

## PRESCRIPTION OF ANTIBIOTICS AND ITS OVERUSE AMONG PEDIATRIC DENTAL PATIENTS: A SYSTEMATIC REVIEW

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### ABSTRACT

Dentists prescribe antibiotics from several classes to treat various oral infections and conditions. Infections caused by bacteria, fungi, and viruses, as well as physical discomfort, fall under this category. Antibiotics are still the most given medication for kids. Antibacterial medications account for an estimated 66.4% of all dental prescriptions in England. A systematic literature review from 2012 to 2022 was performed using PubMed, Medline, and ScienceDirect databases. The keywords used were "antibiotics," "overuse," and "pediatric patients." In addition, the PRISMA flowchart was used to describe the selection process of searched articles. The Cochrane risk of bias assessment method was used to assess the studies' quality. A total of eight studies were found eligible to be included in this study, out of which the majority of studies revealed that pediatric dentists prescribe antibiotics to their patients. There is a need to educate pediatric dentists to avoid prescribing antibiotics in cases where it is not required urgently.

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### Introduction

Dentists prescribe antibiotics from several classes to treat various oral infections and conditions [1-3]. Infections caused by bacteria, fungi, and viruses, as well as physical discomfort, fall under this category. Antibiotics are still the most given medication for kids. Antibacterial medications account for an estimated 66.4% of all dental prescriptions in England [4]. Overuse of antibiotics for nonindicated clinical conditions, including pain control, irreversible pulpitis, and localized dentoalveolar abscess, is on the rise among dentists. Overprescribing antibiotics and the development of antibiotic resistance in children are both facilitated by a lack of awareness of the acceptable clinical reasons for antibiotic prescriptions. It has been shown that multidrug-resistant bacteria may grow in the mouths of children as young as four years old [5]. Clinicians currently face greater challenges than ever when prescribing antibiotics, including rising rates of microbial resistance to antimicrobials and drug interactions as the number of drugs used by adults and children rises. Adjusting prescription doses to account for a child's smaller weight and stature is an additional challenge while treating pediatric patients [6]. Intriguingly, the same research indicated that, for some doctors, the decision to prescribe antibiotics was prompted by motives other than clinical need, such as a lack of convenient appointment times or a goal to satisfy concerned parents [7]. It has been shown that many dentists in underdeveloped nations overprescribe antibiotics for diseases such as dry socket, localized periapical infection, marginal gingivitis, periodontitis, and pulpitis [8]. This lack of understanding of

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clinically useful indications is reflected by a lack of awareness of critical measures that encourage antibiotic stewardship, such as antibiotic stewardship programs. Another kind of antibiotic misuse is the use of broad-spectrum antibiotics to treat illnesses better served by narrow-spectrum antibiotics, improper dose patterns, and antibiotics for too long [9].

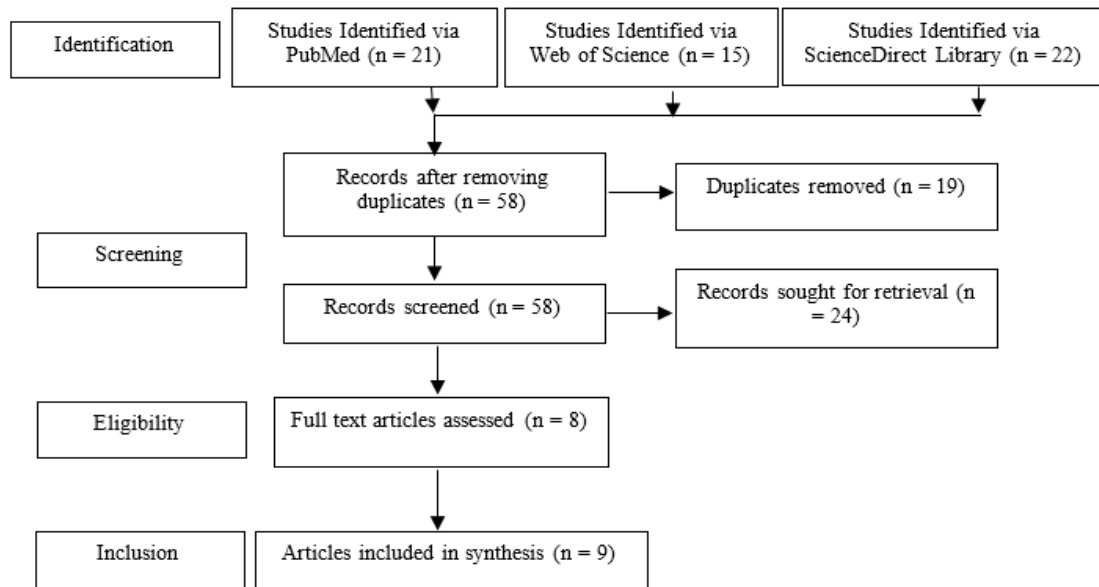
In addition, a greater prevalence of amoxicillin-resistant oral streptococci [10] was observed in individuals who have repeatedly been prescribed amoxicillin, a popular antibiotic in dental prescriptions [11]. Antibiotic resistance is only one of several issues that might arise while treating children with these antibiotics. Some doctors administer sugary medications more often than recommended by the manufacturer and for longer than recommended, often up to 10 days [12]. Children who use sugar-containing drugs risk developing diabetes, which must not be ignored. Additionally, children who are given antibiotics are at a higher risk of developing allergies and respiratory issues [11]. Antibiotic use in infants and young children has been linked to alterations in the composition of gut bacteria and health problems later in life, including obesity. Superinfections with *Candida* species and photosensitivity are two additional consequences. Three-times-daily dosing schedules are more common than twice-daily ones for causing gastrointestinal disorders in children, especially diarrhea [13]. Furthermore, amoxicillin exposure in infancy has been connected to developing enamel abnormalities on both permanent first molars and maxillary central incisors [14]. Thus, there is an immediate need to develop clearer and more definite standards for prescribing dental antibiotics in children for all professionals engaged in treating pediatric oral and maxillofacial infections [15].

**Materials and Methods**

A systematic literature review from 2012 to 2022 was performed using PubMed, Medline, and ScienceDirect databases. The keywords used were "antibiotics," "overuse," and "pediatric patients" (Table 1). In addition, the PRISMA flowchart was used to describe the selection process of searched articles (Figure 1).

**Table 1.** Inclusion and exclusion criteria

Nº	Inclusion criteria	Exclusion criteria
1.	Case-control and randomized control studies	Systematic reviews or meta-analyses or expert opinions, or narrative reviews
2.	Published between 2010 and 2022	Out of the specified time range
4.	English language of publication	Language other than English
7.	In vivo (humans)	In vitro



**Figure 1.** PRISMA Flow Diagram

*Risk of Bias Assessment*

Cochrane risk of bias assessment method was used to assess the studies' quality (Table 2).

**Table 2.** Summary of Cochrane Risk of Bias Assessment

Study	Selection Bias/Appropriate control selection/baseline characteristics similarity	Selection bias in randomization	Selection bias in allocation concealment	Performance-related bias in blinding	Reporting bias/Selective reporting of outcomes	Detection bias Blinding outcome assessors	Accounting for confounding bias
Ahsan <i>et al.</i> (2020) [16]	+	+	-	+	+	+	-
Sharma <i>et al.</i> (2014) [17]	+	+	+	+	+	+	-
Dar-Odeh <i>et al.</i> (2020) [18]	+	+	+	+	+	-	+
Konde <i>et al.</i> (2016) [19]	+	+	+	+	+	+	-
Dar-Odeh <i>et al.</i> (2018) [20]	+	-	+	+	+	-	+
Rubanenko <i>et al.</i> (2021) [21]	+	+	+	-	+	+	+
Shivaleela <i>et al.</i> (2014) [22]	+	+	-	+	+	+	+
Alakhali <i>et al.</i> (2014) [23]	+	+	+	+	+	+	-

## Results and Discussion

The research by Ahsan *et al.* (2020) aimed to determine how often dentists prescribe antibiotics to treat children's dental infections at educational institutions in Karachi, Pakistan [16]. There was a 100% response rate, and 380 children were included in the analysis. The evidence displays dentists' answers to the five detailed clinical studies, following AAPD standards for the dental profession. In the past, dentists who saw more than 15 children under the age of 9 every month were regarded as having a high number of pediatric patients. Facial edema, discomfort, and radiographic signs of pathology are all symptoms in Case 1. Only 26.8% of dentists in the research were found to be following best practices. In Case 2, when the fever was added to the list of symptoms, total participation remained the same at 26.1%. In Case 3, when localized swelling was included with fever as a symptom, research participants were more likely to follow the instructions (36.8% vs. 24.2%). Cases 4 and 5 were categorized as weekend patients, with 44.2% of dentists adhering to the recommended practice of checking the pediatric patient before prescribing antibiotics and limiting antibiotic use to cases involving pain and facial swelling in case 4. In Case 5, however, when participants' skin temperature was considered, the percentage of dentists who followed the instructions dropped to 33.9%. Cases 1, 3, 4, and 5 showed a statistically significant ( $p < 0.001$  for all) difference between the adherence of dentists with low and high volumes of pediatric patients, with dentists treating up to 15 children per month being more likely to stick to standard antibiotic prescribing guidelines than those treating more than 15 children per month.

This analysis by Sharma *et al.* (2014) aimed to analyze the Department of Pedodontics' antibiotics prescription practices [17]. Six hundred and nineteen (619) children aged 2 to 16 were selected for treatment; 205 patients were chosen from the dental schools, and another 415 were chosen from the other four dental schools. It was shown that antibiotics were advised for preventative use in 70.4% of cases and therapeutic use in 29.6% of cases. Prophylactic usage of antimicrobials was observed to last an average of 5.5, and five days were spent in this investigation, which is a longer time than is recommended. When clinical testing cannot determine infectious organisms, bacteriological testing and sensitivity evaluations are required. One hundred percent of the antimicrobials examined in this investigation had no bacteriological evidence to justify their prescription. Concentrated topical fluorides were indicated for home use in 3% of patients with a high caries rate or high-risk assessment for caries (orthodontic treatment). Children's dental health may benefit from fluoride when it is appropriately handled.

The research by Dar-Odeh *et al.* (2020) revealed that the treatment of dental infection in children had been shown to include the incorrect use of antibiotics [18]. Twenty-seven people showed up and filled out the surveys. Questions regarding dentists' familiarity with and feelings about the use of dental antibiotics in pediatric patients were included in the survey. Dentists prescribed amoxicillin more often than any other antibiotic to pediatric patients (62.9%). Only about a third of doctors administer antibiotics for more than 5 days, and only about a third of doctors give antibiotics in combination. Most people who needed an antibiotic other than amoxicillin chose erythromycin (77.8%), followed by clindamycin (22.2%). Antibiotics were often recommended for clinical situations where they were not warranted, including pulpitis and gingivitis. More than half of the sample physicians cited the necessity to postpone treatment and sterilization not ensured as justifications for prescribing antibiotics.

The study by Konde *et al.* (2016) aims to evaluate the prescribing habits of BDS dentists and pediatric dentists and their familiarity with antibiotic resistance [19]. The research's BDS specialists and pediatric dentists were given a questionnaire

with both open-ended and closed-ended items. Most doctors who treated patients for oral disorders used antibiotics. There was statistically significant overprescribing in the BDS group for various diseases compared to pediatric dentists' prescription patterns. Except for localized intra-oral swelling ( $P = 0.3994$ ), acute facial swelling ( $P = 0.122$ ), extraction by open method ( $P = 0.1175$ ), and congenital cardiac abnormalities ( $P = 0.6985$ ), there was a statistically significant increase in the prescription of antibiotics among BDS practitioners when compared to pediatric dentists (MDS). Both groups had sufficient knowledge of the need for antibiotic prophylaxis and the problem of antibiotic resistance. However, there was a widespread lack of familiarity with antibiotic prescription recommendations across all categories.

Dar-Odeh *et al.* (2018) analyzed in their research that cellulitis, aggressive periodontitis, necrotizing ulcerative gingivitis, and pericoronitis were the most common causes. Most doctors prescribe amoxicillin for three to five days, with penicillin-sensitive individuals being given either metronidazole or azithromycin as an alternative [20].

The analysis by Rubanenko *et al.* (2021) aims to compare the expertise of pediatric dentists and general dentists who treat pediatric patients regarding the appropriate use of antibiotics [21]. One hundred pediatric dentists (PD) and one hundred general dentists (GD) who treat pediatric patients (Children 110) completed questionnaires for this research to assess their familiarity with the use of antibiotics in juvenile dental care in 2 months. After considering socioeconomic status, the results revealed that fewer PDs were used in cases with periapical localized abscess ( $OR = 0.72$ ), apical periodontitis ( $OR = 0.54$ ), and dry socket ( $OR = 0.62$ ) as compared to the general population. In PD, the length of time on antibiotics was greater ( $OR = 1.88$ ). Antibiotic use was shown to be significantly lower among PDs compared to GDs. Compared to OD, PD prescribes fewer antibiotics for the following conditions: a) intraoral sinus tract, b) luxation, c) extraction by open method, d) periapical localized abscess, e) apical periodontitis.

Shivaleela *et al.* (2014), in their research, used 100 patient case sheets from the pediatric in-patient department at McGann University Medical Center [22]. Pediatric patients had a mean age of 5.8. For an average interaction, 4.26 antibiotics were recommended. Patients received an average of 2.13 courses of antibiotic treatment. Patients having a history of any infection were included. SPSS was used to analyze the data. Shivaleela *et al.* analyzed data from 100 patient case sheets from McGann's pediatric in-patient unit to conduct their research. Participants must have a patient history of one or more illnesses listed. SPSS was used to analyze the data. Patients were given an average of 2.13 doses of antibiotic treatment. Antibiotics were administered to most patients (92%), with only 8% receiving a single dose of antibiotic treatment, 76% receiving two doses, 11% receiving three doses, 3% receiving four doses, and 1% receiving five doses. About half of the medications recommended in the current research are antibiotics. Over 98% of the medications administered in this research were on the World Health Organization's List of Essential Medicines for 2013.

The primary goal of the study by Alakhali *et al.* (2014) is to analyze antibiotic prescription practices among hospitalized children [23]. One hundred forty-four people were recruited for the research. Patient age was 3.71 3.62 years on average when antibiotics were given. Patients were given 209 antibiotics, averaging 1.45 and 0.58 medications per prescription. Only one patient in our research took all four antibiotics at once, whereas 59 took two, 54 took three, and 85 experienced only one. The most common illnesses for which antibiotics were recommended were fever (12.5%) and pneumonia (9.7%) among babies. In-patients were most often given antibiotics from the cephalosporin (52%) group, followed by the aminoglycoside group, penicillin, macrolides, and quinolone group. Evidence shows that of the 98 drugs other than antibiotics that were given at the same time, 40 (27.2%) were acetaminophen, 23 (16.0%) were steroids, 12 (8.3%) were albuterol, and 12 (8.3%) were ipratropium.

**Table 3** describes the details for each study such as participants, age, objectives, time period, diseases and results.

**Table 3.** Summary of results of selected studies

Author name	Participants	Age	Objective	Time period	Diseases	Results
Ahsan <i>et al.</i> , (2020) [16]	15 children per month	9 years	The purpose of this research was to determine the number of antibiotic prescriptions for treating dental infections in children among dentists in Karachi, Pakistan	5 days	face edema, discomfort, pathologic radiography findings, fever	The difference in adherence of dentists with a low and high volume of pediatric patients was significantly different for case scenarios 1, 3, 4, and 5 ( $P < 0.001$ for all)
Sharma <i>et al.</i> , (2014) [17]	619	2 to 16 years	The current study's goal is to discover the prescription prescribing patterns in the Department of Pedodontics	5 days	Infection	70.4% of antibiotics were suggested for preventive reasons and 29.6% for therapeutic ones
Dar-Odeh <i>et al.</i> , (2020) [18]	27	4 to 10 years	This study aims to inquire about the perspectives and knowledge of a cross-section of pediatric dentists on the prescription of antibiotics.	More than 5 days	dry socket, periapical infection, marginal gingivitis, pulpitis, periodontitis, pulpitis sinusitis, and cellulitis.	Amoxicillin was the most often recommended antibiotic (62.9%) by pediatric dentists

<b>Konde <i>et al.</i>, (2016) [19]</b>	204		The purpose of this study is to examine antibiotic prescription patterns and antibiotic resistance knowledge among Bachelor of Dental Surgery (BDS) practitioners and pediatric dentists.	3 to 5 days	acute facial swelling, intraoral swelling	there was a general lack of understanding of antibiotic prescription recommendations in both groups
<b>Dar-Odeh <i>et al.</i>, (2018) [20]</b>	many	1 to 5 years	This evaluation is intended for dentists who offer oral healthcare to children	3-5 days	non-bacterial infections	Amoxicillin was shown to be the most generally suggested antibiotic.
<b>Rubanenko <i>et al.</i>, (2021) [21]</b>	110	3 to 12 years	The purpose of this research is to assess general dentists' (who also treat children) and pediatric dentists' knowledge of antibiotic usage		apical periodontitis, dry socket periodontal disease, respiratory disorders, and viral infection	PDs recommend fewer antibiotics than GDs
<b>Shivaleela <i>et al.</i>, (2014) [22]</b>	100	5.8 years	The primary goal is to investigate the antibiotic prescription patterns in pediatric in-patients	2 months	acute gastroenteritis, URTI, LRTI, fever	About half of the medications recommended in the current research are antibiotics.
<b>Alakhali <i>et al.</i>, (2014) [23]</b>	144	3 years	The primary goal is to investigate the antibiotic prescription patterns in hospitalized pediatric in-patients	2 months	Fever and pneumonia	Cephalosporins (52%) were the most often prescribed antibiotics, followed by aminoglycosides, penicillins, macrolides, and quinolones

In a 2017 study by Al-Johani *et al.*, dentists' actual antibiotic prescription rates varied from 15.7% to 43.5% of what was suggested by the AAPD standards. Our research findings are like the AAPD recommendations reported in a study conducted in the United States; in the first scenario, for example, only 26.8% of dentists gave antibiotics just for pain and facial swelling with radiographic evidence of disease [24]. Despite the addition of fever to group 2 in our research, the Adherence Rate remained at or around 26.1%, much greater than that found in previous studies. In group 3, when there was no fever but a draining fistula was present, our adherence rate was 36.8%, higher than that reported in studies conducted in the United States and Saudi Arabia. The AAPD's five case scenarios questionnaire divided possible situations into two groups: those within the work week (cases 1, 2, and 3) and those outside (cases 4 and 5). The present study's 44.2% and 33.9% adherence rates for cases 4 and 5 are much higher than those of prior research [25].

When present studies compared the AAPD guideline adherence in these two groups, the result revealed that, contrary to other studies, overall adherence was lower in dentists with a high volume of pediatric patients concerning dentists with a low percentage of pediatric patients in all case scenarios in which antibiotics were prescribed. This research found that dentists' antibiotic prescription practices were inconsistent with established recommendations.

According to the findings, preventive use of antibiotics accounted for 70.4%, while therapeutic use contributed to 29.6%. Antibiotic prophylaxis should be administered within 24 hours at the earliest. The average prophylactic usage of antimicrobials in this research lasted for 5.5 0.5 days, which is much longer than recommended [26]. When clinical testing cannot determine infectious organisms, bacteriological testing and sensitivity evaluations are required. Similarly to what Ergin *et al.* reported, this investigation found that all antimicrobials were recommended without bacteriological evidence [27]. The Essential Drug List in India accounted for 17.8 percent of prescription medications. The number of pharmaceuticals prescribed per patient decreased while the number of drugs prescribed per patient increased, leading to a decrease in the prescription of important drugs. Improvements in the administration of life-sustaining medications are now required [28].

Antibiotic combinations, such as amoxicillin/clavulanic acid coupled with metronidazole, are often prescribed by doctors (29.7%). Metronidazole is effective against anaerobic infections and should discourage you from holding this view. In dentistry, the use of combination medicine prescriptions is significant for treating resistant or mixed illnesses. However, monotherapy is preferred because of its lower potential for unintended consequences, such as developing drug-resistant microorganisms, and reduced therapeutic costs [29].

Another worrying discovery was that some dentists use antibiotics to treat viral diseases like herpes simplex virus-1. Thanaviratananich *et al.* found that 86 percent of BDS dentists and just 12 percent of pediatric dentists recommended medicines for viral illnesses. Two of the few clinical conditions that require antibiotic treatment on an as-needed basis are oral infection with a high fever and symptoms of systemic dissemination, such as lymphadenopathy and trismus [30].

The dentist may have trouble deciding which antibiotic to use and how often to give it. Certain antibiotics, such as fluoroquinolones, which may induce chondrotoxicity in developing cartilage, and tetracycline, which can cause permanent tooth discoloration, should be avoided in youngsters. Furthermore, amoxicillin-clavulanic acid is recommended since it has a larger range of activity than amoxicillin alone. Though clavulanic acid usage in children has been linked to GI problems

(diarrhea), this side effect may be mitigated by switching to a twice-daily dosing schedule [31].

Unjustified antibiotic treatment may occur in apical periodontitis, periapical localized abscess, or the intraoral sinus tract. These situations require antibiotics and a "surgical" procedure like pus drainage or root canal therapy. When asked if they would administer antibiotics for a patient with a local dental abscess and gingival swelling, 68% of dentists in Sivaraman's research said they would. However, just 12% of endodontists said they would prescribe antibiotics for a patient with a draining fistula. They attribute this to endodontists' increased visibility and expertise in treating root canal disorders [32].

Acute GE was the most frequent illness in the research, and Cefixime and Gentamicin are the drugs of choice for treating it. Similar findings were seen in the research by Choudhury DK and Kanish *et al.* [33, 34]. The most usually given antibiotic in the current study was a third-generation cephalosporin. Most antibiotics were prescribed without first obtaining a culture result. Antibiotics were provided in 25% of instances after a positive culture report, although most case files failed to include the culture findings. Antibiotics must be chosen after thoroughly studying a specimen and a culture of the bacterium or yeast. As a result, antibiotic resistance may be avoided, medication adverse effects can be mitigated, and treatment costs can be lowered. This is useful information for choosing effective antibiotics.

According to present research, fever and pneumonia are the leading causes of antibiotic prescriptions, followed by gastroenteritis and bronchitis. These findings corroborate those of prior research showing that acute respiratory infections such as pneumonia, pharyngitis, and fever are common causes of antibiotic prescriptions, which was undertaken by Hersh *et al.* 2011, and Elshout *et al.* 2012 [35, 36].

Nearly 50 million antibiotic prescriptions are written annually in the United States, with one in five pediatric healthcare provider visits resulting in an antibiotic prescription. Cephalosporins (52%) were found to be the most often given antibiotics in the current investigation, followed by Aminoglycosides (17.3%) (Gentamicin) and penicillin (12.5%). (Amoxicillin). These findings are consistent with a previous study by Sharma *et al.* 2012, which found that aminoglycosides were the most prescribed antibiotic group in the teaching hospital and cephalosporins and combinations were the most prescribed antibiotic group in the non-teaching hospital [37].

## Conclusion

Overall, there is a high prevalence of antibiotics prescription by pediatric dentists. However, most of the use is for treating cases of infection or as a preventive measure. There is a need to educate pediatric dentists to avoid prescribing antibiotics in cases where it is not required urgently.

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