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Drug Prescription Knowledge and Practices among Dental Students and Interns Enrolled in Selected Yemeni Universities

Mohammed A. Al-Wesabi[1,*], Saba Al-Sanaani[2], Shrooq Al-Taybi[3], Somya Binrugaan[3], Altaf Al-Raih[3], Abdullkhaleg Albashari[3], Hisham Ebrahem[3]

[1] Department of Biological and Preventive Sciences, Faculty of Dentistry, University of Science and Technology, Sana'a, Yemen

[2] Department of Restorative and Prosthodontic, Faculty of Dentistry, University of Science and Technology, Sana'a, Yemen

[3] Internship Program, Faculty of Dentistry, University of Science and Technology, Sana'a, Yemen

ABSTRACT

Objective: To assess the drug prescription knowledge among dental students and interns in public and private Yemeni universities.

Methods: A descriptive, observational study of drug prescription knowledge and practices was conducted through the distribution of self-administrated questionnaires to a total of 464 dental students and interns enrolled in four universities in Yemen in 2015. The study investigated the factors to be considered before drug prescribing, indications for prescribing antibiotics in dental situations, common antibiotics and analgesics prescribed, difficulties in writing a prescription and knowledge of the World Health Organization's Guide to Good Prescribing. Findings were presented as descriptive statistics of frequencies and percentages, and differences and associations were tested at *P*-values <0.05.

Results: The majority of respondents were females (65.9%; 304/464), being enrolled in public universities (54.1%; 251/464) and from the fifth level of study (54.9%; 251/464). The mean respondents' age was 23.0 ±1.3 years (range: 22–32). Presence of systemic diseases (75.0%), pregnancy status (72.2%) and presence of allergies (68.8%) were the factors most frequently considered by the respondents prior to drug prescribing. On the other hand, presence of abscesses was the most frequent reason for prescribing antibiotics (36.6%). Amoxicillin was the most frequently prescribed antibiotic (74.1%), while paracetamol (58.2%) and ibuprofen (47.0%) were the most frequently prescribed analgesics. Not knowing the brand names of prescribed drugs and wrongly filled prescriptions were the most frequent errors in writing prescriptions, being reported by 79.3% and 55.3% of respondents, respectively. Regarding the factors associated with common prescribing errors, female students had significantly more errors than their male counterparts regarding the posology and knowledge of brand names. In addition, fifth-level students reported significantly fewer errors in writing a drug prescription than fourth-level students, and the interns showed fewer errors than their undergraduate colleagues. Moreover, students from public universities reported significantly more errors in knowing brand names and duration of treatment than private university students.

Conclusions: Dental students enrolled at the fourth and fifth levels as well as in the internship year of dentistry have insufficient knowledge and skills in prescribing drugs used in the dental field because of the perceived gaps in clinical pharmacology courses during their study. Revising the timing and content of pharmacology courses in dental curricula is required in light of the positive aspects of those from the dental faculties worldwide, emphasizing on drug prescribing skills and preparing dental students well before the clinical levels of the study program.

Keywords: Dental students, Interns, Prescription, Dental curriculum, Yemen

* **Corresponding author:** M. A. Al-Wesabi (malwossabi@gmail.com)

1. Introduction

Drug prescription by dental practitioners is an important aspect of dental practice because of the need for the pharmacologic therapy along with dental procedures in several situations. Therefore, it is complementary to the clinical practice of dentistry, raising concerns about the prescription practices gained by dental students and interns during their studies. However, systematic drug prescription is not included in the basic pharmacology curriculum delivered during the study of dentistry (1).

Prescriptions represent the core communicating medication plans from prescribers to patients *via* pharmacists (2). Prescribing drugs, however, is a complex task that requires theoretical knowledge besides the practical skills (3). In dentistry, the most prescribed drugs include local anesthetics for dental procedures, antibiotics and nonsteroidal anti-inflammatory drugs (NSAIDs) (4, 5). According to the World Health Organization (WHO), "*prescription should include: name, address, telephone of prescriber, date, generic name of the drug, strength, dosage form, total amount, label: instructions, warnings, name, address, age of patient, signature or initials of prescriber*" (6). Moreover, knowledge of the accurate dosage, side effects and contraindications of drugs before prescribing is critical.

There is an accumulating evidence of inadequate prescribing practices among dentists because of a number of factors ranging from inadequate knowledge to social factors (7). In addition, the majority of dental students and interns may not be aware of the difference in prescribing for bacterial and viral infections in relation to dosage and duration of therapy (8). Prescription of antibiotics for viral infections and lack of confidence in prescribing antibiotics and analgesics are common among dental students and interns (5, 9).

Inadequate prescribing practices are common among dental students (1), interns (8) and even dentists (7). Therefore, it is critical to qualifying dental students and interns with good and responsible prescribing practices to manage the health effects such as antimicrobial resistance (10) as well as other side effects resulting from faulty and irresponsible prescribing. Prescription of antibiotics over the phone has been reported among medical students because of poor knowledge, negative attitudes and bad practices (9). This is of public health concern because bacteria can develop resistance that may render particular antibiotics useless within one or two decades (7, 11, 12). In addition, there is a need to rationalize the use of analgesics because of their widespread use in the dental field (13). Therefore, rational drug prescribing can counteract the development of antibiotic resistance and reduce the occurrence of adverse reactions.

In 2006, a study among Namibian dental students and interns showed that 44.1% of them believe that they had acquired enough knowledge in pharmacology to be dental practitioners (14). Dental graduates are expected to learn clinical skills, perform certain clinical procedures and demonstrate a good clinical judgment to undertake proper management decisions. Furthermore, effective and safe prescription of commonly used drugs should be a core competency of newly qualified dentists (15, 16). However, Aronson (17) found that there is a lack of clinical knowledge integration into basic dental curricula. In undergraduate dental curricula, pharmacology is taught as a basic science, and most textbooks deal with it as a basic science rather than a discipline that forms part of the medical curriculum, leading to the loss of clinical pharmacology knowledge in the vastness of basic pharmacologic information (18). Moreover, students usually acquire limited prescribing abilities in the pre-clinical stages of their programs.

Teaching pharmacology for dental students should be emphasized in all learning styles such as workshops, tutorials, problem-based learning and e-learning (5), along with training related to the clinical aspects of the subject during the internship period (19). This can help to minimize prescription errors and improve rational prescribing. Dental curricula play an important role in providing graduates with the skills of prescribing safely, not only through lectures on basic and clinical pharmacology but also *via* incorporating more practical sessions using clinical examples (5). Published studies on prescription errors in dentistry, particularly among undergraduates, are very few (4, 19). Prescribing practices are almost lacking in undergraduate and graduate dental programs. Likewise, the year in which the pharmacology is taught greatly varies among dental schools worldwide (18, 20). In addition, the hours devoted to teaching the subject are few in relation to its importance (20), and this indirectly reflects on the patient safety (6, 20–22). In Yemen, there are no published studies on drug prescription practices among dental students or interns. Therefore, the present study aimed to assess the drug prescribing skills and to explore the drugs most frequently prescribed by dental students and interns.

2. Methods

2.1. Study design, setting and sample size calculation

This descriptive, observational study was conducted among dental students and interns of four Yemeni universities, namely; two public (Sana'a University & Aden University) and two private (University of Science and Technology (UST) & Dar Assalam University) in 2015. A minimum sample size of 230 was calculated using OpenEpi® software (www.OpenEpi.com), at a 95.0% confidence level, 80.0% power and a drug

prescribing error rate of 30 %. Nevertheless, 464 students from the fourth, fifth academic levels and internship, who were present at the time of the study and agreed to participate in the study.

2.2. Data collection

Data were collected using a self-administered questionnaire developed with modification from a previously relevant study (4) and pilot tested among 15 dental students at the Faculty of Dentistry of the UST. Reliability of the questionnaire was assessed at a Cronbach's alpha value of 0.8, and some modifications were made in the phrasing of some questions. The final questionnaire included data on gender, age, study level, university name as well as 29 questions about drug prescription. These questions were categorized into six domains: factors to be considered before prescribing (history of drug intake, systemic diseases, pregnancy, allergies, history of past surgeries, malignant diseases and other factors), indications for prescribing antibiotics in dental situations (abscesses, endodontic problems, periodontal diseases, post minor surgeries, cellulitis and other conditions), antibiotics and analgesics prescribed, difficulties in writing a prescription (drug's name, dose and duration of intake) and knowledge of the WHO's Guide to Good Prescribing (6).

2.3. Data analysis

Data were coded, entered and analyzed using the Statistical Packages for Social Sciences (SPSS), version 20.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and proportions, and differences or associations between them were tested using Pearson's chi-square test. Statistically significant differences were considered at P-values <0.05.

3. Results

3.1. Characteristics of the study respondents

The majority of respondents were females (65.9%; 304/464), being enrolled in public universities (54.1%; 251/464) and from the fifth level of study (54.9%; 251/464). The mean respondents' age was 23.0 ± 1.3 years (range: 22–32). Detailed characteristics of respondents categorized by the level of study are shown in Table (1).

3.2. Factors considered before drug prescribing

Presence of systemic diseases (75.0%; 348/464), pregnancy status (72.2%; 335/464) and presence of allergies (68.8%; 319/464) were the factors most frequently considered by the study respondents prior to drug prescribing. On the other hand, presence of malignant diseases was the most ignored factor during daily prescribing practices, being never considered by 29.1% (135/464) of respondents. A detailed description of the factors considered by Yemeni dental students and interns before prescribing drugs and the frequency of their consideration are shown in Table (2).

Table 1. Characteristics of dental students and intern in selected Yemeni universities by the level of study (2015)*

Characteristic		Level of study		
		Fourth n (%)	Fifth n (%)	Internship n (%)
Gender				
	Male	45 (**42.1**)	75 (**29.9**)	38 (**36.5**)
	Female	62 (**57.9**)	176 (**70.1**)	66 (**63.5**)
Age (years)				
	Mean ± SD = 23.0 ± 1.3 (range: 22–32)			
	<22	43 (**39.4**)	45 (**17.9**)	0 (**0.0**)
	≥22	66 (**60.6**)	206 (**82.1**)	104 (**100.0**)
University	Public	45 (**41.3**)	159 (**63.3**)	54 (**51.9**)
	Private	64 (**58.7**)	92 (**36.7**)	50 (**48.1**)
Total		109 (**23.5**)	251 (**54.1**)	104 (**22.4**)

* Total number of respondents was 464 (109 in the fourth level, 205 in the fifth level and 104 in the internship period); SD, standard deviation.

Table 2. Factors considered before drug prescribing by dental students and interns enrolled in Yemeni universities (2015)*

Factors considered	Frequency of consideration n (%)			
	Frequently	Sometimes	Rarely	Never
History of drug intake	296 (**63.8**)	78 (**16.8**)	40 (**8.6**)	50 (**10.8**)
Systemic disease	348 (**75.0**)	59 (**12.7**)	19 (**4.1**)	38 (**8.2**)
Pregnancy	335 (**72.2**)	58 (**12.5**)	21 (**4.5**)	50 (**10.8**)
Allergies	319 (**68.8**)	69 (**14.9**)	31 (**6.7**)	45 (**9.7**)
History of past surgeries	186 (**40.1**)	127 (**27.4**)	71 (**15.3**)	80 (**17.2**)
Malignant diseases	163 (**35.1**)	75 (**16.1**)	91 (**19.6**)	135 (**29.1**)
Other factors	22 (**4.8**)	23 (**5.0**)	19 (**4.1**)	399 (**86.2**)

* Total number of respondents was 464.

3.3. Reasons for antibiotic prescribing

Presence of abscesses was the most frequent reason for prescribing antibiotics by the respondents (36.6%; 170/464), followed by cellulitis and post minor surgeries (32.2%; 150/464 each). However, periodontal diseases (12.7%; 56/464), endodontic problems (9.7%; 45/464) and other conditions (4.1%; 19/464) were the least frequent reasons for antibiotic prescribing by the respondents (Table 3).

Table 3. Reasons for antibiotic prescribing by dental students and interns enrolled in Yemeni universities (2015)*

Reason for prescribing	Frequency (%)
Presence of abscesses	170 (**36.6**)
Endodontic problems	45 (**9.7**)
Periodontal diseases	56 (**12.7**)
Post minor surgeries	150 (**32.3**)
Cellulitis	150 (**32.3**)
Other conditions	19 (**4.1**)

* Total number of respondents was 464.

3.4. Prescription frequency of antibiotics and analgesics

Table (4) shows that the most frequently prescribed antibiotic was amoxicillin (74.1%; 344/464), followed by Augmentin (22.2%; 103/464). On the other hand, paracetamol was the most frequently prescribed NSAID (58.2%; 270/464), followed by ibuprofen (47.0%; 218/464). A detailed description of the frequency of prescribed antibiotics and analgesics among Yemeni dental students and interns is shown in Table (4).

3.5. Prescribing errors and associated factors

Table (5) shows that not knowing the brand names of prescribed drugs and wrongly filled prescriptions were the most common errors in writing prescriptions, being reported by 79.3% (368/464) and 55.3% (256/464) of respondents, respectively. However, less commonly reported errors were writing wrong treatment duration (49.4%; 229/464) and wrong posology (43.8%; 203/464). Regarding the factors associated with common prescribing errors; female students had significantly more errors than their male counterparts regarding posology and knowledge of brand name; $P = 0.001$, $P = 0.030$, respectively. There was a significant reduction in prescription errors by the increase in the student's study level regarding drug posology ($P = 0.040$). Bivariate analysis shows that students from public universities had more errors in knowing the brand names of drugs ($P = 0.030$), whereas their counterparts from private universities had more errors in writing the correct treatment duration ($P = 0.002$) (Table 6).

Table 4. Prescription frequency of antibiotics and analgesics by dental students and interns enrolled in Yemeni universities (2015)*

Drug category	Prescription frequency *n* (%)			
	Frequently	Sometimes	Rarely	Never
Antibiotics				
Amoxicillin	344 (**74.1**)	71 (**15.3**)	14 (**3.0**)	35 (**7.5**)
Augmentin	103 (**22.2**)	178 (**38.4**)	84 (**18.1**)	99 (**21.3**)
Spirazole	67 (**14.4**)	155 (**33.4**)	81 (**17.5**)	161 (**34.7**)
Tetracycline	29 (**6.3**)	69 (**14.9**)	114 (**24.7**)	250 (**54.1**)
Others	9 (**1.9**)	14 (**3.0**)	20 (**4.3**)	420 (**90.7**)
NSAID analgesics				
Paracetamol	270 (**58.2**)	102 (**22.0**)	29 (**6.2**)	63 (**13.6**)
Ketoprofen	60 (**12.9**)	142 (**30.6**)	82 (**17.7**)	180 (**38.8**)
Ibuprofen	218 (**47.0**)	124 (**26.7**)	50 (**10.8**)	72 (**15.5**)
Aspirin	48 (**10.3**)	76 (**16.4**)	88 (**19.0**)	252 (**54.3**)
Others	7 (**1.5**)	10 (**2.2**)	17 (**3.7**)	430 (**92.7**)

* Total number of respondents was 464; NSAID, nonsteroidal anti-inflammatory drug.

Table 5. Prescribing errors by dental students and interns enrolled in Yemeni universities (2015)*

Prescribing error	Frequency (%)
Not knowing the brand names	368 (**79.3**)
Prescriptions wrongly filled	256 (**55.3**)
Wrong treatment duration	229 (**49.4**)
Wrong posology	203 (**43.8**)

* Total number of respondents was 464.

Table 6. Factors associated with the most common prescribing errors among dental students and interns enrolled in Yemeni universities (2015)

Variable	Prescriptions wrongly filled			Wrong posology			Not knowing the brand names			Wrong treatment duration		
	n (%)	OR (95% CI)	P-value	n (%)	OR (95% CI)	P-value	n (%)	OR (95% CI)	P-value	n (%)	OR (95% CI)	P-value
Gender												
Male	77 (**49.0**)	Reference		52 (**33.1**)	Reference		117 (**74.5**)	Reference		68 (**43.3**)	Reference	
Female	176 (**58.1**)	**0.6** (0.4–1.1)	**0.065**	149 (**49.0**)	**0.5** (0.3–0.7)	**0.001**	249 (**81.9**)	**0.6** (0.4–0.8)	**0.030**	158 (**52.0**)	**0.7** (0.4–1.2)	**0.078**
Level of study												
Fourth	69 (**63.3**)	**1.5** (0.9–2.3)	**0.054**	57 (**52.3**)	**1.5** (1.2–2.4)	**0.040**	86 (**78.9**)	**0.9** (0.5–1.6)	**0.904**	57 (**52.3**)	**1.1** (0.7-1.7)	**0.483**
Fifth & interns	187 (**52.8**)	Reference		146 (**41.0**)	Reference		282 (**79.4**)	Reference		172 (**48.0**)	Reference	
Type of university												
Public	137 (**53.3**)	**0.8** (0.5–1.2)	**0.337**	107 (**41.0**)	**0.8** (0.5–1.1)	**0.268**	214 (**82.9**)	**1.6** (1.1–2.5)	**0.031**	111 (**43.0**)	**0.5** (0.3–0.8)	**0.002**
Private	119 (**57.8**)	Reference		96 (**46.6**)	Reference		154 (**74.8**)	Reference		118 (**57.0**)	Reference	

n, Number of respondents; CI, confidence interval; OR, odds ratio.

4. Discussion

Dental students become responsible for treating patients during their clinical sessions and for developing correct treatment plans for each dental health situation under the supervision of their seniors. Although the hours of clinical practice included in the total program hours differ between public and private dental faculties, the curriculum is generally similar. On the other hand, teaching pharmacology course starts from the third level in some programs, but in the fourth level in others. However, clinical pharmacology is taught at the fifth level. Therefore, the present study included dental students from the fourth and fifth levels and interns, whose clinical practice includes drug prescribing, from public and private dental faculties to make the sample as much representative as possible. The treatment plan always includes drug therapy along with clinical procedures. Drug prescribing is a critical task related to dental as well as systemic conditions of the patient. Several factors may play a role in good prescribing practices by dental students and interns. For instance, male students in the present study reported better prescription skills than females. This could be partly attributed to the fact that they depend more on their seniors in prescribing, resulting in less self-

practice and more errors. This is inconsistent with the finding of a previous study among Indian dental interns (5).

In the present study, the most frequent reasons for antibiotic prescribing reported by dental students and interns were the presence of abscesses, cellulitis and post minor surgeries, each accounted for approximately a third of all prescriptions. This could be explained by the fact that most dental patients in Yemen, like in other developing countries with a low socioeconomic status, are usually admitted to the clinics of dental faculties at late stages of odontogenic infections. This finding is in line with that of a previous study among fourth-level dental students in Mexico (4). Amoxicillin was found to be the most frequently prescribed antibiotic, being accounted for three-quarters of all drug prescriptions. This could be attributed to its broad spectrum activity in treating mixed odontogenic infections. However, there are increasing concerns about the development of bacterial resistance against it because of its irrational prescription without antimicrobial susceptibility testing. Its over-prescription by dental students and interns compared to other antibiotics has also been reported by previous studies (4, 5, 23).

Along with antibiotics, analgesics are the most commonly prescribed drugs in dental practice due to their important role as painkillers; however, their use is usually accompanied by a wide range of side effects as gastric ulcers. Although paracetamol has no anti-inflammatory effect, it was the most frequently prescribed analgesic, being prescribed by 58.2% of respondents. This finding is in agreement with those of previous studies from India and Mexico (4, 5). Such a high prescription rate could be attributed to its fewer side effects on the gastric mucosa, though it can be hepatotoxic if used in high doses. Ibuprofen was the second most frequently prescribed analgesic (22.2%) by Yemeni dental students and interns. Generally, these two painkillers are the most widely used among dental students and interns. On the other hand, Aspirin was the least frequently prescribed analgesic, and this could be due to its relation to systemic diseases and bleeding disorders. This finding agrees with that previously reported in India (4).

Dental drug therapy may interact with the general health condition, especially for medically compromised patients. Drugs may exaggerate the disease or interact with pre-existing drug treatment, and this may complicate the systemic health of dental patients. In the present study, high awareness levels of the importance of considering history of drug intake and the presence of systemic conditions before drug prescription were reported by 63.8% and 75.0% of respondents during clinical sessions, respectively. This could be attributed to the fact that they had been taught this topic in the curriculum of other courses other than pharmacology, like oral and maxillofacial surgery, management of medically compromised patients, general medicine, oral medicine and periodontology.

Considering the presence of systemic diseases before drug by dental students and interns in the present study is higher than that reported by Anjum et al study among Indian dental students (63%) (5). The WHO guide (6) determines six steps to be considered before drug prescribing as follows: define the patient's problem, "*specify the therapeutic target, mention the outcome needed from treatment, verify effectiveness and safety, start the treatment, give information, instructions and warnings, and supervise (stop?) the treatment.*" However, only 6.4% (7/107) of the fourth-level students in the present study followed the WHO guide, which is lower than that (30.0%) reported by Guzmán-Álvarez et al. (4) among 66 fourth-level Indian dental students. In Fact, there is a lack of medical and practical issues in pharmacology courses in dental faculties in Yemeni universities, and the credit hours of the subject in the curriculum are inadequate compared to its importance for patients' health and safety in the practical field of dentistry. In addition, clinical dental pharmacology is not taught at early levels of dental programs in the surveyed facilities. Therefore, there is an urgent need to emphasize on the clinical medical subjects.

The high rate of wrong filling of drug prescriptions reported by more than half of respondents (n = 256) is a critical issue that may compromise their patients' safety. The most common prescribing error was choosing drug alternatives of various brand names available for the same drug since there are several local and international drug companies providing their products in the local market. On the other hand, wrong drug dose and treatment duration were also reported by a high proportion of respondents; however, it is lower than that reported by Guzmán-Álvarez et al. (4) among Indian dental students in the fourth level of dentistry. This may be due to differences in the curricula of the dental faculties.

Like other questionnaire-based studies, the present study has some limitations. For instance, self-awareness of errors is a poor method of estimating errors since the respondents tend to under- or over-estimate the real situation. Furthermore, the questionnaire had no open-ended questions to investigate the real drug prescribing errors.

5. Conclusions

Dental students enrolled at the fourth and fifth levels as well as in the internship year of dentistry have insufficient knowledge and skills in prescribing drugs used in the dental field because of the perceived gaps in clinical pharmacology courses during their study. Revising the timing and content of pharmacology courses in dental curricula is required in light of the positive aspects of those from the dental faculties worldwide, emphasizing on drug prescribing skills and preparing dental students well before the clinical levels of the study program.

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Authors' contributions

MAA conceived the study design. SA, SB, AA, AA and HE carried out the study. MAA and SA analyzed the study and wrote the first draft of the manuscript. All authors read, revised and approved the final draft of the manuscript

Competing interests

The authors declare that they have no competing interests associated with this article.

Ethical approval

The ethical clearance of this study was obtained from the Ethics Committee of the University of Science and Technology, Sana'a. Students and interns were asked to fill in and sign a consent form attached to the questionnaire, and those who were not willing to participate were excluded.

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