Antibiotic Prescribing Practices for Upper Respiratory Tract Infections Among Primary Care Providers: A Descriptive Study

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Background. Most antibiotics are prescribed in the ambulatory setting with estimates that up to 50% of use is inappropriate. Understanding factors associated with antibiotic misuse is essential to advancing better stewardship in this setting. We sought to assess the frequency of unnecessary antibiotic use for upper respiratory infections (URIs) among primary care providers and identify patient and provider characteristics associated with misuse.

Methods. Unnecessary antibiotic prescribing was assessed in a descriptive study by using adults ≥18 years seen for common URIs in a large, Upper Midwest, integrated health system, electronic medical records from June 2017 through May 2018. Individual provider rates of unnecessary prescribing were compared for primary care providers practicing in the departments of internal medicine, family medicine, or urgent care. Patient and provider characteristics associated with unnecessary prescribing were identified with a logistic regression model.

Results. A total of 49,463 patient encounters were included. Overall, antibiotics were prescribed unnecessarily for 42.2% (95% confidence interval [CI], 41.7–42.6) of the encounters. Patients with acute bronchitis received unnecessary antibiotics most frequently (74.2%; 95% CI, 73.4–75.0). Males and older patients were more likely to have an unnecessary antibiotic prescription. Provider characteristics associated with higher rates of unnecessary prescribing included being in a rural practice, having more years in practice, and being in higher volume practices such as an urgent care setting. Fifteen percent of providers accounted for half of all unnecessary antibiotic prescriptions.

Conclusions. Although higher-volume practices, a rural setting, or longer time in practice were predictors, unnecessary prescribing was common among all providers.

Keywords. antibiotic stewardship; bronchitis; pharyngitis; sinusitis; viral upper respiratory tract infection.

The World Health Organization and the Centers for Disease Control and Prevention (CDC) have identified antibiotic resistance as one of the greatest threats to global health, food security, and development [1, 2]. Antibiotic resistance is driven by antibiotic use, whether that use is appropriate or inappropriate [3]. Professional societies and public health agencies have called for greater stewardship over antibiotic use to decrease resistance and preserve antibiotic usefulness over time [3, 4].

Although most efforts at antibiotic stewardship have focused on the inpatient setting, the majority of antibiotics prescribed in the United States are in the ambulatory setting [5–7]. One recent study has suggested that as much as 85%–95% of all antibiotics consumed are in the community setting for most countries [8]. Several studies suggest that approximately 30%–50% of all outpatient prescriptions may be unnecessary or inappropriate, most often for viral upper respiratory infections (URIs) [5, 9, 10].

In 2015, the President of the United States released the “National Action Plan to Combat Antibiotic-Resistant Bacteria”, or CARB, which included a goal to decrease rates of unnecessary outpatient antibiotic prescribing by 50% by the year 2020 [11]. The CDC estimated that the United States needed to reduce overall outpatient antibiotic prescriptions by 15% to approach that goal. However, usage only fell from 835 dispensed prescriptions per 1000 population in 2014, to
prescribing was defined as antibiotics given for any nonexcluded primary care providers practicing in the departments of internal medicine, family medicine, or urgent care. Unnecessary prescribing was defined as antibiotics given for any nonexcluded patient with any of the following conditions: (1) acute bronchitis, (2) nonspecific AURI, (3) acute pharyngitis without a documented positive laboratory test for group A Streptococcus, and (4) ARS (<4 weeks of symptoms) without documentation of a guideline-based indication per the Infectious Disease Society of America (IDSA) [16]. Specifically, for appropriate ARS prescribing, documentation needed to be present for 1 of the following 4 indications: (1) symptom duration ≥10 days, (2) “double-sickening” (ie, worsening symptoms after initial improvement), (3) severe pain for at least 3–4 days, or (4) high fever (≥102°F) for at least 3–4 days. Determination of necessary therapy for ARS was assessed by chart review. Reviews were performed by 5 trained public health graduate students or medical students, and interobserver variation was assessed on a random subsample of 5% of the study patients.

The appropriate antibiotic choice for ARS was considered to be a penicillin class antibiotic, (amoxicillin or amoxicillin-clavulanate), unless there was a documented allergy, as per guidelines from the American Academy of Otolaryngology-Head and Neck Surgery Foundation (AAOHN) and the IDSA [16, 17]. The inappropriate antibiotic choice for ARS was a nonpenicillin class antibiotic without a documented penicillin allergy.

Individual prescribing patterns were characterized for any primary care provider having at least 5 encounters during the study period for each of the respiratory conditions. Based on the total number of included ARS encounters, providers were designated as either low volume (<100 encounters over the study period) or high volume (≥100 encounters over the study period). High-volume providers typically had some portion of their practice in an urgent care or walk-in clinic setting and were grouped separately for comparisons. For low-volume providers, 100% of their ARS cases were manually reviewed, whereas high-volume providers had 25% of their encounters randomly subsampled.

**Statistical Analysis**

Logistic regression was used to determine the provider characteristics that were associated with an inappropriate antibiotic prescription. The model adjusted for patient characteristics (including URI condition, patient gender, and patient age) and provider characteristics, including provider gender, specialty (family Medicine, high-volume, internal medicine), setting (urban vs rural), years in practice, provider age, and provider type (medical doctor [MD], nurse practitioner [NP], doctor of osteopathic medicine [DO], physician assistant-certified [PA-C]). An urban practice setting was defined as the clinic being in a city with a population greater than 50,000. Clinic locations in cities with populations less than 50,000 were classified as rural. A random intercept for providers was used to account for the nesting of the patients into providers.

**Chart Reviews**

Interobserver variation in the ARS determination was assessed by raters doing a blinded cross-check of each other’s abstraction on every 20th encounter and performing kappa correlation.
for all rater pairs. Kappa correlation was acceptable [18] and ranged from 0.445 to 0.929 on all abstracted measures; for the measure that accounted for the vast majority of patients meeting ARS guideline criteria, that is, duration of symptoms ≥10 days, the kappa correlation was 0.929.

RESULTS

During the study period, 92,515 patients were seen for one of the included URI conditions. After applying the exclusion criteria, 41,224 (44.6%) of the subjects were excluded (Figure 1). Of the 10,592 patients with ARS, 9,348 (88.2%) subjects received an antibiotic. A total of 1,244 patients did not receive an antibiotic and were excluded from the analysis. In addition, patients who were seen by providers with fewer than 5 encounters or missing information were excluded. This left a total of 49,463 subjects ultimately eligible for analysis, with a total of 429 providers.

Overall, antibiotics were unnecessarily prescribed for the 4 indicated conditions in 42.2% (95% CI, 41.7%–42.6%) of the encounters. Acute bronchitis had the highest rate of unnecessary prescribing, followed by ARS, then AURI, then pharyngitis (see Table 1). For 25.9% of patients with pharyngitis without a documented positive test for group A Streptococcus, the vast majority (96.9%) had no test ordered, and the remaining 3.1% had a negative test documented. Patient characteristics are noted in Table 2. Although more females were seen than males for URIs, males were more likely to be prescribed an unnecessary antibiotic. In addition, patients who were older or lived in a rural setting were more likely to receive antibiotics unnecessarily.

The composite rates of unnecessary antibiotic prescribing for all 4 respiratory conditions by provider type/characteristic are summarized in Table 3. Results from the logistic regression predicting unnecessary antibiotic prescription by patient and provider characteristics are summarized in Table 4. Practitioners in a rural setting (odds ratio [OR], 1.49; 95% CI, 1.20–1.84) and with more years in practice (OR = 1.09, 95% CI = 1.01–1.16 for every 5 years) had higher odds of unnecessary prescribing. Compared to providers in the family medicine specialty, providers in a high-volume specialty such as urgent care had higher odds of unnecessary prescribing.

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Figure 1. Study subject selection after application of inclusion and exclusion criteria. ARS, acute rhinosinusitis; AURI, acute upper respiratory tract infection.
(OR, 1.43; 95% CI, 1.08–1.89), but the odds were not significantly different for internal medicine. Provider sex and provider designation were not associated with unnecessary prescribing. As a supplementary analysis, we considered the interaction between provider characteristics. We found that none of the interaction terms were statistically significant.

The breakdown of antibiotics given to ARS patients is shown in Figure 1. A total of 4223 (45.8%) ARS patients received an antibiotic without a guideline-based indication. In addition, of the 5001 (54.2%) who warranted an antibiotic, 1212 (24.2%) received an inappropriate antibiotic class, for a total of 5435 (58.9%) ARS patients receiving an unnecessary and/or inappropriate antibiotic. After the penicillin class of antibiotics, macrolides were the next most common class of antibiotics used. There is a specific recommendation against the use of macrolide antibiotics by both the IDSA and the AAOHN guidelines.

### DISCUSSION

Most of the research in the area of ambulatory antibiotic stewardship focuses on either antibiotic inappropriate conditions (such as bronchitis or AURI) or on the appropriateness of antibiotic therapy (appropriate class and duration of treatment) for URIs that may warrant an antibiotic, such as otitis media.

### Table 1. Unnecessary Antibiotic Prescriptions by Condition

| Respiratory Condition | Received Unnecessary Antibiotics (N) | Total With Condition (N) | Prescription Rate (95% CI) |
|-----------------------|-------------------------------------|--------------------------|---------------------------|
| Bronchitis            | 8107                                | 10,923                   | 74.2% (73.4–75.0)         |
| ARS without indication| 4223                                | 9224                     | 45.8% (44.8–46.8)         |
| Nonspecific AURI      | 4882                                | 15,283                   | 31.9% (31.2–32.7)         |
| Pharyngitis without a positive test | 3635                           | 14,033                   | 25.9% (25.2–26.6)         |
| Overall               | 20,847                              | 49,463                   | 42.2% (41.7–42.6)         |

### Table 2. Patient Characteristics Compared for Those Who Did or Did Not Receive an Unnecessary Prescription for Antibiotics

| Characteristic        | Received Unnecessary Antibiotics N (%) | Did Not Receive Unnecessary Antibiotics N (%) | Significance (P Value) |
|-----------------------|---------------------------------------|---------------------------------------------|------------------------|
| Male                  | 8396 (45.2)                           | 10,194 (54.8)                              | <.001*                 |
| Female                | 12,452 (40.3)                         | 18,422 (59.7)                              |                        |
| Age (mean ± S.D.)     | 46.2 (18.0)                           | 41.0 (17.5)                                | <.001                  |
| Setting               |                                        |                                            |                        |
| Urban                 | 9773 (39.5)                           | 24,954 (60.5)                              | <.001*                 |
| Rural                 | 11,074 (44.8)                         | 13,662 (55.1)                              |                        |

### Table 3. Provider Characteristics and Composite Rate of Unnecessary Prescribing

| Characteristic   | Number (%) | Composite Rate of Unnecessary Antibiotic Prescription (%) |
|------------------|------------|----------------------------------------------------------|
| Gender           |            |                                                           |
| Male             | 156 (36.4%)| 44.1%                                                     |
| Female           | 273 (63.6%)| 40.7%                                                     |
| Specialty        |            |                                                           |
| Family Medicine  | 307 (71.6%)| 41.0%                                                     |
| Internal Medicine| 59 (13.8%) | 45.0%                                                     |
| High volume      | 63 (14.7%) | 43.2%                                                     |
| Setting          |            |                                                           |
| Urban            | 154 (36.0%)| 39.6%                                                     |
| Rural            | 275 (64.1%)| 44.5%                                                     |
| Provider Type    |            |                                                           |
| MD               | 201 (46.9%)| 43.6%                                                     |
| DO               | 14 (3.3%)  | 40.8%                                                     |
| NP               | 117 (27.3%)| 40.7%                                                     |
| PA-C             | 97 (22.6%) | 43.6%                                                     |
| Provider Volume  |            |                                                           |
| High             | 176 (41.0%)| 42.8%                                                     |
| Low              | 253 (59.0%)| 40.2%                                                     |

### Table 4. Results From Logistic Regression of Patient and Provider Characteristics Predicting Higher Composite Rate of Unnecessary Prescribing

| Characteristic                  | Odds Ratio | 95% Confidence Interval | Significance (P Value) |
|---------------------------------|------------|-------------------------|------------------------|
| Patient Characteristics          |            |                         |                        |
| Respiratory Condition (ref = Pharyngitis) |            |                         |                        |
| AURI                            | 1.03       | 0.97–1.10               | .31                    |
| Bronchitis                      | 8.80       | 8.22–9.41               | <.001                  |
| ARS                             | 2.35       | 2.20–2.50               | <.001                  |
| Patient male (ref = female)     | 1.13       | 1.08–1.18               | <.001                  |
| Patient age (5 years)           | 1.03       | 1.02–1.04               | <.001                  |
| Provider Characteristics         |            |                         |                        |
| Provider Designation (ref = MD)  |            |                         |                        |
| DO                              | 1.24       | 0.70–2.18               | .46                    |
| NP/PA-C                         | 1.19       | 0.94–1.51               | .15                    |
| Provider Specialty (ref = Family Medicine) |            |                         |                        |
| High volume                     | 1.43       | 1.08–1.89               | .01                    |
| Internal medicine               | 1.01       | 0.75–1.40               | .94                    |
| Patient male (ref = female)     | 1.19       | 0.94–1.52               | .15                    |
| Provider years in practice (5 years) | 1.49    | 1.20–1.84               | <.001                  |

Abbreviations: ARS, acute rhinosinusitis; AURI, acute upper respiratory tract infection; CI, confidence interval.
sinusitis, and pharyngitis [19–21]. Our study focused on the necessity of antibiotics for both antibiotic-inappropriate conditions (bronchitis and AURI) and conditions that sometimes warrant an antibiotic (ARS and pharyngitis). Our findings of overall unnecessary prescribing in 42.2% of patients, with very high rates for bronchitis (74.2%) and rates of 31.9% and 25.9% for nonspecific AURI and pharyngitis, respectively, are comparable with previous reports in the literature [7, 22, 23]. Not giving an antibiotic for a nonspecific AURI should seem obvious because the provider is documenting an overt diagnostic code for a presumed viral infection, yet prescribing for this condition is common. The particularly high rates of antibiotics use in cases of acute bronchitis may stem from greater perceived demand from patients with this condition [24, 25]. Notwithstanding, in the absence of chronic lung disease, numerous studies, meta-analyses, and a recent Cochrane review show little to no benefit when patients are given an antibiotic for this condition [26].

In the case of pharyngitis, particularly in adults, viruses account for almost 90% of cases, yet physicians prescribe antibiotics approximately 60% of the time [27]. As such, guidelines recommend only treating acute pharyngitis when there is a positive test for group A Streptococcus [28]. We looked at prescribing rates in adult pharyngitis where no positive test was documented for group A streptococci. Antibiotics were given in 25.9% of these encounters and accounted for 23.4% of the unnecessary antibiotic prescribing overall. In the vast majority of these cases, no streptococcus test was ever ordered.

Management of ARS may warrant an antibiotic, but the majority of cases are due to a virus and will resolve on its own with enough time. It is estimated that only 0.5%–2.0% of ARS will transition to a secondary bacterial infection [29]. Nevertheless, up to 80% of patients with this diagnosis will receive an antibiotic [30, 31]. Our study similarly found that 88.3% of patients with ARS received an antibiotic. Few studies have directly assessed the necessity of antibiotics for this condition because it requires manual data abstraction to look for documentation of a guideline-based indication. The few studies that have attempted this were somewhat limited in size, but they found similar rates of guideline nonadherence as our study [32, 33]. The largest study that abstracted data found 38% of 1200 patients received an antibiotic within 3 or fewer days of symptoms [22]. We abstracted over 9000 medical records in patients who received an antibiotic and used the most recent guidelines outlined by the IDSA and AAOHN to search for documentation of a guideline-based indication [16, 17]. In almost 46% of cases, no appropriate indication for an antibiotic was documented. Most of the time, this was due to prescribing an antibiotic before waiting at least 10 days for symptoms to subside, even though a delay in prescribing has been shown to be safe and effective management for most patients, even in higher risk subgroups [34].

Previous studies have assessed what provider characteristics predict unnecessary or inappropriate prescribing. Similar to several prior studies [35, 36], we found that providers who had spent more years in practice were more likely to give unnecessary prescriptions. In addition, providers in rural settings compared with urban settings were more likely to provide unnecessary antibiotic prescriptions, as seen in studies conducted in different geographic regions [37, 38]. Similar to several other studies showing higher rates of inappropriate prescribing in an urgent-care setting, we found that higher volume providers inappropriate prescribed more often than their lower volume colleagues [23, 30, 36, 39, 40]. Unlike other researchers, we did not find higher rates of inappropriate prescribing associated with any particular medical specialty (internal medicine vs family medicine) nor by provider type (MD, DO, NP, PA) [23, 36]. Most of the differences between our study and others are likely explained by regional differences, different practice settings, different conditions being assessed, and slight differences in how “necessity” and “appropriateness” were defined.

The misuse of antibiotics is ubiquitous. As such, broad stewardship initiatives are needed to address this issue. Notwithstanding, efforts targeting providers more likely to misuse antibiotics (eg, those practicing in high patient volume settings) may be beneficial [41, 42], because approximately 15% of our clinicians were responsible for over 50% of the unnecessary antibiotic usage in our study population.

CONCLUSIONS
Despite multiple public health initiatives and professional society guidelines aimed at producing more judicious use of antibiotics for URIs in the outpatient setting, overuse remains quite common. Efforts using electronic medical record prompts such as “best practice alerts” or suggested non-antibiotic alternatives have had mixed results [14, 15]. However, retrospective audits paired with feedback and peer comparison, public commitment posters, accountable justification, and viral prescription pads have all been shown to lead to significant reductions in both unnecessary and inappropriate antibiotic use [15, 43]. Targeting higher volume clinicians may be particularly impactful. Health systems should be encouraged to engage these, as well as novel strategies, to promote necessary and appropriate antibiotic usage as an urgent priority for their quality improvement initiatives.

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