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Association of a Clinician's Antibiotic-Prescribing Rate With Patients' Future Likelihood of Seeking Care and Receipt of Antibiotics

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Background. One underexplored driver of inappropriate antibiotic prescribing for acute respiratory illnesses (ARI) is patients' prior care experiences. When patients receive antibiotics for an ARI, patients may attribute their clinical improvement to the antibiotics, regardless of their true benefit. These experiences, and experiences of family members, may drive whether patients seek care or request antibiotics for subsequent ARIs.

Methods. Using encounter data from a national United States insurer, we identified patients <65 years old with an index ARI urgent care center (UCC) visit. We categorized clinicians within each UCC into quartiles based on their ARI antibiotic prescribing rate. Exploiting the quasi-random assignment of patients to a clinician within an UCC, we examined the association between the clinician's antibiotic prescribing rate to the patients' and their spouses' rates of ARI antibiotic receipt in the subsequent year.

Results. Across 232,256 visits at 736 UCCs, ARI antibiotic prescribing rates were 42.1% and 80.2% in the lowest and highest quartile of clinicians, respectively. Patient characteristics were similar across the four quartiles. In the year after the index ARI visit, patients seen by the highest-prescribing clinicians received more ARI antibiotics (+3.0 fills/100 patients (a 14.6% difference), 95% CI 2.2–3.8, $P < 0.001$,) versus those seen by the lowest-prescribing clinicians. The increase in antibiotics was also observed among the patients' spouses. The increase in patient ARI antibiotic prescriptions was largely driven by an increased number of ARI visits (+5.6 ARI visits/100 patients, 95% CI 3.6–7.7, $P < 0.001$), rather than a higher antibiotic prescribing rate during those subsequent ARI visits.

Conclusions. Receipt of antibiotics for an ARI increases the likelihood that patients and their spouses will receive antibiotics for future ARIs.

Keywords. antibiotic use; urgent care; care-seeking behaviors; acute respiratory illnesses.

Acute respiratory illnesses (ARIs) are one of the most common reasons patients seek care, accounting for nearly three-fourths of all unnecessary antibiotic prescriptions [1]. Excessive antibiotic prescribing for ARIs remains high [2, 3], in part due to clinicians assuming that patients frequently want antibiotics and that patients are more likely to be satisfied if they receive antibiotics [4, 5].

One other driver of antibiotic prescribing could be a patient's prior care experiences [6]. Receiving an antibiotic for an ARI could lead patients to seek more care and have an increased desire for antibiotics in the future because patients may—rightly or wrongly—attribute the resolution of their symptoms to the antibiotics. In the case of a viral illness, attribution of symptom improvement to the antibiotics is a form of "illusionary correlation," a phenomenon of overestimating the relationship between 2 events [7]. This feedback loop could perpetuate high rates of care seeking and antibiotic prescribing for ARIs. Beliefs about medication use spread within families [8], raising the possibility that this illusionary correlation could spill over to patients' family members as well.

To quantify this potential relationship, we leveraged the quasi-randomization of patients with ARIs to clinicians at urgent care centers (UCCs). Clinician antibiotic-prescribing rates vary within UCCs, but patients are unlikely to know and therefore unlikely to select for clinicians with a low or high antibiotic-prescribing rate. In the year after an index ARI visit, we compared the patients' rates of ARI antibiotic receipt and

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ARI visits to any outpatient care setting across quartiles of clinician antibiotic prescribing. We hypothesized that patients who were treated by clinicians with high antibiotic-prescribing rate at the index visits would be more likely to seek care for ARIs and receive an antibiotics in the subsequent year and these changes would be echoed in their spouses' care patterns.

METHODS

Data Source

Using 1 January 2013 to 30 June 2017 de-identified encounter data from Aetna, a national US health plan, we identified patients less than 65 years old with a visit for an ARI to an urgent care center from 1 January 2013 to 10 June 2016, who had both medical and pharmaceutical coverage at the time of their visit.

Identifying Acute Respiratory Illness Visits and Defining Episodes at Urgent Care Centers

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) diagram [9] details the inclusion/exclusion criteria (Supplementary Figure 1). We defined ARI visits using previously published International Classification of Diseases (ICD), 9th revision (ICD-9), and ICD, 10th revision (ICD-10), Clinical Modification diagnosis codes [10–12] (Supplementary Table 1). We converted ICD-10 codes to ICD-9 codes using a modified cross-walk [13]. Consistent with previous studies [10–12, 14–16], we categorized ARI diagnoses in 2 categories: diagnoses where antibiotics may be indicated (sinusitis, streptococcal pharyngitis, otitis media) and diagnoses where antibiotics are typically not indicated (nonsuppurative otitis, acute nasopharyngitis, nonstreptococcal pharyngitis, bronchitis/bronchiolitis, acute URI, viral pneumonia) (diagnosis codes in Supplementary Figure 1). This allowed us to compare a mix of diagnoses across clinicians with different antibiotic-prescribing rates.

Building on prior work [16–18], we identified ARI visits to UCCs, emergency departments, retail clinics, direct-to-consumer (DTC) telemedicine, and primary care clinicians (definition in Supplementary Methods 1) through a combination of billing codes and facility and clinician identifiers. We identified ARI visits to these 5 care settings because, while our cohort comprised patients who presented specifically to UCCs with an ARI, we recognized that follow-up ARI visits could occur at multiple settings.

From a sample of ARI UCC visits (n = 919 539), we limited our cohort to visits where the clinician was a nurse practitioner, physician assistant, or physician in 1 of 4 generalist specialties for urgent care (emergency medicine, internal medicine, family practice, pediatrics) (excluded n = 28 386 visits). We excluded visits with missing clinic or clinician identifiers (n = 144 396) or where the clinician and clinic had the same identifier (n = 169 364).

The "index" visit was the first ARI UCC visit where the patient had no ARI visits in the preceding 21 days to any setting [16, 18]. Patients could only have 1 index visit. Visits in the following 21 days after an index visit were potential follow-up visits for the same episode of illness and were excluded (n = 173 956). To ensure that all patients had a 365-day observation period after the index visit, we excluded index visits after 10 June 2016 (excluding n = 99 770). Finally, we excluded low-volume clinicians with fewer than 5 index ARI visits and UCCs with fewer than 4 clinicians (n = 71 411).

Categorizing Antibiotic Prescribing for Each Urgent Care Clinician

For each index ARI visit, we linked the visit to antibiotic drug claims filled the day before, the day of, and the subsequent 2 days [13, 15]. To focus on oral systemic antibiotics, we excluded topical, ophthalmic, or otic antibiotics. Recognizing that there are differences in the definition of broad-spectrum antibiotics [19–25], we categorized broad-spectrum antibiotics as macrolides (excluding erythromycin), fluoroquinolones, and non–first-generation cephalosporins [16].

For each urgent care clinician, we calculated their antibiotic-prescribing rate based on their index ARI visits. Within each UCC, we then assigned clinicians to quartiles based on their relative antibiotic-prescribing rates. Clinicians with the lowest antibiotic-prescribing rates were assigned to the first quartile ("low prescribers") and those with the highest antibiotic-prescribing rates to the fourth quartile ("high prescribers"). Some clinicians provided care in more than 1 center and thus, for these clinicians, we assigned center-specific antibiotic-prescribing quartiles (Supplementary Methods 2, Supplementary Figure 5).

Patient Characteristics

Patient characteristics included sex, age (0–5, 6–17, 18–44, and 45–64 years old), geographic region, level of urbanicity in zip code of residence (using the US Department of Agriculture rural-urban commuting area codes) [26], and zip code income (2015 zip code median household income in US dollars, categorized by 2015 federal poverty level for a family of 4) [27].

Outcomes

Our primary outcome was ARI antibiotic receipt per 100 people across all outpatient settings in the year after a patient's index ARI visit. After excluding a period of 21 days after the index visit for potential follow-up visits within the same ARI episode, the subsequent year is defined as days 22 to 385 after the index visit (diagram of the design shown in Supplementary Figure 2). A secondary outcome was receipt of broad-spectrum antibiotics for an ARI in the subsequent year.

Changes in ARI antibiotic receipt rate could be due to changes in the number of ARI visits or, conditional on having an ARI visit, different rates of antibiotic prescribing at the ARI visit. Our other secondary outcomes were therefore ARI visit rate and antibiotic prescribing among follow-up visits (details in Supplementary Methods 3).

We also examined the ARI care-seeking behavior and antibiotic receipt of patients' spouses or partners (Supplementary Figure 3). Based on the theory of illusionary correlation, we hypothesized that any perceived improvement due to antibiotics could spill over and also impact the spouse's rate of ARI antibiotic receipt.

Statistical Analysis

To test the assumption of quasi-randomization of patients within UCCs, we first compared characteristics of patients in the 4 quartiles of clinician antibiotic prescribing. As an additional test of balance, we used a logistic regression to estimate the predicted probability of receiving an antibiotic prescription at an index ARI visit as a function of patient characteristics (sex, age category, rural/urban status, census region, and income category). We compared this predicted probability for patients across the 4 quartiles, controlling for center-level clustering with robust standard errors. If the quasi-randomization was valid, the predicted probability of an antibiotic fill should be similar across groups.

We then compared outcomes across patients in the 4 quartiles in an "intention to treat" analysis. Patients were categorized by their clinician's prescribing quartile regardless of whether the individual patients themselves received antibiotics at the index ARI visit. Using patient-level linear regressions, we estimated the association between antibiotic-prescribing quartile and outcomes, adjusting for sex, age category, rural/urban status, census region, and income category with robust standard errors clustered at the center level. In none of our analyses did we control for specific ARI diagnosis because, as noted below, there is potential subjectivity in diagnoses.

Secondary and Sensitivity Analyses

We performed several secondary analyses. First, we examined the diagnoses given at the index ARI visit across quartiles to see if higher antibiotic-prescribing clinicians listed different diagnoses. Second, we broke down the 12 months of the subsequent year into four 3-month periods (months 1–3, 4–6, 7–9, and 10–12) to assess outcome variation over time. Third, we compared the setting of care for subsequent ARI visits across quartiles. Fourth, within each quartile, we examined the subsequent antibiotic receipt stratified by whether or not the patient indeed received an antibiotic at the index ARI visit (details in Supplementary Methods 4). Fifth, to examine whether patients were truly unaware of clinicians at UCCs, we examined the fraction of follow-up visits returning to the same clinician among patients who had follow-up visits to the same UCC. Finally, as a falsification test, we compared patients' rates of annual preventive examinations (annual physicals) in the subsequent year, which should be unaffected by antibiotic receipt, to access whether patients across the 4 quartiles had a different overall propensity to seek care [28] (Supplementary Methods 5).

We performed a number of sensitivity analyses. To check the robustness of the study design, we replicated our analysis categorizing clinician-prescribing quartiles based on a random half of patients and assessing outcomes separately on the other "leave-out" half (Supplementary Methods 6). Additionally, to address the possibility that any differences in antibiotic receipt in the subsequent year were driven by outlier patients with high antibiotic use, we used a binary outcome of whether a patient received any ARI antibiotics in the subsequent year. Recognizing that many patients receive antibiotics without a visit and this could differ across the 4 quartiles, we examined the receipt of any oral systemic antibiotics in the subsequent year, regardless of whether they were associated with an ARI visit or any visit. To address the concern that care prior to the index visit drove the observed changes, we conducted a subanalysis in which we excluded patients who had ARI visits to any outpatient setting in the 6 months prior to the index visit. Finally, we also replicated the main analysis with a sample of index ARI visits limited to those performed by clinicians with 30 or more ARI visits (Supplementary Methods 7).

We used SAS, version 9.4, for analyses (SAS Institute, Inc, Cary, NC). A 2-tailed *P* value of .05 was considered statistically significant. This study was reviewed by our institution's Institutional Review Board and was determined to be exempt.

RESULTS

From 1 January 2013 to 10 June 2016, there were a total of 232 256 index ARI urgent care visits with 9577 clinicians to 736 UCCs. The median UCC had 8 clinicians (range, 4–201). Across the 4 quartiles of clinician antibiotic prescribing, patients had similar demographics (Table 1) and the predicted probability of patients receiving an antibiotic, based only on patient characteristics, was also similar across the 4 quartiles (63.4%, 63.5%, 63.8%, and 63.5% for quartiles 1–4, respectively).

Large variation in antibiotic prescribing was observed between providers within the same center. For example, patients treated by low prescribers (first quartile) had an antibiotic-prescribing rate of 42.1% while patients treated by high prescribers (fourth quartile) had a rate of 80.8% (Table 1).

Acute Respiratory Illness Care Patterns in the Subsequent Year

The unadjusted rate of antibiotics for ARI visits per 100 people in the subsequent year increased from the low to high antibiotic prescribers (20.4 vs 23.5 ARI antibiotic fills per 100 people, respectively; $P < .001$) (Supplementary Table 2). From a multivariable linear regression adjusting for patient characteristics and clustering at the center level, patients seen by high prescribers received 3.0 more fills per 100 people ($P < .001$) (Figure 1), or 14.6% more fills over the subsequent year, compared with those seen by low prescribers. Patients treated by high prescribers also received 19.4% more ARI

Table 1. Patient Characteristics Across Quartiles of Clinician Antibiotic Prescribing at the Index Urgent Care Visit for Acute Respiratory Illnesses

	Quartile 1 (Low Prescribers)	Quartile 2	Quartile 3	Quartile 4 (High Prescribers)	Standardized Mean Difference Between Quartile 1 and 4[a]
Number of overall visits	43 424	67 047	72 136	49 649	…
Number of urgent care clinicians	2235	2469	2646	2227	…
Antibiotic-prescribing rate, %	42.1	58.4	69.6	80.8	…
Predicted probability of receiving an antibiotic,[b] %	63.4	63.5	63.8	63.5	…
Age category, %					
0–5 years	9.5	9.6	9.3	9.5	0.0
6–17 years	16.2	16.7	16.1	15.9	0.0
18–44 years	52.3	51.3	51.0	50.9	0.1
45–64 years	22.1	22.4	23.6	23.7	0.0
Sex, %					
Female	57.1	57.4	57.6	57.6	0.0
Male	42.9	42.6	42.4	42.4	0.0
Zip code SES,[c] %					
0–200% FPL	22.9	22.1	22.1	22.2	0.0
201–300% FPL	38.1	36.8	38.4	40.0	−0.1
301–400% FPL	26.0	25.4	25.4	24.6	0.0
401–400% FPL	13.0	15.7	14.1	13.2	0.0
Rural/urban, %					
Metropolitan	94.5	93.6	93.9	94.6	−0.4
Micropolitan	4.1	4.4	4.1	3.5	0.0
Small town	0.9	1.4	1.4	1.2	0.0
Rural	0.6	0.7	0.7	0.7	0.0
Region, %					
Northeast	4.1	5.7	5.2	4.9	0.0
Midwest	16.2	14.8	16.4	15.7	0.0
South	45.1	45.8	46.6	45.1	0.0
West	34.6	33.7	31.8	34.3	0.0
Clinician type, %					
Family practice	20.6	22.3	22.5	21.5	0.0
Internal medicine	2.3	3.2	3.9	4.1	0.0
Pediatrics	1.3	1.8	1.3	1.8	0.0
Emergency physician	66.0	62.8	64.0	63.9	0.2
Nurse practitioner	4.2	4.3	3.6	4.2	0.0
Physician assistant	5.6	5.6	4.8	4.6	0.0

Abbreviations: ARI, acute respiratory illness; FPL, federal poverty level; SES, socioeconomic status.

[a]The standardized mean difference was calculated by subtracting the mean over variance of each characteristic in quartile 1 with that of quartile 4.

[b]A multivariable logistic regression was used to estimate the predicted probability of receiving an antibiotic prescription at an index ARI visit as a function of patient characteristics (sex, age category, rural/urban status, census region, and income category) and controlling for center-level clustering with robust standard errors.

[c]Zip code SES is based on 2015 zip code median household income, categorized by 2015 FPL in US dollars for a family of 4.

broad-spectrum antibiotics in the subsequent year versus low-prescribers' patients (1.9 more fills per 100 people, $P < .001$) (Figure 1).

Compared with patients seen by low prescribers, patients seen by high prescribers were more likely to have an ARI visit in the subsequent year (+5.6 ARI visits per 100 people, $P < .001$) (Figure 2A), a relative difference of 8.9%. Conditional on having a subsequent ARI visit in the following year, the relative increase in antibiotic prescribing across quartiles at these subsequent visits was 2.8% (Figure 2B; unadjusted rates presented in Supplementary Table 12). In subgroup analyses stratifying patients by sociodemographic characteristics, results were similar across quartiles (Table 2).

There were 27 770 spouses of patients with an index visit. Compared with spouses of patients seen by a low prescriber, spouses of patients seen by a high prescriber also had a higher rate of ARI antibiotics in the subsequent year (+3.5 fills per 100 patients; 95% confidence interval [CI], 1.6–5.4; $P < .001$) (Table 3).

Secondary and Sensitivity Analyses

Compared with patients treated by low prescribers, patients treated by high prescribers were more likely to receive a diagnoses where antibiotics may be indicated (sinusitis [28.9% high prescribers vs 16.3% low prescribers, $P < .001$], streptococcal pharyngitis [7.4% vs 7.1%, $P < .001$], and otitis media [14.4% vs 8.7%, $P < .001$]) and less likely to receive a diagnosis of viral conditions (51.5% high prescribers vs 68.7% low prescribers, $P < .001$) (Supplementary Table 3).

The percentage difference in antibiotic fills per 100 among patients seen by high versus low prescribers was similar across the four 3-month periods in the subsequent year (Supplementary Table 5). Compared with the low-prescriber group, patients who saw high prescribers were more likely to have more ARI visits in the subsequent year to primary care clinicians (34.0 vs 31.6 visits per 100, $P < .001$) and UCCs (30.3 vs 27.3 visits per 100, $P < .001$) (Supplementary Table 6).

In another secondary analysis, we stratified patients by whether they received an antibiotic at the index visit. Patients who were not prescribed antibiotics at the index ARI visit had a similar likelihood of receiving antibiotics in the subsequent year (16.1% vs 16.5% in quartile 1 and 4, respectively) (Supplementary Figure 4*B*). Patients who received antibiotics also had a similar likelihood of receiving subsequent antibiotics (24.8% vs 24.4% in quartile 1 and 4, respectively) (Supplementary Figure 4*C*). These results are consistent with the idea that differences in subsequent care patterns are due to the receipt of the antibiotic versus another inherent difference in the clinicians.

After controlling for the fact that UCC providers in the different quartiles have a different share of patients, we found no substantial differences across patients in their likelihood of seeing the same clinician (Supplementary Table 7).

In the falsification test, no association was observed between the clinician's prescribing quartile and a patient's future receipt of a preventive health visit (Supplementary Table 8).

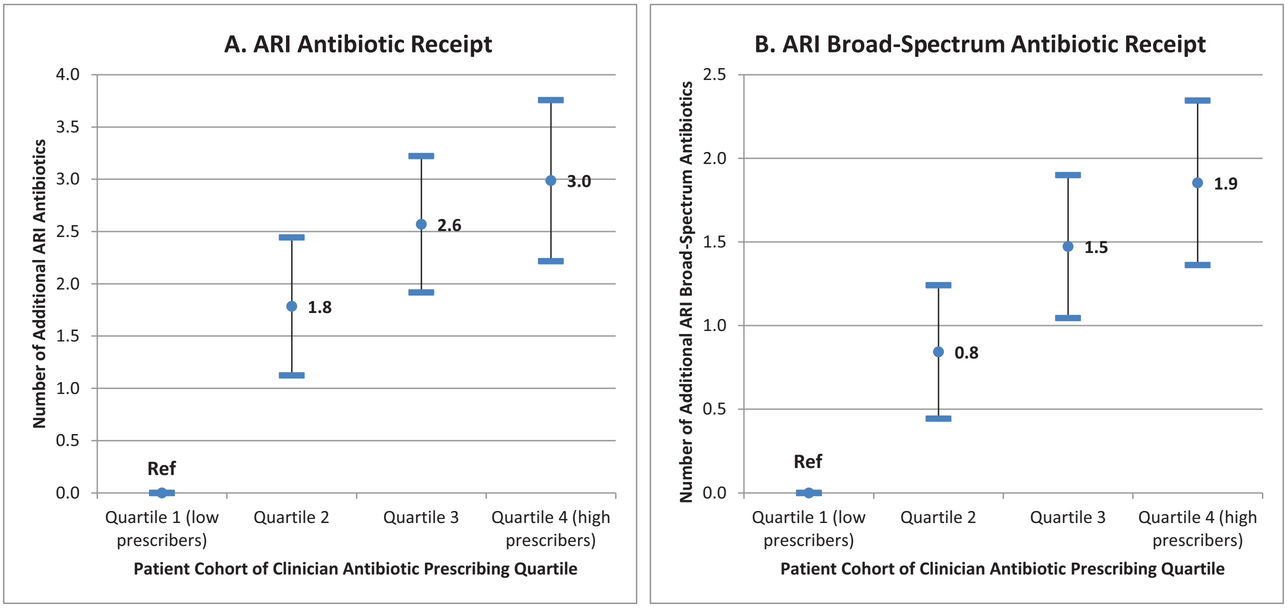

Figure 1. Differences in the rate of antibiotics receipt for ARIs per 100 in the subsequent year of patients seen by high prescribers versus low prescribers. All differences are statistically different from the reference group with a *P* value of <.001. Adjusted for patient demographic characteristics—sex, income category, age category, region, and urban/rural status—and clustered at the center level. Abbreviations: ARI, acute respiratory illness; Ref, reference.

Table 2. Differences in Rate of Antibiotics for Acute Respiratory Illnesses per 100 in Subsequent Year, Stratified by Sociodemographic Characteristics

		Increase in ARI Antibiotics Received per 100 People (95% CI)	
	No. of Visits	Quartile 1 (Low Prescribers) (43 424 Overall Visits)	Quartile 4 (High Prescribers) (49 649 Overall Visits)[b]
Age category			
0–5 years	21 960	Ref	1.5 (–.7 to 3.8)
6–17 years	37 705	Ref	2.7 (1.4 to 4.1)
18–44 years	119 186	Ref	3.2 (2.3 to 4.2)
45–64 years	53 405	Ref	3.2 (2.0 to 4.3)
Sex			
Female	133 417	Ref	3.2 (2.3 to 4.1)
Male	98 839	Ref	2.7 (1.7 to 3.7)
Zip code SES[a]			
0–200% FPL	51 758	Ref	4.0 (2.6 to 5.4)
201–300% FPL	88 747	Ref	2.8 (1.7 to 3.9)
301–400% FPL	58 867	Ref	2.0 (.7 to 3.3)
401–400% FPL	32 884	Ref	3.5 (2.0 to 5.0)
Rural/urban			
Metropolitan	218 457	Ref	2.9 (2.1 to 3.7)
Micropolitan	9390	Ref	4.1 (–.4 to 8.6)
Small town	2892	Ref	4.4 (–2.0 to 10.8)
Rural	1517	Ref	2.9 (–5.4 to 11.1)
Region			
Northeast	11 757	Ref	3.8 (1.1 to 6.6)
Midwest	36 532	Ref	1.8 (.2 to 3.3)
South	106 352	Ref	3.3 (1.8 to 4.7)
West	77 615	Ref	3.0 (2.0 to 3.9)

Abbreviations: ARI, acute respiratory illness; CI, confidence interval; FPL, federal poverty level; Ref, reference; SES, socioeconomic status.

[a]Zip code SES is based on 2015 zip code median household income, categorized by 2015 FPL in US dollars for a family of 4.

[b]A multivariable linear regression was to obtain the difference in ARI antibiotics received per 100 people as a function of patient characteristics (sex, age category, rural/urban status, census region, and income category) and controlling for center-level clustering with robust standard errors.

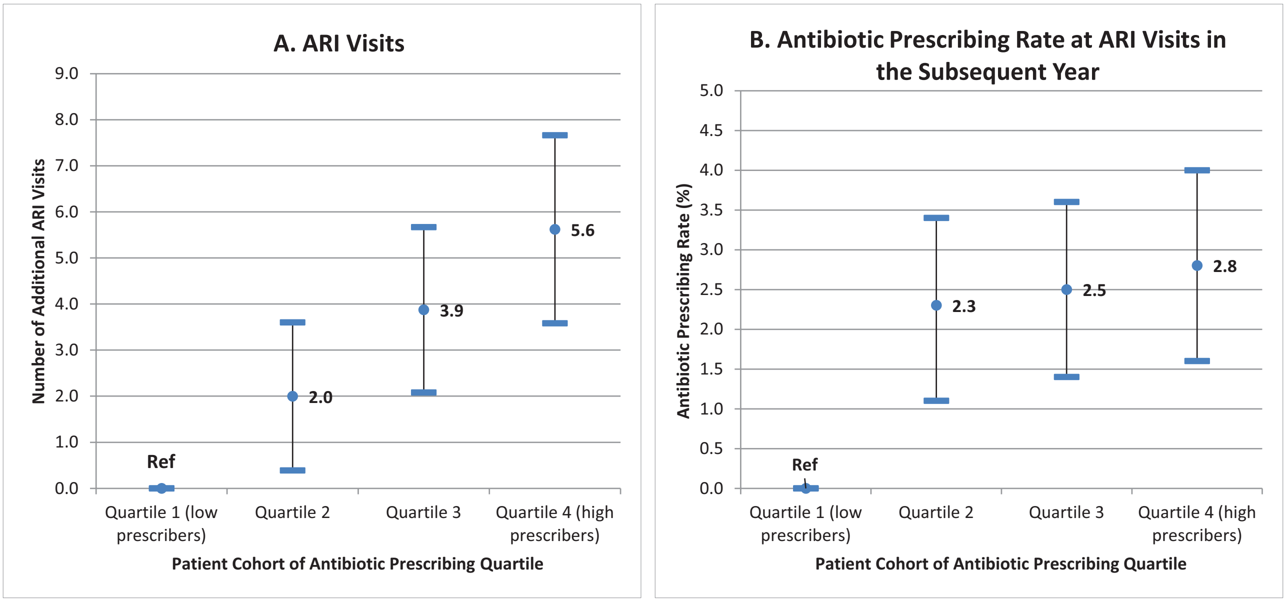

Figure 2. Rate of visits for ARIs compared with the reference group and antibiotic-prescribing rate at subsequent ARI visits. All differences are statistically different from the reference group with a *P* value of <.001. Adjusted for patient demographic characteristics—sex, income category, age category, region, and urban/rural status—and clustered at the center level. Abbreviations: ARI, acute respiratory illness; Ref, reference.

There was no substantive change in our results when we randomly divided the patients into 2 groups and used half of the patients to determine clinician antibiotic-prescribing rate and used the other half to assess outcomes (Supplementary Table 9), when we categorized our outcomes as binary (Supplementary Table 2), when we looked at all oral systemic antibiotic use including those without follow-up ARI visits (Supplementary Table 10*A* and 10*B*), when we excluded patients with ARI visits in the prior 6 months (Supplementary Table 11), and when we limited our sample to visits with clinicians with 30 or more ARI visits (Supplementary Table 12).

DISCUSSION

Using a novel approach of exploiting the quasi-randomization of patients to clinicians in an UCC [29], we demonstrate that patients who visit a clinician with a higher antibiotic-prescribing rate are more likely to receive antibiotics for ARIs in the subsequent year. Interestingly, this increase in antibiotics is also observed among the patients' spouses. The increased rate of antibiotic receipt in the subsequent year was largely driven by patients being more likely to seek care for future ARIs.

Prior evidence suggests that a large fraction of ARI antibiotic prescriptions are inappropriate [14]. However, patients may attribute clinical improvements to the antibiotics, whether or not the antibiotic was truly effective, reflecting a form of illusionary correlation (a variation of the "placebo effect"). Such a response has been observed in other areas of healthcare. For example, many patients perceive benefits in knee arthroplasty [30, 31] and spinal steroid injections [32] despite evidence from clinical trials using sham procedures that demonstrate no benefit. While we do not directly assess patient attitudes or experiences after the visit, our results are consistent with the idea that illusionary correlation drives patients to seek more care for future ARIs.

There have been many efforts to reduce unnecessary antibiotic prescribing for ARIs, often focused on changing clinician behavior within a given encounter [33, 34]. Our results emphasize the importance of how care in 1 encounter drives a patient to seek care for subsequent ARIs. A reduction in antibiotic prescribing may create a feedback loop, such that more judicious antibiotic use in 1 encounter may result in fewer future antibiotics. Thus, an additional benefit of greater antibiotic stewardship is the establishment of new norms for patients on when antibiotics are needed. Our findings could also be used in future clinician educational efforts by illustrating another negative consequence of inappropriate antibiotic prescribing.

The association between antibiotic receipt and future antibiotics extends to spouses. While we did not look at other larger social networks, this association points to an underexplored phenomenon of the network effect of health behaviors. Patients are also possibly changing the perceptions of those close to them on the benefits of antibiotics. In this way, the diffusion of behaviors across social networks could be a powerful mechanism [35] to leverage in decreasing antibiotic-prescribing rate.

Our data support the idea that patients were essentially randomized to an UCC clinician. Yet, clinicians with higher antibiotic-prescribing rates were more likely to diagnose

Table 3. Among Spouses of Patients With an Index Urgent Care Visit for an Acute Respiratory Illness, Differences in Rate of Antibiotics for Acute Respiratory Illnesses in the Subsequent Year

	Quartile 1 (Low Prescribers)	Quartile 2[a]	Quartile 3[a]	Quartile 4 (High Prescribers)[a]
Spousal pairs, n	4834	7939	8895	6102
Additional ARI antibiotics received per 100 people (95% CI)				
Patient	Ref	3.5 (1.6 to 5.5)[b]	3.9 (2.1 to 5.7)[b]	4.6 (2.7 to 6.5)[b]
Spouse	Ref	1.7 (−.4 to 3.8)	1.6 (−.2 to 3.4)	3.5 (1.6 to 5.4)[b]
Additional broad-spectrum ARI antibiotics received per 100 people (95% CI)				
Patient	Ref	1.7 (.4 to 3.0)	2.1 (.8 to 3.4)	2.8 (1.5 to 4.1)[b]
Spouse	Ref	.8 (−.8 to 2.4)	.8 (−.5 to 2.2)	2.0 (.6 to 3.4)[c]

Analysis is limited to the 12% of patients with a spouse who had medical coverage in the year during or the year after the patient's index urgent care visit. This led to a total of 27 770 spousal pairs.

Abbreviations: ARI, acute respiratory illness; CI, confidence interval; Ref, reference.

[a]A multivariable linear regression was used to estimate the predicted probability of receiving an antibiotic prescription at an ARI index visit as a function of patient characteristics (sex, age category, rural/urban status, census region, and income category) and clustering at the center level.

[b]Differences are statistically different from the reference group with a *P* value of <.001.

[c]Differences are statistically different from the reference group with a *P* value of <.01.

conditions where antibiotics may be indicated. This finding, echoed in prior work [36], implies that higher antibiotic-prescribing clinicians may choose to first prescribe antibiotics and then consciously or unconsciously choose a diagnosis to support that decision. If true, this pattern creates a challenge for measuring antibiotic appropriateness since the choice of diagnosis codes remains somewhat subjective.

Our analyses have several limitations. This analysis used administrative data and we did not have additional clinical data to assess illness severity. Although we exploited the quasi-randomization of patients across UCC providers and patients seen by low prescribers were similar to patients seen by high prescribers across a range of observable characteristics, including the predicted probability of antibiotic receipt, there may be differences in other unobserved characteristics that could influence patient care-seeking behaviors. Further, clinicians in higher-prescribing quartiles may have been randomly assigned patients who needed antibiotics. However, our results were similar in the sensitivity analysis when we randomly split our sample to separately categorize clinician-prescribing and patient-care patterns. Also, in the falsification analysis assessing for the possibility of patients having different care-seeking behaviors [28], we did not observe differences in the use of preventive care examinations in the subsequent year. Finally, our analysis focused on those with private insurance in the United States; results for other populations may differ.

In conclusion, leveraging the quasi-randomization of patients to clinicians within a UCC, we found that patients who were treated by high-antibiotic-prescribing clinicians had higher rates of ARI visits and ARI antibiotic receipt in the subsequent year.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

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