

Antibiotic Prescribing in a Family Medicine Residency Program

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A total of 227 ambulatory patients who received prescriptions for antibiotics in a family practice residency program was studied. The common infections treated were urinary tract infections, upper respiratory tract infections, impetigo, nonspecific vaginitis, and bronchitis. Cultures obtained in 21.1 percent of the patients were usually considered to be appropriate. Urinary tract infections were usually treated with co-trimoxazole or other drugs containing sulfonamides; upper respiratory tract infections with amoxicillin, ampicillin, or penicillin; impetigo with penicillin; nonspecific vaginitis with vaginal creams; and bronchitis with ampicillin or erythromycin. Most prescriptions (86 percent) were written generically at an approximate savings of \$2 per prescription. A review panel audited the prescribing practices and often (32.2 percent) disagreed among themselves, yet they did determine 65.4 percent of the prescriptions to be appropriate. The rate of appropriate antibiotic prescribing practices among the residents was found to decrease as the level of supervision decreased ($P < 0.01$).

Each year in the United States there are more new prescriptions written for antibiotics than for any other drug group.¹ Prominent investigators in the field of antibiotic therapy have raised many doubts about the appropriateness of antibiotic prescribing practice,²⁻⁵ and several studies have confirmed that these doubts are well-founded.⁶⁻¹⁰ All these studies, however, were designed to evaluate antibiotic prescribing in a hospital setting. A recent study evaluated the overall prescribing habits

of family physicians in the ambulatory setting, but it did not address the appropriateness of antibiotic prescribing.¹¹

Since a large-scale audit of ambulatory antibiotic prescribing practices among American family physicians has not been done, the authors decided to document various aspects of antibiotic prescribing in a model family practice center. The six major objectives of the study were to determine (1) the most common disease states treated with antibiotics, (2) the frequency with which cultures were obtained, (3) the antibiotics used for each disease, (4) the overall frequency of generic prescribing and cost of the most commonly used antibiotics, (5) the appropriateness of antibiotic prescribing as judged by a review panel, and (6) the effect of the

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prescriber's educational and supervision level on antibiotic prescribing practices.

Methods

A randomized retrospective audit was performed on the medical records of the patients treated at a family medicine residency training office. Every fifth chart was reviewed to determine if a visit to the clinic occurred within the previous year and an antibiotic had been prescribed during this time period. The following data were recorded on each of the antibiotic recipients: name, visit date, age, weight, diagnosis, culture data, name of drug, strength, directions for drug use, treatment duration, and educational level of the prescriber. Accurate prescription information was possible by means of a prescription copy system present in each patient's chart.¹² Once the top five drugs were identified, a survey of three local pharmacies was performed to establish the average cost to the patient of a ten-day course of treatment.

A six-member review panel was formed, composed of one board-certified family physician engaged in private practice, two assistant professors of medicine board-certified in family medicine, one assistant professor of medicine board-certified in both internal medicine and family medicine, one associate professor of medicine board-certified in pediatrics, and one clinical pharmacist who has practiced in a family practice clinic for four years. The members of the panel reviewed the patient data to determine if they agreed with the prescriber's (1) decision to perform or not perform a culture, (2) choice of antibiotic, (3) drug dosage regimen, and (4) treatment duration. Using the information presented, if the physician had indicated agreement, questionable agreement, or disagreement, that information was recorded. If the review panel member could not clearly place the prescription in one of these categories, it was so noted, and additional information was presented that enabled the reviewing panelist to make a clear decision. This information was supplied to the reviewer in a way that preserved the patient's and prescriber's anonymity. The data on the prescriber's educational level were also withheld from the reviewers. Rigid evaluation criteria were not established for each disease state. Rather, it was decided that a case-by-case review using the

reviewers' varied backgrounds constituted a fair approach in determining appropriate therapy. All reviews by the panel members were done independently, without knowledge of the other panelists' decisions. Chi-square analysis at an alpha level = 0.05 was performed on all appropriateness decisions made by the panel.

Results

There were 1,200 patients' medical records randomly selected among 27,845 patient visits at the clinic during the previous year. Of this group, 227 (18.9 percent) received prescriptions for antibiotics. As seen in Table 1, urinary tract infections (UTI) were the most commonly treated problem (15.4 percent). Upper respiratory tract infections were the most commonly seen *group* of infections (otitis media, 13.7 percent; pharyngitis, 10.1 percent; sinusitis, 3.1 percent; and common cold, 3.1 percent, totaling 30.0 percent). The list of infectious disorders was quite varied, totaling 27 different identified conditions. Four percent of the medical records did not clearly state a specific diagnosis. Fifty-one percent of the patients were between the ages of 21 and 64 years. Only 4 percent were 65 years or older, and the remaining 45 percent were pediatric or adolescent patients (6 years, 23 percent; 6 to 12 years, 12 percent; 13 to 20 years, 10 percent).

Cultures were obtained more than once in only the four following disease states: pharyngitis (78 percent), UTI (60 percent), bronchitis (20 percent), and skin infections (15 percent). Eighty-five percent of these were done concomitantly with the initiation of therapy. Cultures were requested more often by physicians' assistants (34 percent), first-year residents (27 percent), and faculty (26 percent). Second-year and third-year residents ordered cultures less often (7 percent and 18 percent, respectively) than did the other prescribers ($P < 0.01$).

Co-trimoxazole was the most frequently prescribed (27 percent) antibiotic for UTI (Table 2). Sulfisoxazole, considered by most to be the drug of choice for UTI, when grouped with sulfamethoxazole and co-trimoxazole, constituted over 60 percent of the prescriptions for UTI. If ampicillin and amoxicillin are grouped, they represent over 30 percent of UTI treatment regimens. When the

Table 1. Frequency of Diseases Treated with Antibiotics and Review Panel Consensus

Disorder	Number of Cases (%)	Predominant Age (yr) (%)	Percent Review Panel Consensus Agreement with Treatment
Urinary tract infection	35 (15.4)	21-64 (76)	71.4
Otitis media	31 (13.7)	6 (71)	67.7
Pharyngitis	23 (10.1)	64 (100)	52.2
Impetigo	16 (7.0)	6 (69)	87.5
Nonspecific vaginitis	16 (7.0)	21-64 (94)	75.0
Bronchitis	15 (6.6)	21-64 (60)	60.0
Skin infections	13 (5.7)	21-64 (54)	53.8
Not identified	9 (4.0)	21-64 (89)	11.1
Sinusitis	7 (3.1)	13-64 (71)	85.7
Urethritis	7 (3.1)	21-64 (100)	28.6
Common cold	7 (3.1)	21-64 (57)	28.6
Conjunctivitis	6 (2.6)	6 (50)	66.7
Otitis externa	6 (2.6)	13-20 (33)	100.0
Pelvic inflammatory disease	6 (2.6)	21-64 (51)	50.0
Trichomonas vaginitis	5 (2.2)	21-64 (80)	100.0
Others*	25 (11.2)	—	64.0

*Less than 2 percent include cellulitis, cervicitis, and pneumonia; less than 1 percent include acne, burns, endometritis, hidradenitis, infected tooth, lacerations, prostatitis, rheumatic fever, and syphilis

data in Table 2 are similarly grouped, it is evident that otitis media was usually treated with amoxicillin or ampicillin (68 percent), pharyngitis and impetigo were usually treated with the penicillins (91 and 81 percent, respectively) and bronchitis, skin infections, sinusitis, and other upper respiratory tract infections were usually treated with either the penicillins (48 percent) or erythromycin (37 percent).

There was a broad assortment of antibiotics prescribed, with the top five totaling 62 percent of all antibiotic prescriptions (Table 3). Ampicillin and amoxicillin were most commonly used (27 percent). The top five agents were prescribed generically 86 percent of the time.

Most infections (79 percent) were treated for a total of 7 (24 percent), 10 (46 percent), or 14 (9 percent) days. Five percent were treated for longer than 14 days, while the remainder (16 percent) were treated for less than a week. Over one third of this latter group received a benzathine penicillin injection for pharyngitis or impetigo as a single-dose treatment.

Approximately one half (51 percent) of the antibiotic prescriptions written at the family medicine clinic were written by first year (6 percent), second-year (30 percent) or third-year (15 percent) family practice residents. The remainder were divided among physicians' assistants (21 percent), faculty (21 percent), and others (7 percent). Both physicians' assistants' prescriptions and those by the first-year residents were countersigned by the faculty.

Table 4 demonstrates an overall consensus among the review panelists that approximately 65.4 ± 6.6 percent of the antibiotic prescriptions were prescribed correctly and without question (range 56.4 to 71.8 percent). When each prescription was analyzed for a consensus, 63.9 percent of the panelists generally agreed (ie, four out of six panelists) on each prescription. A unanimous decision was seen in only 21.6 percent of the 227 prescriptions reviewed. The most common reason for reviewer disagreement with the prescriber was the drug treatment regimen (79.7 percent). Most of the remaining disagreement existed because a cul-

Table 2. Frequency of Specific Antibiotics for Each Infection

Disease	First (%)	Second (%)	Third (%)	Fourth (%)
Urinary tract infection	Co-trimoxazole (27.3)	Ampicillin (21.2)	Sulfisoxazole (18.2)	Sulfamethoxazole (15.0)
Otitis media	Amoxicillin (45.2)	Ampicillin (22.6)	Co-trimoxazole (16.1)	Pen-Vee K (9.7)
Pharyngitis	Pen-Vee K (60.9)	Benzathine penicillin (17.4)	Ampicillin (13.0)	Erythromycin (8.7)
Impetigo	Benzathine penicillin (37.5)	Pen-Vee K (31.3)	Cloxacillin (6.3)	Ampicillin (6.3)
Nonspecific vaginitis	Sultrin (50.0)	Metronidazole (25.0)	Ampicillin (12.5)	AVC Cream (6.3)
Bronchitis	Ampicillin (33.3)	Erythromycin (33.3)	Doxycycline (13.3)	Pen-Vee K (6.7)
Skin infections	Pen-Vee K (38.5)	Erythromycin (30.8)	Tetracycline (15.4)	Dicloxacillin (7.7)
Not identified	Ampicillin (33.3)	Pen-Vee K (22.2)	Benzathine penicillin (11.1)	Erythromycin (11.1)
Sinusitis	Ampicillin (42.9)	Erythromycin (42.9)	Tetracycline (14.2)	
Urethritis	Tetracycline (42.9)	Amoxicillin (14.3)	Erythromycin (14.3)	Sulfisoxazole (14.3)
Common cold	Erythromycin (42.9)	Amoxicillin (14.3)	Ampicillin (14.3)	Benzathine penicillin (14.3)
Conjunctivitis	Chloramphenicol ophthalmic (33.3)	Cortisporin Ophthalmic (33.3)	Sulfacetamide (33.3)	
Otitis externa	Cortisporin Otic (100.0)			
Pelvic inflammation	Ampicillin (50.0)	Tetracycline (33.3)	Pen-Vee K (16.7)	
Trichomonas vaginitis	Metronidazole (100.0)			

ture was not ordered (18.9 percent). Rarely (1.4 percent) did the reviewers think that the prescriber's ordering of cultures was excessive. Most physicians prescribed antibiotics for an appropriate length of time (83.3 percent).

The review panel agreed most frequently (80 percent) with the first-year family medicine residents' antibiotic prescribing habits and least frequently (50 percent) with the third-year residents' prescribing habits. The panelists' agreement with the family medicine faculty was also low (57.4 percent).

Chi-square analysis of appropriate prescribing among the various groups revealed no significant differences, although certain trends were observed. To determine if the level of prescribing experience influenced prescribing appropriateness, the group of second-year residents, third-year residents, physicians' assistants, and faculty were compared with the group of inexperienced prescribers (first-year family practice and psychiatry residents). No difference was discovered. However, when the group of most supervised prescribers

(first-year residents, psychiatry residents, and physicians' assistants) were compared with the third-year residents, who had the least supervision, a difference was observed ($P < 0.01$). This difference remained when the second- and third-year residents were grouped and compared with the most supervised group above ($P < 0.01$).

Discussion

Numerous studies are found in a review of the literature addressing the issue of overall physician prescribing habits, with those including an antibiotic audit numbering 32.^{1,5-11,13-36} Among those auditing overall physician prescribing habits in ambulatory settings, only 12 have included antibiotics.^{11,14,17-20,25,26,32-35} Of these, six ambulatory studies specifically addressed antibiotic use,^{14,18,32-35} four were European studies,³²⁻³⁵ one involved only chloramphenicol and tetracycline use,¹⁴ and the

Table 3. Antibiotic Frequency

Drug	Percent	Generically Prescribed (%)*
Ampicillin	18.1	100.0
Pen-Vee K	16.3	83.3
Erythromycin	11.0	64.1
Amoxicillin	9.3	87.1
Tetracycline	7.0	90.4
Co-trimoxazole	7.0	
Benzathine penicillin	6.6	
Metronidazole	4.4	
Sultrin	4.0	
Cortisporin Otics/ Ophthalmic	3.5	
Sulfisoxazole	3.1	
Sulfamethoxazole	2.6	
Sulfacetamide Ophthalmic	1.3	
Chloromycetin Ophthalmic	0.9	
Doxycycline	0.9	
Others (0.5 percent)	4.5	

*The incidence of generic prescriptions was determined for the top five drugs only because the remaining drugs are rarely prescribed generically

other¹⁸ is yet to be published in other than abstract form. One recently published study assessed the overall prescribing patterns in a family medicine residency program, but little attention was given to antibiotic prescriptions. Many problems also existed with the prescription copy method used, and no review panel was established to determine appropriate therapy.¹¹ Hence, even though 15 to 20 percent of all prescriptions written for ambulatory patients are for antibiotics,¹ and over \$1.55 billion worth of antibiotics were sold in this country alone in 1979,³⁶ a comprehensive audit of antibiotic prescribing practices in an American ambulatory setting has not previously been described.

The 18.9 percent antibiotic prescribing rate per office visit is in close agreement with the 15 to 20 percent reported by Simmons et al¹ for ambulatory patients. As would be expected, the largest group of patients (32.9 percent of the total) received antibiotics for upper respiratory tract infections, but the vast majority had evidence of complications or bacterial infection (ie, otitis media, sinusitis, pharyngitis, etc). Only 3.1 percent of prescriptions were for patients with a simple "common cold"; the remaining 29.8 percent demonstrated evidence of bacterial infection as judged by the review panel's record review. From data available the percentage of patients with common colds treated

Table 4. Overall Agreement with Prescribing Practices Among the Six Review Panelists

	Mean ± SD	Pharmacist	Pediatrician	Internal Medicine Faculty	Family Practice Faculty	Family Practice Faculty	Family Physician
1. Agree (%)	65.4 ± 6.6	67.8	57.7	71.8	68.0	56.4	70.6
2. Questionable agreement (%)	19.5 ± 3.6	20.3	13.7	19.4	23.6	22.5	17.6
3. Disagree (%)	15.1 ± 8.0	11.9	28.6	8.8	8.4	21.1	11.8
Reason (if 2 or 3 above)							
Inappropriate drug	51.5 ± 20.0	63.2	45.7	55.0	21.0	43.8	80.3
Incorrect dose	16.5 ± 6.3	20.6	18.1	10.0	19.4	22.9	7.1
Incorrect duration	11.7 ± 5.5	4.4	19.1	16.7	12.9	9.4	5.4
No culture, need one	18.9 ± 17.0	10.3	14.9	16.7	40.3	24.0	7.1
Culture performed, but not necessary	1.4 ± 2.6	0.0	2.1	0.0	6.4	0.0	0.0

with antibiotics could not be determined, but considering that these patients are frequently seen in this office practice, the rate is probably much lower than the 18 percent antibiotic utilization report by Howie et al³² for coryza or the 49 percent rate reported by Kunin et al.⁴

Roberts and Visconti⁵ showed that most antibiotic prescribing for hospitalized patients occurs without prior bacterial cultures. Furthermore, when cultures were obtained, an appropriate antibiotic was often chosen and continued by the attending physician. Cultures are less often appropriate or needed in an ambulatory setting. Most would agree, for example, that a culture is an unnecessary expense in otitis media, bronchitis, impetigo, and from certain patients with simple cystitis. Cultures were obtained from 21.1 percent of patients receiving antibiotics, and of those prescriptions deemed inappropriate by the review panel, one fifth were for lack of a culture. Second- and third-year residents obtained cultures significantly less often ($P < 0.01$) than did other providers, suggesting a need for increased supervision and teaching in this area.

The use of co-trimoxazole (Table 2) for UTI (27 percent) is similar to that reported in Ireland (35 percent).³⁵ The total of co-trimoxazole and sulfisoxazole (60 percent) is also similar (65 percent); however, the ampicillin/amoxicillin group (30 percent) is larger than that reported in the same study.³⁵ Very few comparisons of the treatment of other disease states are available for ambulatory patients.

It was not surprising to learn that amoxicillin has replaced ampicillin as the most commonly prescribed drug for otitis media, considering the reported decreased incidence of diarrhea secondary to amoxicillin and its convenient dosing regimen of every eight hours.³⁷ Ampicillin, rather than amoxicillin, remained the most common treatment for other infections (eg, bronchitis, sinusitis, and pelvic inflammatory disease). Although it is comforting that the prescribers generally (78.3 percent) chose penicillin as their treatment of choice for pharyngitis, it is disappointing to see physicians (13 percent) still using ampicillin. The use of ampicillin for streptococcal or viral pharyngitis offers no advantage over penicillin, and the disadvantages include higher cost and an increased risk of superinfections and skin rash.³⁸

Determining appropriateness of antibiotic pre-

scriptions is a difficult task, with most studies attempting to do so using a peer review approach. Since no written criteria to judge appropriateness of prescribing were used in this study, an element of subjectivity certainly exists. Several studies using such an approach have found about one half of all antibiotics prescribed in hospitals are inappropriate.²⁷⁻²⁹ One such study recently demonstrated that family physicians prescribed antibiotics appropriately for hospitalized patients only 67 percent of the time.³⁰ These data show a similar rate of appropriate prescribing, with a majority consensus by the review panel agreeing with prescribers 63.9 percent of the time. Unexpectedly, there was unanimous agreement on only 21.6 percent of the prescriptions. This probably reflects the existence of considerable disagreement about antibiotic treatment among physicians, as demonstrated by Greenberg et al³² for respiratory infections. It was encouraging that the overall rate of disagreement (or clearly inappropriate antibiotic use) was only 15.1 percent, with appropriateness open to question in 19.5 percent.

The only member of the panel specializing in a particular age group was the pediatrician. His overall agreement was one of the lowest at 57.7 percent. Since the pediatric population was large, his opinions were examined more closely on this age group. He agreed with the treatment of patients aged 7 to 12 years (73.0 percent) and those aged 13 to 20 years (65.2 percent) more frequently than his overall agreement rate. However, he only agreed on 23 of the 53 (43.4 percent) prescriptions for patients less than seven years of age. His reason for disagreement in the latter group usually involved the drug regimen (90 percent) (incorrect drug 30 percent, incorrect dose 37 percent, incorrect duration 23 percent).

The faculty members of the review panel were also part of the faculty prescribers and were surprised to learn that they agreed with their own prescribing practices less often than with the first-year residents. A possible explanation for this finding is that first-year residents have the least amount of clinical experience and are more likely to rely on "textbook" information, which is acceptable on peer review by faculty. The pattern of appropriate prescribing suggests this because as clinical experience increased, the appropriate prescription rates dropped from 80.0 percent in the first-year residents to 65.7 percent in second-year

residents to 50.0 percent in third-year residents. However, since a significant difference between groups occurred only between the most and least supervised prescribers, level of supervision is most probably the explanation; for although the physicians' assistants in the study averaged five years of clinical experience, they remained under a close supervision review system by attending physicians and had a 70.2 percent appropriateness rating. Other explanations for this observation are possible (eg, the second- and third-year residents and faculty may be responding more than the other group to psychosocial pressures exerted by patients demanding an antibiotic).

Because appropriate treatment, as judged by the panel, occurred in only 65.4 percent of the patients, it would seem that some remedial action should be taken. Considering the evidence presented, it appears that the same peer review supervision currently in operation for the physicians' assistants, psychiatry residents, and first-year family medicine residents should be extended to the second- and third-year residents. A similar follow-up audit should be developed to determine if this change will result in more appropriate antibiotic prescribing practices among second- and third-year residents. Faculty awareness of such plans may also improve their future antibiotic prescribing practices.

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