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## RESEARCH

## Antibiotic prescriptions in the community by type of provider in the United States, 2005–2010

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## ABSTRACT

**Objectives:** Although antibiotic prescriptions are decreasing in the United States, broad-spectrum prescribing is increasing. It is unknown if decreases observed in national antibiotic prescribing differ by provider group. Understanding prescribing trends over time by provider group can be helpful for customizing antimicrobial stewardship efforts. Therefore, the purposes of this study were to describe outpatient antibiotic prescribing by provider group overall and adjusted for population and number of providers. In addition, trends in prescribing by class and seasonal variation are described by provider group over 6 years.

**Design:** Cross-sectional observation of outpatient antibiotic prescriptions.

**Setting and participants:** A population-level analysis of U.S. prescribing from 2005 to 2010 with the use of the IMS Health Xponent dataset.

**Main outcome measures:** Number and rates of prescriptions dispensed overall and by provider group.

**Results:** The majority (81.0%) of antibiotics were prescribed by physicians, followed by dentists (10.4%), nurse practitioners (NPs; 4.5%), and physician assistants (PAs; 4.2%). The percentage of antibiotic prescriptions decreased for physicians, but increased significantly for NPs and PAs. Provider-based and population-based prescribing rates decreased for physicians and dentists and increased for NPs and PAs. Penicillins were prescribed most frequently by all provider groups, decreasing for physicians and dentists. Increased prescribing of broad-spectrum agents was observed for NPs and PAs. With the exception of dentists, antibiotic prescriptions were higher in winter than in summer, with the largest seasonal increase by NPs.

**Conclusion:** Over 6 years, antibiotic prescriptions overall and for broad-spectrum agents decreased for physicians and increased for NPs and PAs. Thus, increasing trends in the US of broad-spectrum antibiotic prescriptions can be attributed to midlevel providers. Interventions should be designed to reverse increasing prescribing trends, especially of broad-spectrum agents prescribed by NPs and PAs. Stewardship efforts should also be targeted towards dentists, since this group prescribes a higher proportion of antibiotics compared with midlevel providers.

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Bacterial resistance and limited antibacterial drug development have become a public health crisis.<sup>1</sup> Efforts to stimulate drug development have thus far had limited

success.<sup>2</sup> Although stewardship efforts are increasing and implementation encouraged by various groups, including the US government,<sup>3–8</sup> most of these programs are focused on the inpatient setting.<sup>9</sup> However, only one-third of antibiotics are used in the inpatient setting; the majority are consumed in the community.<sup>10</sup> Although antibiotic prescribing is decreasing in the community secondary to improved education and increasing vaccination rates,<sup>11–13</sup> many antimicrobials continue to be prescribed inappropriately.<sup>11,14,15</sup>

It is unknown if decreases observed in national antibiotic prescribing are similar for physicians, nurse practitioners, physician assistants, and dentists. Evidence on prescribing by provider type can assist with targeting interventions. Similar antibiotic prescribing for viral respiratory tract infections has been reported for nurse practitioners and physicians.<sup>16</sup>

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**Key Points****Background:**

- Most stewardship efforts have been initiated in the acute care setting. However, the majority of antibiotics are dispensed in the community.
- Although national antibiotic prescription rates are decreasing, broad-spectrum prescribing is increasing. It is unknown if these trends are similar for physicians, nurse practitioners, physician assistants, and dentists.

**Findings:**

- Nurse practitioners had the largest winter seasonal increase, an indication of inappropriate prescribing for viral respiratory tract infections.
- Dentists, a group where stewardship efforts are not traditionally targeted, prescribe a high proportion of antibiotics compared with midlevel providers.
- Over 6 years, antibiotic prescriptions overall and for broad-spectrum agents decreased for physicians while increasing for nurse practitioners and physician assistants.

However, a study in emergency departments compared unsupervised midlevel practitioners (defined as nurse practitioners and physician assistants) with midlevel practitioners supervised by a physician.<sup>17</sup> There was an increase in inappropriate prescribing of antibiotics by unsupervised midlevel practitioners compared with supervised midlevel practitioners.<sup>17</sup> Compared with dentists, physicians are more likely to prescribe antibiotics, especially broad-spectrum agents, for tooth-related problems.<sup>18</sup> Comparisons of prescribing practices of dentists with treatment guidelines have shown that overprescribing of antimicrobials occurs.<sup>19,20</sup>

**Objectives**

Although a recent publication reports that dentists and nurse practitioners prescribed 10% and 7%, respectively, of oral antibiotics in the outpatient setting in the United States in 2011,<sup>21</sup> data describing prescribing rates by provider type is limited. Therefore, the purpose of the present study was to compare outpatient antibiotic prescriptions dispensed in the United States by provider group overall and adjusted for population and number of providers. In addition, trends in prescribing by antibiotic class and seasonal variation are described by provider group from 2005 to 2010.

**Methods**

This study was a population-level analysis of a nationally representative database (IMS Health Xponent) of outpatient antibiotic prescriptions in the United States from January 1, 2005, through December 31, 2010. Oral and injectable systemic antibiotic prescriptions dispensed from retail community pharmacies, mail service pharmacies, and medical clinics were included in the analysis. The United States

division of IMS Health captures 70% of all prescription medication use, comparable to the U.S. Census. These data are then reconciled to wholesale deliveries and extrapolated to a statistically valid projection of prescription medication use to reflect 99% of the U.S. population using a patented projection method based on a comprehensive sample of patient deidentified prescription transactions from pharmacies that participate in weekly reporting of their entire business to IMS Health.<sup>22</sup> Variables in the dataset include the name of the antibiotic, the month prescribed, county as defined by the provider location, and provider group. With the exception of antimycobacterial agents, all systemic antibacterials were included. Antibiotic class was defined according to the American Hospital Formulary Service.<sup>23</sup> Sulfamethoxazole/trimethoprim and their individual components (not in combination) are grouped into the sulfonamide class. Ketolides and azalides are included with the macrolide class. The macrolide class was primarily composed of azalides.<sup>21</sup> Cephamycins are grouped with the cephalosporins. Broad-spectrum antibiotic classes were defined as the fluoroquinolone, macrolide, tetracycline, and third- and fourth-generation cephalosporin classes.

The prescription dispense date was grouped into calendar month and year. Winter months were defined as the first and fourth quarters of the calendar year. Monthly rates of antibiotic use were annualized. Antibiotic use was adjusted for population size by calculating the annual population-based rate. This rate is defined as the annual number of antibiotic prescriptions divided by midyear estimates of the U.S. population as reported by the U.S. Census Bureau. Providers were grouped into “physician,” “nurse practitioner,” “physician assistant,” and “dentist,” as categorized by the American Medical Association and the American Dental Association. Prescription counts were adjusted for annual numbers of each provider group considered to be actively practicing. Nurse practitioner numbers were provided by the Pearson Report, an annual report of nurse practitioner demographics. The other provider counts were provided by the American Association of Physician Assistants (physician assistants), American Dental Association (dentists), and the Association of American Medical Colleges (physicians).

The statistical program SAS Version 9.3 (SAS, Cary, NC) was used for data and statistical analyses. To assess annual trends in the overall number and rate of prescriptions dispensed by provider group during the study period, simple linear regression was applied. Multiple regression was performed to test for seasonality with month and year as dummy variables. *P* values were computed as if these census-level measurements were statistical estimates based on a small random sample to conform to other *P* value interpretations in the literature and for comparison, but, in fact, all differences and trends represent census-measured, not small-sample-estimated, changes. A *P* value of  $\leq 0.05$  was considered statistically significant.

**Results**

From 2005 to 2010, 1.56 billion systemic antibiotic prescriptions were dispensed. Physicians prescribed the majority of antibiotics (81.0%), followed by dentists (10.4%), nurse practitioners (4.5%), and physician assistants (4.2%).

The percent of antibiotic prescriptions dispensed decreased for physicians ( $P < 0.01$ ) and dentists ( $P < 0.03$ ) over the study period, but increased significantly for nurse practitioners ( $P < 0.01$ ) and physician assistants ( $P \leq 0.001$ ; [Table 1](#)). The number of prescriptions per provider and prescriptions per 1,000 population decreased for physicians ( $P \leq 0.01$ ) and dentists ( $P \leq 0.01$ ) and increased for nurse practitioners ( $P < 0.01$ ) and physician assistants ( $P < 0.01$ ).

The predominant antibiotic classes prescribed annually by nurse practitioners and physician assistants remained unchanged from 2005 through 2010. Of all antibiotics prescribed by nurse practitioners and physician assistants, penicillins were prescribed most frequently (31.9% of all antibiotics prescribed by nurse practitioners and 29.1% of all antibiotics prescribed by physician assistants; [Figure 1](#)). Macrolides were the second most common class (26.5% and 24.7%, respectively), followed by cephalosporins (14.0% and 15.1%), quinolones (12.0% for both), sulfonamides (8.2% and 8.4%), and tetracyclines (6.1% and 9.1%). When adjusted for number of providers, macrolides, cephalosporins, quinolones, sulfonamides, and tetracyclines increased over the study period for physician assistants and nurse practitioners ( $P \leq 0.02$ ; [Supplemental Table 1](#), available online at [japha.org](http://japha.org)). For nurse practitioners, the sulfonamide class increased by 132.5% ([Supplemental Table 1](#);  $P < 0.001$ ), followed by tetracyclines (85.7% increase;  $P = 0.001$ ), macrolides (58.2%;  $P = 0.01$ ), quinolones (51.4%;  $P = 0.001$ ), penicillins (51.2%;  $P = 0.01$ ), and cephalosporins (50.0%;  $P = 0.01$ ). Physician assistants had similar increases for sulfonamides (137.3% increase;  $P < 0.001$ ), tetracyclines (90.7%;  $P = 0.001$ ), quinolones (45.5%;  $P = 0.01$ ), macrolides (43.9%;  $P = 0.01$ ), cephalosporins (38.9%;  $P < 0.01$ ), and penicillins (34.6%;  $P = 0.01$ ). Within the cephalosporin class, first-generation agents decreased for nurse practitioners (8.1%;  $P = 0.0035$ ) and second-generation cephalosporins decreased for both groups (nurse practitioner, 16.1%; physician assistant, 22.5%;  $P < 0.01$  for both). While there were no significant trends in fourth-generation prescriptions, third-generation cephalosporins increased; 32.3% by nurse practitioners and 33.3% by physician assistants ( $P < 0.01$  for both). When stratified by beta-lactamase inhibitor agents and non-beta-lactamase inhibitor penicillins (e.g., aminopenicillins), there were no significant changes in

prescribing within the penicillin class ( $P > 0.05$  for both nurse practitioners and physician assistants).

Similar to physician assistants and nurse practitioners, physicians prescribed penicillins (28.1% of all antibiotics prescribed by physicians; [Figure 1](#)), macrolides (23.2%), cephalosporins (15.7%), quinolones (15.3%), tetracyclines (8.0%), and sulfonamides (7.7%). Physicians showed a >20% decrease in prescriptions for penicillins ([Supplemental Table 1](#); 22.7% decrease;  $P < 0.001$ ) and cephalosporins (20.7% decrease;  $P < 0.001$ ), with sulfonamide prescribing increasing (12.9% increase;  $P < 0.05$ ) in 2010 compared with 2005. There were nonsignificant decreases in prescribing for the macrolide (12.9%), quinolone (15.5%), and tetracycline (1.6%) classes. Within the cephalosporin class, prescriptions for first-, second-, and third-generation agents experienced nonsignificant decreases. However, fourth-generation cephalosporins and beta-lactamase inhibitors experienced a 126.0% and 14.2% increased growth, respectively, by physicians ( $P \leq 0.01$  for both). Non-beta-lactamase inhibitor penicillins decreased by 6.0% in 2010 compared with 2005 ( $P = 0.0048$ ).

Penicillins were 69.8% of antibiotics prescribed by dentists ([Figure 1](#)). Cephalosporins (6.1%), macrolides (6.0%), and tetracyclines (3.1%) were also prescribed by dentists, with the other classes prescribed infrequently (less than 1%). Dentists had a larger proportion of antibiotic prescribing in classes not commonly prescribed by other providers (e.g., lincosamides). By class, the greatest decrease for dentists was for the tetracyclines (38.1% decrease;  $P < 0.001$ ) and beta-lactams (cephalosporins, 29.9% decrease,  $P < 0.001$ ; penicillins, 13.5% decrease,  $P < 0.01$ ). However, beta-lactamase inhibitors and third-generation cephalosporins prescribed by dentists increased by 62.2% and 73.2%, respectively ( $P < 0.02$  for both). Trends in prescribing of first-, second-, and fourth-generation cephalosporins and non-beta-lactamase inhibitor penicillins were not significant.

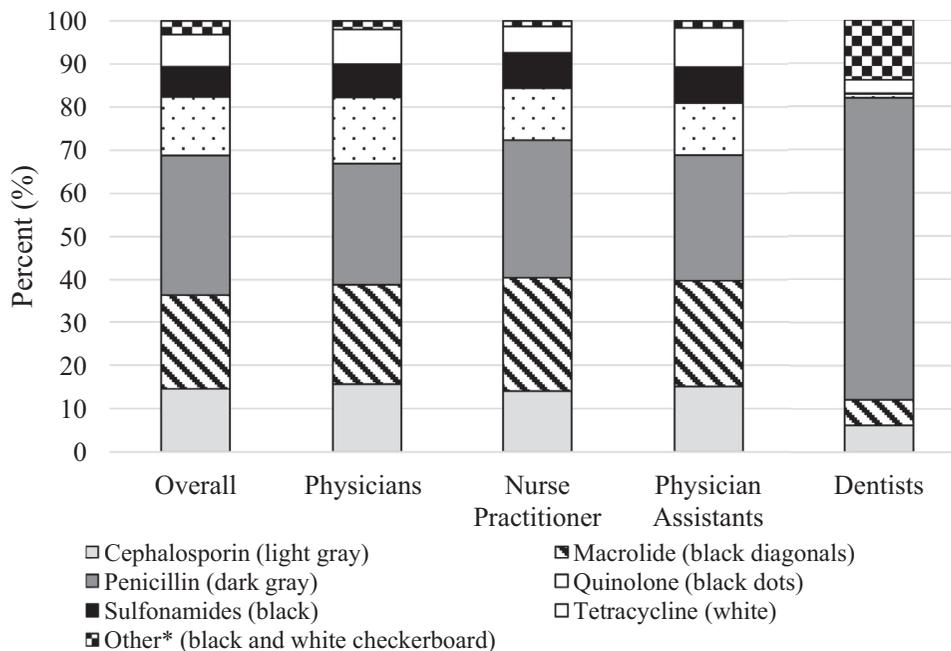
Significant increases in prescribing in the winter months compared with the summer months were observed for physicians, nurse practitioners, and physician assistants ( $P < 0.001$  for seasonality; [Supplemental Figure 1](#), available online at [japha.org](http://japha.org)). The highest increase in antibiotic prescribing in the winter was observed for nurse practitioners (27.0%), followed by physicians (23.8%) and physician assistants (19.6%)

**Table 1**

Annual rates and percentages of outpatient antibiotic prescriptions by provider group, 2005-2010

Provider and prescription data	2005	2006	2007	2008	2009	2010	<i>P</i> value <sup>a</sup>
Proportion of all prescriptions (%)							
Dentists	10.7	10.9	10.7	10.2	9.8	10.0	0.0215
Nurse practitioners	3.2	3.4	3.8	4.4	5.3	6.6	0.0025
Physician assistants	2.8	3.1	3.6	4.3	5.2	6.0	0.0003
Physicians	83.3	82.5	81.8	81.1	79.7	77.5	0.0015
Prescriptions per provider (n)							
Dentists	171.4	170.7	167.7	157.8	151.3	148.5	0.0014
Nurse practitioners	63.4	63.7	72.9	78.7	89.1	102.0	0.0011
Physician assistants	123.4	127.5	137.4	150.4	181.2	186.2	0.0018
Physicians	294.2	284.9	278.8	273.5	267.7	251.5	0.0006
Prescriptions per 1000 population (n)							
Dentists	94.0	94.3	92.8	87.0	84.2	83.6	0.0038
Nurse practitioners	27.7	29.8	33.2	38.1	45.8	55.4	0.0016
Physician assistants	24.5	27.2	31.1	36.5	44.3	50.3	0.0003
Physicians	729.7	713.7	707.5	695.7	685.6	650.5	0.0023

<sup>a</sup> *P* value calculated with the use of simple linear regression analysis.



**Figure 1.** Proportions of antibiotic classes by provider group. The focus of the present analysis was on the most commonly prescribed antibiotic classes over the 6 years (2005–2010); however, an “other” category is included for completeness.

(Supplemental Figure 1). Dentists did not exhibit any trends in prescribing by season (1.3% decrease;  $P = 0.20$ ).

## Discussion

Consistently with other recent reports of decreasing antibiotic prescribing in the United States,<sup>12,13</sup> our results demonstrate that similar trends are being observed for physician providers. Reasons for this decrease likely include provider and patient education, leading to changes in prescribing behavior and increases in vaccination rates causing a subsequent decrease in outpatient visits for acute respiratory infections.<sup>11,24,25</sup> However, antibiotic prescriptions by physician assistants and nurse practitioners are increasing, more than doubling over the study period. These trends may be a reflection of the increasing autonomy and, thus, number of infections treated by these providers. Convenient care clinics (retail clinics affiliated with a pharmacy or retail chain) emerged during the study period and may also have contributed to these results.<sup>26</sup> Retail clinics emerged in the 2000s, are primarily staffed by nurse practitioners, and are generally protocol driven.<sup>27</sup> Services provided include school health screenings, select preventative care services, and treating infections.<sup>27</sup> Quality of care provided for otitis media, pharyngitis, and urinary tract infection in retail clinics have been shown to be comparable, with similar antibiotic prescribing rates as physician offices, urgent care clinics, and emergency departments.<sup>28,29</sup> However, it has been well demonstrated that the majority of upper respiratory tract infections seen in retail clinics and elsewhere are viral in nature and do not require an antibiotic. Therefore, although antibiotic prescribing rates have been shown to be similar, significant inappropriate antibiotic prescribing for viral respiratory tract infections likely remains in all primary care settings.

Decreasing prescribing of penicillins and increasing prescribing of macrolides have been observed in the United States.<sup>12,13,30</sup> Interestingly, although macrolide prescriptions decreased for physicians, this class increased significantly for nurse practitioners and physician assistants. Similar increases were seen with quinolone and third-generation cephalosporin prescribing; an upward trend was observed for nurse practitioners and physician assistants whereas physicians experienced a nonsignificant decrease. Nationally, prescribing of broad-spectrum agents has been increasing, primarily driven by the macrolide and quinolone classes.<sup>13,31,32</sup> Use of antibiotics, especially broad-spectrum agents, leads to resistance and is a patient safety concern. Our results demonstrate that midlevel providers showed a 15% increase in broad-spectrum prescriptions. Thus, increasing trends in prescribing of broad-spectrum agents can be attributed to nurse practitioners and physician assistants. This is worrisome, because these providers are increasingly prescribing antibiotics. Possible reasons for increasing trends may be increased professional autonomy, emerging health care settings, lack of education, and types of diagnoses seen by these providers (e.g., acute infections). However, the most dramatic increase by class for physician assistants and nurse practitioners were for sulfonamides and tetracyclines. These trends in prescribing may be secondary to increasing resistance observed in the community, especially for skin and skin structure infections caused by community-acquired methicillin-resistant *Staphylococcus aureus*.<sup>33,34</sup>

Seasonality of antibiotic prescribing can be an indicator of inappropriate use and is primarily driven by the macrolide and penicillin classes.<sup>12,35,36</sup> With the exception of dentists, seasonality was detected for each provider group, led by nurse practitioners. Increases in antibiotic prescriptions by physicians, nurse practitioners, and physician assistants in the winter months parallels surveillance of outpatient influenza

diagnoses.<sup>12,37</sup> These trends are likely due to the increase in respiratory tract infections, most of which are viral in nature, which commonly occur in the first and fourth quarters of the calendar year.<sup>37</sup>

U.S. guidelines for the use of antimicrobial prophylaxis for endocarditis during dental procedures changed in 2007, reducing the number of patients requiring antibiotic prophylaxis.<sup>38,39</sup> Our results illustrate decreases in the prescribing rate for dentists since the 2007 guidelines were published. However, the decrease in overall proportion of antibiotic prescriptions was small (from 10.7% in 2005 to 10% in 2010), and the statistical significance may have been secondary to the size of the dataset and may not reflect a meaningful decrease. Prescribing of the penicillins, the primary class recommended for endocarditis prophylaxis during dental procedures,<sup>39</sup> also decreased over the 6 years. However, adherence with these guidelines is unknown. With dentists prescribing approximately 10% of all outpatient antibiotics annually, adherence with antibiotic prescribing guidelines for endocarditis prophylaxis and tooth-related conditions should be assessed.

Although our results are from a robust data source representing national outpatient antibiotic use rather than claims or expenditures data, our analysis does have some limitations. A prescription dispensed does not necessarily reflect actual consumption or patient adherence. With 22% of prescribed medications never being dispensed,<sup>40</sup> a dispensed prescription may more accurately reflect antibiotic consumption compared with evaluating written prescriptions. Although the dataset used included provider type, diagnosis information obtained from patient encounter data was not available. Therefore, appropriate antibiotic use based on patient encounter and diagnosis could not be assessed and should be evaluated in a subsequent study. Also, the accuracy of the counts of providers considered to be actively practicing have not been validated and may affect the denominators used to calculate provider-based rates. However, the counts used in our analysis are those applied consistently by the respective professional societies and likely reflect the most accurate estimates. Finally, antimicrobial stewardship efforts have gained significant attention since 2010 (the last year included in this study). Therefore, prescribing trends may have changed subsequent to our study period.

Antimicrobial stewardship programs and appropriate use campaigns have been credited with contributing to national declines in antibiotic prescribing.<sup>13,41,42</sup> These programs can use our results to tailor their interventions to reverse increasing prescribing by nurse practitioners and physician assistants, while still focusing on physicians who prescribe the majority of antibiotics. This becomes even more pertinent with the increasing numbers of nurse practitioners and physician assistants and a potential physician shortage.<sup>43</sup> Dentists have not traditionally been included in outpatient antimicrobial stewardship efforts but should be considered for inclusion, because they prescribe more antibiotics than physician assistants and nurse practitioners. In addition, interventions focusing on appropriate prescribing of broad-spectrum agents, such as macrolides and quinolones, by nurse practitioners and physicians assistants should also be incorporated into these stewardship programs. Timing of appropriate-use campaigns to occur just before or at the beginning of the respiratory infection season may be more

effective in reducing prescribing for viral infections. In the United States, the Centers for Disease Control and Prevention Get Smart: Know When Antibiotics Work program has year-round educational efforts on appropriate use of antibiotics. In addition, there is a U.S. annual observance, “Get Smart About Antibiotics Week,” scheduled in November at the beginning of respiratory season.<sup>44</sup> This observance week also coincides with international observances, such as the World Health Organization’s World Antibiotic Awareness Week and the European Union’s Antibiotic Awareness Day on November 18 annually. In addition, a recent Presidential Executive Order established a Task Force and Advisory Board for Combating Antibiotic-Resistant Bacteria to optimize antimicrobial stewardship efforts in the United States.<sup>8</sup>

## Conclusion

Although the majority of antibiotics in the outpatient setting are prescribed by physicians, prescribing by nurse practitioners and physician assistants is increasing. Dentists prescribe a higher proportion of antibiotics than midlevel providers. Nurse practitioners had the most dramatic seasonal increase in prescribing rates during the winter months. All providers prescribed penicillins most frequently, although the amount of these drugs prescribed decreased over the study period for physicians and dentists. Prescribing of all antibiotic classes, including broad-spectrum agents, increased for nurse practitioners and physician assistants, whereas physicians primarily had decreasing trends in prescribing of these agents. Thus, increasing trends in the United States of broad-spectrum antibiotic prescriptions can be attributed to nurse practitioners and physician assistants. Understanding antibiotic prescribing trends over time by provider group can be applied to customize antimicrobial stewardship efforts to physicians, nurse practitioners, physician assistants, and dentists.

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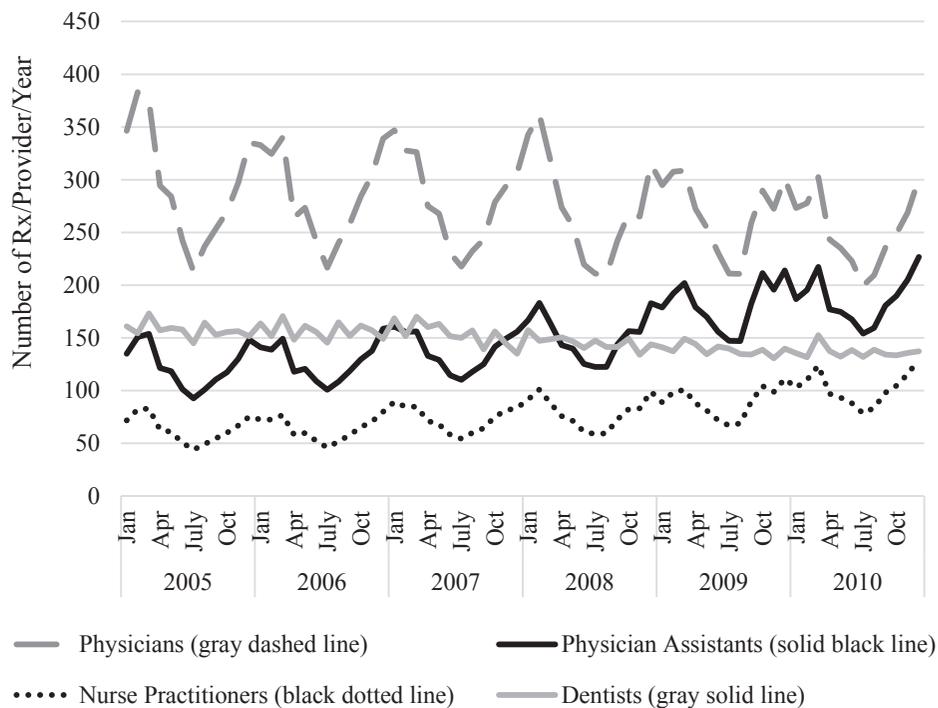
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## Appendix



Note: Prescribing rates calculated as (Number of prescriptions) ÷ (Number of providers)

\*P-value calculated with multiple regression analysis.

**Supplemental Figure 1.** Monthly variation of rate of outpatient antibiotic use by provider group, 2005 to 2010 ( $P < 0.0001$  for seasonality for all providers except dentists; calculated with the use of multiple regression analysis). Prescribing rates calculated as: (number of prescriptions) ÷ (number of providers).

## Supplemental Table 1

Provider-based prescribing rates<sup>a</sup> for dentists, physician assistants, nurse practitioners and physicians by antibiotic class, 2005-2010

Provider	Class	2005	2006	2007	2008	2009	2010	P value <sup>b</sup>
Dentists	Cephalosporin	11.7	11.1	10.2	9.5	8.8	8.2	<0.0001
	Macrolide	9.9	9.6	9.6	9.8	9.5	9.3	0.0700
	Penicillin	120.0	120.0	117.5	109.4	105.0	103.8	0.0024
	Quinolone	1.4	1.4	1.5	1.5	1.4	1.3	0.4898
	Sulfonamides	0.3	0.3	0.3	0.3	0.3	0.3	0.1583
Physician assistants	Tetracycline	6.3	5.7	5.2	4.7	4.3	3.9	<0.0001
	Cephalosporin	19.8	20.6	21.4	22.2	26.2	27.5	0.0035
	Macrolide	31.4	30.7	33.2	37.5	45.6	45.2	0.0058
	Penicillin	39.3	39.0	40.1	42.3	51.4	52.9	0.0118
	Quinolone	14.3	15.8	17.7	19.3	21.3	20.8	0.0013
Nurse practitioners	Sulfonamides	7.5	9.1	11.1	13.0	16.3	17.8	<0.0001
	Tetracycline	9.7	10.7	11.8	13.6	17.4	18.5	0.0010
	Cephalosporin	9.2	9.5	10.7	10.8	12.1	13.8	0.0019
	Macrolide	17.0	16.3	18.8	21.2	24.2	26.9	0.0018
	Penicillin	21.7	21.0	22.9	23.9	27.7	32.8	0.0111
Physicians	Quinolone	7.4	8.0	9.6	10.2	10.4	11.2	0.0008
	Sulfonamides	4.0	4.6	5.8	6.7	7.8	9.3	<0.0001
	Tetracycline	3.5	3.6	4.3	4.9	5.6	6.5	0.0004
	Cephalosporin	48.0	46.5	44.6	41.4	40.2	38.0	<0.0001
	Macrolide	68.6	62.5	62.3	64.8	64.7	59.8	0.1861
Physicians	Penicillin	88.4	83.3	77.8	73.5	73.0	68.3	0.0005
	Quinolone	42.9	44.4	45.3	44.0	39.7	36.3	0.0846
	Sulfonamides	19.2	20.8	21.5	22.1	22.2	21.7	0.0437
	Tetracycline	22.2	22.1	21.8	22.0	22.4	21.8	0.5819

<sup>a</sup> Prescribing rates calculated as: (number of prescriptions) ÷ (number of providers).

<sup>b</sup> P value calculated with the use of simple linear regression analysis.