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Abstract

Objective: To examine whether patient and provider concordance by sex or race predicts antibiotic prescribing for acute bronchitis.

Study setting: General Internal Medicine and Family Medicine adult clinics at a large safety-net hospital.

Study design: We used a logistic model of prescribing as a function of race and sex concordance.

Data extraction: Data were extracted from de-identified patient records for those with an acute bronchitis visit between 2008 and 2010.

Principal findings: 71% (95% CI 68%-73%) of visits resulted in an antibiotic prescription. Patients in race-concordant visits were 17% (95% CI 8%-25%) less likely to receive a prescription.

Conclusions: Race-concordant outpatient visits were associated with more appropriate antibiotic use. Examination of characteristics such as concordance can improve our understanding of the prescribing process and inform stewardship efforts.

Keywords

concordance; antibiotics; overprescribing

Cover Page Footnote

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ABSTRACT

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INTRODUCTION

Antibiotics are prescribed for acute bronchitis 60%-80% of the time despite clinical guidelines strongly advocating against the practice (Centers for Disease Control and Prevention 2014). Efforts to combat overprescribing in outpatient settings have proven largely unsuccessful (Davey et al. 2013). This lack of success is worrisome given increasing bacterial resistance; the CDC estimated that over 2 million individuals were infected with antibiotic resistant bacteria in 2013 (Centers for Disease Control and Prevention 2014). Better characterizing predictors of the prescribing decision may inform the development of more effective antibiotic stewardship interventions. Previous research has demonstrated associations between prescribing and patient factors including age, sex, and comorbidities (Barlam et al. 2015; Kroening-Roche et al. 2012);

physician factors such as practice years, teaching experience, practice volume, and specialty (Barlam et al. 2015; Steinman, Landefeld, and Gonzales 2003); and practice variation across geographic regions (Barlam et al. 2015).

The patient-provider relationship is potentially an important determinant of antibiotic prescribing decisions. Patient expectations (Coenen et al., 2013), the provider's perception of a patient's preferences (Tonkin-Crine et al., 2014), and communication (Mangione-Smith, Stivers, Elliott, McDonald, & Heritage, 2003) have been suggested as catalysts for antibiotic overuse. Race and sex may impact the patient-provider relationship by affecting communication during the clinical encounter. Providers knowledgeable about a patient's culture may be better able to clearly explain medical diagnoses, and a patient with a sense of shared experience may be more likely to trust their provider's judgment (Cooper-Patrick et al. 1999). Studies of cross-cultural communication have found, for example, that black patients treated by black providers rated the visits as more participatory than when treated by white providers (Cooper-Patrick et al. 1999). Similar trends have been observed in studies of gender concordance where care of a female patient by a female provider is more likely to be patient centered as measured by the Davis Observation Code (Bertakis and Azari 2012). However, other research has failed to find significant associations between medical care and patient-provider race or sex concordance (Jerant et al. 2011). Measures of sex and race concordance have not yet been used to examine inappropriate antibiotic prescribing for acute bronchitis. The objective of this study was to examine the effect of race and sex concordance with other predictors on prescribing in cases of acute bronchitis.

METHODS

Design

We used retrospective electronic medical record (EMR) data to identify outpatient visits for acute bronchitis at a large, urban safety-net hospital. Visit data on patients and providers were abstracted from the EMR via the hospital's clinical data warehouse. Provider characteristics not in the medical record were abstracted from publicly available physician profiles. Study staff reviewed the professional headshot, educational history, and provider name to estimate race. The Boston University Institutional Review Board approved all study activities.

Visits

Visits for acute bronchitis (ICD-9-CM codes 466.x, 490) conducted between 2008 and 2010 in the outpatient clinic by either Family Medicine or General Internal Medicine attending physicians were included if the clinician had at least 10 visits for respiratory tract infections in the dataset. All visits included in the study involved patients over 18 years of age.

Variables

The primary outcome was the prescription of an antibiotic for an acute bronchitis visit. We reviewed a sample of charts to confirm that the ICD-9 diagnosis of bronchitis matched the documented clinical indicators. Visits where patients were diagnosed with both acute bronchitis and another infection that might warrant an antibiotic were excluded because it was unclear which diagnosis was considered in the prescribing decision. In general, antibiotics are not indicated for acute bronchitis (Centers for Disease Control and Prevention 2014).

The primary independent variables were: 1) race concordance between patient and provider and 2) sex concordance between patient and provider. Race was recorded in six categories – white, black, Hispanic/Latino, Asian, Middle Eastern or other/unknown. Patient race was based on self-report. The EMR combines race and ethnicity, thus Hispanic/Latino was included in this category. To determine provider race, a five-person panel used a consensus method to assign one of the six racial categories based on a photo (Ellis and Deregowski 1981), surname (Elliott et al. 2008), and/or medical school (Elliott et al. 2008). This method was informed by previous research demonstrating over 95% agreement between observer-recorded race and self-reported race (Sohn et al., 2006). Panel members were given a card for each race category to hold up each time they were presented with a photo, surname, and school. Members were not prompted beforehand, and used their own judgement to assign race based only on photo, surname, and school in order to solicit their most natural response. If there was disagreement, the panel was given the opportunity to reach consensus. When consensus could not be reached, race was assigned as "other/unknown." Patients or providers with a race of "other/unknown" were excluded from the analysis as concordance could not be established. Provider sex was recorded as male or female.

Other chosen covariates were those previously found to be associated with antibiotic prescribing in the literature and potentially confound the relationship between concordance and prescribing, including patient factors – age (Barlam, Soria-Saucedo, Cabral, & Kazis, 2016), sex (Barlam, Morgan, Wetzler, Christiansen, & Drainoni, 2015), insurance status (Vaz et al., 2015), race (Hicks et al., 2015), and history of chronic lung or heart disease (Shapiro, Hicks, Pavia, & Hersh, 2013) – and provider factors – age (Tell, Engström, & Mölstad, 2015), sex (Jerant, Bertakis, Fenton, Tancredi, & Franks, 2011), race (Cooper-Patrick et al., 1999), specialty (Family vs. General Internal Medicine) (Steinman, Landefeld, & Gonzales, 2003), and U.S. region of residency training (Barlam et al., 2015). Race and sex covariates reflect only the race and sex of the individual patient or provider and are different than the concordance variable, which measures the agreement in either sex or race between patients and providers.

<u>Statistical Analysis</u>

We performed chi-square tests to analyze differences between patient and provider characteristics in visits resulting in an antibiotic prescription compared with visits where no antibiotic was prescribed. Multivariable regression was used to examine the predictors of antibiotic prescribing, and we conducted an effect modification analysis to evaluate the effect of the presence of both race and sex concordance compared to the independent effect of each. Relative risks from the multivariable models were estimated with a binomial complementary log-log (cloglog) model including random effects to control for individual provider heterogeneity and to ensure that any findings around concordance were not artifacts of individual prescribing practices. Methods of estimating the relative risk from the cloglog model are described elsewhere (Cummings 2009).

We conducted several sensitivity analyses to evaluate model fit. Because our data did not include potentially relevant clinical variables, such as underlying immunosuppression, we evaluated adding a measure of patient complexity, the Charlson Comorbidity Index (CCI) (Charlson et al. 1987; Grant et al. 2011). The CCI was initially developed to classify comorbid conditions which may affect mortality, and has since been more widely used to control for comorbidities and patient complexity more broadly (Charlson et al. 1987; Grant et al. 2011). We evaluated the increased chance (Sohn et al., 2006) of misclassifying Hispanic/Latino patients and providers by conducting a sensitivity analysis excluding these individuals and comparing the results to the full sample, and also evaluated inclusion of fixed effects for year. Sensitivity analyses using other regression link functions and using the model with a random subsample of 1/3 of the dataset further validated the results. All analyses were conducted in Stata 13.1.

RESULTS

There were 1,177 visits for acute bronchitis included in our study. These visits were overseen by 70 unique providers. Two providers and 81 patients had a race of "other/unknown" and were excluded from the analysis. There were no other missing data. Most visits were with patients who were female, non-white, and publicly insured through Medicare or Medicaid (Table 1). The majority of physicians conducting the visits were female and white. Overall, 831 (71%; 95% CI 68%-73%) visits resulted in an antibiotic prescription. Visits in which patients received an antibiotic were associated with patients of younger age (72% vs. 64% under age 65), female sex (75% vs. 63%), and a history of lung disease (75% vs. 67%) (Table 1). An antibiotic was more often prescribed when the visit was conducted by a physician who was female (76% vs. 65% for males), under age 45 (78% vs. 68% for 45 or older), and specializing in Family Medicine (84% vs. 67% for General Internal Medicine).

In the primary adjusted model, visits where the patient and provider shared the same race had an 17% lower risk of resulting in an antibiotic prescription compared to visits which were not race concordant (RR=0.83, 95% CI 0.75-0.92) (Table 2). This result was unchanged if Hispanic/Latino patients were excluded. Sex-concordant visits were not associated with antibiotic prescriptions (RR=0.94, 95% CI 0.88-1.01) while visits with white patients (RR=1.13, 95% CI 1.06-1.21) resulted in more prescriptions.

Visits with male patients were less likely to be prescribed (RR=0.89, 95% CI 0.82-0.97) and those with a history of heart disease (RR=1.13, 95% CI 1.01-1.26) were more likely. There was a higher risk of prescribing (RR=1.29, 95% CI 1.10-1.50) if the visit was conducted by a provider who had completed residency in the West, although this result was based on a small sample.

The effect modification analysis included a term interacting race and sex concordance (Table 2). After controlling for other confounders, the interaction between race and sex concordance did not significantly predict an antibiotic prescription (RR=0.93, 95% CI 0.77-1.12). As in the primary analysis, sex-concordant visits were not associated with antibiotic prescribing (RR=0.97, 95% CI 0.87-1.07). The effect modification analysis did not change the size, direction, or significance of any of the estimated effects of confounders.

Our results did not substantially change in sensitivity analyses. Inclusion of the CCI in order to measure patient complexity did not change the results and was insignificant (p=0.3) and was thus excluded in favor of highlighting the effect of comorbidities often cited as related to antibiotic prescription, chronic lung disease and heart disease. Year fixed effects were insignificant and did not affect the overall results, suggesting prescribing trends were stable over our observation period.

Table 1: Prescribing at acute bronchitis visits

		Antibiotic Prescription				
		Yes		No		p-value
	Total	n	(%)	n	(%)	
Race Concordant Visit	454	287	(63.2)	167	(36.8)	<0.01
Race Non-Concordant Visit	723	544	(75.2)	179	(24.8)	
Sex Concordant Visit	327	221	(67.6)	106	(32.4)	0.16
Sex Non-Concordant Visit	850	610	(71.8)	240	(28.2)	
Visit-Level Patient Characteristics						
Sex						
Male	447	281	(62.9)	166	(37.1)	<0.01
Female	730	550	(75.3)	180	(24.7)	
Age group						
Under 65 years old	945	682	(72.2)	263	(27.8)	0.02
Over 65 years old	232	149	(64.0)	83	(36.0)	
Race						
White	551	382	(69.3)	169	(30.7)	
Black	413	298	(72.2)	115	(27.9)	
Asian	33	21	(63.6)	12	(36.4)	0.52
Middle Eastern	8	5	(62.5)	3	(37.5)	
Hispanic/Latino	170	124	(72.9)	46	(27.1)	
Insurance						
Commercial	490	335	(68.4)	155	(31.6)	
Medicare	306	220	(71.9)	86	(28.1)	
Medicaid	277	202	(72.9)	75	(27.1)	0.49
Other Insurance	54	41	(75.9)	13	(24.1)	
Uninsured	50	33	(66.0)	17	(34.0)	
History of Heart Disease	109	82	(75.2)	27	(24.8)	0.27
History of Chronic Lung Disease	550	411	(74.7)	139	(25.3)	<0.01
Visit Level Provider Characteristics						
Sex						
Male	587	382	(65.0)	205	(35.0)	<0.01
Female	590	449	(76.1)	141	(23.9)	
Age group						
Under 45 years old	467	366	(78.4)	101	(21.6)	<0.01
Over 45 years old	710	465	(65.5)	245	(34.5)	
Race						
White	821	557	(67.8)	264	(32.2)	<0.01
Non-White	356	274	(77.0)	82	(23.0)	
Provider Residency Training						
Northeast	1,047	741	(70.8)	306	(29.2)	
South	38	35	(92.1)	3	(7.9)	<0.01
Midwest	76	40	(52.6)	36	(47.4)	
West	16	15	(93.8)	1	(6.3)	
Specialty of provider						
Family Medicine	267	223	(83.5)	44	(16.5)	<0.01
General Internal Medicine	910	608	(66.8)	302	(33.2)	

Table 2: Risk ratios of receiving an antibiotic prescription

	Primary analysis Risk Ratio (95% CI)		Effect modification analysis Risk Ratio (95% CI)	
Race and sex concordant visit	-	-	0.93	(0.77 - 1.12)
Race concordant visit	0.83	(0.75 - 0.92)	0.87	(0.76 - 0.99)
Sex concordant visit	0.94	(0.88 - 1.01)	0.97	(0.87 - 1.07)
Visit-Level Patient Characteristics				
Sex				
Male	0.89	(0.82 - 0.97)	0.89	(0.82 - 0.97)
Female	1.00	(Reference)	1.00	(Reference)
Age group				
Under 65 years old	1.00	(Reference)	1.00	(Reference)
Over 65 years old	0.84	(0.70 - 1.02)	0.84	(0.69 - 1.02)
Race*				
White	1.13	(1.06 - 1.21)	1.13	(1.06 - 1.21)
Black	1.00	(Reference)	1.00	(Reference)
Insurance				
Commercial	1.00	(Reference)	1.00	(Reference)
Medicare	1.06	(0.94 - 1.20)	1.06	(0.94 - 1.20)
Medicaid	1.00	(0.90 - 1.10)	1.00	(0.91 - 1.11)
Other insurance	1.07	(0.93 - 1.22)	1.07	(0.94 - 1.23)
Uninsured	0.98	(0.87 - 1.11)	0.99	(0.87 - 1.12)
History of heart disease	1.13	(1.01 - 1.26)	1.13	(1.01 - 1.26)
History of chronic lung disease	1.08	(0.98 - 1.18)	1.07	(0.98 - 1.18)
Visit Level Provider Characteristics				
Sex				
Male	0.92	(0.76 - 1.10)	0.91	(0.76 - 1.09)
Female	1.00	(Reference)	1.00	(Reference)
Age group				
Under 45 years old	1.00	(Reference)	1.00	(Reference)
Over 45 years old	0.95	(0.80 - 1.12)	0.95	(0.80 - 1.13)
Race				
White	1.02	(0.81 - 1.28)	1.02	(0.81 - 1.28)
Non-white	1.00	(Reference)	1.00	(Reference)
Provider residency training				
Northeast	1.00	(Reference)	1.00	(Reference)
South	1.24	(0.99 - 1.57)	1.24	(0.99 - 1.57)
Midwest	0.90	(0.55 - 1.47)	0.91	(0.55 - 1.48)
West	1.29	(1.10 - 1.50)	1.28	(1.09 - 1.51)
Specialty of provider				
Family medicine	1.16	(0.97 - 1.38)	1.16	(0.97 - 1.38)
General internal medicine	1.00	(Reference)	1.00	(Reference)

*Race categories were collapsed to white vs. non-white due to sample size.

DISCUSSION

Our study demonstrated that race concordance played a role in appropriate antibiotic prescribing. We found that for acute bronchitis visits where the provider and patient were of the same race were 17% less likely to result in an antibiotic prescription. We did not find a significant relationship for sex concordance. The effect modification analysis yielded similar results, with only race concordance (and not sex or dual race and sex concordance) predicting antibiotic prescribing. This suggests that any effect of a combined race/sex concordance variable is driven by the association between race concordance and prescribing. Previous studies have focused on the relationship between either provider factors or patient factors and inappropriate prescribing (Kroening-Roche et al. 2012). To our knowledge, sex and race-concordance have never been used in an explanatory model of antibiotic prescribing, and the results of this study suggest that further concordance research would be fruitful.

Our findings can be used to inform efforts to improve antimicrobial stewardship interventions, which to date have had limited success. Currently, interventions have focused on provider knowledge and behavior (Davey et al. 2013). Interventions directed towards the patient have been less frequent and often are limited to provision of informational materials (Davey et al. 2013). Our findings indicate that the patient-provider relationship may be a useful area to explore possible interventions, whether through provider training aimed at improving cross-cultural communication, relationship-building, or patient-centered communication which engages and educates the patient.

Several systematic reviews have suggested that patient-provider communication may be an important area of focus, but there is no consensus on the area of communication that is weakest, or the best way to improve it (Davey et al. 2013). Our results suggest that cross-cultural communication can affect prescribing. This is particularly important in urban safety-net medical centers, which often serve racially diverse and socioeconomically disadvantaged populations who may experience disparities in care (Fiscella and Williams 2004). Our analysis is not able to determine whether the prescription of antibiotics, or the effect of race-concordance, is primarily a patient- or provider-driven phenomenon. It could be that a provider was less able to convince a non-concordant patient that antibiotics were unnecessary because he or she could not culturally connect with the patient. Or perhaps patients are more likely to trust, and take advice from, providers with whom they feel a sense of shared identity. Future research should consider employing strategies identified in studies on health care disparity, including cross-cultural communication and awareness, to better understand the dynamics of the patient-provider relationship in prescribing.

Our study has several limitations. This study did not collect provider race data directly from physicians. It is possible several providers were misclassified, affecting our results. However, previous research has demonstrated strong agreement between observed and self-reported race (Sohn et al. 2006). Hispanic/Latino origin is an important cultural variable, but is difficult to assess with certainty via clinical records or visual inspection. It is possible that some Hispanic/Latino providers may have been misclassified as non-Hispanic/Latino and some who were not Hispanic/Latino may have been misclassified as such. After excluding patients who identified as Hispanic/Latino our results were unchanged, but further research is important to evaluate potential variations in care. In particular, future researchers should attempt to use the gold-standard of self-report when evaluating race/ethnicity for providers as well, as this is the most accurate way to capture this factor. Our study was limited by the data available in the EMR, so we are missing some variables, such as duration of symptoms or immunosuppression, which may be important. We limited our sample to visits where an attending physician had direct interaction with the patient. However, some attending physicians may have been accompaniefd by medical students, residents, or fellows. While our sample size was too small to examine these different potential pairings, future research should examine how the presence of trainees affects the prescription of antibiotics for acute bronchitis. Identification of bronchitis relied on ICD-9 codes in the medical record, which may be imperfect. A sample of chart reviews confirmed ICD-

9 coding accuracy and past research suggests that these codes reliably identify bronchitis (Maselli, Gonzales, and Colorado Medical Society Joint Data Project 2001).

CONCLUSION

In conclusion, patient-provider race concordance was associated with reduced antibiotic prescribing. While gender concordance was not significant, the direction was the same and it may prove significant in a larger study. Race concordance is not the only aspect of the patient-provider relationship, but it may measure elements important to that relationship such as cultural competency, patient-centered explanations of care, or trust. The findings can be used to inform efforts to improve antimicrobial stewardship interventions, which to date have had limited success and have largely focused on provider knowledge and behavior (Davey et al. 2013). Interventions directed towards the patient have been less frequent and often are limited to provision of informational materials (Davey et al. 2013). Future research should explore the mechanisms behind the effect of patient-provider race concordance, perhaps through qualitative interviews of patient/provider dyads. Non-clinical indicators such as race and sex concordance may enhance our understanding of how to combat unnecessary prescribing and inform the design of future interventions.

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