DO TOO MANY COOKS SPOIL THE BROTH? MULTIPLE PHYSICIAN INVOLVEMENT IN MEDICAL MANAGEMENT OF ELDERLY PATIENTS AND POTENTIALLY INAPPROPRIATE DRUG COMBINATIONS

Robyn M. Tamblyn,*† PhD; Peter J. McLeod,*‡ MD; Michal Abrahamowicz,† PhD; Réjean Laprise,† PhD

Abstract • Résumé

Objectives: To determine (a) whether the risk of a potentially inappropriate drug combination (PIDC) increases with the number of physicians involved in the medical management of an elderly patient and (b) whether the risk of a PIDC is reduced if a patient has a single primary care physician or a single dispensing pharmacy, or both.

Design: Cross-sectional retrospective provincial database study.

Participants: A regionally stratified random sample of 51 587 elderly medicare registrants in Quebec who (a) visited at least one physician in 1990, (b) were not living in a health care institution for the entire year and (c) had been dispensed at least one prescription for a cardiovascular drug, a psychotropic drug or a nonsteroidal anti-inflammatory drug (NSAID).

Outcome measures: Information on all physician visits and drugs dispensed during 1990. Physician claims were used to identify the number of physicians involved in a patient's management and whether the patient had one primary care physician. Prescription claims were used to identify the number of PIDCs, prescribing physicians and dispensing pharmacies.

Results: The prevalence of PIDCs ranged from 4.0% (among those in the NSAID group) to 20.3% (among those in the psychotropic drug group). Of the PIDCs identified, 17.6% to 25.8% resulted from contemporaneous prescribing by different physicians. The number of prescribing physicians was the most important risk factor for a PIDC in all drug groups (odds ratio [OR] 1.44 to 1.71). The presence of a single primary care physician lowered the risk for cardiovascular and psychotropic PIDCs (OR 0.70 and 0.79 respectively) but not for NSAID PIDCs (OR 0.94). The use of a single dispensing pharmacy lowered the risk of a PIDC in all drug groups (OR 0.68 to 0.79).

Conclusion: The greater the number of physicians prescribing medications for an elderly patient, the greater is the risk that the patient will receive a PIDC. A single primary care physician and a single dispensing pharmacy may be "protective" factors in preventing PIDCs.

Objectifs : Déterminer a) si les risques d'association de médicaments qui pourraient être contre-indiquées (AMCI) augmentent avec le nombre de médecins qui interviennent dans le traitement médical d'un patient âgé et b) si le risque d'AMCI diminue lorsqu'un patient est traité par un seul médecin de première ligne ou une seule pharmacie distributrice, ou les deux.

Conception : Étude rétrospective transversale d'une base de données provinciale.

Participants : Échantillon aléatoire stratifié à l'échelon régional de 51 587 personnes âgées inscrites à l'assurance-maladie au Québec qui a) ont consulté au moins un médecin en 1990, b)ne vivaient pas dans un établissement de santé pendant toute l'année et c) avaient reçu des médicaments prescrits dans au moins une ordonnance, soit un médicament cardiovasculaire, un psychotrope ou un anti-inflammatoire non stéroïdien (AINS).

Mesures des résultats : Renseignements sur toutes les consultations de médecins et sur tous les médica-

*From the departments of *Medicine, †Epidemiology and Biostatistics, and ‡Pharmacology, McGill University, Montreal, Que.*

Reprint requests to: *Dr. Robyn M. Tamblyn, Health Services and Outcomes Research Group, Division of Clinical Epidemiology, Royal Victoria Hospital, Ross 4, 687 Pine Ave. W, Montreal QC H3A 1A1; robyn@benzo.epidrug.mcgill.ca*

ments distribués en 1990. On a utilisé les demandes de paiement des médecins pour établir le nombre de médecins qui sont intervenus dans le traitement d'un patient et pour déterminer si le patient avait un médecin de première ligne. On a utilisé les demandes de paiement d'ordonnances pour établir le nombre d'AMCI, celui des médecins prescripteurs et celui des pharmacies distributrices.

Résultats : La prévalence des AMCI a varié de 4,0 % (chez ceux qui ont reçu un AINS) à 20,3 % (chez ceux qui ont reçu un psychotrope). Parmi les AMCI identifiées, de 17,6 % à 25,8 % ont découlé d'ordonnances simultanées établies par des médecins différents. Le nombre de médecins prescripteurs était le plus important facteur de risque d'AMCI dans tous les cas (coefficient de probabilité [CP], 1,44 à 1,71). La présence d'un seul médecin de première ligne a réduit le risque d'AMCI dans le cas des médicaments cardiovasculaires et des psychotropes (CP 0,70 et 0,79 respectivement), mais non dans celui des AINS (CP 0,94). Le recours à une seule pharmacie distributrice a réduit le risque d'AMCI dans toutes les catégories de médicaments (CP 0,68 à 0,79).

Conclusion : Plus les médecins qui prescrivent des médicaments à un patient âgé sont nombreux, plus le risque d'AMCI est élevé pour ce patient. Un seul médecin de première ligne et une seule pharmacie distributrice peuvent être des facteurs de «protection» dans la prévention des AMCI.

Improvement in physician prescribing has been the objective of a variety of published intervention programs.[1] Although these programs vary in their approach and effectiveness, all focus on the individual physician as the primary "cause" of inappropriate prescriptions. Yet in the elderly patient population the assumption that most prescribing problems are created by individual physicians may not be correct. Elderly patients are more likely than younger patients to have a number of health problems,[2] and therefore they may see several physicians, many of whom may prescribe drug treatment. Contemporaneous interventions by different physicians in the management of the same patient could lead to the inadvertent prescription of inappropriate drug combinations or of two drugs from the same group (therapeutic duplication) (e.g., two ß-blockers). Patients who have no primary care physician to coordinate care or a single pharmacy to monitor current prescriptions may be particularly susceptible to these types of prescribing problems. Col, Fanale and Kronholm[3] noted that elderly patients who saw a number of physicians were more likely than those who saw one physician to be admitted to hospital for drug-related illness. However, no study has determined whether the number of physicians involved in a patient's medical management is related to the risk of inappropriate prescriptions or whether there are any benefits of a single primary care physician or pharmacist in relation to the occurrence of potential prescribing problems.

We designed this study to answer three questions: What proportion of potentially inappropriate drug combinations (PIDCs) among elderly patients results from contemporaneous prescribing by two or more physicians? Does the risk of receiving a PIDC increase with the number of physicians involved in a patient's management? Are patients who have a single primary care physician or a single dispensing pharmacy at less risk of a PIDC than other patients?

Methods

Study design

We conducted a retrospective, cross-sectional, 1-year period-prevalence study to evaluate the relation between multiple physician involvement and PIDCs prescribed for elderly patients in the three drug groups most commonly implicated in drug-related illness: cardiovascular drugs,[4,5] psychotropic drugs[6–8] and nonsteroidal anti-inflammatory drugs (NSAIDs).[4,5,9]

Study population

The study population comprised all Quebec residents 65 years of age or more as of Jan. 1, 1990, who visited a physician or who had medication dispensed between Jan. 1 and Dec. 31, 1990; this group accounted for 89% of all Quebec seniors.[10] Members of the study population were identified from the file of medicare registrants in Quebec. All Quebec residents are registered by the Régie de l'assurance maladie du Québec (RAMQ), the government body responsible for payment of physician services and prescription drugs.[10] A regionally stratified sample of 65 349 people was randomly selected from the study population: 6040 from each of the 12 geographically defined health care regions in Quebec, or all people when fewer than 6040 were available in a region. People were excluded if they resided in a health care institution for all of 1990, since no information is available on institutional drug prescribing, or if they resided in the most northern region of Quebec, where information on physician visits is incomplete. People were included if they had been dispensed a cardiovascular drug, a psychotropic drug or an NSAID.

Measurement

All physician billings and prescription claims for pa-

tients in the study sample made between Jan. 1 and Dec. 31, 1990, were retrieved from the medical services and pharmacy databases of the RAMQ. For each visit billed by a physician the RAMQ maintains an electronic record of the patient's medicare number, the physician's billing number and specialty, the date and location of service, the medical service provided and the diagnosis. For each prescription drug dispensed to registrants 65 years of age or more the RAMQ records the pharmacy's identification number, the patient's medicare number, the name, dose and amount of the drug dispensed, the date, the duration of treatment and the prescribing physician's billing number. The accuracy of the prescription claims data has been verified by us previously.[11]

Two variables were created from the medical services and pharmacy files to measure the number of physicians involved in each patient's management. First, using the medical services database, we computed the number of different physicians seen by each patient by counting the number of physicians who billed for a patient in 1990. Second, we determined the number of different prescribing physicians for each patient by counting the number of prescribing physicians listed in the pharmacy records for dispensed drugs.

Two variables were created to measure factors that we hypothesized would lessen the risk of a PIDC: the presence of a single primary care physician to coordinate the care, and the presence of a single pharmacy to monitor dispensing. We assumed that a patient had a single primary care physician if the patient saw only one general practitioner during the study year. The number of different pharmacy identification codes in records of dispensed prescriptions was used to classify patients as using a single pharmacy or multiple pharmacies to fill their prescriptions.

A PIDC was defined as a drug combination for which (a) there was established or probable evidence of a risk of interaction that could lead to significant deterioration in patient health or there was a risk of toxic effects because of therapeutic duplication and (b) use could not be justified to achieve safe and effective treatment in elderly people except in rare circumstances. Drug combinations that might increase the risk of a serious adverse event or that represented unnecessary duplication were identified from an existing expert review.[12] Six university-affiliated specialists (two cardiologists, two psychiatrists and two internists) then independently classified each combination as rational (justified in some disorders because of known therapeutic benefit) or potentially inappropriate (use could not be justified as effective treatment in elderly people except in rare circumstances). Disagreements were arbitrated by a clinical pharmacologist (P.J.M.). Of the 57 cardiovascular combinations identified, 12 were considered PIDCs (agreement 83%), as were 15 of the 51 psychotropic combinations (agreement 80%) and 3 of the 15 NSAID combinations (agreement 100%) (Table 1).

To accurately measure the occurrence of PIDCs, we needed to exclude drug combinations that could have represented changes in drug therapy (substitutions) rather than contemporaneous prescriptions. Since information about substitutions was not available in the pharmacy database, we used a conservative approach to PIDC measurement. For an individual patient, a PIDC was considered present only if (a) there was an overlap in the time in which the two drugs could be administered, the overlap being determined by the date and duration of therapy for the two drugs in a combination, or (b) both drugs were dispensed on the same day or prescriptions for both drugs were refilled after the date the initial overlap in prescriptions was documented. This definition effectively excluded all substitutions but likely underestimated the prevalence of PIDCs.

We organized prescription claims for each patient into a drug-by-day matrix using the date dispensed as the start date for each prescription and the duration of the prescription to define the end date. This matrix of daily drug use was inspected for the presence of PIDCs that met our study definition. For each type of PIDC listed in Table 1, only the first occurrence in the calendar year was counted for each patient. We considered that a PIDC was due to two prescribing physicians if the physician identification numbers in the records for the two drugs differed.

Statistical analysis

In each drug group, we calculated the proportion of patients with at least one PIDC as well as the prevalence of individual PIDCs; the denominator for this calculation was the number of patients dispensed a drug from the respective group. The proportion of patients with a PIDC attributable to more than one prescribing physician for each drug group was then estimated; the denominator for this calculation was the number of patients with a PIDC in the respective drug group.

We evaluated the association between multiple physician involvement and the risk of a PIDC for each drug group using the occurrence of at least one PIDC in the drug group as a binary outcome variable. We expected that the association would be nonlinear, hypothesizing that the increase in the risk of a PIDC would be much greater for a change from one to two prescribing physicians than for a change from five to six physicians. We used goodness-of-fit statistics based on log likelihood values from logistic regression analysis to evaluate the assumption that log transformation of the number of physicians and number of prescribing physicians pro-

Table 1: Proportion of randomly selected elderly patients in Quebec with a potentially inappropriate drug combination (PIDC) and of those with a PIDC due to multiple prescribers

PIDC*	% of patients	
	With a PIDC†	With a PIDC due to multiple prescribers‡
Cardiovascular		
Potassium-sparing diuretic with potassium supplement	1.4	14.1
Two or more calcium-channel blockers	1.1	24.1
Two or more thiazide diuretics	0.8	18.4
ß-blocker with theophylline	0.8	20.3
Two or more furosemides	0.7	30.0
Two or more ß-blockers	0.6	29.6
Two or more ACE inhibitors	0.4	25.4
Two or more potassium-sparing diuretics	0.2	15.7
Indapamide with thiazide diuretic	0.2	29.0
ß-blocker with verapamil	0.2	20.0
Ethacrynic acid with furosemide	0	–
Indapamide with lithium	0.01	60.0**
At least one cardiovascular PIDC	5.9	22.0
Psychotropic		
Two or more benzodiazapines (except clonazepam)	16.9	17.1
Benzodiazapine with diverse sedative§	2.6	20.3
Two or more tricyclic antidepressants	1.0	10.3
Clonezepam with other benzodiazapine	0.6	19.7
Two or more tranquilizers‖	0.4	9.0
Two or more diverse sedatives	0.3	10.5
Two or more clonazepams	0.07	23.8**
Barbiturate with antidepressant¶	0.04	30.8**
Two or more barbiturates	0.03	0**
Diverse sedatives with barbiturate	0.02	0**
MAO inhibitor with antidepressant	0.01	0**
Barbiturate with opiate	0	–
MAO inhibitor with levodopa	0	–
MAO inhibitor with meperidine	0	–
Two or more MAO inhibitors	0	–
At least one psychotropic PIDC	20.3	17.6
NSAID		
Two or more non-ASA NSAIDs	2.8	24.6
Two or more ASAs	1.1	27.0
ASA with warfarin	0.1	41.9**
At least one NSAID PIDC	4.0	25.8

*ACE = angiotensin-converting enzyme, MAO = monoamine oxidase, ASA = acetylsalicylic acid.
†Percentages in this column are based on the number of patients in the respective drug group.
‡Percentages in this column are based on the number of patients with a PIDC in the respective drug group.
§Diverse sedatives = chloral hydrate, hydroxyzine, meprobamate and promethazine.
‖Tranquilizers = phenothiazines, thioxanthenes, butyrophenones, methotrimeprazine and other heterocyclic antipsychotic agents.
¶Antidepressants = tricyclic antidepressants, tetracyclic antidepressants and MAO inhibitors.
**Point estimate is relatively unstable; 95% confidence interval is wider than 20%.

vided a better fit for the explanation of each study outcome than the untransformed values of these variables. Associations between the two measures of multiple physician involvement and the risk of a PIDC were estimated separately with the use of logistic regression analysis. The effects of a single primary care physician and a single dispensing pharmacy were estimated through bivariate analysis, and the independent effects of each factor on the risk of a PIDC was assessed using multiple logistic regression analysis.

Results

Of the 65 349 patients in the sample, we excluded 2081 (3.2%) because they were living in an institution for the entire year and 351 (0.5%) because they resided in the most northern region in Quebec. Of the remaining 62 917 patients 51 587 (82.0%) were prescribed drugs from one or more of the three drug groups studied: 35 815 (56.9%) were dispensed cardiovascular drugs, 30 354 (48.2%) were dispensed psychotropic drugs, and 35 390 (56.2%) were dispensed NSAIDs.

The mean age of the patients was 74.7 years, and 59.2% were women (Table 2). The median number of prescriptions dispensed per patient was 28 (range 1 to 550); this represented a median of 7 (range 1 to 51) unique medications per patient (a count based on the number of different drug identification numbers represented in claims for prescriptions dispensed to the same patient during the study year). For most of the patients medical care was provided by more than one physician. A median of 3 different physicians (range 1 to 58) per patient were visited during the year. Two thirds of the patients had two or more prescribing physicians during the year (range 1 to 18). Most had a single primary care physician and had their prescriptions filled at a single pharmacy. The number of pharmacies used ranged from 1 to 12. Moderate associations were observed between the number of different physicians visited and the number of prescribing physicians ($r = 0.57$). Compared with patients who did not have one primary care physician, those who did visited fewer different physicians (median 5 v. 2), consulted fewer specialists (median 2 v. 1), had fewer prescribing physicians (median 3 v. 2) and fewer prescribing specialists (median 1 v. 0), and were more likely to have a single pharmacy (52.0% v. 68.1%).

Overall, 8976 (17.4%) of the patients had at least one PIDC during the year; among these patients 10 320 PIDCs were identified. PIDCs were most common among the patients receiving a psychotropic drug prescription (20.3% of these patients); the prevalence rate of PIDCs was 5.9% among those receiving a cardiovascular drug combination and 4.0% among those receiving an NSAID combination (Table 1). In the psychotropic drug group, the most common PIDC was the concurrent prescription of two benzodiazepines (16.9%); the next most common PIDC was the prescription of a benzodiazepine with another type of sedative (2.6%). In the cardiovascular drug group, the most common PIDC was the prescription of a potassium-sparing diuretic with a potassium supplement (1.4%); the next most common was the concurrent prescription of two or more calcium-channel blockers (1.1%). Among patients prescribed NSAIDs, the most common PIDC was the concurrent prescription of two or more non-ASA (acetylsalicylic acid) NSAIDs (2.8%).

Among the patients with a PIDC, the proportion of those who received it as a result of multiple prescribers was 22.0% for cardiovascular combinations, 17.6% for psychotropic combinations and 25.8% for NSAID combinations (Table 1). These figures varied moderately

Table 2: Demographic characteristics and health care utilization patterns of the 51 587 elderly patients in the study sample

Variable	% of sample
Age group, yr	
65–75	60.1
76–85	33.9
86–95	5.9
> 95	0.1
Mean age (and standard deviation)	74.7 (6.0)
Sex	
Female	59.2
Male	40.8
No. of physicians visited	
1–3	55.8
4–6	25.5
7–9	10.1
≥ 10	8.6
Median no. (and range)	3 (1–58)
No. of prescribing physicians	
1	31.3
2–3	47.8
4–5	15.7
≥ 6	5.2
Median no. (and range)	2 (1–18)
Single primary care physician	
Yes	51.9
No	48.1
Single dispensing pharmacy	
Yes	60.4
No	39.6

among the most common drug combinations: 14.1% for a potassium-sparing diuretic with a potassium supplement, 17.1% for the concurrent prescription of two or more benzodiazepines and 24.6% for two or more non-ASA NSAIDs.

In examining the association between multiple physician involvement and the risk of a PIDC, we first evaluated whether our assumption of a nonlinear relation was correct. Log transformation of values for the number of different physicians visited by each patient and the number of prescribing physicians improved the fit of the logistic models for each drug group (increases in log likelihood ranged from 10 to more than 50 when compared with linear models). This meant that an increase in the risk of a PIDC was greater when the increase in the number of physicians was at the lower end of the distribution (e.g., from 2 to 3 physicians) than when it was at the upper end of the distribution (e.g., from 12 to 13 physicians).

There was a significant relation between the number of physicians involved in a patient's medical management and the risk of a PIDC across all three drug groups ($p < 0.0001$) (Fig. 1). Of the two measures of multiple physician involvement, the number of prescribing physicians was more strongly associated with the risk of a PIDC than was the number of physicians providing medical care. For cardiovascular drug combinations the risk of a PIDC increased by 71% for each doubling in the number of prescribing physicians (odds ratio [OR] 1.71; 99% confidence interval [CI] 1.6 to 1.8). Therefore, compared with patients who had one prescribing physician during the study year, those with four prescribing physicians had almost three times the risk of a cardiovascular PIDC (OR 2.94), and those with eight prescribing physicians had five times the risk (OR 5.0). Similarly, each doubling in the number of prescribing physicians increased the risk of a psychotropic PIDC by 44% (OR 1.44; 99% CI 1.4 to 1.5) and an NSAID PIDC by 45% (OR 1.45; 99% CI 1.3 to 1.6). Patients who had four prescribing physicians had slightly more than two times the risk of an NSAID or a psychotropic PIDC (OR 2.1) compared with patients who had one prescribing physician; patients with eight prescribing physicians were at three times the risk (OR 3.0). In contrast, each doubling in the number of physicians providing medical care increased the risk of a cardiovascular PIDC by 39% (OR 1.39; 99% CI 1.3 to 1.5), a psychotropic PIDC by 21% (OR 1.21; 99% CI 1.2 to 1.3) and an NSAID PIDC by 17% (OR 1.17; 99% CI 1.1 to 1.3).

Patients who had a single primary care physician or a single dispensing pharmacy, or both, were less likely to receive a PIDC than those who did not (Table 3). The protective effects of both factors were most pronounced for patients in the cardiovascular drug group: the risk of a PIDC was 30% less among the patients with a single primary care physician (OR 0.70; 99% CI 0.6 to 0.8) and 32% less among those with a single dispensing pharmacy (OR 0.68; 99% CI 0.6 to 0.8). Either factor reduced the risk of a psychotropic PIDC by 21%. For potentially inappropriate NSAID combinations, the use of a single pharmacy was the only factor that had a significant protective effect. When both variables were put into a multiple logistic regression model, the estimated ORs remained quite stable (single primary physician: OR 0.74 [cardiovascular PIDC] to 0.98 [NSAID PIDC]; single pharmacy: OR 0.72 [cardiovascular PIDC] to 0.79 [psychotropic PIDC]). This suggests that the two variables operated relatively independently as "protective" factors.

We examined whether limitations of our study design could account for these results. Patients with many prescribing physicians may have been sicker, and as a result their drug therapies may have needed to be managed by a number of physicians. These patients may have also

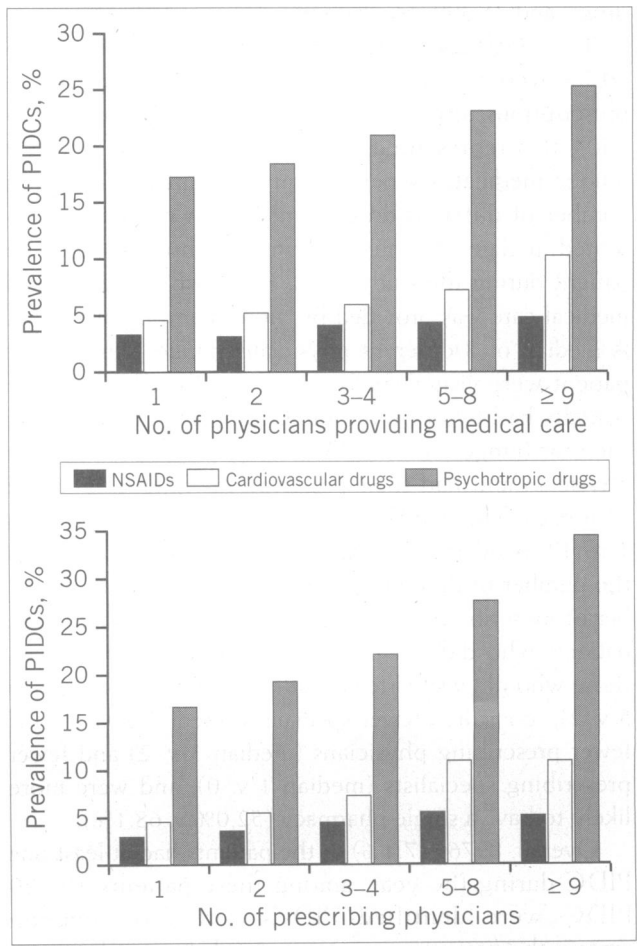

Fig. 1: Prevalence of potentially inappropriate drug combinations (PIDCs) by number of physicians providing medical care (top) and number of prescribing physicians (bottom), by type of drug combination. NSAIDs = nonsteroidal anti-inflammatory drugs. See Results section for odds ratios of PIDCs derived from these data.

represented the rare exceptions when PIDCs are warranted to manage illness effectively. To examine this possibility, we assessed the association between the number of prescribing physicians and the risk of a PIDC among the 12 788 patients who saw only general practitioners. In this subpopulation of patients, it is less likely that multiple prescribing physicians or PIDCs are justified by the patient's health status. We found that the number of general practitioners prescribing for a patient remained a strong and significant risk factor for a PIDC. The ORs were very similar to those estimated for the total sample, varying from a low of 1.4 for potentially inappropriate NSAID combinations to 1.7 for cardiovascular PIDCs.

Discussion

In this study we used census information from provincial health care databases to evaluate the association between multiple physician involvement in medical management and the risk of a PIDC among elderly patients. Our findings were not subject to the selection biases introduced by voluntary participation or eligibility screening for health insurance coverage.[13,14] We based the measurement of physician involvement on all visits made by a patient, not just those known by one physician or those recalled by the patient. We based the measurement of potentially inappropriate prescribing on the pharmacist's documentation of drugs actually dispensed to the patients. Since all prescription drugs for elderly patients in Quebec are covered by RAMQ, the provincial database provides an accurate method of estimating potential exposure to drugs prescribed by more than one physician.

For elderly patients, it seems that "too many cooks can spoil the broth." We found that the risk of a PIDC increased with the number of physicians involved in a patient's management, especially the number of prescribing physicians. From the population perspective, this association is important because 20.9% of the elderly patients in our sample (about 145 000 Quebec seniors) have four or more prescribing physicians. In comparison with patients who had one prescribing physician, those who had four had almost three times the risk of a cardiovascular PIDC and two times the risk of a psychotropic or an NSAID PIDC.

Although 17.6% to 25.8% of the PIDCs we identified were attributable to multiple physician involvement, most were not. Prescribing habits of individual physicians are also a factor. Thus, to reduce the number of PIDCs among elderly patients, future health care policy may have to be targeted at two levels. First, prescribing assistance and feedback could be given to individual physicians. Second, a reduction in the number of prescribing physicians could be encouraged. To address the latter, studies need to be performed that explore what mechanisms lead to multiple prescribing physicians, including patient use or misuse of medical services and patient health status.

Our findings suggest that elderly patients in Quebec receive some protection against suboptimal drug prescribing when they have a single primary care physician. Patients who had one primary care physician saw fewer physicians overall and fewer specialists. Thus, part of the protective effect we observed was likely due to a reduction in the opportunity for multiple prescribers. Primary care physicians may also play an active role in coordinating drug therapy, and the potential protective effects of this practice should be evaluated in subsequent research. From a health care policy perspective, our study adds to the existing body of evidence supporting the idea that primary care physicians are needed to provide comprehensive and accessible primary health care and to coordinate specialty services.[15,16] Our finding that most of the elderly patients did not have a single primary care physician is therefore troubling. This may have been due in part to our definition of primary care physician, since

Table 3: Proportion of patients with a single primary care physician or a single dispensing pharmacy who had a PIDC, by type of drug combination

	Type of drug combination; % of patients with a PIDC		
Variable	Cardiovascular	Psychotropic	NSAID
Single primary care physician			
Yes	5.1	18.3	3.8
No	7.1	22.1	4.0
Odds ratio	0.70*	0.79*	0.94
Single dispensing pharmacy			
Yes	5.0	18.7	3.5
No	7.2	22.4	4.6
Odds ratio	0.68*	0.79*	0.75*

*$p < 0.001$.

patients were classified as having one only if they visited a single general practitioner. This criterion excluded patients who may have received primary care from a number of different physicians working in the same group practice or from a specialist. Although physicians in group practice have to rely on the adequacy of chart documentation[17] or patient drug history[18] to identify current medication, primary care management by physicians in group practice may be an equally effective means of minimizing suboptimal prescribing; this possibility should be tested.

We found that patients with a single dispensing pharmacy were at significantly lower risk of a PIDC than those who had their prescriptions filled at more than one pharmacy. Pharmacists maintain drug profiles for each patient and use this information to screen for potentially inappropriate prescriptions. The beneficial effects of the pharmacist's review probably depends on the completeness of the drug list more than on the number of physicians who prescribe for a patient. Although it may be impractical to insist that all patients use a single pharmacy, the same beneficial effects of the pharmacist's role in minimizing suboptimal prescribing could be realized if pharmacies had access to all information about each patient's current drug therapy. The pharmacy network project in Ontario[19] and the health care "smart-card" project in Quebec[20] are examples of how such information could be made available to pharmacists.

Ultimately the cost benefit of interventions to reduce prescribing problems will need to be judged in relation to the desired results: reduced numbers of drug-related illness and death, and improved quality of life. Although PIDCs contribute to unwarranted costs in health care delivery, we do not know to what extent potentially inappropriate prescribing contributes to avoidable illness and death. This should be addressed in subsequent research.

We thank the Régie de l'assurance maladie du Québec for its assistance in completing this project, particularly Gérard Soucy and Jacques Barry for helping us access the databases and answering our many questions with patience and good humour. We also thank the following research assistants in the Division of Clinical Epidemiology, Royal Victoria Hospital: Jimmy Fragos for his essential contributions in managing the databases and creating study variables, Lina Petrella for her assistance in creating reference banks for interpreting the data, and Gilles Lavoie for his dedicated assistance in analysing the data.

This research was supported by grants from the Fonds de la recherche en santé du Québec, the Royal Victoria Hospital Research Institute and Upjohn Canada. Drs. Tamblyn and Abrahamowicz are research scholars supported by the Fonds de la recherche en santé du Québec.

References

1. Soumerai SB, McLaughlin TJ, Avorn J: Improving drug prescribing in primary care: a critical analysis of the experimental literature. *Milbank Q* 1989; 67: 268–317
2. Beers MH, Ouslander JG: Risk factors in geriatric drug prescribing: a practical guide to avoiding problems. *Drugs* 1989; 37: 105–112
3. Col N, Fanale JE, Kronholm P: The role of medication noncompliance and adverse drug reactions in hospitalizations of the elderly. *Arch Intern Med* 1990; 150: 841–845
4. Ives TJ, Bentz EJ, Gwyther RE: Drug-related admissions to a family medicine inpatient service. *Arch Intern Med* 1987; 147: 1117–1120
5. Colt HG, Shapiro AP: Drug-induced illness as a cause for admission to a community hospital. *J Am Geriatr Soc* 1989; 37: 323–326
6. Larson EB, Kukull WA, Buchner D et al: Adverse drug reactions associated with global cognitive impairment in elderly persons. *Ann Intern Med* 1987; 107: 169–173
7. Tinetti ME, Speechley M, Ginter SF: Risk factors for falls among elderly persons living in the community. *N Engl J Med* 1988; 319: 1701–1707
8. Ray WA, Griffin MR, Schaffner W et al: Psychotropic drug use and the risk of hip fracture. *N Engl J Med* 1987; 316: 363–369
9. Grymonpre RE, Mitenko PA, Sitar DS et al: Drug-associated hospital admissions in older medical patients. *J Am Geriatr Soc* 1988; 36: 1092–1098
10. *Statistiques annuelles 1990*, Service des communications de la Régie de l'assurance-maladie du Québec, Québec, 1990: 1–280
11. Tamblyn RM, Lavoie G, Petrella L et al: The use of prescription claims databases in pharmacoepidemiological research: the accuracy and comprehensivness of the prescription claims database in Quebec. *J Clin Epidemiol* 1995; 48: 999–1009
12. Tatro DS (ed): *Drug Interaction Facts. Facts and Comparisons*, Wolters Kluwer Co, St Louis, 1992
13. Siddharthan K: HMO enrollment by medicare beneficiaries in heterogeneous communities. *Med Care* 1990; 28: 918–927
14. Stiefel MD, Gardelius DA, Hayami DE: Selection bias: a comparison of inpatient utilization, demographics and premiums for HMO "leavers", "stayers," and "joiners." In *Proceedings of the 34th Annual Group Health Institute*, Group Health Institute, Philadelphia, 1984: 235
15. Working Group on Primary Care: *Strengthening the Foundation: the Role of the Physician in Primary Health Care in Canada*, Canadian Medical Association, Ottawa, 1994
16. *Primary Care and Health Care Reform* [grant announcement], Agency for Health Care Policy and Research, Rockville, Md, June 1993
17. Gurwich EL: Comparison of medication histories acquired by pharmacists and physicians. *Am J Hosp Pharm* 1983; 40: 1541–1542
18. Kendrick R, Bayne JRD: Compliance with prescribed medication by elderly patients. *Can Med Assoc J* 1982; 127: 961–962
19. Health Network: *A New Service for Your Health and Safety* [cat no 2127399], Ontario Ministry of Health, Toronto, 1994
20. *L'utilisation rationnelle des médicaments chez les personnes agées: Stratégie d'action*, Ministère de la Santé et des Services sociaux du Québec, Québec, 1994: 1–47