

**Antibiotic Use for Treating Dental Infections in Children:
A Survey of Dentists' Prescribing Practices**

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ABSTRACT

Antibiotic Use for Treating Dental Infections in Children: A Survey of Dentists' Prescribing Practices

(Under the direction of Jessica Y. Lee DDS, MPH, PhD)

Objective: To examine the antibiotic prescribing practices of general and pediatric dentists in the management of odontogenic infections in children.

Design: We relied upon a cross-sectional study design. The survey instrument consisted of five clinical case scenarios that included antibiotic-prescribing decisions in a self-completed questionnaire. The participants were privately practicing dentists attending one of four CE courses. Practitioner responses for each case were compared to the prescribing guidelines provided by the AAPD and the ADA.

Results: The sample included 153 surveys (response rate: 55%). For the 3 in-office case scenarios, adherence to guidelines was as follows: 11%, 26%, and 32%, respectively. For the 2 after-hours case scenarios, adherence dropped to 15% and 17%, respectively. Dentists who had completed post-graduate training were more likely ($P < .05$) to adhere to guidelines. No statistical difference was found between general and pediatric dentists.

Conclusions: Adherence to professional guidelines for prescribing antibiotics for odontogenic infections in children was extremely low.

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BACKGROUND AND SIGNIFICANCE

Antibiotic Resistance Phenomenon

Antibiotics should be used for the management of active infectious diseases and/or to prevent the systemic spread of infection^{1,2,3} and should not be used to treat viral diseases.^{1,4} Antibiotic resistance occurs when bacteria modify themselves by mutations or by exchanging resistant determinants so they can survive even though antibiotics are being used against them.^{5,6} Antibiotic resistance is most commonly attributed to two main processes: 1) genetic mutations or 2) the exchange of resistant determinants between sensitive and resistant organisms.⁵ Many argue that reduction in antibiotic resistance can only occur following a significant reduction in antibiotic use.^{5,7}

Misuse of antibiotics have given rise to the growing problem of antibiotic resistance.^{1,3} Even when used correctly, there can still be problems because past antibiotic use can be linked to an individual developing resistant microbes;^{8,9,10} therefore, the decision to prescribe an antibiotic is extremely important because the negative consequences outweigh the positive results in magnitude and number.¹¹ Pallasch argues that there are six possible results with antibiotic prescriptions and only one of them is a positive outcome for the patient.¹¹ The benefit occurs when the antibiotic assists a host's immune systems to gain control and eliminate the infection.¹¹ The negative results mentioned include toxicity, allergy, superinfection with resistant bacteria, chromosomal mutations to resistance, gene transfer to vulnerable organisms, and expression of dormant

resistant genes.¹¹ In short, the potential negative outcomes make the use and choice of antibiotics crucial to their continued success in treating both dental and medical infections.

Widespread use of antibiotics by the health professions and the livestock industry has resulted in an alarming increase in the prevalence of drug-resistant bacterial infections; moreover, the increase in antibiotic resistance has contributed significantly to the morbidity and mortality of infectious diseases.^{5,12,13} Several studies have found that children treated recently with an antibiotic were more likely to be colonized with bacteria resistant to the same antibiotic.^{1,2,3,5} More importantly, it appears that some type of resistance has been developed for **all** currently available antibiotics.^{5,14} Because there is a growing and persistent problem with antibiotic overuse, it is imperative that dentists, along with their medical colleagues, help address this growing and potentially devastating problem by prescribing antibiotics only when appropriate and necessary for resolving an infection.

Antibiotic Use and Indications in Dentistry

In the US more antibiotics are sold than over-the-counter drugs.¹ Dentistry accounts for roughly 200-300 million prescriptions annually in the US.¹⁵ Although dentists do not treat as many patients with antibiotics as physicians, antibiotic therapy is a valuable treatment option for certain dental infections. Currently, antibiotics and analgesics are the most commonly prescribed medications by dentists^{1,16} and it is estimated that 10% of antibiotic prescriptions in the USA are dentally-related.¹⁷

There are several indications for the use of antibiotics in dentistry including the treatment of periodontal disease, severe soft tissue lacerations and following the

placement of dental implants. The two major reasons that antibiotics are used in children are: 1) to treat oral infections and 2) to prevent a bacteremia caused by dental treatment.¹⁸ The goal of antibiotic treatment is to use the smallest amount of the drug that is most effective against the organism causing the infection.¹⁹ Antibiotic therapy for orofacial infections can achieve excellent benefits in selected clinical situations³ but **should not** be the primary treatment modality for orofacial infections unless there is spreading cellulitis.¹ Orofacial infections often need to be treated with local drainage. This may include removal of the infected tooth to achieve drainage through the socket or drainage through an incision of the area. Antibiotics should be considered as an adjunct to treatment when there are signs of systemic involvement such as fever or diffuse swelling. When used, the minimal duration of the prescription should be five days past the improvement or resolution of the patient's symptoms.¹⁴

To prevent misuse of antibiotics, dentists need to know the indications and contraindications for prescribing them, proper dosing schedules, and the risk of allergic and toxic adverse reactions, superinfections, and development of antibiotic-resistant organisms.³ A major distinction between medical and dental conditions is that most dental infections can be treated successfully by removal of the source.⁷

Professional Organizations and Guidelines

Many medical and dental practitioners and professional associations have recognized the growing problem of antibiotic resistance. Two dental organizations have promulgated guidelines (Figure 1) to try and cope with the growing problem. The American Academy of Pediatric Dentistry (AAPD) is concerned with the upward trend of antibiotic resistance and has developed specific clinical indications for antibiotic usage.¹⁴

The AAPD Guidelines rely upon clinical scenarios to underscore conservative antibiotic use. The American Dental Association (ADA) has acknowledged the antibiotic resistance phenomenon and its relevance to dentistry in a 2004 article in JADA entitled, *Combating Antibiotic Resistance*, wherein a special panel outlines recommendations.⁵

SPECIFIC AIMS

Previous investigations have examined physicians' antibiotic prescribing practices but to date few have examined US dentists' practices and none have examined pediatric dentists' practices. This study examined the antibiotic prescribing practices among general and pediatric dentists in North Carolina (NC) for children with odontogenic infections with various symptoms and under varying circumstances. Specifically, we examined dentists' adherence to professional guidelines and explored prescribing practices in relation to postgraduate training.

MATERIALS AND METHODS

Study Design and Sample

We relied upon cross-sectional-survey approved by the UNC-CH Institutional Review Board to assess the antibiotic prescribing practices of general and pediatric dentists in NC. A convenience sample of general and pediatric dentists was identified during professional meetings and continuing education courses. Dentists were surveyed if they attended one of the meetings where data collection occurred. Exclusion criteria included full- time faculty members at UNC-CH, those not engaged in clinical practice, and those who did treat children less than 15 years of age.

Survey Development

Prior to data collection, the development and pre-testing of a survey instrument was completed in three phases: 1) expert panel review, 2) recorded and transcribed semi-structured interviews, and 3) piloting testing. Open-ended interview questions were developed by an expert panel of two pediatric dentists, a general dentist, and an oral surgeon. Content of the survey questionnaires was based on the objectives of the overall study, information obtained from a review of the literature, the AAPD and ADA guidelines, and from structured interviews with practicing dentists.

A total of nine one-hour structured interviews were conducted with pediatric, general, and public health dentists. The interviews were taped and transcribed. AAPD and ADA clinical guidelines (Figure 1) were reviewed to determine the recommended professional practices for prescribing antibiotics.^{5,13} Data from these structured interviews

were reviewed by the expert panel and the survey instrument was developed. The draft survey instrument covered three main domains: dentist characteristics, practice characteristics, and case scenarios involving the decision-making process for prescribing antibiotics during selected clinical situations (Figure 2).

To assist with modifications for survey content, clarity, and length, the survey instrument was pilot-tested with four general and six pediatric dentists in private practice in the community. The final survey instrument was a three-page, self-completed questionnaire consisting of Likert-type responses for most questions. It included demographic questions consisting of those related to their personal characteristics as well as their practice characteristics. The five clinical case scenarios are illustrated in Figure 2. Each case varied by the clinical signs, symptoms, and presentation. Clinical signs and symptoms included pain, fever, localized swelling, warmth of skin and facial swelling. Practice-related presentation (during regular office hours, after hours, being patients of record) was also structured into the scenarios. Dentists were asked to respond whether they would prescribe based on the case information provided.

Data Collection and Statistical Analysis

The surveys were distributed and collected during professional and continuing education courses. At the course registration, dentists were asked if they treated children in their practice and if so, they were asked to participate in the study. Two trained data collectors collected the data.

The final survey instrument was produced using the scannable TeleForm format by the UNC School of Dentistry Data Capture Unit. The TeleForm format reduced potential errors due to data entry. Each returned survey was verified for completeness

prior to scanning. Questionnaires were scanned and data analyzed by the Biostatistical Support Unit at the UNC School of Public Health. Data were analyzed using SAS statistical software (SAS Corporation, Cary, North Carolina). The primary outcome measure was dentists' prescribing decisions/recommendations for each of the five clinical case scenarios.

RESULTS

A total of 280 dentists attended the four meetings where data collection occurred. For those who attended more than one meeting, only one survey was completed. The final sample included the 153 dentists who treated children in their practices and agreed to participate.

Dentists' practice and demographic characteristics are presented in Table 1. The mean age was 47 with a range of 27-68. The mean number of years in practice was 19 with a range of 1-43. Nearly 30% were pediatric dentists and 70% were general dentists. The majority of respondents were males (66%) and UNC-CH School of Dentistry alumni (69%). Among the general dentists, 33% completed a general practice residency (GPR) or advanced general education in dentistry (AEGD) post-graduate training program. The majority was in a solo private practice setting (54%).

Relative to after-hours emergency care coverage, 51% reported taking solo after-hours emergency call duties. Amoxicillin was the most commonly reported antibiotic used (67%). One third reported seldom writing prescriptions for dental infections.

The responses to the clinical case scenarios are presented in Table 2. Dentists were deemed to be in *adherence* with professional guidelines if they reported they would prescribe for the appropriate collective signs/symptoms. Clinical scenarios 1, 2, and 3 were in-office cases and clinical case scenarios 4 and 5 were after-hours/weekend cases. For the after-hours/weekend cases, dentists were deemed to be in *adherence* to clinical

guidelines if they would see the child prior to prescribing antibiotics *and* prescribed for the appropriate collective sign/symptoms.

Overall, adherence rates were low, ranging from 11%-32%. Pediatric dentists had higher levels of adherence to professional guidelines *versus* general dentists. According to professional guidelines, antibiotics should be prescribed when a patient presents with facial swelling with or without pain, and/or radiographic pathology. Case 1 represents the collective symptoms of facial swelling, pain, and radiographic pathology. Overall, 26% of the dentists in the study were in adherence to the professional guidelines. Among the pediatric dentists, 31% were in adherence to the professional guidelines *versus* 23% of general dentists. When fever was added to the list of collective signs and symptoms (Case 2), the overall adherence level dropped to 11%. When local swelling was added and fever removed from the list of collective signs and symptoms (Case 3), the overall adherence level increased to 32%.

Dentists' adherence to professional guidelines dropped for the after hours/weekend cases. According to the guidelines, dentists should see the patient prior to prescribing antibiotics. Less than one quarter (Case 4=15% and case 5=17%) of the dentists reported that they would see the patient prior to prescribing antibiotics.

The bivariate analyses examining factors associated with antibiotic prescribing practices are presented in Table 3. For all the in-office cases (1, 2 and 3), dentists who reported prescribing antibiotics more frequently were more likely to not be in adherence to professional guidelines ($p<0.05$). Specifically for cases 1 and 3, practicing in rural areas was associated ($p<0.05$) with not adhering to the professional guidelines. In these cases, provider type and age of provider (pediatric dentists *versus* general dentists) were

not associated with adherence to the guidelines. Dentists who had completed some type of post-graduate training were more likely to prescribe antibiotics consistent with guidelines ($p<0.05$).

DISCUSSION

This is the first study to investigate the use of antibiotics to treat dental infections in children. Overall, adherence to professional guidelines for prescribing antibiotics for odontogenic infections in children was low. On the basis of our findings, there is a lack of adherence between how dentists in NC are treating dental infections in children and what the recommended professional guidelines suggest. Our results would indicate there is a potential problem in how antibiotics are being used to treat dental infections in children.

We hypothesized that there would be a difference between general dentists and pediatric dentists because they treat children more often, usually have more years of training through their respective residency programs, and the AAPD guidelines offer clinical scenarios and more specific guidance than do the ADA guidelines (Figure 1). In four of the five cases, when the pediatric dentists were analyzed separately, they prescribed antibiotics more closely to the recommended professional guidelines; however, the differences were only modestly better and none were statistically significant ($p < 0.05$). The findings reveal a low percentage of adherence ranging from 11-32%. Previous investigations examining dentists' adherence to professional guidelines have also found low adherence. Nelson and colleagues found that dentists and physicians had low adherence (32.9%) when prescribing antibiotics for SBE coverage.²⁰ Hu and colleagues found that less than 20% of dentists provided adequate counseling for tobacco

users and explained that most of the dentists were unfamiliar with the guidelines and did not follow them.²¹

On the basis of these findings, although one might conclude that the participants are either unaware or unwilling to adhere to guidelines, there may be another explanation. It is possible that the professional guidelines are lacking in clear direction for certain clinical situations. The ADA guidelines (Figure 1) do not provide clinical situations to support prescribing practices. Although most clinical situations are individually different, the guidelines might be more helpful if there were representative clinical cases available to illustrate recommended prescribing patterns. The AAPD guidelines appear to be more specific than the ADA guidelines, but maybe these too could be expanded or explained further. Moreover, given the significance of this issue, both organizations could undertake more active roles in educating their members.

The demographic data gathered were not inconsistent with expectations for a survey of NC dentists.²² The majority attended UNC-CH for dental school and the mean age was 47 years with a the average number of years in practice being 19. Almost the entire sample reported taking some type of solo call or sharing call with others for after-hours emergency cases. In addition, most of the practices were either solo or group practices. Most of the dentists' labeled their practice as being in either a suburban or urban location within NC. Amoxicillin was the drug of choice for treating dental infections. Almost 90% of the sample practiced over 30 hours per week. Interestingly, the vast majority reported that they did not write prescriptions for dental infections very often, and one could possibly relate this to the low adherence to the guidelines.

Limitations and Strengths

These results should be considered in the light of some study limitations. The cross-sectional design limited potential to draw causal inferences. Because the survey was self-completed and based on case scenarios, responses may be susceptible to response bias. Dentists, who attended the continuing education courses where the surveys were distributed, may not be a representative sample of NC dentists. For example, those that attended the courses may have been more informed and more eager to learn about new ideas in dentistry. Participant dentists may have been more informed or more comfortable with the topic. In the aggregate, these limitations hint that professional adherence to the guidelines for antibiotic use may be worse than reported here. Another limitation of our study is the power of the study. Although a few trends were evident, the sample size was small so inferences were difficult.

Despite these limitations, this study has several strengths including it is the first to report on this topic of importance and clinical relevance. Very little is known about antibiotic prescribing practices of dentists in the US and almost nothing is known about prescribing practices when treating children. The study provides preliminary data for one state on the extent to which the dental professionals are adhering to professional guidelines for prescribing antibiotics for children with dental infections. The data also include factors associated with prescribing practices. Understanding these factors will help shape educational strategies and the development of future professional guidelines.

Future Research

This study sets the stage for future research. We obtained *self-reported* practices, which is a first first-step to understanding dentists' antibiotic prescribing practices. Future research should include a more randomized approach with more participants to increase statistical power. Practice-based networks would be an excellent research environment for further study of this topic.

Conclusions

Adherence to professional guidelines for prescribing antibiotics for odontogenic infections in children was extremely low. There appears to be a lack of concordance between the recommended professional guidelines and the antibiotic prescribing practices of dentists in North Carolina.

Figure 1: Professional Guidelines for the Use of Antibiotics

Recommended Professional Guidelines for Antibiotic use

American Dental Association (ADA)

1. Make an accurate diagnosis.
2. Use appropriate antibiotics and dosing schedules.
3. Consider using narrow-spectrum antibacterial drugs in simple infections to minimize disturbance of the normal microflora, and preserve the use of broad-spectrum drugs for more complex infections.
4. Avoid unnecessary use of antibacterial drugs in treating viral infections.
5. If treating empirically, revise treatment regimen based on patient progress or test results.
6. Obtain thorough knowledge of the side effects and drug interactions of an antibacterial drug before prescribing it.
7. Educate the patient regarding proper use of the drug and stress the importance of completing the full course of therapy (that is, taking all doses for the prescribed treatment time).
8. Diagnosis and antibiotic selection should be based on thorough medical and dental history.
9. Weigh the known risks against the benefits of antibiotic use for treatment.
10. Use drugs in an appropriate manner.

American Academy of Pediatric Dentistry (AAPD)

1. Oral Wound Management. Antibiotic therapy should be considered with oral wounds that are at an increased risk of bacterial contamination. Examples are: soft tissue lacerations, complicated crown fractures, severe tooth displacement, extensive gingivectomy, and severe ulcerations.
2. Pulpitis/apical periodontitis/draining sinus tract/localized intraoral swelling. If child has acute symptoms of pulpitis and the infection is contained within the pulpal tissue or the immediate surrounding tissue, treatment should be performed and an antibiotic should not be prescribed.
3. Acute facial swelling of dental origin. Facial swelling secondary to a dental infection should receive immediate dental attention. Treatment is usually either, extracting or treating the tooth with antibiotic coverage or antibiotic coverage for a few days to contain the spread of the infection and then treat the tooth.
4. Dental Trauma. Antibiotic to the root surface of an avulsed tooth is recommended to prevent resorption and increase rate of pulpal revascularization. Systemic antibiotics are unclear as to the necessity to use them with avulsions.
5. Pediatric periodontal diseases. In pediatric periodontal diseases associated with other systemic diseases such as neutropenia, Papillon-LeFevre syndrome, and leukocyte adhesion deficiency, antibiotic therapy is indicated.
6. Viral diseases. The only indication to use antibiotics with a viral infection is if there is evidence of a secondary bacterial infection exists.

Figure 2: Clinical Case Scenarios for Use of Antibiotics

Clinical Scenarios

Case #1

A healthy (ASA I) 9 year old, who is a patient of record, presents to your office during regular business hours with tooth pain in the lower right. On clinical exam you notice a deep carious lesion on #T (lower right primary 2nd molar). Would you prescribe antibiotics for: Pain only? Symptoms of pain and local swelling with no radiographic pathology? Symptoms of pain and local swelling with radiographic pathology? Symptoms of pain and facial swelling with radiographic pathology?

Case #2

A healthy (ASA I) 9 year old, who is a patient of record, presents to your office during regular business hours with tooth pain in the lower right and a fever of 101 degrees. On clinical exam you notice a deep carious lesion on #T (lower right primary 2nd molar). Would you prescribe antibiotics for: Pain and fever? Symptoms of pain and local swelling with no radiographic pathology? Symptoms of pain and local swelling with radiographic pathology? Symptoms of pain and facial swelling with radiographic pathology?

Case #3

A healthy (ASA I) 9 year old, who is a patient of record, presents to your office during regular business hours with tooth pain in the lower right. No fever. On clinical exam you notice a deep carious lesion on #T (lower right primary 2nd molar) along with a draining fistula. Would you prescribe antibiotics for: Pain only? Symptoms of pain and local swelling with no radiographic pathology? Symptoms of pain and local swelling with radiographic pathology? Symptoms of pain and facial swelling with radiographic pathology?

Case #4

A healthy (ASA I) 9 year old, who is a patient of record, calls you on Saturday afternoon with a chief complaint of tooth pain in the lower right. Please review the following symptoms that mom describes on the phone and answer if you would prescribe antibiotics for: Pain only? Symptoms of pain and local swelling? Symptoms of pain and facial swelling? Would you see the child prior to prescribing antibiotics?

Case #5

A healthy (ASA I) 9 year old, who is a patient of record, calls you on a Saturday afternoon and the mother reports pain on the lower right with some warmth of the skin and some swelling that she noticed this morning. Please review the following signs and symptoms and answer if you would prescribe antibiotics for: Pain only? Symptoms of pain and warmth of the skin? Symptoms of pain, warmth of the skin and localized swelling? Symptoms of pain, warmth of the skin, and facial swelling? Would you see the child prior to prescribing antibiotics?

Table 1: Demographics and Practice Characteristics of Study Sample (N=153)

Demographics /Practice Characteristics		N*	%
Gender	Male	101	66%
	Female	52	34%
Dental School Attended	UNC	102	69%
	Other	47	31%
Postgraduate Residency	AEGD/GPR	23	32%
	Pedo	48	66%
	Other	2	3%
	None	69	
After-hours Call	Solo	79	52%
	Share with others	58	38%
	No call	10	7%
	Other	7	5%
Practice Type	Group practice	53	35%
	Solo private	83	54%
	Public health	11	7%
	Military	1	1%
	Other	6	4%
Location of Practice	Urban	55	36%
	Rural	35	23%
	Suburban	61	40%
Type of Antibiotic used	Penicillin	47	31%
	Amoxicillin	103	67%
	Clindamycin	2	1%
	Keflex	2	1%
How many children do you treat per month	Less than or equal to 15	36	26%
	Greater than 15	104	74%

Table 1 (Cont'd): Demographics and Practice Characteristics of Study Sample (N=153)

Demographics/Practice Characteristics		N	%
How many hours per week do you provide pt care	10-20	5	3%
	21-30	15	10%
	30+	134	87%
How often do you write scripts for dental infections	Daily	11	7%
	Weekly	41	27%
	Monthly	51	33%
	Hardly ever	50	33%
How often do you write scripts for SBE	Daily	4	3%
	Weekly	17	11%
	Monthly	40	26%
	Hardly ever	92	60%
		<u>Mean</u>	<u>Range</u>
Age		47 years	27-68
Years in practice		19	1-43

* If total does not add up to 153, responses were missing

Table 2: Responses to Clinical Scenarios: Adherence to Professional Guidelines

Responses to Clinical Scenarios N=153			
	Overall % Adherence to Guidelines	General Dentists % Adhering	Pediatric Dentists % Adhering
Case #1 (Only prescribe antibiotics for pain, facial swelling, and radiographic pathology)*	26%	23%	31%
Case #2 (Only prescribe antibiotics for pain, facial swelling, and radiographic pathology)	11%	10%	15%
Case #3 (Only prescribe antibiotics for pain, facial swelling, and radiographic pathology)	32%	28%	42%
Case #4 (Would see prior to prescribing antibiotics and only prescribe antibiotics for pain and facial swelling)	15%	15%	13%
Case #5 (Would see prior to prescribing antibiotics and only prescribe antibiotics for pain, warmth of skin, and facial swelling)	17%	16%	18%

Table 3: Bivariate Analyses

	Case #1	Case #2	Case #3	Case #4	Case #5
Gender	NS*	NS	NS	NS	NS
Dental School Attended	NS	NS	NS	NS	NS
UNC					
Other					
Postgraduate Residency	NS	NS	P<0.05	NS	NS
AEGD/GPR					
Pediatrics					
Other					
None					
After-hours Call	NS	NS	NS	NS	NS
Solo					
Share with others					
No call					
Other					
Practice Type	NS	NS	NS	NS	NS
Group Practice					
Solo Private					
Public Health					
Military					
Other					
Location of Practice	P<0.05	NS	P<0.05	NS	NS
Urban					
Rural					
Suburban					
# of children you treat per month	NS	NS	NS	NS	P<0.05
Less than or equal to 15					
Greater than 15					
# of hours per week you provide care	NS	NS	NS	NS	NS
11-20					
20-30					
30-40					
40+					
How often write scripts for dental infections	P<0.05	NS	P<0.05	NS	P<0.05
Daily					
Weekly					
Monthly					
Hardly Ever					
How often write scripts for SBE	NS	NS	NS	NS	NS
Daily					
Weekly					
Monthly					
Hardly Ever					

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