










Original article

## Antibiotic Prescribing Among General Dental Practitioners in Libya: A Cross-Sectional Study

Ukwas A.<sup>1</sup>, Elsalhin A.<sup>2</sup>, Elego A.<sup>3</sup>, Abuaisha Karim B.<sup>4</sup>, Elheyal M.<sup>4</sup>, Elawami H.<sup>3</sup>, Alsadawi N.<sup>5</sup>, Elhrary F.,  
Alazrag M.<sup>5</sup><sup>1</sup> Eastman Dental Institute, University College London, London, United Kingdom<sup>2</sup> Faculty of Dentistry, University of Tripoli, Tripoli, Libya<sup>3</sup> Faculty of Dentistry, The Libyan International Medical University, Benghazi, Libya<sup>4</sup> Faculty of Dentistry and Craniofacial Sciences, London, King's College London, United Kingdom<sup>5</sup> Faculty of Dentistry, Attahaddi Medical University, Tripoli, Libya<sup>5</sup> Faculty of Dentistry, University of Khalij-Libya, Tripoli, LibyaCorresponding Email: [abdouldaim.ukwas.09@ucl.ac.uk](mailto:abdouldaim.ukwas.09@ucl.ac.uk)

### Abstract

The past couple of decades have seen an alarming increase in antibiotic resistance (ABR), largely due to the injudicious use of these medications across the medical field, with an estimated 1.27 million deaths attributed to bacterial antibiotic resistance globally in 2019. General dental practitioners (GDPs) account for approximately 10% of all antibiotic prescriptions in primary care. The aim of the present study was to explore antibiotic prescribing practices among GDPs in Libya, as well as their attitudes towards antibiotic resistance. A survey questionnaire consisting of 17 questions was sent to 367 GDPs who met our inclusion criteria. 341 GDPs answered all the survey questions and were included. The most commonly prescribed antibiotic was amoxicillin with clavulanic acid (Augmentin, Co-amoxiclav). Macrolides were the most commonly prescribed antibiotic class. If a patient was allergic to penicillin, followed by clindamycin. Furthermore, antibiotic misuse and overuse were common among the participants. The present study has demonstrated that inappropriate antibiotic prescription is common among GDPs in Libya. There is an urgent need to develop national guidelines and introduce a stewardship programme to improve antibiotic prescribing practices and attitudes among dentists in the country.

**Keywords.** Antibiotics, Antibiotic Prescription, Antimicrobial Resistance, Dentistry, Primary Dental Care.

### Introduction

Since the discovery of penicillin by Alexander Fleming in 1928, antibiotics have become the cornerstone of modern medicine, saving millions of lives every year [1]. Indeed, effective antibiotics are crucial for both preventive and curative measures, protecting patients undergoing complex treatments (common examples include organ transplantation and cancer chemotherapy) from potentially fatal infections [2]. However, the past couple of decades have seen an alarming increase in antibiotic resistance (ABR), largely due to the injudicious use of these medications across the medical field—approximately 1.27 million deaths were attributed to bacterial antibiotic resistance globally in 2019 [3]. It is now estimated that this number will substantially increase to 10 million deaths every year globally by 2050, at a cumulative cost of 100 trillion USD in lost productivity to the global economy [4].

Antibiotic resistance is a naturally occurring process in bacteria that develops through genetic mutations. However, human activities—primarily due to antibiotic overuse and misuse in medicine, but also through antibiotic use to tackle infections in animals and agriculture—can hasten this process [5]. Once resistance has developed, it cannot be reversed [6], and antibiotics become increasingly less effective. In 2015, the World Health Organization (WHO) adopted a global action plan to tackle antibiotic resistance, stating several objectives including improving awareness of antibiotic resistance, optimizing the safe use of antibiotics in humans and animals, and reducing the incidence of infections by improving sanitation and hygiene [2].

General dental practitioners (GDPs) account for approximately 10% of all antibiotic prescriptions in primary care [1], it is prudent to assume a potential role of dental prescribing in the rise of antibiotic resistance [7]. This assumption is supported by several studies which have indicated that a significant proportion (30% to 75% depending on the country) of antibiotic prescribing in dentistry is inappropriate—examples include prescribing antibiotics for acute dental

conditions (such as irreversible pulpitis and apical abscess) without evidence of spread of infection and/or without applying proper local measures e.g., root canal treatment (RCT) [7–9]

The role of antibiotics in dentistry is predominantly *adjunctive* to local treatment measures (e.g., root canal treatment (RCT)) when encountering acute or chronic infections. Antibiotics can only be used *therapeutically* when there are signs of spread of infections (e.g., patients who present with fever (over 38°C), generalized malaise, tachycardia, significant trismus, or marked regional lymphadenopathy) or when the definitive treatment cannot be provided due to referral delays, especially in immunocompromised patients. Furthermore, antibiotics can sometimes be used as a *prophylaxis* in a limited spectrum of cases [10]. The aim of the present study is to explore antibiotic prescribing practices among GDPs in Libya, as well as their attitudes towards antibiotic resistance.

## Methodology

### Study design

The study was based on a cross-sectional survey that was conducted from July 2025 through September 2025. An anonymized, self-reported questionnaire was sent to a random sample of GDPs in Libya.

**Questionnaire:** The questionnaire was developed using Google Forms (<https://docs.google.com/forms>) by the authors (MA) and (AU). It consisted of 17 close-ended questions: the first five questions addressed demographic information (such as gender and years since graduation); questions 6 to 15 addressed the practices of antibiotic prescribing, and the last two questions explored the attitudes towards antibiotic prescribing and resistance (Table 1). The questionnaire did not include any private or identifiable information of the participants, and was pilot-tested on 18 GDPs (5% of the estimated sample size), who were not included in the final data analysis.

### Participants

#### Inclusion criteria

General dental practitioners who were fully registered with their regional municipal dental syndicates in Libya and actively practicing dentistry at primary care dental clinics at the time of the survey.

#### Exclusion criteria

- Dentists who were not registered or not actively practicing dentistry at the time of the survey
- Dentists who were practicing at secondary care settings or university hospitals
- Dentists who hold a master's or PhD degree in a dental specialty
- Dentists who were board-certified or recognized by the healthcare authority in Libya as specialists or consultants.

Therefore, a total of 367 GDPs who were fully registered with their regional municipal dental syndicates and actively practicing dentistry at primary care dental clinics at the time of the survey were randomly selected. All participants were properly informed about the aim of the study and voluntarily agreed to participate based on confidentiality and anonymity. No financial incentives were proposed.

### Sample size

We estimated that there were 8,000 actively practicing GDPs at the primary care settings at different regional municipal syndicates in Libya. Therefore, using 50% as the most conservative proportion for sample calculation, we calculated that 367 participants would be required to estimate a 95% confidence interval and a 5% margin of error.

### Data collection and analysis

All responses were collected and transferred to an Excel spreadsheet for analysis. Incomplete responses were 23% (n=79) identified and subsequently excluded. Descriptive statistics were used to analyze data and demonstrate the results.

## Results

A total of 367 responses from GDPs registered at 12 municipal dental syndicates in Libya were received. However, only 341 responses were complete; thus, included in the present study 26 (7%) incomplete responses were excluded. More than two-thirds of the respondents were females (69%;  $n=236$ ), while males represented approximately 31% ( $n=105$ ) of the participants, at a male-to-female ratio of 1:2.25. Furthermore, approximately 65% ( $n=220$ ) of the respondents graduated from public universities, and the remaining graduated from private universities. Approximately 62% ( $n=210$ ) of the participants indicated that they only had a university dental degree (i.e. Bachelor of Dental Surgery (BDS)) as their highest qualification in dentistry, 9% ( $n=31$ ) had a Membership of the Faculty of Dental Surgery (MFDS or MFD), and the remaining 29% ( $n=100$ ) had other postgraduate qualifications (a postgraduate certificate or diploma.) About 43% ( $n=147$ ) of the participants worked in both private and public clinics, 41% ( $n=139$ ) worked only in private clinics; and only 16% ( $n=55$ ) worked solely in public clinics. Participants who had been in practice for more than 6 years constituted 45% ( $n=153$ ) of the respondents, whereas 32% ( $n=109$ ) had been in practice for less than 3 years, and 23% ( $n=79$ ) had been in practice for a period between 3 and 6 years.

Although approximately 35% ( $n=120$ ) of participants reported that they “Rarely” prescribed antibiotics, and 30% ( $n=103$ ) “Occasionally” prescribed them, about 35% ( $n=119$ ) of respondents indicated that they prescribed antibiotics either “Always” or “Frequently”—25% ( $n=85$ ) of the respondents answered “Frequently” and 10% ( $n=34$ ) answered “Always”. Of note, approximately 62% ( $n=22$ ) of those who indicated they always prescribe antibiotics were dentists with more than 6 years of experience.

The most commonly prescribed antibiotic in our cohort was amoxicillin with clavulanic acid (Augmentin™ or Co-amoxiclav), which was prescribed by 65% ( $n=221$ ) of participants, followed by amoxicillin, which was prescribed by 17% ( $n=58$ ) of participants. Additionally, a combination of amoxicillin and metronidazole was prescribed by 14% ( $n=48$ ) of participants (Figure 1). Therefore, amoxicillin—either alone or in combination with clavulanic acid or metronidazole—was prescribed by more than 95% of the participants ( $n=327$ ). The frequency of antibiotic prescription does not seem to be significantly affected by any other factors such as the years of experience, the nature of the university (public or private) the participant had graduated from, the type of clinic they practiced at (public or private or a combination), and the highest qualifications they held.

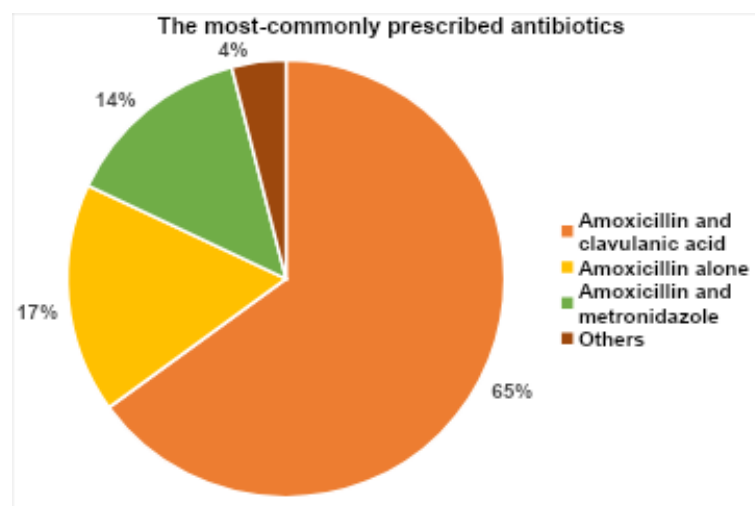


Figure 1. The most commonly prescribed antibiotics in our study

Approximately 90% ( $n=308$ ) of the participants reported that they “Always” took a medical history prior to prescribing antibiotics—only a small proportion of the respondents (2.6%;  $n=9$ ) answered “Occasionally” or “Never” to this question. Our data have shown that the participants’ answers to this question were not affected by other factors such as the years of experience, the nature of the university, the nature of the dental practice, or the highest dental qualification.

As regards the practice of prescribing antibiotics, 68% (n=233) of the participants indicated that they used the commercial (brand) drug names (e.g., Flagyl®), and the remaining participants used the generic names. This practice was common among participants regardless of the years of experience, the nature of the university, the nature of the clinical setting, and the highest qualification in dentistry.

Although more than half of the participants (57%; n=193) reported that they “Never” prescribed antibiotics upon patients’ request (patient satisfaction), about 21% (n=70) of them indicated that they “Sometimes” did, and 7% (n=24) “Always” did. Answers to this question were consistent between genders—only 28% of both females (n=65) and males (n=29) answered “Yes” or “Sometimes” to this question. Interestingly, 26% (n=40) of dentists with more than 6 years of experience would “Sometimes” or “Always” prescribe antibiotics upon the patient’s request, a result that is close to dentists with less than 3 years of experience (24%; n=26).

If a patient was allergic to penicillin, the most commonly prescribed antibiotic class was macrolides, prescribed by approximately 50% (n=170) of the respondents. The second most commonly prescribed antibiotic alternative was clindamycin, reported by 34% (n=117) of the dentists. Interestingly, 12% of the participants indicated that they would prescribe tetracyclines in case of penicillin allergy (Figure 2).

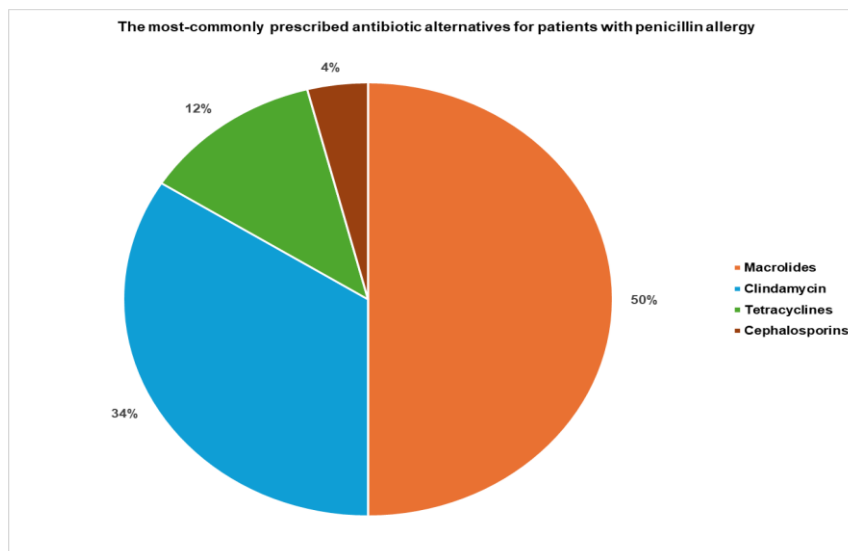
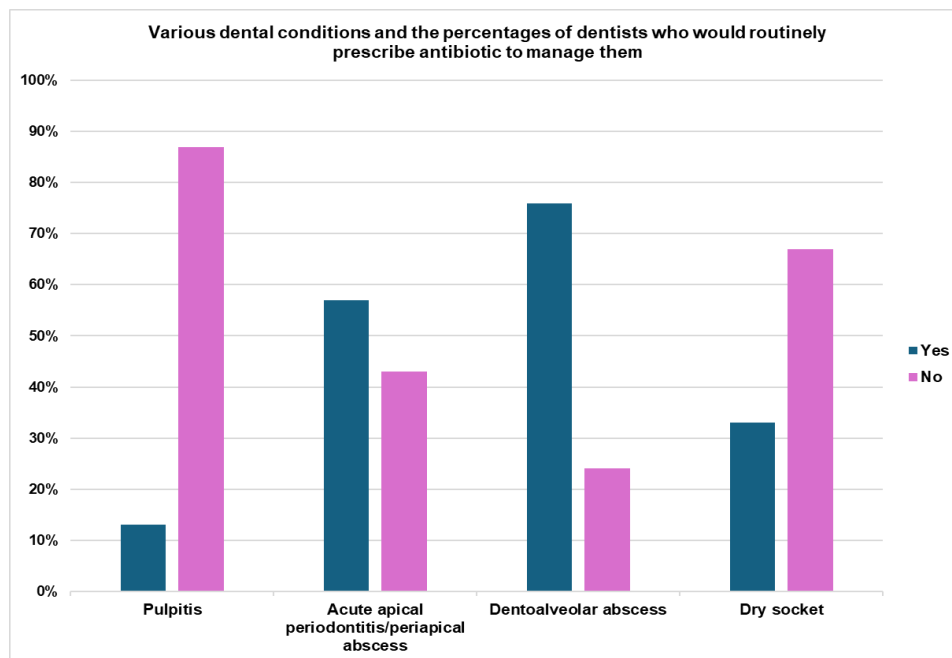


Figure 2. The most commonly prescribed antibiotic alternatives in patients with penicillin allergy

In case the patient's condition did not improve following antibiotic prescription, the majority of the participants would either “Rethink the diagnosis” (49%; n=167), or “Refer the patient to a specialist” (27%; n=92). However, almost a quarter of the respondents (n=82) would either add—or switch to another—antibiotic. Of note, dentists with more than 6 years of experience, and those who worked in the private or in combined private and public clinics were more likely to prescribe – or switch to – another antibiotic than dentists with fewer years of experience and those who worked in the public sector only. Additionally, approximately 30% (n=62) of participants who had BDS only would refer patients to a specialist care if the antibiotic therapy failed, a considerably higher proportion than participants with higher dental qualifications.

As regards the conditions which do not need routine antibiotic prescription, 76% (n=259) of the respondents reported that they would prescribe antibiotics for dentoalveolar abscess (with or without a draining sinus), and 57% (n=159) would prescribe them for acute apical periodontitis/periapical abscess. Additionally, approximately 33% (n=113) of participants reported that they would prescribe antibiotics for dry socket, and 13% (n=44) of them indicated that they would prescribe antibiotics for pulpitis (Figure 3).



**Figure 3. Different dental conditions and the percentage of the participants who would prescribe an antibiotic for their management**

The likelihood of routinely prescribing antibiotics for the management of acute apical periodontitis/periapical abscess seems to increase with years of experience. Also, participants with other postgraduate qualifications and those who worked in both private and public clinics were more likely to prescribe antibiotics to manage this condition. Additionally, the practice of routine prescription of antibiotics for cases with dentoalveolar abscess (with or without a draining sinus) was common among the participants, regardless of their years of experience or the highest qualification they held, but was significantly more common in dentists who worked either in private or private and public clinics. The choice of prescribing antibiotics for the management of dry socket was not affected by the years of experience—approximately one third of the participants indicated they would prescribe antibiotics for this condition regardless of their experience. Also, this practice was not different according to the nature of the clinical setting, but participants who held MFD or MFDS were less likely to prescribe antibiotics for a dry socket than those with BDS only or other qualifications.

Responses to our survey have shown that regular prescription of antibiotics for procedures that do not necessarily need routine antibiotic cover was common. Indeed, 64% (n=218) would regularly prescribe antibiotics following dental implant placement, 43% (n=148) would regularly prescribe them following dental extractions (surgical or non-surgical), 29% (n=98) after subgingival scaling/root planning, and 18% (n=62) after root canal treatment (RCT) (Figure 4). The practice of prescribing antibiotic cover for dental extractions was consistent across all comparisons, regardless of the respondents' experience, the nature of the clinics they practiced at, or their highest qualification. The same pattern was observed with the dental implant placement, although dentists who held MFDS/MFD were slightly more likely to prescribe antibiotic coverage for this procedure.

Regarding updates on antibiotics, 55% (n=188) of participants indicated that they kept up to date via peer-reviewed dental journals, 75% (257) by attending conferences and workshops, while 65% (n=220) utilize general online sources, including social media.

As regards the participants' attitude towards antibiotic prescribing, 66% (n=226) of the respondents believed that antibiotics were overprescribed in Libya, as compared to 34% (n=115) who answered "No" or "I am not sure" to this question. Also, approximately 82% (n=279) of the cohort were concerned about antibiotic resistance, while 18% (n=62) were either not concerned or unsure.

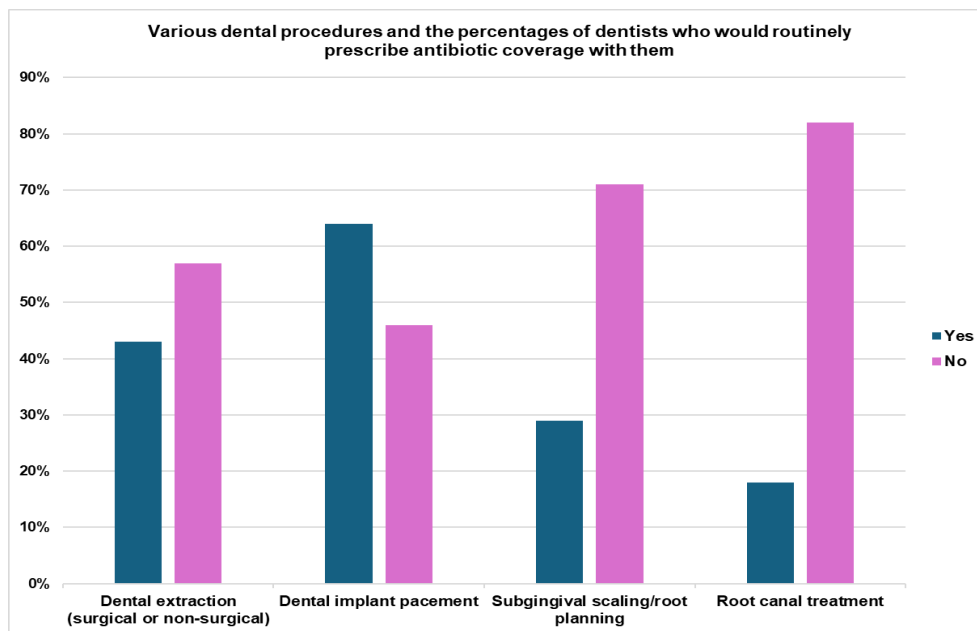


Figure 4. Various dental procedures and the percentage of participants who would prescribe antibiotic cover for them

## Discussion

The present study provides a comprehensive insight into the attitudes and practices pertaining to antibiotics among GDPs in Libya. The sample was nationally representative, including dentists of both genders practicing in various geographic regions and practice settings, with diverse professional experience and academic credentials.

Analysis of the participants' responses has demonstrated that a significant proportion of the participants (approximately 35%) would either "Always" or "Frequently" prescribe antibiotics, which indicates that antibiotic overprescription is common among them. This was subsequently supported by responses to question number [16] (Table 1) in which 66% (n=226) of the respondents believed that antibiotics were overprescribed in Libya. The decision to prescribe antibiotics for dental infections should always have a valid clinical justification following thorough dental and medical histories, clinical examinations, and relevant investigations. Factors such as the severity of infection as well as the patient's overall health status—including the presence of comorbidities, allergies, and current intake of other medications—should all be carefully considered before prescribing an antibiotic [11]. The practice of "just in case" prescription can result in significant (even serious) consequences—examples include gastrointestinal disturbances, allergic reactions (ranging from skin rash and urticaria to anaphylaxis), toxicity, and untoward interactions with other systemic medications [10,12]. This can also result in delayed diagnosis and increase the risk of the development of bacterial resistance.

The most commonly prescribed antibiotic in our study was amoxicillin with clavulanic acid (Augmentin™ or Co-amoclav), which was prescribed by 65% (n=221) of participants, a finding like previous studies [13,14]. Amoxicillin with clavulanic acid is a broad-spectrum antibiotic that is effective against an extended spectrum of bacterial species; thus, it should only be prescribed against serious infections with systemic manifestations [12,15]. If a patient was allergic to penicillin, 47% (n=160) of the respondents would prescribe macrolides as an alternative, and 32% (n=109) would prescribe clindamycin. It is well-recognized that many antibiotics prescribed in dentistry can have serious drug interactions with other systemic medications, e.g., the British National Formulary (BNF) warns about a potential drug interaction between these antibiotics—including amoxicillin, macrolides, and metronidazole—and warfarin, as they can enhance the anticoagulant effect of warfarin, increasing the risk of bleeding. This interaction is considered severe, and patients taking both medications require close monitoring of their International Normalized Ratio (INR) levels [16]. Furthermore, although clindamycin has a high oral absorption and a significant tissue penetration (including into bones), it is effective against Gram-positive cocci—including streptococci and penicillin-resistant staphylococci—and

can be prescribed if the patient is allergic to penicillin; it can cause the serious adverse effect of antibiotic-associated colitis more frequently than other antibiotics [17,18].

Perhaps a less-appreciated contributing factor to the antibiotic overprescription in dentistry is the patient influence (patient satisfaction or pressure), which has been highlighted in previous studies [19,20]. This was also evident in the present study, as approximately 28% (n=94) of the participants indicated they would either “Sometimes” or “Always” prescribe antibiotics upon the patient’s request. Even if the prescribed antibiotic failed to improve the patient’s condition, approximately 25% (n=82) of the respondents would opt to add—or switch to—another antibiotic, rather than re-thinking the diagnosis or referring the patient to a specialist where a definitive diagnosis can be achieved and perhaps a culture and sensitivity test obtained. But there is also the worrying issue of self-medication—there is a widespread, over-the-counter accessibility of antibiotics in many developing countries (including Libya). Consequently, patients frequently present to their dental practitioners having already purchased and self-administered these medications.

The available evidence indicates that inappropriate antibiotic prescription is common among dental practitioners, and our study further supports that. Indeed, participants indicated that they would *routinely* prescribe antibiotics for several dental conditions in the absence of a valid clinical justification, including pulpitis (13%; n=44), acute apical periodontitis/periapical abscess (57%; n=159), dentoalveolar abscess (with or without a draining sinus) 76% (n=259), and dry socket 33% (n=113). These practices were consistent with previous studies in which dental practitioners inappropriately prescribed antibiotics to manage such conditions [6,11,12]. The prescription of antibiotics—even as a temporary measure, except in uncommon cases when it is impossible to remove the source of the infection or immediately establish drainage, particularly in immunocompromised patients—is not only injudicious, but also ineffective in the management of acute conditions such as irreversible pulpitis and periapical abscess [10,11,21]. It is well-established that the majority of uncomplicated dental infections (i.e., when there are no signs of spread) can readily be managed by local treatment measures, e.g., extirpation of an infected pulp, incision and drainage of an abscess, or extraction of the offending (often unsalvageable) tooth [10]. Additionally, current evidence does not support the use of antibiotics for the management of dry socket, which is not an infection and can readily be managed by different local measures, e.g., hyaluronic acid, platelet-rich fibrin, or Alveogyl [22,23].

Although approximately 50% (n=167) of the participants reported that they would “Re-think the diagnosis” in case the prescribed antibiotic failed to improve the patient’s condition, almost a quarter of the respondents (n=82) would either add—or switch to another—antibiotic. This is clinically invalid, and such a practice could potentially complicate the patient’s condition and significantly delay the provision of proper treatment. Indeed, blindly prescribing antibiotics without the eradication of the local nidus of infection will ultimately fail [10].

Despite being invasive, dental procedures (such as extractions and implant placement) do not warrant routine antibiotic cover. Nevertheless, 43% (n=148) of participants in the present study would *regularly* prescribe antibiotics following dental extractions (surgical or non-surgical) and 64% (n=218) following dental implant placement. Of note, 18% (n=62) of the respondents believed that regular antibiotic cover was required for a minimally invasive procedure such as RCT. Current literature indicates that there is not sufficient evidence to support routine prophylactic use of antibiotics following dental extractions or implant placement [24–26], especially in young and healthy patients.

Most of the participants in the present study (82%; n=279) indicated that they were concerned about antibiotic resistance, but this has not been reflected in their answers to the survey. This may be attributed to a lack of understanding of the mechanisms underpinning microbial resistance, and/or the role of antibiotic overprescription in the development of this global issue.

While 75% (257) of participants indicated that they followed the latest antibiotic guidelines by attending conferences and workshops, and 55% (n=188) of them via peer-reviewed journals, their prescription patterns, as demonstrated by their answers to the other questions of this survey, did not support this, potentially implying a reporting bias. Additionally, using general online resources (including social media), as indicated by 65% (n=220) of the participants, may be confusing as many unregulated online resources provide conflicting—sometimes misleading—information.

The present cross-sectional study highlights a concerning widespread antibiotic misuse and overuse among GDPs in Libya, which supports similar findings demonstrated by previous regional studies conducted in the country [27–30]. However, this practice is not unique to Libya, but rather represents a global pattern recognized in several previous

studies both in the neighboring Arab countries [6,13,14], and the rest of the world, including high-income, developed countries [8,11,12,19,31].

The irrational antibiotic prescription among GDPs is perhaps not only the result of a lack of knowledge or understanding of the pathogenesis of dental infection or the effectiveness of the relevant antibiotics. Indeed, previous studies have highlighted several contributing factors that may potentially complicate the issue, including clinical time constraints, heavy workload, patient requests (or pressure), patient's incomppliance with the treatment plan, failure to obtain sufficient local anesthesia, lack of affordability to treatment, and medicolegal concerns [19,32,33].

There are many available dental antibiotic prescribing guidelines from reputable institutes in the USA [34], England [35], and Scotland [18]. However, there is an urgent need to develop national guidelines for antibiotic prescribing in general dental practice in Libya to help reduce the inappropriate use of antibiotics in the management of dental infections. This is important because guidelines developed in high-income countries may not be suitable for low- and middle-income countries (such as Libya) due to potential differences in the quality of the antibiotics and different socioeconomic status and education levels of the patients [1]. This will also allow the introduction of a national antibiotic stewardship program—similar to many developed nations [36–38—to optimize antibiotic prescribing in accordance with the (to-be-developed) national guidelines, and help tackle the growing issue of antimicrobial resistance. Furthermore, there is an obvious necessity to develop regular, comprehensive educational programs and updates provided by experts on the rational antibiotic prescription in the primary dental settings. Additionally, the widespread use of social media can be utilized to disseminate educational materials (e.g., short, animated films) to improve patients' knowledge and attitudes towards antibiotics, a technique that has already been demonstrated to reduce patients' demand for antibiotics [39].

## Conclusion

The present study has demonstrated that inappropriate antibiotic prescription is common among GDPs in Libya. There is an urgent need to develop national guidelines and introduce a stewardship program to improve antibiotic prescribing practices and attitudes among dentists in the country. The relevant healthcare authorities should introduce a regular, comprehensive program to update dentists on the rational use of antibiotics, as well as disseminate educational materials to improve patients' understanding and attitudes towards antibiotics.

## *Ethical approval and consent to participate*

This study was approved by the Ethics Committee of Health Research in Libya (27-11-25-B). It was conducted as per the Declaration of Helsinki principles. All participants provided their informed consent to the study.

*Consent for publication:* Not applicable.

## *Availability of data and materials*

The datasets generated and/or analyzed during the current study are available from the corresponding author upon request.

## *Competing interests*

The authors declare that there are no competing interests

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## *Author contributions*

Authors AU and MA initiated and designed the study, including the questionnaire. AE and AE were responsible for data analysis. BAK, ME, HE, NA, and FE were responsible for the dissemination of the questionnaire as well as the collection and organization of data. Author AU wrote the final draft, and MA reviewed and approved it.

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