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Outpatient antibiotic prescribing by general dentists in the United States from 2018 through 2022

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Abstract

Background. Dentists play a role in combatting antimicrobial resistance. This analysis characterizes antibiotic prescribing changes by dentists after the American Dental Association's dental infection treatment guideline was released in 2019.

Methods. The Xponent (IQVIA) database was used to extract antibiotic prescriptions dispensed from 2018 through 2022. General dentist prescriptions were compared with total outpatient oral antibiotics and summarized by patient and provider characteristics. Census denominators were used to calculate prescribing rates per 1,000 people.

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DISCLOSURE

None of the authors reported any disclosures.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official positions of the Centers for Disease Control and Prevention.

SUPPLEMENTAL DATA

Supplemental data related to this article can be found at: <https://doi.org/10.1016/j.adaj.2024.12.003>.

Results. Dentists prescribed 24.65 million antibiotics in 2018 compared with 25.17 million in 2022, resulting in 75.5 prescriptions per 1,000 people for both years. From 2018 through 2022, dentists prescribed 9.8% through 12.1% of all outpatient antibiotics. Females, patients 65 years and older, and patients in the Northeast received the most antibiotic prescriptions.

Conclusions. Prescribing by general dentists remained stable from 2018 through 2022 despite guideline recommendations to limit antibiotic use for dental infections. Variation by patient and provider characteristics may represent unnecessary antibiotic use.

Practical Implications. Antibiotic stewardship is needed to optimize prescribing in the dental care setting. The Centers for Disease Control and Prevention's Core Elements of Outpatient Antibiotic Stewardship framework can be adapted for dental stewardship implementation.

Keywords

Antibiotics; antibiotic stewardship; dentistry

Antimicrobial resistance is a major public health threat, and antibiotic use is a primary driver of resistance patterns worldwide. In the United States, the Centers for Disease Control and Prevention (CDC) estimates that more than 2.8 million antimicrobial-resistant infections occur each year, causing nearly 36,000 deaths and resulting in more than \$4.6 billion in health care costs annually.^{1,2} Optimizing antibiotic use across health care delivery settings is paramount to combating antimicrobial resistance, ensuring patient safety, and delivering high-quality health care. Outpatient settings are particularly important in this effort because most human antibiotic use by volume occurs there.³

Dentists prescribe antibiotics for the treatment of bacterial oral infections and for prophylaxis before invasive dental procedures among certain patients at high risk of complications. In 2013, general dentists accounted for nearly 10% of all outpatient oral antibiotic prescriptions⁴ and were the fourth highest prescriber type, after family practitioners (24%), pediatricians (12%), and internists (12%).⁵ In addition to the large volume of antibiotic prescribing, studies have shown a high rate of unnecessary dental prescribing.^{6–9} As a result, the dental care setting is an important area to focus on for efforts aimed at improving antibiotic use.

In 2019, the American Dental Association (ADA) released a clinical practice guideline that recommended limited use of antibiotics for the treatment of pulpal and periapical-related dental pain and intraoral swelling with no systemic involvement.¹⁰ The purpose of our analysis is to characterize changes in antibiotic prescribing by general dentists in the United States from 2018 through 2022 and evaluate differences in prescribing by patient and provider characteristics.

METHODS

For this cross-sectional study, we extracted all oral antibiotic prescriptions dispensed from 2018 through 2022 from the Xponent (IQVIA) database, which captures 92% or more of all US outpatient prescriptions dispensed in retail pharmacies and reconciles them to wholesale delivery. Using a patented projection methodology, IQVIA projects its data to

100% coverage of retail prescriptions dispensed from pharmacies. We aggregated antibiotic agents into antibiotic class categories following the Uniform System of Classification (eBox, available online at the end of this article).^{4,5} Information on prescriber specialty was collected by IQVIA; for general dentists, this is based on Drug Enforcement Agency and state licensing authority records. The analysis was limited to providers practicing in general dentistry and did not include antibiotic prescriptions written by dental specialists because they are aggregated into broader specialty categories by IQVIA (eg, oral surgeons are in the surgery category). We compared prescriptions by general dentists with total outpatient oral antibiotic prescriptions and summarized them by patient sex and age group, antibiotic class and agent, and prescriber geography by US Census Bureau region. We limited antibiotic agents to those constituting more than 1% of all dental outpatient prescriptions.

We calculated antibiotic prescribing rates per 1,000 people using the total number of prescriptions for each characteristic by year and the corresponding US Census Bureau population estimate denominators.^{11,12} For 2022, we also examined antibiotic prescribing rates per 1,000 people by state. We computed all statistics using SAS Version 9.4 (SAS Institute) and Excel Version 2308 (Microsoft 365). This activity was reviewed by the CDC, was deemed research not involving human participants, and was conducted consistently with applicable federal law and CDC policy.

RESULTS

General dentists prescribed 24.65 (9.9%) million antibiotic prescriptions in 2018 compared with 25.17 (10.7%) million in 2022. This resulted in a prescribing rate of 75.5 antibiotic prescriptions per 1,000 people for both years. In 2020, during the COVID-19 pandemic, there was an overall decline of 5.1% in total dental antibiotic prescriptions compared with 2019. However, from 2019 through 2020, the percentage of all outpatient oral antibiotics prescribed by general dentists increased from 9.8% to 11.6% (Figure 1).

Penicillins were the most prescribed antibiotic class, comprising 72.4% of all dental antibiotic prescriptions in 2018 and 73.2% in 2022 (17.85 and 18.43 million prescriptions, respectively), followed by lincosamides and macrolides (Table). Some antibiotic classes make up a small portion of dental outpatient prescriptions but have no clear dental indication, including quinolones (0.5%) and urinary anti-infectives (0.1%). Amoxicillin was the most prescribed antibiotic agent, accounting for 64.0% of all prescriptions in 2018 (15.79 million prescriptions) and 68.1% of all prescriptions in 2022 (17.16 million prescriptions), followed by clindamycin, which accounted for 14.2% of all prescriptions in 2018 (3.50 million prescriptions) and 11.8% of all prescriptions in 2022 (2.98 million prescriptions). From 2018 through 2022 there was an 8.7% increase in amoxicillin prescriptions and a 14.8% decline in clindamycin prescriptions.

Dental antibiotic prescription rates were higher for female patients (≈ 82 prescriptions per 1,000 females) than male patients (≈ 69 prescriptions per 1,000 males) in 2018 and 2022 (Table). Prescribing rates increased with patient age, and more than 90% of antibiotic prescriptions written by dentists were for adults older than 19 years. Among patients 65 years and older, prescribing rates increased over time from 130.6 prescriptions per 1,000

people in 2018 to 139.1 prescriptions per 1,000 people in 2022 (Figure 2). Dental prescribers in the Northeast had the highest prescription rates (84.6 prescriptions per 1,000 people in 2018 and 85.5 prescriptions per 1,000 people in 2022), whereas those in the West had the lowest prescription rates (68.7 prescriptions per 1,000 people in 2018 and 66.2 prescriptions per 1,000 people in 2022). The South had the highest total number of antibiotic prescriptions with 9.45 million in 2018 and 9.97 million in 2022 (Table). In 2022, New York had the highest antibiotic prescription rate (94 prescriptions per 1,000 people), whereas Alaska had the lowest (49 prescriptions per 1,000 people) (Figure 3).

DISCUSSION

Our study compared dental prescriptions with overall antibiotic prescriptions using national surveillance data to investigate antibiotic prescriptions and compared antibiotic prescribing patterns among dentists before and after release of the ADA treatment guideline. We found that the outpatient antibiotic prescription rate by general dentists remained stable from 2018 through 2022. Other published studies also support stable prescription rates by general dentists.^{13,14} Over the same time frame, the total number of antibiotic prescriptions from all prescribers decreased by 5.4% from 249.8 million in 2018 to 236.4 million in 2022.¹⁵ As a result, general dentists' relative share of all outpatient antibiotic prescriptions increased compared with previous years, particularly from 2020 through 2022 during the COVID-19 pandemic. This pattern underscores a need for additional efforts to optimize antibiotic prescribing in dentistry, including antibiotic stewardship activities.^{14,16}

As part of the US National Action Plan for combating antimicrobial resistance, the ADA made a commitment to develop guidance to help dentists prescribe antibiotics more judiciously.¹⁷ The ADA's clinical practice guideline for urgent management of dental pain and intraoral swelling was the result of this commitment and aimed to reduce unnecessary antibiotic use. The guideline recommends definitive, conservative dental treatment and reserves antibiotics for dental infections with signs of systemic involvement.¹⁰ Despite the release of this guideline in 2019, antibiotic prescription rates by general dentists have had relatively no change in subsequent years. Possible reasons for the continued rate of prescribing may include slow adoption of the new guideline, pressure from patients and other health care professionals to prescribe antibiotics, or limited awareness among dentists of the full impact of antibiotic use on adverse events and antimicrobial resistance and the role they play in improving patient safety.^{6,18–20} Ongoing opportunities to optimize antibiotic prescribing among dentists include both reducing unnecessary prescriptions^{6,7} and improving antibiotic selection and duration of therapy when antibiotics are indicated.^{21,22} Widespread dissemination of the ADA treatment guideline needs to be combined with effective strategies for changing prescribing behavior among dentists.^{23–25}

Most dental prescriptions were for amoxicillin, which is the first-line agent recommended in the ADA treatment guideline as well as by the dental prophylaxis guidelines.^{18,26,27} The increase in amoxicillin and decrease in clindamycin over the time frame represents a favorable shift in antibiotic agent selection, possibly due to the ADA treatment guideline deemphasizing the use of clindamycin as a penicillin alternative or growing awareness of the higher risk of *Clostridioides difficile* infection related to clindamycin use.¹⁹ However,

prescriptions for antibiotic classes like quinolones and urinary anti-infectives, which lack clear dental indications, show an opportunity to further evaluate indication for dental prescribing, assess antibiotic appropriateness, and tailor education for dentists to optimize antibiotic use.

The higher rate of antibiotics prescribed for female patients has been reported previously⁴ and may be due to higher use of health care services than men.²⁸ In particular, women use more preventive oral health care services and are more likely to visit the dentist for a condition noted in a previous visit.^{29,30} Higher rates of antibiotic prescribing among adults 65 years and older may reflect differences in dental disease burden and underlying health status. Older adults commonly undergo invasive dental procedures, such as extractions and implants and are more likely to have complex medical histories, including multiple comorbidities than younger adults and children.^{7,27,31} As a result, dentists may perceive them as being at greater risk of experiencing complications or poor outcomes if an antibiotic is not prescribed. Prescribing antibiotics as prevention for possible complications appears to be a common practice in older adults but is not supported by any existing treatment or prophylaxis guidelines.³²

Geographic variability in antibiotic prescribing has been shown previously. A 2013 analysis of outpatient dental antibiotic prescriptions found regional prescribing rates similar to those reported in our study and found that the West had the lowest dental antibiotic prescribing rate, whereas the Northeast had the highest.⁴ This differs from the regional pattern seen for nondental medical providers, among whom the highest antibiotic prescribing rates consistently have been seen in the South.^{6,33–35} The geographic variation in dental antibiotic prescriptions is likely the result of a combination of factors, which may include differences in dental disease burden, access to oral health care and use of services, and patterns of unnecessary prescribing.^{5,21,31}

The CDC's Core Elements of Outpatient Antibiotic Stewardship outline an adaptable, evidence-based framework for implementing stewardship activities.³⁶ Elements of the framework have been used to improve antibiotic use across outpatient settings, including in dental care setting.^{37–39} Commitment to and accountability for optimizing antibiotic use and patient safety from leadership is the first Core Element. Dentists can display public commitment posters in support of appropriate antibiotic prescribing, and dental networks can ensure resources and support for a person to direct stewardship activities across the organization.⁴⁰ The second Core Element is action for policy and practice and entails implementing interventions in a stepwise approach to improve prescribing practices. Priority actions for dental care settings might include standardization of antibiotic prescribing through use of evidence-based treatment recommendations; development of practice-specific requirements, such as documentation of indication for antibiotic use in the medical record; or integration of clinical decision support tools into the oral health care workflow.^{41,42} Tracking and reporting antibiotic prescribing, the third Core Element, is important for identifying opportunities for improvement, providing feedback to clinicians on their prescribing practices, and monitoring the effect of stewardship interventions.^{43,44} Engaging with electronic health record companies to incorporate antibiotic use tracking and reporting and clinical decision support to improve antibiotic prescribing in products used

in dental care settings could support stewardship efforts and patient safety.⁴⁵ Education, the last Core Element, is most impactful in the context of other stewardship interventions.⁴⁶ Deficits in clinical knowledge are usually not the only barrier to appropriate antibiotic prescribing, and effective education needs to address the psychosocial pressures that influence dental prescribing practices, such as possible concerns over patient satisfaction and retention.⁴⁷ Education also needs to include all clinicians and staff members who interact directly with patients and may influence their expectations regarding antibiotics. Engaging medical providers and dental specialists specifically can help address requests for antibiotic prescribing not supported by existing guidelines.^{37,48} The Association for Dental Safety has developed educational resources tailored for dentists, dental team members, and patients that support antibiotic stewardship efforts.⁴⁹

There are limitations to our analysis. Xponent does not include diagnoses or indications for prescriptions in the data set, so appropriateness could not be assessed. In addition, there were limited sociodemographic variables available, so we could not discern if prescribing disparities existed for certain characteristics, such as patient race and ethnicity. Antibiotics prescribed by medical providers and dental specialists were not captured in this analysis. Therefore, the study results are an underestimate of all antibiotic prescribing for dental-related conditions.^{50,51}

CONCLUSIONS

The stable rate of antibiotic prescriptions by general dentists suggests ongoing unnecessary prescribing and highlights the need for antibiotic stewardship in dentistry. The ADA's dental infection treatment guideline and evidence-based strategies for changing prescribing behavior should be implemented. The CDC's Core Elements of Outpatient Antibiotic Stewardship provide an effective framework for implementing stewardship activities and should be considered in the dental care setting to improve antibiotic use.^{36,37} Variation in prescribing rates by patient and provider characteristics may represent unnecessary antibiotic use. Further evaluation of prescribing indications and prescribing practices in various dental care settings and by dental specialists is needed to better inform dental stewardship priorities.⁵² ■

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATION KEY

ADA	American Dental Association
CDC	Centers for Disease Control and Prevention

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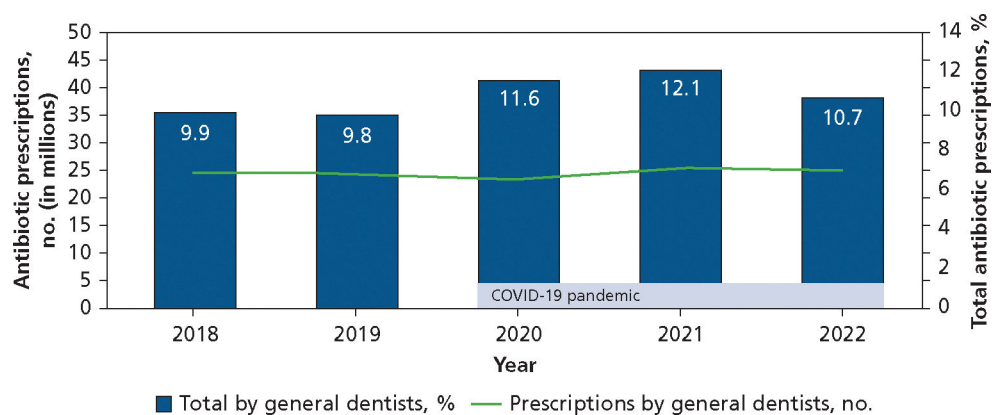


Figure 1. Outpatient antibiotic prescriptions and percentage of total antibiotics prescribed by general dentists in the United States from 2018 through 2022. Data source: Xponent (IQVIA).

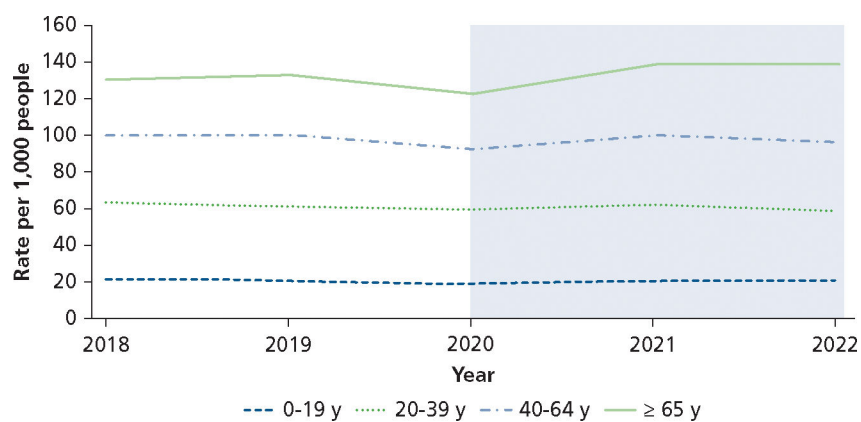
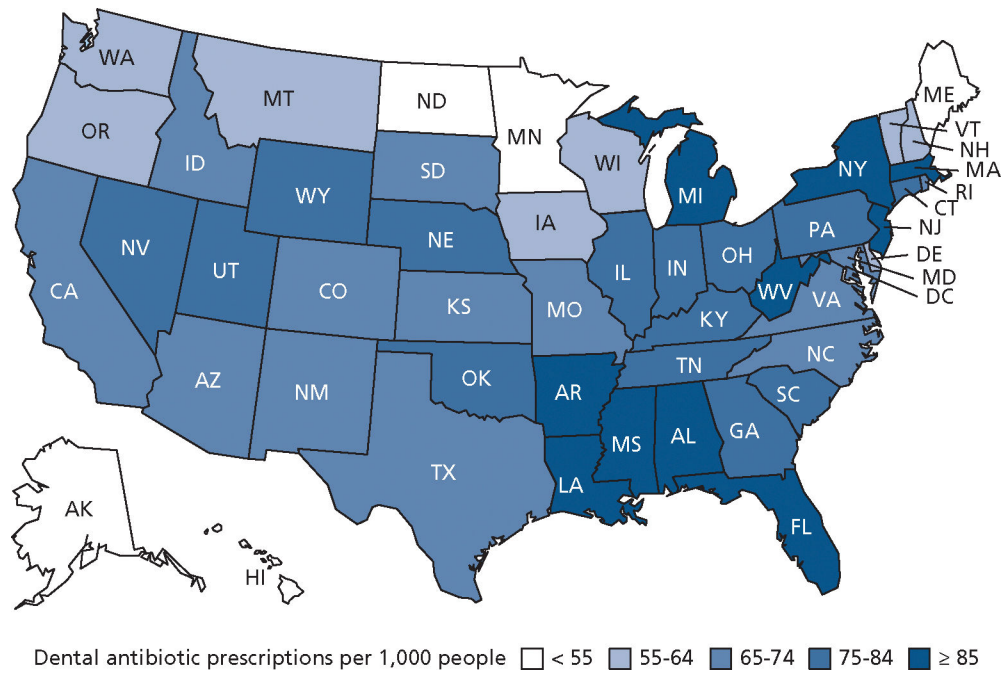


Figure 2. Dental outpatient antibiotic prescriptions by age group in the United States from 2018 through 2022. Shaded area denotes COVID-19 pandemic. Data source: Xponent (IQVIA).

**Figure 3.**

Rate of dental outpatient antibiotic prescriptions per 1,000 people by state, United States, 2022. Data Source: Xponent (IQVIA).

Table.

Outpatient antibiotic prescriptions by general dentists according to patient sex, age group, prescriber region, antibiotic class, and antibiotic agent in 2018 and 2022, United States.*

CHARACTERISTIC	2018 PRESCRIPTIONS		2022 PRESCRIPTIONS	
	No. in Millions (%)	Rate per 1,000 People	No. in Millions (%)	Rate per 1,000 People
Total	24.65 (100)	75.5	25.17 (100)	75.5
Sex [†]				
Male	11.03 (44.7)	68.5	11.38 (45.2)	68.9
Female	13.62 (55.2)	82.2	13.79 (54.7)	82.1
Age Group, Y [†]				
0–19	1.77 (7.2)	21.6	1.73 (6.9)	21.3
20–39	5.65 (22.9)	63.5	5.32 (21.2)	58.8
40–64	10.39 (42.2)	100.4	10.08 (40.0)	97.0
≥ 65	6.84 (27.8)	130.6	8.04 (32.0)	139.1
Prescriber Region				
Midwest	5.13 (20.8)	75.2	5.11 (20.3)	74.3
Northeast	4.74 (19.2)	84.6	4.88 (19.4)	85.5
South	9.45 (38.3)	75.9	9.97 (39.6)	77.5
West	5.35 (21.7)	68.7	5.21 (20.7)	66.2
Antibiotic Class [†]				
Penicillins	17.85 (72.4)	54.7	18.43 (73.2)	55.3
Lincosamides	3.50 (14.2)	10.7	2.98 (11.8)	8.9
Macrolides	1.09 (4.4)	3.3	1.39 (5.5)	3.7
Cephalosporins	0.92 (3.7)	2.8	0.77 (3.1)	2.3
β -lactams, increased activity	0.84 (3.4)	2.6	1.24 (4.9)	3.7
Tetracycline	0.31 (1.3)	1.0	0.26 (1.0)	0.8
Quinolones	0.12 (0.5)	0.4	0.08 (0.3)	0.2
Trimethoprim-sulfamethoxazole	0.03 (0.1)	0.1	0.02 (0.1)	0.1
Urinary anti-infectives [‡]	0.02 (0.1)	0.0	0.01 (0.0)	0.0
Other	0.00 (0.0)	0.0	0.00 (0.0)	0.0
Antibiotic Agent ^{†,§}				
Amoxicillin	15.79 (64.0)	48.3	17.16 (68.1)	51.5
Clindamycin	3.50 (14.2)	10.7	2.98 (11.8)	8.9
Penicillin V	2.05 (8.3)	6.3	1.26 (5.0)	3.8
Azithromycin	1.04 (4.2)	3.2	1.36 (5.4)	4.1
Cephalexin	0.88 (3.6)	2.7	0.74 (2.9)	2.2
Amoxicillin clavulanate	0.84 (3.4)	2.6	1.24 (4.9)	3.7
Doxycycline	0.30 (1.2)	0.9	0.25 (1.0)	0.8

* Data source: IQVIA Xponent.

[†] Total percentage does not add up to 100% of prescriptions due to rounding.

[‡] Urinary anti-infectives prescribed from 2018 through 2022 are listed in the eBox, available online at the end of this article.

[§]The 7 antibiotic agents most commonly prescribed by dentists are reported and capture 98.9% of antibiotic prescriptions.

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