Antibiotic Use in a Family Practice Setting

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ABSTRACT

Background: Widespread interest in the appropriate use of antibiotics has led to the publication of anti-infective guidelines for a variety of infectious diseases.

Objective: To determine adherence to Ontario's 1997 *Anti-infective Guidelines for Community-Acquired Infections.*

Methods: This study was a prescriber-blinded, concurrent review of prescriptions over a 2-month period at a university-affiliated family practice clinic. Patients who received antibiotic prescriptions for an infection specified in the guidelines were enrolled. The initial antibiotic regimen (agent, dose, frequency, and duration) was evaluated for adherence to the recommendations. Health records were reviewed over a subsequent 6-week period to determine the occurrence of repeat contact with a health care provider, the outcome of the infection, and antibiotic-related complications.

Results: Of the 144 initial regimens assessed, 135 (94%) involved first-, second-, or third-line agents listed in the guidelines; 114 (79%) involved first-line agents. One hundred and five (73%) of the regimens were adherent to the guidelines in terms of agent, dose, frequency, and duration. Among the 98 patients with repeat contact with a health care provider, there was a higher incidence of antibiotic-related complications in association with nonadherent therapy (5 of 26 cases [19%]) than with adherent therapy (2 of 72 cases [3%]) (p = 0.013). There were no differences in outcomes of the diagnosed infections.

Conclusions: Adherence to recommendations for antibiotic therapy was high in this family practice clinic. A larger prospective study is necessary to confirm the lower rate of antibiotic-associated complications observed with adherent therapy.

Key words: antibiotics, guideline adherence, community-acquired infections, family practice

RÉSUMÉ

Historique : L'intérêt largement répandu pour l'utilisation adéquate des antibiotiques a mené à la publication de lignes directrices sur l'utilisation des antiinfectieux pour différentes maladies infectieuses.

Objectif : Évaluer la conformité aux *Lignes directrices sur l'utilisation des antiinfectieux dans les infections communautaires* de l'Ontario, publiées en 1997.

Méthodes : Il s'agit d'une évaluation concurrente en aveugle des ordonnances prescrites sur une période de deux mois à une clinique familiale affiliée à une université. Les patients qui ont reçu des prescriptions d'antibiotiques pour une infection stipulée dans les lignes directrices ont été inscrits à l'étude. Le schéma antibiothérapeutique initial (agent, dose, fréquence et durée) a été évalué pour déterminer dans quelle mesure les recommandations avaient été observées. Les dossiers médicaux ont aussi été examinés au cours d'une période ultérieure de six semaines, pour déterminer l'occurrence des visites répétées auprès d'un prestataire de soins de santé, l'issue de l'infection et les complications liées à l'antibiothérapie.

Résultats : Des 144 traitements initiaux évalués, 135 (94 %) mettaient en jeu des agents de première, de deuxième ou de troisième intention listés dans les lignes directrices ; 114 (79 %) des agents de première intention ; et 105 (73 %) étaient conformes aux lignes directrices en termes d'agent utilisé, de dose, de fréquence et de durée. Des 98 patients qui ont visité de façon répétée un prestataire de soins de santé, l'incidence des complications liées aux antibiotiques était plus élevée dans les cas de non-observance thérapeutique (5 cas sur 26 [19 %]) que dans les cas d'observance thérapeutique (2 cas sur 72 [3 %]) (p = 0.013). Aucune différence n'a été observée dans l'issue des infections.

Conclusions : La conformité aux recommandations antibiothérapeutiques était élevée à cette clinique familiale. Une étude prospective plus importante est nécessaire pour confirmer l'incidence moindre des complications liées à l'antibiothérapie dans les cas d'observance thérapeutique.

Mots clés : antibiotiques, conformité aux lignes directrices, infections communautaires, médecine familiale

INTRODUCTION

Oral antibiotics were the second most commonly prescribed drug class (after cardiovascular agents) in Canada in 1996, accounting for 26.3 million prescriptions.[1] General practitioners and family physicians were responsible for more than 21 million of these prescriptions.[1] Outpatient antibiotic expenditures for people 65 years and older in Ontario in 1994/95 exceeded $30 million.[2] Despite the frequency of antibiotic prescribing, there is a scarcity of published information describing the use of these agents in the family practice setting. Carrie and Zhanel[3] reviewed epidemiologic studies on antibacterial use in community practice but found no recent Canadian data. Subsequently, they undertook a study to determine the frequency of antibiotic use in community practice in Manitoba and to describe evolving trends in antibiotic selection.[4] They noted a trend toward increased use of newer, broad-spectrum agents such as ciprofloxacin, cefuroxime, clarithromycin, and azithromycin, accompanied by a decline in use of older, narrow-spectrum agents, such as amoxicillin, erythromycin, trimethoprim–sulfamethoxazole, and penicillins, between 1995 and 1998.[4]

Increasing antibiotic resistance of *Streptococcus pneumoniae* and *Haemophilus influenzae* has been observed in Canada since the 1980s.[5-7] Correlations between the use of antibacterial agents in the community and resistance patterns have been reported in Canada and Europe.[8,9] In a Canadian surveillance study, Chen and colleagues[8] found that the highest prevalence of *S. pneumoniae* with reduced susceptibility to fluoroquinolones occurred in Ontario, which was also the province with the highest per capita use of these agents.

To promote the optimal use of anti-infectives, the Ontario Ministry of Health has funded publication of the *Anti-infective Guidelines for Community-Acquired Infections* as a tool for general practitioners.[10] The guidelines were developed by an independent consensus panel that included family physicians, specialists, and pharmacists using a transparent process that included a wide external review by a network of family physicians.[11] The content of the anti-infective guidelines combines evidence, expert opinion, and practitioner input from provincial, national, and international levels to identify first-, second-, and third-line choices for a variety of infections, including those of the respiratory system, skin and genitourinary tract, as well as dosing and cost information. The antibiotic choices have been carefully selected on the basis of spectrum of activity, anticipated efficacy, safety, and previous clinical experience, as well as resistance patterns.[10] The incorporation of such resistance information is important to the success of anti-infective guidelines.[12]

If guidelines are to be effective, they must become part of routine practice.[13] Two recently published studies have used the anti-infective guidelines as a basis for educational programs to improve antibiotic prescribing in community practice.[11,14] However, neither of these studies assessed adherence to the guidelines and associated outcomes at a patient-specific level. Thus, the primary objectives of the current study were to determine the frequency with which the initial antibiotic regimen (agent, dose, frequency, and duration) prescribed for a diagnosed infection adhered to the anti-infective guidelines and to evaluate the outcomes associated with adherent and nonadherent regimens in a family practice setting. Secondary objectives were to determine the frequency with which adherent regimens were also appropriate (on the basis of patient-specific factors) and to determine the outcomes associated with appropriate and inappropriate therapy. Additional objectives included determining prescriber adherence to the anti-infective guidelines according to number of years of clinical experience and determining the frequency with which initial regimens required modification because of reported resistance. This study was undertaken preparatory to institution of an educational intervention to promote adherence to the anti-infective guidelines.

METHODS

The study was conducted as a concurrent review of prescriptions and charts at a family practice clinic affiliated with a university and teaching hospital in southwestern Ontario. At the time of the study, the clinic had 12 prescribers (4 junior residents, 4 senior residents, and 4 staff physicians). Consent to review prescriptions and health records was obtained through the hospital medical records department. The chief of family medicine and the clinic's research committee also granted their approval and were blinded to study design. Blinded approval was necessary to minimize potential modification of usual antibiotic prescribing patterns. All clinic physicians and staff were blinded as to the purpose of the study and the content of the prescription and chart review.

A system of numbered, carbonless triplicate prescription forms was introduced at the clinic on January 1, 2000. With the introduction of the new

system, a written prescription was required for all medications prescribed at clinic or home visits, for prescriptions called in to a pharmacy, and for office samples provided. One copy of each prescription was retained by the investigators, one copy was given to the patient, and the third copy was placed in the health record. Prescriptions and charts were reviewed daily in a private area of the clinic to preserve blinding.

The period of patient enrollment was prospectively defined as beginning on February 1 and ending on March 31. Prescribers and clinic staff were blinded to this predetermined period and were to follow study procedures instituted on January 1 for an indefinite period. The patient follow-up period ended on May 12, and clinic staff were informed of the conclusion of the review on May 17.

Adults and children receiving a prescription at the clinic between February 1 and March 31 were screened daily for suitability for study enrollment. Adults were defined as patients greater than 16 years of age. Children were defined as those up to and including 16 years of age.

The charts of patients who received prescriptions for oral systemic antibiotics were reviewed, and only those who received one or more antibiotics for an infection defined in the anti-infective guidelines were enrolled. A patient could be enrolled only once, and only the initial antibiotic regimen received during the study period was analyzed for adherence. Regimens prescribed at a repeat health care contact were excluded from analysis.

Patients remained in the study for a period of 6 weeks from the date of enrollment. At that time, the chart was reviewed for the occurrence of repeat health care contacts. The intent of the follow-up was to determine the outcome of the diagnosed infection and to identify any reported antibiotic-related complications associated with the initially prescribed regimen.

Data collection was performed by 2 investigators not involved in prescribing at the clinic (S.K., A.M.B.). A standardized data collection form was completed for each patient enrolled. Patient characteristics, drug allergies, comorbidities, diagnoses, antibiotic regimen(s), concurrent medications, microbiology results, repeat health care contacts, and antibiotic-related complications were documented. No attempt was made to verify the physicians' diagnoses, since the primary objective of the study was to analyze adherence to the anti-infective guidelines for the stated diagnoses.

Initial antibiotic regimens were assessed by the primary author (S.K.). For controversial cases, decisions were made by consensus among a panel of 3 of the investigators, who were not involved in prescribing at the clinic (S.K., Z.H., A.M.B.). Each regimen was assessed from 2 perspectives: first in terms of strict adherence to the anti-infective guidelines, with respect to drug, dose, frequency, and duration, and second in terms of appropriateness. The latter was based on adherence to the guidelines, as well as whether the regimen took into account patient-specific factors including precautions, contraindications, and interactions. The *AHFS Drug Information (AHFS-DI)*[15] was used to assess precautions and contraindications, and *Hansten and Horn's Drug Interactions, Analysis and Management*[16] was used to assess interactions. These assessments were made with respect to patient-specific allergies, comorbidities, and concurrent drug therapy. Patients with a documented repeat health care contact were assessed for treatment success or failure and antibiotic complications according to receipt of adherent or nonadherent therapy and appropriate or inappropriate regimens. Reported antibiotic complications were assessed according to the *AHFS-DI.*[15] Terms used in the data analysis are defined in Appendix 1.

Fisher's exact test was used for statistical analysis of proportional data. The Epistat program was used to execute the data analyses. Differences associated with p values less than 0.05 were considered statistically significant.

RESULTS

Oral antibiotics accounted for 186 (6%) of the 3114 prescriptions written at the clinic between February 1 and March 31; these antibiotic prescriptions were given to a total of 157 patients. Oral antibiotics represented the third most common class of drugs prescribed during this period. A summary of the antibiotic classes and agents prescribed is provided in Table 1. Older agents such as amoxicillin, trimethoprim–sulfamethoxazole, and penicillin-V accounted for 97 (52%) of the 186 prescriptions and were prescribed 48, 32 and 17 times, respectively. The new macrolides (clarithromycin and azithromycin) and fluoroquinolones represented 19 and 9 prescriptions, respectively, accounting for 15% of all prescriptions.

Of the 186 prescriptions for oral antibiotics, 21 were excluded because they were written for a diagnosis not addressed in the anti-infective guidelines, and 1 was excluded because the diagnosis was unclear. The most common conditions accounting for exclusion were *Clostridium difficile* infection (8 prescriptions), acne (7), and post-splenectomy prophylaxis (2). Thus,

Table 1. Antibiotic Classes and Agents Prescribed for 157 Patients between February 1 and March 31, 2000

Class or Agent	No. (and %) of Cases	
Penicillins	82	(44)
Trimethoprim–sulfamethoxazole	32	(17)
Macrolides	27	(15)
Metronidazole	15	(8)
Fluoroquinolones	9	(5)
Cephalosporins	6	(3)
Nitrofurantoin	6	(3)
Tetracyclines	5	(3)
Clindamycin	2	(1)
Erythromycin–sulfisoxazole	1	(1)
Glycopeptides	1	(1)

Table 2. Adherence and Appropriateness of 144 Antibiotic Regimens

Adherence or Appropriateness*	No. (and %) of Regimens	
Drug choice adherent (first-line, second-line, or third-line)	135	(94)
Regimen adherent	105	(73)
Regimen appropriate	96	(67)

*See Appendix 1 for definitions.

164 antibiotic prescriptions were available for analysis. Sixteen of these prescriptions related to a repeat health care contact in February or March and hence were also excluded. The data analysis was therefore based on 148 individual antibiotic prescriptions, representing 144 initial antibiotic regimens (140 monotherapy regimens and 4 combination regimens), for a study population of 144 patients.

The study population consisted of 112 (78%) adults (with 24 of these [17% of the total] being at least 65 years of age) and 32 (22%) children; 96 (67%) of the total were female. One hundred and forty (97%) of the patients were living in family dwellings and 4 (3%) in group homes. The most commonly recorded diagnoses were respiratory tract infections (85 or 59%), genitourinary tract infections (36 or 25%), and skin infections (19 or 13%). For 29 (20%) of the patients, an allergy to at least one antibiotic was recorded in the chart. The most commonly recorded allergies were to penicillins and sulfonamides.

In total, 135 of the initial 144 regimens prescribed were recommended by the anti-infective guidelines as first-, second-, or third-line choices for treatment of the diagnosed infection (Table 2). Adherence with regard to choice of agent was therefore 94%, and a first-line agent was prescribed in 114 (79%) of the initial regimens. Of the 135 regimens that were adherent with respect to the choice of antibiotic agent, 30 were nonadherent in terms of at least one other component of the recommendations for the diagnosed infection: 14 were nonadherent because of dose, 13 because of duration, and 6 because of frequency. Regimens prescribed for urinary tract infections, acute otitis media, and pharyngitis accounted for 21 (64%) of these 33 deviations. Deviations of dose

and duration were most commonly associated with prescriptions for urinary tract infections (12 of 33), followed by deviations of dose for acute otitis media (6 of 33). In summary, 105 (73%) of the 144 regimens were completely adherent to the anti-infective guidelines in terms of agent, dose, frequency, and duration.

A total of 96 (67%) of the 144 regimens were adherent to the anti-infective guidelines and were also deemed to be appropriate on the basis of patient-specific factors (Table 2). An adherent regimen was more than 5 times as likely to be appropriate as inappropriate. Nine of the 105 adherent regimens were deemed to be inappropriate. The most common reason for this was the use of a second- or third-line agent in the absence of a precaution for, contraindication to, or drug interaction with a first-line agent (7 regimens).

For 98 patients, at least one repeat health care contact was documented in the chart during the 6-week follow-up period. Repeat health care contacts were related to the initial diagnosis of infection, the initial regimen, or a complication related to the initial regimen (58 cases); a subsequent infection that occurred more than 1 week after discontinuation of the initial regimen (11); or an unrelated problem (29). Outcomes were determined for these 98 patients. For 73 of the patients (74%), the initial antibiotic regimen was a success and for 25 patients (26%), the regimen was a failure (according to the study definitions). Table 3 summarizes these outcomes according to receipt of an adherent or nonadherent and appropriate or inappropriate regimen. No significant differences in success and failure of therapy were observed in this analysis.

Seven (7%) of the 98 patients with a repeat health care contact met the study definition of having experienced an antibiotic-related complication. The complications involved the gastrointestinal (4 patients), genitourinary (1 patient), dermatological (1 patient), and neurological (1 patient) systems. Oral and vaginal candidal superinfections accounted for 2 of the 7 complications. Although amoxicillin–clavulanic acid was rarely prescribed (4 of the 144 initial regimens, or 4 of

Table 3. Treatment Outcomes for 98 Regimens Associated with a Repeat Health Care Contact, According to Adherence and Appropriateness

	No. (and %) of Regimens				*p* value
	Success*		Failure*		
Adherence					0.94
Adherent (*n* = 72)	54	(75)	18	(25)	
Nonadherent (*n* = 26)	19	(73)	7	(27)	
Appropriateness					0.94
Appropriate (*n* = 64)	48	(75)	16	(25)	
Inappropriate (*n* = 34)	25	(74)	9	(26)	

*See Appendix 1 for definitions.

Table 4. Antibiotic-Related Complications for 98 Regimens Associated with a Repeat Health Care Contact, According to Adherence and Appropriateness

	No. (and %) of Regimens				*p* value
	Complications		No Complications		
Adherence					0.013
Adherent (*n* = 72)	2	(3)	70	(97)	
Nonadherent (*n* = 26)	5	(19)	21	(81)	
Appropriateness					0.047
Appropriate (*n* = 64)	2	(3)	62	(97)	
Inappropriate (*n* = 34)	5	(15)	29	(85)	

the 98 patients with a repeat health care contact), it was implicated in 2 complications, both gastrointestinal. Trimethoprim–sulfamethoxazole was one of the more frequently prescribed initial regimens (30 of the 144 initial regimens, or 27 of the 98 patients with a repeat health care contact) and was implicated in 4 complications, candidal superinfection being the problem in 2 of these.

An antibiotic-related complication was the primary reason for a repeat health care contact in 4 (4%) of the 98 cases. An antibiotic modification occurred because of a complication attributed to the initial regimen in 3 of the 98 cases (3%), and these cases were deemed failures. Two additional cases (2%) required treatment for the complication, for which one patient self-medicated. The number of complications according to adherence and appropriateness of the initial regimen is presented in Table 4. A significantly higher proportion of complications was associated with receipt of a nonadherent than an adherent regimen (*p* = 0.013). A similar trend was observed for inappropriate and appropriate regimens (*p* = 0.047). Because of the small number of complications in each group, further analysis was not feasible.

Physicians with 1 to 2 years of clinical experience prescribed the majority of initial regimens (73 of 144 or 51%). Medical staff with more than 2 years of clinical experience prescribed 31 (22%) of the initial regimens, and those with less than 1 year of experience prescribed 40 (28%) of the initial regimens. No significant differences were observed in the prescription of adherent or nonadherent (*p* = 0.14) and appropriate or inappropriate (*p* = 0.41) regimens according to years of clinical experience.

Cultures were obtained in 50 (35%) of the 144 cases. Respiratory and urinary specimens accounted for 47 of these. The culture results were negative in 18 (36%) of the 50 cases. Therapy adherent to the anti-infective guidelines was resistant to the organism(s) isolated in 3 (9%) of the 32 cases with positive cultures. The resistant organisms were isolated from the urinary tract. They were *Staphylococcus saprophyticus* (2 cases) and *Escherichia coli* (1 case). The resistance information resulted in modification of therapy in 2 of the 3 cases, which were deemed failures according to the study definition. Therapy was not modified in the remaining case because the 3-day course of antibiotic therapy had been completed, and the clinical signs and symptoms had resolved, before the susceptibility data became available.

DISCUSSION

Before institution of a labour-intensive educational intervention to promote adherence to Ontario's anti-

infective guidelines, a review of baseline prescribing practices was undertaken during a period of expected high-frequency antibiotic use (i.e., the winter season) at a university-affiliated family practice clinic. During the 2-month study period, oral antibiotics were the third most commonly prescribed class of agents, a finding comparable to 1996 Canadian data indicating that oral antibiotics were the second most commonly prescribed class of drugs.[1] Canadian data for antibiotic use according to indication are generally unavailable.[13] In this family practice setting, respiratory, genitourinary and skin infections accounted for 59%, 25%, and 13%, respectively, of the diagnosed infections for which an antibiotic was prescribed in the largely adult female population.

Fifteen of the 22 antibiotic prescriptions excluded from the analysis were prescribed for the treatment of *C. difficile* infection or acne, neither of which is addressed in the anti-infective guidelines. Given the frequency with which these conditions were encountered during the enrollment period, consideration should be given to their inclusion in future editions of the guidelines.

In 1996, amoxicillin was reportedly the most frequently prescribed antibiotic in Canada, accounting for approximately 25% of all antibiotic prescriptions (6.8 million prescriptions), followed by cephalosporins (3.3 million prescriptions) and erythromycin (2.7 million prescriptions).[1] Similarly, amoxicillin was the most commonly prescribed antibiotic in this family practice clinic. The penicillin class, followed by trimethoprim–sulfamethoxazole and then macrolides, were the most frequently prescribed antibiotics. Fluoroquinolones and cephalosporins together accounted for less than 10% of prescriptions. The clinic's 5% prescription rate for fluoroquinolones is below the 6.8% figure reported for the province of Ontario in 1997.[8]

In this study, 79% of initial antibiotic regimens for the specified diagnoses adhered to first-line recommendations in the anti-infective guidelines. Adherence with all components of the recommendations (agent, dose, frequency, and duration) was slightly lower (73%). Deviations in dose for treatment of acute otitis media may have been the result of literature published after the anti-infective guidelines, which recommended a higher dose of the first-line antibiotic.[17] When regimens were further analyzed in relation to patient-specific factors, such as allergies, comorbidities, and drug–drug interactions, 67% of the initial regimens were found to be appropriate. Initial antibiotic regimens were more than

5 times as likely to be appropriate if they were adherent than if they were nonadherent. Culture and sensitivity data were obtained in 35% of cases, and resistance to the initial adherent regimen was reported in 9% of cases with positive culture results. Therefore, it appears that the anti-infective guidelines offer prescribers a sufficient choice of agents to permit individualization of therapy according to patient-specific factors and resistance patterns in this community setting.

Two studies conducted in Ontario and employing the anti-infective guidelines as the basis of educational interventions and audits of physicians' prescribing practices have recently been published.[11,14] Stewart and colleagues[11] found an overall decrease in the total number of drug claims for antibiotics after institution of multiple community-based educational strategies and the anti-infective guidelines to improve use of these agents. The total volume of first-line antibiotics prescribed by study physicians was similar during the control and intervention periods.[11] However, physicians were 29% less likely to prescribe second-line antibiotics during the study period than physicians in the rest of the province.[11] Hux and colleagues[14] promoted the implementation of the anti-infective guidelines through an educational campaign and provision of confidential prescriber feedback. These investigators demonstrated statistically greater prescribing of first-line agents in the experimental group than in the control group. Physicians who received the educational intervention initially prescribed a first-line antibiotic in 67.2% of episodes of care; this proportion increased to 69.8% after educational feedback was provided.[14] However, both of these values are lower than the 79% adherence figure for first-line agents observed in the current study in the absence of an educational intervention; this difference may be related to the university-based teaching practice setting for the current study. Hux and colleagues[14] used Ontario Drug Benefit claims to obtain prescribing data, and the study population was limited to patients 65 years of age and older. Both studies[11,14] relied on drug claim data rather than chart reviews and patient-specific information.

Pennie[18] conducted a prospective study of antibiotic prescribing for children in outpatient primary care settings in south-central and eastern Ontario. A minor component of the trial was to determine doctors' choice of antibiotic for acute otitis media relative to the anti-infective guidelines. Family physicians, pediatricians, and urgent care centre physicians went against the guidelines by choosing second-line antibiotics in 5%, 32%, and 25% of cases, respectively.[18]

Unlike the previously discussed studies,[11,14] this investigation did not rely on prescription claim data, but rather on self-reporting by participating physicians. Although this approach permitted the inclusion of patient-specific information for analysis of the prescribed regimen, it may have introduced bias in antibiotic selection and subsequent reporting of data.

None of the 3 studies[11,14,18] were designed to assess outcomes or impact on patient care associated with adherence to the anti-infective guidelines. Failure to measure medical outcomes has been considered a shortcoming of treatment guidelines.[12] Limited numbers of investigations have assessed therapeutic outcomes of infectious disease guidelines, and those that have most often focused on guidelines for community-acquired pneumonia.[19-23] Mortality rate or length of stay declined in 2 of these studies.[21,23] Although outcome could be assessed in only 98 (68%) of the patients in this study, no differences in therapeutic outcome (success or failure) were found between adherent and nonadherent regimens. However, antibiotic-related complications were significantly more often associated with nonadherent therapy. Because of the small number of complications observed, specific trends could not be identified; to do so would require further investigation in a larger trial. An antibiotic complication was the primary reason for a repeat health care contact in 4% of cases with such repeat contact. In 5 of the 7 cases involving antibiotic complications, a new antibiotic or a specific treatment was prescribed to manage the complication. Because of the observational nature of this study, the estimate of antibiotic-related complications is probably conservative.

The strengths of this investigation include the concurrent collection of patient-specific information and the blinding of clinic staff to the content and the precise time frame of the review, to minimize changes in routine prescribing practices. The limitations of the study include the university-affiliated practice setting, the observational design (which did not permit patient contact), and the short study period. Prescribing practices in a university-affiliated family practice clinic may not reflect general community practice. The lack of patient contact limited the ability to assess patient compliance, drug benefit eligibility, and outcomes for the entire population enrolled. It was assumed that patients took their medication as prescribed unless otherwise documented in the chart. Drug benefit eligibility may have been known to the prescriber and might have influenced the selection of agents adherent to the guidelines. Patients may have had repeat health care contacts external to the clinic and its affiliated hospital for which transcripts were not received. A longer study period extending over several winter months would have enhanced the ability to detect potential differences in therapeutic outcomes and complication rates between adherent and nonadherent regimens.

Because this study was conducted at a university-affiliated clinic, it was expected that significant education about prescribing practices would be ongoing. The educational interchange occurring in this setting probably led to a lack of differences in prescribing practices among the clinic physicians. Senior medical staff reviewed patient care documentation by junior staff either during or after patient visits. The time required for giving and receiving educational feedback might have affected the number of patients seen and the number of prescriptions written. These factors may partially explain why prescribers with the greatest number of years of clinical experience (attending staff) and those with the fewest (junior residents) wrote the least number of antibiotic prescriptions. In addition, junior residents at the clinic see fewer patients than senior residents, and attending staff tend to do less episodic care and see more patients for follow-up of chronic problems.

CONCLUSIONS

Oral antibiotics were the third most commonly prescribed class of drugs, and amoxicillin was the most frequently prescribed antibiotic. Prescribing adherence to the antibiotics recommended by the anti-infective guidelines was high in this family practice clinic. Intensive educational strategies to promote first-line antibiotic choices for common diagnoses addressed in the anti-infective guidelines are not required at this site. If educational efforts are to be undertaken, they should focus on dose and duration of therapy, particularly with respect to the management of urinary tract infections, rather than on antibiotic choice.

The anti-infective guidelines[10] offer prescribers sufficient flexibility to individualize antibiotic regimens according to patient-specific factors. Although culture and sensitivity tests were performed only infrequently, adherent regimens rarely had to be modified as a result of microorganism resistance in this community setting. Prescribing adherence may be associated with a lower rate of antibiotic complications; however, a larger prospective study is necessary to confirm this finding.

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Appendix 1. Definitions of Terms

Adherent regimen: Initial antibiotic regimen representing a first-, second-, or third-line agent administered at the dose, frequency, and duration specified in Ontario's anti-infective guidelines.[10]

Antibiotic complication: Undesirable sign or symptom reported by the patient, documented in the chart, and specified in the *AHFS Drug Information*[15] with a time course consistent with receipt of the initial regimen; complications were classified according to the organ system involved (neurological, dermatological, cardiorespiratory, gastrointestinal, genitourinary, musculoskeletal, or hepatic) and included candidal superinfections.

Appropriate regimen: First-line regimen, as specified in the anti-infective guidelines, in the absence of patient-specific precautions or contraindications (e.g., comorbidities, allergies, or intolerances) or drug interactions; second- and third-line agents as specified in the anti-infective guidelines were considered appropriate if there was a precaution concerning, a contraindication to, or an interaction with a first-line drug.

Failure of initial regimen: Continued or worsening signs and symptoms of the primary infection diagnosis and/or modification (drug, dose, frequency, duration, or antibiotic addition/deletion) of the initial regimen and/or recurrence of signs or symptoms of the primary diagnosis within 7 days of discontinuation of the initial regimen.

Initial antibiotic regimen: Systemic oral antibiotic (monotherapy or combination therapy): dose, frequency, and duration prescribed at the first health care contact during the enrollment period.

Interactions: Classified as major, moderate, or minor in severity according to *Hansten and Horn's Drug Interactions, Analysis and Management*[16]; antibiotics were screened for interactions with concurrent medications. Only major interactions, for which the recommendation is to avoid or usually avoid the combination, were considered clinically significant.

Repeat health care contact: Chart documentation of clinic or home visits, telephone assessments, transcripts of hospital admissions, emergency room visits, or other health care facility contacts during the 6-week follow-up period.

Success of initial regimen: Improvement or resolution of signs and symptoms of the primary infection diagnosis and/or no modification (drug, dose, frequency, duration, or antibiotic addition/deletion) of the initial regimen and/or no recurrence of signs or symptoms of the primary diagnosis within 7 days of discontinuation of the initial regimen.