

## Antibiotic prescription for the treatment of endodontic pathology: a survey among Lithuanian dentists

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**Key words:** antibiotic prescription; endodontic treatment; survey.

**Summary.** *Objective.* To describe a pattern of antibiotic prescription during root canal treatment procedures based on the reports of Lithuanian general dental practitioners.

*Materials and methods.* Questionnaires concerning endodontic treatment were sent to all 2850 Lithuanian dental practitioners registered on the database of the Lithuanian Dental Chamber. Only the questions containing general information and individual decisions about antibiotic prescription for endodontic treatment were selected for the analysis.

*Results.* The response rate was 53.8%. Of the 1532 responses, 1431 questionnaires received from licensed general dental practitioners were analyzed. More than 60% of the respondents reported prescribing antibiotics in cases of symptomatic apical periodontitis. Majority of the respondents (83.9%) reported symptomatic apical periodontitis with periostitis being a clear indication for the prescription of antibiotics. Nearly 2% of the respondents reported prescribing antibiotics in cases of symptomatic pulpitis. With an increasing duration of professional activity, an increase in the proportion of the respondents reporting prescription of antibiotics was observed. Amoxicillin was the most preferable antibiotic during endodontic treatment, followed by amoxicillin with clavulanic acid. An increase in reporting penicillin prescription and decline in prescribing amoxicillin and amoxicillin with clavulanic acid with regard to the increasing age of respondents was observed.

*Conclusions.* Lithuanian dentists, particularly those with longer duration of professional activity, tended to exceed general recommendations for the antibiotics prescription in cases of endodontic infections. However, a trend toward prescription of broader spectrum antibiotics by younger dentists, compared with those with longer professional activity, was observed.

### Introduction

Bacterial resistance to antibiotics is a serious public health problem. A major contributing factor for the development of this problem is the excessive use of antibiotics in medicine and agriculture. In dental practice, antimicrobial drugs are prescribed during treatment of particular clinical situations related to inflammatory processes in the periodontium or bone. Evidence exists that the resistance of oral microflora to antibiotics has increased during the past decades (1–3). Overuse of antibiotics in dental practice has been observed (4–8).

Remarkable differences in the use of systemic antibiotics as well as in the antimicrobial drug resistance of human pathogens exist among different countries (9, 10). According to the data of the European Surveillance of Antimicrobial Consumption (ESAC), the highest consumption rates of antibiotics are found in the southern and eastern Euro-

pean countries, whereas in the north Europe and Russian Federation it is much lower (10). Data on the prescribing patterns of antibiotics among Lithuanian medical doctors are limited. A trend in the increased prescription rates of some antibiotics during the past years has been observed (11). Moreover, the administration of antibiotics by family doctors was considered being irrational in most of the studied cases (12).

Data on the prevalence of endodontic pathology in Lithuania are scarce. However, 70% of 35–44-year-old citizens of Vilnius (capital of Lithuania) had been diagnosed with apical periodontitis 10 years ago (13). In a more recent report, one-third of all attendances to the specialized Clinic of Endodontics were due to acute pain related to symptomatic apical periodontitis (14).

Endodontic pain (i.e., pain induced by inflammation of dental pulp or periapical tissues) alone is

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not an indication for antimicrobial treatment. The vast majority of infections of endodontic origin could be managed without antibiotics (15, 16). The most important problem of decision-making in the administration of antibiotic therapy is to determine the indications and type of antibiotics suitable for a particular clinical situation. Incorrect use of antibiotics in dentistry may predispose secondary and superinfections and render drugs ineffective against potentially fatal medical infectious diseases (1).

The aim of this study was to determine the pattern of antibiotic prescription during endodontic treatment based on the reports of Lithuanian dental practitioners.

### Material and methods

Questionnaires concerning endodontic treatment were sent to all 2850 Lithuanian dental practitioners registered at the database of the Lithuanian Dental Chamber. The questionnaire was made up of 58 questions with multiple-choice answers and was sent along with an explanatory covering letter with a stamped addressed, return envelope. The questionnaire was fully piloted and refined for clarity and scope before being issued.

For this study purpose, only the questions containing general information such as respondent's age, duration of professional activity, their practice location (urban or rural) as well as questions related to individual decisions about antibiotic prescription in dental practice were selected for analysis. The respondents were asked to provide information about the preferred antibiotics and indications for their prescription during treatment of different types of endodontic pathology:

- symptomatic pulpitis (SP);
- symptomatic apical periodontitis (SAP);
- symptomatic apical periodontitis with periostitis (SAPP), without incision of soft tissues;
- symptomatic apical periodontitis with periostitis (SAPP), with incision of a periapical abscess;
- any endodontic pathology with concurrent systemic diseases.

The questions regarding the use of antibiotics were formulated with possible answer options (always; often; sometimes; seldom; never), and the respondents were invited to choose the answer that best affirmed their clinical attitude by indicating only one category.

From all obtained responses, only those from dentists having a license of general dental practitioner (excluding dental specialists) were included in this study.

For more detailed comparison of the data, the sample was divided, according to the duration of professional activity, into the following groups: group A (up to 9 years in practice), group B (10–19

years), group C (20–29 years), and group D (more than 30 years). In addition, the respondents were compared by geographic location of working place (rural or urban). During the data analysis, the obtained responses were categorized into three alternatives (always and often; sometimes; seldom and never).

All returned forms were coded by a single operator, and the data were checked and entered twice in a personal computer. Blank or multiple answers were all treated as missing values; only single unequivocal replies were included in calculating percentages.

Statistical analysis included the chi-square test for analyzing differences between the groups. Odds ratio (OR) and 95% confidence interval (CI) were calculated for comparison of the responses between the groups of professional activity (reference group was the group D with a duration of more than 30 years in practice). The significance level for all the tests was set at  $P < 0.05$ .

Sample size was calculated using the Paniotto formula (17). The sample size determined according to this formula shows that having questioned 1532 respondents, it will be possible to make conclusions leading to a 2% sample error with a possibility of 0.98.

### Results

The flowchart showing the study design and distribution of study participants by duration of professional activity and practice location is presented in Figure 1. Thus, of the 2850 questionnaires mailed, 1532 questionnaires were returned (response rate, 53.8%). A total of 956 dentists practicing in urban and 576 dentists practicing in rural areas responded to the present inquiry, while 802 urban and 516 rural dentists did not respond. There was no significant difference between the respondents and nonrespondents with respect to their distribution according to practice location ( $P = 0.417$ ).

From all obtained responses, a total of 1431 responses belonging only to general dental practitioners were analyzed. The mean age of the respondents was 45 years (range, 23–75 years). More respondents from the group A worked in urban areas while the respondents from the group D worked more frequently in rural areas ( $P < 0.001$ ).

The percentage distribution of responses concerning antibiotic choice in cases of endodontic treatment with respect to practice location is presented in Figure 2. Thus, 50.4% of all respondents reported prescribing amoxicillin always or often and 27.1% did it sometimes. Amoxicillin with clavulanic acid was a preferable antibiotic for 54.7% of all respondents. Penicillin and lincomycin were not prescribed (never or seldom) by 72.4% and 85.4% of all respondents, respectively. Additionally, 5.6%

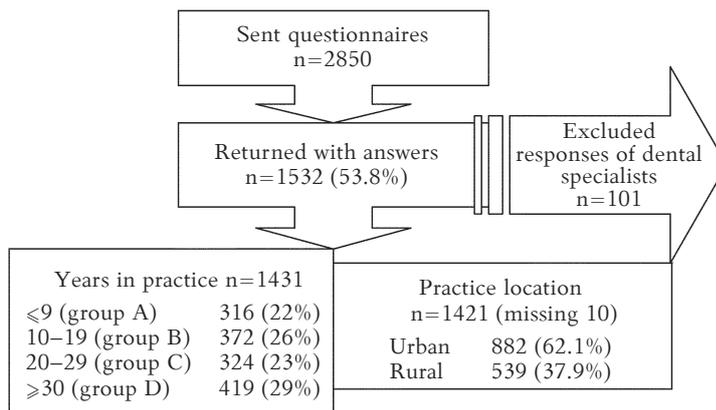


Fig. 1. Flowchart showing the study design and distribution of study participants by duration of professional activity and practice location

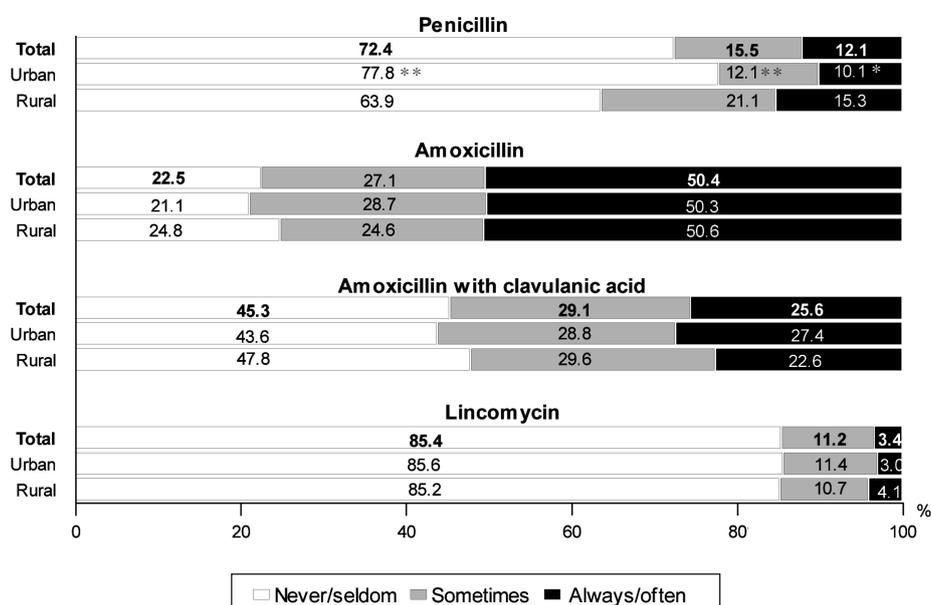


Fig. 2. Percentage distribution of responses concerning antibiotic choice in cases of endodontic treatment, as reported by Lithuanian dental practitioners, with respect to practice location

\*\* $P < 0.001$ ; \* $P = 0.01$  with respect to practice location.

of respondents identified antibiotics, such as clindamycin, doxycycline, metronidazole, as well as antibiotics mentioned above but known by different names (Ospen, Ospamox, Dalacin), as alternatives to antibiotics given in the questionnaire.

Comparison of the results of antibiotic choice according to practice location of the respondents showed that dental practitioners in rural areas prescribed penicillin more often than those in urban areas ( $P < 0.001$ ) (Fig. 2). No significant differences in the reported prescription rates of other antibiotics with regard to practice location were seen (Fig. 2).

The odds ratio estimates indicated a tendency to the increased proportion of respondents reporting prescription of penicillin and decline in prescribing amoxicillin and amoxicillin with clavulanic acid

with regard to increasing years in practice (Table 1). Thus, practitioners with practice of less than 9 years were 2.6 (95% CI, 1.9–3.5) and 1.5 (95% CI, 1.1–2.1) times more likely to prescribe amoxicillin and amoxicillin with clavulanic acid, respectively, and 3 (95% CI, 2.1–4.3) times less likely to prescribe penicillin than their senior colleagues (practice duration of more than 30 years).

The percentage distribution of responses concerning the prescription of antibiotics for a particular type of endodontic pathology with respect to practice location is presented in Fig. 3. Thus, majority of the respondents (83.9%) reported cases of inflammatory exudate passing through the bone underneath the periosteum (SAPP) being a clear indication for the prescription of antibiotics, and 19.4%

Table 1. Odds ratio estimates for an association between the reported prescription of antibiotics in relation to antibiotic type and duration of professional activity

Antibiotic	Groups by professional activity (years)*	Incidence of antibiotic prescription		
		never/seldom OR (95% CI)	sometimes OR (95% CI)	always/often OR (95% CI)
Penicillin	A (<9)	3.0 (2.1–4.3)	0.3 (0.2–0.4)	0.6 (0.4–0.9)
	B (10–19)	1.6 (1.2–2.2)	0.6 (0.4–0.9)	0.7 (0.5–1.1)
	C (20–29)	1.7 (1.2–2.3)	0.7 (0.5–1.1)	0.5 (0.3–0.8)
Amoxicillin	A (<9)	0.5 (0.3–0.7)	0.6 (0.4–0.8)	2.6 (1.9–3.5)
	B (10–19)	0.6 (0.5–0.9)	0.8 (0.6–1.2)	1.6 (1.2–2.1)
	C (20–29)	0.6 (0.4–0.8)	1.0 (0.7–1.4)	1.5 (1.1–2.0)
Amoxicillin with clavulanic acid	A (<9)	0.7 (0.5–0.9)	1.0 (0.8–1.4)	1.5 (1.1–2.1)
	B (10–19)	0.8 (0.6–1.1)	0.8 (0.6–1.1)	1.6 (1.2–2.2)
	C (20–29)	0.8 (0.6–1.1)	1.1 (0.8–1.5)	1.2 (0.8–1.7)
Lincomycin	A (<9)	2.0 (1.3–3.2)	0.5 (0.3–0.9)	0.5 (0.2–1.1)
	B (10–19)	1.5 (1.0–2.2)	0.9 (0.6–1.3)	0.3 (0.1–0.8)
	C (20–29)	1.4 (0.9–2.0)	0.9 (0.6–1.3)	0.5 (0.2–1.1)

\*Reference category was group D, >30 years in practice. OR, odds ratio; CI, confidence interval.

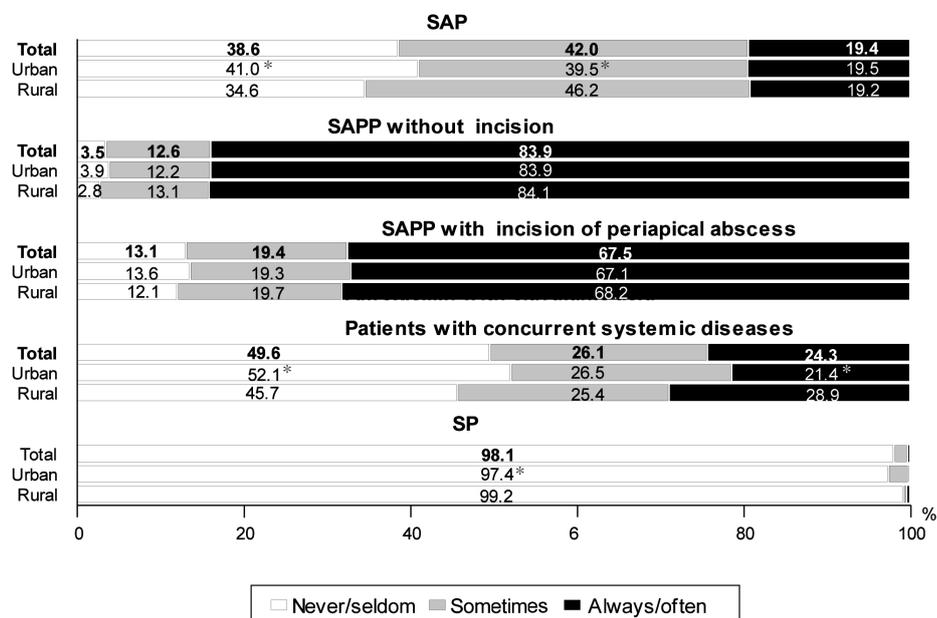


Fig. 3. Percentage distribution of responses concerning the prescription of antibiotics for a particular type of endodontic pathology, as reported by Lithuanian dental practitioners, with respect to practice location

SAP, symptomatic apical periodontitis; SAPP, symptomatic apical periodontitis with periostitis; SP, symptomatic pulpitis.

\* $P < 0.01$  with respect to practice location.

of dentists always or often prescribed antibiotics for the treatment of SAP. Almost 68% of the respondents did it in cases of SAPP with incision of a periapical abscess. Only 1.9% of respondents reported prescribing antibiotics in cases of symptomatic pulpitis. About 50% of the respondents considered prescribing antibiotics (always or often; sometimes) for the treatment of endodontic pathology with concurrent systemic diseases (Fig. 3).

The data analysis showed that more respondents from urban areas reported never prescribing antibiotics in cases of SAP and any endodontic pathology with concurrent systemic diseases than those from rural areas ( $P < 0.01$ ).

The results concerning association between antibiotic prescription in relation to the type of endodontic pathology and duration of practice are presented in Table 2. A trend toward an increase in the proportion of the respondents reporting prescription of antibiotics in clinical situations such as SAP, SAPP with incision, and in cases with concurrent systemic diseases with regard to increasing duration of practice was observed. The dental practitioners with practice of less than 9 years were 1.7 (95% CI, 1.3–2.3) times and 2.5 (95% CI, 1.6–3.9) times less likely to prescribe antibiotics in cases of SAP and SAPP with incision, respectively, than the respondents with practice of more than 30 years.

Table 2. Odds ratio estimates for an association between the reported prescription of antibiotics in relation to type of endodontic pathology and duration of professional activity

Clinical case	Groups by professional activity (years)*	Incidence of antibiotic prescription		
		Never/seldom OR (95% CI)	Sometimes OR (95% CI)	Always/often OR (95% CI)
SAP	A (<9)	1.7 (1.3–2.3)	0.6 (0.4–0.7)	0.8 (0.6–1.2)
	B (10–19)	1.4 (1.0–1.8)	0.6 (0.5–0.8)	1.0 (0.7–1.4)
	C (20–29)	1.0 (0.7–1.3)	0.9 (0.7–1.1)	1.0 (0.7–1.4)
SAPP without incision	A (<9)	1.2 (0.6–2.6)	0.9 (0.5–1.5)	1.0 (0.7–1.6)
	B (10–19)	1.3 (0.6–2.7)	1.3 (0.9–2.1)	0.7 (0.5–1.1)
	C (20–29)	0.5 (0.2–1.3)	1.4 (0.9–2.1)	0.9 (0.6–1.3)
SAPP with incision of periapical abscess	A (<9)	2.5 (1.6–3.9)	1.0 (0.7–1.5)	0.6 (0.4–0.8)
	B (10–19)	2.1 (1.3–3.3)	0.9 (0.6–1.3)	0.8 (0.6–1.0)
	C (20–29)	1.4 (0.8–2.2)	0.9 (0.6–1.4)	0.9 (0.7–1.3)
Any endodontic pathology with concurrent systemic diseases	A (<9)	1.8 (1.4–2.5)	0.9 (0.6–1.2)	0.5 (0.3–0.7)
	B (10–19)	1.6 (1.2–2.1)	0.9 (0.7–1.3)	0.6 (0.4–0.8)
	C (20–29)	1.2 (0.9–1.6)	0.9 (0.7–1.3)	0.9 (0.6–1.2)
SP	A (<9)	2.0 (0.5–7.8)	0.5 (0.1–1.9)	...
	B (10–19)	1.0 (0.4–2.8)	1.0 (0.4–2.7)	...
	C (20–29)	0.7 (0.3–1.8)	0.8 (0.3–2.5)	...

\*Reference category was group D, >30 years in practice. OR, odds ratio; CI, confidence interval; SAP, symptomatic apical periodontitis; SAPP, symptomatic apical periodontitis with periostitis; SP, symptomatic pulpitis. Ellipses indicate ORs not computed.

## Discussion

Rational use of antibiotics is based on well-defined indications in cases of infections of endodontic origin. Symptomatic apical periodontitis with localized swelling in a healthy patient and without systemic involvement does not require systemic antibiotic therapy. In such cases, incision, drainage, and conventional root canal treatment can effectively control the spread of infection (15, 18). However, antibiotics can help to impede the spread of infection in particular clinical cases associated with progressive diffuse swelling and systemic involvement, including fever, malaise, and lymphadenopathy, as well as in medically compromised patients (15, 16). It must be emphasized that antibiotic therapy alone in cases of SAP can help just to relieve clinical symptoms. The source of infection can be eliminated only by an appropriate root canal cleaning and disinfection procedures or tooth extraction. Therefore, antibiotics must be considered only as an adjunct to the conventional root canal therapy or when an emergency treatment is impossible (15, 16). Dental practitioners must have a thorough understanding of the clinical indications for antibiotic prescription in order to prevent misuse or overuse of these medicaments (16, 19).

With some degree of caution, the present sample can be considered being representative of Lithuanian dentists. More than 60% of all respondents reported prescribing antibiotics in cases of symptomatic apical periodontitis. Almost all of those (97%) prescribed antibiotics in cases of SAPP without incision of soft tissues as well as in cases of SAPP with incision

(87%). When compared to other studies, it seems that Lithuanian dentists tend to prescribe antibiotics during endodontic treatment more often than their colleagues in other countries (7, 20, 21). Thus, 69% of general dental practitioners in England prescribed antimicrobial drugs before drainage of acute abscesses and only 23% of them did it after abscess drainage (7). In cases of symptomatic apical periodontitis, 48% of the respondents in Belgium and 54% in the United States prescribed antibiotics (20, 21).

Essentially, there is no indication for antimicrobial therapy in cases of symptomatic pulpitis. Results of this study showed that only about 2% of the respondents reported prescribing antibiotics in cases of SP. This percentage was much lower than in the studies carried out in Turkey (60%), Kuwait (20%), England (13%), and the United States (17%) (4, 6, 7, 20).

When analyzing an association between the reported prescription rates of antibiotics in relation to the type of endodontic pathology and duration of professional activity, it was noticed that the respondents with longer professional activity tended to prescribe antibiotics more often than their younger colleagues in most of the clinical situations listed in the questionnaire. Dentists with a shorter duration of professional activity seemed to be more careful when prescribing antibiotics in cases of endodontic treatment. Potentially, this could be explained by the changes in the undergraduate curriculum of dental education in Lithuania over the past decade and also by the fact that the courses of continuing education for practicing dentists lack professional

information about antimicrobial management of dental infections.

$\beta$ -Lactam antibiotics are drugs with a similar chemical structure that include the  $\beta$ -lactam ring. Antibacterial spectrum of these antibiotics varies from narrow (penicillins) to broad (cephalosporins) (3, 16). Although there is an evident increase in the resistance of different pathogens to  $\beta$ -lactam antibiotics, penicillin and amoxicillin remain the first-choice antibiotics recommended for the treatment of dental infections in many countries (15, 22–24).

This study showed that amoxicillin was the most preferable antibiotic for the treatment of endodontic infections by Lithuanian dentists. The prescription rate of penicillin for the treatment of such infections, as reported by the practitioners, in Lithuania is much lower when compared with the United States where penicillin was found to be the most frequently antibiotic prescribed by dentists (20). However, amoxicillin with clavulanic acid was the second most preferable medicament after amoxicillin in this study. Since amoxicillin with clavulanic acid is characterized by a much broader spectrum of activity compared to penicillin and amoxicillin, it carries a higher risk of the development of bacterial resistance. Amoxicillin with clavulanic acid was prescribed more frequently by dental practitioners with a shorter duration of practice as compared with their senior colleagues. However, an increasing number of respondents reporting penicillin prescription with an increasing duration of professional activity were observed. In addition, this trend was more expressed in rural than urban areas, possibly because more senior dentists indicated working in the rural areas. Unfortunately, a lack of knowledge concerning the names of antibiotics among Lithuanian dentists was noticed as well. In some of the reports, the generic names of drugs were disregarded, and only the names given by producers were indicated. For example, Oспен, Ospamox, and Augmentin were named by some of the respondents as different types of antibiotics from those given in the questionnaire. Such flaws could possibly be explained by existing advertisement of drugs by pharmaceutical industry and lack of practitioner's attention to the composition and basis of the advertised drug. It is evident that pharmaceutical companies may influence the choice of antibiotics used by practitioners (4). Amoxicillin with clavulanic acid, reported as the drug superior to penicillin, could be an example of such influence.

Essentially, the choice of antimicrobial agents for the treatment of dental infections is empirical and based on the published data about susceptibility of the most frequently found pathogens in a particular infection. Such recommendations should be based on information concerning susceptibility of local pathogens as it can vary according to the geographic location of the country and may differ over time (25–28). Therefore, an antibiotic being considered as most effective in one country could not be certainly appropriate in other. There is no available information concerning the resistance of endodontic pathogens to  $\beta$ -lactam antibiotics as well as findings on  $\beta$ -lactamase-producing bacteria in cases of odontogenic infections in Lithuania. Therefore, recommendations for pharmacists to use amoxicillin with clavulanic acid for treatment of dental infections are often based on the reports of studies performed in other countries (29, 30).

Irrational prescription of antibiotics could be influenced by many other factors, such as patient's belief that it is necessary to administer antibiotics to cure a disease, workload of practitioners, and lack of time assigned to a patient as well. Nevertheless, decision about prescription of drugs depends on a clinician. Every dental practitioner should be aware that the benefits of antibiotic treatment come together with the risk of antibiotic resistance development. Therefore, it is important that dental practitioners should continue their restrictive use of antibiotics despite the influence of pharmaceutical companies or patient's intention and, whenever possible, should reduce the use of these drugs.

### Conclusions

The prescription of antibiotics in cases of endodontic pathology tended to exceed general indications of their application and in some cases is irrational. Lithuanian dentists with a shorter duration of professional activity were less likely to prescribe antibiotics for endodontic treatment; however, they preferred broader spectrum antibiotics as compared with their senior colleagues. In order to deepen the knowledge of rational use of antibiotics, infection control, and microbial resistance among dental professionals, evidence-based national guidelines for rational antibiotic use in dental practice are needed. Furthermore, trends of antibiotic consumption and antimicrobial susceptibility of endodontic pathogens should be monitored, and recommendations for antibiotic therapy should be updated periodically.

## Lietuvos odontologų skiriami antibiotikai endodontinės kilmės ligoms gydyti

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**Raktažodžiai:** antibiotikai, endodontinis gydymas, apklausa.

**Santrauka.** *Tyrimo tikslas.* Remiantis Lietuvos odontologų apklausos duomenimis, apžvelgti antibiotikų pasirinkimą bei jų skyrimo indikacijas dantų šaknų kanalams gydyti.

*Medžiaga ir metodai.* Visiems 2850 Lietuvos odontologų rūmuose registruotiems gydytojams odontologams buvo išsiųstos anketos su klausimais apie endodontinį gydymą. Tyrimui atrinkti tik klausimai, susiję su antibiotikų skyrimu endodontinio gydymo metu bei bendrąja informacija apie odontologą.

*Rezultatai.* Į anketą atsakė 1532 gydytojai odontologai (53,8 proc. gavusiųjų anketas). Atmetus odontologų specialistų atsakymus, išnagrinėta 1431 gydytojų odontologų anketa. Daugiau kaip 60 proc. atsakiusiųjų skiria antibiotikus simptominiam viršūniniam periodontitui gydyti. Dauguma gydytojų odontologų (83,9 proc.) atsakė, kad simptominio viršūninio periodontito su periostitu atvejais skiriami antibiotikai. Beveik 2 proc. atsakiusiųjų teigė skiria antibiotikus simptominio pulpito atveju. Nustatyta, kad, didėjant atsakiusiųjų darbo stažui, proporcingai auga odontologų, skiriančių antibiotikus, skaičius. Amoksicilinas bei amoksicilinas su klavulano rūgštimi – tai dažniausiai odontologų skiriami antibiotikai. Pastebėta, kad, didėjant atsakiusiųjų amžiui, daugėja odontologų, skiriančių peniciliną ir mažėja skiriančių amoksiciliną bei amoksiciliną su klavulano rūgštimi.

*Išvados.* Lietuvos odontologai, ypač turintys didesnę profesinę patirtį, linkę viršyti racionalaus antibiotikų skyrimo rekomendacijas, gydydami dantis. Be to, pastebėta, kad jaunesni odontologai linkę skirti platesnio veikimo antibiotikus nei vyresni jų kolegos.

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