Published in final edited form as:

J Eval Clin Pract. 2011 December ; 17(6): 1176–1183. doi:10.1111/j.1365-2753.2010.01495.x.

Antimicrobial Prescribing in the U.S. for Adult Acute Pharyngitis in Relation to Treatment Guidelines

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Abstract

i. Rationale, aims and objectives—American College of Physicians (ACP) published guidelines for the diagnosis and treatment of acute pharyngitis in adults in 2001. The objective of this study is to characterize antibiotic prescribing patterns in the United States for acute pharyngitis and evaluate concordance with the 2001 ACP pharyngitis treatment guidelines

ii. Methods—Patients aged ≥ 18 years identified with acute pharyngitis via (ICD-9 CM) diagnosis codes were identified from data collected annually (1996-2006) by the National Center for Health Statistics (NCHS) and Centers for Disease Control and Prevention (CDC) from the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS). Total US office visits for acute pharyngitis were estimated. Logistic regression was performed to determine whether antibiotic prescribing was associated with the publishing of the ACP guidelines.

iii. Results—3,791 office visits met study criteria. We extrapolated 78.0 million visits for acute pharyngitis from 1996-2006. Antibiotics were prescribed in 62.6% of cases and 7.5% of cases received ACP-recommended antibiotics. There was a significant decrease in the rate of antibiotic prescriptions from 66.5% to 59.1% after publication of ACP guidelines. Univariate analysis showed that antibiotic prescribing decreased by 27%, OR=0.73 (0.55-0.95), $p=0.021$. Multivariate analyses confirmed this finding, OR=0.72 (0.56-0.94), $p=0.014$. The prescribing of ACP-recommended antibiotics did not significantly change, 8.5% to 6.6% $p=0.519$.

iv. Conclusions—Publishing of ACP guidelines for the diagnosis and treatment of pharyngitis was associated with a decrease in the overall prescribing of antibiotics but not the prescribing of ACP-recommended antibiotics.

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Conflict of Interest: All authors have no potential conflicts of interest

Keywords

guidelines; infectious disease; pharmacoepidemiology; physician behavior; health education

1. INTRODUCTION

Streptococcus pyogenes (Group A streptococcus), found in approximately 5-17% of adults with acute pharyngitis¹, is the only cause of acute pharyngitis warranting antibiotic therapy. Historically, primary care physicians have aggressively prescribed antibiotics in cases of pharyngitis where therapy was not indicated, frequently with more costly broad-spectrum agents.¹

The appreciation of favorable antibiotic adverse event profiles allows physicians to prescribe antimicrobial therapy very loosely, often “just in case.” Patients' expectations, time pressure on physicians, and concerns about patient follow-up may result in the administration of antibiotics to patients without definitive evidence of infection. However, such use of broad-spectrum antibiotics has led to the emergence of antimicrobial resistance among clinically relevant bacterial pathogens such as *S. pneumonia*, *S. aureus*, and the Enterobacteriaceae. At the public health level, the emergence of drug-resistant pathogens has significant consequences that many physicians may not appreciate during an individual patient encounter.^{2,3,4,5,6,7,8,9,10}

In order to offer clinicians a framework for prescribing antimicrobials more judiciously, to prevent the emergence of antibiotic resistance, and to decrease costs, hospitals are now investing resources in antimicrobial stewardship programs.¹¹ At a national level, physician organizations such as the American College of Physicians (ACP) and the Infectious Diseases Society of America (IDSA) have published treatment guidelines for empiric and directed therapy of various conditions.^{12,13,14}

To guide antibiotic prescribing practices for pharyngitis in adults, the ACP published treatment guidelines in 2001 recommending antibiotic treatment only in patients who were likely to have Group A streptococcus infection based on the presence of at least 3 of 4 Centor criteria: 1. history of fever, 2. tonsillar exudate, 3. tender anterior cervical lymphadenopathy, 4. absence of cough; or adults with two or more Centor criteria in the presence of a positive rapid antigen detection test (RADT).^{15,16} For cases meeting the clinical and/or laboratory criteria of streptococcal pharyngitis the recommended agents include penicillin or erythromycin, depending on patient antibiotic allergies. Authors of the ACP guideline anticipated antibiotic prescribing rates of 10.6% to 33.0% of all visits for pharyngitis if the guidelines were followed.^{15,16} The IDSA followed with an update on its guidelines for the diagnosis and management of Group A streptococcus pharyngitis in 2002,¹⁷ which in contrast to the ACP strategies, recommended microbiologic confirmation for all adults with pharyngitis prior to antibiotic prescribing.

In order to measure the rate of adherence of physicians to different management strategies, Linder et al. performed a retrospective analysis of 2097 visits to Boston area primary care clinics by adults with a diagnosis of pharyngitis.¹⁸ Clinicians were adherent to the ACP empirical strategy in 12% of visits, the ACP test strategy in 30% of visits, the IDSA strategy in 30% of visits, and adherent to none of these strategies in 66% of visits. Thus, the authors conclude that the major problem in the testing and treatment of adults with pharyngitis was not which guideline to follow, but that clinicians usually failed to follow any guideline.

The purpose of this analysis was to characterize antibiotic prescribing patterns in the US for adult patients with acute pharyngitis and evaluate concordance with the 2001 ACP guidelines using the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS).

2. METHODS

Identification of Cases

Patient data were derived from the NAMCS and the NHAMCS from 1996 to 2006. Collected annually by the National Center for Health Statistics (NCHS), the United States Centers for Disease Control and Prevention (US-CDC)¹⁹, these surveys describe utilization of ambulatory medical care services in the US. Data provided from each patient visit include patient demographic information, reasons for the visit, patient diagnoses, procedures and tests performed, and medications prescribed. NAMCS and NHAMCS are cross-sectional studies; NAMCS provides data on visits to non-federally employed, office-based physicians who are primarily engaged in direct primary care. NHAMCS provides data on visits to emergency departments and outpatient departments of non-institutional general and short-stay hospitals, exclusive of federal, military, and Veterans Administration hospitals. NAMCS and NHAMCS databases were combined for this study. For the purposes of this analysis, data on emergency department visits from the NHAMCS were excluded.

NAMCS and NHAMCS employ a multistage sampling design. NAMCS uses a three-stage probability design with samples of geographically defined areas, physician offices within these areas, and patient visits to offices. NHAMCS uses a four-stage probability design with samples of geographically defined areas, hospitals within these areas, clinics within the outpatient departments of these hospitals, and patient visits to these clinics.

With the combined NAMCS and NHAMCS database, we used International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9 CM) diagnosis codes²⁰ to identify patients aged 18 years or older who were diagnosed with acute pharyngitis. ICD-9 CM codes included were streptococcal sore throat (034.0), acute nasopharyngitis (460), acute pharyngitis (462) and acute laryngopharyngitis (465.0). Because ACP guidelines for diagnosis and treatment of streptococcal pharyngitis do not apply to patients who are immunocompromised with diabetes or human immunodeficiency virus (HIV), or patients with a history of rheumatic fever, valvular heart disease, recurrent or chronic pharyngitis, or patients with alternative identifiable etiologies of pharyngitis such as sinusitis, infectious mononucleosis, or gonococcal infection, these patients were excluded using ICD-9 CM codes.

Data Analysis

National estimates of office visits for acute pharyngitis were extrapolated utilizing the multilevel sampling design of both databases. Characteristics of office visits were summarized, including patient demographic information, physician specialty, whether a streptococcus test was completed, and which antibiotics were prescribed, if any. Summary statistics were calculated using t-distribution. Percent of antibiotics prescribed was calculated.

To determine whether prescribing practices and/or prescribing of ACP-recommended antibiotics changed in relation to the publishing of the ACP guidelines, logistic regression was performed using the guidelines' year of publication (2001) as a binomial predictor for the use of antibiotics.

To assess for potential confounding variables, the following covariates were also analyzed: age, sex, race, physician specialty (general medicine, general surgery, OB/GYN, other), outpatient setting (private office vs. hospital clinic), whether the patient was seen on a prior visit, whether a strep culture was performed, geographic region (northeast, Midwest, south, west), and type of payment (private, medicare/Medicaid, self-pay, other).

These variables were analyzed as possible predictors in a univariate logistic regression, where the outcome of interest was whether antibiotics were prescribed during the visit. Significant univariate predictors with $P < 0.05$ were then included in a multivariate model.

All analyses were performed using Stata version 8.0 (Stata Corp., College Station, Texas, USA). In order to account for the multilevel sample design of the NAMCS and NHAMCS, the “svy” commands from Stata were used, which estimate sampling variances by using approximation from ultimate cluster variance, described by Hansen, Hurwitz, and Madow.

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3. RESULTS

We identified 3,791 office visits for acute pharyngitis meeting study criteria. We extrapolate that there were approximately 78.0 million outpatient visits for acute pharyngitis in the U.S. from 1996-2006, or 7.1 million per year. There were an estimated 48.8 million antibiotic prescriptions for pharyngitis from 1996-2006, or approximately 4.4 million prescriptions per year.

Based on the survey data, 11.9% of visits for pharyngitis were reported as “Group A streptococcus pharyngitis” and 88.8% were reported as “other pharyngitis”. 60.2% of patients seen for pharyngitis were female and 39.8% were male. White patients comprised 85.3% of visits, with black patients making up 7.9% and other races 6.8%. The majority of visits for pharyngitis were evaluated by general medicine physicians (87.2%), and the majority were seen in private offices (89.1%) as opposed to hospital-based clinics (10.9%). 83.3% of patients were established patients and 16.7% were new visits. The majority of cases were observed in patients with private insurance (67.0%), followed by Medicare/Medicaid (17.4%), and Self-pay (8.6%). (Table 1)

Antibiotics were prescribed for 62.6% of patients diagnosed with acute pharyngitis. (Table 1). After the publication of ACP guidelines in 2001, a significant decrease in the rate of antibiotic prescription for acute pharyngitis was observed. Univariate analysis showed that antibiotic prescribing decreased by 27% after publication of the ACP guidelines, OR 0.73 (0.55-0.95), $p=0.021$. (Table 2) Multivariate analyses confirmed that antibiotic prescribing was significantly associated with the timing of the publication of the ACP guidelines, OR 0.72 (0.56-0.94), $p=0.014$.

Age, gender, physician specialty and pay type were also independent predictors of antibiotic prescribing in multivariate analysis. (Table 2) As age increased, patients were less likely to be prescribed antibiotics. Women were also less likely to be prescribed antibiotics, and physicians in specialties other than general medicine, general surgery, and OB/GYN were less likely to prescribe antibiotics. Patients who were paying for their own treatment were more likely to receive an antibiotic prescription than patients with private insurance, while patients with “other” type of payment were less likely to be prescribed an antibiotic compared to private insurance.

Among those receiving antibiotics for acute pharyngitis, only 7.5% received ACP-recommended antibiotics. After the publication of the ACP guidelines, a trend towards use of non-recommended antibiotics was observed (8.5 to 6.6%). (Figure) Univariate analysis

showed that publication of the ACP guidelines was not associated with the prescribing of ACP-recommended antibiotics among physicians who did prescribe antibiotics, OR 0.77 (0.34-1.72), $p=0.519$. (Table 3) Multivariate analyses confirmed that ACP-recommended antibiotic prescribing was not significantly associated with ACP guidelines, OR 0.76 (0.34-1.71), $p=0.502$.

In multivariate analyses, patient age and gender were independent predictors of physician prescribing practices. (Table 3) As patient age increased and if patients were prescribed antibiotics, they were more likely to receive a non-ACP recommended antibiotic; age range 60-79 years, OR 0.24 (0.08-0.75), $p=0.014$. Independent of age, women were more likely to receive non-recommended antibiotics, OR 0.55 (0.34-0.88), $p=0.012$.

Overall, the most frequently prescribed antibiotics were: (1) amoxicillin (29.7%) (2) extended macrolides (24.3%) (3) cephalosporins (17.2%) (4) amoxicillin/clavulanate (7.2%). (Table 4) Penicillin, the ACP-recommended antibiotic, was prescribed in only 4.5% of cases, and this rate did not significantly change after the publication of the ACP guidelines, 4.0% to 5.1%, $p=0.637$. The use of amoxicillin, the most commonly prescribed antibiotic, did not significantly change after the publication of the ACP guidelines, 29.2% to 30.3%, $p=0.758$, but a significant increase in the use of extended-macrolides from 19.3% to 29.3%, $p=0.007$, was observed. There was a significant decrease in the use of cephalosporins and erythromycin, 21.5% to 12.7, $p=0.012$, and 4.5% to 1.5%, $p=0.026$, respectively after publication of the ACP guidelines. The use of amoxicillin/clavulanate did not significantly change after the publication of the ACP guidelines, 7.0% to 7.3%, $p=0.881$.

From 1996 to 2004, a rapid Group A streptococcus test or throat culture was performed in 27.8% of patients diagnosed with acute pharyngitis. After the publication of ACP guidelines, a significant increase in the frequency of Group A streptococcus test/throat culture testing was observed; 24.0% to 32.8%, $p=0.031$. Beginning in 2005, the "Group A streptococcus test" field was removed from both the NAMCS and NHAMCS survey instruments; thus, we were unable to assess physician usage of rapid Group A streptococcus tests or throat culture during the period of 2005 to 2006.

4. DISCUSSION

In 2001, the ACP published guidelines for the management of acute pharyngitis in adults, and the IDSA followed by updating its guidelines for the diagnosis and management of Group A streptococcus pharyngitis in 2002. The authors of the ACP guidelines predicted antibiotic prescribing rates of 10.6% to 33.0% in cases of acute pharyngitis if the guidelines were followed. Our analysis demonstrated an overall prescribing rate of 59.1% during the time period of 1996-2006. However, we found that the publication of the 2001 ACP guidelines was followed by decreased physician antibiotic prescribing in the US for adults with acute pharyngitis.

We did not observe a significant change in the prescribing of ACP-recommended antibiotics amongst physicians who prescribed an antibiotic. In fact, a trend toward the prescribing of non-recommended antibiotics was observed. Because penicillin (ACP-recommended antibiotic) prescribing rates did not significantly change, the trend toward non-recommended antibiotics was largely due to a significant decrease in erythromycin (ACP-recommended antibiotic) prescribing. The significant decrease in erythromycin use may have been due to the substitution of an extended-macrolide, a non-recommended antibiotic. The prescribing of amoxicillin, the most frequently prescribed antibiotic, did not change in relation to the publication of the ACP guidelines. However, the publication of guidelines was followed by a significant decrease in inappropriate cephalosporin prescribing for acute pharyngitis.

Importantly, in accordance with our results, Grijalva in a recent JAMA article made similar observations in analyzing antibiotic prescribing for pediatric and adult ambulatory acute respiratory tract infections in the US in the period of 1995-2006.²² A decrease in acute respiratory tract infection-associated antibiotic prescribing rates of 18% (95% CI, 6%-29%) was observed for patients over 5 years of age, and 24% (95% CI, 10%-37%) for non-otitis media acute respiratory tract infections.

In order for treatment guidelines to influence physician behavior, there are many powerful obstacles to overcome. Cabana, et al.²³ in a review looking at reasons for physician guideline non-adherence divided obstacles to guideline adherence into physician factors and external factors. Physician factors include: lack of awareness and familiarity with proposed guidelines, lack of physician agreement with guidelines, belief that he/she cannot perform guideline recommendations, belief that following recommended guidelines will not achieve the desired outcome, and lacking ability to overcome the inertia of previous practice. External factors to perform recommendations include: guideline, environmental and patient factors.²³

Despite many barriers to changing physician prescribing behaviors, results from our study indicate that physician prescribing practices in the U.S. for adult acute pharyngitis have changed since the publication of antibiotic prescribing guidelines. Contrary to previous studies which failed to find changes in physician practices in relation to treatment guidelines,^{24-25, 26-27} to our knowledge, this is the first study to document altered physician prescribing behavior after the publication of antimicrobial guidelines.

It may be that the observed difference in antibiotic prescribing in relation to these guidelines may be explained by the fact that in the 1990s the Centers for Disease Control (CDC), several state and local health departments, and other organizations launched interventions to promote appropriate antibiotic prescriptions.²⁸ The CDC's national campaign involved a social ecological framework, targeting changes at multiple levels—individuals, groups, and organizations or institutions. The CDC program aimed at encouraging appropriate use of antibiotics by the use of the following components and strategies: forming a coalition of diverse partners; targeting changes at multiple levels (ie, individuals, groups, and organizations or institutions); educating patients; educating providers; educating the public; and evaluating program efforts. In addition to providing support for local campaign efforts, the CDC developed a national media campaign called “Get Smart: Know When Antibiotics Work,” to provide a coordinated message on appropriate use of antibiotics and to create a foundation for implementing local efforts across the country.²⁸

Therefore, in order to promote adherence to important antibiotic guidelines, in addition to improving the availability and distribution of the guidelines, the incorporation of these guidelines into broader, proven quality-improvement (QI) and incentive initiatives is required.²⁹

Several study limitations warrant discussion. We identified cases of acute pharyngitis using ICD-9 CM codes for streptococcal sore throat, acute nasopharyngitis, acute pharyngitis and acute laryngopharyngitis. It is possible that, in some cases physicians used these terms but, in actuality, treated a more complicated bacterial infections or less serious viral infections. We attempted to limit these possibilities by excluding patients who had comorbidities which may have put them at risk for the development of complications. Additionally, physicians may have had culture or rapid strep tests results available; however, these results were unavailable in either databases. Although individual laboratory confirmatory test results were unavailable, our analyses assessed the total amount of antimicrobial prescribing at the

population level and not determine whether or not each individual was appropriately prescribed an antibiotic.

Publishing of 2001 ACP guidelines for the diagnosis and treatment of acute pharyngitis in adults was associated with a decrease in the overall prescribing of antibiotics but not the prescribing of ACP-recommended antibiotics. To our knowledge, this is the first study to document altered physician prescribing behavior after the publication of antimicrobial guidelines. It may be that the incorporation of these guidelines into broader, proven QI and incentive initiatives may have led to this observed difference and may give guidance on how to optimize adherence to future guidelines.

Acknowledgments

Funders: SYH was supported by the National Institute for Allergy and Infectious Disease: T32 AI007438-16. MRJ was supported by the National Institute for Allergy and Infectious Disease: K23 AI074423-01.

6. REFERENCES

1. Linder JA, Stafford RS. Antibiotic Treatment of Adults with Sore Throat by Community Primary Care Physicians: A National Survey, 1989-1999. *JAMA*. 286:1181-1186. [PubMed: 11559262]
2. Goossens H, Guillemot D, Ferech M, et al. National campaigns to improve antibiotic use. *Eur J Clin Pharmacol*. 2006; 62:373-379. [PubMed: 16568344]
3. Goossens H, Ferech M, Vander Stichele R, et al. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet*. 2005; 365:579-587. [PubMed: 15708101]
4. Lipsitch M, Samore MH. Antimicrobial use and antimicrobial resistance: a population perspective. *Emerg Infect Dis*. 2002; 8:347-354. [PubMed: 11971765]
5. Samore MH, Lipsitch M, Alder SC, et al. Mechanisms by which antibiotics promote dissemination of resistant pneumococci in human populations. *Am J Epidemiol*. 2006; 163:160-170. [PubMed: 16319292]
6. Arason VA, Sigurdsson JA, Erlendsdottir H, et al. The role of antimicrobial use in the epidemiology of resistant pneumococci: a 10-year follow-up. *Microb Drug Resist*. 2006; 12:169-176. [PubMed: 17002543]
7. Bergman M, Huikko S, Huovinen P, et al. Macrolide and azithromycin use are linked to increased macrolide resistance in *Streptococcus pneumoniae*. *Antimicrob Agents Chemother*. 2006; 50:3646-3650. [PubMed: 16940064]
8. Hofmann J, Cetron MS, Farley MM, et al. The prevalence of drug-resistant *Streptococcus pneumoniae* in Atlanta. *N Engl J Med*. 1995; 333:481-486. [PubMed: 7623880]
9. Kleven RM, Morrison MA, Fridkin SK, et al. Community-associated methicillin-resistant *Staphylococcus aureus* and healthcare risk factors. *Emerg Infect Dis*. 2006; 12:1991-1993. [PubMed: 17326962]
10. Marco CA, Parker K. Antimicrobial resistance among organisms causing urinary tract infections. *Acad Emerg Med*. 1997; 4:159-160. [PubMed: 9043549]
11. Dellit TH, Owens RC, McGowan JE, et al. Infectious Disease Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship. *Infectious Diseases Society of America. Clin Infect Dis*. Jan 15.2007 44:159-77. [PubMed: 17173212]
12. Warren, John W.; Abrutyn, Elias; Hebel, J. Richard, et al. Guidelines for Antimicrobial Treatment of Uncomplicated Acute Bacterial Cystitis and Acute Pyelonephritis in Women. *Clinical Infectious Diseases*. 1999; 29:745-58. [PubMed: 10589881]
13. Solomkin, Joseph S.; Mazuski, John E.; Bradley, John S., et al. Diagnosis and Management of Complicated Intra-abdominal Infection in Adults and Children: Guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. *Clinical Infectious Diseases*. 2010; 50:133-64. [PubMed: 20034345]

14. Mandell, Lionel A.; Wunderink, Richard G.; Anzueto, Antonio, et al. Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults. *Clinical Infectious Diseases*. 2007; 44:S27–72. [PubMed: 17278083]
15. Snow V, Mottur-Pilson C, Cooper RJ, Hoffman JR. Principles of Appropriate Antibiotic Use for Acute Pharyngitis in Adults. *Ann Intern Med*. 2001; 134:506–508. [PubMed: 11255529]
16. Cooper RJ, Hoffman JR, Bartlett JG, Besser RE, Gonzalez R, Hickner JM, Sande MA. Principles of Appropriate Antibiotic Use for Acute Pharyngitis in Adults: Background. *Ann Intern Med*. 2001; 134:509–517. [PubMed: 11255530]
17. Bisno AL, Gerber MA, Gwaltney JM Jr, Kaplan EL, Schwartz RH. Infectious Diseases Society of America. Practice guidelines for the diagnosis and management of group A streptococcal pharyngitis. Infectious Diseases Society of America. *Clin Infect Dis*. Jul 15; 2002 35(2):113–25. [PubMed: 12087516]
18. Linder JA, Chan JC, Bates DW. Evaluation and treatment of pharyngitis in primary care practice: the difference between guidelines is largely academic. *Arch Intern Med*. Jul 10; 2006 166(13): 1374–9. [PubMed: 16832002]
19. <http://www.cdc.gov/nchs/namcs.htm>
20. <http://www.cdc.gov/nchs/icd9.htm>
21. Hansen, MH.; Hurwitz, WN.; Madow, WG., editors. *Sample survey methods and theory*. Vol. 1: methods and applications. John Wiley and Sons; New York, NY: 1993. Chapter 6: simple one- or two-stage sampling; p. 257-8.
22. Grijalva CG, Nuorti JP, Griffin MR. Antibiotic Prescription Rates for Acute Respiratory Tract Infections in US Ambulatory Settings. *JAMA*. August 19.2009 302:7.
23. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? a framework for improvement. *JAMA*. 1999; 282:1458–1465. [PubMed: 10535437]
24. Irani J. Nonadherence to guidelines. *Arch Intern Med*. Nov 13.2006 166(20):2291. author reply 2292. [PubMed: 17101957]
25. Kaiser R. Antiemetic guidelines: are they being used? *Lancet Oncol*. 2005; 6:622–625. [PubMed: 16054573]
26. Leape LL. Adherence to practice guidelines: the role of specialty society guidelines. *Am Heart J*. 2003; 145:19–26. [PubMed: 12514650]
27. Taur Y, Smith MA. Adherence to the Infectious Diseases Society of America guidelines in the treatment of uncomplicated urinary tract infection. *Clin Infect Dis*. Mar 15; 2007 44(6):769–74. Epub 2007 Feb 1. [PubMed: 17304445]
28. Weissman J, Besser RE. Promoting appropriate antibiotic use for pediatric patients. *Semin Pediatr Infect Dis*. 2004; 15(1):41–51. [PubMed: 15175994]
29. Ranji, Sumant R.; Steinman, Michael A.; Shojania, Kaveh G.; Gonzales, Ralph. Interventions to Reduce Unnecessary Antibiotic Prescribing A Systematic Review and Quantitative Analysis. *Med Care*. 2008; 46:847–862. MD. MD. MD. MD, MSPH. [PubMed: 18665065]

Figure. Estimated Antibiotics Prescribed for Acute Pharyngitis in US 1996-2006

This figure illustrates the estimated number of antibiotic prescriptions for adult acute pharyngitis in the United States according to year. Antibiotic prescriptions are also divided into ACP-recommended and non-recommended antibiotics according to the different shade.

Table 1

Characteristics of Adult Visits for Acute Pharyngitis in U.S. 1996-2006

Characteristic	Count	Proportion of Pharyngitises (95% CI)	Proportion of Pharyngitises before ACP	Proportion of Pharyngitises after ACP
All pharyngitis	3,791	100 (--)	100	100
Strep pharyngitis	552	11.9 (9.7–14.1)	10.8	12.9
Other pharyngitis	3,286	88.8 (86.6–91.0)	90.2	87.6
Given Antibiotics?				
Yes	2,330	62.6 (59.3–65.9)	66.5	59.1
No	1,461	37.4 (34.1–40.7)	33.5	40.9
Age group				
18-39	2,249	51.0 (47.7–54.4)	52.7	49.5
40-59	1,081	33.0 (30.4–35.6)	30.0	35.6
60-79	385	13.7 (10.8–16.6)	15.0	12.5
80+	76	2.3 (1.5–3.1)	2.3	2.3
Sex				
Male	1,374	39.8 (36.9–42.8)	41.3	38.6
Female	2,417	60.2 (57.2–63. 1)	58.7	61.4
Race				
White	3,193	85.3 (81.3–89.3)	86.8	83.9
Black	419	7.9 (6.1–9.7)	8.7	7.2
Other	179	6.8 (2.9–10.7)	4.4	8.9
Specialty				
General Medicine	3,263	87.2 (84.7–89.8)	86.2	88.1
General Surgery	56	0.3 (0.1–0.6)	0.4	0.3
OB/GYN	44	1.0 (0.4–1.6)	1.0	1.0
Other	427	11.4 (8.9–13.9)	12.3	10.6
Outpatient Setting				
Private Office (NAMCS)	1,489	89.1 (87.4–90.9)	90.9	87.6
Hospital Clinic (NHAMCS)	2,302	10.9 (9.1–12.6)	9.1	12.4
Seen Before				
Yes	2,833	83.3 (80.5–86.1)	86.2	80.7
No	924	16.7 (13.9–19.5)	13.7	19.3
Strep culture?				
Yes	1,021	22.9 (19.6–26.3)	24.0	22.0
No	2,770	77.1 (73.7–80.4)	76.0	78.0
Geographic Region				
Northeast	654	17.0 (13.8–20.3)	15.6	18.3
Midwest	1,134	25.6 (21.7–29.4)	28.0	23.4
South	1,242	36.4 (31.7–41.1)	36.4	36.4

Characteristic	Count	Proportion of Pharyngitises (95% CI)	Proportion of Pharyngitises before ACP	Proportion of Pharyngitises after ACP
West	761	21.0 (16.6–25.4)	20.0	21.9
Type of Payment				
Private	2,221	67.0 (63.0–71.1)	63.2	70.4
Medicare/Medicaid	768	17.4 (13.4–21.4)	17.2	17.6
Self-pay	478	8.6 (7.0–10.1)	10.2	7.1
Other	324	7.0 (5.6–8.5)	9.5	4.9

* Note: sample sizes are not directly proportional to percentages, due to weighting of observations. In particular, observations from hospital-based practices (NHAMCS) were weighted much less than those from office-based practices (NAMCS).

Table 2

Univariate and Multivariate Analysis of Antibiotic Prescribing for Acute Pharyngitis in U.S. 1996-2006

	Univariate		Multivariate	
VARIABLE	OR	P	OR	P
ACP guideline (2001)	0.73 (0.55-0.95)	0.021	0.72 (0.56-0.94)	0.014
Age group				
18-39				
40-59	0.70 (0.54-0.92)	0.009	0.73 (0.55-0.96)	0.025
60-79	0.42 (0.29-0.60)	0.000	0.54 (0.35-0.81)	0.003
80+	0.50 (0.24-1.04)	0.062	0.70 (0.32-1.52)	0.366
Sex (female)	0.75 (0.59-0.96)	0.021	0.73 (0.56-0.95)	0.021
Race				
White				
Black	1.05 (0.70-1.58)	0.804	1.13 (0.75-1.69)	0.571
Other	0.60 (0.36-0.99)	0.044	0.76 (0.46-1.25)	0.282
Specialty				
General Medicine				
General Surgery	1.30 (0.49-3.43)	0.593	1.26 (0.48-3.30)	0.635
OB/GYN	0.85 (0.26-2.81)	0.793	0.74 (0.26-2.10)	0.575
Other	0.51 (0.35-0.74)	0.000	0.51 (0.35-0.76)	0.001
Outpatient Setting				
Private Office (NAMCS)				
Hospital Clinic (NHAMCS)	0.99 (0.78-1.27)	0.947		
Seen Before				
Yes	0.78 (0.56-1.09)	0.145		
No				
Strep culture?				
Yes	1.26 (0.94-1.70)	0.127		
No				
Geographic Region				
Northeast				
Midwest	1.44 (0.99-2.09)	0.059		
South	1.33 (0.92-1.91)	0.132		
West	1.05 (0.66-1.66)	0.842		
Type of Payment				
Private				
Medicare/Medicaid	0.56 (0.41-0.77)	0.000	0.76 (0.50-1.15)	0.200
Self-pay	2.72 (1.74-4.27)	0.000	2.59 (1.62-4.15)	0.000
Other	0.65 (0.42-1.02)	0.060	0.59 (0.38-0.92)	0.021

Table 3

Univariate and Multivariate Analysis of ACP-Recommended Antibiotics for Acute Pharyngitis in U.S. 1996-2006

	Univariate		Multivariate	
VARIABLE	OR	P	OR	P
ACP Guideline (2001)	0.77 (0.34-1.72)	0.519	0.76 (0.34-1.71)	0.502
Age group				
18-39				
40-59	0.78 (0.38-1.60)	0.494	0.77 (0.37-1.64)	0.501
60-79	0.26 (0.09-0.82)	0.021	0.24 (0.08-0.75)	0.014
80+				
Sex (female)	0.58 (0.37-0.91)	0.018	0.55 (0.34-0.88)	0.012
Race				
White				
Black	0.52 (0.23-1.19)	0.120		
Other	1.00 (0.34-2.97)	0.994		
Specialty				
General Medicine				
General Surgery	0.87 (0.13-5.68)	0.885		
OB/GYN				
Other	0.68 (0.24-1.94)	0.472		
Outpatient Setting				
Private Office (NAMCS)	0.68 (0.39-1.19)	0.174		
Hospital Clinic (NHAMCS)				
Seen Before				
Yes	0.60 (0.28-1.29)	0.189		
No				
Strep culture?				
Yes	1.57 (0.74-3.34)	0.237		
No				
Geographic Region				
Northeast				
Midwest	0.89 (0.38-2.08)	0.784		
South	0.55 (0.24-1.29)	0.170		
West	2.32 (0.84-6.39)	0.104		
Type of Payment				
Private				
Medicare/Medicaid	0.96 (0.46-2.01)	0.915		
Self-pay	1.07 (0.56-2.06)	0.838		
Other	1.59 (0.61-4.19)	0.345		

Table 4

Distribution of Antibiotic Classes Prescribed to Adults with Acute Pharyngitis, 1996-2006

Antibiotic	Total (95% CI)	Before ACP (95% CI)	After ACP (95% CI)	p-value
Recommended Antibiotic				
Penicillin	4.5 (2.2–6.9)	4.0 (2.2–5.8)	5.1 (0.7–9.5)	0.637
Erythromycin	3.0 (1.8–4.2)	4.5 (2.4–6.5)	1.5 (0.3–2.8)	0.026
Non-Recommended Antibiotic				
Amoxicillin	29.7 (26.2–33.2)	29.2 (24.6–33.7)	30.3 (24.9–35.7)	0.758
Extended macrolides	24.3 (20.6–28.0)	19.3 (14.9–23.7)	29.3 (23.5–35.1)	0.007
Cephalosporins	17.2 (13.6–20.7)	21.5 (16.1–27.0)	12.7 (8.5–16.9)	0.012
Amoxicillin/clavulanic acid	7.2 (5.1–9.2)	7.0 (4.6–9.5)	7.3 (4.0–10.7)	0.881
Quinolones	3.1 (1.7–4.5)	2.5 (1.0–4.1)	3.7 (1.4–6.0)	0.388
Tetracyclines	1.6 (0.8–2.5)	2.1 (0.8–3.3)	1.2 (0.1–2.3)	0.336
Trimethoprim/sulfamethoxazole	1.3 (0.5–2.1)	1.6 (0.3–2.8)	1.0 (–0.1–2.0)	0.480

* Note: sample sizes are not directly proportional to percentages, due to weighting of observations (as in Table 1)