

Prospective study of antibiotic prescribing for children

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ABSTRACT

OBJECTIVES To observe the frequency with which children in outpatient primary care settings are prescribed antibiotics and to investigate why these antibiotics are prescribed. To compare the prescribing behaviour of family doctors, primary care pediatricians, and urgent care physicians and to determine where refinements in management are most needed to reduce the number of antibiotic prescriptions appropriately.

DESIGN Prospective study using a data entry form with mostly closed-ended questions.

SETTING Ten primary care offices in urban south-central and eastern Ontario: five family practices, three pediatric practices, and two urgent care centres (UCC).

PARTICIPANTS Every child younger than 16 years visiting these offices during a 3-week period in February and March 1997.

MAIN OUTCOME MEASURES Frequency, clinical indications, and nature of the antibiotics prescribed.

RESULTS There were 4344 observed visits. Of 1706 antibiotic prescriptions, 1481 were for 10 days, and 1577 (92%) were for acute respiratory infections, 920 (53%) specifically for acute otitis media (AOM). Full courses of antibiotics were given immediately (ie, without test results) to 321 (76%) of 425 children with pharyngitis. Antibiotics were prescribed for 145 (90%) of 163 children with bronchitis. Urgent care physicians were significantly more likely than pediatricians or family physicians to prescribe immediate antibiotics and to disregard guidelines when choosing antibiotics for uncomplicated AOM.

CONCLUSIONS Three diagnoses accounted for 82% of antibiotic prescriptions: AOM, pharyngitis, and bronchitis. Physicians should be more selective when deciding whether, and for how long, to prescribe antibiotics for those three common conditions. Substantial reductions in antibiotic use will require changes in how physicians manage suspected AOM, the most common indication for antibiotics.

RÉSUMÉ

OBJECTIFS Observer la fréquence de la prescription d'antibiotiques à des enfants, dans le contexte des soins de première ligne en clinique externe, et déterminer la raison de l'ordonnance. Comparer les habitudes de prescription des médecins de famille, des pédiatres de première ligne et des urgentologues, et identifier les sources de soins médicaux où des améliorations s'imposent le plus pour réduire de manière appropriée le nombre de prescriptions d'antibiotiques.

CONCEPTION Une étude prospective à l'aide d'un formulaire de saisie de données, comportant surtout des questions fermées.

CONTEXTE Dix cabinets de soins de première ligne en milieu urbain dans les régions du sud, du centre et de l'est de l'Ontario: cinq cabinets de médecins de famille, trois cabinets de pédiatres, et deux centres de soins d'urgence.

PARTICIPANTS Tous les enfants de moins de 16 ans qui se sont présentés à ces cabinets durant une période de trois semaines, en février et mars 1997.

PRINCIPALES MESURES DES RÉSULTATS La fréquence, les indications cliniques et la nature des antibiotiques prescrits.

RÉSULTATS L'étude a porté sur 4 344 visites. Des 1 706 ordonnances d'antibiotiques, 1 481 étaient pour une durée de dix jours et 1 577 (92%) visaient le traitement d'infections respiratoires aiguës, plus précisément 920 (53%) pour des otites moyennes aiguës. L'antibiothérapie complète a été prescrite immédiatement (c'est-à-dire sans avoir eu au préalable des résultats de tests) à 321 (76%) des 425 enfants souffrant de pharyngite. Une ordonnance d'antibiotiques a été donnée à 145 (90%) des 163 enfants atteints de bronchite. Les urgentologues étaient beaucoup plus souvent susceptibles que les pédiatres ou les médecins de famille de prescrire immédiatement des antibiotiques et de ne pas adhérer aux lignes directrices dans le choix des antibiotiques pour traiter une otite moyenne aiguë sans complications.

CONCLUSIONS Trois diagnostics sont à l'origine de 82% des ordonnances d'antibiotiques: l'otite moyenne aiguë, la pharyngite et la bronchite. Les médecins devraient exercer un plus grand discernement dans leur décision de prescrire ou non des antibiotiques et quant à la durée de la thérapie pour ces trois états pathologiques courants. Des réductions substantielles dans l'usage des antibiotiques exigeront des changements dans la façon dont les médecins traitent les cas d'otite moyenne aiguë suspectée, où l'antibiothérapie est le plus fréquemment indiquée.

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Antibiotics are commonly used in outpatient practice to treat acute viral respiratory tract infections,^{1,3} although the drugs neither shorten the course of the illness nor prevent secondary bacterial infection.⁴ It has been shown in the United States³ and in Iceland⁵ that children who receive repeated courses of oral antibiotics are at increased risk of nasopharyngeal carriage of drug-resistant *Streptococcus pneumoniae*. Data confirm the rising prevalence of drug-resistant *S pneumoniae* and *Haemophilus influenzae* in Canada.^{6,8}

Several authorities have called for judicious use of antibiotics.^{9,11} Educating health care providers and the public about appropriate antibiotic prescribing has been advocated repeatedly.^{10,11} The lack of prospective data on the prescribing habits of Canadian physicians has been acknowledged.¹² Such data are necessary to delineate, understand, and modify the scenarios that frequently lead to inappropriate antibiotic prescribing.

This article describes a prospective study of all visits made by children younger than 16 years to three types of primary care settings in Ontario during a 3-week period in February and March 1997. The primary objective was to determine the frequency, indications, and nature of the children's antibiotic prescriptions. Secondary objectives were to compare the antibiotic prescribing behaviour of a sample of family doctors, primary care pediatricians, and urgent care physicians; and to determine where refinements in outpatient management strategies are most needed to reduce the number of antibiotic prescriptions appropriately.

METHODS

The study population consisted of all children younger than 16 years assessed during a 3-week period in five family physicians' offices (three solo, two six-member groups), three independent primary care pediatricians' practices, and two free-standing urgent care centres (UCC) staffed by emergency-room physicians. All 10 settings were in south-central and eastern Ontario. Participating offices were selected purposefully because the study required a level of commitment not possible without acquaintance with the investigator. The investigator was, however, not

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sufficiently familiar with the participating physicians to know their antibiotic prescribing habits. Of 11 offices invited to participate, only one declined. Physicians were asked to refrain from modifying their prescribing habits during the study period.

A data entry form, consisting of mainly closed-ended questions in menu format, was completed at the time of every visit. The form had been pilot tested and refined during the summer of 1996 when 389 children's visits were observed in four family practice offices. Demographic characteristics and time of day were recorded, but not dates or names. Attending physicians recorded tests ordered, diagnoses made, and details of oral antibiotic prescriptions. No attempt was made to verify the accuracy of the doctors' diagnoses because the study aimed to observe doctors' recommendations about antibiotics rather than to obtain accurate epidemiologic data about childhood illnesses. Form completion rate was determined by comparing daily office patient tallies with the number of completed forms returned.

Acute respiratory infection (ARI) was defined as the presence of at least one of the following: viral cold, acute otitis media (AOM), sinusitis, pharyngitis, croup, bronchitis, bronchiolitis, pertussis, or pneumonia. A new case of AOM was one occurring in a child who had not had AOM within the previous 2 months. Statistical analysis was carried out using χ^2 and Fisher's exact tests. Statistical significance was defined as $P < .02$.

RESULTS

Between February 10 and March 16, 1997, physicians in the 10 practices completed 4344 data entry forms. Completion rates in the various offices ranged from 96% to 100%, and every physician in each office participated. **Table 1** shows the characteristics of the 4344 observed visits. In all settings, ARI was the most common diagnosis, occurring in 33% to 67% of visits.

The total number of prescriptions for oral antibiotics was 1706 (39% of all visits), of which 1629 (95%) were to be filled immediately and 77 (5%) were to be filled later if parents felt the child's illness worsened. Therapy was 10 days' duration for 1481 (87%) prescriptions. Of the 1706 prescriptions, 1395 (82%) were for only three diagnoses: AOM, pharyngitis, and bronchitis. The type of the drug plan families had did not influence whether children were prescribed oral antibiotics: 222/577 (38%) Ontario Drug Benefit Plan users, 1108/2633 (42%) employer-plan members, and 242/609 (40%) patients without drug plans received prescriptions.

RESEARCH

Prospective study of antibiotic prescribing for children

Only 250 (10%) of 2577 children with respiratory illnesses (ARI or asthma or both) had diagnostic tests: 202 throat cultures, 35 chest and five sinus x-ray examinations, seven heterophile agglutinins for infectious mononucleosis, and one nasopharyngeal culture for *Bordetella pertussis*. No children had antigen tests in the office for group A streptococcus. **Table 2** shows physicians' management strategies for the 2467 children with ARI with and without asthma.

Overall, 1508 of 2467 (61%) children with ARI were treated with oral antibiotics to be started immediately. The 927 cases of AOM accounted for 21% of all visits, 38% of ARI diagnoses, and 53% of all oral antibiotic prescriptions. Immediate antibiotics were prescribed for 97% of these children with AOM, and 94% of

prescriptions were for 10 days' duration; <1% were for 5 days. Sinusitis, pertussis, bronchitis, and AOM were almost always treated immediately with antibiotics ($\geq 89\%$ of cases). Croup, bronchiolitis, and viral cold were infrequently treated with antibiotics ($\leq 10\%$ of cases). Pharyngitis was treated immediately with a full course of antibiotics, without confirmation of group A streptococcus by throat culture in 321/425 (76%) cases.

The UCC physicians prescribed antibiotics immediately for 82% of 330 pharyngitis cases, a rate significantly higher than family physicians (53% of 34 cases, odds ratio [OR] 4.08, 95% CI 1.82 to 9.00, $P < .001$) and pediatricians (64% of 61 cases, OR 2.59, 95% CI 1.35 to 4.85, $P = .002$). Whether children had asthma associated with ARIs did not influence

Table 1. Characteristics of 4344 visits made by children younger than 16 years to three primary care settings in Ontario during 3 weeks in February and March 1997

CHARACTERISTICS OF VISITS	FAMILY PHYSICIANS*	PRIMARY CARE PEDIATRICIANS†	URGENT CARE PHYSICIANS‡	TOTALS
All visits	595	1079	2670	4344
Visits per doctor per half-day clinic	1.7	17.8	7.9	
Patient belonging to practice	572 (96%)	976 (90%)	0	1548 (36%)
Age				
0-3 mo	62 (11%)	69 (6%)	56 (2%)	187 (4%)
3-36 mo	207 (35%)	433 (40%)	775 (29%)	1415 (33%)
3-5 y	114 (19%)	283 (26%)	657 (25%)	1054 (24%)
6-15 y	205 (34%)	266 (25%)	1083 (40%)	1554 (36%)
Unrecorded	7 (1%)	28 (3%)	99 (4%)	134 (3%)
Diagnosis				
• ARI§	196 (33%)	486 (45%)	1785 (67%)	2467 (57%)
• Acute otitis media	64 (33%)	192 (40%)	671 (38%)	927 (38%)
• Viral cold alone	66 (34%)	159 (33%)	507 (28%)	732 (30%)
• Pharyngitis	34 (17%)	61 (13%)	330 (18%)	425 (17%)
• Bronchitis	13 (7%)	23 (5%)	127 (7%)	163 (7%)
• Pneumonia	8 (4%)	13 (3%)	34 (2%)	55 (2%)
Well child care	180 (30%)	211 (20%)	0	391 (9%)
Rash or skin lesion	61 (10%)	53 (5%)	151 (6%)	265 (6%)
Fever, no focus of infection	9 (2%)	20 (2%)	36 (1%)	65 (1%)
Gastroenteritis	7 (1%)	18 (2%)	100 (4%)	125 (3%)
Asthma without ARI	11 (2%)	63 (6%)	36 (1%)	110 (3%)
Injury	19 (3%)	14 (1%)	291 (11%)	324 (7%)
Immediate referral to hospital	2 (<1%)	6 (<1%)	3 (<1%)	11 (<1%)
Oral antibiotics started immediately	111 (19%)	321 (30%)	1197 (45%)	1629 (38%)

*Five family practices (15 physicians).

†Three independent FRCPC-certified pediatricians.

‡Two walk-in facilities staffed by non-hospital-based emergency physicians.

§Viral cold, acute otitis media, sinusitis, pharyngitis, croup, bronchitis, bronchiolitis, pertussis, or pneumonia.

||Proportion of all ARI.

treatment with antibiotics. Only six of 110 (6%) children with asthma who did not have ARIs received antibiotic prescriptions. Children with ARIs were started immediately on oral antibiotics on Friday afternoons as often as they were on Mondays through Thursdays.

Table 3 shows physicians' use of diagnostic tests and antibiotic treatment for ARIs. Compared with all other physicians, UCC physicians were significantly less likely to perform and await the results of diagnostic tests before prescribing antibiotics ($P < .0001$) and were significantly more likely to prescribe immediate antibiotics for ARI than pediatricians (OR 1.28, 95% CI 1.04 to 1.58, $P = .02$) or family physicians (OR 1.54, 95% CI 1.13 to 2.10, $P = .0004$).

Doctors' choice of antibiotic for AOM was examined by determining what proportion of new cases were treated with the nongeneric antibiotics recommended only as second-line therapy by Ontario's Anti-infective Guidelines for Community-Acquired Infections.¹³ Family physicians, pediatricians, and UCC physicians went against the guidelines by choosing second-line antibiotics in 3/50 cases (6%), 36/111 cases (32%), and 140/561 cases (25%), respectively. Compared with family physicians, the OR that pediatricians did not follow the guidelines was 7.52 (95% CI 2.16 to 39.91, $P < .001$), and that UCC physicians did not follow the guidelines was 5.21 (95% CI 1.63 to 26.53, $P = .004$).

DISCUSSION

Observed high frequencies of office visits and antibiotic prescriptions for AOM and other ARIs are in keeping with previous studies reporting that normal children suffer about eight common colds yearly,^{14,15} that AOM is the most common childhood diagnosis made in office practice,^{16,17} and that antibiotics are prescribed to 50% to 80% of children diagnosed with ARIs.^{3,9,17} Similarities between current prospective data and previously published data gathered retrospectively suggest that the act of completing data forms did not alter physicians' prescribing behaviour substantially during the study period.

Limitations of this study include the small number of practices under observation and the fact that the practices were not chosen at random. Studying a large number of practices would document the scope of variations in physicians' antibiotic prescribing behaviour.

Conditions rarely treated with antibiotics in this study were viral cold, asthma, croup, bronchiolitis, and gastroenteritis, suggesting that physicians felt

Table 2. Management of 2467 acute respiratory infections (ARI) by diagnosis for 4344 children presenting to primary care settings in Ontario during 3 weeks in February and March 1997

MAIN DIAGNOSIS*	ORAL ANTIBIOTICS	
	TO BE GIVEN IMMEDIATELY	PRESCRIPTION GIVEN; PARENTS TO FILL ONLY IF CHILD WORSENS
Viral cold† (n = 732)	11 (2%)	38 (5%)
Acute otitis media (n = 927)	901 (97%)	19 (2%)
Pharyngitis (n = 425)	321 (76%)	7 (1%)
Croup‡ (n = 37)	1 (3%)	0
Sinusitis§ (n = 77)	70 (91%)	3 (4%)
Bronchitis¶ (n = 163)	145§ (89%)	2 (1%)
Bronchiolitis† (n = 41)	4 (10%)	0
Pertussis† (n = 10)	9 (90%)	0
Pneumonia (n = 55)	46 (84%)	
TOTAL (N = 2467)	1508 (61%)	69 (3%)
Asthma plus at least one of the listed ARIs (n = 67)¶¶	43 (64%)	2 (3%)

*Children diagnosed with two or more concomitant respiratory infections are listed only once and according to the hierarchy: pneumonia, acute otitis media, pharyngitis, sinusitis.

†Child did not have any of the other respiratory infections listed.

‡Four of 77 children (5%) had sinus x-ray examinations.

§Five of 145 children (3%) had chest x-ray examinations.

¶Twenty-eight of 55 children (51%) had chest x-ray examinations.

¶¶Included in totals above. Four of 67 children (6%) had chest x-ray examinations.

confident in their ability to diagnose those illnesses on clinical criteria and in their knowledge that antibiotics were not indicated.^{4,18-20} Such results are encouraging and exemplify appropriate prescribing.

In this study, 54% of the antibiotic prescriptions were given for AOM. I made no attempt to validate physicians' diagnosis of AOM. Accurate diagnosis of AOM is difficult at times because diagnostic criteria are not standardized clearly,²¹ resulting in overdiagnosis due to confusion with other conditions that cause otalgia and redness of the tympanic membrane.²² Doctors and patients need to be aware that AOM is often self-limiting and does not always benefit from antibiotics.^{23,24} We need to formulate and

RESEARCH

Prospective study of antibiotic prescribing for children

Table 3. Management of 2467 acute respiratory infections (ARI)* by practice type for children assessed in primary care settings in Ontario in February and March 1997

PRACTICE	ORAL ANTIBIOTICS		DIAGNOSTIC TESTS	
	TO BE GIVEN IMMEDIATELY	PRESCRIPTION GIVEN; PARENTS TO FILL IF CHILD WORSENS	TESTS PERFORMED; NO ANTIBIOTIC UNLESS RESULTS POSITIVE	CHEST X-RAY EXAMINATION PERFORMED
Family physicians [†] (n = 196 ARI)	103 (53%)	5 (3%)	37 (19%)	6 (3%)
Primary care pediatricians [‡] (n = 486 ARI)	278 (57%)	6 (1%)	62 (13%)	15 (3%)
Urgent care physicians [§] (n = 1785 ARI*)	1126 (63%)	58 (3%)	105 [¶] (6%)	34 (2%)

*Viral cold, acute otitis media, sinusitis, pharyngitis, croup, bronchitis, bronchiolitis, pertussis, or pneumonia.

[†]Five family practices (15 physicians).

[‡]Three independent FRCPC-certified pediatricians.

[§]Two walk-in facilities staffed by non-hospital-based emergency physicians.

^{||}Urgent care centres were significantly more likely to prescribe oral antibiotics than family physicians ($P = .0004$) or pediatricians ($P = .02$).

[¶]Urgent care centres were significantly less likely to perform laboratory tests than family physicians or pediatricians ($P < .0001$).

evaluate better AOM treatment guidelines paying attention to ameliorating the uncertainties in clinical diagnosis^{21,22,24} and to providing criteria for withholding antibiotics.^{24,25}

Experts recommend that childhood pharyngitis be treated with antibiotics only after positive test results for group A streptococcus.^{9,26-29} Because at least two thirds of pharyngitis cases are caused by viruses,^{26,30} most do not require antibiotics. Nonetheless, this study, one reported by Arnold et al,³ and another by Nyquist et al¹⁷ found that pharyngitis was treated with antibiotics without regard to group A streptococcus testing in 76%, 81%, and 71% of cases, respectively. A clinical score for sore throats, recently validated for children older than 3 years,³¹ could help decrease the proportion of unnecessary antibiotics for pharyngitis by 48%. Its large-scale use for children should be evaluated.

Of the 1706 antibiotic prescriptions, 147 (9%) were for acute bronchitis, for which there is no exact clinical definition,^{32,33} but which nonetheless is a common pediatric diagnosis.^{3,17,32-34} Although antibiotics are rarely indicated for acute bronchitis in children because the cause is almost always viral,^{32,34} 80% to 90% of cases were treated immediately with antibiotics in this and other studies.^{3,9,17} Common colds and acute bronchitis are virtually indistinguishable conditions,³² but this study showed that the diagnostic label greatly affected choice of treatment. Antibiotics were prescribed to 2% of children with viral colds but to 89% of those with bronchitis. Perhaps physicians diagnose acute bronchitis and prescribe antibiotics

for children who look particularly unwell with cough and fever. A recent review by O'Brien et al³³ of bronchitis and cough in children cites several studies in which antibiotics neither improved the cough nor prevented bacterial complications. Consensus guidelines do not recommend antibiotics for children with bronchitis.^{33,35}

The significantly higher rates of antibiotic prescription observed for UCC physicians compared with family physicians cannot be explained by saying patients were sicker at the UCC because the UCC did not have increased rates of AOM, pneumonia, asthma, or immediate referral to hospital. The greater frequency of antibiotic prescriptions at the UCC appeared to be due, in part, to the management of pharyngitis. The UCC physicians prescribed immediate antibiotics to children with pharyngitis significantly more frequently than other physicians.

For AOM, pediatricians were significantly more likely to prescribe brand-name, second-line antibiotics (broader spectrum and more expensive) than recommended first-line agents.^{13,36,37} Why? Like those in other specialties, pediatric training programs centre on hospitalized patients with complex illnesses. The paradox for primary care pediatricians is that almost 50% of their office patients have relatively self-limited ARIs for which pediatricians receive limited formal training in evidence-based management.

In this study, antibiotics were prescribed for 10 days' duration for almost 90% of all prescriptions (94% of AOM prescriptions). Antibiotic treatments of shorter duration (5 days), however, have been

evaluated recently as alternatives to traditional, longer courses of therapy for ARI. A review by Pichichero and Cohen³⁸ concludes that accumulating data support the efficacy of shorter courses of therapy, which could reduce antibiotic use, reduce costs, improve compliance, and decrease antibiotic resistance. In addition, a recent meta-analysis of treating AOM with a shortened course of antibiotics³⁹ concludes that 5 days of short-acting antibiotic is effective treatment of uncomplicated AOM for children older than 2 years who do not have underlying chronic illness. This study suggests that 10-day prescriptions have become entrenched in Canada. Now might be the time to examine ways to guide physicians toward shorter-course therapy in order to reap the benefits of reduced antibiotic exposure among children with ARI.

Of all antibiotic prescriptions written, 82% were for only three diagnoses: AOM, pharyngitis, and bronchitis. Physicians need improved diagnostic techniques, guidance on more effective use of laboratory tests, and evidence-based patient care guidelines³¹ to help them decide whether, and for how long, to prescribe antibiotics for those three common conditions.

Because children diagnosed with AOM received more than 50% of all antibiotic prescriptions, substantial reductions in prescribing rates will be possible only if fewer visits result in antibiotic prescriptions for AOM. Some physicians in this study went against published guidelines by prescribing second-line, brand-name antibiotics for up to one third of children with uncomplicated AOM. Strategies that help physicians adhere to antibiotic prescribing guidelines need to be refined and implemented.

CONCLUSIONS

In this study, viral cold, asthma, croup, bronchiolitis, and gastroenteritis were infrequently treated with antibiotics. These encouraging results stand as examples of appropriate prescribing behaviour. Only three diagnoses accounted for 82% of antibiotic prescriptions for children: AOM, pharyngitis, and bronchitis. Studies should focus on those three conditions to determine which case definitions, diagnostic techniques, evidence-based patient care guidelines, and education strategies (for both the public and the medical community) will appropriately reduce antibiotic prescription rates and improve adherence to existing published guidelines. Priority should be given to AOM because it is associated with more than 50% of antibiotic prescriptions. ♦

Key points

- More than 80% of antibiotic prescriptions were for acute otitis media, pharyngitis, and bronchitis.
- Urgent care physicians prescribed antibiotics for acute respiratory illness more frequently than pediatricians or family physicians. Urgent care physicians and pediatricians used second-line antibiotics more often than family physicians did.
- Antibiotic use will be reduced most by reducing the number of prescriptions for acute otitis media.

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RESEARCH

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Prospective study of antibiotic prescribing for children

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