Geographic Variation in Outpatient Antibiotic Prescribing Among Older Adults

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Background: Consequences of antibiotic overuse are substantial, especially among older adults, who are more susceptible to adverse reactions. Findings about variation in antibiotic prescribing can target policy efforts to focused areas; however, little is known about these patterns among older adults.

Methods: Using Medicare Part D data from January 1, 2007, through December 31, 2009 (comprising 1.0-1.1 million patients per year), we examined geographic variation in antibiotic use among older adults in 306 *Dartmouth Atlas of Health Care* hospital referral regions, 50 states and the District of Columbia, and 4 national regions (South, West, Midwest, and Northeast). In addition, we examined the quarterly change in antibiotic use across the 4 regions. Differences in patient demographics, insurance status, and clinical characteristics were adjusted for across regions.

Results: Substantial geographic and quarterly variation in outpatient antibiotic prescribing existed across regions after adjusting for population characteristics. This variation could not be explained by differences in the prevalences of the underlying conditions. For example, the ratios of the 75th percentile to the 25th percentile of adjusted annual antibiotic spending were 1.31 across states and 1.32 across regions. The highest antibiotic use was in the South, where 21.4% of patients per quarter used an antibiotic, whereas the lowest antibiotic use was in the West, where 17.4% of patients per quarter used an antibiotic ($P < .01$). Regardless of region, the rate of antibiotic use was highest in the first quarter (20.9% in January through March) and was lowest in the third quarter (16.9% in July through September) ($P < .01$).

Conclusions: Areas with high rates of antibiotic use may benefit from targeted programs to reduce unnecessary prescription. Quality improvement programs can set attainable targets using the low-prescribing areas as a reference, particularly targeting older adults.

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THE OVERUSE OF ANTIBIOTICS is common, and the consequences are clinically and financially substantial. Not only can overuse lead to unnecessary spending for prescription drugs, but also it can increase the risk for adverse effects and population-level antimicrobial resistance.[1] Older patients may be more susceptible to adverse drug reactions because of an increased comorbidity burden and subject to more severe adverse outcomes of antibiotic overuse.[2-5] Different geographic regions have different patterns of antimicrobial resistance, which might be due to the regional variation in practice patterns of antibiotic prescription.

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Antibiotic use variation in the non-Medicare population has been investigated, but little is known about the antibiotic prescribing patterns among older adults. As national Medicare Part D data have become available, research on regional variation in pharmacy prescribing has emerged.[6-8] However, to our knowledge, no study to date using Medicare Part D data has examined variation in antibiotic use among older adults.

Regional variation in antibiotic prescription has important policy implications. Many programs have aimed to reduce inappropriate antibiotic use in ambulatory care settings,[9] but ample room exists for additional reductions, especially in the overuse of antibiotics for acute respiratory tract infections and other unnecessary indications.[10] Findings on variation in antibiotic prescribing can guide policy efforts to improve more targeted areas or specific therapeutic subclasses of antibiotics.

Using Medicare Part D data from January 1, 2007, through December 31, 2009 (comprising 1.0-1.1 million patients per year), we examined geographic variation in antibiotic use among older adults at the following 3 levels: 306 *Dartmouth Atlas of Health Care* (http://www.dartmouthatlas

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.org) hospital referral regions (HRRs), 50 states and the District of Columbia, and 4 national regions (South, West, Midwest, and Northeast). In addition, we examined the quarterly change in antibiotic use across the 4 regions. In the winter months, some antibiotic use could be from inappropriate prescription because of an increased rate of nonspecific respiratory tract infections and other acute respiratory tract infections that do not require antibiotic treatment. Examining how quarterly patterns of antibiotic use relate to geographic variation can help us understand when and where inappropriate use is likely to occur. In addition, we compare the use by each subclass of antibiotics and evaluate how regional and quarterly variation might be driven by a specific subclass, especially the more expensive and broad-spectrum antibiotics.

METHODS

DATA SOURCE AND STUDY POPULATION

From the Centers for Medicare & Medicaid Services, we obtained prescription drug event data from January 1, 2007, through December 31, 2009, for a 5% random sample of Medicare beneficiaries. The Medicare Part D prescription drug event data represent the most comprehensive database from a national prescription drug perspective. We constrained our study sample to beneficiaries 65 years and older because antibiotic prescribing may be different for younger adults who are eligible for Medicare because of disability. For each year of the 3-year study period, we identified beneficiaries who were continuously enrolled in a Medicare Part D plan for the entire year (998 703 in 2007, 1 047 467 in 2008, 1 086 798 in 2009, and 825 977 in all 3 years), so we could observe their full-year drug use and calculate the rate of antibiotic use in the year.

GEOGRAPHIC AREAS

We evaluated geographic variation at the following 3 levels on the basis of the beneficiary's zip code of residence: 306 HRRs, 50 states and the District of Columbia, and 4 national regions (South, West, Midwest, and Northeast). Hospital referral regions were defined by where patients were referred for major cardiovascular surgical procedures and for neurosurgery and are often used as proxies for regional health care markets. Many programs have aimed to improve appropriate antibiotic use and to reduce inappropriate use in ambulatory care settings. Because some of these programs represent efforts as a result of policy at the state level, we also examined variation in antibiotic use across states. Finally, we attempted to link quarterly data with the aggregated level of regional data for the prevalence of some conditions. These 4 areas were defined using the US Census region definitions, which are as follows: the South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia), the West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming), the Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin), and the Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont).

OUTCOMES

We defined the following measures for antibiotic use per person per year or per person per quarter: proportion of patients using an antibiotic, mean number of antibiotic prescriptions filled, and mean total gross spending for antibiotics. In addition, we measured the proportions of patients using each major antibiotic therapeutic subclass, including quinolones, macrolides, penicillins, cephalosporins, and tetracyclines. Quinolones and the most commonly used macrolides are mainly brand-name and broad-spectrum antibiotics.[11,12]

PREVALENCE RATES OF 3 CONDITIONS

To check whether regions with high rates of antibiotic use are likely because of higher prevalences of conditions that require antibiotic treatment, we identified the following 3 conditions: (1) bacterial pneumonia (*International Classification of Diseases, Ninth Revision* codes 481, 482, 483, 485, and 486), which should almost always require antibiotics; (2) acute nasopharyngitis (common cold) and nonspecific upper respiratory tract infections (codes 460 and 465), for which antibiotics typically should not be used because these are often viral infections; and (3) other acute respiratory tract infections (codes 461, 462, 463, 466, 473, and 490). Other acute respiratory tract infections include sinusitis (codes 461 and 473), pharyngitis and tonsillitis (codes 462 and 463), and bronchitis (codes 466 and 490), for which antibiotic use may have some indications but is often unnecessary. Using Medicare data for each region and each quarter, we calculated the percentages of patients who received these diagnoses. We also conducted a sensitivity analysis using National Ambulatory Medical Care Survey data to calculate the prevalences of the 3 conditions by quarter and by the 4 national regions.

ADJUSTMENT VARIABLES

To control for the differences in population mix across regions, we adjusted for 3 major categories of beneficiary-level variables that might influence antibiotic prescribing patterns, namely, patient demographics, insurance status, and clinical characteristics. Patient demographics included the following: (1) age (65-69, 70-74, 75-79, 80-84, 85-89, 90-94, or ≥95 years), (2) sex (1 for female and 0 for male), and (3) race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian, or other) based on patient self-report and verified by first and last name algorithms.[13]

Insurance status included several indicators. These included whether the beneficiary was covered by a stand-alone Medicare Part D or Medicare Advantage Part D plan, whether the beneficiary had supplementary drug coverage (eg, having generic coverage in the standard doughnut-hole gap), and whether the beneficiary had dual Medicaid coverage or federal low-income subsidies for the Medicare Part D program in which the beneficiary paid nothing or a small copayment for drugs.

Clinical characteristics included an indicator for nursing home residence (defined as having a nursing home stay of ≥90 days) and the prospective prescription drug hierarchical condition category risk scores calculated using prior-year diagnosis and spending.[14] The Centers for Medicare & Medicaid Services prospective prescription drug hierarchical condition category is the beneficiary risk adjuster used by the centers to adjust payment to plans for pharmacy costs and is used as a proxy for health status.

STATISTICAL ANALYSIS

We plotted the proportions of patients using any antibiotic and each subclass of antibiotics, by national region and by quarter. We performed regression analysis to test whether the regional and quarterly differences in these proportions were statistically significant.

We used 2009 data to report geographic variation in the proportions of patients using any antibiotic, mean number of antibiotic prescriptions filled, and mean total gross spending for antibiotics per person per year, at state and HRR levels. To adjust for population characteristics in the different regions, we conducted individual-level regression analysis for each outcome. Each regression analysis included year indicators, regional indicator variables (state or HRR), and all the aforementioned adjustment variables. For each outcome, we calculated the predicted value for each region using the estimating equation at national means for the covariates, capturing variation for the region after adjusting for the variation in the adjustment variables across regions. After making these adjustments, we created maps to show variation in the adjusted numbers across regions in the United States and reported variation statistics such as the ratio of the 75th percentile to the 25th percentile and the coefficient of variation, which is used to compare variation across distributions with different means.

RESULTS

RATES OF ANTIBIOTIC USE BY REGION AND BY QUARTER

Figure 1 shows the proportions of older adults using any antibiotic by region and by quarter. The rates of patients taking antibiotics were highest in the South and lowest in the West. The rate in the South was 4.0 percentage points higher than that in the West (21.4% vs 17.4% per quarter used an antibiotic, $P<.01$). The rate in the Midwest (19.2%) was 1.8 percentage points higher than that in the West ($P=.01$). We also observed significant quarterly differences in antibiotic use. The rate of antibiotic use was highest during the first 3 months of the year (quarter 1). The rate of antibiotic use was lowest during July, August, and September (quarter 3), which was 4.0 percentage points lower than that in quarter 1 (16.9% vs 20.9%, $P<.01$). Including an interaction term between region and quarter in our regression model revealed that quarterly patterns of variation were similar across regions but were slightly greater in the South than in other regions. For example, compared with the South, which had the largest quarterly variation (the difference in use between the first and third quarters was 5.0 percentage points), the differences in use between the first and third quarters were 1.3 percentage points lower in the Northeast ($P=.02$), 1.3 percentage points lower in the Midwest ($P=.02$), and 0.8 percentage points lower in the West ($P=.12$).

The proportions of older adults using each subclass of antibiotics generally showed a similar pattern (eFigure 1; http://www.archinternmed.com). Compared with other regions, the South had the highest rate of use for every subclass of drugs ($P<.05$). The West had the lowest use of macrolides, penicillins, and quinolones ($P<.01$). Except for cephalosporins, each drug subclass exhibited a significant quarterly trend, with the highest use occurring in quarter 1 and the lowest use occurring in quarter 3.

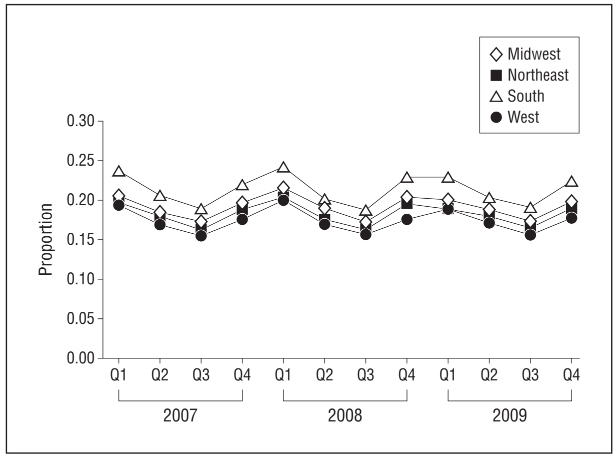

Figure 1. Proportions of older adults using any antibiotic by region and by quarter (Q). The 4 regions include the following states: Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin), Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont), South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia), and West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming).

In addition, the regional differences were mainly driven by 2 expensive and broad-spectrum antibiotic subclasses, quinolones and macrolides, because of the higher prevalence of use of these 2 subclasses (eFigure 1). The quarterly trends were also mainly driven by changes in the use of quinolones and macrolides.

PREVALENCE RATES OF 3 CONDITIONS BY REGION AND BY QUARTER

The regional and quarterly differences in antibiotic use do not seem to be explained by differences in prevalence rates of the 3 underlying conditions (bacterial pneumonia, acute nasopharyngitis, and other acute respiratory tract infections), as shown in eFigure 2. The prevalence rates of the 3 conditions among the National Ambulatory Medical Care Survey data confirm these results (data not shown). The Northeast had the highest prevalence of bacterial pneumonia, despite having the lowest use of antibiotics ($P<.05$). In contrast, the South had the highest prevalence of nonspecific acute respiratory tract infections, for which antibiotics should not necessarily be used.

STATE VARIATIONS IN ANTIBIOTIC SPENDING, COUNTS, AND USE RATES

The **Table** gives the variations in total antibiotic spending, counts of antibiotics, and proportions of patients using each drug subclass across states. Geographic variation was similar across years, so we reported data only for 2009. Overall, we found a high degree of variation in the use of antibiotics across states, with coefficients of variation of 0.17 for total antibiotic spending, 0.14 for counts of

Table. Variations in Adjusted Total Antibiotic Spending, Counts of Antibiotics, and Rates of Antibiotic Use per Older Adult in 2009[a]

			Proportion of Patients Using an Antibiotic[b]					
Variable	Total Antibiotic Spending	Count of Antibiotics	Any Antibiotic	Quinolones	Macrolides	Penicillins	Cephalosporins	Tetracyclines
Across States								
Minimum	19.94	0.82	0.39	0.15	0.12	0.12	0.08	0.03
Percentile								
10th	26.23	0.93	0.42	0.17	0.13	0.14	0.09	0.04
25th	27.54	0.98	0.44	0.18	0.14	0.15	0.11	0.04
50th	31.89	1.04	0.46	0.20	0.16	0.16	0.13	0.05
75th	36.18	1.20	0.50	0.22	0.17	0.17	0.15	0.06
90th	39.45	1.31	0.53	0.25	0.20	0.17	0.16	0.08
Maximum	46.54	1.42	0.57	0.26	0.20	0.19	0.18	0.10
Mean (SD)	32.14 (5.38)	1.09 (0.16)	0.47 (0.04)	0.20 (0.03)	0.16 (0.02)	0.16 (0.01)	0.13 (0.03)	0.05 (0.02)
75th:25th[c]	1.31	1.23	1.13	1.20	1.21	1.11	1.36	1.37
COV	0.17	0.14	0.09	0.14	0.13	0.08	0.21	0.28
Across Regions								
Minimum	18.91	0.77	0.38	0.14	0.08	0.11	0.07	0.02
Percentile								
10th	24.74	0.90	0.42	0.17	0.13	0.14	0.09	0.03
25th	27.42	0.98	0.45	0.19	0.14	0.15	0.11	0.04
50th	31.94	1.08	0.47	0.21	0.16	0.16	0.13	0.05
75th	36.15	1.21	0.51	0.23	0.18	0.17	0.14	0.07
90th	41.86	1.34	0.54	0.25	0.19	0.18	0.17	0.08
Maximum	62.51	1.58	0.60	0.29	0.25	0.21	0.21	0.18
Mean (SD)	32.65 (6.99)	1.10 (0.17)	0.48 (0.05)	0.21 (0.03)	0.16 (0.03)	0.16 (0.02)	0.13 (0.03)	0.06 (0.02)
75th:25th[c]	1.32	1.24	1.14	1.25	1.23	1.15	1.34	1.55
COV	0.21	0.15	0.10	0.15	0.17	0.11	0.22	0.34

Abbreviation: COV, coefficient of variation.

[a] The study sample (n = 1 086 798) includes all older adults with continuous enrollment in a Medicare Part D plan in 2009. The data in the table are based only on 2009 because geographic variation was similar between 2007 and 2009.

[b] The proportions of patients using any antibiotic and patients using a drug in each therapeutic subclass are higher than those in Figure 1 because the values in the table are for any use within the entire year, whereas the values in the figure are for use within a specific quarter. In addition, the rates of use for each therapeutic subclass do not add up to the rate of any antibiotic use because patients could use drugs in more than 1 therapeutic subclass. All values were adjusted for patient demographics (age, sex, and race/ethnicity), insurance status (an indicator for having supplementary drug coverage, for being in a stand-alone Medicare or dual Medicare Advantage Part D plan, and for having dual Medicaid or Medicare Advantage Part D coverage and federal low-income subsidies for the Part D program), and clinical characteristics (an indicator for nursing home residence and the prospective prescription drug hierarchical condition category risk scores).

[c] Ratio of the 75th percentile to the 25th percentile.

antibiotics, and 0.09 for use of any antibiotic. The ratio of the 75th percentile to the 25th percentile of adjusted annual antibiotic spending was 1.31 across states. Similar to our findings at the aggregated regional level, we found the highest antibiotic spending and use rates in Alabama and Mississippi, whereas the lowest antibiotic spending and use rates occurred in Oregon, Wyoming, Maine, and New Hampshire (**Figure 2**). The variation in the proportions of patients using quinolones and macrolides is greater than the variation in the proportions of patients using penicillins and any antibiotic.

HRR-LEVEL VARIATIONS IN ANTIBIOTIC SPENDING, COUNTS, AND USE RATES

The Table gives the variations in total antibiotic spending, counts of antibiotics, and proportions of patients using each drug subclass across HRRs. The variation at the HRR level is slightly greater than the variation at the state level for antibiotic spending and for counts of antibiotics, with coefficients of variation of 0.21 and 0.15, respectively, partially because of the smaller sample size at the HRR level compared with the state level. Hospital referral regions in the South used more antibiotics in general (eFigure 3).

COMMENT

Herein, we found substantial variation in the use of antibiotics across regions at all levels after adjusting for population characteristics. These regional differences did not seem to be explained simply by differences in the prevalences of the underlying conditions because we found that regions with high use of antibiotics often had lower rates of bacterial pneumonia diagnosis.

Compared with previous studies[6,8] that examined geographic patterns of the use of all medications, we found that variation in the use of antibiotics was substantially larger. For example, Zhang and colleagues[6] found that the ratio of the 75th percentile to the 25th percentile for spending on all drugs at the HRR level was 1.12. In contrast, the ratio herein for antibiotic spending was 1.32 across regions. We found that the population covered by Medicare (aged ≥65 years) used more antibiotics, 1.10 per person per year in our sample, compared with 0.88 per person per year in a study[15] that examined antibiotic use in a commercial population (children and adults aged <65 years). In addition, variation in the use of antibiotics that we observed across states was similar to what Stein-

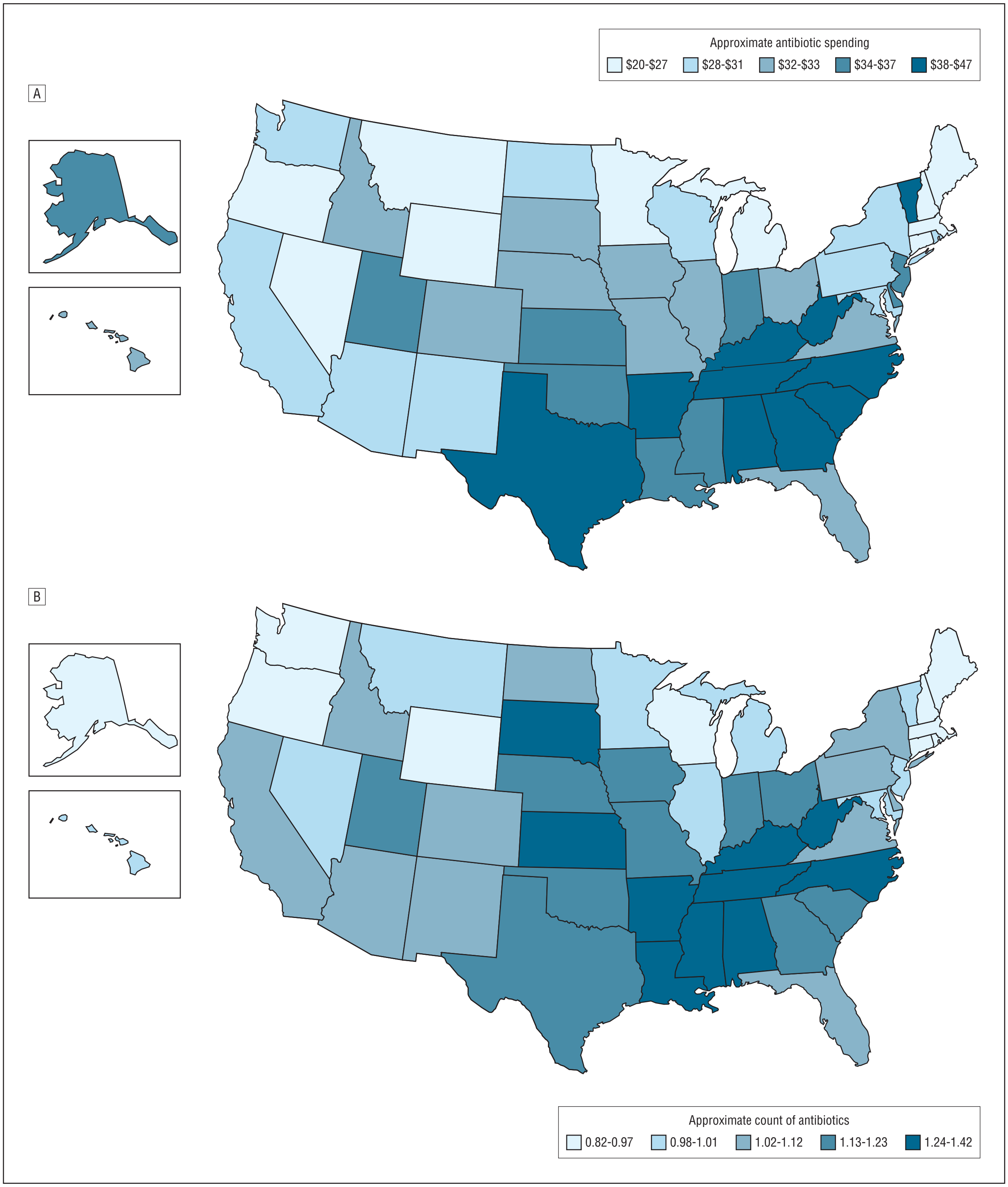

Figure 2. Quintiles of adjusted annual antibiotic spending and counts of antibiotics by state in 2009. A, Variation in adjusted antibiotic spending. B, Variation in adjusted counts of antibiotics.

man and colleagues[15] reported across commercial health plans. For example, reexamination of their results shows that the ratio of the 90th percentile to the 10th percentile of counts of antibiotics is approximately 1.50 across commercial plans. Our results demonstrate that the variation across states is 1.42. Our findings show that the South had the highest use of antibiotics, consistent with previous studies of antibiotic use[15] and of overall prescribing quality (which found worse quality of prescribing in the South compared with other regions of the country).[7]

In addition to regional differences, we found significant patterns of quarterly variation in antibiotic use, with the highest use during the winter months. Although the rates of bacterial pneumonia were also higher in these months, so were the rates of acute nasopharyngitis and other acute respiratory tract infections. Because patients with these conditions are often prescribed antibiotics unnecessarily, it is likely that the rates of inappropriate use of antibiotics are also highest in the winter months.

Our data and methods have several limitations. First, we adjusted for observable patient characteristics, including demographics, insurance status, and some clinical characteristics. However, we could not fully adjust for disease severity and other discrete health status measures or for patient preferences and explicit requests for and expectations of antibiotic treatment. These unadjusted factors could explain part of the variation we found. Second, we could not directly measure appropriate and inappropriate use of antibiotics at the individual level because undercoding and miscoding in claims data are common for bacterial pneumonia and for other acute respiratory tract infections.[16] Instead, we examined this issue by determining whether regions that use more antibiotics have higher disease incidence. This is still subject to undercoding and miscoding but is less problematic because we are examining only the aggregated trend over time instead of measuring at the individual level. In addition, by looking at diagnosis independent of drug prescribing, we reduce the bias of upcoding when a diagnosis may be entered to implicitly justify the decision to prescribe an antibiotic. We are simply demonstrating substantial variation in antibiotic use across regions. Observed variation described herein suggests that inappropriate use of antibiotics in some regions and months might be higher than that in other regions and months, but it is difficult to know the correct level of antibiotic use.

Despite these limitations, our study yields some important findings that have policy implications. Our study may be the first to date to use the most recent national Medicare Part D data to evaluate geographic variation in outpatient antibiotic prescribing among older adults. Medicare Part D data represent the most comprehensive data set to examine national regional variation in antibiotic use, with no other comparable national data in existence. Although we did not have access to other data to directly address the degree to which the results seen among patients covered by Medicare extrapolate to younger patients, the results of our study (eg, the observation of higher rates of antibiotic use in the South) are consistent with similar findings among younger adults.[15] This suggests a possible correlation between prescribing behaviors for younger and older adults.

In addition, it is important to examine antibiotic use among Medicare beneficiaries because older patients often have multiple comorbid conditions, which make them more susceptible to complications and adverse outcomes from untreated infections.[17,18] Consequently, physicians are motivated to treat older patients more aggressively with antibiotics. On the other hand, older patients might be subject to more severe adverse outcomes of antibiotic use regardless of whether the antibiotic actually was indicated, including (for example) *Clostridium difficile* colitis, cognitive disturbance with quinolone use, and clinically significant drug-drug interactions.[3-5] In addition, bacterial resistance is a societal concern. Therefore, physicians should be extra careful to ensure that they are not prescribing unnecessary antibiotics to older patients. However, no quality measure to date tracks the use of antibiotics among older adults. For example, the National Committee for Quality Assurance[19] does not trace antibiotic use among older adults but only among children, as well as avoidance of antibiotic treatment in adults younger than 65 years with acute bronchitis but not in older adults.

Overall, areas with high rates of antibiotic use may benefit from more targeted programs to reduce unnecessary antibiotic use. Although antibiotic use in the regions with lower use does not necessarily represent the clinically appropriate use given that overuse of antibiotics is common, quality improvement programs set attainable targets using the low-prescribing areas (ie, the states in the West) as a reference. In the past, quality measures looking at the overuse of antibiotics have tended to exclude older patients. Although older adults may have higher risk for adverse outcomes from infection, they may also be at particularly high risk for adverse outcomes from antibiotic use. Therefore, it might be necessary to target some quality improvement initiatives toward this age group.

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INVITED COMMENTARY

Can Implementation Science Help to Overcome Challenges in Translating Judicious Antibiotic Use Into Practice?

In this issue of the *Archives*, 2 national studies[1,2] provide distinct perspectives on the problem of antibiotic overuse in the United States. Fairlie et al[1] conducted a secondary analysis of National Ambulatory Medical Care Survey data covering a 10-year period to measure antibiotic prescription rates for the common condition of acute sinusitis. Zhang et al[2] analyzed Medicare Part D claims data for patients 65 years or older from 2007 through 2009 to assess geographic and seasonal variation in antibiotic prescriptions, considering prevalence patterns of common acute respiratory tract infections (ARIs) and various covariates.

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Both studies used appropriate methods and advanced statistical analyses to show that the overuse of antibiotics remains high and that variation in overuse is not fully explained by clinical factors available in these data sets. Studies such as these are important reminders that the United States still has a long way to go in reducing antibiotic overuse.

In the context of past efforts to understand and improve antibiotic prescribing in the United States, the results from these 2 studies raise the question of why the problem of overprescribing persists. More than 15 years have elapsed since antibiotic overuse became a national priority, largely in response to the emergence of penicillin resistance to *Streptococcus pneumoniae*, a major threat to public health given its dominant role in severe community-acquired infections, such as pneumonia, meningitis, and sepsis.[3,4] Beginning in 1995, studies[5-7] based on the National Ambulatory Medical Care Survey have shown that approximately 3 of every 4 antibiotic prescriptions in US ambulatory practices were for the treatment of ARIs, most of which have a viral origin. In the lay press, reports and stories related to antibiotic resistance (such as superbugs) and antibiotic overuse have appeared on national television network news, in magazines, and in newspapers. Studies[8,9] during this period have shown that nonclinical factors (such as patient volume or patient expectations and requests for antibiotics) influence prescribing decisions as much as or more than clinical factors (such as purulent secretions or duration of illness).

During the past 15 years, the Centers for Disease Control and Prevention have sponsored 2 multiagency task forces on strategies to address antibiotic resistance, have