.81).

**Conclusions:** Awareness of antibiotic stewardship was low among dentists with different levels of experience. However, dentists were willing to change their antibiotic prescription habits if policies were implemented as part of a stewardship programme at the school.

## 1 | Background

Microorganisms resistance to antimicrobial medications is a natural evolutionary phenomenon that has been occurring since the introduction of the first antibiotic classes. As new antibiotics are discovered, selective pressure is exerted on microbial populations, driving the emergence of resistance mechanisms. The continued and widespread use of antimicrobial agents accelerates the development of resistance mechanisms, rendering these drugs progressively less effective. Consequently, these drugs have become ineffective, which has led to infections persisting in the host, with a high risk of spreading in the population [1, 2].

The global threat of antimicrobial resistance is rapidly growing worldwide. Studies have found that antimicrobial resistance patterns vary among countries, reflecting differences in the consumption of antimicrobial medications [3, 4]. Studies from the Gulf Cooperation Council Region have revealed a high rate of antimicrobial resistance of different bacterial strains in the region [5]. Moreover, alarming reports have also disclosed that the region harbours several bacterial strains with rare and novel resistance mechanisms [5–8].

Several reports from the World Health Organization (WHO) have revealed that the most crucial risk factor contributing to

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the spread of antimicrobial resistance is the unoptimized use of antibiotics worldwide. Other factors include poor quality of antimicrobial medications, weak laboratory capacity, lack of surveillance and inadequate infection prevention. In many countries, antimicrobial medications are easily accessible without a prescription and with no systems to monitor and track their over-the-counter sale [9].

Antimicrobial stewardship involves collective strategies for monitoring antibiotic usage in hospitals to ensure appropriate use and to minimize side effects [10]. Research has shown that adopting antimicrobial stewardship programmes may reduce the spread of antimicrobial resistance, sustain appropriate use of antibiotics, and increase annual drug cost savings [11–14].

However, even though most antibiotics are prescribed in outpatient clinics (including dental clinics), a majority of antibiotic stewardship initiatives are implemented in hospitals. Additionally, most stewardship programmes are focused on physicians and ignore other antibiotic prescribers in the healthcare sector [15]. For example, dentists are responsible for 10% of all antibiotic prescriptions in the United States; however, ~30%–85% of their prescriptions were inappropriate or not indicated [16, 17]. Another study from Canada found an overall reduction in antibiotic prescriptions by physicians from 1996 to 2013; in contrast, antibiotic prescriptions by dentists increased significantly, especially for broad-spectrum antibiotics (such as amoxicillin and clindamycin), over the same period [18]. This trend is continuing. Tolsdorf and colleagues reported that antibiotic prescriptions among dentists were higher than among other outpatient prescribers in Germany [15].

In dentistry, antibiotics are indicated to be prescribed as prophylaxis for patients at high risk of systemic or oral infections and post-oral surgeries. However, in the past 10 years, the guidelines for antibiotic prophylaxis prior to dental procedures have been revisited to limit their indications to patients at a high risk of a distal site infection. Despite these revisions, adherence to the guidelines remains weak, and dentists often prescribe prophylactic antibiotics even when they are not clinically indicated. To better understand the underlying factors contributing to this practice, this survey was conducted to assess dentists' awareness of antibiotic stewardship and their willingness to participate in and support stewardship initiatives within a dental hospital setting.

## 2 | Methods

### 2.1 | Study Design and Population

This cross-sectional study was approved by the Ethical Committee at King Abdulaziz University, Faculty of Dentistry. The study was conducted from 1 January 2020 to 30 April 2020 at King Abdulaziz University Dental Hospital (Jeddah, Saudi Arabia). Participation in the study was voluntary with the study population comprised dental students, dental interns, general dentists and specialists working or training in the participating departments during the study period. Before commencing the survey, all participants were provided with a consent form in the first page. The subjects' identities were kept anonymous and undisclosed, ensuring confidentiality throughout the study.

### 2.2 | Sample Size

Convenience sampling was performed to include all eligible participants until the target sample size was reached. The sample size was calculated to detect an unknown proportion ( $p = 50\%$ ) corresponding to the percentage of participants who would be aware of antibiotic stewardship, among the total estimated number of eligible dentists and interns of 500, with 95% confidence interval (CI), 80% statistical power and a 0.05 type 1 error. The target sample size was 218 patients.

### 2.3 | Questionnaire Development

We developed a structured questionnaire and tested it in a pilot study involving 13 participants to ensure its reliability; the survey was then revised based on the study findings. The survey consisted of the following parts:

Part 1: Collecting demographic and professional information (such as sex, level of experience, specialty and years of practice).

Part 2: Exploring antimicrobial prescription practices. The parameters analyzed included involvement in antimicrobial prescription (yes, no and referral), estimated prescribing frequency out of 10 patients (1–3, 4–6 and > 6), prescription documentation practices (never, rarely, sometimes, often or always) and consultation with supervisors (for students).

Part 3: Exploring confidence in antimicrobial prescription, using four items rated on a 5-frequency Likert-type scale (*never* to *always*). These items explored the participants' experience in prescribing antibiotics in cases of fear of medical or dental complications, to accommodate the patient's request, or in cases of diagnostics uncertainty.

Part 4: Assessing awareness of antimicrobial stewardship using a single question “Do you know about antimicrobial stewardship?”

Part 5: Assessing willingness to change prescription practices using the following single-item question: “If antibiotic stewardship is implemented at the KAU Dental Hospital, how willing are you to change your daily practice of antibiotic prescription?” The question was answered on an 11-point numerical scale, ranging from 0 (*extremely unwilling*) to 10 (*extremely willing*) [19].

Two consultant dentists assessed the questionnaire for face and content validity.

The questionnaire was self-administered to reduce social desirability bias. The eligible participants were approached randomly by the investigators. The study objectives and the importance of the study were explained verbally and included in the consent which is part of the cover letter of the survey.

### 2.4 | Statistical Analysis

The study had two primary outcomes: awareness of antibiotic stewardship and willingness to change prescribing practices if the programme was implemented. Both were analyzed as

dependent variables. Other variables, including demographic and professional factors, prescribing practice and confidence in antimicrobial prescription, were analyzed as independent variables.

We analyzed the participants' demographic and professional characteristics (Part 1) and their antimicrobial prescription practice (Part 2) and prescription confidence (Part 3) according to the status of their awareness of antibiotic stewardship. Statistical significance was determined using the  $\chi^2$  test. Among participants who were aware of antibiotic stewardship, the level of willingness to change one's prescribing practice was compared across demographic and professional groups using an independent *t*-test and a one-way analysis of variance, as appropriate. All statistical analyses were performed using the SAS statistical software (version 9.4; SAS Institute, Cary, NC, USA).

### 3 | Results

#### 3.1 | Participant Characteristics

Of the 412 eligible individuals who received the questionnaires, 256 (men: 53.1%) responded completely and were included in the study. Among these, 20.7%, 11.7%, 7.8%, 38.3% and 21.5% were specialists/consultants, residents, general dentists, interns and dental students, respectively. Distribution by specialty revealed that the study population comprised a relatively high proportion of periodontics (30.1%) and prosthodontists (22.9%); oral medicine specialists accounted for only 2.4% of the population. The majority of the participants were students (42.6%) or had 1–5 years of experience (29.3%) (Table 1).

#### 3.2 | Awareness About Antibiotics Stewardship

The level of awareness regarding antibiotic stewardship was as low as 16.4% (95% CI = 12.1%–21.5%). The awareness level was significantly higher among specialists (28.3%) and residents (30.0%) than among general dentists (15.0%), interns (10.2%), and dental interns (9.1%) ( $p < 0.01$ ). Additionally, the awareness level increased from 8.3% in dental students with no experience to 29.4% in those with > 20 years of experience ( $p = 0.02$ ). Notably, although not statistically significant ( $p = 0.05$ ), the awareness rates were relatively higher among participants specializing in oral surgery or pedodontics than in those with other specializations (Table 1).

#### 3.3 | Antibiotic Prescription Practice and Its Association With Awareness About Antibiotics Stewardship

The majority of the participants (83.2%) declared prescribing antibiotics. Furthermore, the majority of the participants (66.0%) also reported prescribing antibiotics to an average of 1–3 patients out of every 10 patients. Overall, 41% of the participants declared that they did not always document the antibiotic prescription; 9.0% and 6.6% of these declared that they rarely or never documented it, respectively. The majority of the students (73.1%) often or always referred to their supervisors for antibiotic prescription. There was no significant association between prescription practices and the awareness of antibiotic stewardship (Table 2).

#### 3.4 | Confidence in Antibiotic Prescription and Its Association With Awareness About Antibiotics Stewardship

A total of 57.9% and 34.7% of the participants declared prescribing antibiotics for fear of medical and dental complications, respectively, as a common practice (sometimes, often or always). This was significantly associated with awareness of antibiotic stewardship ( $p < 0.05$ ). Specifically, the awareness level was lower among participants who systematically prescribed antibiotics for fear of medical (6.3%) or dental (16.7%) complications and also, paradoxically, among those who declared never having engaged in such a practice (5.8% and 8.4%, respectively). Meanwhile, prescriptions to accommodate patient requests were a common practice (often or always) in 5.5% of the participants, and this was significantly associated with an inconsistent awareness of antibiotic stewardship ( $p = 0.02$ ) (Table 3).

#### 3.5 | Willingness to Change the Antibiotic Prescription Practice

The mean score of willingness to change the antibiotic prescription practice was 8.78 (SD  $\pm$  1.81). The willingness score was higher in women than in men (mean [SD]: 9.05 [1.73] vs. 8.54 [1.84],  $p = 0.02$ ; Table 4).

### 4 | Discussion

Prudent prescription of antibiotics has become crucial as new antibiotic-resistant bacterial strains continue to appear and spread worldwide. Studies have shown that implementing stewardship programmes in different medical settings can minimize and control antibiotic use, which may help slow the spread of antibiotic resistance [20]. The current survey found a low level of awareness of antibiotic stewardship programmes among dentists. Only 42 of the 256 participants (16%) included had prior knowledge of the concept of antimicrobial stewardship. The level of awareness was significantly associated with the level of training and the years of experience. This result is not surprising because only limited studies on antimicrobial stewardship in dental settings have been conducted in the past few years [21].

In 2016, the Centers for Disease Control and Prevention (CDC) published four core elements for outpatient antibiotic stewardship. These elements can be applied in different outpatient settings, including dental clinics. Before implementing interventions as part of antibiotic stewardship in a dental clinic or hospital, potential opportunities and existing barriers to improving prescription practices should be studied. First, high-priority conditions should be identified and targeted. Examples of these conditions include overprescription, under-prescription and misuse [22]. In 2019, Gross and colleagues reported the successful implementation of antibiotic stewardship in academic dental practice after following the CDC guidelines. A team of dentists, pharmacists, and physicians was created to assess the actual need for antibiotic stewardship interventions at their institution. Based on a baseline assessment, the team

**TABLE 1** | Characteristics of the study population.

	Total sample	Knowledge about antibiotic stewardship		p value
		Yes	No	
Sex				
Male	136 (53.1)	27 (19.9)	109 (80.1)	
Female	120 (46.9)	15 (12.5)	105 (87.5)	0.11
Level of experience				
Specialist/consultant	53 (20.7)	15 (28.3)	38 (71.7)	
Resident/post-graduate student	30 (11.7)	9 (30.0)	21 (70.0)	
General dentist	20 (7.8)	3 (15.0)	17 (85.0)	
Intern	98 (38.3)	10 (10.2)	88 (89.8)	
Undergraduate dental students	55 (21.5)	5 (9.1)	50 (90.9)	< 0.01*
Specializations of the consultants/specialists and residents/post-graduation students (n = 83)				
Periodontics	25 (30.1)	7 (28.0)	18 (72.0)	
Endodontics	10 (12.1)	2 (20.0)	8 (80.0)	
Oral surgery	6 (7.2)	3 (50.0)	3 (50.0)	
Prosthodontics	19 (22.9)	4 (21.1)	15 (78.9)	
Restorative dentistry	5 (6.0)	1 (20.0)	4 (80.0)	
Oral medicine	2 (2.4)	0 (0.0)	2 (100.0)	
Pedodontics	14 (16.9)	5 (35.7)	9 (64.3)	0.29
Length of practice, years				
0 (dental student)	109 (42.6)	9 (8.3)	100 (91.7)	
1–5	75 (29.3)	12 (16.0)	63 (84.0)	
6–10	29 (11.3)	9 (31.0)	20 (69.0)	
11–15	19 (7.4)	5 (26.3)	14 (73.7)	
16–20	7 (2.7)	2 (28.6)	5 (71.4)	
> 20	17 (6.6)	5 (29.4)	12 (70.6)	0.02*

Note: Data are presented as n (%).

\*p < 0.05.

identified areas of possible enhancement and developed appropriate interventions accordingly. The recommended interventions were prioritized based on their feasibility, impact, and likelihood of success. A significant reduction in antibiotic prescriptions in urgent care visits was observed at the institution [23].

In the current survey, antibiotic prescriptions driven by fear of medical or dental complications were reported by approximately one-third of the participants, consistent with findings from other studies on antibiotic prescription patterns among dentists [24, 25]. Previously, dentists were advised to prescribe prophylactic antibiotics before dental procedures involving mucosal manipulation in patients at a risk of distal site infections (e.g., those with orthopaedic implants) and those at a risk of bacterial endocarditis. However, the clinical practice guidelines regarding antibiotic use for these conditions have been updated based on recent evidence. As a result, antibiotic prophylaxis is significantly limited to a few high-risk cases [26, 27]. Yet, many dentists continue to prescribe antibiotics as

prophylaxis even when unnecessary [25, 28, 29]. Possible explanations for this failure to adhere to the guidelines are a lack of knowledge, lack of confidence in managing medically compromised patients, or fear of medicolegal liability [30]. Thus, the abovementioned findings highlight an area of antibiotic overuse by dentists that can be targeted to optimize antibiotic use.

Approximately two-thirds of the dentists in this survey also reported prescribing antibiotics sometimes because of fear of dental complications, and 5% of the participants reported prescribing antibiotics to accommodate their patients' desires. This practice was significantly related to the level of awareness of antibiotic stewardship. These results reflect previous findings that dentists prescribe antibiotics to meet their patients' expectations and to avoid complications that could result in losing the patients [25, 30, 31]. Additionally, the guidelines regarding antibiotic use for dental reasons (e.g., odontogenic infections, surgical dental implants and periodontal procedures) vary widely [32]. The CDC and WHO guidelines on antibiotic use in the medical field advise against extending antibiotic use after

**TABLE 2** | The association between the prescription habits of the study population and stewardship knowledge.

	Total	Knowledge about antibiotic stewardship		p value
		Yes	No	
Are you involved in prescribing antibiotics to patients?				
Yes	213 [83.2]	34 (16.0)	179 (84.0)	
No	27 [10.6]	3 (11.1)	24 (88.9)	
I refer	16 [6.3]	5 (31.3)	11 (68.7)	0.21
Out of every 10 patients whom you treat in your clinic, how many do you prescribe antibiotics to?				
1–3	169 [66.0]	29 (17.16)	140 (82.8)	
4–6	23 [9.0]	4 (17.4)	19 (82.6)	
> 6	1 [0.4]	0 (0.0)	1 (100.0)	
None	63 [24.6]	9 (14.3)	54 (85.7)	0.92
How often do you document your prescription of antibiotics in the patient’s dental record?				
Always	151 [59.0]	25 (16.6)	126 (83.4)	
Often	36 [14.1]	6 (16.7)	30 (83.3)	
Sometimes	29 [11.3]	7 (24.1)	22 (75.9)	
Rarely	23 [9.0]	4 (17.4)	19 (82.6)	
Never	17 [6.6]	0 (0.0)	17 (100.0)	0.33
If you are a student, how often do you consult your supervisor before prescribing antibiotics?				
Always	107 [53.2]	14 (13.1)	93 (86.9)	
Often	40 [19.9]	6 (15.0)	34 (85.0)	
Sometimes	35 [17.4]	6 (17.1)	29 (82.9)	
Rarely	13 [6.5]	3 (23.1)	10 (76.9)	
Never	6 [3.0]	2 (33.3)	4 (66.7)	0.63

Note: Data are presented as frequency [standard deviation] or as frequency (%).

surgery because there is no strong evidence to support its role in preventing surgical site infection [33, 34].

There are no clear recommendations in dentistry in this regard. A survey evaluating antibiotic prescription in periodontal surgeries revealed that periodontists were more likely to prescribe antibiotics when the surgery involved the use of a bone graft. This practice was mainly aimed at decreasing the risk of post-operative infection, which may increase the treatment cost and duration. The periodontists reported that they relied on their clinical experience to decide on antibiotic use [35]. The study highlighted the need for evidence-based guidelines to control antibiotic prescriptions after periodontal surgeries and to protect both patients and practitioners.

Contrary to expectations, approximately one-third of the dentists in this survey failed to register every antibiotic prescription ordered. Documenting antibiotic prescriptions in patient records is crucial for developing effective stewardship programmes. Tracking and reporting of antibiotic use is one of the core elements of developing a stewardship programme in outpatient settings. In addition, proper documentation facilitates monitoring of antibiotic use (which allows identification of

areas where an improvement in the antibiotic prescribing practice is needed) and implementation of policies for combating inappropriate use of antibiotics.

This study included dental students and interns to assess their knowledge of future antibiotic prescriptions. The survey revealed a low level of awareness regarding antibiotic stewardship in this group. In addition, only 53% of the students consulted their supervisors before providing antibiotic prescriptions. A previous study in Riyadh assessed dental students’ attitudes towards antibiotic prescription and found that these students commonly prescribed antibiotics in cases where the prescriptions were not recommended according to the guidelines, despite most of them being familiar with the concept of antibiotic resistance. These cases included those of patients with pulpitis, periodontal disease, dental extraction and dry sockets [36]. Therefore, there seems to be a definite need for improving dental students’ antibiotic prescription habits and for integrating antibiotic stewardship programmes in the undergraduate curriculum. The University of Glasgow Dental School reported the experience of using an online course on tackling antibiotic resistance by a dental team in undergraduate dental education. The students in the study reported that this online training enhanced their understanding of

**TABLE 3** | Association between prescription frequency and stewardship knowledge.

	Total	Knowledge about antibiotic stewardship		p value
		Yes Frequency (%)	No Frequency (%)	
How often do you prescribe prophylactic antibiotics because of fear of medical complications?				
Always	48 [18%]	3 (6.3)	45 (93.7)	
Often	22 [8.6]	5 (22.7)	17 (77.3)	
Sometimes	78 [30.5]	20 (25.6)	58 (74.4)	
Rarely	56 [21.9]	11 (19.64)	45 (80.4)	
Never	52 [20.3]	3 (5.8)	49 (94.2)	< 0.01*
How often do you prescribe antibiotics because of fear of dental complications?				
Always	6 [2.3]	1 (16.7)	5 (83.3)	
Often	21 [8.2]	7 (33.3)	14 (66.7)	
Sometimes	62 [24.2]	14 (22.6)	48 (77.4)	
Rarely	84 [32.8]	13 (15.5)	71 (84.5)	
Never	83 [32.4]	7 (8.4)	76 (91.6)	0.04*
How often do you prescribe antibiotics because the patients will not understand why they are not indicated?				
Always	5 [2.0]	1 (20.0)	4 (80.0)	
Often	9 [3.5]	1 (11.1)	8 (88.9)	
Sometimes	21 [8.2]	9 (42.9)	12 (57.1)	
Rarely	51 [19.9]	8 (15.7)	43 (84.3)	
Never	170 [66.4]	23 (13.5)	147 (86.5)	0.02*
How often do you prescribe antibiotics because you were not certain about the diagnosis of an infection or swelling?				
Always	24 [9.4]	3 (12.5)	21 (87.5)	
Often	26 [10.2]	2 (7.7)	24 (92.3)	
Sometimes	39 [15.2]	5 (12.8)	34 (87.2)	
Rarely	57 [22.3]	12 (21.1)	45 (78.9)	
Never	110 [43.0]	20 (18.2)	90 (81.8)	0.52

Note: Data are presented as frequency [standard deviation] or as frequency (%).  
\*p < 0.05.

antibiotic resistance and stewardship [37]. A prior interventional study by Teoh and colleagues showed that targeted education regarding antibiotic prescription and the use of online prescribing tools resulted in a 44.6% reduction in the number of inappropriate antibiotics prescribed by dentists [38].

The majority of the dentists included in this survey reported a positive willingness to implement changes in their antibiotic prescription habits, if recommended by an antibiotic stewardship programme in the institution. A previous interventional study that included private practice dentists from different specialties showed that dentists were willing to participate in stewardship programmes and change their prescribing habits. After several education sessions, weekly feedback, and audits, the appropriateness of prescribing

antibiotics for prophylaxis and treatment significantly improved from 19% to 87% [39].

With the emerging global threat of antimicrobial resistance, including dentists in stewardship programmes has become critical. Health authorities worldwide emphasize the importance of reducing antibiotic use to limit the impact of antibiotic resistance. Dentists can play a vital role in implementing the modern principles of antibiotic stewardship.

This study has some limitations. First, it was conducted in a dental hospital and included dentists who practiced in an academic setting. Therefore, the results of this survey cannot be generalized to private practice dentists. Additionally, Dental emergency clinics are available in the dental hospital to manage

**TABLE 4** | Willingness to change the antibiotic prescription habits according to the participant characteristics ( $N = 256$ ).

	Score of willingness to change daily antibiotic prescription practice if antibiotic stewardship is implemented at KAUDH	p value
Sex		
Male	8.54 (1.84)	
Female	9.05 (1.73)	0.02*
Level of experience		
Specialist/consultant	8.96 (1.89)	
Resident/post-graduation student	8.97 (1.67)	
General dentist	8.25 (2.00)	
Intern	8.66 (1.78)	
Dental intern	8.89 (1.79)	0.53
Specialty (consultants/specialists and residents/post-graduation students, $n = 83$ )		
Periodontics	9.44 (1.08)	
Endodontics	9.30 (2.21)	
Oral surgery	9.17 (1.17)	
Prosthodontics	8.74 (1.76)	
Restorative dentistry	8.60 (2.07)	
Oral medicine	9.50 (0.71)	
Pedodontics	8.00 (2.63)	0.39
Length of practice, years		
0 (dental student)	8.91 (1.64)	
1–5	8.69 (1.79)	
6–10	7.97 (2.46)	
11–15	9.21 (1.69)	
16–20	9.71 (0.49)	
> 20	8.82 (1.78)	0.09

Note: Data are presented as mean (standard deviation).

\* $p < 0.05$ .

cases of dental pain. It is unlikely that dentists will prescribe an antibiotic because of a lack of time to manage emergency dental cases. Second, the answers provided by the dentists were not taken from the patients' records, which may result in some inaccuracy. Further prospective studies are needed to evaluate the prescription patterns in dentists, prioritize interventions for improving their prescription habits, and assess their adherence to these interventions.

## 5 | Conclusion

This survey found a low level of awareness regarding dental antibiotic stewardship among dentists at a university dental hospital setting. However, the dentists were highly willing to change their antibiotic prescription habits if a stewardship programme was implemented. These changes can significantly reduce inappropriate antibiotic prescriptions, which can help with the efforts for addressing the threat of antibiotic resistance.

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### Conflicts of Interest

The author declares no conflicts of interest.

### Data Availability Statement

The data will be made available upon request to the corresponding author.

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