

# Antibiotic Prescribing for Endodontic Infections and Prophylaxis for Medically Compromised Patients: A Survey on Dental Students in Turkey

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## ABSTRACT

**Introduction:** High and wrong antibiotic usage causes Antimicrobial Resistance (AMR) which is a worldwide problem. Dental students, as future dentists are likely to provoke this public health issue by inappropriate prescribing choices. There is a need of further education of antibiotic prescription in endodontic infections, as well as prophylaxis.

**Aim:** The aim of this study was to establish the knowledge of dental students on the suitable use of systemic antibiotics for endodontic infections and prophylaxis for medically compromised patients.

**Materials and Methods:** A survey was done on dental students at the end of third, fourth and fifth years, who answered a questionnaire about antibiotic use for endodontic infections and prophylaxis for various immunocompromised patients. Pharmacology and endodontics lectures should be taken by respondents; was the inclusion criterion. Data were analysed using descriptive statistics and Chi-square test. Statistical significance was fixed at  $p < 0.05$ .

**Results:** Amoxicillin + clavulanic acid (500/125 mg) was the first-choice antibiotic of students. The percentage of fifth

grade students who would prescribe amoxicillin + clavulanic acid (500 mg/125 mg) was lower than third and fourth grade students ( $p=0.006$ ). In case of allergy to penicillin, clindamycin 300 mg was selected as a first-choice antibiotic by 78.3% of students. About 50.2% of the respondents indicated a treatment duration of 3-7 days, while 28.5% chose more than seven days usage. Fourth grade dental students who would prescribe antibiotics for more than seven days (40.7%) were found to be statistically more significant than third (27.8%) and fifth (16%) grade students ( $p=0.004$ ). In case of acute apical abscess with systemic manifestations, 94.5%, which is the highest percentage of all, of students would prescribe antibiotic. Third grade dental students were the most antibiotic prescribing group for chronic apical periodontitis and periradicular (pocket) cyst ( $p < 0.001$ ). Patients with history or risk of bacterial endocarditis, were prescribed prophylactic antibiotics at a rate of 92.3% by students.

**Conclusion:** Even though the results showed acceptable levels of competence, dental education should place greater focus on prescription of antibiotics to prevent Antimicrobial Resistance (AMR).

**Keywords:** Antimicrobial resistance, Dental education, Questionnaire

## INTRODUCTION

The Antimicrobial Resistance (AMR) is the capability of a micro-organism to endure the influence of antibiotics [1,2] which might happen owing to certain micro-organism types developing resistance to antimicrobial agents in prolonged usage [3]. In addition, non essential use or erroneous prescription of antibiotics have been identified as primary factors in AMR which is one of the most important risks to community health and also threatens the efficient prevention and treatment of bacterial infections [4,5]. Clinicians' responsibility is to re-evaluate the correct use of antibiotics in regular practice.

There is a worldwide consensus that extensive prescription of antibiotics in treatment of endodontic diseases is not recommended. In endodontics, it is advised that antibiotics should only be used as an addition to root canal treatment for individuals who have systemic symptoms related to endodontic infections, with progressive infections and immunological issues [4,6-8]. On the other hand, antibiotic prophylaxis prior to endodontic treatment might be considered for specific patient groups; those with immunocompromising conditions and in case of the presence of systemic or persistent infections, along with endodontic treatment. The European Society of Endodontology (ESE) undergraduate curriculum guidelines for Endodontology [9] recommend a list

of skills which graduating dental students are supposed to have mastered. According to the guidelines, dental students should not be educated simply as technicians, but should receive training in microbiology, AMR mechanisms, immunology and infection control. Moreover, they should be trained to handle endodontic emergencies such as acute pulpitis, acute apical periodontitis and acute apical abscess.

The dental curriculum in Turkish universities contains pharmacology, including the study of antibiotics, in the third year of dental studies. Theoretical lectures of endodontics are in the second, third and fourth years. Lectures on endodontic infections and emergency treatment related to pulpal pathologies are completed at the end of third year. As a result, before performing on patients, students should be aware of the fact that antibiotic usage is not indicated in irreversible pulpitis, necrotic pulp and chronic apical periodontitis cases, which are most commonly seen in practice. In addition, dental undergraduates are taught that dental infections can mostly be treated by surgical or non surgical endodontic therapy without the use of antibiotics. Undergraduates consolidate this theoretical knowledge into practice in endodontics clinics in the fourth and fifth years [10].

According to Kandemir S and Ergül N, a high percentage of Turkish dentists (74.4%) prescribe antibiotics unnecessarily [11]. Dental students should be aware of the increasing AMR problem due to unnecessary or erroneous antibiotic prescriptions, as they will

be antibiotic-prescribing clinicians in future[12]. In Turkey, there are not enough studies analysing undergraduates' knowledge of antibiotic use in endodontic infections. The aim of this study was to determine the awareness of dental students at a Turkish University, of indications for systemic antibiotic usage in the management of endodontic diseases and prophylactic indications before root canal treatment and to modify the dental curriculum to improve undergraduates' learning about the proper use of antibiotics and the threat of AMR.

## MATERIALS AND METHODS

This cross sectional study was approved by the Ethics Committee of Biruni University, Istanbul, Turkey (2019/29-54) and was in full agreement with the World Medical Association Declaration of Helsinki. A questionnaire was given to dental students of Biruni University at the end of third (Grade III), fourth (Grade IV) and fifth (Grade V) years in June 2019. The duration of the study was two weeks, including data collection, data input and statistical analysis. Pharmacology and theoretical lectures of endodontics should be taken by third grade dental students and theoretical lectures of endodontics along with clinical practice in endodontics clinic should be completed by fourth and fifth grade students as an inclusion criterion. Questionnaire was formed based on previously published surveys [13,14] with additional parameters regarding antibiotic prophylaxis. Informed consent was obtained from the undergraduates who participated in the study voluntarily, anonymously and without compensation. First, a pilot study was performed on randomly selected 20 dentists to validate the questionnaire and its Cronbach's alpha was obtained to be 0.78. The questionnaire used in the pilot study was formed of five questions related to the knowledge of antibiotic prescription in endodontic infections and prophylaxis. For the reason that the questions were understandable, the same questions were decided to be used in the main study. The pilot study respondents were excluded from the main study.

A total of 250 undergraduates of the third, fourth and fifth grades fulfilling the inclusion criteria, participated in the research, and 235 (94%) answered the questionnaire adequately. The respondents of the study were the present dental students of university Biruni. The total number of the third, fourth and fifth grades students fulfilling the inclusion criteria (completing pharmacology and endodontic lectures) in the university was 250. Of 250 students, 15 of them didn't answer the questionnaire adequately (at least one question) which left with 235 respondents to evaluate. The survey was formed of eight questions in total with personal information, separated into two sections: the first section (3 questions) was a record of individual data such as gender, age and grade; the second section (five questions) involved questions related to knowledge of antibiotic prescription in endodontic infections and prophylaxis [Table/Fig-1]. The questionnaire was answered by the respondents at the end of the spring term, in a single day, in 10 minutes time duration. The answers were not graded or scored due to the fact that the study was considered as a survey.

## STATISTICAL ANALYSIS

Data were gathered in an Excel file (Microsoft Corp., Redmond, WA, USA). Statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) Statistics 22 (IBM SPSS, Turkey). Chi-square test and Fisher's Freeman Halton test was used for statistical analysis. Significant differences were set at 5% ( $p < 0.05$ ).

## RESULTS

Of 235 students, male respondents ( $n=87$ ) accounted for 37% and females ( $n=148$ ) which accounted for 63%. The respondents'

Gender: Male  Female  Age:.....Grade: 3  4  5

1) When systemic antibiotics are indicated, which antibiotic would you choose for the treatment of an endodontic infection in an adult, healthy patient with no medical allergies? (only one answer):

- Amoxicillin: 500 mg  750 mg  1 gr

- Amoxicillin + Clavulanic Acid: 250 mg/625 mg   
500 mg/125 mg   
875 mg/125 mg

- Clindamycin: 300 mg

- Azithromycin: 250 mg  500 mg  1 gr

- Metronidazole + Spiramycin: 250 mg/1.5 MIU

- Other: .....

2) For how many days would you prescribe antibiotics?:  
.....

3) When systemic antibiotics are indicated, which antibiotic would you choose for the treatment of an endodontic infection in an adult, healthy patient with allergy to penicillin? (only one answer):

- Clindamycin: 300 mg

- Azithromycin: 250 mg  500 mg  1 gr

- Metronidazole + Spiramycin: 250 mg/1.5 MIU

- Erythromycin: 500 mg

- Lincomycin: 600 mg

- Other: .....

4) In which of the following situations do you consider that antibiotics are indicated? Check all that apply:

- Irreversible pulpitis (Symptomatic)

- Acute apical abscess with systemic manifestations

- Chronic pulpitis (pulp polyp, ulcerative pulpitis)

- Chronic apical periodontitis with sinus tract

- Acute apical periodontitis

- Chronic apical periodontitis without sinus tract

- Acute apical abscess without systemic manifestations

- Periradicular (pocket) cyst

5) In which of the following systemic situations do you consider that antibiotics are indicated for prophylaxis? Check all that apply:

- Myocardial infarction

- Unstable angina pectoris

- Prosthetic heart valve

- Heart transplant

- History/risk of bacterial endocarditis

- Congenital heart disease

- Acute rheumatic fever

- Leukemia

- Diabetes mellitus

- Other organ transplants

**[Table/Fig-1]:** Antibiotic use in endodontic infections and prophylaxis questionnaire administered to dental undergraduates.

mean age was  $22.68 \pm 1.58$  years. The percentages of third, fourth and fifth grade respondents were ( $n=79$ ) 33.6%, ( $n=81$ ) 34.5% and ( $n=75$ ) 31.9%, respectively [Table/Fig-2].

Demography		Grade 3	Grade 4	Grade 5	p-value
		n (%)	n (%)	n (%)	
Age		21.91 $\pm$ 1.48	22.58 $\pm$ 1.66	23.59 $\pm$ 1.08	$^{\dagger} < 0.001$
Gender	Male	27 (34.2)	31 (38.3)	29 (38.7)	$^{\dagger} 0.812$
	Female	52 (65.8)	50 (61.7)	46 (61.3)	

**[Table/Fig-2]:** Description of respondents.

$^{\dagger}$ One-way Anova test;  $^{\ddagger}$ Chi-square test;  $^{\ast} p < 0.05$

### Prescription and Duration of Antibiotics

The highest percentage of the respondents with regard to patients with no medical allergies chose amoxicillin + clavulanic acid 500/125 mg. Amoxicillin 1000 mg, amoxicillin 500 mg and amoxicillin + clavulanic acid 875/125 mg were the following most popular responses. Other antibiotics were rarely chosen in the survey. There were significant differences among the results of the third, fourth and fifth grade students ( $p=0.006$ ;  $p<0.05$ ). A 50.2% of the respondents indicated a treatment duration of 3-7 days, while 28.5% chose more than seven days usage. The percentage of students who prescribed antibiotics for less than three days was 21.3%. In case of penicillin allergy, clindamycin 300 mg was selected as a first-choice antibiotic by 78.3% of students, whereas 8.5%, 4.3%, 3%, 3%, 2.6% and 0.4% of the respondents selected azithromycin 500 mg, azithromycin 250 mg, metronidazole + spiramycin 250 mg/1.5 MIU, erythromycin 500 mg, azithromycin 1000 mg and lyncomycin 600 mg, respectively. Accordingly, the percentage of fifth grade students who would prescribe amoxicillin + clavulanic acid (500 mg/125 mg) was lower than that of third and fourth grade students. When the grades were compared by duration of antibiotic prescription, fourth grade dental students who would prescribe antibiotics for more than 7 days (40.7%) were found to be statistically more significant than third (27.8%) and fifth (16%) grade students ( $p<0.05$ ) [Table/Fig-3].

### Indications for Use of Antibiotics

The percentage of respondents who would prescribe antibiotics for different pulpal and periapical diseases are presented in [Table/Fig-4]. This shows that acute apical abscess with systemic manifestations, acute apical periodontitis, acute irreversible pulpitis, chronic apical periodontitis without sinus tract, chronic apical periodontitis with sinus tract, periradicular (pocket) cyst, chronic pulpitis and acute apical abscess without systemic manifestations were the cases which the respondents would prescribe antibiotics; the percentages being 94.5%, 26.4%, 20.4%, 19.1%, 18.3%, 16.2%, 6.4% and 6%, respectively. The percentage of dental students who would choose antibiotic prophylaxis for medically compromised patients are also shown in [Table/Fig-4]. Accordingly, patients with medical

Antibiotics		Total	Grade 3	Grade 4	Grade 5	p-value
		n (%)	n (%)	n (%)	n (%)	
<b>For the treatment of an endodontic infection in an adult, healthy patient with no medical allergies</b>						
Amoxicillin	500 mg	48 (20.4)	26 (54.2)	11 (35.5)	11 (27.5)	0.120
	750 mg	5 (2.1)	1 (2.1)	2 (6.5)	2 (5)	
	1 gr	66 (28.1)	21 (43.8)	18 (58.1)	27 (67.5)	
Amoxicillin + Clavulanic acid	250 mg/ 62.5 mg	6 (2.6)	2 (7.4)	4 (8.5)	0 (0)	0.006*
	500 mg/ 125 mg	78 (33.2)	24 (88.9)	35 (74.5)	19 (59.4)	
	875 mg/ 125 mg	22 (9.4)	1 (3.7)	8 (17)	13 (40.6)	
Clindamycin	300 mg	4 (1.7)	2 (100)	2 (100)	4 (100)	-
Azithromycin	250 mg	2 (0.9)	1 (100)	1 (50)	0 (0)	0.287
	500 mg	1 (0.4)	0 (0)	0 (0)	1 (100)	
	1 gr	1 (0.4)	0 (0)	1 (50)	0 (0)	
Metronidazole + Spiramycin	250 mg/ 1.5 MIU	1 (0.4)	-	1 (100)	-	-
Other		1 (0.4)	1 (100)	-	-	-
Duration of therapy (days)	<3	50 (21.3)	22 (27.8)	10 (12.3)	18 (24)	0.004*
	3-7	118 (50.2)	35 (44.3)	38 (46.9)	45 (60)	
	>7	67 (28.5)	22 (27.8)	33 (40.7)	12 (16)	
<b>For the treatment of an endodontic infection in an adult, healthy patient with allergy to penicillin</b>						
Clindamycin	300 mg	184 (78.3)	46 (100)	71 (100)	67 (100)	-
Azithromycin	250 mg	10 (4.3)	7 (28)	2 (28.6)	1 (25)	0.244
	500 mg	20 (8.5)	16 (64)	2 (28.6)	2 (50)	
	1 gr	6 (2.6)	2 (8)	3 (42.9)	1 (25)	
Metronidazole + Spiramycin	250 mg/ 1.5 MIU	7 (3)	4 (100)	1 (100)	2 (100)	-
Erythromycin	500 mg	7 (3)	3 (100)	2 (100)	2 (100)	-
Lincomycin	600 mg	1 (0.4)	1 (100)	-	-	-

[Table/Fig-3]: Distribution of antibiotic preferences and duration of antibiotic prescription between grades. Chi-square test; \* $p<0.05$

Conditions	Total	Grade 3	Grade 4	Grade 5	p-value	
	n (%)	n (%)	n (%)	n (%)		
<b>Therapeutic conditions where use of antibiotics was indicated</b>	Irreversible pulpitis (Symptomatic)	48 (20.4)	24 (30.4)	11 (13.6)	13 (17.3)	<sup>†</sup> 0.022*
	Chronic pulpitis (pulp polyp, ulcerative pulpitis)	15 (6.4)	9 (11.4)	4 (4.9)	2 (2.7)	<sup>†</sup> 0.069
	Acute apical periodontitis	62 (26.4)	22 (27.8)	24 (29.6)	16 (21.3)	<sup>†</sup> 0.470
	Acute apical abscess without systemic manifestations	14 (6)	5 (6.3)	5 (6.2)	4 (5.3)	<sup>†</sup> 1.000
	Acute apical abscess with systemic manifestations	222 (94.5)	73 (92.4)	79 (97.5)	70 (93.3)	<sup>†</sup> 0.309
	Chronic apical periodontitis with sinus tract	43 (18.3)	19 (24.1)	11 (13.6)	13 (17.3)	<sup>†</sup> 0.223
	Chronic apical periodontitis without sinus tract	45 (19.1)	26 (32.9)	6 (7.4)	13 (17.3)	<sup>†</sup> <0.001*
	Periradicular (pocket) cyst	38 (16.2)	25 (31.6)	7 (8.6)	6 (8)	<sup>†</sup> <0.001*
<b>Systemic conditions where use of antibiotics was indicated for prophylaxis</b>	Myocard infarction	100 (42.6)	40 (50.6)	28 (34.6)	32 (42.7)	<sup>†</sup> 0.121
	Unstable angina pectoris	59 (25.1)	24 (30.4)	18 (22.2)	17 (22.7)	<sup>†</sup> 0.414
	Prosthetic heart valve	202 (86)	63 (79.7)	74 (91.4)	65 (86.7)	<sup>†</sup> 0.105
	Heart transplant	190 (80.9)	55 (69.6)	71 (87.7)	64 (85.3)	<sup>†</sup> 0.007*
	History/risk of bacterial endocarditis	217 (92.3)	64 (81)	80 (98.8)	73 (97.3)	<sup>†</sup> <0.001*
	Congenital heart disease	155 (66)	46 (58.2)	64 (79)	45 (60)	<sup>†</sup> 0.009*
	Acute rheumatic fever	158 (67.2)	39 (49.4)	66 (81.5)	53 (70.7)	<sup>†</sup> <0.001*
	Leukemia	93 (39.6)	28 (35.4)	34 (42)	31 (41.3)	<sup>†</sup> 0.652
	Diabetes mellitus	46 (19.6)	17 (21.5)	14 (17.3)	15 (20)	<sup>†</sup> 0.791
	Other organ transplants	172 (73.2)	48 (60.8)	67 (82.7)	57 (76)	<sup>†</sup> 0.006*

[Table/Fig-4]: Distribution of therapeutic conditions and systemic conditions where use of antibiotics was indicated between grades. <sup>†</sup>Chi-square test; \*Fisher Freeman Halton test; <sup>†</sup> $p<0.05$

history or risk of bacterial endocarditis, prosthetic heart valve, heart transplant, any other organ transplant, acute articular rheumatism, congenital heart disease, myocardial infarction, leukemia, unstable angina, uncontrolled diabetes mellitus were prescribed prophylactic antibiotics at a rate of 92.3%, 86%, 80.9%, 73.2%, 67.2%, 66%, 42.6%, 39.6%, 25.1% and 19.6%, respectively, by dental students.

According to statistical significances among the antibiotic prescription for pulpal and periapical diseases by different grade students, third grade dental students were the most antibiotic prescribing group for chronic apical periodontitis and periradicular (pocket) cyst ( $p < 0.05$ ). There was also statistical significance among students in different grades about antibiotic prophylaxis before endodontic treatment in various medically compromised patients. Third grade students had the lowest percentage of antibiotic prophylaxis consideration for heart and any other organ transplants, history or risk of bacterial endocarditis and acute articular rheumatism ( $p < 0.05$ ). On the other hand, antibiotic prophylaxis consideration for congenital heart diseases was found to be significantly higher in fourth grade students than third and fifth grades ( $p < 0.05$ ).

## DISCUSSION

The results of the present study provide a range of information on the prescription of antibiotics both in pulpal and periapical diseases and prophylaxis for medically compromised patients before endodontic treatment by different grades of dental students at a dental faculty in Istanbul. Similar previous researches [13,14] only included final year dental students, whereas present study also included third and fourth year undergraduates. All the respondents took the theoretical pharmacology and endodontics lectures including survey subjects. Although a lack of clinical experience was still indicated in some of the responses. Even though the majority of students selected the appropriate antibiotics for endodontic infections and prophylactic purposes, there were still some inappropriate antibiotic prescribing choices.

The present study showed that the selection of amoxicillin alone, or in association with clavulanate was the first preference of 95.8% of dental students. Amoxicillin + clavulanic acid (500 mg/125 mg) was the first choice antibiotic (at 33.2%) for endodontic infections, followed by 1000 mg amoxicillin alone (28.1%). The results of the studies conducted by Salvadori M et al., and Martín-Jiménez M et al., are in agreement with the results of the present study [13,14]. Moreover, surveys performed among European dentists in other nations showed that amoxicillin is the first choice of antibiotic for the treatment of pulpal and periapical diseases [15-17]. On the other hand, surveys conducted among students in other countries have indicated lower level of amoxicillin prescribing as first choice of antibiotics. Indian dentists also selected amoxicillin as the primary choice, followed by ofloxacin/ornidazole [18,19]. In contrast, the second antibiotic choice in the present study was clindamycin, although its percentage was low. Guzmán-Álvarez R et al., found that 78.9% of fourth grade students indicated amoxicillin as first-choice antibiotic for endodontic infections [20]. Similarly, in present study, third grade students selected amoxicillin as their first choice. Amoxicillin is appropriate for endodontic infections, as it supplies coverage for many types of microorganisms [8]. However, its efficiency is decreased when identical infections are maintained by beta-lactamase-producing bacteria. Thus, amoxicillin is commonly administered in combination with clavulanic acid, which boosts its bactericidal effect [21]. Furthermore, information from the literature asserts that amoxicillin alone and in combination with clavulanic acid is an optimum first-choice antibiotic in the endodontic treatment of periradicular infections [4].

Clindamycin 300 mg was the first choice antibiotic of 78.3% of the respondents (78.3%) in case of beta-lactam allergy. Similarly, Martín-Jiménez M et al., found that the first choice of antibiotic of almost all the respondents (99%) was clindamycin 300 mg in patients with beta-lactam allergy [14]. Regarding pulpal and periradicular infections, Guzmán-Álvarez R et al., and Jain A et al., noted clindamycin as the most popular antibiotic in the event of penicillin allergy [20,22]. Furthermore, ESE advised the use of clindamycin, clarithromycin or azithromycin in patients who were allergic to beta-lactam antibiotics [4].

Salvadori M et al., demonstrated that 99% of Italian students prescribed antibiotics for three to seven days, while 0.1% of students prescribed for more than seven days [13]. On the other hand, Martín-Jiménez M et al., noted that 7 days being the more commonly selected duration by respondents (69%) while 20% of Spanish dental students indicated antibiotic therapy of more than seven days [14]. According to present study, the duration of antibiotic treatment as 3-7 days was suggested by 50.2% of respondents which is the highest percentage. Endodontic infections have a quick onset and limited period of time, generally lasting from three to seven days, hence therapy for less than seven days is indicated, and both situations are widely in line with the literature recommendations [15].

Acute apical abscess with systemic manifestations is identified by quick onset, spontaneous pain, pus composition and swelling of soft tissues. About 94.5% of respondents prescribed antibiotics as essential in acute apical abscess with systemic involvement. Similarly, over 90% of Italian dental students regarded the selection of the antibiotics as necessary in acute apical abscess [13]. This outcome verifies that the dental students can identify the clinical scenario which requires systemic antibiotic treatment. In addition, 6% of the students in this study indicated that antibiotic prescription is needed in patients with acute apical abscess without systemic manifestations. On the contrary, Salvadori M et al., noted that 86% of dental students recommended antibiotic prescription in these cases [13]. The common agreement is that intracanal or surgical drainage is enough to control the infection and systemic antibiotic treatment is not needed [8].

In case of acute apical periodontitis, 26.4% of respondents advocated antibiotic prescription in present study. On the other hand, Martín-Jiménez M et al., and Al Masan AA et al., noted that 44% and 75% of their respondents, respectively, prescribed antibiotics for the treatment of acute apical periodontitis [14,23]. It is a fact that antibiotics are not useful in managing pain in endodontic diseases [6,24]. Instead, the suggested control of acute apical periodontitis is endodontic therapy with the prescription of analgesics and anti-inflammatory drugs [25].

The students in the present study prescribed antibiotics in chronic apical periodontitis with or without sinus tract at the rates of 18.3% and 19.1%, respectively. On the other hand, Salvadori M et al., and Martín-Jiménez M et al., showed that the percentage of antibiotic prescription for chronic apical periodontitis with sinus tract was found more than twice as high (30% and 38%, respectively) than cases without sinus tract (14% and 16%, respectively) [13,14]. Hence, present study results seems to be more realistic, as the existence of sinus tract does not signify an exacerbating periapical infection, and chronic apical periodontitis related to the sinus tract must be treated with endodontic therapy and intracanal medicaments but not with antibiotics [26].

Even though periradicular (pocket) cysts can only be verified with histopathological analysis, they generally appear in radiographs

as round, locular and lucent lesions surrounded with radio-opaque borders [27]. Because of the limitations to the diagnosis of histopathological analysis during routine endodontic treatment, previous studies might not have evaluated the prescription of antibiotics in these cases. In contrast, the study included periradicular (pocket) cysts in present study, with the result that 16.2% of the students indicated that they would consider prescribing antibiotics. This result confirms that a notable percentage of dental students ignored the correct prescription of antibiotics.

One of the contraindications of antibiotics is symptomatic or asymptomatic pulpitis [8]. Salvadori M et al., noted that 29% of respondents would prescribe antibiotics for symptomatic pulpitis [13]. In this study, the percentages of respondents prescribing antibiotics for acute (20.4%) and chronic (6.4%) pulpitis were lower, but the proximity of the percentages showed that students have trouble in determining the contraindications of antibiotic prescribing. The importance of clinical experience in managing the proper indications of antibiotics prescription was clear, with the third-graders having the highest percentage of antibiotic prescribing for acute pulpitis in present study.

Most patients do not need antibiotic prophylaxis in dental care and endodontic treatment. Still, antibiotic prophylaxis may be needed (in consultation with a physician) for certain patient groups with congenital heart defects, a prosthetic cardiac valve, a history of infective endocarditis and multiple medical conditions such as uncontrolled diabetes mellitus, malignancy, immunosuppressive diseases and chronic inflammatory diseases [28-30]. The instructions of the European Society of Cardiology (ESC) [31] advise antibiotic prophylaxis only for dental therapies including perforation of the oral mucosa, the manipulation of gingival and periapical areas of the teeth and endodontic treatment for the management of infective endocarditis. According to results of the present study, 92.3% of respondents recommended antibiotic prophylaxis for patients with history or risk of bacterial endocarditis. Additionally, 86%, 81%, 73% and 67% of respondents chose antibiotic prophylaxis for patients with prosthetic cardiac valve, heart transplant, any other transplanted organ and acute articular rheumatism, respectively. These results indicate that a significant percentage of the dental students followed the scientific basis for antibiotic prophylaxis in endodontics. On the other hand, the correct antibiotic recommendation for these conditions was significantly lower in third grade students than those in the fourth and fifth grades. These results may be related to the absence of clinical experience of the third graders.

### Limitation(s)

Since this study included only the students of Biruni University Faculty of Dentistry, the low number of respondents can be considered as a limitation of this study. Moreover, similar survey studies can be conducted to students from different universities and the results can be compared. The education curriculum can be updated according to the results obtained. In addition, owing to the lack of studies on antibiotic prophylaxis in endodontics, the results of this study can not be directly compared with other studies. Further researches are needed concerning these parameters.

### CONCLUSION(S)

In conclusion, systemic antibiotic use for inappropriate conditions in endodontic procedures threatens public health by causing AMR. The results of this study confirm the importance of clinical experience, along with training in compliance with recent international guidelines regarding the correct indications for antibiotic prescription. Even though the results showed acceptable levels of competence, dental education should still

place greater focus on the prescription of antibiotics in certain conditions, in order to guarantee the efficiency in the treatment and prevention of infections and fight against AMR. Dental curriculum and clinical courses can be altered for a better understanding and application of antibiotic use for endodontic infections or prophylaxis.

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