Patient and provider characteristics and outcomes associated with outpatient antibiotic overuse in acute adult bronchitis

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ABSTRACT

Nonbacterial acute bronchitis leads to many outpatient clinic visits in the US that result in an antibiotic prescription. Understanding antibiotic prescribing patterns and their clinical consequences will help improve antimicrobial stewardship efforts. A retrospective chart review was conducted to identify any correlations between patient and provider characteristics with antibiotic use in adult acute bronchitis (AAB) and to compare the clinical outcomes and rates of health care utilization between those who did and did not receive antibiotics. Study participants included adults with uncomplicated AAB seen by family medicine or internal medicine, specialty, and mid-level practitioners in a Baylor Scott & White Health outpatient facility. Phase 1 investigated whether prescribing rates varied by provider- or patient-level characteristics. Phase 2 compared clinical outcomes and health care utilization between patients who received an antibiotic versus those who did not receive an antibiotic for AAB. Among 35,383 visits for AAB, 81.4% resulted in a prescription for an antibiotic. Physicians >35 years of age and internal and family medicine physicians were more likely to prescribe antibiotics. Health care utilization rates did not differ between cohorts. The number of *Clostridium difficile* events was negligible.

KEYWORDS Acute bronchitis; community-acquired *Clostridium difficile*; health care utilization; outpatient antibiotics; upper respiratory tract infection

Acute respiratory tract infections are the leading drivers in outpatient visits in the US.¹ Nearly 68 million outpatient visits for this diagnosis per year result in an antibiotic prescription, and 50% of those antibiotics may be unnecessary.² Uncomplicated adult acute bronchitis (AAB) is diagnosed after ruling out risk factors such as asthma, chronic obstructive pulmonary disease, heart failure, and pneumonia in patients with productive or nonproductive cough lasting up to 6 weeks.³ Evidence from 40 years of studies has shown the lack of efficacy of antibiotics in AAB,^{4,5} as bacteria are detected in only 1% to 10% of AAB cases.³ Thus, professional societies and medical organizations strongly recommended against antibiotic use in uncomplicated AAB.^{2,3,6–9} Despite this, antibiotics were still prescribed in about 70% of AAB visits from 1996 to 2010,

and the prescription rate continued to increase during this time.⁵ Increased prescribing may be associated with patients' misconceptions about the need for antibiotics to treat acute respiratory tract infections as well as physicians' overestimations of patient expectations for antibiotics.^{10–14} Outcomes of antibiotic overuse are centered on patient safety and health care resource use: the risk of *Clostridium difficile* infections increases with antibiotics, and adverse events result in more than 140,000 emergency room visits a year.² To our knowledge, there is minimal evidence that comprehensively looks into clinical, demographic, and socioeconomic characteristics that may influence prescribing rates, and no known study exists within the Baylor Scott & White Health system.^{15,16} The aim of phase 1 of this study was to characterize and compare patient- and provider-level factors associated with

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Table 1. Patient and provider demographic factors associated with antibiotic prescription for adult acute bronchitis

Variable	Antibiotic (n = 28,788)	No antibiotic (n = 6,595)	P value
Provider			
Number	837 (50.2%)	829 (49.8%)	
Age: mean (SD)	46.9 (10.4)	44.5 (11.1)	<0.0001
≤35 years	2788 (12.0%)	1156 (21.6%)	
36–65 years	18,913 (81.6%)	3895 (72.8%)	
>65 years	1477 (6.4%)	300 (5.6%)	<0.0001
Type			
Internal or family medicine	20,265 (70.7%)	4239 (64.8%)	
Specialist	429 (1.5%)	187 (2.9%)	
Mid-level practitioner	7982 (27.8%)	2116 (32.3%)	<0.0001
Patient			
Age: mean (SD)	54.8 (16.2)	55.2 (16.9)	0.0983
18–64 years	20,086 (69.8%)	4432 (67.2%)	
≥65 years	8702 (30.2%)	2163 (32.8%)	<0.0001
Gender			
Female	17,573 (61.0%)	4306 (65.3%)	
Male	11,215 (39.0%)	2289 (34.7%)	<0.0001
Race			
White	22,523 (78.2%)	5120 (77.6%)	
Black	2551 (8.9%)	612 (9.3%)	
Asian	950 (3.3%)	161 (2.4%)	
Other	600 (2.1%)	180 (2.7%)	
Unknown	2164 (7.5%)	522 (7.9%)	<0.0001
Primary insurance provider			
Commercial	19,892 (69.1%)	4350 (66.1%)	
Medicare	7788 (27.1%)	1946 (29.5%)	
Medicaid	35 (0.1%)	18 (0.3%)	
Self-pay	1045 (3.6%)	267 (4.0%)	
Other	28 (0.1%)	5 (0.1%)	<0.0001
Household median income: mean (SD)	77,144 (30,880)	73,887 (29,329)	<0.0001
<\$65,000	11,744 (41.6%)	2902 (44.8%)	
\$65,000–\$130,000	15,264 (54%)	3325 (51.3%)	
>\$130,000	1254 (4.4%)	249 (3.8%)	<0.0001
OP/IP/ER visits 1 year before visit: mean (SD)	3.2 (3.9)	4.2 (6.2)	<0.0001
Range	(0–62)	(0–182)	
0	5761 (20.0%)	1166 (17.7%)	
1–2	10,367 (36.0%)	2083 (31.6%)	

(Continued on next column)

Table 1. Continued

Variable	Antibiotic (n = 28,788)	No antibiotic (n = 6,595)	P value
3–4	7713 (26.8%)	1773 (26.9%)	
>5	4947 (17.2%)	1573 (23.9%)	<0.0001

ED indicates emergency department; IP, inpatient; OP, outpatient; SD, standard deviation.

antibiotic prescribing for AAB. The aim of phase 2 was to compare the outcomes—rates of *C. difficile* infections and health care utilization—between patients who did and did not receive an antibiotic for AAB.

METHODS

Baylor Scott & White Health is the largest not-for-profit health care system in Texas and one of the largest in the US, with 48 hospitals, >800 patient care sites, and >7800 active physicians.¹⁷ This two-phase retrospective chart review consisted of two cohorts—AAB visits that resulted in an antibiotic order and AAB visits that did not result in an antibiotic order—from January 1, 2017, to August 13, 2018 in both Central Texas and North Texas locations. The study was approved by the Baylor Scott and White institutional review board in Temple, Texas.

The sample population included all adult patient visits to primary care providers with a physician-recorded ICD-9 or ICD-10 diagnosis of uncomplicated AAB, as specified in the HEDIS acute bronchitis value set.⁸ Patients must have been diagnosed by a Baylor Scott & White-affiliated provider in an outpatient setting on the date of service. Visits were excluded according to the HEDIS acute bronchitis value set criteria: a diagnosis of human immunodeficiency virus, malignant neoplasm, emphysema, chronic obstructive pulmonary disease, cystic fibrosis, or any disorder of the immune system 12 months prior to date of service; pharmacy claims for HEDIS-specified antibiotics within 30 days prior to the date of service; or diagnosis of pharyngitis or a HEDIS-specified competing diagnosis from 30 days prior to the date of service through 7 days after the date of service.⁸

In phase 1, patient-level characteristics were descriptively compared between the two cohorts using the following variables: race, gender, age, smoking history, primary insurance provider at the initial date of service, household median income obtained by correlated ZIP code income quintile as defined by the US Census Bureau, and Elixhauser index score on the index date. Provider-level characteristics were similarly compared between cohorts using two variables: age and subspecialty. Subspecialty comprised three groups: family medicine or internal medicine, mid-level practitioner, or other specialty.

In phase 2, the primary outcome was the difference in subsequent health care utilization, defined as any outpatient,

inpatient, or emergency department visit within 6 weeks of the date of service. The secondary outcome of phase 2 was the difference in subsequent community-acquired *C. difficile* infections, defined as a positive stool test within 12 weeks of the date of service. The secondary outcome subanalysis included the following variables: patient medication history up to 3 months before the date of service, an overnight stay in the hospital or long-term care facility 12 weeks before the date of the positive stool test, and a positive stool test within 8 weeks before the current positive stool test.

Descriptive statistics and bivariate analysis were used for demographic variables. *T* tests were used for continuous variables, and chi-squared tests were used for categorical variables. A multivariate logistic regression analysis was performed to predict the relationship between patient- and provider-level characteristics and antibiotic prescribing rates. An unadjusted and adjusted logistic regression analysis was conducted to assess the likelihood of subsequent health care utilization within 6 weeks after the index date between cohorts. All statistical analyses were conducted using SAS software version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

A total of 35,383 visits were coded for AAB at Central Texas and North Texas divisions of Baylor Scott & White Health during the study period. Of those visits, 31,618 unique patients were diagnosed and cared for by 1019 unique providers. Of all AAB visits, 81.4% resulted in an antibiotic prescription.

Phase 1 results are summarized in *Tables 1* and *2*. Patients were more likely to receive an antibiotic from providers who were 36 to 65 years of age (odds ratio [OR] 1.75, 95% confidence interval [CI] 1.60, 1.91; $P < 0.001$) and >65 years of age (OR 1.74, 95% CI 1.50, 2.03; $P < 0.001$), compared to providers who were ≤ 35 years of age. Specialty providers were less likely to order an antibiotic (OR 0.56, 95% CI 0.46, 0.68; $P < 0.001$) than internal medicine, family medicine, and mid-level providers.

Phase 2 results are summarized in *Table 3*. The primary outcome of subsequent health care utilization occurred more frequently in visits that did not result in an antibiotic compared with visits that did result in an antibiotic (39.8% vs 37.2%; $P < 0.001$). Unadjusted logistic regression analysis showed that patients who did not receive an antibiotic were significantly more likely to utilize health care resources after the initial date of service (OR 1.12, 95% CI 1.06, 1.18; $P < 0.001$). This difference was no longer significant (OR 1.02, 95% CI 0.95, 1.09; $P = 0.56$) after adjusting for covariates listed in *Table 1*. The secondary outcome of *C. difficile* infections was eight positive stool tests. *C. difficile* subanalysis was not further investigated due to the small number.

Table 2. Multivariate analysis of patient and provider characteristics for predicting antibiotic prescription for adult acute bronchitis

	OR	95% CI	P value
Provider			
Age: mean (SD)			
≤ 35 years	1.00		
36–65 years	1.75	1.60, 1.91	<0.001
>65 years	1.74	1.50, 2.03	<0.001
Type			
Internal or family medicine	1.00		
Specialist	0.56	0.46, 0.68	<0.001
Mid-level practitioner	0.70	0.64, 0.76	0.25
Patient			
Age: mean (SD)			
18–64 years	1.00		
≥ 65 years	0.91	0.81, 1.02	0.11
Gender			
Male	1.00		
Female	0.87	0.82, 0.93	<0.001
Race			
White	1.00		
African American	0.96	0.86, 1.07	0.87
Asian	1.19	0.99, 1.44	0.006
Other	0.77	0.64, 0.93	0.002
Primary insurance provider			
Commercial	1.00		
Medicare	0.996	0.88, 1.12	0.39
Medicaid	0.47	0.23, 0.94	0.007
Self-pay	0.79	0.66, 0.93	0.06
Other	6.91	0.93, 51.52	0.03
Household median income: mean (SD)			
$< \$65,000$	1.00		
$\$65,000$ – $\$130,000$	1.17	1.09, 1.25	0.046
$> \$130,000$	1.13	0.95, 1.33	0.63
OP/IP/ER visits 1 year prior to visit			
0	1.00		
1–2	0.95	0.86, 1.04	<0.001
3–4	0.84	0.76, 0.92	0.61
>5	0.58	0.52, 0.64	<0.001

CI indicates confidence interval; ED, emergency department; IP, inpatient; OP, outpatient; OR, odds ratio; SD, standard deviation.

Table 3. Comparison of postvisit health care utilization between visits that did or did not result in an antibiotic

	OR	95% CI	P value	Adjusted OR	95% CI	P value
Antibiotics (reference group)	1.00			1.00		
No antibiotics	1.12	1.06, 1.18	<0.001	1.02	0.95, 1.09	0.556

CI indicates confidence interval; OR, odds ratio.

DISCUSSION

Our study's findings are consistent with previous studies' antibiotic prescribing rates for acute upper respiratory infections, in that rates still remain high over recent years.^{18–20} The correlation between provider characteristics and increased antibiotic use is explained by a range of factors, such as the importance placed on patient satisfaction surveys, years of practice, time pressures, and longstanding relationships between the provider and patient.^{2,20–25} In our study, physician specialists and providers ≤ 35 years of age were significantly less likely to prescribe antibiotics in AAB, likely explained by the notion that physician specialists are not typically first-line providers who treat uncomplicated AAB. Our results could also be explained by the notion that younger providers completed their education and training more recently than older providers. Medical education and training experiences now place a heavier emphasis on antibiotic stewardship efforts than earlier medical training experiences did. Recently, there have been more endorsements from medical organizations and societies that highlight the importance of appropriate antibiotic use in the outpatient setting.^{20,26}

The patient-level characteristics identified in this study serve as a general description of the patient population at Baylor Scott & White Health who required medical care for a common viral diagnosis. This can be a useful baseline when evaluating trends and patterns from a patient-level perspective over time. Phase 2 demonstrated that antibiotic use is not likely to change the patient's prognosis or medical needs related to AAB, nor will it dramatically shift health care utilization rates in any direction. Antibiotics would merely increase the risks of harmful adverse drug reactions without providing any clinical or cost-effective benefits in the health care system. For the secondary outcome, the negligible incidence of *C. difficile* could be explained by the difficulty in diagnosing the infection in the outpatient setting.

Study strengths include our exclusion criteria, which ruled out visits with patients who may have been indicated for antibiotics. Utilizing the HEDIS value sets eliminated high-risk patients who may have had complications if left untreated for an acute respiratory condition or those who may have had a bacterial AAB. The exclusion criteria made clear that antibiotics would not provide any additional benefit to patients in either study cohort. Our population size of 35,383 is another study strength, as it provides stronger

evidence of suspected associations between antibiotic use and clinical outcomes.

The potential for inaccurate ICD-9 and ICD-10 codes associated with an AAB visit is a study limitation. AAB codes could be misclassified or even purposefully avoided by providers to bypass negative health care quality metrics. Thus, all true AAB visits may not have been captured, thereby confounding some variables of interest such as comorbidity severity of our study sample. Another study limitation is that only two provider-level characteristics were evaluated (age and subspecialty). Studies have looked at additional variables such as medical school graduation date, practice volume (i.e., the higher the volume, the higher degree of prescribing), and perception of patient desire for antibiotics.^{24,27} Evaluating more provider-level characteristics in future studies is crucial for understanding prescribing habits and can help with developing effective and sustainable outpatient antibiotic stewardship programs. Lastly, we did not evaluate antibiotic resistance patterns, one of the most concerning consequences of inappropriate antibiotic use in the outpatient setting.

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