Antibiotic Treatment of Children With Sore Throat

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PHARYNGITIS ACCOUNTS FOR 6% of visits by children to family medicine physicians and pediatricians.1 The most common manifestation of acute pharyngitis is sore throat.2 Most sore throats are due to upper respiratory viruses such as rhinovirus, coronavirus, and adenovirus.3 The main bacterial cause of sore throat and the only common cause of sore throat warranting antibiotic treatment is group A β-hemolytic streptococci (GABHS).4-5 GABHS are cultured from 15% to 36% of children with sore throat.6-13

The American Academy of Pediatrics (AAP), the Centers for Disease Control and Prevention (CDC), and the Infectious Diseases Society of America (IDSA) recommend penicillin as the antibiotic of choice for children with sore throat due to GABHS,5 but also identify amoxicillin, erythromycin (for penicillin-allergic patients), and first-generation cephalosporins as acceptable alternatives. In addition, to improve diagnostic accuracy and reduce unnecessary antibiotic treatment, the AAP, CDC, and IDSA all recommend performance of a GABHS test prior to treating children with an antibiotic.

Prior studies have found high rates of antibiotic prescribing to children diagnosed with pharyngitis14-16 but have not focused on children presenting with a chief complaint of sore throat, a more clinically relevant approach. An analysis of children with a chief complaint of sore throat would allow comparison between the antibiotic prescribing rate and the known prevalence of GABHS. In addition, these prior studies have not measured changes in the rates of recommended and nonrecommended antibiotic prescribing over time.

Context Of children with sore throat, 15% to 36% have pharyngitis caused by group A β-hemolytic streptococci (GABHS). Performance of a GABHS test prior to antibiotic prescribing is recommended for children with sore throat. Penicillin, amoxicillin, erythromycin, and first-generation cephalosporins are the recommended antibiotics for treatment of sore throat due to GABHS.

Objectives To measure rates of antibiotic prescribing and GABHS testing and to evaluate the association between testing and antibiotic treatment for children with sore throat.

Design, Setting, and Participants Analysis of visits by children aged 3 to 17 years with sore throat to office-based physicians, hospital outpatient departments, and emergency departments in the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey, 1995 to 2003 (N=4158) and of a subset of visits with GABHS testing data (n=2797).

Main Outcome Measures National rates of antibiotic prescribing, prescribing of antibiotics recommended and not recommended for GABHS, and GABHS testing.

Results Physicians prescribed antibiotics in 53% (95% confidence interval [CI], 49%-56%) of an estimated 7.3 million annual visits for sore throat and nonrecommended antibiotics to 27% (95% CI, 24%-31%) of children who received an antibiotic. Antibiotic prescribing decreased from 66% of visits in 1995 to 54% of visits in 2003 (P=.01 for trend). This decrease was attributable to a decrease in the prescribing of recommended antibiotics (49% to 38%; P=.002). Physicians performed a GABHS test in 53% (95% CI, 48%-57%) of visits and in 51% (95% CI, 45%-57%) of visits at which an antibiotic was prescribed. GABHS testing was not associated with a lower antibiotic prescribing rate overall (48% tested vs 51% not tested; P=.40), but testing was associated with a lower antibiotic prescribing rate for children with diagnosis codes for pharyngitis, tonsillitis, and streptococcal sore throat (57% tested vs 73% not tested; P<.001).

Conclusions Physicians prescribed antibiotics to 53% of children with sore throat, in excess of the maximum expected prevalence of GABHS. Although there was a decrease in the proportion of children receiving antibiotics between 1995 and 2003, this was due to decreased prescribing of agents recommended for GABHS. Although GABHS testing was associated with a lower rate of antibiotic prescribing for children with diagnosis codes of pharyngitis, tonsillitis, and streptococcal sore throat, GABHS testing was underused.

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or evaluated the role of GABHS testing. To measure changes in the rate and type of antibiotics prescribed to children with a chief complaint of sore throat, and their relationship to GABHS testing, we analyzed data from the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 1995 to 2003.

METHODS

Data Sources
The NAMCS and the NHAMCS are administered by the Ambulatory Care Statistics Branch of the CDC National Center for Health Statistics (NCHS). The NAMCS collects information on patient visits to non–federally funded, community, office-based physician practices throughout the United States. The NHAMCS collects information on patient visits to hospital outpatient departments and hospital emergency departments as separate components.

The surveys have multistage probability designs. The NAMCS has a 3-stage sampling design, with sampling based on geographic location, physician practices within a geographic location (stratified by physician specialty), and visits within individual physician practices. Physicians who are selected to participate in the NAMCS during a particular calendar year are not eligible to be selected again for at least another 3 years. The NHAMCS has a 4-stage sampling design, with sampling based on geographic area, hospitals within a geographic area, clinics or emergency departments within hospitals, and patient visits within clinics or emergency departments. The NHAMCS has a panel of hospitals that rotates so that a given hospital participates every 15 months.

Physician (NAMCS only), hospital (NHAMCS only), and patient and clinical (both surveys) information is collected at each selected visit and is recorded on patient record forms by participating physicians, office staff, hospital staff, or Census Bureau representatives. Patient information includes demographic data and insurance status. Race and ethnicity are classified by the person filling out the patient record form, according to an office or hospital’s usual practice for collecting such information. Physician and hospital information includes self-identified specialty (in the NAMCS only), clinic type (in the NHAMCS only), geographic region, and whether the practice is in a rural area. Clinical characteristics include up to 3 reasons for the visit (1 “most important” and 2 “other”; coded using the NCHS Reason for Visit Classification), 3 diagnoses (1 primary and 2 secondary diagnoses; coded using the International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]), up to 8 medications, and the corresponding National Drug Code Directory class number for each medicine.

The NAMCS included a variable indicating performance of a GABHS test (culture or rapid test) from 1997 to 2003. The NHAMCS included a variable indicating performance of a GABHS test from 1997 to 2003 in hospital outpatient departments and from 2001 to 2003 in hospital emergency departments. Neither survey includes GABHS test results.

The surveys collected 768,553 patient records between 1995 and 2003. The participation rate of contacted physicians as visits to emergency medicine physicians as visits to emergency departments. We considered visits to emergency medicine physicians as visits to emergency departments. We excluded from the analysis visits by children with a chief complaint of sore throat with a diagnosis—primary, secondary, or tertiary—that could account for an antibiotic prescription other than for GABHS pharyngitis (eg, otitis media, sinusitis, pneumonia, cellulitis [n=660]). There were 4138 sample records for sore throat that met all inclusion and exclusion criteria.

Data Analysis
We identified antibiotics by using the National Drug Code Directory class prefix 03 (“antimicrobials”) and excluded polymyxin, aminoglycosides (which generally are not prescribed for systemic use in the outpatient setting), and antimycobacterial, antifungal, and antiviral agents. We defined penicillin, amoxicillin (including ampicillin), erythromycin, and first-generation cephalosporins as antibiotics recommended for treat-
ment of GABHS infection.2–5 We considered all other antibiotics, including amoxicillin/clavulanate, as nonrecom-
mended for GABHS treatment. If more than 1 antibiotic was used in a single visit (1.3% of sample records), we counted each antibiotic prescribed in its respective subclass, but we counted the visit only once as an epi-
sode of care in which an antibiotic was prescribed. If a patient received both a recommended and a nonre-
commended antibiotic, we considered him or her to have received a recom-
mended antibiotic.

We analyzed the subset of records for which GABHS testing information was available from 1997 to 2003 (n=2797). In
addition, to approximate a Health Plan Employer Data and Information Set (HEDIS) quality measure that
was introduced in 2004, we analyzed visits for which GABHS testing information was available and that had a
primary diagnosis code of acute pharyngitis (ICD-9-CM 462), acute tonsillitis (ICD-9-CM 463 and 465), and streptococcal
sore throat (ICD-9-CM 034, 041.0, 041.00, 041.01, and 041.09).24 We also examined the complementary set of
visits by children with a report of sore throat who had diagnoses that did not fall under the HEDIS measure defi-
nition.

Statistical Analysis
We calculated SEs for all results as recommended by the NCHS using SUDAAN software, which accounts
for the complex sampling design of the NAMCS/NHAMCS.20,21 All statistical
tests were based on estimates that had a less than 30% relative SE (ie, the
SE divided by the estimate expressed as a percentage of the esti-
mate) and were based on 30 cases or more in the sample data. According to
the NCHS, estimates with a greater than 30% relative SE or based on
fewer than 30 sample cases may be unreliable. Due to this restriction, and
because of the small size of nonwhite racial groups, we dichotomized the
race variable into white and nonwhite categories.

We evaluated categorical variables with the χ² test. To assess changes in
prescribing over time, we used the linear trend test. All statistical trend tests
take into account data from all 9 years from 1995 through 2003.

We developed 3 multivariable logistic regression models, adjusting for patient demographic, insurance,
and physician and hospital information. We included race and ethnicity because we have previously found
race and ethnicity to be associated with differing prescribing practices for acute respiratory tract infec-
tions.26,27 The first logistic regression model included all sore throat visits and had antibiotic prescribing as the
dependent variable (n=4158). The second logistic regression model included visits at which an antibiotic
was prescribed and had prescribing of nonrecommended antibiotics as the dependent variable (n=2313). These
2 models reflect our hypothesis that physicians first decide whether or not to
prescribe an antibiotic and then decide which antibiotic to prescribe.
The third model included visits for
which data about GABHS testing were available from 1997 to 2003 and had
GABHS testing as the dependent variable (n=2797). All analyses were per-
formed with SAS version 9.1 (SAS
Institute Inc, Cary, NC) and SAS-
callable SUDAAN version 9.0.1 (Re-
search Triangle Institute, Research
Triangle Park, NC). All P values are
2-tailed; P<.05 was considered sig-
ificant.

RESULTS
Sore Throat Visit Rates
and Characteristics
After excluding visits with a con-
comitant nonpharyngitis, antibi-
appropriate diagnosis, there were an
estimated 66 million (95% confidence interval [CI], 59 million–73 million) visits in the United States by children
aged 3 to 17 years with sore throat to pediatricians, other primary care phy-
icians and clinics, and emergency
Annual visits for sore throat averaged
7.3 million visits per year, ranging
from 6.2 million visits in 1997 to 9.7
million visits in 2002. However, there
was no significant change in the propor-
tion of all visits that were for sore
throat over time, decreasing from
6.4% of visits in 1995 to 5.9% in 2001
and increasing to 8.1% in 2003
(P=.19 for trend).

The most frequent physician-
reported primary diagnoses for visits
with a chief complaint of sore throat
were acute pharyngitis (34% of visits),
streptococcal sore throat (17%), and up-
per respiratory tract infection (17%)
(TABLE 1). Children with sore throat
were 47% male and 85% white
(TABLE 2). Fifty-six percent of visits were
to pediatricians or pediatric clinics, 36%
of visits were to other primary care phy-
icians or clinics, and 9% of visits were
to emergency departments.

Antibiotic Prescribing
Over the 9-year study period, phy-
sicians prescribed antibiotics in 53% of vis-

<table>
<thead>
<tr>
<th>Table 1. Primary Diagnosis Codes for Visits by Children With Sore Throat (N = 4158)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Diagnosis</strong></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Acute pharyngitis</td>
</tr>
<tr>
<td>Streptococcal sore throat</td>
</tr>
<tr>
<td>Upper respiratory tract infection</td>
</tr>
<tr>
<td>Acute tonsillitis</td>
</tr>
<tr>
<td>Unspecified viral infection</td>
</tr>
<tr>
<td>Acute bronchitis</td>
</tr>
<tr>
<td>Other primary diagnosis*</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

*Most common “other” diagnoses were no diagnosis given (12%), allergic rhinitis (11%), influenza (8%), asthma (7%), infectious mononucleosis (4%), and pyrexia of unknown origin (3%).

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its (95% CI, 49%-56%; Table 3). Antibiotics were prescribed in 38% of visits (95% CI, 36%-41%), and nonrecommended antibiotics were prescribed in 14% (95% CI, 12%-17%). Physicians prescribed nonrecommended antibiotics to 27% (95% CI, 24%-31%) of children who received an antibiotic.

Antibiotic prescribing for patients with sore throat decreased over time from 66% of visits in 1995 to 44% of visits in 2002, then increased to 54% of visits in 2003 (P = .01 for linear trend from 1995 to 2003) (Figure). Recommended antibiotic prescribing decreased from 49% of visits in 1995 to 38% of visits in 2003 (P = .002 for trend), but there was no significant change in the prescribing of nonrecommended antibiotics over time (18% in 1995 to 16% in 2003; P = .82 for trend).

Physicians prescribed amoxicillin (26% of visits), penicillin (7%), first-generation cephalosporins (3%), and erythromycin (2%) (Table 3). The most commonly prescribed nonrecommended antibiotics were other cephalosporins (6% of visits), extended-spectrum macrolides (5%), and amoxicillin/clavulanate (3%).

In multivariable logistic regression modeling, independent predictors of any antibiotic prescribing were calendar year (odds ratio [OR], 0.93 per year; 95% CI, 0.88-0.97), age 6 to 11 years (vs 3-5 years: OR, 1.52; 95% CI, 1.10-2.11), nonwhite race (vs white race: OR, 0.67; 95% CI, 0.47-0.94), other primary care visits (vs pediatric visits: OR, 1.58; 95% CI, 1.13-2.21), emergency department visits (vs pediatric visits: OR, 1.60; 95% CI, 1.21-2.11), and southern region (vs Northeast: OR, 1.61; 95% CI, 1.07-2.44) (Table 2). Among children receiving antibiotics, independent predictors of prescribing nonrecommended antibiotics were “other” insurance (vs private insurance: OR, 0.37; 95% CI, 0.18-0.75) and emergency department visits (vs pediatric visits: OR, 0.61; 95% CI, 0.39-0.93) (Table 2).

### Table 2. Prescribing of Recommended and Nonrecommended Antibiotics at Visits by Children With Sore Throat

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Proportion of Visits, % (N = 4158)</th>
<th>All Antibiotics (N = 4158)</th>
<th>Nonrecommended Antibiotics* (n = 2313)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calendar year, per 1 y</td>
<td>%†</td>
<td>Adjusted OR (95% CI)‡</td>
<td>%†</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5</td>
<td>17</td>
<td>49</td>
<td>0.93 (0.88-0.97)</td>
</tr>
<tr>
<td>6-11</td>
<td>45</td>
<td>58</td>
<td>1.52 (1.10-2.11)</td>
</tr>
<tr>
<td>12-17</td>
<td>38</td>
<td>48</td>
<td>0.87 (0.62-1.20)</td>
</tr>
<tr>
<td>Male sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>54</td>
<td>1.12 (0.89-1.41)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>White</td>
<td>85</td>
<td>54</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>15</td>
<td>46</td>
<td>0.67 (0.47-0.94)</td>
</tr>
<tr>
<td>Latino ethnicity</td>
<td>12</td>
<td>57</td>
<td>1.21 (0.80-1.83)</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>66</td>
<td>50</td>
<td>1.00</td>
</tr>
<tr>
<td>Medicaid</td>
<td>20</td>
<td>56</td>
<td>1.15 (0.80-1.64)</td>
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<tr>
<td>Self-pay</td>
<td>8</td>
<td>67</td>
<td>1.43 (0.93-2.19)</td>
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<tr>
<td>Other</td>
<td>7</td>
<td>51</td>
<td>1.01 (0.67-1.52)</td>
</tr>
<tr>
<td>HMO</td>
<td>21</td>
<td>48</td>
<td>0.79 (0.59-1.06)</td>
</tr>
<tr>
<td>Specialty and setting§</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pediatrics</td>
<td>56</td>
<td>47</td>
<td>1.00</td>
</tr>
<tr>
<td>Other primary care</td>
<td>36</td>
<td>60</td>
<td>1.58 (1.13-2.11)</td>
</tr>
<tr>
<td>Emergency department</td>
<td>9</td>
<td>60</td>
<td>1.60 (1.21-2.11)</td>
</tr>
<tr>
<td>Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>25</td>
<td>46</td>
<td>1.10 (0.76-1.61)</td>
</tr>
<tr>
<td>Midwest</td>
<td>27</td>
<td>52</td>
<td>1.61 (1.07-2.44)</td>
</tr>
<tr>
<td>South</td>
<td>31</td>
<td>60</td>
<td>1.13 (0.76-1.69)</td>
</tr>
<tr>
<td>West</td>
<td>17</td>
<td>51</td>
<td>1.18 (0.89-1.56)</td>
</tr>
</tbody>
</table>

**Table 2.** Prescribing of Recommended and Nonrecommended Antibiotics at Visits by Children With Sore Throat

**Figure.** Prescribing of recommended and nonrecommended antibiotics among children with acute pharyngitis from 1997 to 2003.

**GABHS Testing and Association With Antibiotic Prescribing**

From 1997 to 2003, when performance of a GABHS test was recorded, physicians performed a GABHS test in 53% (95% CI, 48%-57%) of visits (n = 2797). In a multivariable logistic regression model of GABHS testing, there was no change in testing over time (OR, 1.01 per year; 95% CI, 0.93-1.11), but independent predictors of GABHS testing were other primary care visit (vs pediatric visits: OR, 0.46; 95% CI, 0.32-0.66), emergency department visit (vs pediatric visits: OR, 0.45; 95% CI, 0.29-0.70), and western region (vs Northeast: OR, 0.55; 95% CI, 0.34-0.92).

Physicians prescribed antibiotics at 48% of visits in which they performed a GABHS test and 51% of visits in which they did not perform a GABHS test (P = .40) (Table 4). There was no association between GABHS testing and antibiotic prescribing after adjusting for study year (P = .40). Among children with a primary diagnosis code for acute pharyngitis, tonsillitis, and streptococcal sore throat (n = 1799), 63% (95% CI, 57%-69%) had a GABHS test performed. There was a significant difference in an-
tibiotic prescribing between those who had a GABHS test performed (57%) and those who did not (73%) (P<.001). For children with a diagnosis code for upper respiratory tract infection, unspecified viral infection, acute bronchitis, and other diagnoses, those who had a GABHS test performed had an antibiotic prescribed at 21% of visits vs 30% for those who did not (n=998; P=.11).

Overall, physicians performed a GABHS test in 51% (95% CI, 45%-57%) of visits for sore throat at which they prescribed an antibiotic. Among children with a diagnosis code for pharyngitis, tonsillitis, and streptococcal sore throat who received antibiotics (ie, the subgroup targeted by the HEDIS measure), 57% (95% CI, 50%-63%) had a GABHS test performed.

**COMMENT**

Although 15% to 36% of children with sore throat have GABHS,7,8,11,12 we found that physicians prescribed antibiotics to 53% of children with a chief complaint of sore throat between 1995 and 2003. Encouragingly, we found a significant decrease in the proportion of patients receiving antibiotics over the study period. However, even at the end of the study period, the proportion of children prescribed an antibiotic still exceeded the maximum expected prevalence of GABHS among children with sore throat.

Of note, the decrease in prescribing was due to a decreased use of agents recommended for GABHS; there was no change in the proportion of children prescribed nonrecommended agents. Indeed, we found a trend over time toward increased use of nonrecommended antibiotics among children receiving antibiotics (OR, 1.05 per year; 95% CI, 0.97-1.12). This is consistent with other studies suggesting an increase in the use of broad-spectrum agents (especially clarithromycin and azithromycin among children) during the study period, even as overall antibiotic prescribing rates were stable or decreasing.10,12,20 This is of particular interest given the increasing prevalence of macrolide resistance found in GABHS and other common pediatric pathogens, such as *Streptococcus pneumoniae*.30-32

Physicians were more likely to prescribe antibiotics to children aged 6 to 11 years, consistent with the higher prevalence of GABHS in this age group.2,4 Other primary care physicians and emergency departments were approximately 50% less likely to use GABHS testing and approximately 60% more likely to prescribe antibiotics than pediatricians. Other primary care physicians and emergency department clinicians, because they care for both adults and children, may have been exposed to conflicting messages about the role of clinical criteria and GABHS testing in adults and extrapolated this conflict to their treatment of children.6,9,10,13-36

Children seen in emergency departments were less likely to receive nonrecommended antibiotics than children seen in pediatric practices, despite...
a higher antibiotic prescribing rate in emergency departments. Physicians were less likely to prescribe antibiotics to nonwhite children, which appears to reflect antibiotic overprescribing to white children. Physicians in the South were more likely to prescribe antibiotics, consistent with other analyses showing higher rates of antibiotic and broad-spectrum antibiotic prescribing in the South. Physicians were less likely to prescribe nonrecommended antibiotics to children with “other” insurance, a small group for whom insurance information was blank or unknown or who received charity care.

In the United States, to better target antibiotic treatment of children with sore throat, the AAP, CDC, and IDSA all recommend laboratory confirmation of GABHS prior to prescribing antibiotics, a strategy that has been empirically validated. Because most tests for GABHS are negative, one would expect there to be an association between GABHS testing and lower antibiotic prescribing rates. In an unstratified analysis of children with sore throat, we found no association between performing a GABHS test and antibiotic prescribing. In a stratified analysis, among children with a diagnosis code for upper respiratory tract infection, unspecified viral infections, acute bronchitis, and other primary diagnoses (see Table 1 footnote),}

**Table 4. Association of GABHS Testing and Antibiotic Prescribing Among Children With Sore Throat, Stratified by Diagnostic Group, 1997-2003**

<table>
<thead>
<tr>
<th>Visits in Thousands, No. (%)†</th>
<th>Antibiotics</th>
<th>No Antibiotics</th>
<th>Row Totals</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All diagnosis codes (n = 2797)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GABHS test</td>
<td>12,603 (48)</td>
<td>13,637 (52)</td>
<td>26,239 (53)</td>
<td>.40</td>
</tr>
<tr>
<td>No GABHS test</td>
<td>12,030 (51)</td>
<td>11,392 (49)</td>
<td>23,423 (47)</td>
<td></td>
</tr>
<tr>
<td>Column totals</td>
<td>24,633 (50)</td>
<td>25,029 (50)</td>
<td>49,662 (100)</td>
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</tr>
<tr>
<td><strong>Pharyngitis, tonsillitis, and streptococcal sore throat diagnosis codes (n = 1799)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GABHS test</td>
<td>11,186 (57)</td>
<td>8,393 (43)</td>
<td>19,579 (63)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>No GABHS test</td>
<td>8,510 (73)</td>
<td>3,101 (27)</td>
<td>11,610 (37)</td>
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</tr>
<tr>
<td>Column totals</td>
<td>19,696 (63)</td>
<td>11,494 (37)</td>
<td>31,190 (100)</td>
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</tr>
<tr>
<td><strong>Other diagnosis codes (n = 998)</strong>‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GABHS test</td>
<td>14,16 (21)</td>
<td>5,244 (79)</td>
<td>6,660 (36)</td>
<td>.11</td>
</tr>
<tr>
<td>No GABHS test</td>
<td>3,520 (30)</td>
<td>8,292 (70)</td>
<td>11,812 (64)</td>
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<tr>
<td>Column totals</td>
<td>4,637 (27)</td>
<td>13,536 (73)</td>
<td>18,472 (100)</td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviation:** GABHS, group A β-hemolytic streptococci.

*Among children who received antibiotics, the proportion who had a GABHS test performed was 51% for all diagnosis codes; 57% for pharyngitis, tonsillitis, and streptococcal sore throat diagnosis codes (the best approximation of the Health Plan Employer Data and Information Set pharyngitis measure); and 26% for other diagnosis codes.

†Due to rounding, rows and columns may not exactly sum.

‡Other diagnosis codes are for upper respiratory tract infection, unspecified viral infections, acute bronchitis, and other primary diagnoses (see Table 1 footnote).
with a diagnosis code for pharyngitis, tonsillitis, and streptococcal sore throat treated with antibiotics.

Attention to prescribing for sore throat has been part of comprehensive attempts to promote judicious antibiotic prescribing by the CDC and others. Successful interventions to promote judicious antibiotic prescribing have included academic detailing, for-mulary restrictions, and multidimensional interventions involving patients and clinicians. Other programs have been less successful. The sustainability of most successful interventions is unknown, and simpler, less expensive interventions are needed. The widening deployment of electronic health records with integrated clinical decision support holds the promise of improving care for acute respiratory tract infections.

The evaluation and treatment of most children with sore throat is reasonably straightforward. All children with sore throat should be offered adequate analgesia with acetaminophen or ibuprofen. Physicians should restrict testing to children likely to have GABHS pharyngitis: those older than 3 years with acute onset of sore throat, fever, headache, pain on swallowing, abdominal pain, nausea, vomiting, or tender anterior cervical lymphadenopathy. Children with symptoms suggestive of viral infections, such as cough, conjunctivitis, hoarseness, cough, anterior stomatitis, or diarrhea are unlikely to have GABHS and should generally not be tested. If a child is initially treated with antibiotics pending test results, antibiotics should be stopped if the GABHS test result is negative. The antibiotic of choice for pharyngitis caused by GABHS is penicillin, which is narrow-spectrum, inexpensive, and to which GABHS is universally susceptible.

In conclusion, we found that physicians prescribed antibiotics less frequently over time to children with sore throat. However, the overall antibiotic prescribing rate continues to exceed the expected prevalence of GABHS, and physicians continue to select unnecessarily broad-spectrum antibiotics. Unnecessary antibiotic prescriptions are not benign: they increase the prevalence of antibiotic-resistant bacteria, expose patients to adverse drug events, and increase costs. Perhaps unique among upper respiratory tract infections, clinicians have good, objective criteria in the form of GABHS testing to guide the antibiotic treatment of children with sore throat. Limiting antibiotic prescribing to children with a positive GABHS test result is a feasible goal for primary care physicians and an important step toward judicious use of antibiotics overall.

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