

Original Article

Antibiotic use and resistance: Information sources and application by dentists in Jordan

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Abstract

Introduction: The availability of evidence-based information sources for dentists is essential to influence antibiotic prescribing practices and we need to understand how dentists interact with such sources and how this influences their practice. The present study aimed to evaluate dentists' preferred sources of information and their awareness of available information and initiatives on prudent antibiotic prescribing practices in Jordan.

Methodology: An online cross-sectional questionnaire was administered to dentists between July to September 2021. It was an adapted version of the European Centre for Disease Prevention and Control (ECDC) survey for antibiotic use and resistance.

Results: A total of 204 dentists responded to the survey. The main sources of information regarding avoiding unnecessary antibiotic prescribing were published guidelines (35.5%), the dental professional body (20.0%), colleagues or peers (18.6%), and scientific organizations (17.2%), with the influence of these sources on changing prescribers' views being 40.7%, 9.8%, 10.3%, and 14.2%, respectively. Of the surveyed dentists, 9.3%, 33.8%, and 56.9% were aware, unaware, and unsure of the presence of national action plans on antimicrobial resistance, respectively. Dentists reported their desire to receive more information about resistance to antibiotics (57.8%), medical conditions for which antibiotics are used (52.9%), how to use antibiotics (41.2%), prescribing of antibiotics (39.7%), and links between the health of humans, animals, and the environment (26.0%).

Conclusions: The study provided insights into the information available to and used by dentists, which can inform effective antimicrobial stewardship strategies for improving antibiotic prescribing.

Key words: Dentists; antimicrobial; resistance; knowledge; behavior; attitude; prescribing practices; antimicrobial stewardship.

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Introduction

Antimicrobial resistance (AMR) is a serious threat to global health. There is growing evidence documenting the relationship between antibiotic use and misuse and the development of AMR [1,2]. Dentists generate 7-10% of total prescriptions globally, and the rate of prescribing by dentists is increasing in many countries [3–8]. Many studies have indicated inappropriate and unnecessary prescribing of antibiotics by dentists [9,10]. Antibiotic resistance is sometimes encountered in dental infection, with some reports highlighting the issue of emerging antibiotic

resistance in oral flora [11]. Coupled with the high rates of prescribing of antibiotics by dentists, particularly if indiscriminate [9,10], can aggravate the spread of antimicrobial resistance. In dental practice, antibiotics should be used legitimately and adjunctly, such as to prevent the spread of systematic infections and not to replace dental procedures [3,9,12–16].

To reduce the incidence of resistance to antibiotics, antimicrobial stewardship (AMS) has been proposed as a remedial action to facilitate prudent antimicrobial use [17]. Reducing inappropriate and unnecessary prescribing of antibiotics will lower the spread of

antimicrobial resistance and decrease associated cost [8,18]. Given the high incidence of antibiotic prescribing by dentists [9,10], it is postulated that dentists could have a significant role in supporting and promoting prudent antimicrobial use. Transfer of appropriate knowledge from reliable information resources is a key component of a successful AMS strategy and can influence views and practice. Factors governing prescribing of antibiotics can be the unique characteristics of the disease condition, patient factors, prescriber perceptions, diagnostic uncertainty and demand, and the overall evidence presented in guidelines and information resources [8,19]. Such factors should be taken into consideration in the design of AMS interventions.

Dentists' prescribe antibiotics during about 5% of dental appointments, and the most frequent reason for their prescription is for a periapical abscess [20]. The indications for antibiotics are limited in dental practice [21], and across all indications most of the prescribing in the dental practice is not supported by guidelines [18]. To decrease the sequelae of antimicrobial resistance due to the indiscriminate use of antimicrobials, AMS should be effectively implemented. The availability appropriate information sources is essential to influence antibiotic prescribing practices. Getting correct knowledge, in addition to attitude and appropriate work environments, can help promote prudent antimicrobial use and compliance with therapeutics guidelines [9]. The present study aimed to evaluate dentists' preferred sources of information and dentists' awareness of available information and initiatives on prudent antibiotic prescribing practices in Jordan.

Methodology

A 17-item online questionnaire was designed to assess the information resources and awareness of initiatives for prudent antibiotic use among a sample of dentists from Jordan. The questionnaire was distributed to dentists in Jordan using online survey software (Google Forms). Invitations to complete the questionnaire were sent via a web-based link to dentists' institutional emails and professional dental social media websites. To maintain ethical requirements, the invitation included a description of the study and its aims. Participation was voluntary, and responses to the questionnaire items were anonymous, i.e., no personal identifiers or geolocation data were collected. Survey questions appeared only after the dentist choose the "accept" option, as a proxy for consent. To prevent multiple completions and to

enhance the quality of responses, the "required" and "limit to one response" options were applied. There was no randomization of items of the questionnaire and respondents were not offered an incentive

The survey was an adapted version of a questionnaire developed, piloted, tested, and validated by the European Center for Disease Prevention and Control (ECDC) [22] and was available in both English and Arabic. Content was validated by experts within the research field and minor changes were made to the questionnaire based on their feedback. A forwards-backwards procedure was used to validate translation of the Arabic version. The questionnaire was pilot tested on 10 dentists and their comments were incorporated into the final version. Responses from the pilot were excluded from the final sample analyzed. The questionnaire is available as supplementary material (Annex 1).

The questionnaire included several sections related to information sources on prudent antimicrobial use. One section included information on socio-demographic characteristics, job title, experience, practice setting, and practice location. The questionnaire asked about the most frequently used social media platforms for professional use and routinely used information sources related to prudent antimicrobial use.

The respondents were asked whether they had recently received any information about avoiding unnecessary prescribing of antibiotics and whether such information changed their views or practice. The questionnaire included items assessing sources of information regarding unnecessary prescription of antibiotics and their influence on changing dentists' views. Respondents were asked whether they were aware of any national plan(s) regarding antimicrobial resistance or other initiatives and were asked to gauge their opinion on the effectiveness of the national initiatives related to antimicrobial use. Finally, the survey also explored perceptions regarding topics requiring more information.

The sample size was determined using the Raosoft sample size calculator (<http://www.raosoft.com/samplesize.html>). Within a margin of error of 7%, a confidence level of 95%, and a population size of 10,000 (registered dentists in Jordan), the sample size needed was 193. Analysis was carried out using IBM SPSS (Statistical Package for the Social Sciences) version 24.0 software. Data were described using percentages and univariable chi-square analysis was also used.

Results

The study included 204 dentists (56.4% females and 43.6% males). Approximately sixty percent (59.8%) of respondents were less than 35 years old, 51.5% were specialists and 48.5% were generalists, 43.1% of the respondents had experience of five years or less, and approximately half (52.0%) of the respondents worked in private clinics (Table 1).

The most common social media platforms utilized by the respondents for professional activities were Facebook (66.7%) and Instagram (29.9%). Common resources used regularly by respondents for the management of patients with infections were clinical practice guidelines (72.0%), continuing education training courses (41.0%), previous clinical experience (34.8%), professional resources/publications (23.0%), and scientific journals (16.6%). Social media appeared as information sources used by 11.2% of the respondents (Table 2). By studying potential relationships between demographic variables and the common resources used regularly, specialist dentists were more likely to refer to published guidelines as a source of information regarding prudent antimicrobial use ($p = 0.004$), and dentists who were more than 56 years old were more likely to utilize documentation from the pharmaceutical industry ($p = 0.011$). Male dentists were more likely to refer to infections specialists for advice regarding prudent antimicrobial use ($p = 0.041$) and dentists with less than 5 years’ experience were more likely to refer to social media for such purposes ($p = 0.006$).

When the respondents were asked whether they received any information about avoiding unnecessary prescribing of antibiotics, 56.0% of the responders reported that they received such information, whereas 37.7% of the responders did not receive information and 5.9% were unsure. Of those who received information, 100% of them claimed that the information received contributed to a change in their views and 95.7% of them reported that the information received contributed to change in their practice when prescribing antibiotics (Table 3). Figure 1 compares the information sources and their influence on changing views. The

Table 1. Sociodemographic characteristics (n = 204).

Variable	N (%)
Gender	
Female	115 (56.4)
Male	89 (43.6)
Age, years	
23-35	122 (59.8)
36-55	78 (38.2)
≥ 56	4 (2.0)
Job title	
Specialist	105 (51.5)
Generalist	99 (48.5)
Experience (years)	
0-5	88 (43.1)
6-15	68 (33.3)
≥ 16	48 (23.6)
Practice setting	
Public Clinic	29 (14.2)
Academia / Research	23 (11.3)
Hospital	46 (22.5)
Private Clinic	106 (52.0)
Practice region	
North Jordan	97 (47.5)
Middle Jordan	97 (47.5)
South Jordan	10 (5.0)

Table 2. Social media platforms and resources used for the management of patients with infections (n = 204).

Social media platform used for professional activities	n (%)
Twitter	6 (2.9)
Facebook	136 (66.7)
LinkedIn	16 (7.8)
Google+	26 (12.7)
YouTube	26 (12.7)
Instagram	61 (29.9)
I do not use social media	31 (15.2)
Resources used regularly for management of patients with infections	
Clinical practice guidelines	147 (72.0)
Documentation from the pharmaceutical industry	37 (8.1)
Medical representatives from industry	13 (6.3)
Previous clinical experience	71 (34.8)
Continuing education training courses	82 (41.0)
Consulting specialist in infectious disease	12 (5.8)
Scientific journals	34 (16.6)
Professional resources/publications	47 (23.0)
Social media	23 (11.2)

Table 3. Respondents (%) who received information on avoiding unnecessary prescribing of antibiotics and its impact on changing their views and practice.

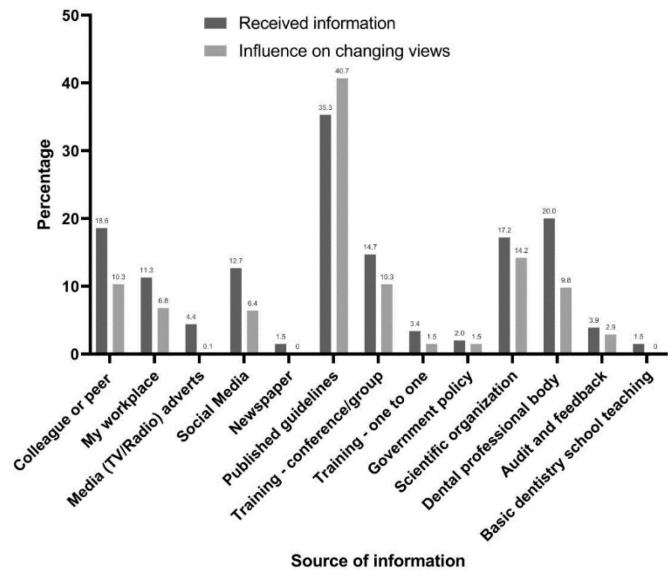
Question	Yes	No	Unsure
In the last 12 months, did you receive any information about avoiding unnecessary prescribing of antibiotics? (n = 204)	115 (56.4%)	77 (37.7%)	12 (5.9%)
Did the information contribute to changing your views about avoiding unnecessary prescribing of antibiotics? (n = 115)	115 (100.0%)	0 (0.0%)	0 (0.0%)
On the basis of the information you received, have you changed your practice on prescribing antibiotics? (n = 115)	110 (95.7%)	4 (3.5%)	1 (0.8%)

most common source of information that the dentists relied on was published guidelines (35.3%). Other sources of information were the dental professional body (20.0%), a colleague or peer (18.6%), and scientific organizations (17.2%). Published guidelines were the most common (40.7%) source that influenced a change in their views. Social media contributed to influencing just 6.4% of the respondents. Respondents were also asked about initiatives focusing on prudent antibiotic use (Table 4). Only 8.8% of the respondents were not aware of any initiatives. The most common (24.5%) initiatives cited were conferences/events focused on tackling antibiotic resistance. Only 9.3% of the respondents knew about the national action plan on antimicrobial resistance. The respondents reported that they need more information about resistance to antibiotics (57.8%), medical conditions for which antibiotics are used (52.9%), how to use antibiotics (41.2%), and prescription of antibiotics (39.7%). A lower percentage of respondents (26.0%) reported that they need more information regarding links between the prescribing of antibiotics (including stimulation of animal growth) and the health of humans, animals, and the environment.

Discussion

Identification of the current state of information utilization regarding prudent antibiotic use is important for dentists, as this will shape efforts to enhance antibiotic use in the future. This study identified the information sources used by dentists and their awareness of system-based initiatives focused on prudent antibiotic prescribing practices. In the present study, a detailed survey based on the European Center for Disease Prevention and Control (ECDC) tool was

Figure 1. Sources of information about avoiding unnecessary prescribing antibiotics and its influence on changing physicians’ views (n = 204).



used for data collection. This is the first to assess the information resources for prudent antimicrobial use among dentists in the Middle East utilizing the ECDC-developed instrument.

Respondents used key social media platforms, such as Facebook which can be utilized for interprofessional or patient communication, for professional use [23]. Interactive communication is possible with social media applications distributing content to patients synchronously and asynchronously [24]. There are concerns regarding the dissemination of misleading drug information through social media that could be detrimental to the health of the public [25]. Fortunately, respondent dentists did not rely heavily on these resources, i.e., only 11.2% of respondents used social

Table 4. Awareness about initiatives and national action plans that focus on prudent antibiotic use and its perceived effectiveness by respondent dentists.

Awareness about initiatives that focuses on antibiotic	N (%)
Initiatives dentists are aware of	
I am not aware of any initiatives	18 (8.8)
TV or Radio advertising for the public	38 (18.6)
World Antibiotic Awareness Week	29 (14.2)
Conference/Events focused on tackling antibiotic resistance	50 (24.5)
National or regional posters or leaflets on antibiotic awareness	27 (13.2)
Awareness-raising by professional organizations	48 (23.5)
Toolkits and resources for healthcare workers	38 (18.6)
National or regional guidelines on the management of infections	38 (18.6)
Newspaper (national) articles on antibiotic resistance	21 (10.3)
Social media	1 (0.05)
Awareness about national action plan on antimicrobial resistance	
Does your country have a national action plan on antimicrobial resistance	
Yes	19 (9.3)
No	69 (33.8)
Unsure	116 (56.9)

media routinely as a source of information. To allow for safe and effective use of antibiotics, dentists should refer to drug information resources, adopting an evidence-based approach [26]. Clinical guidelines are viewed as a resource supporting prudent antibiotic use and they help to address widespread use of antibiotics and their misuse [9]. In the UK, there has been a drive to publish evidence-based guidelines to influence dental prescribing, from organizations including the Scottish Dental Clinical Effectiveness Programme and Faculty of General Dental Practitioners (FGDP) [12,13]. However, it has been identified that, in some circumstances, guidelines might not be followed by prescribers; barriers include lack of awareness and unfamiliarity with guidelines [27].

It is known that poor prescribing practice for antimicrobials can enhance the risk of resistance [20], particularly with regard to broad-spectrum antibiotics [28], and drug information resources are part of the defense against this. In Saudi Arabia, dentists recognized the importance of drug information resources in avoiding medication errors and improving the outcomes of drug therapy [29]. In the present study, and when information was provided, almost all respondent dentists' views and behaviors were influenced by the information received relating to avoiding unnecessary prescribing of antibiotics. This was most commonly from published guidelines and scientific organizations. It is noteworthy that social media and media advertisements did not influence views to a large extent (6.4% for social media, 0.05% for media, and 0% for newspapers). An educational-based intervention was reported to lead to improved compliance with prescribing guidelines by dentists in the UK [30] and could therefore be perceived to improve antibiotic prescribing. In Saudi Arabia, dentists commonly (in about half of the cases) get medication safety information from other healthcare practitioners [31]. Thirty-two percent of the time dentists in the UK contacted drug information center, and national medicines information, for advice regarding the appropriate use of antibiotics [32].

In many regions of the world, dentists are provided with information about antibiotic use and resistance together with other initiatives through the health care system [32,33]. To address the challenge of antimicrobial resistance, input at the level of the healthcare system is needed, including antimicrobial stewardship. In Jordan, several initiatives have been launched to address antimicrobial resistance, such as the National Action Plan on Antimicrobials [34]. However, in the present study, the awareness of such

initiatives was poor. This highlights that there is a need to increase awareness of the risk of unnecessary antibiotics, governmental initiatives, and antimicrobial stewardship. In order to apply effective measures to address antimicrobial resistance, awareness of guidelines and their implementation into practice is a first step [27]. Also, knowledge of the prescribing drivers would inform the development of interventions required to change prescribing behaviors [35].

Assessment of knowledge of dentists about antibiotic prescribing was investigated in a study from the UK [36]. Continuing education concerning antibiotic topics is considered a primary pillar in the battle against antimicrobial resistance. In the development of continuous educational efforts for health professionals, it is important to survey training needs. In the present study, results revealed the need for more continuing education for the respondents dentists about antibiotic resistance, medical conditions for which antibiotics are used, how to use antibiotics, and prescribing of antibiotics.

A selection bias can be introduced due to the online distribution of the survey. Despite this, this bias might not affect the generalization of the results given the widespread availability of information technology and smartphones among professional groups, such as dentists [37]. Those who are young are most likely to respond to the online questionnaire, although the use of smartphones and social media is more widespread than in the past. [38].

Conclusions

In conclusion, the present study evaluated dentists' preferred sources of information and dentists' awareness of available information and initiatives on prudent antibiotic prescribing practices in Jordan. The main sources of information about avoiding unnecessary antibiotic prescribing were published guidelines, the dental professional body, a colleague or peer, and scientific organizations. The present study summarized the status quo of the information resources for antimicrobial use and resistance used by dentists and highlighted the need for increasing dentists' awareness of these resources. These findings can inform effective antimicrobial stewardship strategies for better antibiotic prescribing.

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Authors' Contributions

Conceptualization: all authors; methodology: GMA-T, SA-A, RAK, OBA-B, YSK and MAA; software: GMA-T and MA; formal analysis: GMA-T and MA; resources: SA-A, BRC and MAA; writing—original draft preparation: GMA-T; writing—review and editing: all authors; supervision: SA-A, and MAA. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of the Jordan University of Science and Technology (IRB, Reference: 10/140/2021).

Informed Consent Statement

The participants received an invitation leading them to a Google Forms-based online survey.

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Annex – Supplementary Items

Survey of dentists' sources of information about antibiotic use and antibiotic resistance

Dear Respondent,

You are invited to complete the following survey of dentists about their knowledge and attitudes about antibiotic use and antibiotic resistance.

Researchers from UK, Jordan University of Science and Technology, and Yarmouk University are seeking responses from dentists. We would really value you completing the survey that will take 5 to 10 minutes to complete. It includes predominantly multiple-choice questions.

Please feel free to cascade the link of the survey widely to colleagues.

In which language would you prefer to complete this survey? بأيّ لغة تفضل اتمام الاستبيان؟

English

Arabic

➤ Demographic Section

1. Please specify in which governorate you practice

Amman

Irbid

Salt

Zarqa

Madaba

Jerash

Ajloun

Mafraq

Karak

Tafilah

Ma'an

Aqaba

2. What is your predominant role? (i.e.>50% of your time)?

Generalist

Specialist

Academia/ Research

3. Where do you predominantly practice? (i.e. >50% of your time):

Hospital (any hospital type)

University (as an Academic) or research institute

Public clinic

Private clinic

4. How many years have you been practicing in your current profession?

0-2 years

3-5 years

6-10 years

11-15 years

16-20 years

21-25 years

>25 years

5. What is your age?

- 22-35 years
- 36-45 years
- 46-55 years
- 56-65 years
- >66 years

6. What gender do you identify with?

- Male
- Female

➤ Used resources for professional activities Section**7. Which of the following social media networks do you mainly use for professional activities?
(Choose all that apply)**

- Twitter
- Facebook
- LinkedIn
- Google+
- YouTube
- Instagram
- I do not use social media
- Others _____

8. In the management of infections, which of these do you use regularly? (Choose all that apply)

- Clinical practice guidelines
- Documentation from the pharmaceutical industry
- Medical representatives from industry
- Previous clinical experience
- Continuing education training courses
- Infection specialists
- Scientific journals
- Professional resources/publications
- Social media
- None of the above
- I do not know
- Others: _____

➤ Sources of information about avoiding unnecessary prescribing of antibiotics Section**9. In the last 12 months, do you remember receiving any information about avoiding unnecessary prescribing of antibiotics?**

- Yes
- No
- Unsure

10. How did you first get this information about avoiding unnecessary prescribing of antibiotics? (Select all that apply).

- Colleague or peer
- My workplace
- Media (TV/Radio) adverts

Social Media
 Newspaper
 Published guidelines
 Training - conference/group
 Training - one to one
 Government policy
 Scientific organization
 My medical professional body
 Audit and feedback
 Others: _____

11. Did the information contribute to changing your views about avoiding unnecessary prescribing of antibiotics?

Yes
 No
 Unsure

12. Which source(s) of information has had the most influence on changing your views? Select no more than 2.

Colleague or peer
 My workplace
 Media (TV/radio) adverts
 Social media
 Newspaper
 Published guidelines
 Training - conference/group
 Training - one to one
 Government policy
 Scientific organization
 My medical professional body
 Audit and feedback
 Others: _____

13. On the basis of the information you received, have you changed your practice on prescribing of antibiotics?

Yes
 No
 Unsure

➤ **Awareness of initiatives and national action plans on antimicrobial resistance Section**

14. What initiatives are you aware of which focus on antibiotic awareness and resistance? Select all that apply

TV or Radio advertising for the public
 Toolkits and resources for healthcare workers
 National or regional guidelines on management of infections
 Awareness raising from professional organizations
 Conference/Events focused on tackling antibiotic resistance
 National or regional posters or leaflets on antibiotic awareness
 Newspaper (national) articles on antibiotic resistance

World Antibiotic Awareness Week
Social media
I am not aware of any initiatives

15. Does your country have a national action plan on antimicrobial resistance?

Yes
No
Unsure

16. On which topics would you like to receive more information? (Choose all that apply)

Resistance to antibiotics
How to use antibiotics
Medical conditions for which antibiotics are used
Prescription of antibiotics
Links between the health of humans, animals and the environment
None
Others: _____

17. Regarding the national initiatives about prudent use of antibiotics in your country, to what extent do you agree or disagree "There has been good promotion of prudent use of antibiotics and antibiotic resistance in my country"?

Strongly agree
Agree
Disagree
Strongly disagree
Neutral
Not Applicable
I don't remember