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Experience of Malaysian Undergraduate Dental Students on the Appropriate Use of Systemic Antibiotics for Endodontic Pathology

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KEYWORDS

Antibiotics, endodontic infections, dental student survey, experience

ABSTRACT

This study aims to explore experiences of Malaysian undergraduate dental students on the appropriate use of systemic antibiotics for pulp and periapical pathology. Final-year students from thirteen Malaysian dental schools were invited to participate in an online survey on the use of systemic antibiotics for treatment of pulp and periapical infections. The questionnaire was divided into i) respondents' demographic data; ii) experiences and practices related to antibiotic use in managing endodontic pathology. Two open-ended questions were included to assess awareness on i) existing guidelines for prescribing antibiotics for endodontic pathology; ii) consequences of overprescribing antibiotics. Response rate was 100%. Amoxicillin (with or without clavulanic acid) (85.0%) was the most used antibiotic while clindamycin (53.7%) was chosen for penicillin-allergic patients. Antibiotic treatment was carried out for five-day duration. Cases of acute apical abscess with systemic involvement received the most antibiotic prescriptions (88.5%). A considerable number of students inappropriately prescribe antibiotics for asymptomatic apical periodontitis with or without sinus tract (29.0%) and reversible pulpitis (5.6%). 87.0% of respondents were aware of detrimental effects of antibiotics overuse. Despite high awareness on antibiotics' side effects, some students still prescribe antibiotics unnecessarily. Enhancement of undergraduate endodontic education is highly recommended to avoid unnecessary antibiotic prescriptions.

INTRODUCTION

Polymicrobial species have been identified in primary endodontic infections, including a combination of Gram-positive and Gram-negative bacteria, facultative anaerobes, and strict anaerobes that can be successfully treated with chemomechanical debridement [1]. However, when dentists encounter cases of periapical infection, especially those with pain and swelling, they continue to overprescribe antibiotics [2]. The use of antibiotics for the treatment of endodontics infections has been extensively studied by researchers worldwide because of the growing concerns about the emergence of antimicrobial resistance (AMR) [3,4,5,6]. Studies highlight a concerning trend of inappropriate antibiotic prescribing practices among Malaysian dentists [7]. found that while 62% of dentists reported prescribing antibiotics for dental-related infections, only a mere 6.9% adhered to the recommended guidelines. This issue extends beyond over-prescription, as evidenced by a clinical audit of public dental primary care in Malaysia. The audit revealed a concerning increase in inaccurate antibiotic prescriptions, particularly for periapical pathology, rising from 20.6% in 2018 to 25.7% in 2019. These findings underscore a pressing need to address inappropriate antibiotic use in dental practices to mitigate the risk of antibiotic resistance and promote responsible prescribing habits [7,8]. This high rate of antibiotic use significantly contributes to the global rise of antimicrobial resistance, a phenomenon where bacteria develop

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resistance to antibacterial agents upon repeated or inappropriate exposure [9].

The Ministry of Health in Malaysia has developed antibiotic guidelines: the National Antimicrobial Guideline (NAG) and the Clinical Practice Guidelines (CPG). While the NAG provides guidance on antibiotic use for a range of dental infections, it lacks specific recommendations for endodontic infections such as pulpal necrosis and apical periodontitis cases. Conversely, the CPG primarily focuses on antibiotic prophylaxis [10,11]. The European Society of Endodontology (ESE) has published a position statement that provides dentists with evidence-based indication criteria for antibiotics usage in managing endodontic infections, traumatic injuries, revascularization procedures in immature teeth with pulpal necrosis, and prophylaxis for medically compromised patients [12]. The antibiotic prescription habits of Spanish endodontists have improved following the publication of the ESE evidence-based position statement [13]. Acute apical abscess with systemic involvement such as fever, lymphadenopathy, trismus, or facial cellulitis is typically of endodontic origin and requires antibiotics because of possible lymphatic or bloodstream spread of infection. Conversely, pain that originates from symptomatic irreversible pulpitis, symptomatic apical periodontitis, or localized acute apical abscess without systemic involvement does not require antibiotics [5,13]. However, a survey in the UK found that 40% of general dentists prescribe antibiotics thrice a week, and 15% prescribe them daily [14]. This issue has highlighted the necessity of rationalizing the use of antibiotics because such prescribing patterns are unnecessary [15,16].

Evidence of improper prescription attitudes among dentists has emerged for various reasons, ranging from a lack of awareness to social circumstances [17]. A survey among final-year dental students at Cardiff University revealed that one-quarter of respondents were unaware of the existence of guidelines for the use of antibiotics in endodontic conditions [18]. A survey among Italian undergraduate students revealed that 85% of them prescribed antibiotics for endodontic infection unnecessarily and a similar finding was seen among 66% of Spanish undergraduate students [5,19]. These findings strongly support the need for students to gain adequate knowledge of antibiotic usage prior to graduation [20].

There is limited data on antibiotic prescription patterns for endodontic infections in Asian countries, including Malaysia [4]. Hence, this study aims to address this gap by investigating the experiences of undergraduate dental students in Malaysia regarding the appropriate use of systemic antibiotics for managing endodontic pathology.

MATERIALS AND METHODS

This study was approved by the Research Ethics Committee of the Universiti Kebangsaan Malaysia (UKM) [Reference Number JEP- 2021- 462].

Sample size

This study was conducted among final-year dental students from all thirteen dental schools including both government-funded dental schools and private dental schools in Malaysia. A total of 260 respondents were calculated using an online sample size calculator *(https://www.surveysystem.com/sscalc.htm#one).* Considering the 10% attrition rate, the sample size was increased to 287 with an average of 22 students from each dental school. This study focuses specifically on Malaysian final-year undergraduate students enrolled in Malaysian institutions. A convenience sampling method was employed to recruit final-year undergraduate students from every dental school.

Development of questionnaires

The questionnaire was adapted from a previously published study [5]. The questionnaire comprised of fifteen questions divided into two parts. Part A gathered students' demographic data and Part B focused on their experiences with antibiotic use in managing endodontic pathology. This section explored various aspects including the endodontic diagnoses requiring a decision on antibiotic prescriptions, types of first-choice antimicrobial agents as well as antibiotics chosen for patients with allergies to beta-lactams, and dosage. Additionally, two open-ended questions were included to assess students' awareness of i) existing guidelines for prescribing antibiotics for endodontic pathology and ii) the consequences of overprescribing antibiotics for endodontic pathology. The Malay questionnaire was cross-culturally translated from an English questionnaire and validated using content validity, face validity, and reliability tests. The questionnaire was validated by an expert panel of three endodontists with more than 10 years of experience based on the relevance, clarity, and necessity of each item. All items were deemed necessary by the panel with a Content Validity Ratio (CVR) of 1.00. All items were also deemed relevant and clear as each item scored excellent on the Item-level Content Validity Index (I-CVI).

The questionnaire was pre-tested online among 4th-year students (n=10) who were conveniently sampled from the Universiti Kebangsaan Malaysia to answer the questionnaire twice at 2–4 weeks apart. After validation and reliability testing, the questionnaires were adjusted accordingly.

Data collection

An email to request permission to conduct the study was sent to the relevant Head of Department at each faculty in advance. The questionnaires were created using a web-based survey tool (Google form) and then distributed through emails together with a participant information sheet summarizing the aims of the study and a consent form. The students were given the questionnaire in English and Malay language and requested to fill in their demographic data and their experience while prescribing antibiotics for endodontic pathology. The students were given 3 weeks to complete the online questionnaire. A reminder was sent 2 weeks after the initial online questionnaire. The timeframe allocated for data collection spanned 4-6 months.

Statistical analysis

Data were tabulated and statistically tested using IBM SPSS© version 26. Descriptive analysis was performed to identify the sample composition of gender and race. Frequency distributions were performed to describe the percentages of responses in terms of the prescription of antibiotics and the cases where respondents considered that the administration of antibiotics was appropriate.

RESULTS

Demographics of the respondents

The total response rate was 100% (n=287).The demographics data of the students show an unequal ratio between female and male students (1:3). This survey includes students from multiracial backgrounds was illustrated in Table 1.

Table 1 Demographic distribution of the students

Demographic distribution	n (%)
Gender	
Male	92 (32)
Female	195 (68)
Race	
Malay	125 (43)
Chinese	124 (42)
Indian	33 (11)
Others	5 (4)

The pattern of antibiotics prescription

Generally, a majority of students (56.1%, n=161) reported having dealt with endodontic pathology in their clinical experience. Figure 1 illustrates the pattern of antibiotic prescriptions for various endodontic pathology. In total, 61% of students had experience in prescribing antibiotics. Less than 10% of students prescribe antibiotics for symptomatic irreversible and reversible pulpitis. In chronic apical abscesses without a sinus tract, the prescription rate was 8%. The presence of sinus tract increases the prescription rate to 29%. The highest prescription rate was observed in acute apical abscesses with systemic involvement (89%). More than half of the students (64.8%) have written five-day prescriptions. Only approximately a quarter of them prescribed antibiotics for three, seven, or more days (Table 2).

Table 2 Duration of antibiotic prescription

Duration	n (%)
3 days	49 (17.1)
5 days	186 (64.8)
7 days	47 (16.4)
10 days	2 (0.7)
Until symptoms disappear	3 (1.0)

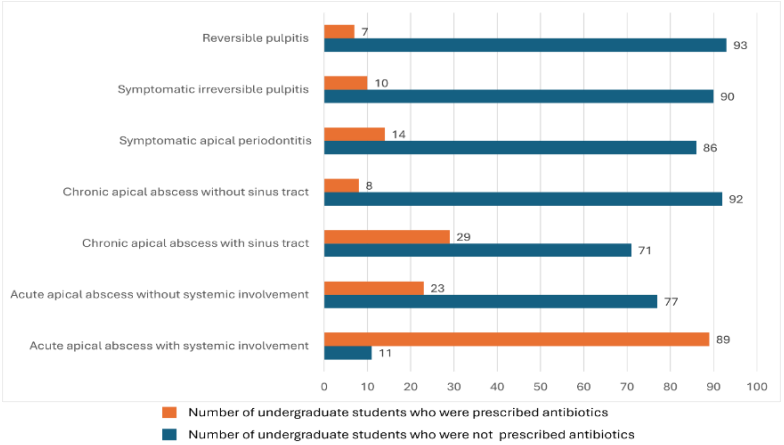

Figure 1 Endodontic conditions that systemic antibiotics were prescribed

Choice of systemic antibiotic prescription

For healthy patients without allergies, amoxicillin (68.3%) and the combination of amoxicillin with clavulanic acid (16.4%) were the most frequently prescribed antibiotics. Clindamycin (53.7%) and metronidazole (16%) were selected as their antibiotics of choice for a patient who reported allergies to penicillin (Table 3).

Table 3 Antibiotic selection to manage endodontic pathology selected by undergraduate students

Drug	Dose (mg)	n (%)
Patients without penicillin allergy		
Amoxicillin	500	196 (68.3)
Amoxicillin & clavulanic acid	625	47 (16.4)
Ampicillin	250-500	1 (0.3)
Azithromycin	500	4 (1.4)
Clindamycin	300	2 (0.7)
Clarithromycin	250-500	1 (0.3)
Erythromycin	250	1 (0.3)
Metronidazole	400	20 (7.0)
Penicillin	500	14 (4.9)
Patient with penicillin allergy		
Amoxicillin	500	12 (4.2)
Amoxicillin and clavulanic acid	625	17 (5.9)
Ampicillin	250-500	3 (1.0)
Azithromycin	500	22 (7.7)
Ciprofloxacin	300	14 (4.9)
Clindamycin	300	154 (53.7)
Clarithromycin	250-500	4 (1.4)
Erythromycin	250	11 (3.8)
Metronidazole	400	46 (16.0)

Students' awareness of existing antibiotic guidelines in endodontics

More than two-thirds (67.9%, n=194) of students were aware of antibiotic prescribing guidelines for endodontic pathology and a significant majority (87.1%, n=250) were aware of the negative consequences of antibiotic overuse.

DISCUSSION

This study examined antibiotic prescribing experiences for endodontic pathology among final-year dental students in Malaysia. The findings indicate that while the majority demonstrated appropriate antibiotic use, a concerning minority reported engaging in unnecessary antibiotic prescriptions. The response rate was high (100%) and the findings in this study can be regarded as representative of the dental student population in Malaysia. High response rates have also been observed in comparable studies that were carried out under similar circumstances [5,19,21].

This study reveals that Malaysian dental students largely adhere to established guidelines [12] for antibiotic use in endodontic pathology. Specifically, most students reserved antibiotic prescriptions for cases presenting with systemic symptoms like fever, swelling, or malaise, aligning with recommendations for acute apical abscesses with systemic involvement. Only a small percentage of students opted for antibiotics in less severe cases, such as acute apical abscesses without systemic involvement or apical periodontitis. This suggests a good understanding of the predominantly inflammatory nature of acute apical abscesses, where the treatment is to relieve the inflammatory pressure in the periapical area via intraoral or surgical drainage and root canal treatment to facilitate the body's natural defenses. The host defenses should be able to control the periapical infections following root canal treatment [1,22]. Similarly, a survey among undergraduate Italian students revealed that only 29.7% and 13.5% indicated the use of antibiotics for apical periodontitis with or without sinus tract, respectively [5]. By contrast, Al Masan *et al.,* reported that 75% of their students provide antibiotics for the treatment of teeth with pulpal necrosis and apical periodontitis [18]. Considering that students were asked to make a choice based on a given diagnosis, the discrepancy in the questionnaire's components may result in inconsistent findings. For example [18] gave a case scenario in which the students were asked to make a diagnosis that might be incorrect, resulting in an erroneous antibiotic prescription [18].

Only 10% of Malaysian students would recommend antibiotics for irreversible pulpitis. This result was lower than studies conducted among Saudi Arabian dental students (32%) and Cardiff University students (25%). In reversible pulpitis or symptomatic irreversible pulpitis, antibiotics are typically unnecessary as they are ineffective in alleviating the symptoms [23]. Besides, less invasive vital pulp therapy such as partial or full pulpotomy can be opted for the treatment of mature permanent teeth diagnosed with symptomatic irreversible pulpitis [24].

Penicillin, penicillin V, metronidazole, and amoxicillin/clavulanate are commonly prescribed in the dental setting [25]. In the present study, amoxicillin was the most frequently prescribed antibiotic to patients without a penicillin allergy. This finding is consistent with earlier studies among

undergraduate students in Spain, Saudi Arabia, and India [19,21,26]. Amoxicillin is a moderate-spectrum beta-lactam antibiotic that is suitable for endodontic infections because it is effective towards gram-positive, gram-negative, anaerobic, and strictly anaerobic bacteria [12,27]. The other recommended antibiotic for patients without penicillin allergies was the combination of amoxicillin and clavulanic acid [12] Clavulanic acid improves amoxicillin's defense against degradation by beta-lactamase-producing bacteria, thereby enhancing their bactericidal effect. Although the combination of amoxicillin and clavulanic acid has a wide range of bactericidal action, patients may be put at risk for gastrointestinal side effects, especially diarrhea, compared with the use of amoxicillin alone. Additionally, the overuse of broad-spectrum antibiotics like this combination raises concerns about antimicrobial resistance [28]. Excessive or inappropriate antibiotic use encourages the emergence and spread of resistant bacteria, making infections harder to treat and increasing the risk of complications, prolonged illness, hospitalization, and the need for more intensive and costly treatments [29,30]. Therefore, it is recommended to limit the daily dose of clavulanic acid to 500 mg [31].

In the present study, clindamycin was the first antibiotic chosen by more than half of the students (53%) for penicillin-allergic patients. The finding is consistent with the surveys conducted among undergraduate students in Italy and Spain [5,19]. Clindamycin is recommended for penicillin-allergic patients in primary endodontic infection because it has a great antimicrobial effect on anaerobes and streptococci species [27,32]. The results of the present study revealed that metronidazole is the second-line antibiotic of preference for patients with penicillin allergies. This finding slightly deviates from the recommended use of clarithromycin or azithromycin in patients with penicillin allergies instead of clindamycin [2]. Considering that metronidazole is ineffective against aerobic and facultative anaerobic bacteria, therefore, the prescription of metronidazole alone is not recommended for the treatment of endodontic infections as it may not be clinically sufficient to eliminate the endodontic microorganism [4,5,32]. The use of the combination of metronidazole and amoxicillin can increase the susceptibility of bacteria by up to 99% [32]. Nevertheless, the combination of antibiotics used by Malaysian undergraduate students was not investigated in this study, indicating the need for an additional survey.

Most Malaysian final-year dental students chose a 5-day antibiotic therapy course as their recommended length. The recommended duration for prescribing an antibiotic for endodontic infection ranges from 3 days to 7 days [2]. Prescription of antibiotics for a longer period is not recommended, because endodontic infections have a relatively quick onset and typically last for 3–7 days after the initiation of root canal treatment [17]. Additionally, a short course of antibiotic therapy can lessen the likelihood of antibiotic-induced toxicity and allergic reactions, which is important for lowering the risk of the emergence of antibiotic-resistant microbial strains such as methicillin-resistant *Staphylococcus aureus*. Similar results were also observed in Italy (5.5 ± 1.1 days), Saudi Arabia (3–5 days), and India (4.26 ± 1.26 days) [5,21,26].

Nearly half of the students in this study reported being unaware of the guidelines for prescribing antibiotics. Similarly, a study conducted at Cardiff University found that more than a third of the respondents lacked awareness of the available antibiotic prescribing guidelines [18]. The American Association of Endodontics guidelines [33] and the ESE position statement [12] are the foundation of antibiotic recommendations for endodontic infections. These guidelines are intended to present the available evidence related to prescribing antibiotics, highlight appropriate clinical indications, and facilitate the clinician in assessing risks and benefits in daily practice. Although antibiotic guidelines are freely available and accessible online, nearly half of the students in this study were unaware of them, as evidenced by instances of unnecessary antibiotic prescriptions. This may be due to the effort required to locate, read, and apply these guidelines, which demands both interest and initiative. The finding also highlights a critical gap in Malaysia undergraduate endodontic education that lack of dedicated instruction on antibiotic prescribing for endodontic pathology in didactic teaching [34]. Besides, in this study, only 61% of students had experience prescribing antibiotics, while the remaining 39% had never prescribed antibiotics. This lack of direct prescribing experience may explain why some students were unaware of the availability of antibiotic guidelines for endodontic infections. Without practical exposure to prescribing decisions, students may not actively seek out or engage with established guidelines, leading to reduced awareness and understanding.

To curb unnecessary antibiotic prescriptions, integrating antibiotic stewardship principles into

both undergraduate and continuing dental education is crucial. As highlighted by [18] incorporating prescribing guidelines into endodontic curricula and professional development programs can significantly enhance dentists' understanding of appropriate antibiotic use [18]. By equipping dental professionals with the knowledge and skills for responsible antibiotic use, we can foster a culture of judicious prescribing and mitigate the growing threat of antibiotic resistance.

Even though they can be helpful as a supplemental treatment for endodontic infections in some circumstances, antibiotics cannot replace endodontic care. The results of this study provide important information about the amount of experience final-year undergraduate dental students possess and highlight areas where gaps in their experience exist. In actual clinical practice, undergraduate students typically seek direct guidance and approval from supervisors before prescribing systemic antibiotics for their patients. However, the findings of this study have yielded preliminary evidence of students' limited experience with the appropriate indication of antibiotics and low of awareness regarding existing guidelines for pulp and periapical pathology. Thus, students should stay current with their knowledge of the pathogenesis of endodontic pathology, the inflammatory process, and pharmacology to understand the need for antibiotics to address these deficiencies. This issue requires adequate attention to prevent future instances of malpractice during their professional careers.

Further research is warranted to gain a more comprehensive understanding of antibiotic prescribing practices among undergraduate dental students in Malaysia for managing endodontic pathology. Future studies should delve deeper into prescribing patterns, exploring aspects such as antibiotic combinations and factors influencing antibiotic prescribing decisions. Importantly, incorporating robust statistical analysis to compare these parameters will significantly enhance the strength and generalizability of the findings.

CONCLUSION

Within the limitation, this survey revealed a slight disagreement between perceived and actual adherence to antibiotic prescribing guidelines among Malaysian dental students. While two-thirds of Malaysian dental students prescribed antibiotics for endodontic pathology in line with the recommendation, a concerning minority indicated potential antibiotic misuse of antibiotics for pulp and periapical pathology. This discrepancy underscores the need for enhanced education and awareness regarding appropriate antibiotic use. Integrating clear guidelines into dental curricula is crucial to ensure the responsible and judicious prescribing practices of future dentists.

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DECLARATION OF INTEREST

Authors declare no conflict of interest.

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