The Laryngoscope

TRIOLOGICAL SOCIETY CANDIDATE THESIS

Diagnosis and Treatment of Acute Sinusitis in the Primary Care Setting: A Retrospective Cohort

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Objectives and Hypothesis: Our objectives were to characterize the quality of acute sinusitis care and to identify nonclinical factors associated with antibiotic use for acute sinusitis. We hypothesized that we would identify provider-level factors associated with antibiotic use.

Study Design: Retrospective cohort at a single academic institution.

Methods: We developed and clinically annotated an administrative dataset of adult patients diagnosed with acute sinusitis between January 1, 2005, and December 31, 2006. We used identify factors associated with receipt of antibiotics.

Results: We find that 66.0% of patients with mild symptoms of short duration are given antibiotics, and that nonclinical factors, including the individual provider, the provider's specialty, and the presence of a medical trainee, significantly influence antibiotic use. Relative to internal medicine providers, family medicine providers use fewer antibiotics, and emergency medicine providers use more antibiotics for acute sinusitis.

Conclusions: Antibiotics continue to be overused for patients with mild acute sinusitis of short duration. Nonclinical characteristics, including the individual provider, the provider's specialty, and the presence of a medical trainee, significantly influence use of antibiotics for acute sinusitis.

Key Words: Sinusitis, adult, retrospective cohort, survey, provider.

Level of Evidence: 4.

***Laryngoscope*, 125:2266–2272, 2015**

INTRODUCTION

Sinusitis is one of the most common conditions treated by primary care providers.[1–3] As with other upper respiratory infections (URIs), sinusitis is usually a viral infection. Despite the lack of efficacy, antibiotics are pervasively overused for sinusitis, resulting in widespread antibiotic resistance.[4,5] Decreasing antibiotic use for uncomplicated sinusitis is an important focus of antimicrobial stewardship.

A few studies have examined specific factors related to antibiotic use, including provider specialty,[6] visit duration,[7] and resident physician provider.[6] However, these studies were based on population-based surveys that include minimal clinical data. Without clinical data, it can be difficult to discern illness duration, symptom severity, or relevant comorbidities that may impact the provider's decision to prescribe antibiotics.

In order to identify factors that may contribute to antibiotic overuse for acute sinusitis, we designed an observational cohort based on administrative data with clinical details extracted from the electronic medical record (EMR). Our first objective was to broadly characterize the quality of care for patients with acute sinusitis at initial diagnosis using the American Academy of Otolaryngology–Head and Neck Surgery (AAO–HNS) Clinical Practice Guideline: Adult Sinusitis as a benchmark. Our second objective was to identify nonclinical factors associated with antibiotic use.

MATERIALS AND METHODS

Patient Identification

We identified adult patients diagnosed with acute or chronic sinusitis or upper respiratory infection (URI) (International Classification of Diseases, 9th edition [ICD-9] codes 461.x, 473.x, 460, 465) between January 1, 2005, and December 31, 2006, within the University of Michigan Health Care System, Ann Arbor, Michigan. These patients were identified through our institution's robust Clinical Research and Health Information Exchange (data repository), which contains demographic, clinical, and professional fee billing information. We included patients from the emergency department or primary care practices, together with geriatrics, family medicine, and internal medicine, and excluded patients from subspecialty practices. We excluded patients with concurrent pharyngitis, otitis media, acute tonsillitis, bronchitis, strep throat (ICD-9 codes 462, 034.0, 463–464, 381.0–381.4, 382, 466, 490, 491.21).

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Editor's Note: This Manuscript was accepted for publication April 8, 2015.

This work was supported by the Triological Society; the National Center for Advancing Translational Sciences of the National Institutes of Health: 2KL2TR000434 (M.A.P); and the National Institutes of Health: 2TL1TR000435 (S.R.A.) and 2UL1TR000433 (N.R.K.).

The authors have no other funding, financial relationships, or conflicts of interest to disclose.

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DOI: 10.1002/lary.25363

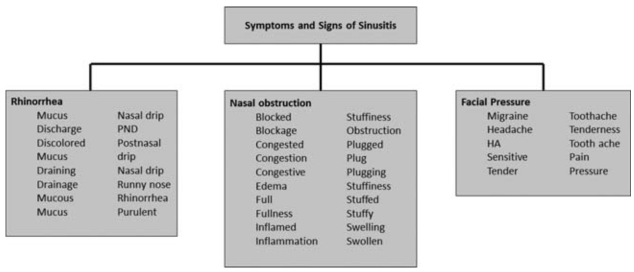

Fig. 1. Electronic Medical Record Search Engine search bundles for each of the three major symptoms of sinusitis.

To minimize confounding by chronic sinusitis, we excluded patients with a visit for sinusitis or URI in the preceding 365 days, and patients who may have not have had access to care (no visit to a primary care provider in the preceding 365 days).

We created variables to describe the provider from the visit corresponding to cohort inception, including gender, department affiliation, medical specialty, degree type (Doctor of Medicine, Doctor of Osteopathic Medicine, Bachelor of Medicine Bachelor of Surgery, or midlevel provider) and years in practice (reference year = 2006).

Electronic MEdical Record Search Engine

We clinically annotated the dataset by reviewing EMR documentation from the date of cohort inception using EMERSE (Electronic Medical Record Search Engine) software.[8,9] This internally developed Web-based application provides a simple interface for searching the EMR with a bundle of words and phrases for variables of interest. For example, we created EMERSE search bundles for each of the three major symptoms of sinusitis (rhinorrhea, nasal obstruction, facial pressure) using medical and lay terms[3] (Figure 1). Each bundle was tested and modified in an iterative fashion. The finalized bundle facilitated rapid and thorough review of the EMR by highlighting text matching one or more of the terms in the search bundle. For example, "pain" was in the facial pressure bundle, and EMERSE highlighted the word "pain" regardless of the textual context ("patient reports facial pain," "patient denies facial pain," "sinuses are painful"), allowing the reviewer to quickly identify text for reading and coding.

We created additional EMERSE search bundles as needed to facilitate identification and coding of other clinical data points described in the protocol below.

Protocol for EMR Review and Coding Clinical Variables

We developed an explicit protocol to code variables of interest, as documented in the provider's narrative documentation of the sinusitis visit. We coded symptoms/signs of sinusitis and patient-reported fever as present or absent. We coded symptom duration as the number of days from symptom onset and systematically coded nonspecific references to symptom duration (few = 3; several = 7; week and a half = 10; many = 11; couple weeks = 14; few weeks = 21; several weeks = 28; last month = 30; couple months = 60; several months = 90). We identified patients with possible severe illness with indicator variables for pain (any pain except that characterized as mild or minimal), documented fever (temperature > 101°F), or immunocompromised status. We coded the provider's impression of sinusitis etiology in three categories: bacterial, nonbacterial (includes viral and noninfectious causes), and undocumented.

We extracted recommendations for nonprescription therapy (analgesics and decongestants) and prescription therapy (nasal steroid sprays and antibiotics). We coded antibiotic use in four categories: 1) observation without antibiotics, 2) continue current antibiotic, 3) antibiotic prescribed, and 4) wait-and-see instructions given with an antibiotic prescription. We coded provider specialty and the presence of a medical trainee (medical student or resident). We reviewed subsequent encounters to determine if 1) an antibiotic was prescribed after an initial trail of observations, or 2) if the antibiotic type was changed within 5 days.

We tested the protocol on the first 100 patients. Team members independently coded the cases and then met to review coding and revise the protocol to ensure data capture and uniform coding across team members. Thereafter, study team members worked in pairs. Each member independently reviewed the EMR, and the pair met weekly to compare codes. The entire team met weekly to resolve discrepancies.

Statistical Analysis

Because we were focused on antibiotic prescription at initial diagnosis, we excluded from statistical analysis 30/1,302 patients who were advised to "continue current antibiotic" prescribed prior to the inception visit date. We analyzed the remainder of the cohort (1,272) analysis. In order to characterize the quality of sinusitis care institution, we calculated descriptive statistics to describe demographic and clinical characteristics and medical treatment for the remaining cohort. We determined the proportion of patients who were eligible for observation by excluding from the denominator patients with documented fever, pain, or immune suppression.

To identify clinical and nonclinical factors associated with antibiotic use, we performed bivariable, multivariable, and multilevel analyses using receipt of antibiotics versus observation as the outcome of interest. For this outcome, we compared patients who were prescribed antibiotics versus those who were not prescribed antibiotics, or who were given wait-and-see instructions with an antibiotic prescription. Bivariable analyses were performed using logistic regression with $P < 0.05$ as the level of significance.

We developed the multivariable model by including in the full model all variables with $P < 0.2$ on bivariable analysis. To check for confounding, the nonsignificant variables were individually forced back into the model using a 15% change in the parameter estimate as the retention criterion. We developed a two-level generalized linear mixed model, logistic regression, to account for the nested study design and to test our hypothesis. The patient was the primary unit of analysis. A total of 1,272 patients were nested in 153 providers. The provider level variables were specialty, gender, and years in practice. The patient level control variables were gender, age, race, type of insurance, and presence of a medical trainee. The patient level predictor variables were nasal obstruction, rhinorrhea, pain, facial pressure, symptom duration, and presumed etiology.

First, we examined the initial effect sizes of all provider level variables, followed by all patient-level variables. Second, we examined the full model with variables from both levels as fixed effects. We used a cutoff of $P \leq 0.2$ to determine which variables to retain in subsequent modeling. We also looked for significant interactions between patient symptoms (nasal obstruction, rhinorrhea, pain, facial pressure) and between provider specialty and patient symptoms using $P \leq 0.1$ as the cutoff. All statistical analyses were performed with SAS 9.3 (SAS Institute, Inc., Cary, NC).

RESULTS

We identified 7,402 adults with sinusitis or URI diagnosed in a primary care or emergency department

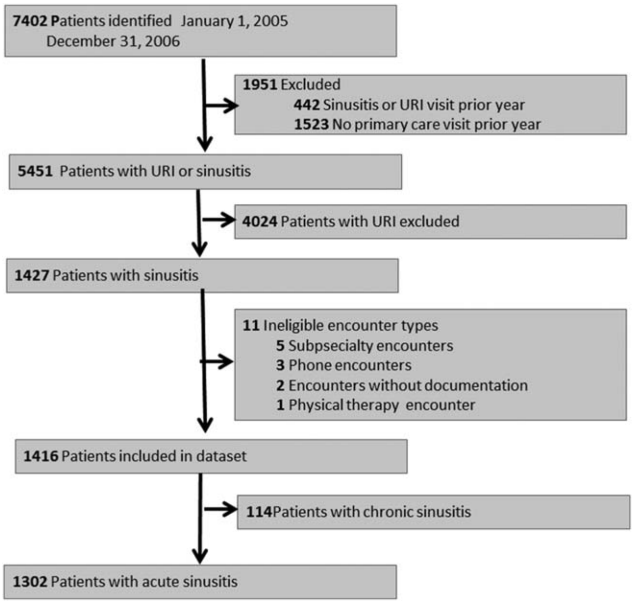

Fig. 2. Flow chart depicting identification of patients for inclusion in analytic dataset.

setting. We excluded patients who might have had preexisting sinusitis based on prior visits for sinusitis or without clear access to care (1,951). We excluded patients with URI (4,024) and reviewed the EMR for the remaining patients with sinusitis (1,427). We excluded patients with ineligible encounter type (e.g., telephone notes) or absent documentation (11). We excluded patients diagnosed with chronic sinusitis (114) because they will be described in a separate manuscript. The remaining patients with acute sinusitis (1,302) were the focus of this study.

Review of the EMR found that 30 of these 1,302 patients were advised to "continue current antibiotic." In some cases, the documentation indicates the current antibiotic was for a recently diagnosed respiratory infection; other cases are unclear. Because the decision to prescribe antibiotics at the initial diagnosis of acute sinusitis is the primary outcome measure of this study, we excluded these 30 patients from analysis, leaving 1,272 patients for statistical analysis (Figure 2).

Patient and Provider Characteristics

Most of the patients were women (73.0%), with a mean age across men and women of 44.5 years. Consistent with our regional demographics, most patients were white (88.8%), with private insurance (86.4%). Similar proportions of patients had symptoms $\geq$10 days (44.3%) versus $<$ 10 days (40.4%), and the rest were undocumented (15.3%). Symptoms of facial pressure (76.7%), rhinorrhea (74.8%), and nasal obstruction (66.0%) were common. The majority of patients (81.3%) reported at least two of these three symptoms, although 3.4% of patients had none. Pain (41.0%) and patient-reported fever (20.1%) were common, but documented fever (0.6%) was very uncommon. Documentation of the presumed etiology of the acute sinusitis, whether viral or bacterial, was lacking in the majority of records (76.7% undocumented). Medical student or resident trainees were present at a minority of patient visits (11.6%) (Table I).

TABLE I.
Patient Characteristics for Adult Acute Sinusitis Visits, Institution.

Characteristic (N = 1272)	N (%)
Age, mean (SD)	44.5 (13.9)
Female	928 (73.0)
*Race (n = 1227)	
White	1,089 (88.8)
non-White	138 (11.3)
*Insurance (n = 1271)	
Private	1098 (86.3)
Public or uninsured	173 (13.6)
Symptom duration	
Undocumented	194 (15.3)
$<$ 10 days	514 (40.4)
$\geq$ 10 days	564 (44.3)
Symptoms	
Facial pressure	975 (76.7)
Rhinorrhea	952 (74.8)
Nasal obstruction	839 (66.0)
Pain	521 (41.0)
Patient-reported fever	256 (20.1)
Documented fever	8 (0.6)
Immunocompromised	14 (1.1)
Penicillin allergy	223 (17.5)
Etiology	
Undocumented	975 (76.7)
Nonbacterial	208 (16.4)
Bacterial	89 (7.0)
Trainee present	148 (11.6)

*Numbers do not total 100% because of missing observations.
SD = standard deviation.

Analysis of the providers found similar proportions of internal medicine (42.8%) and family medicine

TABLE II.
Provider Characteristics for Adult Acute Sinusitis Visits, UMHS.

Characteristic (N = 153)	N (%)
Provider specialty	
Internal medicine	65 (42.8)
Family medicine	61 (39.9)
Emergency medicine	27 (17.7)
Female	81 (52.9)
Degree	
MD	139 (90.9)
DO	6 (3.9)
Midlevel provider	6 (3.9)
MBBS	2 (1.3)
Years in practice, mean (SD)	11.6 (8.1)

DO = Doctor of Osteopathic Medicine; MBBS = Bachelor of Medicine Bachelor of Surgery; MD = Doctor of Medicine; SD = standard deviation; UMHS = University of Michigan Health System.

TABLE III.
Medical Care Across Adult Acute Sinusitis Visits at UMHS (N = 1272).

*Adjunctive Treatment	N (%)
Decongestants	512 (40.3)
Nasal steroid sprays	156 (12.3)
Analgesics	142 (11.2)
No adjunctive treatment	613 (48.2)
Antibiotic Treatment	**N (%)**
Antibiotic prescribed	1,005 (79.0)
Wait-and-see prescription for antibiotic	90 (7.1)
No antibiotic	177 (13.9)

*Proportions do not total 100% because some patients were prescribed or advised to use more than one medication.
UMHS = University of Michigan Health System.

(39.9%) and fewer emergency medicine providers (17.7%). Most were women (52.9%), with a mean of 11.6 years in practice (Table II).

Medical Care

Medical therapy included decongestants (40.3%), nasal corticosteroids (12.3%), and analgesics (11.2%). Antibiotic prescriptions were given to 86.1% patients overall, including 79.0% who were given a prescription for immediate use and an additional 7.1% who were given a prescription with wait-and-see instructions. The remaining 13.9% of patients were not given antibiotics. However, for the analysis of antibiotic use versus observation, we defined observation to include the 7.1% of patients given a prescription with wait-and-see instructions. Using this more liberal definition, observation was used for 20.9% of all patients (13.9% no prescription, 7.1% prescription with wait-and-see instructions) (Table III). If we examine only the patients with symptoms less than 10 days and without immune suppression, pain, or documented fever, we find that observation was employed for 34.1% (95/184) of eligible patients (data not shown). In other words, 69.9% (89/184) of patients with mild symptoms of short duration were given an antibiotic.

TABLE IV.
Antibiotics for Adult Acute Sinusitis at UMHS (N = 1095).

Antibiotic	All Patients N (%)	No Allergy N (%)	Penicillin Allergy N (%)
Amoxicillin	524 (47.9)	523 (59.1)	1 (0.5
Azithromycin	212 (19.4)	117 (13.2)	95 (45.2)
Trimethoprim/ sulfamethoxazole	182 (16.6)	112 (12.7)	70 (33.3)
Amoxicillin/clavulanic acid	63 (5.8)	63 (7.1)	0
Fluoroquinolone	54 (4.9)	35 (3.9)	19 (9.1)
Other macrolide	17 (1.6)	8 (0.9)	9 (4.3)
Cephalosporin	21 (1.9)	14 (1.6)	7 (3.3)
Doxycycline	20 (1.8)	12 (1.4)	8 (3.8)
Clindamycin	2 (0.2)	1 (0.1)	1 (0.5)

UMHS = University of Michigan Health System.

TABLE V.
Predictors of Antibiotic Use for Acute Sinusitis, UMHS (N = 1,272).

Variable	Unadjusted OR (CI)	*P* Value
Patient Demographics		
Age (unit = 10 years)	.99 (0.90–1.10)	0.91
Gender (female vs. male)	1.17 (0.87–1.58)	0.29
Race (nonwhite vs. white) (n = 1,227)	.90 (0.59–1.38)	0.62
Insurance (public or uninsured vs. private) (n = 1,265)	1.15 (0.77–1.72)	0.50
Clinical Variables		
Duration		
> 10 days vs. < 10days	2.15 (1.58–2.94)	< 0.001
> 10 days vs. undocumented	2.59 (1.75–3.83)	< 0.001
< 10 days vs. undocumented	1.2 (0.83–1.74)	0.32
Nasal obstruction	1.28 (0.97–1.70)	0.079
Rhinorrhea	1.50 (1.11–2.01)	0.008
Facial pressure	3.35 (2.50–4.48)	< 0.001
Pain	2.78 (2.04–3.79)	< 0.001
Reported fever	2.75 (1.79–4.23)	< 0.001
Documented fever	1.33 (0.21–8.59)	0.76
Immunocompromised	7.83 (0.42–145.45)	0.17
Trainee present	0.68 (0.46–1.00)	0.052
Etiology		
Undocumented vs. nonbacterial	7.25 (5.24–10.05)	< 0.001
Bacterial vs. undocumented	9.77 (4.79–19.91)	< 0.001
Provider Variables		
Provider specialty		
Internal vs. family medicine	1.89 (1.43–2.49)	< 0.001
Emergency vs. family medicine	8.11 (2.49–26.35)	0.001
Female provider	1.00 (0.76–1.32)	1.00
Years in practice	1.03 (1.01–1.05)	0.007

CI = confidence interval; OR = odds ratio; UMHS = University of Michigan Health System.

Across all patients, amoxicillin (47.9%) was the most commonly prescribed antibiotic, followed by azithromycin (19.4%) and trimethoprim/sulfamethoxazole (16.6%). Among patients treated with antibiotics, 33.6% were given broad-spectrum therapy (macrolides, fluoroquinolones, beta-lactamase inhibitors, and cephalosporins) (Table IV). No patient who was initially managed without antibiotics received an antibiotic within the subsequent 5 days, and fewer than 1% of patients prescribed antibiotics changed them within 5 days.

On bivariable analysis, we modeled the outcome of interest as receipt of antibiotics versus observation. We found that none of the patient demographic characteristics was associated with receipt of antibiotics. Of the clinical characteristics, symptom duration, facial pressure, rhinorrhea, pain, reported fever, and presumed

TABLE VI.
Summary of Multilevel Regression Analysis for Variables Predicting Receipt of Antibiotics (N = 1272).

	Provider Covariates	Patient Covariates	Provider and Patient Covariates (full model)	Final Model
Variable	Adjusted OR (CI)	Adjusted OR (CI)	Adjusted OR (CI)	Adjusted OR (CI)
Fixed Effects: Level 2 Covariates				
Provider specialty				
Internal vs. Family medicine	1.80 (1.19–2.74)*		2.56 (1.43–4.57)*	2.57 (1.42–4.66)†
Emergency vs. Family medicine	8.90 (2.45–32.30)‡		17.7 (3.68–85.09)‡	18.33(3.87–87.78)‡
Emergency vs. Internal medicine	4.93 (1.36–17.87)*		6.91 (1.44–33.22)†	7.13 (1.52–33.54)†
Female provider	1.20 (0.77–1.88)		1.14 (0.62–2.1)	
Years in practice	1.02 (0.99–1.05)		1.03 (0.99–1.07)	
Fixed Effects: Level 1 Covariates				
Age (unit = 10 years)		0.99 (0.97–1.00)	0.99 (0.97–1.01)	
Patient gender (female vs. male)		0.87 (0.57–1.33)	0.88 (0.58–1.34)	
Race (nonwhite vs. white)		0.98 (0.52–1.82)	1 (0.54–1.85)	
Insurance (public/uninsured vs. private)		1.46 (0.78–2.75)	1.36 (0.72–2.57)	
Duration				
+ 10 days vs. < 10 days		1.92 (1.25–2.94)†	1.99 (1.3–3.04)†	2.10 (1.38–3.18)‡
10 + days vs. undocumented		1.91 (1.1–3.3)*	1.9 (1.11–3.28) *	1.81 (1.05–3.13)*
< 10 days vs. undocumented		1.00 (0.58–1.71)	0.96 (0.56–1.64)	0.86 (0.50–1.49)
Nasal obstruction		1.42 (0.95–2.12)	1.46 (0.98–2.18)	
Rhinorrhea		1.9 (1.21–2.97)†	2.01 (1.29–3.14)†	2.74 (1.71–4.39) ‡
Facial pressure		3.52 (2.23–5.58)‡	3.49 (2.21–5.51)‡	5.49 (3.30–9.13)‡
Pain		2.54 (1.61–4.02)‡	2.53 (1.61–4)‡	2.40 (1.54–3.74)‡
Reported fever		4.19 (2.38–7.37)‡	4.19 (2.39–7.34)‡	4.88 (2.76–8.64)‡
Trainee (present vs. absent)		0.39 (0.22–0.71)†	0.33 (0.18–0.59)‡	0.36 (0.2–0.65) ‡
Etiology				
Bacterial vs. undocumented		17.3 (7.03–42.58)‡	15.95 (6.49–39.19)‡	19.71 (8.02–48.44) ‡
Bacterial vs. undocumented		1.39 (0.62–3.14)	1.37 (0.61–3.08)	1.52 (0.68–3.43)
Undocumented vs. nonbacterial		12.44 (7.64–20.25)‡	11.66 (7.20–18.90)‡	12.94 (8.0–20.93) ‡
Rhinorrhea* Pressure				
Rhinorrhea yes (pressure yes vs. no)				1.90 (1.11–3.24)*
Rhinorrhea no (pressure yes vs. no)				15.86 (6.81–6.96)‡
Pressure yes (rhinorrhea yes vs. no)				0.95 (0.53–1.70)
Pressure no (rhinorrhea yes vs. no)				7.91 (3.70–16.94)‡

*$P = < .05$.
†$P = < .01$.
‡$P = < .001$ (two-tailed test).
CI = confidence interval; OR = odds ratio.

etiology were significant predictors of antibiotic use. Of the provider characteristics, provider specialty and years in practice were significant predictors of antibiotic use (Table V). On multivariable analysis of the patient and clinical characteristics, we found that antibiotic use was significantly associated with symptom duration longer than 10 days, facial pressure, pain, reported fever, bacterial or undocumented etiology, and medical trainee (data now shown).

With multilevel analysis, we found that all of the patient characteristics from the final multivariable model remained statistically significant predictors and rhinorrhea became significant. Notably, addition of the provider level covariates was statistically significant in explaining some of the variation in antibiotic use[10] (Table VI).

DISCUSSION

This is the first study with detailed clinical data to benchmark the quality of care for acute sinusitis against the AAO–HNS Clinical Practice Guideline: Adult Sinusitis. This is also the first detailed study of provider level factors associated with antibiotic use. The primary strength of this article is the study design, which provided detailed patient and provider information that allowed us to focus the analysis on patients with newly diagnosed acute sinusitis.

In this study, we find that symptom duration and severity influence the decision for antibiotics. We also find that the visit provider, provider's medical specialty, and presence of a medical trainee influence antibiotic use. Because the diagnosis of acute sinusitis is subjective, and because the use of antibiotics may be influenced by patient expectations, it is not surprising that its use varies across providers. However, we did not expect the magnitude of the effect of individual provider to be as substantial as it is. In this same vein, the presence of a medical trainee appears to have a strong protective effect against antibiotic use for acute sinusitis. It appears that when a trainee is involved in patient care, providers are more likely to observe a patient rather than treat with antibiotics. This appears to be a case of the Hawthorne effect, mediated by medical students and residents.[11]

Consistent with clinical practice guideline (CPG) statements to assess pain and provide symptom relief, we find that approximately half of all patients receive analgesics, decongestants, or nasal steroid sprays. Despite the CPG recommendation to differentiate viral from bacterial sinusitis, and the option to observe the patient with mild bacterial sinusitis without antibiotics, we find 66% of patients with mild symptoms of short duration received antibiotics. As recommended by the CPG, amoxicillin is frequently used as first-line antibiotic therapy (48%). Aside from clinical factors, we find that the medical provider, provider's specialty, and presence of a medical trainee significantly impact use of antibiotics.

The rate of decongestant use that we report is higher (40% vs. 24%) than previously reported,[12] and analgesic use is lower (11% vs. 19%–23%).[13,14] Previous reports analyzed prospectively collected data to determine medical treatment, whereas our study design relied on narrative documentation. As a result, our study may have underestimated some treatments, particularly nonprescription therapies that may not be as well-documented as prescription therapy. This may explain the lower-than-expected rates of analgesic use but does not explain the higher-than-expected rates of decongestant use.[12] The proposed explanation of our finding of high rates of decongestant use is discussed below.

Overall, antibiotic use in this study was high and comparable that in other studies (86% vs. 75%–86%).[6,12,13,15] However, the strength of this study is the clinically detailed nature of our dataset, which allowed us to examine antibiotic use in a manner that has not been reported previously. We were able to focus the analysis on patients with mild symptoms[3] and analyze patients who were given wait-and-see instructions with the observation group. With this more nuanced analysis, the frequency of antibiotic use decreases from 86% to nearly 66%. It is impossible to know what proportion of patients merit antibiotics versus observation. However, in light of the self-limiting nature of acute sinusitis, its high rate of spontaneous resolution, and the large and growing problem of antibiotic resistance, the frequency of antibiotic use in this study and in the published literature is probably too high.[16,17]

Amoxicillin as a first-line antibiotic was higher (48% vs. 8%–29%)[6,12,13] than previously reported and broad spectrum antibiotic use was lower (34% vs. 55%–76%).[6,15] The greater use of amoxicillin and lower use of broad spectrum antibiotics, as well as differential use of decongestants as mentioned above, likely reflect concerted institutional efforts to influence treatment of acute sinusitis. Those efforts include development of a local CPG for acute sinusitis.[18] The CPG is developed and regularly updated by a multidisciplinary panel, including family medicine, internal medicine, and otolaryngology clinicians. The CPG recommends decongestants and amoxicillin but is silent about recommendation of analgesics. The CPG is promoted through local educational forums and is available on the institutional home page of its website with other commonly accessed clinical care reference for easy access during routine clinical care. In addition to this educational effort centered on the CPG, individual providers also received a periodic profile describing their individual use of antibiotics for acute sinusitis and a comparison with their peers.

These intensive efforts to modify treatment of acute sinusitis began in 1995 and thus preceded the 2005 to 2006 time period studied in this thesis. As a result, the educational and physician profiling efforts may partially explain the greater use of amoxicillin and decongestants and the lesser use of analgesics. This is interesting due to the known difficulty of changing provider behavior through educational efforts.[19–21] Because the current dataset does not extend prior to 1995, when the institutional intervention began, we do not know how much of these differences are due to these institutional efforts to change provider treatment. However, the finding that some of the marked differences in our study data compared to previously published data correlate with specific recommendations within our local CPG supports the value of locally developed and promulgated CPGs.

Study Limitations

This study has significant limitations worth noting. There are important differences in our study methodology compared to studies based on a large cross-sectional survey such as that available from the National Ambulatory Medical Care Survey (NAMCS).[6,12–14] Our study methodology entailed detailed review of clinical documentation from the patient encounter. To our knowledge, it is the only study on this topic using such detailed clinical information. Studies using NAMCS data are also based on diagnostic codes and prescription and nonprescription medication use, but those studies lack important clinical information. For example, studies based on NAMCS are not able to exclude patients who are already taking an antibiotic, and are not able to discern patients with newly diagnosed acute sinusitis from those with recurrent or persistent sinusitis. The longitudinal nature of the data repository from which we obtained this dataset and our access to the EMR allowed us to develop a highly selected dataset with detailed clinical information in order to gain insight into the pervasive problem of overuse of antibiotics for acute sinusitis.

Statistics based on administrative data are confounded by providers' biases in their manner of diagnostic coding. For example, one provider may utilize ICD-9 465, "acute upper respiratory infection," for patients with infection whom the provider manages with observation, and may reserve ICD-9 461, "acute sinusitis," for those patients whom the provider treats with antibiotics. This lack of consistency in diagnostic coding across providers would result in a nondifferential bias over a large number of providers. However, in this institutional dataset with a more limited number of providers, we do not know the effect of such biases, if indeed they are present. If this bias is present, it would contribute to the amount of variation in antibiotic use attributable to the individual provider. Also, the results of this study from a single institution cannot necessarily be generalized to a wider population.

CONCLUSION

Antibiotics continue to be overused for patients with mild acute sinusitis of short duration. We report that nonclinical characteristics, including the medical provider, the provider's specialty, and the presence of a medical trainee, significantly influence use of antibiotics for acute sinusitis.

Acknowledgment

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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