Antibiotic Prescribing by Primary Care Physicians for Children With Upper Respiratory Tract Infections

David R. Nash, MD; Jeffrey Harman, PhD; Ellen R. Wald, MD; Kelly J. Kelleher, MD

Objectives: To determine if the rate of appropriate antibiotic use in the treatment of children with bronchitis, viral upper respiratory tract infections, sinusitis, otitis media, and pharyngitis has changed in recent years and to identify factors that are associated with the use of inappropriate antibiotic therapy.

Design: The National Ambulatory Medical Care Survey was used to examine the antimicrobial prescribing habits of physicians who provide primary care for children. Data were analyzed from 1995-1998.

Setting: Office-based physician practices.

Participants: Pediatricians, family physicians, and generalists completing survey forms for patients younger than 18 years.

Main Outcome Measure: The appropriate use of antibiotics for upper respiratory tract infections.

Results: Multivariate analyses were used to examine factors associated with the use of inappropriate antibiotics to treat either upper respiratory tract infections or bronchitis. Patients seen in 1998 and diagnosed as having upper respiratory tract infections were 0.69 (95% confidence interval, 0.59-0.81) times less likely to be treated with antibiotics compared with patients seen in 1995. Multivariate analyses were also used to assess factors associated with the use of antibiotics with a suboptimal therapeutic profile for the treatment of either sinusitis or otitis media. Children diagnosed as having either sinusitis or otitis media were 0.3 (95% confidence interval [CI], 0.16-0.48) times less likely to receive antibiotics with a suboptimal therapeutic effect in 1998 compared with 1995.

Conclusions: Physicians are slowly improving their antibiotic prescribing patterns but the use of inappropriate antibiotics is still common. Almost half of patients with upper respiratory tract infections receive antibiotics.

Arch Pediatr Adolesc Med. 2002;156:1114-1119

THE EMERGENCE of bacterial species that are increasingly resistant to antimicrobial agents is a growing concern. These resistant strains are, in part, due to frequent and inappropriate antibiotic therapy for children with upper respiratory tract illnesses. Approximately three fourths of all outpatient antibiotic prescriptions given to children are for upper respiratory tract conditions, such as viral upper respiratory tract infections (URTIs), bronchitis, pharyngitis, sinusitis, and otitis media. To address this growing problem, the Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics published “The Principles of Judicious Use of Antimicrobial Agents for Pediatric Upper Respiratory Tract Infections.” This document focuses on decreasing the use of antibiotics for conditions unlikely to respond to them (URTIs and bronchitis) and encouraging the use of narrow- rather than broad-spectrum antibiotics.

There are no published studies, to our knowledge, that have examined the effectiveness of the recent efforts of the CDC and other organizations to promote the judicious use of antibiotics. Studies of antibiotic use patterns before the CDC initiative found high rates of use of inappropriate antibiotics in 44% to 66% of patients with URTIs. Several investigators have focused on whether medical specialty influences antibiotic prescribing practices. These studies have demonstrated that nonpediatricians are more likely to prescribe antibiotics than pediatricians. Although there has been significant discussion regarding the meaningfulness of the differences among medical specialists, the data clearly show that many physicians from all specialties prescribe antibiotics inappropriately.
In contrast with treatment for URTI and bronchitis, it is generally accepted practice in the United States to treat acute otitis media and sinusitis with antibiotics. However, there are no recent data examining the appropriateness of antibiotic selection with regard to spectrum of coverage. One study that examined data from 1980 to 1992 showed increasing use of broad-spectrum antibiotics. In an effort to increase the use of appropriate antibiotic therapy for these conditions, professional societies, the Agency for Healthcare Research and Quality, and the CDC have suggested the use of narrow-spectrum antibiotics as first-line therapy for sinusitis and otitis media.

This study was undertaken to determine if the rate of appropriate antibiotic use has changed in recent years and to identify factors that are associated with the use of inappropriate antibiotic therapy. The National Ambulatory Medical Care Survey (NAMCS) was used to examine the antimicrobial prescribing habits of physicians who provide primary care for children. The NAMCS is conducted by the National Center for Health Statistics (Hyattsville, Md) on a periodic basis. It is composed of a nationally representative sample of all office visits, from all geographic regions and a variety of medical specialties, and reports both system (insurance status, practice type, etc) and patient (age, symptoms, etc) factors that may influence prescribing practices.

### Methods

#### Data

We analyzed data from the 1995, 1996, 1997, and 1998 NAMCS. The database excludes visits to physicians in certain specialties (anesthesiology, pathology, and radiology) and encounters made by telephone, outside of the physician’s office, and in hospital and other institutional settings. The sample of visits was chosen using a 3-stage sampling design, selecting primary sampling units (PSUs), physician practices within PSUs, and patient visits within practices. Physicians were asked to record information on visits made during a randomly selected 1-week period each year. Depending on the size of the practice, the proportion of visits sampled during the 1-week period ranged from 20% to 100%.

The NAMCS samples included 36875 visits in 1995, 29805 visits in 1996, 24715 visits in 1997, and 23399 visits in 1998. Only visits by children aged 0 to 18 years to pediatricians and family/general practice physicians were included in our analyses. To increase power, data from all 4 years were combined. There were a total of 13078 visits by children to pediatricians and family/general practice physicians in the 4 years of combined data. For each office visit, the survey provided information on physician specialty, up to 3 diagnoses, and up to 6 medications prescribed during the visit. The characteristics of the sample used in this analysis are presented in Table 1.

### Visits with Antibiotic Prescriptions

Visits in which an antibiotic was prescribed, supplied, administered, ordered, or continued were identified. Antibiotics were classified as either appropriate or inappropriate for the treatment of sinusitis and otitis media. Antibiotics were considered appropriate if (1) they were recommended by national guidelines for use in either sinusitis or otitis media; (2) they possessed good antimicrobial activity against the common pathogens of sinusitis and otitis media; and (3) they were an alternative for patients who are allergic to penicillins. The list of appropriate antibiotics includes amoxicillin, amoxicillin-clavulanic acid, cefuroxime axetil, cefpodoxime, clindamycin, trimethoprim-sulfamethoxazole, clarithromycin, azithromycin, and erythromycin plus sulfisoxazole. Antibiotics were considered inappropriate if (1) they lacked antimicrobial activity against any of the common pathogens of sinusitis and otitis media; (2) similar antibiotics with superior antimicrobial activity against relevant pathogens were available; and (3) they were not approved for use in children. The list of inappropriate antibiotics for either sinusitis or otitis media includes cefaclor, cefadroxil, cefixime, cefotin, cephalaxin, ciprofloxacin, dicloxacillin sodium, doxycycline, erythromycin, erythromycin ethyl succinate, erythromycin estolate, loracarbef, nafcillin, and penicillin. Any antibiotic prescription for either URTI or bronchitis was considered inappropriate.

#### Table 1. Characteristics of Visits to Pediatricians and Family Practice Physicians by Children

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Unweighted</th>
<th>Weighted</th>
<th>%</th>
<th>Unweighted</th>
<th>Weighted</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visits to Family/General Physician</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>1156</td>
<td>35 400 000</td>
<td>23.7</td>
<td>2585</td>
<td>83 850 000</td>
<td>23.4</td>
</tr>
<tr>
<td>1996</td>
<td>1032</td>
<td>37 440 000</td>
<td>25.0</td>
<td>2107</td>
<td>91 420 000</td>
<td>25.5</td>
</tr>
<tr>
<td>1997</td>
<td>712</td>
<td>36 540 000</td>
<td>24.4</td>
<td>2614</td>
<td>90 050 000</td>
<td>25.1</td>
</tr>
<tr>
<td>1998</td>
<td>769</td>
<td>40 200 000</td>
<td>62.9</td>
<td>2103</td>
<td>93 760 000</td>
<td>26.1</td>
</tr>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4</td>
<td>-1324</td>
<td>55 040 000</td>
<td>36.8</td>
<td>5439</td>
<td>209 100 000</td>
<td>58.2</td>
</tr>
<tr>
<td>5-9</td>
<td>702</td>
<td>27 990 000</td>
<td>18.7</td>
<td>2126</td>
<td>82 570 000</td>
<td>23.0</td>
</tr>
<tr>
<td>10-18</td>
<td>1643</td>
<td>66 550 000</td>
<td>44.5</td>
<td>1844</td>
<td>67 400 000</td>
<td>18.8</td>
</tr>
<tr>
<td><strong>Insurance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>1756</td>
<td>74 390 000</td>
<td>49.7</td>
<td>5588</td>
<td>214 300 000</td>
<td>59.7</td>
</tr>
<tr>
<td>Medicaid</td>
<td>933</td>
<td>39 240 000</td>
<td>26.2</td>
<td>1814</td>
<td>68 980 000</td>
<td>19.2</td>
</tr>
<tr>
<td>Other</td>
<td>980</td>
<td>35 950 000</td>
<td>24.0</td>
<td>2007</td>
<td>75 770 000</td>
<td>21.1</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>2508</td>
<td>100 300 000</td>
<td>67.1</td>
<td>8523</td>
<td>327 400 000</td>
<td>91.2</td>
</tr>
<tr>
<td>Urban</td>
<td>1161</td>
<td>49 240 000</td>
<td>32.9</td>
<td>886</td>
<td>31 710 000</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Identification of visits by patients with sinusitis, otitis media, bronchitis, URTIs, and pharyngitis was based on International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnoses assigned by physicians during the visit. The NAMCS database was assessed for primary, secondary, and tertiary diagnoses of sinusitis, acute otitis media, bronchitis, pharyngitis, and URTI. Patients with a primary, secondary, or tertiary diagnosis of either sinusitis or otitis media were assessed to determine if inappropriate antibiotics were used to treat these patients. Patients with a primary, secondary, or tertiary diagnosis of either URTI or bronchitis and no diagnosis of either sinusitis or otitis media were assessed to determine if inappropriate antibiotics were used to treat these patients. Patients with a diagnosis of both URTIs and bronchitis were excluded.

Statistical analysis was performed that used the sample weights provided by the National Center for Health Statistics to overcompensate rather than undercompensate for artifacts caused by clustering within strata, it produces results that tend to overcompensate rather than undercompensate for artifacts produced from stratification. The reduced sample size was determined by adjusting the weight with a constant factor equal to the sum of the poststratification weights provided by the National Center for Health Statistics, divided by the sum of the squared weights.

Each visit weight was then multiplied by the weight adjustment. This downweighting procedure effectively reduced the size of the sample, on average, by one half. Significant differences were identified using $\chi^2$ statistics with a 2-tailed cutoff of $P=.05$. The analyses controlled for patient age, type of insurance, physician specialty, urban vs rural, year, and whether the patient had a fever. The analyses used all 4 years of data combined but included dummy variables for each year so that year to year differences in prescribing patterns could be assessed.

We analyzed the NAMCS from 1995-1998 to determine the prevalence of and treatment patterns for URTIs in children. Table 2 presents the proportion of office visits with a diagnosis of a URTI made by pediatrics and family physicians. Although there was a statistically significant difference between physician types in the proportion of patients diagnosed as having URTIs, bronchitis, or otitis media, the actual difference between the physicians was very small.

As presented in Table 3, the proportion of patients with bronchitis, sinusitis, pharyngitis, and otitis media who were treated with antibiotics was very similar for pediatrics and family physicians. However, bi-variate analysis showed that pediatrics were slightly less likely than family physicians to use antibiotics in patients with URTIs (37.8% vs 47.4% [P<.05]). Table 4 presents the proportion of patients who either received antibiotics with an inappropriate spectrum of coverage for otitis media or sinusitis or any antibiotic prescription for a diagnosis of bronchitis or URTI.
Multivariate analyses were used to examine factors that might be associated with the use of inappropriate antibiotics to treat either URTI or bronchitis (Table 5). After controlling for physician type, insurance status, age, primary symptom, urban or rural location of practice, and year of visit, significant independent associations remained for year of visit and physician type. An effect for the year of the study was observed for the use of antibiotics in children with URTIs or bronchitis. In the last year of the study period (1998), patients diagnosed as having either URTIs or bronchitis were 0.69 (CI, 0.59-0.81) times less likely to receive antibiotics compared with those in 1997 (data not shown). The decrease in antibiotic prescribing for URTI and bronchitis was seen only in 1998. Physician type also affected the likelihood of antibiotic prescriptions for children with either URTIs or bronchitis. Pediatricians were 0.81 (CI, 0.73-0.90) times less likely to prescribe antibiotics than family/general practice physicians during the 4-year study period.

Multivariate analyses were also used to assess factors associated with the use of inappropriate antibiotics for either sinusitis or otitis media (Table 6). After controlling for physician type, insurance status, age, primary symptom, urban or rural location of practice, and year of visit, significant independent associations remained for year of visit. No differences were observed in the use of inappropriate antibiotics according to physician type or any other factor. The use of inappropriate antibiotics for either sinusitis or otitis media decreased significantly during the last year of the study. Patients were 0.30 (CI, 0.16-0.48) times less likely to have an inappropriate antibiotic prescribed for either sinusitis or otitis media in 1998 compared with 1995 and 0.35 (CI, 0.22-0.53) times less likely compared with 1997.

The use of inappropriate antibiotic therapy has gained considerable attention in the medical and lay literature during the last 5 years. The NAMCS data from 1995-1998 showed a decrease in the rate of inappropriate antibiotic prescriptions. Patients with either bronchitis or URTIs were less likely to be treated, and those with either sinusitis or otitis were more likely to receive an appropriate antibiotic during the 4-year study period. These results are encouraging and suggest that recent national efforts to influence the antibiotic prescribing practices of physicians may be effective.

Classifying any antibiotic use to treat either URTI or bronchitis as inappropriate can be justified in the medi-
The diagnosis of URTI is widely used to describe URTIs that are of viral origin, and consequently, treatment with antibiotics is not necessary. Acute bronchitis is an ill-defined diagnosis that lacks any confirmatory diagnostic test, specific physical finding, or definitive clinical history. While the use of antibiotics in adults with acute exacerbations of chronic bronchitis is variably acceptable among physicians, the role of antibiotics in the treatment of acute bronchitis is not supported by published studies, pediatric textbooks, or national guidelines.1,14-17

It was not possible to use the NAMCS database to evaluate whether antibiotics were used appropriately to treat pharyngitis. The NAMCS database only included a very small number (data not shown) of patients diagnosed as having pharyngitis due to group A β-hemolytic streptococcus (ICD-9-CM 0334). The surprisingly small number of patients diagnosed as having streptococcal pharyngitis precluded evaluating whether appropriate antibiotics were used to treat this condition. It also was not possible to evaluate whether the other causes of pharyngitis (presumed to be of viral origin) were treated with antibiotics inappropriately, since some of these diagnostic codes may have included children with bacterial pharyngitis.

The categorization of antibiotics as either appropriate or inappropriate in the treatment of both sinusitis and otitis media is supported by: (1) guidelines from professional societies; (2) technical reports from the Agency for Healthcare Research and Quality; (3) recommendations from the CDC; and (4) the in vitro antimicrobial activity of different antibiotics for common pathogens of both sinusitis and otitis media.18-21 Several of the antibiotics considered to be inappropriate are widely used and indicated by the Food and Drug Administration (Rockville, Md) for the treatment of either otitis media or sinusitis. These were classified as inappropriate because their activity against the common pathogens was either incomplete or inferior to other antibiotics of the same class. Many of these changes have to do with the ongoing emergence of antibiotic resistance among common pathogens. Despite our consideration of some commonly used antibiotics as inappropriate for treating either sinusitis or otitis media, only 13% of patients with these conditions received an inappropriate antibiotic. In contrast, 39.2% of patients with either URTIs or bronchitis received an inappropriate antibiotic. The data suggest that efforts to improve antibiotic prescribing practices should focus on eliminating the use of antibiotics in conditions known to be of viral origin.

As in previous studies,2 URTIs and bronchitis were identified as the diagnoses most frequently associated with inappropriate antibiotic use. In 1998 compared with 1995, patients with either bronchitis or URTIs were 0.69 (CI, 0.59-0.81) times less likely to be treated with antibiotics. Most of this improvement occurred during the final year of analysis. The use of inappropriate antibiotics to treat sinusitis or otitis media is much less common than to treat bronchitis or URTI; nonetheless, there was a significant decline in the use of inappropriate antibiotics for these conditions. Inappropriate antibiotics were 0.3 (CI, 0.16-0.48) times less likely to be prescribed for either sinusitis or otitis media in 1998 compared with 1995; again, most of the improvement occurred in 1998. The last year of the study corresponded to the first year of intense efforts by the CDC to promote the judicious use of antibiotics.

Even though prescribing practices have improved, a high rate of inappropriate antibiotic prescribing continues. Previous studies have focused on physician type as an important factor in the use of inappropriate antibiotics in patients with URTIs. Although our data confirm this observation, the magnitude of the difference between pediatricians and nonpediatricians has decreased. In 1992, pediatricians were 0.57 (95% CI, 0.35-0.92) times less likely to prescribe antibiotics for URTIs compared with nonpediatricians.5 The NAMCS data from 1995-1998 shows that pediatricians are 0.81 (95% CI, 0.73-0.90) times less likely to prescribe antibiotics than family physicians. The decrease in the difference between the medical specialties could be due to at least 2 different factors: (1) the 1992 data compared pediatrics with all nonpediatricians (family physicians, generalists, internists, and subspecialists) while the 1995-1998 data compared pediatricians with family physicians and generalists; (2) family physicians may have been quicker to adopt the recommendations of the CDC. The specialty of the physician had no effect on the rate (13%) of inappropriate prescriptions for patients with either sinusitis or otitis media.

The NAMCS data show that pediatricians and family/general practice physicians are much more alike than they are different. Although the difference in antibiotic prescribing between pediatricians and family physicians for URTIs reached statistical significance, the use of antibiotics was very similar for all other conditions. As seen in the study by Nyquist et al22 and contrary to studies of antibiotic use in adults, there was no significant difference in antibiotic prescribing between physicians practicing in urban compared with rural communities.22

The limitations of our study relate to the use of secondary databases. It is possible that the methods used to collect data led to reporting diagnoses in a manner that would justify antibiotic use. Inconsistencies in the diagnosis of these conditions could also bias the results. Each of these infections has a similar clinical presentation and there are no uniform diagnostic criteria to ensure that these conditions are diagnosed in a consistent manner. Furthermore, the database does not allow us to assess the health beliefs of either physicians or patients, which may have a larger effect on prescribing practices than any of the variables that were examined in this study.

What This Study Adds

Studies throughout the 1990s demonstrated the high rate of inappropriate antibiotic use in adults and children with URTIs. Extensive efforts have been made by the CDC, and other organizations to improve the use of antibiotics for the treatment of URTIs. It is essential to determine (1) if these efforts have been successful; and (2) what factors continue to lead to the use of inappropriate antibiotics. Our data demonstrate a decrease in the use of inappropriate antibiotics for the treatment of URTIs.
Despite modest improvements demonstrated by a review of the NAMCS data, inappropriate antibiotic use is still common. Almost half of patients with URTIs received antibiotics even though these conditions are known to be of viral origin. Even in conditions like sinusitis and otitis media, for which antibiotic therapy is appropriate, an inappropriate antibiotic is used more than 10% of the time. Our results suggest that interventions to improve the prescribing of antibiotics should focus on changing treatment patterns for both URTIs and bronchitis. The interventions should be aimed at all types of physicians and also directed toward parents and patients to dampen their enthusiasm for antibiotics.

Accepted for publication June 20, 2002.

Corresponding author and reprints: David R. Nash, MD, Department of Pediatrics, University of Pittsburgh School of Medicine, Children’s Hospital of Pittsburgh, 3705 Fifth Ave, Pittsburgh, PA 15213 (e-mail: david.nash@chp.edu).

REFERENCES