RESEARCH LETTER

Antibiotic Prescribing for Adults With Acute Bronchitis in the United States, 1996-2010

Acute bronchitis is a cough-predominant acute respiratory illness of less than 3 weeks' duration. For more than 40 years, trials have shown that antibiotics are not effective for acute bronchitis.[1] Despite this, between 1980 and 1999, the rate of antibiotic prescribing for acute bronchitis was between 60% and 80% in the United States.[2] During the past 15 years, the Centers for Disease Control and Prevention (CDC) has led efforts to decrease antibiotic prescribing for acute bronchitis.[3,4] Since 2005, a Healthcare Effectiveness Data and Information Set (HEDIS) measure has stated that the antibiotic prescribing rate for acute bronchitis should be zero.[5]

To estimate the association with ongoing CDC efforts and the implementation of the HEDIS measure, we evaluated the change in antibiotic prescribing rates for acute bronchitis in the United States between 1996 and 2010.

Methods | The National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey (NAMCS/NHAMCS) are annual, nationally representative, multistage probability surveys of ambulatory care in the United States.[6] The NAMCS/NHAMCS collect information about physicians, outpatient practices, and emergency departments (EDs), as well as visit-level data including patient demographics, reasons for visits, diagnoses, and medications. Physicians, office staff, and US Census Bureau representatives collect information (including information about patient race/ethnicity to enable assessment of health care disparities) on visit record forms. Each visit in the NAMCS/NHAMCS is weighted to allow extrapolation to national estimates. The National Center for Health Statistics institutional review board approved the protocols for the

Table. Visits and Antibiotic Prescribing for Adults With Acute Bronchitis in the United States, 1996-2010

	Acute Bronchitis Visits		Any Antibiotic	
	Unweighted (n = 3153)	Weighted Proportion (95% CI), %	Prescribed (95% CI),%[a]	Adjusted OR (95% CI)[b]
Year, per decade				1.75 (1.06-2.90)
Age group, y				
18-44	2037	58 (54-63)	71 (65-76)	1 [Reference]
45-64	1116	42 (37-46)	71 (65-78)	0.99 (0.64-1.53)
Sex				
Female	1918	60 (55-64)	70 (65-76)	1 [Reference]
Male	1235	40 (36-45)	72 (65-78)	0.95 (0.64-1.40)
Race				
White	2379	82 (78-86)	72 (67-77)	1 [Reference]
Black	672	12 (9-15)	71 (64-79)	0.96 (0.56-1.63)
Other[c]	102	6 (3-9)	51 (35-66)	0.39 (0.16-0.95)
Insurance				
Private	1480	62 (57-67)	71 (66-77)	1 [Reference]
Medicare	190	5 (3-7)	74 (66-82)	1.16 (0.57-2.34)
Medicaid	595	11 (9-14)	63 (55-71)	0.73 (0.39-1.37)
Uninsured or other	888	22 (18-26)	73 (67-79)	1.25 (0.83-1.89)
Specialty or setting				
Primary care[d]	971	74 (71-77)	72 (65-78)	1 [Reference]
Emergency department	2182	26 (23-29)	69 (65-72)	0.86 (0.57-1.29)
Region				
Northeast	525	15 (11-19)	70 (61-79)	1 [Reference]
Midwest	877	27 (22-34)	72 (61-83)	1.16 (0.60-2.21)
South	1240	41 (33-48)	73 (66-80)	1.14 (0.64-2.04)
West	511	17 (12-21)	65 (54-75)	0.87 (0.46-1.63)
Population density				
Rural	463	15 (8-23)	68 (58-79)	1 [Reference]
Urban	2690	85 (77-92)	71 (66-77)	1.23 (0.61-2.49)

Abbreviation: OR, odds ratio.

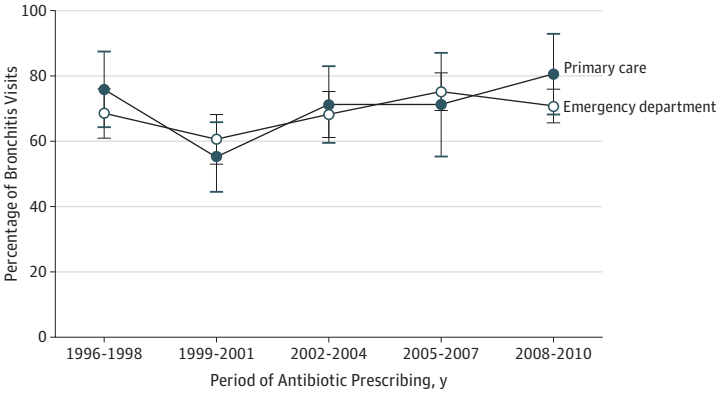
[a] Indicates the proportion of patients with acute bronchitis in each category (row %) who received any antibiotic.

[b] Based on a logistic regression model that includes all variables shown. Calendar year was modeled using each year during the study period. To facilitate interpretation, the result is the adjusted odds of antibiotic prescribing per 10-year interval.

[c] Included Asian, Native Hawaiian/Pacific Islander, American Indian/Alaska Native, or more than 1 race.

[d] Included primary care physicians (family practice, general practice, internal medicine, and pediatrics) from the National Ambulatory Medical Care Survey and general medical practices from the National Hospital Ambulatory Medical Care Survey.

Figure. Antibiotic Prescribing for Acute Bronchitis in the United States by Site of Care, 1996-2010



No. of sampled visits					
Primary care	168	167	185	217	234
Emergency department	293	401	499	462	527

For trends across periods, $P = .06$ for primary care and $P = .03$ for emergency department. Linear trends across time were assessed using survey-weighted logistic regression by estimating the P value of the coefficient for year as an explanatory variable for the outcome of antibiotic prescription. Error bars indicate 95% confidence intervals.

NAMCS/NHAMCS, including a waiver of the requirement for patient informed consent.

We strove to include visits that would be eligible for the HEDIS measure.[5] We included NAMCS/NHAMCS new problem visits made by adults aged 18 to 64 years to primary care physicians, general medicine clinics, or EDs from 1996 to 2010 with any diagnosis of acute bronchitis (*International Classification of Diseases, Ninth Revision*, code 466.0). We excluded patients who were admitted to the hospital or visits associated with chronic pulmonary disease, immunodeficiency, cancer, or concomitant infectious diagnoses. We classified antibiotics, the main outcome, as either extended macrolides or other.

We calculated standard errors for all results using logistic regression and the survey package in R (version 3.0.1, R Project for Statistical Computing). We considered 2-sided P values less than .05 as significant. To increase reliability, we combined data into 3-year periods.

Results | There were 3153 sampled acute bronchitis visits meeting our inclusion and exclusion criteria between 1996 and 2010. The overall antibiotic prescription rate was 71% (95% CI, 66%-76%) and increased between 1996 and 2010 (adjusted odds ratio per 10-year period, 1.75 [95% CI, 1.06-2.90]; $P = .03$) (**Table**). There was a statistically significant increase in antibiotic prescribing in EDs (**Figure**). Physicians prescribed extended macrolides at 36% (95% CI, 32%-41%) of acute bronchitis visits and extended macrolide prescribing increased from 25% of visits in 1996-1998 to 41% in 2008-2010 ($P = .01$). Other antibiotics were prescribed at 35% (95% CI, 30%-39%) of visits, and most commonly were fluoroquinolones, aminopenicillins, and cephalosporins. The antibiotic prescribing rate for other antibiotics did not change significantly over time (48% of visits in 1996-1998 to 35% of visits in 2008-2010; $P = .55$).

Discussion | Despite clear evidence, guidelines, quality measures, and more than 15 years of educational efforts stating that the antibiotic prescribing rate should be zero, the antibiotic prescribing rate for acute bronchitis was 71% and increased during the study period. Physicians continue to prescribe expensive, broad-spectrum antibiotics.

Our analysis has limitations. First, the sample size for some estimates was small. Second, the surveys do not capture care provided outside of clinic visits. Third, the surveys capture limited clinical information, restricting our ability to identify exclusionary factors. Fourth, as an analysis of visits, an individual patient could theoretically be included more than once, although this is unlikely given the sampling design.

Avoidance of antibiotic overuse for acute bronchitis should be a cornerstone of quality health care. Antibiotic overuse for acute bronchitis is straightforward to measure. Physicians, health systems, payers, and patients should collaborate to create more accountability and decrease antibiotic overuse.

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Author Contributions: Dr Barnett had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
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Drafting of the manuscript: All authors.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: All authors.
Obtained funding: Linder.
Administrative, technical, or material support: All authors.
Study supervision: Linder.

Conflict of Interest Disclosures: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Barnett reported serving as a medical advisor to Ginger.io, which has no relationship to this research. No other disclosures were reported.

Funding/Support: Dr Linder's work on acute respiratory tract infections was supported by grant RC4 AG039115 from the National Institutes of Health, grant R21 AI097759 from the National Institute of Allergy and Infectious Diseases, and grant R18 HS018419 from the Agency for Healthcare Research and Quality.

Role of the Sponsor: The National Institutes of Health, National Institute of Allergy and Infectious Diseases, and Agency for Healthcare Research and

Quality had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Previous Presentations: Presented in part at the Society of General Internal Medicine Annual Meeting; April 25, 2013; Denver, Colorado; and at IDWeek; October 4, 2013; San Francisco, California.

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COMMENT & RESPONSE

CPAP and Reduced Blood Pressure

To the Editor Dr Martínez-García and colleagues[1] reported that continuous positive airway pressure (CPAP) reduced 24-hour mean blood pressure in patients with resistant hypertension and obstructive sleep apnea (OSA). Moreover, this intervention had favorable effects on the circadian pattern, as demonstrated by the reduction in the proportion of patients with a riser pattern.

These results are potentially important in the current management of resistant hypertension, a condition that affects a considerable proportion of patients with hypertension undergoing treatment.[2] However, the effects of CPAP on the systolic and diastolic components of blood pressure were not as expected. Indeed, CPAP treatment promoted a significant reduction of 24-hour diastolic blood pressure (DBP), but the effect on systolic blood pressure (SBP) only became significant after multiple adjustments.

It is unclear why the authors chose mean blood pressure instead of SBP as their primary outcome because SBP is the main blood pressure component related to cardiovascular outcome. At baseline, the mean age of the patients was older than 55 years and blood pressure elevation was predominantly systolic. The 24-hour SBP was 14.2 mm Hg above 130 mm Hg, which is considered the upper limit of normal (11.1 mm Hg for daytime components and 20.8 mm Hg for nocturnal components), whereas 24-hour DBP was only minimally elevated (3.0 mm Hg for 24-hour, 0.2 mm Hg for daytime components, and 8.6 mm Hg for nighttime components). This pattern of blood pressure elevation suggests increased arterial stiffness.

A therapeutic maneuver resulting in a reduction of mainly the diastolic component cannot be seen as necessarily beneficial. Previous observational studies[3] and randomized trials[4] of patients with elevated SBP have been consistent in showing that lower values of DBP were related to a worse prognosis. In this study, pulse pressure (difference between SBP and DBP) was reduced by 0.8 mm Hg in the intervention group and 0.7 mm Hg in the control group.

Even if CPAP can help some patients with resistant hypertension and OSA with minimal or no symptoms, the lack of a significant effect on SBP warrants caution in interpreting the results as unequivocal evidence of benefit. Moreover, the relationship between resistant hypertension and OSA can be bidirectional. Recent reports on treatment of resistant hypertension using sympathetic renal denervation have also suggested beneficial effects on OSA.[5]

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Conflict of Interest Disclosures: The author has completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

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In Reply In the intention-to-treat (ITT) analysis performed in our study, the decrease in mean 24-hour SBP did not reach statistical significance in the unadjusted analysis ($P = .10$). However, it reached significance ($P = .03$) in the adjusted analysis. The decrease, which was between 3.1 mm Hg and 3.9 mm Hg in favor of the CPAP group, could be clinically significant and can hardly be attributed to chance.

In addition, recent studies have shown that adequate adherence to CPAP is paramount to achieve a positive effect on cardiovascular outcomes.[1,2] For this reason, we analyzed our study not only as ITT, which provides the most robust conclusions, but also per protocol, which provides results for patients adherent to CPAP and conclusions that are closer to clinical reality. The statistical power of our study reinforces the validity of the per-protocol analysis with a decrease in 24-hour mean SBP of 4.9 mm Hg and a 7.1 mm Hg decrease during nighttime.

Some randomized clinical trials on this topic have used the change in SBP as the main outcome. Others have chosen changes in a set of variables (not only SBP) from ambulatory