

Use of Antibiotics for Adult Upper Respiratory Infections in Outpatient Settings: A National Ambulatory Network Study

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Background and Objectives: *Studies have suggested that antibiotics are often inappropriately used in the treatment of acute upper respiratory tract infections (URIs). This study examined antibiotic use for adult URIs in a large national network of offices that use electronic health records (EHRs).* **Methods:** *Using the Medical Quality Improvement Consortium (MQIC) database, URI episodes were identified for patients ages 18 to 65 years from January 1, 1998, to March 31, 2003. The percentage of episodes for which antibiotics were prescribed and the proportion of antibiotics that were broad spectrum were calculated.* **Results:** *Of the 52,135 URI episodes identified, 65% received antibiotics. Antibiotics were prescribed for 78% of acute bronchitis episodes, 65% of acute pharyngitis episodes, 81% of acute sinusitis episodes, and 33% of nonspecific URI episodes. The proportion of antibiotics that were broad spectrum was 56% for all URI episodes, 68% for acute bronchitis, 55% for acute sinusitis and nonspecific URI, and 40% for pharyngitis.* **Conclusions:** *This study demonstrates overuse of antibiotics for adult URIs in a large national ambulatory care network, with particular overuse of broad-spectrum antibiotics. The study also illustrates the enormous potential of EHR data for conducting practice-based research across large national office networks.*

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There is evidence that antibiotics are often used inappropriately to treat upper respiratory tract infections (URIs).¹ According to recent studies, acute respiratory infections are the reason for 75% of the antibiotic prescriptions each year and are the most frequent reason for seeking medical attention in the United States.² This occurs despite the fact that in most cases of URIs, antibiotics confer little or no benefit.³ Some concerns about overuse of antibiotics are that it leads to unnecessary cost and the potential of adverse effects for the individual taking the antibiotic. But even more

important is the adverse effect on public health, because excessive use of antibiotics has led to the development of antibiotic-resistant bacteria.⁴⁻⁷

To help physicians improve their use of antibiotics for URIs, the Centers for Disease Control and Prevention (CDC) created guidelines for appropriate use of antibiotics in adult URIs.¹ These guidelines, published in 2001, were endorsed by the American Academy of Family Physicians, the American College of Physicians-American Society of Internal Medicine, and the Infectious Diseases Society of America. The guidelines for four major categories of URI are summarized in Table 1.

There is evidence that physicians and other health care professionals often do not follow these guidelines. A study using data from the National Ambulatory Care Medical Survey (NAMCS) found that 63% of adults

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seen for URIs in 1997–1999 received antibiotics, including 46% of those with nonspecific URIs and more than 60% of those with acute bronchitis.¹² Another study using NAMCS data also found high rates of antibiotic use for adult URIs, although they showed a decreasing trend from 1993 to 1999.¹³ However, large-scale studies in ambulatory settings are often difficult to perform because of the difficulty in obtaining data on both diagnoses and medications from outpatient encounters. Further, when data are available from national surveys such as NAMCS, there is often a lag time of 2 years or more between data collection and its availability for review. Fortunately, use of electronic health records (EHRs) in ambulatory settings is making data more available and in a more timely fashion. Several studies have demonstrated the utility of using EHR data for measuring quality of care on a small scale.^{14,15} Merging EHR data across large numbers of practices, however, would allow for more robust studies. This study examined patterns of antibiotic use across a large national sample of outpatient practices that participate in an EHR network.

Methods

Medical Quality Improvement Consortium

This was a retrospective cohort study in a national network of outpatient practices called the Medical Quality Improvement Consortium (MQIC). MQIC practices all use an ambulatory EHR (Logician, Version 4.6, Hillsboro, Ore, MedicaLogic/Medscape, Inc, 1994). Each practice regularly downloads blinded clinical data into a central secure repository. These data include patients' demographic information, medications, diagnoses or problems, laboratory and x-ray results, and other clinical data such as blood pressure, weight, and physical exam findings. The data are then cleaned and standardized by a data team at General Electric (GE) Healthcare Information Technology. An example of cleaning data is when a weight of 2,500 pounds is coded as "out of range." An example of standardizing data is when the terms "done" and "completed" for an influenza vaccine are both mapped to the common term of "done."

Once cleaned and standardized, the data are moved into a reporting data set that can be used for primary care research and quality of care projects. This reporting data set is provided by GE Healthcare to researchers who participate in the MQIC consortium. Progress notes and communications are not included in this reporting data set because these free-text notes sometimes contain potentially identifying information.

Table 1

Guidelines for Treating Upper Respiratory Tract Infections (URIs)

- Antibiotics should not be used to treat **nonspecific upper respiratory tract infections** in adults, since antibiotics do not improve illness resolution.⁸
 - Antibiotic treatment of uncomplicated **acute bronchitis** is not recommended because most patients have a self-limiting viral illness.⁹
 - For **acute sinusitis**, narrow-spectrum antibiotics should be given only to patients with persistent purulent nasal discharge and facial pain or tenderness who have not improved after 7 days or those with severe symptoms. Recommended antibiotics include amoxicillin, doxycycline, or trimethoprim-sulfamethoxazole.¹⁰
 - For **acute pharyngitis**, antibiotic use should be limited to patients who are most likely to have group A β -hemolytic streptococcus. If given, the preferred antibiotic is penicillin or erythromycin in penicillin-allergic patients.¹¹
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Each member institution is given an option to decline participation in any MQIC study and thereby have its data excluded from the study. No member institution declined participation in this study.

Currently, MQIC consists of more than 5,000 physicians and other providers, 63% of whom are primary care physicians (more than 1,000 in internal medicine and more than 800 in family medicine). These providers are in offices from more than 65 institutions in 35 states across the country.

The current MQIC database includes approximately 4.2 million patients. However, the size of the database has grown over time. At the time of this study, there were approximately 815,000 active patients in the database, which were distributed among practices in 17 institutions, including multi-practice institutions.

There was a total of 1,942 providers, 1,761 of whom were physicians (the remainder were nurse practitioners, physician assistants, and other providers). The number of providers per institution ranged from two to 1,196 (eight institutions had fewer than 10 providers, four had 10–99 providers, and the remainder had 100 or more providers). Approximately 75% of physicians were in primary care (family medicine, general internal medicine, pediatrics, obstetrics-gynecology, and geriatrics).

Subjects and Data Collection

For this study, patients were included if they were ages 18 to 65 years and were diagnosed with a URI between January 1, 1998, and March 31, 2003. Diagnoses were defined by *International Classification of Diseases, Ninth Edition* (ICD-9) codes on the EHR problem lists. Four specific URIs were included: acute nonspecific upper respiratory tract infections (ICD-9 codes 465.0, 465.8, 465.9, and 460), acute bronchitis (466.0), acute sinusitis (461.0–461.3, 461.8, and 461.9), and acute pharyngitis (462).

The URI episode was used as the unit of analysis (so a single patient could have more than one episode). However, URI episodes were excluded if the patient had a previous diagnosis of the same condition as the index diagnosis within 60 days prior to the index diagnosis. Also, episodes were excluded if the patient had a codiagnosis of a chronic condition that could complicate the URI. These included asthma (493), emphysema (492), chronic bronchitis (491), or other chronic obstructive pulmonary disease (494, 495, 496). Episodes were excluded where any of these comorbidities were active at the time of the index visit or within 60 days prior to the index visit. Episodes were also excluded in cases where there was a codiagnosis of pneumonia (485, 486) or chronic sinusitis (473) at the time of index diagnosis or 60 days prior to the index visit. For episodes with both nonspecific URI and a specific URI diagnosis (eg, sinusitis), the specific diagnosis was used; episodes with more than one specific diagnosis (eg, acute bronchitis and acute sinusitis) were excluded from the analysis. Finally, episodes were excluded if the patient was already on an antibiotic prior to the index visit.

The main outcome for each episode was whether or not an antibiotic was prescribed. Antibiotics were included if they were listed on the EHR medication list, with a start date that was the same as the date of the URI diagnosis. Antibiotics were categorized as either a broad- or narrow-spectrum antibiotic. The definition of broad and narrow spectrum was defined by the investigators, with guidance from a previous study.¹² The categorization scheme for antibiotics is shown in Table 2.

Data Analysis

Descriptive statistics were used to analyze rates of antibiotic use for each category of URI, as well as the proportion of antibiotics that were broad spectrum versus narrow spectrum. Data manipulation and analysis were conducted using SAS statistical software (SAS II, Version 8, www.SAS.com/software/index.html,

November 21, 2001.) The study was deemed exempt by the Institutional Review Board of Thomas Jefferson University.

Results

Overall, 52,135 episodes of URIs met inclusion criteria and were included in the study. Of these, 17,409 (33.4%) episodes were acute sinusitis, 12,775 (24.5%) were acute bronchitis, 8,580 (16.5%) were acute pharyngitis, and 13,371 (25.6%) were nonspecific URIs.

Antibiotics were prescribed for 65% of all URI episodes. Figure 1 shows the rate of antibiotic prescriptions and the distribution of broad- versus narrow-spectrum antibiotics for each diagnosis. For specific diagnoses, the proportion of episodes in which antibiotics were prescribed was 81.3% for acute sinusitis, 75.7% for acute bronchitis, and 65% for acute pharyngitis. For nonspecific URIs, antibiotics were prescribed in 33.4% of episodes.

When antibiotics were prescribed (for all URIs combined), 56% were broad-spectrum antibiotics. For specific diagnoses, the proportion of antibiotics that were broad spectrum was 55% for acute sinusitis, 68% for acute bronchitis, and 40% for acute pharyngitis. For nonspecific URI, 55% of antibiotics were broad spectrum.

Discussion

We found that in a national sample of office-based practices, use of antibiotics for URIs is much higher than what is recommended by current guidelines. Almost two thirds of URI episodes resulted in an antibiotic prescription. Specifically, antibiotics were used in one third of nonspecific URIs and 75% of the episodes of acute bronchitis. This occurred despite the fact that antibiotics are not recommended in either of these conditions.^{8,9} The rate of antibiotic use was even

Table 2

Antibiotic Categories

<i>Narrow Spectrum</i>	<i>Broad Spectrum</i>
<ul style="list-style-type: none"> • Amoxicillin • Sulfamethoxazole • Clindamycin • Doxycycline • Erythromycin • Cephalixin • Minocycline • Penicillin 	<ul style="list-style-type: none"> • Azithromycin • Moxifloxacin • Clarithromycin • Cefuroxime Axetil • Ciprofloxacin • Ofloxacin • Levofloxacin • Cefdinir • Gatifloxacin • Cefpodoxime Proxetil

higher for acute sinusitis, at 81%. It is likely that this also represents overprescribing, since antibiotics are recommended for acute sinusitis only when symptoms are prolonged or severe.¹⁰

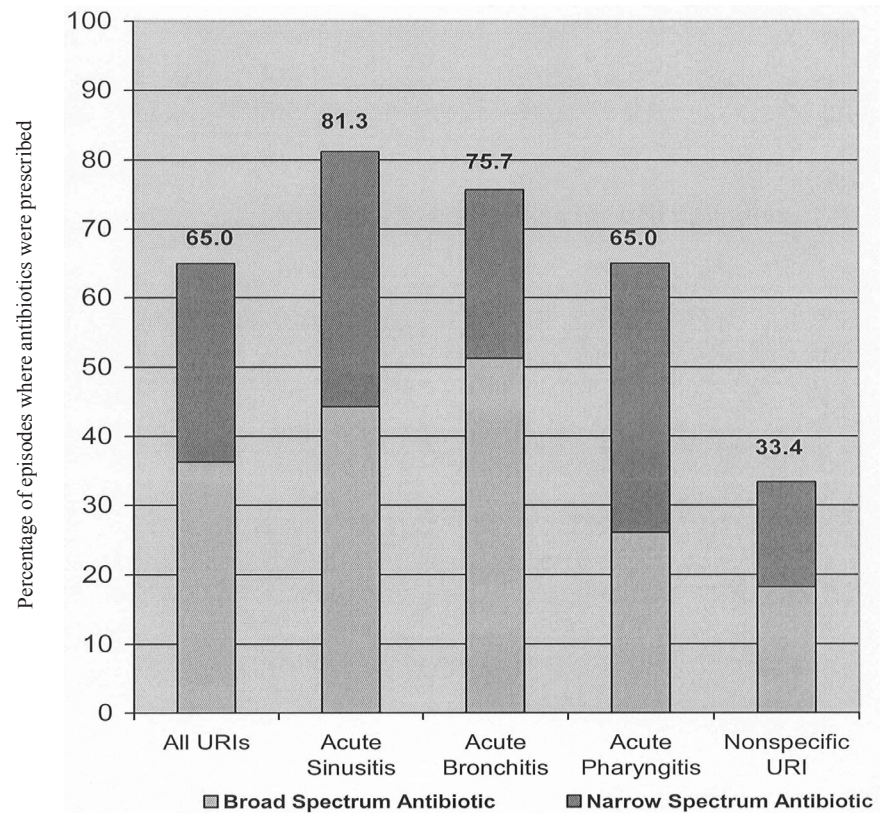
Perhaps even more striking than the overall rate of antibiotic use is the high rate of prescribing broad-spectrum antibiotics. Overall, broad-spectrum antibiotics were used for more than half of URI episodes, including 68% for acute bronchitis. Again, this contradicts current guidelines, which state that even when antibiotics are appropriate (such as in selected cases of acute sinusitis and pharyngitis), broad-spectrum antibiotics should not be used as first line agents.^{10,11} Since we excluded cases in which the patient had a recurrent or resistant URI, or when the patient was already on an antibiotic at the time of diagnosis, we can be fairly confident that this represents inappropriate prescribing in the large majority of cases.

The results of this study are similar to what was found in a recent national study using NAMCS data.¹² That study found that antibiotics were used in 63% of all URIs combined, 46% of nonspecific URIs, 69% of acute sinusitis, and 61% of acute bronchitis (the proportion for acute pharyngitis cannot be determined since they combined pharyngitis with “other” URIs). The proportion of broad-spectrum antibiotics was also similar to the NAMCS data study, at 54% overall, 51% of nonspecific URIs, 52% of acute sinusitis, and 62% of acute bronchitis. These similarities suggest that use of antibiotics for URIs has not changed much, despite the advent of national guidelines.

However, another large study using NAMCS data suggests that there may be a decreasing trend in antibiotic prescribing, at least in the 1990s.¹³ That study showed that antibiotic use for nonspecific URI visits in adults decreased from 55% in 1993 to 20% in 1999. A similar pattern was seen for acute bronchitis, with 72% getting antibiotics in 1993 and 29% in 1999. However, most of the decrease occurred between 1995 and 1997, with much less change from 1997 to 1999. Also, all of

Figure 1

Antibiotic Prescriptions for URI Episodes



URI—upper respiratory tract infection

these episodes occurred prior to the publication of the CDC guidelines regarding antibiotic use for adults. However, the CDC guideline for antibiotics in children had already been published;^{16,17} this may have had some effect on treatment of adults as well.

Several studies besides ours have used EHR networks to examine the issue of antibiotics for URIs. One study in the US-based Practice Partner Research Network examined 25,000 episodes of “viral URI” (including nonspecific URI, acute bronchitis, or influenza).¹⁸ They found that antibiotics were prescribed in 48% of the 18,500 adult episodes and 33% of the 6,700 childhood episodes. The difference in findings between this study and the current study could be due to different definitions of URIs (the Practice Partners study examined only viral URIs, while our study included sinusitis and pharyngitis) or in the population definitions (the current study excluded patients with serious comorbidities while the other study did not).

Limitations

There are several limitations that one must consider when interpreting the results of this study. First, since the data were obtained from EHRs, they reflect prescribing of antibiotics, not necessarily use of antibiotics. It could be that some antibiotics were prescribed but not used by patients. For example, there is a growing trend toward giving antibiotic prescriptions with instructions to use them only if symptoms do not resolve spontaneously.^{19,20} Alternatively, it could be in some cases that antibiotics were used but not prescribed, such as when physicians give samples for the entire antibiotic course. While these antibiotic samples are sometimes recorded in the EHR, they often are not. There could be other cases where the antibiotic was not recorded, such as when it was called in, or when it was written on a paper prescription rather than printed through the EHR.

In addition to limitations of data capture, there are limitations in interpreting the appropriateness of antibiotic use. This is particularly true for pharyngitis, since penicillin is indicated for streptococcal pharyngitis. We were not able to distinguish streptococcal pharyngitis from other causes of pharyngitis. If one assumes that streptococcal pharyngitis could be responsible for up to 20% of cases of pharyngitis in adults,¹¹ it could be that the 40% rate of antibiotics was not particularly high.

It is also difficult to determine appropriateness for acute sinusitis, since we did not have access to clinical data that are used to determine appropriateness (eg, duration and severity). There is less of a problem in determining appropriateness for nonspecific URIs or acute bronchitis, since antibiotics are not indicated in any uncomplicated case of URI, and we excluded those cases that were complicated by codiagnoses or recurrence.

Finally, this study was conducted in a network of practices that use a particular EHR. Findings may not be generalized to other settings.

Conclusions

Despite these limitations, the results of our study have significant implications for demonstrating the quality of care in ambulatory care. The study supports the findings of previous studies—that antibiotics are overused in adult URIs and that broad-spectrum antibiotics are particularly overused. This occurs despite clear evidence showing lack of benefit of antibiotics in most URIs and that even when antibiotics are warranted, broad-spectrum antibiotics usually confer no additional benefit.^{1,21} This suggests that there is a great deal of room for improvement in quality of ambulatory care.

In addition to demonstrating the gap in quality of care for treatment of URIs, this study demonstrates that the EHR is a promising tool for measuring quality of outpatient care across a variety of conditions. Doing large and representative studies in primary care has been difficult, mainly because of the difficulty in obtaining clinical data across a large network of offices. The ambulatory EHR network permits conduct of large studies across a large number of offices. It allows for relatively easy access to de-identified clinical data. These data can be merged across a large population of patients in many diverse office settings. Access to these types of data will make it much easier to conduct studies on quality of care in primary care and other ambulatory settings. Several previous studies have demonstrated the utility of using EHR data in individual practices or small networks.^{14,15} Access to EHR data on a national scale allows larger studies that can be more widely generalized.

There have been several previous studies using large-scale EHR networks both in the United States¹⁹ and in Great Britain.²² These studies focused not only on antibiotics for URIs,^{18,21,22} but also quality of care for other conditions such as diabetes^{23,24} and coronary heart disease.²³ While the EHR network used in this study is not the first such network to be used for outcomes research, it is the largest network of its kind (currently at 4.2 million patients and growing). The ability to conduct such large-scale studies using EHR networks in outpatient care is a necessary step in measuring and thereby improving the quality of primary care practice in our country.

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