Method of physician remuneration and rates of antibiotic prescription

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Abstract

Background: Rates of antibiotic prescription in Canada far exceed generally accepted rates of bacterial infection, which led the authors to postulate that rates of antibiotic prescription depend to some extent on factors unrelated to medical indication. The associations between antibiotic prescription rates and physician characteristics, in particular, method of remuneration and patient volume, were explored.

Methods: The authors evaluated all 153 047 antibiotic prescriptions generated by 476 Newfoundland general practitioners and paid for by the Newfoundland Drug Plan over the 1-year period ending Aug. 31, 1996, and calculated rates of antibiotic prescription. Linear and logistic regression models controlling for several physician characteristics, specifically age, place of education (Canada or elsewhere), location of practice (urban or rural) and proportion of elderly patients seen, were used to analyse rates of antibiotic prescription.

Results: Fee-for-service payment (rather than salary) and greater volume of patients were strongly associated with higher antibiotic prescription rates. Fee-for-service physicians were much more likely than their salaried counterparts to prescribe at rates above the median value of 1.51 antibiotic prescriptions per unique patient per year. The association between rate of antibiotic prescription and patient volume (as measured by number of unique patients prescribed to) was evident for all physicians. However, the association was much stronger for fee-for-service physicians. Physicians with higher patient volumes prescribed antibiotics at higher rates.

Interpretation: In this study factors other than medical indication, in particular method of physician remuneration and patient volume, played a major role in determining antibiotic prescribing practices.

Many recent reports and editorials have focused on the threat posed by antibiotic resistance in microorganisms.[1-3] Despite concerns expressed by experts, antibiotic prescription has not changed significantly in Canada over the last 5 years (source: IMS Health Canada). High-volume, fee-for-service general practice is the predominant method of primary health care delivery in Canada, and antibiotics are generally perceived as being liberally prescribed for community-acquired infections.[4] In Newfoundland in 1995, approximately 800 000 prescriptions for oral antibiotics were filled by the 550 000 inhabitants; approximately 600 000 of those prescriptions were for the treatment of respiratory tract disease (source: IMS Health Canada). This rate of prescription implies a rate of bacterial respiratory illness of more than 1000 per 1000 patient-years and cannot possibly be justified by known rates of community-acquired pneumonia, sinusitis, group A streptococcal pharyngitis and otitis media, the 4 principal bacterial infections of the respiratory tract. Most measurements of the incidence of community-acquired pneumonia suggest a rate of 10 to 20 per 1000 person-years.[5,6] The annual incidence of the common cold in adults is 2 to 4 per person,[7,8] and it has been estimated that only 0.5% of these episodes are complicated by acute sinusitis.[7] This corresponds to an incidence of acute sinusitis of 10 to 20 per 1000 person-years. The incidence of group A streptococcal pharyngitis is not known for Canada, but it has been estimated that 80% to 90% of patients presenting with sore throat do not have this type of infection.[9] Acute otitis media is a common childhood illness; in one study, more than 90% of children experienced at least one episode before age 7.[10] However, according to the 1996 census,[11] only

6% of the Canadian population is less than 5 years of age, the age group most frequently affected. The authors of a recent study of data from the American National Ambulatory Medical Care Survey — 1992[12] concluded that in the United States antibiotics were frequently prescribed to adults for colds, upper respiratory tract infections and bronchitis, a conclusion that corroborates our perceptions. These observations and the personal experience in general practice of one of the authors (J.M.H.) led us to postulate that factors other than medical indications may influence antibiotic prescribing practices.

Our objective was to evaluate potential associations between physician and practice characteristics and antibiotic prescription rates. In particular, we wished to evaluate the association among method of remuneration, patient volume and rate of antibiotic prescription.

Methods

Subjects

Newfoundland (population 550 000) has a relatively high proportion of salaried general practitioners, a large proportion of physicians who graduated from medical schools outside Canada and a single urban centre with more than 50 000 inhabitants (St. John's). All physicians, whether paid by salary or on a fee-for-service basis, are remunerated through a single government agency, the Medical Care Plan.

The Newfoundland Drug Plan, a government-sponsored program, fully covers most medications, including antibiotics, for approximately 120 000 Newfoundlanders. People receiving social assistance, as well as means-determined, needy elderly people (over 65 years of age), are eligible for coverage.

We obtained data on all antibiotic prescriptions paid for by the Newfoundland Drug Plan for the 1-year period ending Aug. 31, 1996, and the corresponding data on physician and practice characteristics from the Medical Care Plan. We then calculated the mean number of antibiotic prescriptions per unique patient receiving such prescriptions per year for each physician and analysed those rates with reference to physician and practice characteristics.

Analysis

Categorical variables were compared using the χ^2 test; continuous variables were compared using Student's t-test.

For each physician the rate of antibiotic prescription per unique patient per year was determined by dividing the total number of antibiotic prescriptions by the total number of unique patients receiving such prescriptions. Unadjusted and adjusted linear regression analyses were used to determine the associations between antibiotic prescription rates and method of remuneration, patient volume (expressed as the number of unique patients receiving an antibiotic prescription over the 1-year period of the study), physician's age, proportion of elderly patients in the practice, physician's country of graduation and location of practice. The dependent variable for the linear regression was the rate of antibiotic prescription per unique patient per year. Similarly, lo-

Physician and practice characteristics	All physicians $n = 476$	Method of remuneration; physician characteristic			Rate of prescription;* physician characteristic		
		Salary $n = 154$	Fee-for-service $n = 322$	p value	Low	High	p value
Mean no. (and 95% CI) of unique patients receiving antibiotic prescriptions per year	181 (166–196)	117 (98–135)	212 (193–231)	< 0.001	109 (95–122)	255 (232–278)	< 0.001
Mean no. (and 95% CI) of prescriptions per unique patient per year	1.58 (1.52–1.63)	1.27 (1.23–1.32)	1.72 (1.65–1.79)	< 0.001	–	–	–
No. (and %) salaried physicians	152 (32)	–	–	–	127 (53)	28 (12)	< 0.001
Mean age (and 95% CI), yr	43.6 (42.7–44.6)	40.8 (39.3–42.4)	45.0 (43.8–46.2)	< 0.001	41.3 (40.0–42.6)	46.0 (44.6–47.4)	< 0.001
Mean proportion (and 95% CI) of elderly patients in practice, %	25 (24–27)	26 (24–29)	24 (23–26)	0.26	24 (23–25)	26 (25–27)	0.21
No. (and %) graduating from Canadian medical school	271 (56.9)	35 (22.7)	236 (73.3)	< 0.001	113 (47)	158 (67)	< 0.001
No. (and %) practising in St. John's	152 (31.9)	19 (12.3)	133 (41.3)	< 0.001	70 (29)	83 (35)	0.133

Table 1: Characteristics of 476 general practitioners who prescribed antibiotics in Newfoundland between Aug. 31, 1995, and Aug. 30, 1996

Note: CI = confidence interval.
*Low rate of prescription was defined as 1.51 or fewer prescriptions per unique patient per year; high rate of prescription was defined as more than 1.51 prescriptions per unique patient per year.

gistic regression was employed to evaluate factors associated with antibiotic prescription rates. Here, the dependent variable was the presence or absence of an antibiotic prescription rate above the median rate of 1.51 antibiotic prescriptions per unique patient per year. The decision to define high rates as being above the median was arbitrary and was made before the data were analysed. Our findings were almost identical when the 75th percentile was used to define "high" prescription rates.

A second logistic regression model was employed to examine the interrelation of patient volume and payment method. The dependent variable was the presence or absence of an antibiotic prescription rate above the median rate, and adjustments were made for physician's age, proportion of elderly patients in the practice, physician's country of graduation and practice location. Physicians were divided by patient volume into quartiles and secondarily by payment method into 8 groups. Odds ratios for the likelihood of an antibiotic prescription rate above the median rate were then calculated, with salaried physicians in the lowest quartile as the reference category.

All statistical comparisons were carried out in SPSS for Windows (release 8.0.0; SPSS Inc., Chicago, 1997).

Results

Physician characteristics

We analysed 153 047 prescriptions generated by 476 physicians, of whom 154 were paid by salary and 322 were paid on a fee-for-service basis. The mean age of the physicians was 43.6 years, 271 (56.9%) were graduates of Canadian universities, and 152 (31.9%) worked in St. John's (Table 1). The mean proportion of elderly patients in the physicians' practices was 25%. The mean number of unique patients who received antibiotic prescriptions from a physician was 181.0; the corresponding 25th, 50th and 75th percentiles were 56.0, 151.5 and 252.5 patients respectively. The mean antibiotic prescription rate was 1.58 per unique patient receiving a prescription per year (Table 1).

Comparison of salaried and fee-for-service physicians

Salaried physicians had fewer unique patients who received antibiotic prescriptions, had lower rates of antibiotic prescription per unique patient per year, were less likely to be graduates of Canadian universities and were less likely to practise in St. John's than fee-for-service physicians (Table 1). The proportions of elderly patients were similar for salaried and fee-for-service physicians (Table 1).

Characteristics of physicians with high antibiotic prescription rates

Physicians with relatively high prescription rates (more than 1.51 prescriptions per unique patient per year) were more likely to be older, to have prescribed to more unique patients per year, to be remunerated on a fee-for-service basis and to be graduates of Canadian universities than physicians with lower antibiotic prescription rates (Table 1). They prescribed to the same proportion of elderly patients as physicians with lower prescription rates and were not more likely than physicians with lower prescription rates to practise in St. John's than in a rural setting.

Linear regression analysis showed that higher antibiotic prescription rates were significantly associated with fee-for-service remuneration, greater patient volume and older physician age (Table 2). This model explained about one-fifth of the variability in antibiotic prescription rates (R^2 = 0.21). Logistic regression analysis revealed that fee-for-service physicians were more likely than their salaried counterparts to have antibiotic prescription rates above the median of 1.51 per unique patient per year (Table 3). Physicians who prescribed to more unique patients were also more likely to prescribe above the median rate, as were older physicians. Physicians who prescribed to a high pro-

Table 2: Factors associated with antibiotic prescription rates, as determined by linear regression

Factor	Unadjusted regression			Adjusted regression		
	Mean difference* (and 95% CI)		p value	Mean difference* (and 95% CI)		p value
Method of remuneration (fee-for-service v. salary)	0.45	(0.34 to 0.56)	< 0.001	0.30	(0.16 to 0.43)	< 0.001
No. of unique patients receiving antibiotic prescriptions per year (per 100 patients)	0.13	(0.10 to 0.16)	< 0.001	0.10	(0.07 to 0.13)	< 0.001
Physician age (per 10 years)	1.16	(0.93 to 1.39)	< 0.001	0.06	(0.01 to 0.11)	0.018
High proportion of elderly patients (> median value of 23%)	0.02	(0.09 to 0.13)	0.74	0.04	(–0.06 to 0.15)	0.390
Country of graduation (Canada v. elsewhere)	0.22	(0.11 to 0.33)	< 0.001	0.12	(0.00 to 0.24)	0.054
Practice location (St. John's v. elsewhere)	–0.02	(–0.14 to 0.10)	0.71	–0.10	(–0.21 to 0.02)	0.103

Note: R^2 for the model = 0.21.
*The mean difference in the rate of antibiotic prescription per unique patient per year. For instance, the adjusted mean difference of 0.30 in row 1 indicates that the typical patient of a fee-for-service physician filled 0.3 more antibiotic prescriptions per year than the typical patient of a salaried physician. Each adjusted estimate is corrected for differences in the other listed factors.

portion of elderly patients were also more likely to prescribe at higher rates.

Volume of patients and remuneration method

A comparison of prescribing rates by patient volume and method of remuneration revealed an interesting finding: the rates for both groups of physicians increased with increasing patient volume, but the association was far more prominent for fee-for-service physicians (Fig. 1). A similar analysis using logistic regression adjusted for physician age, country of graduation, proportion of elderly patients and location of practice confirmed the strong association between antibiotic prescription rate and patient volume for fee-for-service physicians (Fig. 2). A steep relation between number of patients receiving prescriptions and the odds ratio for prescription rate above the median was seen for fee-for-service physicians. No such relation was observed for the salaried physicians.

Interpretation

We found a strong association between antibiotic prescription rate and method of physician remuneration: fee-for-service physicians prescribed at a much higher rate than did salaried physicians. Increasing patient volume was also associated with higher prescription rates, for both salaried physicians, in the unadjusted analysis only, and fee-for-service physicians, for whom the association was much stronger. A less striking relation was observed for physician age, older physicians prescribing at a higher rate than younger ones.

There are limitations to any study that uses information from administrative databases, because important variables may not be available. It is possible that there are fundamental differences between salaried and fee-for-service physicians that could not be addressed in this study, such as proportion of young patients, who have higher rates of infection. How-ever, given that the sample included all of the physicians in the province, it is unlikely that the overall type of patients seen was markedly different between the 2 groups.

Rising levels of antibiotic resistance in common human pathogens is an issue of grave concern. It may be the most important world public health issue of our era. Antibiotic resistance is irrefutably linked to antibiotic consumption.[13-15] Why, then, do antibiotic prescription rates continue to far exceed those justified by established rates of bacterial infection? Many factors might contribute to overprescription of antibiotics, including patient demand, perceived harmlessness of antibiotics and fear of litigation.
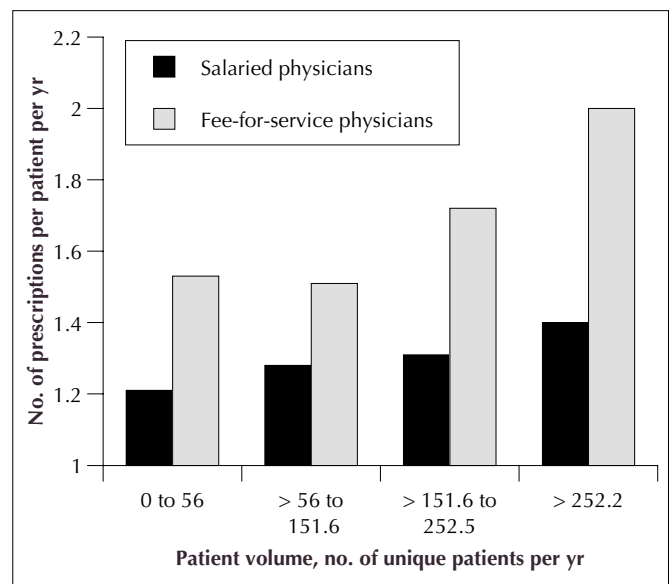

Fig. 1: Rate of antibiotic prescription for salaried and fee-for-service physicians, according to quartiles defined by a physician's patient volume (number of unique patients receiving antibiotic prescriptions from the physician per year). The trend was significant for both salaried ($p = 0.03$) and fee-for-service ($p < 0.001$) physicians.

Table 3: Factors associated with high antibiotic prescription rates, as determined by logistic regression

Factor	Unadjusted regression		Adjusted regression	
	OR (and 95% CI)	*p* value	OR (and 95% CI)	*p* value
Method of remuneration (fee-for-service v. salary)	8.2 (5.1–13.1)	< 0.001	4.7 (2.6–8.6)	< 0.001
No. of unique patients receiving antibiotic prescriptions per year (per 100 patients)	2.2 (1.9–2.7)	< 0.001	2.2 (1.8–2.7)	< 0.001
Physician age (per 10 years)	1.6 (1.3–1.9)	< 0.001	1.4 (1.1–1.8)	0.002
High proportion of elderly patients (> median value of 23%)	1.4 (1.0–2.0)	0.07	2.0 (1.3–3.3)	0.002
Country of graduation (Canada v. elsewhere)	2.3 (1.6–3.3)	< 0.001	1.6 (0.9–2.7)	0.10
Practice location (St. John's v. elsewhere)	1.3 (0.9–2.0)	0.13	1.2 (0.2–2.0)	0.47

Note: OR = odds ratio.

Our findings suggest that monetary factors play a significant role. A previous Canadian study,[16] which prompted much controversy, described an association between patient volume and prescription rate for all classes of pharmaceuticals prescribed to elderly beneficiaries of a provincial drug payment program. However, method of payment was not evaluated in that study. We were in a unique position to evaluate this important variable, because the proportion of salaried general practitioners is greater in Newfoundland than in any other province. The finding of higher antibiotic prescription rates among fee-for-service physicians and the striking association between patient volume and prescription rate within this group have profound implications for health care funding agencies everywhere. In the Canadian primary health care delivery system, in which remuneration per patient is low, fee-for-service general practitioners see large numbers of patients and have correspondingly short individual physician–patient encounters. Prescription of antibiotics may be viewed by fee-for-service physicians as necessary to cope with high daily patient numbers and to retain patients in their practices. A commonly expressed sentiment is "If I don't prescribe an antibiotic, my patients will go to another physician who will." Although no data exist to support this perception, there is no financial disincentive for Canadian patients who visit several physicians for a single illness.

This article is not meant to be an endorsement of the salary method of remuneration or an indictment of fee-for-service physicians. In a socialized medical system there are pros and cons for all methods of physician remuneration. It appears, however, that higher rates of antibiotic prescription and the concomitant problems of increasing antibiotic resistance and other adverse effects are a product of the predominant primary care delivery structure in Canada — that is, high-volume, fee-for-service practices. In this time of rapid evolution in all aspects of health care delivery, knowledge and acceptance of these non-medical influences on physicians' prescribing practices should help guide fundamental decisions about primary care delivery and medical education that will promote the rational use of antibiotics.

Competing interests: None declared.

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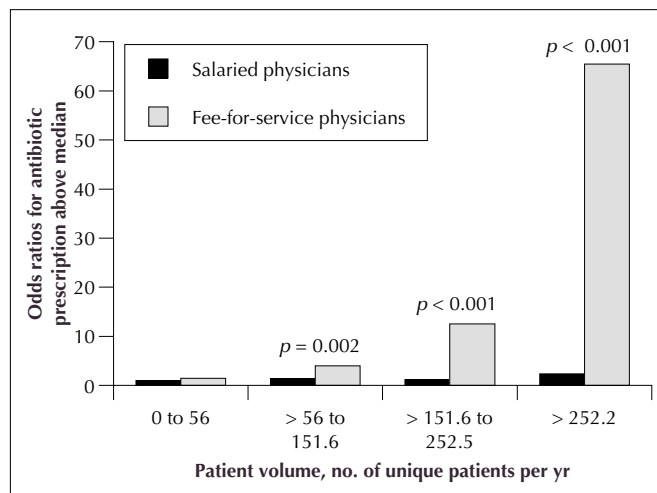
Fig. 2: Likelihood of high prescription rate by patient volume and method of remuneration, according to patient volume quartiles. The odds ratios were obtained by a logistic regression model adjusted for physician age, proportion of elderly patients in the practice, country of graduation and practice location. The median rate of antibiotic prescription was 1.51 prescriptions per unique patient per year. The reference category for the analysis was salaried physicians giving prescriptions to 0 to 56 patients per year. Comparisons for which no *p* value is given were not significant.

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