Infection Control & Hospital Epidemiology (2024), **45**, 890–899
doi:10.1017/ice.2024.13

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Original Article

Prevalence of unnecessary antibiotic prescriptions among dental visits, 2019

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Abstract

Objective: The US National Action Plan for Combating Antibiotic-Resistant Bacteria established a goal to decrease unnecessary outpatient antibiotic use by 50%. However, data to inform this goal have been limited to medical settings and have not included dental prescribing. Thus, we sought to identify the proportion of antibiotics prescribed inappropriately by dentists to inform outpatient stewardship efforts.

Methods: Cross-sectional analysis of 2019 Veterans' Affairs (VA) national electronic health record data. Antibiotics prescribed by dentists were evaluated for appropriateness based on 2 definitions: one derived from current guidelines (consensus-based recommendations) and the other based on relevant clinical literature (nonconsensus). A clustered binomial logistic regression model determined factors associated with discordant prescribing.

Results: In total, 92,224 antibiotic prescriptions (63% amoxicillin; mean supply, 8.0 days) were associated with 88,539 dental visits. Prophylaxis for complications in medically compromised patients was associated with the most (30.9%) antibiotic prescriptions, followed by prevention of postsurgical complications (20.1%) and infective endocarditis (18.0%). At the visit level, 15,476 (17.5%) met the consensus-based definition for appropriate antibiotic usage and 56,946 (64.3%) met the nonconsensus definition.

Conclusions: More than half of antibiotics prescribed by dentists do not have guidelines supporting their use. Regardless of definition applied, antibiotics prescribed by dentists were commonly unnecessary. Improving prescribing by dentists is critical to reach the national goal to decrease unnecessary antibiotic use.

(Received 27 October 2023; accepted 1 January 2024; electronically published 20 February 2024)

The US National Action Plan for Combating Antibiotic-Resistant Bacteria (CARB) established a goal to decrease unnecessary antibiotic prescribing by 50% in outpatient healthcare settings.[1] Progress toward this goal has been modest, with a minimal 2% reduction in unnecessary prescriptions with scant progress in adult patients.[2] Additionally, data informing progress toward this goal have exclusively focused on outpatient medical settings and have not included dental encounters. This gap is critical because dentists are the top specialty prescriber of antibiotics in the United States, prescribing an estimated 10% of all antibiotic prescriptions.[3] Furthermore, antibiotics prescribed by primary care, emergency medicine, dermatology, and surgery clinicians have decreased, but prescribing has remained unchanged among dentists.[4,5]

Despite recommendations by the American Dental Association (ADA) to prioritize effective dental intervention and to utilize antimicrobials only in very specific situations, antibiotics are commonly overprescribed by dentists.[4,6,7] Antibiotics are prescribed in the dental setting to prevent infections and to treat acute oral infections. The ADA guidelines addressing treatment of acute oral infection focus on the management of irreversible pulpitis, periodontitis, and apical abscess. These guidelines recommend that definitive conservative dental treatment (DCDT) be utilized over antibiotic therapy except in the setting of acute apical abscesses with pulp necrosis and/or systemic signs of an infection (eg, fever).[7,8] With input from the ADA, the American Heart Association (AHA) released guidelines for the prevention of infective endocarditis in 2007 (updated in 2021). According to the ADA/AHA recommendations, antibiotic prophylaxis for infective endocarditis is recommended if the patient is undergoing an invasive dental procedure with a pre-existing cardiac condition at high risk for an adverse outcome if the patient is diagnosed with infective endocarditis.[9]

High-quality evidence from the Cochrane collaboration has also been used to inform the use of antibiotic prophylaxis in the prevention of complications associated with tooth extractions and dental implants.[6,10–12] A 2012 meta-analysis of randomized

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Cite this article: Murphy A. M., Patel U. C., Wilson G. M., Suda K. J. Prevalence of unnecessary antibiotic prescriptions among dental visits, 2019. *Infect Control Hosp Epidemiol* 2024. 45: 890–899, doi: 10.1017/ice.2024.13

controlled trials by the Cochrane collaboration showed that antibiotics administered prior to third molar extractions decreased the risk of postoperative oral infection and dry socket.[11] A 2013 Cochrane review revealed that preoperative amoxicillin decreased dental implant failures when compared to placebo.[12] Because many studies exclude medically complex patients (eg, patients with uncontrolled diabetes or who are immunocompromised), many dentists prescribe antibiotics prophylactically for these populations who generally have an increased risk of infection or who may have delayed healing.[13]

Accounting for guidelines along with the literature when assessing appropriateness of antibiotics can yield a better understanding of the prescribing practices as well as provide opportunities for the implementation of antimicrobial stewardship. Although previous research has separately reported on the appropriateness of antibiotic prescribing by dentists for prevention[4,6] and treatment of oral infections,[14] analyses have not comprehensively assessed the appropriateness of all antibiotics prescribed by dentists. We sought to identify the appropriateness of all antibiotics prescribed by dentists practicing in the Department of Veterans' Affairs (VA) over a 1 year period.

Methods

Study design and patient population

This study was a cross-sectional analysis of veterans who received dental care through the VA between January 1, 2019, and December 31, 2019. Participants were included if they were at least 18 years of age, received care in the Veterans Health Administration, and received an antibiotic prescription written by a nontrainee dentist within 7 days of a VA dental encounter. Patients were excluded if they received antibiotics within a hospital admission, received nonsystemic antibiotics (eg, mouth washes), were nonveterans, or had missing encounter data. Variables obtained through the national VA Corporate Data Warehouse (CDW) included demographics, antibiotic prescription information, visit information, and diagnoses (coded using Comprehensive Dental Terminology [CDT], Comprehensive Procedural Terminology [CPT], or *International Classification of Disease, Tenth Revision Clinical Modification* [ICD-10-CM]). The institutional review board of the VA Pittsburgh Healthcare System approved this study.

Study definitions

The population was examined utilizing a guideline-based definition (labeled as "consensus") as well as an evidence-based definition (labeled as "nonconsensus") for appropriateness of prescribing antimicrobial therapy (Fig. 1). The consensus definition included antibiotic prescribing consistent with the ADA Guidelines for Dental Pain and Swelling (ie, caused by acute oral infections) or the AHA Guidelines for the Prevention of Infective Endocarditis.[7–9] The criteria included (1) treatment for acute apical abscesses or (2) prophylaxis for dental procedures involving manipulation of the gingival tissue, periapical region of the teeth, or perforation of the oral mucosa in individuals with a high-risk cardiac condition (ie, prosthetic valves or material, congenital heart diseases, history of endocarditis, or cardiac transplant). Consistent with ADA guidelines, antibiotic prophylaxis associated with prosthetic joints was considered inappropriate.[15–19]

The nonconsensus definition encompassed any antibiotic prescribing consistent with guidelines (see consensus definition above) as well as prescribing that was consistent with high-level evidence for the prevention of postoperative complications (ie, meta-analyses from the Cochrane collaboration).[11,12] In addition to indications recommended in guidelines, patients undergoing surgical tooth extractions, dental implants, and who were medically compromised were categorized as appropriate indications.[20] Medically compromised included immunosuppressive therapy (eg, cancer on chemotherapy, transplant on immunosuppressive therapy), immunocompromising conditions (AIDS-defining condition, inherited diseases of immunodeficiency, rheumatoid arthritis), and uncontrolled diabetes (defined as HgbA1c $\geq$ 8).[6]

Consistent with past work,[6,14] participants with an antibiotic prescribed by a dentist or dental specialist (eg, oral surgeon) within 7 days before or after a dental visit were categorized based on diagnosis in a hierarchical manner due to the potential for multiple non–mutually exclusive indications (Fig. 1). Any participant with a diagnosis of acute apical abscess was placed into the acute apical abscess group regardless of other diagnoses. Remaining participants were next assessed for AHA cardiac conditions.[9] In the absence of cardiac conditions, those who underwent surgical tooth extractions or dental implants were grouped together. Participants who did not meet the previous criterion were evaluated for the presence of a condition that would lead a participant to be classified as medically compromised. In the absence of these conditions, antibiotics were deemed to be inappropriate based on the consensus and nonconsensus definitions.

Statistical analysis

Unadjusted analyses were performed using independent *t* tests and the Wilcoxon rank-sum test for continuous data and the χ^2 test for categorical data. These analyses were used to determine factors associated with discordant antibiotics using both the consensus definition and, separately, the nonconsensus definition. A clustered binomial logistic regression was performed to determine covariates associated with discordant prescribing for both the consensus and nonconsensus definitions as the dependent variables. Patients were clustered to account for multiple visits within 1 episode of care. Unadjusted risk ratios that were nonsignificant ($P > .10$) were excluded from the full model. Covariates colinear with the outcome, such as presence of a cardiac condition, were also excluded yielding an initial adjusted model. Variables that were significant in the unadjusted analyses, defined as a $P < .10$, were included in the adjusted models. For the parsimonious model, nonsignificant variables were removed to identify significant variables associated with inappropriate antibiotic prescribing. We used SAS version 9.4 software (SAS Institute; Cary, NC) for data and statistical analyses.

Results

Of the 68,439 patients initially screened, 68,357 unique patients representing 88,539 dental visits and 92,224 antibiotic prescriptions were included in the analysis (Fig. 2). Most study participants were White (67.8%) and male (90.6%), with an average age of 63.4 ±12.7 years. Almost half (44.6%) of the patient population studied received care at a VA in the Southern region; 18.2 % of patients had a high-risk cardiac condition, 28.3% had a prosthetic joint, and 53.9% were medically compromised. The average Charlson score was 1.0 (range, 0–3) (Table 1). Amoxicillin (57.8%) and clindamycin (11.2%) were the most prescribed antibiotics

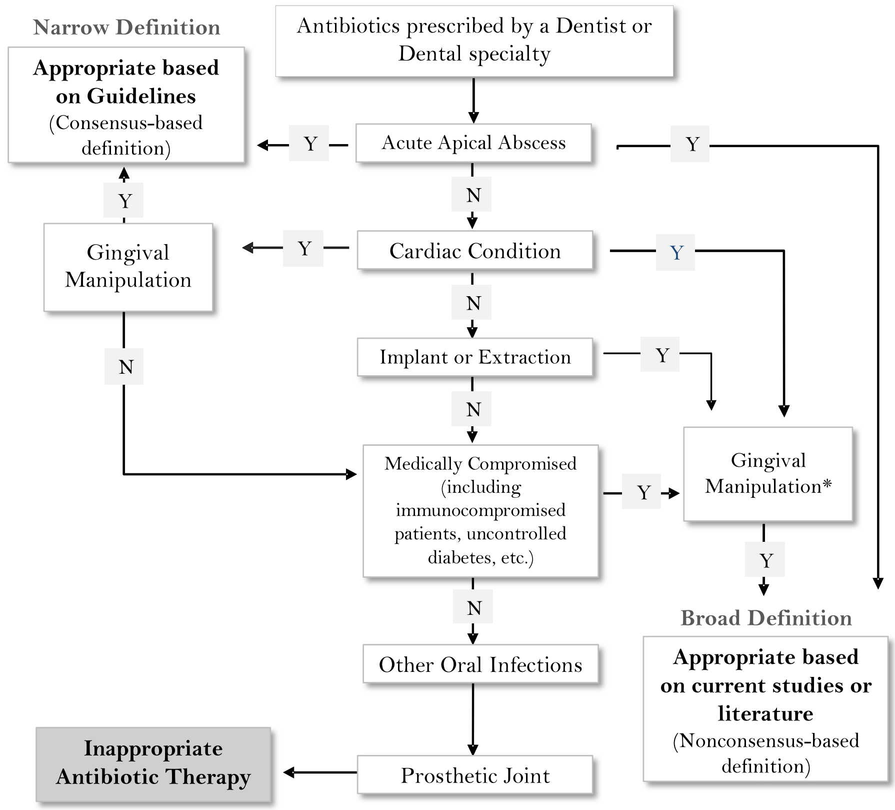

Figure 1. Decision tree for evaluation of antibiotic appropriateness. *Implants and extractions were considered to involve gingival manipulation.

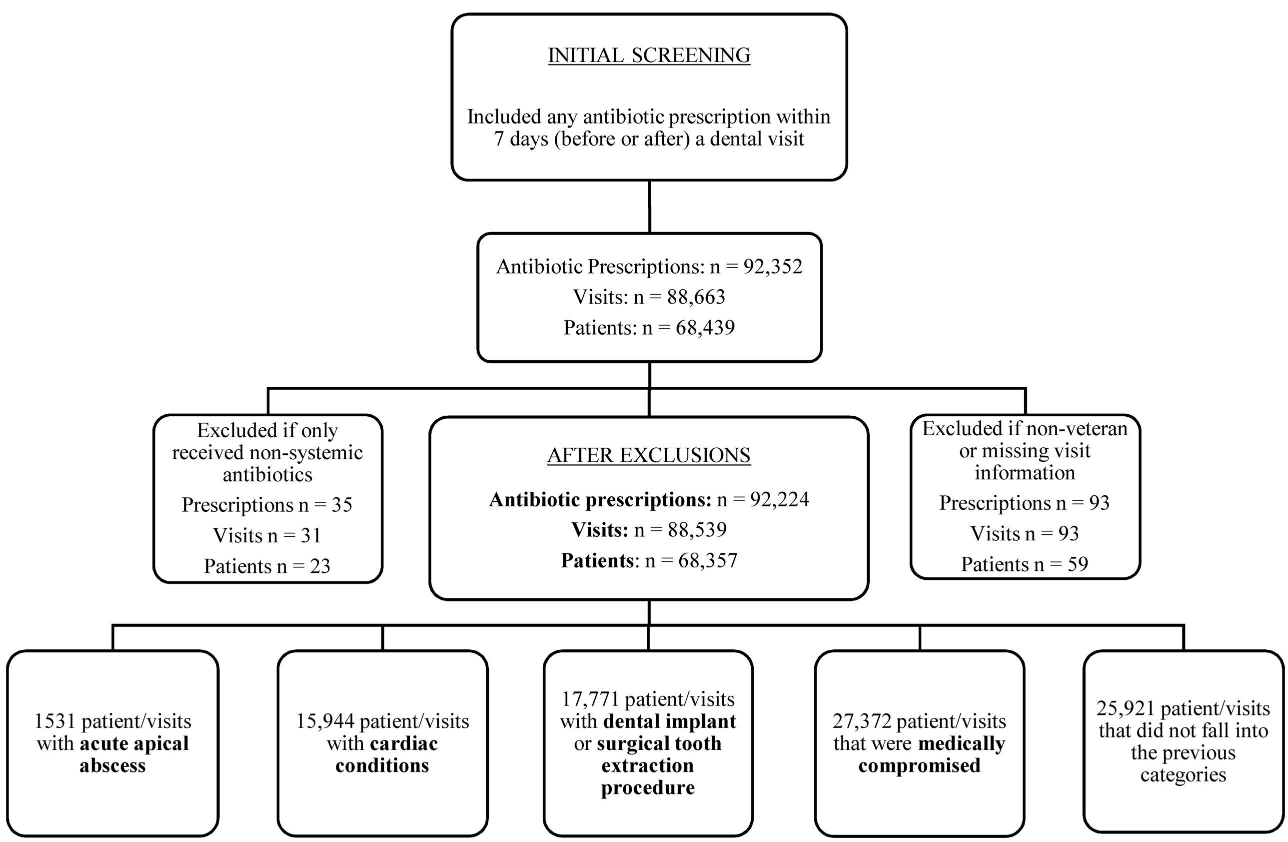

Figure 2. Screening process for visits included in the analysis.

https://doi.org/10.1017/ice.2024.13 Published online by Cambridge University Press

Table 1. Characteristics of Eligible Dental Visits and Incidence of Antibiotic Prescribing in 2019

Variable	Visit Dates (N=88,539), No.	%
Age group		
Age, median y (range)	63.4±12.7 (20–101)	
18–44 y	8,888	10.0
45–64 y	29,546	33.4
≥65	50,105	56.6
Sex		
Male	80,208	90.6
Female	8,331	9.4
Race		
White	59,991	67.8
Black	21,908	24.7
Other	6,640	7.5
Ethnicity		
Non-Latine	79,960	90.3
Latine	6,751	7.6
Region		
Northeast	13,781	15.6
Midwest	17,190	19.4
South	39,507	44.6
West	16,874	19.1
Other	1,187	1.3
Coexisting conditions		
Cardiac condition	16,144	18.2
Prosthetic joint or material	25,082	28.3
Medically compromised	47,683	53.9
Diagnosis		
Periodontitis	701	0.8
Irreversible pulpitis	21,373	24.1
Apical abscess	1,548	0.1
Charlson score		
0	31,495	35.6
1	15,633	17.7
2 or more	41,411	46.8
Charlson comorbidity categories		
Cancer	12,936	14.6
Cardiovascular disease	5,483	6.2
Congestive heart failure	7,740	8.7
Chronic obstructive lung disease	14,923	16.9
Diabetes	33,280	37.6
HIV/AIDS	542	0.6
Prior myocardial infarction	1,088	1.2
Renal disease	12,250	13.8
Rheumatologic disease	1,841	2.1

(Continued)

Table 1. *(Continued)*

Variable	Visit Dates (N=88,539), No.	%
Antibiotic prescribed		
Total supply, d (range)	8.0±8.7 (1–200)	
Amoxicillin	50,911	57.5
Amoxicillin/clavulanate	3,784	4.3
Azithromycin	624	0.7
Cephalosporin	410	0.5
Clindamycin	9,610	10.9
Doxycycline	459	0.5
Fluoroquinolone	64	0.07
Metronidazole	410	0.5
Penicillin	3,105	3.5
Other antibiotics	130	0.2
Antibiotic prescribed	Prescriptions (N=92,224), No.	%
Total supply, d (range)	8.3±8.69 (1–200)	
Amoxicillin	53,353	57.8
Amoxicillin/Clavulanate	4,005	4.3
Azithromycin	690	0.8
Cephalosporin	439	0.5
Clindamycin	10,284	11.2
Doxycycline	521	0.6
Fluoroquinolone	77	0.1
Metronidazole	712	0.8
Penicillin	3,288	3.6
Other antibiotics	162	0.2

Note. HIV/AIDS, human immunodeficiency virus, acquired immunodeficiency syndrome.

(Table 1). The average duration for antibiotics prescribed was 8.3 ± 8.7 days (range, 1–200).

Unadjusted analyses

Of the 88,539 patient and visit dates, 30.9% were associated with antibiotics used to prevent complications in medically compromised patients, 20.1% were to prevent postsurgical complications, 18.0% were for patients with high-risk cardiac conditions, and 1.7% were for patients with acute apical abscess.

Of the antibiotics prescribed, 17.5% were considered concordant based on the consensus definition. Using evidence in addition to guidelines to define appropriateness of antibiotics, 64.3% were considered non–consensus concordant. In the unadjusted analyses for the consensus and nonconsensus definitions, significant associations were identified between the consensus-based prescribing for patient age, sex, race, ethnicity, geographic location, and diagnoses (Tables 2 and 3).

Adjusted analyses

In the final consensus-based concordant model, age ≥65 years (prevalence ratio [PR], 0.91; 95% confidence interval [CI], 0.9–0.91; $P < .001$; reference, 18–44 years), female sex (PR, 0.98;

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Table 2. Unadjusted Model for the Consensus Definition Based on Clinical Treatment Guidelines

Variable	Total (n=88,539), No. (%)	Meets Consensus-Based Definition (n=15,476), No. (%)	Prevalence Ratio (Unadjusted)	*P* Value
Age group				
18–44 y	8,888 (10.0)	610 (6.9)	Reference	
45–64 y	29,546 (33.4)	3,892 (13.2)	0.93 (0.93–0.94)	<.0001
≥65 y	50,105 (56.6)	10,974 (21.9)	0.84 (0.83–0.84)	<.0001
Sex				
Male	80,208 (90.6)	14,331 (17.9)	Reference	
Female	8,331 (9.4)	1,145 (13.7)	1.05 (1.04–1.06)	<.0001
Race				
White	59,991 (67.8)	11,248 (18.7)	Reference	
Black	21,908 (24.7)	3,241 (14.8)	1.05 (1.04–1.06)	<.0001
Native American/Alaskan	724 (0.8)	122 (16.9)	1.02 (0.99–1.06)	.2126
Native Hawaiian/Pacific Islander	914 (1.0)	141 (15.4)	1.04 (1.01–1.07)	.0103
Ethnicity				
Non-Latine	79,960 (90.3)	14,144 (17.7)	Reference	
Latine	6,751 (7.6)	1,009 (14.9)	1.03 (1.02–1.04)	<.0001
Region				
Northeast	13,781 (15.6)	2,461 (17.9)	Reference	
Midwest	17,190 (19.4)	3,560 (20.7)	0.97 (0.95–0.98)	<.0001
South	39,507 (44.6)	6,471 (16.4)	1.02 (1.01–1.03)	<.0001
West	16,874 (19.1)	2,774 (16.4)	1.02 (1.01–1.03)	.001
Health condition				
Cardiac condition	16,144 (18.2)	14,128 (87.5)	0.13 (0.12–0.13)	<.0001
Prosthetic condition	25,082 (28.3)	5,021 (20)	0.96 (0.95–0.96)	<.0001
Medically compromised	47,683 (53.9)	9,471 (19.9)	0.94 (0.93–0.95)	<.0001
Diagnosis				
Irreversible pulpitis	21,373 (24.1)	3,988 (18.7)	0.985 (0.975–0.99)	<.0001
Periodontitis	701 (0.8)	106 (15.1)	1.03 (1.00–1.06)	.1099
HIV/AIDS	542 (0.6)	87 (16.1)	1.02 (0.98–1.06)	.4269
Cancer	12,936 (14.6)	2,729 (21.1)	0.95 (0.94–0.96)	<.0001
Charlson classifications				
Congestive heart failure	7,740 (8.7)	3,601 (46.5)	0.63 (0.62–0.64)	<.0001
COPD	14,923 (16.9)	3,597 (24.1)	0.91 (0.90–0.91)	<.0001
Cardiovascular disease	5,483 (6.2)	2,071 (37.8)	0.74 (0.73–0.76)	<.0001
Diabetes	33,280 (37.6)	7,224 (21.7)	0.92 (0.91–0.93)	<.0001
Liver disease	5,534 (6.3)	1,139 (20.6)	0.96 (0.95–0.97)	<.0001
Myocardial infarction	1,088 (1.2)	509 (46.8)	0.64 (0.61–0.68)	<.0001
Renal disease (ESRD)	12,250 (13.8)	3,594 (29.3)	0.84 (0.83–0.85)	<.0001
Rheumatologic condition	1,841 (2.1)	414 (22.5)	0.94 (0.92–0.96)	<.0001

Note. HIV/AIDS, human immunodeficiency virus, acquired immunodeficiency syndrome; COPD, chronic obstructive pulmonary disease; ESRD, end-stage renal disease.

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Table 3. Unadjusted Model for the Non-Consensus Definition Based on High-Level Evidence

Variable	Total (n=88,539), No. (%)	Meets Nonconsensus Definition (n=56,946), No. (%)	Prevalence Ratio (Unadjusted)	*P* Value
Age group				
18–44 y	8,888 (10.0)	5,441 (61.2)	Reference	
45–64 y	29,546 (33.4)	19,285 (65.3)	0.90 (0.87–0.92)	<.0001
≥65 y	50,105 (56.6)	32,220 (64.3)	0.92 (0.89–0.95)	<.0001
Sex				
Male	80,208 (90.6)	51,330 (64)	Reference	
Female	8,331 (9.4)	5,616 (67.4)	0.91 (0.88–0.93)	<.0001
Race				
White	59,991 (67.8)	38,675 (64.5)	Reference	
Black	21,908 (24.7)	14,190 (64.8)	0.99 (0.97–1.01)	.4235
Native American/Alaskan	724 (0.8)	455 (62.8)	1.05 (0.95–1.15)	.3692
Native Hawaiian/Pacific Islander	914 (1.0)	549 (60.1)	1.12 (1.04–1.22)	.0066
Ethnicity				
Non-Latine	79,960 (90.3)	51,296 (64.2)	Reference	
Latine	6,751 (7.6)	4,554 (67.5)	0.91 (0.88–0.94)	<.0001
Region				
Northeast	13,781 (15.6)	8,793 (63.8)	Reference	
Midwest	17,190 (19.4)	11,230 (65.3)	0.96 (0.93–0.99)	.0053
South	39,507 (44.6)	25,328 (64.1)	0.99 (0.97–1.02)	.5228
West	16,874 (19.1)	10,667 (63.2)	1.02 (0.99–1.05)	.2886
Health condition				
Cardiac condition	16,144 (18.2)	14,128 (87.5)	0.31 (0.29–0.32)	<.0001
Prosthetic condition	25,082 (28.3)	15,370 (61.3)	1.12 (1.10–1.14)	<.0001
Medically compromised	47,683 (53.9)	42,940 (90.1)	0.15 (0.15–0.16)	<.0001
Diagnosis				
Irreversible pulpitis	21,373 (24.1)	14,263 (66.7)	0.91 (0.89–0.93)	<.0001
Periodontitis	701 (0.8)	433 (61.8)	1.07 (0.98–1.18)	.1659
Charlson classifications				
HIV/AIDS	542 (0.6)	378 (69.7)	0.85 (0.75–0.96)	.008
Cancer	12,936 (14.6)	9,080 (70.2)	0.81 (0.79–0.84)	<.0001
Congestive heart failure	7,740 (8.7)	5,934 (76.7)	0.63 (0.61–0.66)	<.0001
COPD	14,923 (16.9)	11,198 (75)	0.66 (0.64–0.68)	<.0001
Cardiovascular disease	5,483 (6.2)	4,136 (75.4)	0.67 (0.64–0.71)	<.0001
Diabetes	33,280 (37.6)	22,681 (68.2)	0.84 (0.82–0.85)	<.0001
Liver disease	5,534 (6.3)	4,140 (74.8)	0.69 (0.66–0.73)	<.0001
Myocardial infarction	1,088 (1.2)	864 (79.4)	0.57 (0.51–0.65)	<.0001
Renal disease (ESRD)	12,250 (13.8)	9,031 (73.7)	0.71 (0.68–0.73)	<.0001
Rheumatologic condition	1,841 (2.1)	1,432 (77.8)	0.62 (0.57–0.67)	<.0001

Note. HIV/AIDS, human immunodeficiency virus, acquired immunodeficiency syndrome; COPD, chronic obstructive pulmonary disease; ESRD, end-stage renal disease.

95% CI, 0.97–0.99; $P = .001$; reference, male), patients categorized as medically compromised (PR, 0.98; 95% CI, 0.98–0.99; $P < .001$), and receipt of care in the Midwest (PR, 0.98; 95% CI, 0.97–0.99; $P = .001$; reference, Northeast) had a decreased prevalence of unnecessary antibiotics. Latine ethnicity (PR, 1.02; 95% CI, 1.01–1.03; $P = .004$; reference, non-Latine) and African American race (PR, 1.03; 95% CI, 1.02–1.04; $P < .001$; reference, White) were predictive of receipt of unnecessary antibiotics (Fig. 3).

Similarly, the final non–consensus-concordant model demonstrated that age ≥65 years (PR, 0.96; 95% CI, 0.93–0.99;

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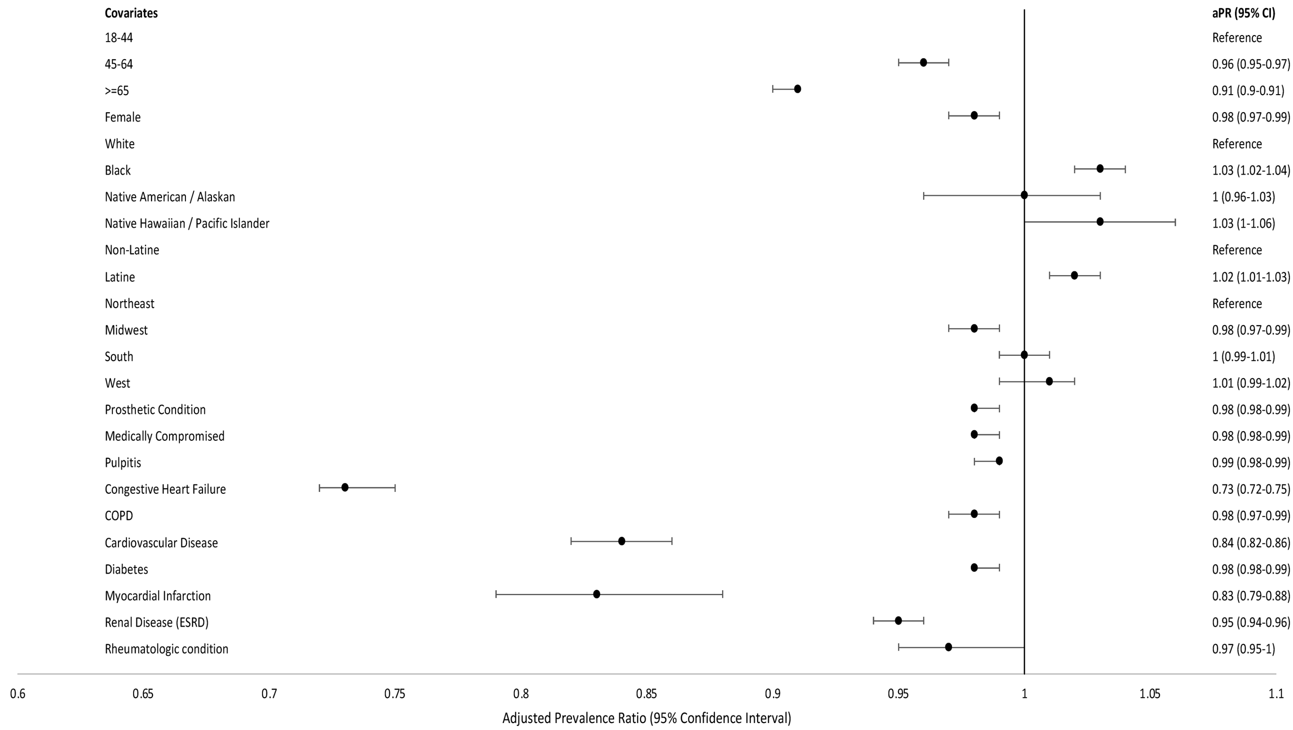

Figure 3. Adjusted model for the consensus-based definition.

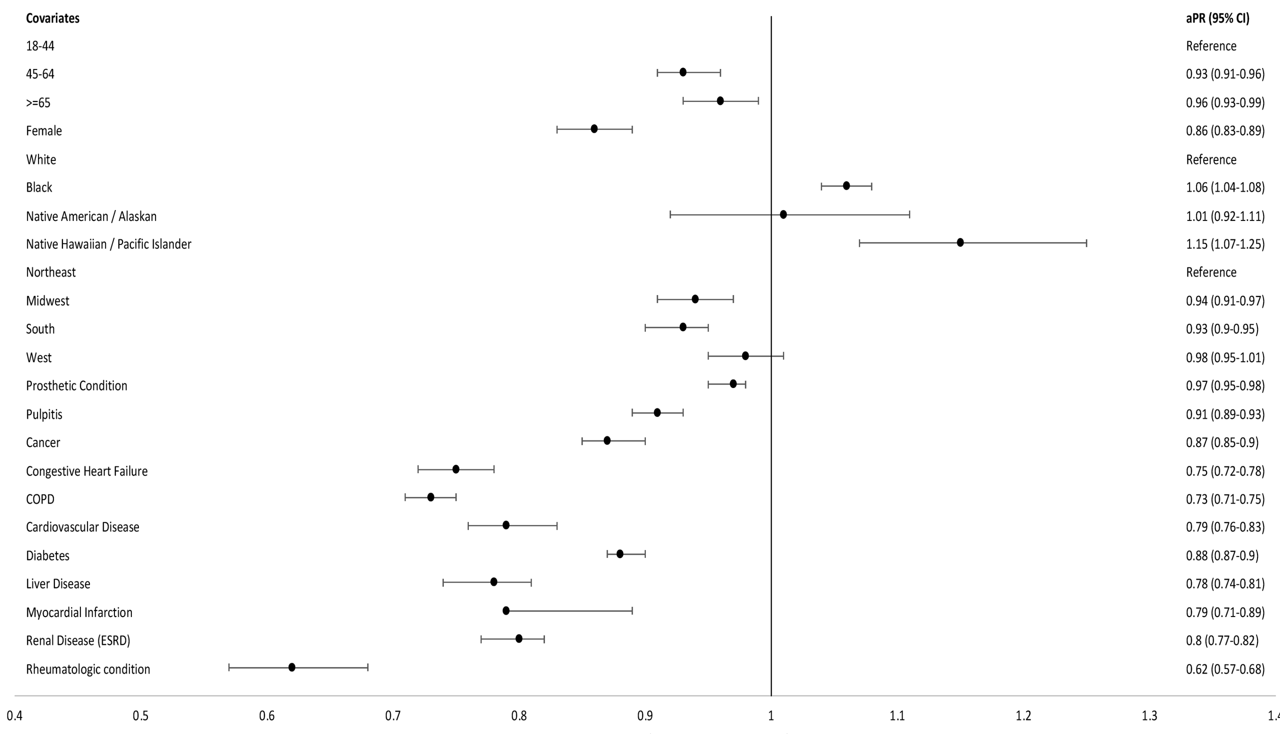

Figure 4. Adjusted model for the nonconsensus definition.

P = .004; reference, 18–44 years), female sex (PR, 0.86; 95% CI, 0.83–0.89; P < .001; reference, male), and the Midwest (PR, 0.94; 95% CI, 0.91–0.97; P < .001) and South (PR, 0.93; 95% CI, 0.9–0.95; P < .001; reference, Northeast) predicted decreased prevalence of unnecessary antibiotics. Meanwhile, African American race (PR, 1.06; 95% CI, 1.04–1.08; P < .001; reference, White) predicted increased prevalence of unnecessary antibiotics (Fig. 4).

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Discussion

Recent studies have shown marginal progress toward national goals to reduce inappropriate outpatient antibiotics. Most substantial reductions were observed in the pediatric, and not adult, populations.[3,21] Notably, these studies did not consider the prescribing behaviors of dentists, who account for a significant 10% of all outpatient prescriptions.[22] The findings of our research provide valuable insights into potential opportunities for realizing the goals set forth by the US National Action Plan for Combating Antibiotic-Resistant Bacteria.

Of the 88,539 patient visit dates, 17.5% and 64.3% of patients prescribed antibiotics met the criteria for concordance based on the consensus and nonconsensus definitions, respectively. More than half of all antibiotics were prescribed to prevent complications after surgery and in medically compromised patients, areas where professional guidance is lacking. Patients received an average of 8 days of antibiotics, and the most prescribed antibiotics were amoxicillin (57.8%) and clindamycin (11.2%). Patient-specific factors that were predictors of receipt of inappropriate antibiotics included African American race, Native Hawaiian or Pacific Islander race, and Hispanic ethnicity. These differences in appropriateness of prescribing based on race and ethnicity may be due to structural inequities in access to preventative health care, burden of medical conditions, availability of oral health care, or differences in socioeconomic status.

Some factors were protective against receipt of inappropriate antibiotic therapy. These included age ≥45 years, female sex, location in the Midwest region, and other patient factors, such as being medically compromised or having cardiovascular disease. Although antimicrobial therapy is important for prevention of infections, such as endocarditis, current guidelines establish that a relatively small subset of the population may benefit from antibiotic prophylaxis prior to dental care.[9,15,16,23–25] For most dental indications, only appropriate dental intervention is required and should not require supplemental antimicrobial therapy, which is converse to the findings of this study. The results of our study provides insight on current prescribing practices, serves as a baseline for improvement in dental antimicrobial prescribing, and aids in the implementation and evaluation of stewardship initiatives.

Other studies have also detailed the high utilization of antimicrobial therapy in the dental setting, with results comparable to those of the current study. Previous national analyses in VA and the private sector have evaluated the appropriateness of prophylactic antibiotic use prior to dental procedures.[4] These studies determined that ~80% of prophylactic antibiotics prior to dental procedures were unnecessary. Another study by Carlsen et al[14] evaluated the treatment of acute oral infections in the VA patient population. This study, which was performed prior to the release of the 2019 ADA guidelines, demonstrated that unnecessary antibiotic prescribing was associated with 11.7% of dental visits for irreversible pulpitis and 17.4% of visits for apical periodontitis.[14] While prescribing of oral antibiotics was mostly consistent with ADA guidelines, 42.5% of these patients received antibiotics for irreversible pulpitis, 44.9% received antibiotics for apical periodontitis, and 49.4% received antibiotics for acute apical abscesses for prolonged durations (≥8 days).[14] We identified similar prolonged durations, with a mean duration exceeding 8 days. Because many antibiotics prescribed by dentists are for prophylactic indications and only a single dose is recommended prior to the dental visit, these durations are excessive.

Data from these studies underscore the need to improve antibiotic prescribing practices in dental outpatient settings to continue making progress toward reducing inappropriate antibiotic prescription. In 2020, the Combating Antibiotic-Resistant Bacteria (CARB) task force issued an updated iteration of the national action plan that outlined priority actions for 2020–2025 aimed at mitigating antibiotic resistance.[26] A cornerstone of the plan underscores the importance of antimicrobial stewardship practices in healthcare settings to curb the overuse of unnecessary antimicrobials. Despite the high volume of antibiotic prescriptions that originate from dental practice, deciphering trends in dental prescribing can be challenging due to the use of CDT procedure coding rather than standard medical diagnostic codes such as ICD-10-CM. However, because dentists within the VA utilize both CDT and ICD-10-CM codes, the Veterans Health Administration provides a unique setting in which to gather data on the appropriateness of antibiotic prescribing by dentists for the treatment and prevention of infections. The data from this study could assist in bridging this knowledge gap.

According to the CDC, ~23,000 deaths annually in the United States are caused by infections with antibiotic-resistant bacteria.[27] Inappropriate antibiotic use not only contributes to the spread of antibiotic resistance but also contributes to rises in healthcare costs, adverse drug reactions, and the risk of *Clostridioides difficile* infection.[27] The presence of antimicrobial stewardship activity in healthcare settings is an important step in preventing consequences associated with misuse of antimicrobial agents. A few small studies have outlined the benefit of antimicrobial stewardship interventions in healthcare and dental settings. A prospective cohort study by Goff et al[28] demonstrated the effect of stewardship education on antibiotic use among 15 dentists practicing in private dental practices. As a result of the study intervention, the number of antibiotic prescriptions decreased from 2,124 to 1,816 ($P < .0001$). Overall, appropriate use (prophylaxis and treatment) increased from 19% before the intervention to 87.9% after the intervention ($P < .0001$), 7 months after recruitment of these dentists.[28] Another study by Gross et al[29] assessed antibiotic prescription rates in the urgent care environment before and after the implementation of stewardship initiatives. These initiatives consisted of educating both patients and providers, establishing clinical guidelines, and evaluating the frequency of antibiotic prescriptions for urgent-care dental visits.[29] Following the implementation of these stewardship measures, a 72.9% reduction in antibiotic prescriptions associated with urgent-care visits was observed ($P < 0.001$).[29] These studies illustrate the possibility for improvement in antibiotic prescribing practices within the dental community.

Many helpful resources are available to assist dental practitioners in improving antimicrobial prescribing. In addition to utilizing the ADA and AHA guidelines, the CDC has a wealth of information on antimicrobial stewardship.[27] Furthermore, the Organization for Safety, Asepsis and Prevention (OSAP), a dental membership association with a focus on dental infection prevention and patient and provider safety, offers antibiotic stewardship resources to dental prescribers, team members, patients, and policy makers.[30] Several state health departments also offer antibiotic stewardship tool kits for dental providers, that include resources to support appropriate antibiotic prescribing, which are often organized around the CDC Core Elements of Outpatient Antibiotic Stewardship.[31] However, further customized resources are likely needed to increase the uptake of antibiotic stewardship in dentistry. As a cornerstone of appropriate prescribing, guidelines are urgently needed for the prevention of complications after dental surgery and in medically compromised patients.

This study had several limitations. The retrospective study design relied upon the accuracy of the electronic health record, which potentially contains misclassified data. Additionally, the data captured were only representative of veterans who received care from dentists practicing in the VA. Thus, these findings may not be generalizable to dentists or patients receiving care in non-VA settings. Despite these limitations, this study provides the first comprehensive evidence on the overall proportion of antibiotics prescribed by dentists that are unnecessary, whereas previous research has focused on prophylaxis or treatment. Because VHA dental appointments include diagnostic codes that allow for identifying antibiotics that were likely prescribed to treat infections, we were able to capture a clearer understanding of dental antibiotic prescribing practices.

At least 1 in 3 antibiotics prescribed by dentists are not supported by our categories of consensus-based or nonconsensus definitions of appropriate indications. In addition, the duration of antibiotic prescriptions exceeded recommendations. Thus, antimicrobial stewardship focused in the dental setting is critical to decrease antimicrobial resistance, to preserve the effectiveness of antimicrobials in our communities, and to help meet the national goal of decreasing inappropriate antibiotic prescribing. The first steps to achieving this goal are to perform clinical trials and to develop evidence-based guidelines for the use of antibiotics to prevent complications in medically compromised patients and after extraction and implant procedures.

Acknowledgments.

Financial support. This work was supported by the Department of Veterans' Affairs, Veterans' Health Administration VA Health Services Research & Development Merit Review Award (grant no. HX002452 to K.J. Suda). The views in this article are those of the authors and do not represent those by the Department of Veterans' Affairs or the U.S. government.

Competing interests. All authors report no conflicts of interest relevant to this article.

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