

Concise Communication

Appropriateness of antibiotic prescriptions for acute sinusitis and pharyngitis in an integrated healthcare system

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Abstract

We evaluated the appropriateness of antibiotic prescriptions for acute sinusitis and pharyngitis. Overall, 81% of antibiotic prescriptions for acute sinusitis were inappropriate and 48% of antibiotic prescriptions for pharyngitis were inappropriate. Types of prescribing errors differed between the 2 infections, including lack of an indication for antibiotics and excessive duration in ~50% of sinusitis cases and incorrect antibiotic dose in ~33% of pharyngitis cases.

(Received 21 February 2018; accepted 28 April 2018; electronically published May 29, 2018)

The National Action Plan for Combating Antibiotic Resistance calls for a 50% reduction in inappropriate antibiotic use in outpatient settings by 2020,¹ and the Centers for Disease Control and Prevention (CDC) guidance suggests identifying 1 or more high-priority conditions for initial intervention.² Acute sinusitis and pharyngitis are 2 of the 3 most common indications for antibiotic prescriptions.³ Numerous studies suggest that a large proportion of these prescriptions may be inappropriate;^{3–8} however, given the use of administrative data, the appropriateness of prescriptions could not be directly assessed in these studies. The objective of this study was to evaluate the appropriateness of antibiotic prescriptions for acute sinusitis and pharyngitis.

Methods

Study design and setting

Denver Health is an integrated healthcare system with ambulatory-care sites including an emergency department, 2 urgent care centers, 9 primary care clinics, and 17 school-based health centers.⁹ This study was a retrospective cross-sectional study of patients diagnosed with acute sinusitis or pharyngitis between May 1, 2016, and October 31, 2016.

Data collection

Potentially eligible cases were identified from the institutional data warehouse using *International Classification of Disease*,

Tenth Revision (ICD-10) codes for acute rhinosinusitis, acute streptococcal pharyngitis, acute pharyngitis, and acute tonsillitis (Supplemental Table 1). The medical records of a random sample of cases were manually reviewed. The main exclusion criteria were symptoms lasting >28 days, not the initial visit for the infection, specialty clinic appointment, recurrent infection, <1 year of age, pregnancy, or hospitalization. Antibiotic prescriptions were recorded based on the provider's intent, irrespective of patient adherence to the treatment.

Definitions

A prescription was classified as inappropriate if any of 4 prescribing errors occurred: an antibiotic was not indicated or the antibiotic choice, dose, or duration of therapy was discordant with Infectious Diseases Society of America (IDSA) guidance (Supplemental Table 2).^{10,11} For acute sinusitis, an antibiotic was deemed to be indicated when at least 1 criteria for acute bacterial sinusitis was present: (1) persistent symptoms not improving for ≥ 10 days; (2) severe symptoms (temperature $>38^{\circ}\text{C}$ [101°F] or severe sinus pain) for ≥ 3 days; or (3) initial improvement followed by worsening symptoms.¹⁰ Although amoxicillin is not recommended in the current IDSA guideline, Denver Health guidance advocates its first-line use; thus, it was classified as appropriate for the purposes of the study. For pharyngitis, an antibiotic was deemed to be indicated if (1) signs or symptoms of acute pharyngitis were present and (2) a rapid antigen test or throat culture was positive for group A streptococcus.¹¹

Statistical analyses

Multivariable logistic regression models were developed to evaluate patient and prescriber factors associated with the 3 most common prescribing errors identified. Factors with $P < .20$ in

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PREVIOUS PRESENTATION: This work was presented in part at IDWeek on October 5, 2017, in San Diego, California (abstract #675)

Cite this article: Chauhan L, et al. (2018). Appropriateness of antibiotic prescriptions for acute sinusitis and pharyngitis in an integrated healthcare system. *Infection Control & Hospital Epidemiology* 2018, 39, 991–993. doi:10.1017/ice.2018.117

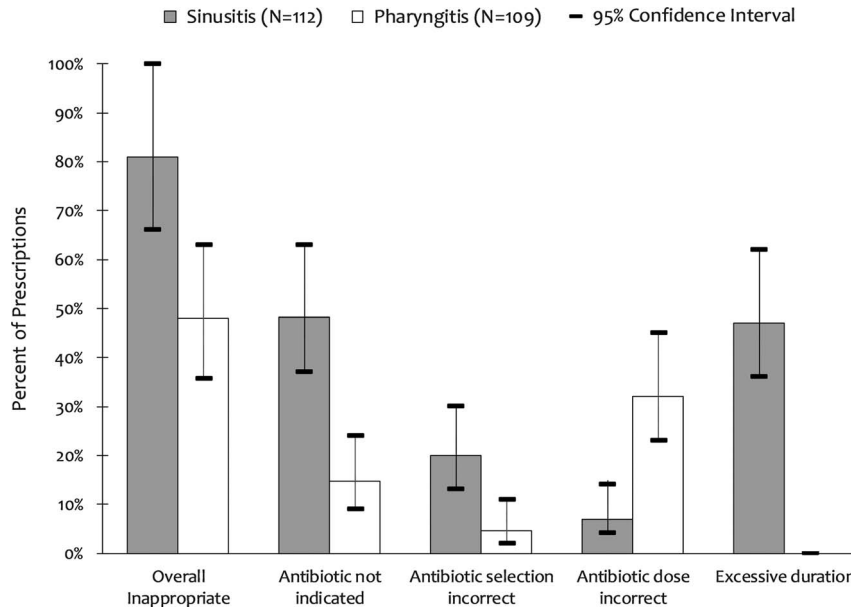


Fig. 1. Frequency of inappropriate antibiotic prescriptions overall and by specific prescribing error in cases of acute sinusitis and pharyngitis. Note. The analysis was limited to cases in which the antibiotic was prescribed only for sinusitis ($n = 112$) or pharyngitis ($n = 109$).

bivariate analysis and those deemed to be clinically important were used to develop the regression models.

Results

During the study period, 674 cases of acute sinusitis and 2,942 cases of pharyngitis were identified by our ICD-10 search. Among them, 201 cases of sinusitis and 338 of pharyngitis were reviewed; 130 and 275 cases, respectively, were included for analysis.

Acute sinusitis

The median age of patients with sinusitis was 46 years, and 75% were female. Other demographic and clinical characteristics are shown in Supplemental Table 3. Penicillin allergy was documented in 18 cases (14%).

In total, 117 patients (90%) with sinusitis were prescribed an antibiotic; 87 of these prescriptions (74%) were for a first-line agent (ie, amoxicillin or amoxicillin-clavulanate). The median duration of therapy was 7 days (interquartile range, 7–10 days) (Supplemental Table 4). Of 112 cases in which sinusitis was the sole indication for the prescription, 91 prescriptions (81%) were classified as inappropriate due to 1 or more prescribing errors (Fig. 1). Lack of an indication for antibiotics (48% of cases) and excessive duration of therapy (47% of cases) were the most common errors. By logistic regression, factors independently associated with prescription of antibiotics when not indicated included urgent care or emergency department site of visit (odds ratio [OR], 3.7; 95% confidence interval [CI], 1.0–13.3) and presence of purulent nasal discharge (OR, 2.6; 95% CI, 1.1–6.4) (Table 1). The only factor independently associated with excessive duration of therapy was urgent care or emergency department visit (OR, 6.6; 95% CI, 1.8–24.9).

Pharyngitis

The median age of patients with pharyngitis was 13 years. Other demographic and clinical characteristics are shown in Supplemental Table 3. Penicillin allergy was documented in 15 cases (5%).

In total, 130 patients with pharyngitis (47%) were prescribed an antibiotic; 105 of these prescriptions (81%) were for a first-line agent (eg, penicillin V potassium, amoxicillin, or benzathine penicillin) (Supplemental Table 4). Of 109 cases in which pharyngitis was the sole indication for the prescription, 52 prescriptions (48%) were classified as inappropriate (Fig. 1). Incorrect antibiotic dose was the most common error, which occurred in 35 prescriptions (32%). In all but 1 case, the dose was higher than recommended. By logistic regression, prescription of amoxicillin was the only factor independently associated with incorrect antibiotic dose (OR, 3.8; 95% CI, 1.6–9.1) (Table 1).

Discussion

A substantial proportion of both acute sinusitis and pharyngitis cases involved inappropriate antibiotic prescriptions; however, the types of prescribing errors differed between these 2 infections.

Using national administrative datasets, Fleming-Dutra *et al.*³ estimated that antibiotic prescriptions could be reduced by 51% in adult sinusitis cases and by 34% in pediatric pharyngitis cases.³ In our patient-level analysis, we confirmed that for sinusitis, nearly half of prescriptions were not indicated, whereas this was much less common in pharyngitis (14% not indicated). Lack of an objective diagnostic test and difficulty in clinically distinguishing bacterial from viral sinusitis likely contribute to this marked antibiotic overuse and highlight the need for novel interventions to reduce overprescribing for sinusitis.

Hersh *et al.*⁵ recently estimated that 48%–63% of prescriptions for sinusitis and 40%–67% for pharyngitis are for non-first-line antibiotics.⁵ Our study revealed substantially lower rates of incorrect antibiotic choice for both sinusitis (20%) and pharyngitis (5%), underscoring the importance of understanding prescribing practices at one's own institution prior to developing stewardship interventions. We also identified a high frequency of dosing errors (nearly always higher doses than recommended) in ~33% of prescriptions for pharyngitis. Finally, similar to findings from a recent CDC study,⁸ almost half of prescriptions for sinusitis were for 10 or more days rather than the recommended 5–7 days, demonstrating

Table 1. Multivariable Logistic Regression Models of Factors Associated With Common Prescribing Errors

Model	Variable	Bivariate Analysis OR (95% CI)	Adjusted Analysis OR (95% CI)
Factors associated with prescription of antibiotic for sinusitis when not indicated			
	Physician (vs advanced practice provider)	2.1 (1.0–4.2)	1.8 (0.8–4.2)
	Urgent care/ED site of visit (vs outpatient clinic)	1.8 (0.6–5.2)	3.7 (1.0–13.3)
	Cough	0.3 (0.1–0.6) ^a	0.2 (0.1–0.5)
	Purulent nasal discharge	1.5 (0.7–3.1) ^a	2.6 (1.1–6.4)
	Prescription of nonantibiotic adjuvant therapy	0.8 (0.4–1.7)	0.5 (0.2–1.1)
Factors associated with excessive duration of therapy for sinusitis			
	Physician (vs advanced practice provider)	2.1 (1.0–4.2)	0.7 (0.3–1.6)
	Urgent care/ED site of visit (vs outpatient clinic)	1.8 (0.6–5.2)	6.6 (1.8–24.9)
	Diabetes mellitus	1.1 (0.4–2.8) ^a	0.1 (0.04–0.5)
	Asthma	1.4 (0.6–3.4) ^a	0.4 (0.1–1.3)
	Prescription of nonantibiotic adjuvant therapy	0.8 (0.4–1.7)	0.9 (0.3–2.3)
	Prescription of azithromycin	0.6 (0.2–1.9) ^a	0.04 (0.004–0.3)
Factors associated with incorrect antibiotic dose for pharyngitis			
	Physician (vs advanced practice provider)	1.0 (0.5–2.2)	0.8 (0.3–1.8)
	Urgent care/ED site of visit (vs outpatient clinic)	0.5 (0.2–1.3)	0.4 (0.1–1.3)
	Weight (kilograms)	1.8 (0.8–4.2) ^a	1.9 (0.7–5.0)
	Prescription of amoxicillin	2.9 (1.3–6.6) ^a	3.8 (1.6–9.1)

NOTE. OR, odds ratio; CI, confidence interval; ED, emergency department.

^aP value < .20 on bivariate analysis.

a substantial opportunity to shorten treatment durations. In aggregate, our data highlight that in addition to prescription of antibiotics when not indicated, incorrect antibiotic choice, dose, and duration of therapy are common prescribing errors that are important targets for intervention. These errors may be particularly amenable to electronic health record-based interventions. Our logistic regression models suggest that the urgent care and emergency department settings may be an important area of focus.

This study has several limitations. This study was performed in a single ambulatory-care network with an active antibiotic stewardship program; hence, these results may not be generalizable to other practice settings. Furthermore, given the retrospective design,

incomplete medical record documentation may have led to overestimation of the proportion of sinusitis cases in which an antibiotic was not indicated. Finally, the relatively small sample size limited the statistical power of the logistic regression models and precluded inclusion of all potentially relevant variables in the final models.

In conclusion, considerable opportunity exists to reduce inappropriate antibiotic prescriptions in both acute sinusitis and pharyngitis. This study highlights the idea that optimizing prescribing in ambulatory care requires attention to all 4 aspects of the stewardship mantra: “Right antibiotic, at the right dose, at the right time, and for the right duration,” and our findings support the CDC recommendation to identify high-priority conditions for initial stewardship interventions.²

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2018.117>

Acknowledgments

Financial support. No financial support was provided relevant to this article.

Conflicts of interest. All authors report no conflicts of interest relevant to this article.

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