Pharmaceutical Use among Older Adults: Using Administrative Data to Examine Medication-Related Issues

Colleen Metge,[1,2] Ruby Grymonpre,[2] Matthew Dahl,[1,2] and Marina Yogendran[1,2]

RÉSUMÉ

La consommation de médicaments est reconnue comme la prestation de soins la moins chère et la plus rentable. Cela est particulièrement important chez les aînés, puisqu'il s'agit des personnes qui consomment le plus de médicaments sur ordonnance. Nous décrivons un ensemble de données qui sont liées, y compris des données fournies par l'industrie pharmaceutique, les médecins et les hôpitaux, de manière à étudier la consommation de produits pharmaceutiques chez les personnes âgées, puis nous fournissons plusieurs exemples de mise en œuvre. Des indicateurs permettant de déterminer la consommation de médicaments globale dans la population ainsi qu'une consommation appropriée de certains médicaments ont été élaborés. Les indicateurs relatifs à une consommation appropriée sont décrits en fonction de la distribution de benzodiazépines à des personnes âgées. Nous avons découvert qu'une proportion appréciable des nouveaux utilisateurs de benzodiazépines (plus de 10 p. 100) reçoivent encore des ordonnances pour une version à action prolongée, ce qui semble témoigner d'une mauvaise utilisation potentielle. Les données permettent également de décrire certaines conséquences graves de la consommation de produits pharmaceutiques comme des décès, des fractures ainsi que des mesures cliniques fondées sur la population, le cas échéant.

ABSTRACT

Medication use is recognized as the least expensive, most cost-effective health care intervention. In older adults this is especially important, as they are the largest consumer of prescription medications. We describe the use of a linked data set including pharmaceutical, medical, and hospital claims to examine pharmaceutical use in the population of older adults and then give several examples of its application. Indicators to describe the population's overall use of medication and the appropriate use of specific medication have been developed. Indicators of appropriate use are characterized using the dispensation of benzodiazepines to older adults. We have found that a significant proportion of new users of benzodiazepines are still prescribed a long-acting version (over 10%), signifying potential inappropriate use. The data are also able to describe some significant outcomes from the use of pharmaceuticals such as death, fracture, and population-based clinical measures where available.

1 Department of Community Health Sciences, Faculty of Medicine, University of Manitoba

2 Faculty of Pharmacy, University of Manitoba

Manuscript received: / manuscrit reçu : 21/04/03

Manuscript accepted: / manuscrit accepté : 15/05/04

Mots clés: médicaments sur ordonnance; consommation de médicaments; pertinence; données administratives

Keywords: prescription drugs; utilization; appropriateness; administrative data

Requests for offprints should be sent to: / Les demandes de tirés-à-part doivent être addressées à :

Colleen Metge, Ph.D.
Manitoba Centre for Health Policy
Department of Community Health Sciences
University of Manitoba
727 McDermot Avenue, Suite 408
Winnipeg, MB R3C 3P5
(c_metge@umanitoba.ca)

Introduction

Medication use is recognized as the least expensive, most cost-effective component of health care expenditures (Medication Working Group, 1988). Its appropriate use is an important preventative as well as curative strategy in maintaining health. Therefore, *optimal therapy* in the older adult is especially important, since this population is, proportionately, the largest consumer of prescription medications. Although comprising about 13 per cent of the Canadian population (Statistics Canada, 2003), older adults are consumers of over one third of all prescriptions (Metge, Kozyrskyj, Dahl, Yogendran, & Roos, 2003). Coupled with this imbalance in the burden of medication-taking is an impending growth in the next 40 years of the numbers of persons over the age of 65 as a proportion of the population, and the recognized higher prevalence of medication-related problems in this segment of the population compared to the general population (Chutka, Takahashi, & Hoel, 2004; Liu & Christensen, 2002; Shimp, Scione, Glazer, & Atwood, 1985).

Observational studies suggest that comprehensive medication reviews conducted by pharmacists identify potential or actual medication-related issues in at least 80% of the older adults reviewed (Grymonpre, Williamson, Huynh, & Desilets, 1994; Kassam et al., 2001; Lipton, Bero, Bird, & McPhee, 1992; Sellors et al., 2003; Grymonpre, Sitar, Montgomery, Mitenko, & Aoki, 1991). For example, between 12 and 46 per cent of drugs prescribed for older persons have been estimated to be either inappropriate or unnecessary (Futterman, Fillit, & Roglieri, 1997; Spore, Mor, Larrat, Hawes, & Hiris, 1997; Stuck et al., 1994; Tamblyn et al., 1994; Willcox, Himmelstein, & Woolhandler, 1994), about 50 per cent of pharmaceutical users, including older adults, do not adhere to prescribed regimens (Coambs et al., 1995), and the incidence of adverse drug events in older outpatients has been reported to be between 10 and 21 per cent (Hanlon & Lewis, 1995). Combined, these drug-related problems are often significant and can be associated with a significant increase in the hospitalization of older adults (Grymonpre, Mitenko, Sitar, Aoki, & Montgomery, 1988).

Using administrative data, however, one can efficiently isolate where the potential or actual medication-related issues are found or developing (Lipton & Bird, 1993). In the following, we outline how pharmaceutical claims data, along with other health services utilization data and pharmacoepidemiological approaches, can be used to inform on the quality of pharmaceutical use in older adults. Specifically, we address three attributes of quality: (1) utilization, (2) appropriateness, and (3) effectiveness of the prescription drugs being taken in community settings by older adults (≥65 years of age). These three dimensions of quality of pharmaceutical use mirror the quality of care framework for examining a health care system, such as that originally proposed by Donabedian (1980) and, more recently, encouraged by Romanow's health care commission (Commission on the Future of Health Care in Canada, 2002). Figure 1 draws the parallel between Donabedian's quality of care framework and one used by the Manitoba Centre for Health Policy (MCHP) in the framing of questions related to pharmaceutical use by the population.

Donabedian's Model on Measures of Health Care Quality		
Structure	**Process**	**Outcome**
Professional and organizational resources associated with the provision of care	Things done to and for the patient in the course of treatment	Desired states resulting from care, including a decrease in morbidity/mortality and an increase in quality of life
Proposed Model on Measures of the Quality of the Population's Use of Pharmaceuticals		
Utilization	**Appropriateness**	**Effectiveness**
Quantitative data on the access, extent, variability, and cost of the use of pharmaceuticals	Determination of whether the right drug was prescribed to the right person at the right time and dose	Outcomes or the net of benefit and harm* when a pharmaceutical is prescribed, dispensed, and taken under real-life circumstances

*Measures of outcome typically used to describe either outcome or effectiveness are the five *D*'s: death, disease including a co-morbid condition like side effects, disability or loss of optimal functioning, discomfort, and dissatisfaction (Lohr & Donaldson, 1990).

Figure 1: A model of a quality of care framework for examining a population's use of pharmaceuticals

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

Tognoni (1983) notes that before one can measure the medical and social consequences of pharmaceutical use, quantitative data need to be obtained on the extent and variability in the usage and costs of drug therapy. We call this an examination of pharmaceutical *utilization*. *Appropriateness* is a process measure; it is the subset of quality that is concerned with determining whether the right thing was done for the patient (Institute of Medicine, 2001). In a health system performance sense, it is the provision of care or interventions (including pharmaceuticals) based on established standards or evidence. *Effectiveness*, on the other hand, concerns the results or outcomes achieved in the actual practice of health care, or dispensation of prescription drugs, with typical patients and providers (Laupacis, Paterson, Mamdani, Rostom, & Anderson, 2003; Rawson, 2001).

Within a framework of evaluating the quality of pharmaceutical use, a question about pharmaceutical effectiveness could be, ''To what extent is the care or intervention achieving the desired outcome(s)?'' Using the prescription of the lipid-lowering drugs, statins, for example, a *utilization* measure would be the rate at which these drugs are prescribed across a province within different regions or according to differing levels of co-morbidity; an *appropriateness* measure would be the rate at which statins are prescribed after an acute myocardial infarction, as compared to the rate expected under best practice and the prescribing of a lipid-lowering drug that is optimal for a given patient (that is, the right drug at the right dose, well tolerated, good adherence); and an *effectiveness* measure would be a decrease in coronary heart disease events and premature mortality (death before age 75) in those prescribed the statins (MacWilliam, 1999; Eyles, Birch, Chambers, Hurley, & Hutchinson, 1993).

The purpose of this paper is to illustrate how utilization, appropriateness, and effectiveness link in a framework for examining the quality of pharmaceutical use, using administrative data. First, we describe the data set we use to examine quality of medication use in older adults and then give the reader two examples of how the framework can be applied in determining quality of pharmaceutical use in older adults, using administrative data.

Source of Pharmaceutical Use Data

Pharmaceutical quality indicators of utilization, appropriateness, and effectiveness are identified from a previously described population-based administrative data repository for all Manitoba Health registrants (Roos & Shapiro, 1999) housed at MCHP. This data repository captures provincially reimbursed physician services, hospitalizations, and pharmaceutical dispensations, and includes information on the identity of the patient, the date of service, services provided or drugs dispensed, and diagnoses as *International Classification of Disease-9-Clinical Modification* (ICD-9-CM) codes. The accuracy of these administrative data has been established for a wide range of clinical disorders, including outcomes following hip fracture (Roos, Sharp, & Wajda, 1989; Roos, Walld, Romano, & Roberecki, 1996).

Specifically, pharmaceutical use is reported within a population-based framework, meaning that virtually all prescriptions claims to Manitoba residents that are registered by the province's Drug Programs Information Network (DPIN) can be counted. Rates of drug utilization are based on dispensed prescription claims submitted to Manitoba Health by about 300 pharmacies providing pharmaceuticals to Manitoba residents. In-hospital use of prescription drugs is not captured by DPIN and is excluded from any data analyses; however, use by residents of personal care homes ($n = 9400$) not affiliated with acute care hospitals is captured in the data.

Data Description

The pharmaceutical data have information about prescriptions, persons, and the drug prescribed. Prescription data include drug identification number (DIN) – a key variable linking the drug dispensed to other drug descriptors like dosage form, date provided, days of medication supplied, metric quantity claimed, ingredient cost, and dispensing fee paid, and a prescribing physician identification code scrambled for confidentiality. Pharmacy and pharmacist codes are also provided but not currently under use. Prescription data do not include reasons for use or instructions for use.

Person-based data per prescription comprises the provincial health information number (PHIN) – which is scrambled and used as a key linking variable within the pharmaceutical use data (e.g., for compilation of longitudinal dispensations of one drug for one person over time) – and other MCHP-held databases like the Manitoba Health Registry. The registry is used to access the person's birthdate, sex, and first three digits of his/her postal code (forward sortation area).

Pharmaceutical use by Manitoba residents is reported according to the area of an individual's residence, not according to the site where the prescription medication is purchased. Specifically, residents of Manitoba are identified and information about region of residence is obtained using the Manitoba municipal

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

code on the Manitoba Health Registry file as of December 31 of a specified fiscal year, except for Treaty First Nations residents. For these individuals, postal code information is used to assign region of residence. Individuals are grouped by age and assigned, usually, a 5-year age-group based on age at first prescription dispensed in the fiscal year studied or reported on.

The descriptors for each drug dispensed in the system are read from a master DIN file. This file contains the generic or chemical name of the product dispensed, its brand name in English and French, strength of the active ingredient (for single entity products), dosage route (e.g., orally or rectally administered), dosage form, and way in which the drug is supplied (as a tablet or liquid). Classification codes from Health Canada's Drug Products Database file (Health Canada) are added to each DIN in the file after the data are received by MCHP. Two primary classification codes are used: WHO's Anatomical-Therapeutic-Chemical (ATC) classification and the American Hospital Formulary System (AHFS) (Sketris, Metge, Blackburn, & MacCara, 2004).

The ATC classification system for human medicines from WHO's Collaborating Centre for Drug Statistics Methodology is used to classify drug entities in our master list of pharmaceuticals (WHO, 2003; World Health Organization, n.d., 1995). We use this classification system to group different drugs used for similar indications. The ATC classification system divides drugs into different groups according to the organ or system on which they act, or on their therapeutic and chemical characteristics. The first level of the code is based on a letter for the anatomical group, e.g., *N* for nervous system; the second level of the code is the therapeutic main group, e.g., *N05* for psycholeptics (includes antipyschotics, anxiolytics, hypnotics, and sedatives); the third level of the code is the pharmacological subgroup, e.g., *N05 B* for anxiolytics, including the benzodiazepine derivative Valium®. We use the fourth level or chemical subgroup for our measure of ''number of different drugs,'' e.g., N05 BA is a category called benzodiazepine derivatives; the fifth (and last) level of classification is at the drug molecule or specific chemical substance level (e.g., diazepam).

The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults. The rate of the number of DDDs dispensed to the population (of residents or users) per day and per year can be calculated to measure various aspects of intensity of pharmaceutical use. For example, the number of DDDs used per prescribed day per pharmaceutical user should equal one (= 1), if the drug or groups of drugs being examined are primarily used for the main indication at the recommended dose (Metge, Black, Peterson, & Kozyrskyj, 1999; Sketris et al., 2004). A clinical measure of prescribed doses per day (PDD) by individual drug (e.g., diazepam) can also be calculated, although the measure is not a metric that can be summed across different drugs and drug groups (Metge et al., 1999).

The data field used to describe *metric quantity dispensed* contains inconsistencies that render non-discrete dosage forms (e.g., creams, ointments, eye drops, reconstitutable antibiotic powders) unusable for calculation of defined daily doses (DDD). DDDs, therefore, are calculated using about 65 per cent of total claims available for analyses. Other utilization rate calculations, like indicators of ''access to pharmaceuticals'' (defined as dispensation of at least one prescription drug in a year) and expenditure, are not affected by this limitation.

Finally, the data are used to describe the population's use of pharmaceuticals via indicators of utilization, appropriateness, and effectiveness. Usually, rates of these indicators are reported on a per fiscal-year basis, which corresponds to the timing of the receipt of our data files from Manitoba Health. Denominators are based on counts of individuals resident in one of 11 rural regions or 12 urban (Winnipeg) regions, as per the population registry information of June 30 in each fiscal year. The numerators for pharmaceutical utilization rates, for example, are calculated by counting or adding individuals, prescription claims, number of different drugs at Anatomical-Therapeutic-Chemical classification level 4 (ATC-4), defined daily doses, and expenditures during the year for individuals according to their area of residence.

The following two questions are examples of how pharmaceutical data can be used within the quality evaluation framework as proposed in Figure 1. Using the data structure as described above, we describe the methods and results of two questions about pharmaceutical use in Manitoba. All study protocols for the questions posed were approved by the Health Research Ethics Committee, University of Manitoba, and permission to access the data was obtained from the Manitoba Health's Health Information Privacy Committee.

How has the use of pharmaceuticals changed within Manitoba's population over a period of four years (1996 to 2000) according to measures of access, intensity, and cost?

Measuring drug utilization indicators creates a ''quality assurance'' system that satisfies the need

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

for accountability (Starfield et al., 1985). Indicators of access, for example, describe for us the persons and the prescribers of their drugs that account for the largest share of pharmaceutical use or expenditures. Measures of access and utilization are important to determine the attainment of attributes of quality, like contact with care (access to pharmaceuticals) and comprehensiveness (insurance coverage for pharmaceuticals deemed ''medically necessary'' by the insurer). The following highlights our development of indicators of drug utilization and the potential of combining them to inform on equitable distribution of pharmaceutical resources.

Methods

The data for this question were obtained from DPIN data fiscal years April 1 to March 31, 1996/1997 to 1999/2000. The utilization rates shown in this report have been age- and sex-adjusted to account for the differences in demography across Manitoba regions. For comparison, some analyses report pharmaceutical use by all ages; utilization rates for those aged 65 and over (age as of December 31 in any fiscal year) are reported separately.

Three categories of drug utilization indicators are illustrated: (1) *access* to prescription drugs defined as the per cent of the population having at least one prescription drug dispensed per year, which approximates other population-based measures of ''access'' used by the centre (Roos et al., 2001), (2) measures of *intensity of use* by therapeutic class (ATC) and population descriptors like age and sex and a co-morbidity descriptor like Adjusted Clinical Groups (ACGs), and (3) *expenditures* or costs of prescription drugs, regardless of government's fiduciary responsibility, and reportable by income quintile and age categories. Some of the measures, like DDDs, number of different drugs, and expenditures are combined to illustrate the value of the utilization indicators. Figure 2 is a representation of the data's possible combinations.

Access to prescription drugs is shown by age and sex groupings. Number of prescriptions dispensed per unit of population is the usual measure of intensity of use for pharmaceuticals. It is a problematic measure, because the metric quantity of the prescription (e.g., tablets, capsules, etc.) varies from prescription to prescription. However, the defined daily dose measure helps to standardize pharmaceutical use across a population by totalling individual dosage units and then ascribing total DDDs (or maintenances doses of a number of drugs) dispensed per resident.

''Number of different drugs'' is yet another measure of intensity. A ''different'' drug is defined at the fourth level of Anatomical-Therapeutic-Chemical classification system, that is, at the chemical subgroup but not at the drug molecule level; individuals are assigned a value for number of different drugs dispensed within one year. We demonstrate how closely this measure corresponds to the categorization of individuals using the Adjusted Clinical Group adjustment tool.

A commonly referred to limitation of pharmacoepidemiologic studies using administrative data post-approval is called channelling bias. It has been described as the propensity of ''sicker'' patients to be prescribed disproportionately the newer and perceived to be more potent medications differentially (Metge et al., 2003). We illustrate the use of a stratification variable called the Adjusted Clinical Group (ACG) with an intensity of use measure for pharmaceuticals – number of different drugs. Assignment of an ACG to Manitoba residents is the application of a population/patient case-mix adjustment system developed by researchers at Johns Hopkins University School of Hygiene and Public Health in Baltimore (Starfield, Weiner, Mumford, & Steinwachs, 1991). The ACG system quantifies morbidity by grouping individuals by their age and gender and all known medical diagnoses (which have been assigned over a defined period of time, typically one year). *International Classification of Disease-9-Clinical Modification* (ICD-9-CM) diagnosis codes for similar conditions are clustered on the basis of expected consumption of health care resources and short-term clinical outcomes. An ACG assigned to an individual, then, represents a combination of one or more diagnostic groups (up to 32) and their age and gender. Adjusted Clinical Groups help to quantify morbidity on a population basis for the purposes of stratifying individuals by their level of co-morbidity (Reid, Roos, MacWilliam, Frohlich, & Black, 2002).

Finally, a variety of utilization measures are reported on using ''income quintiles.'' These are geographic area measures of socio-economic status derived from Canadian 1996 census data. Census-derived household income data, aggregated to the geographic unit of the enumeration area, are used to rank neighbourhoods by average household income. The average (mean) household income of residents living in specific neighbourhoods is ranked from poorest to wealthiest, and then grouped into five income quintiles (1 being poorest and 5 being wealthiest), each quintile containing approximately 20 per cent of the population. Income quintiles are available for both urban and rural populations, although usually only Winnipeg is reported on (Metge et al., 2003; Metge et al., 1999).

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

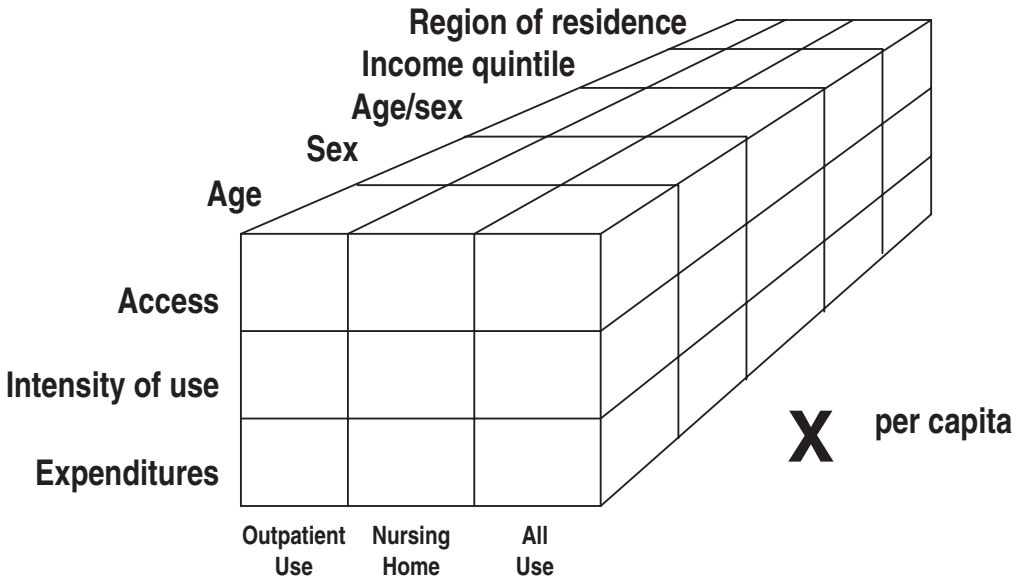

Figure 2: Analysis orientation for describing drug utilization

Results

Population-based measures of outpatient pharmaceutical use in Manitoba are based on the dispensing of over 8 million prescriptions per year and costing about $286 million (based on 1999/2000 data). Table 1 is a summary of the drug utilization indicators used to describe Manitobans' use of prescription drugs from April 1, 1996, to March 31, 2000.

At least two thirds of Manitobans (67.3%) had access to pharmaceuticals (i.e., were dispensed at least one prescription per year) in 1999/2000. However, approximately 85 per cent of older Manitobans (≥65 years old) are pharmaceutical users in any one year (in 1996/1997, 84.4%; in 1999/2000, 87.0%). Figure 3 is a graphic representation of the proportion of the population using at least one prescription drug per year by age and sex categories.

The mean number of different drugs dispensed per pharmaceutical user was 3.7 in 1999/2000 – an increase of 9.1 per cent over the 1996/1997 baseline value of 3.3 in the data. The mean number of different drugs dispensed to older pharmaceutical users was 5.9 in 1999/2000 – an increase of 15.7 per cent over the 1996/1997 baseline value of 5.1. Mean number of different drugs mirrors the other co-morbidity measure used to describe Manitoba's population, "Adjusted Clinical Group" (ACG), ($\chi^2 = 0.0005$, $df = 4$, *ns*).

Expenditure indicators describe the dollar costs of prescription drugs to pharmaceutical users and on a per capita basis. The mean expenditure per prescription was $32.61 in 1999/2000 – an increase of 18.7 per cent over the baseline value of $27.47. The price per prescription varies little between those Manitobans less than 65 years old and those 65 years of age and older (Table 1). Total expenditures for pharmaceuticals per capita and pharmaceutical user were $249 and $370, respectively, for the 1999/2000 fiscal year. However, when one compares the amount spent per capita by the older versus the younger adult population, we see that those 65 years of age cost approximately four times more ($708:$177 in 1999/2000).

Figure 4 shows a combination of two measures: intensity of use and expenditures. It appears that older residents of Manitoba pay four times more per person for pharmaceuticals in a year than younger residents, and the dollars spent per defined daily dose (DDD) is 20 per cent more for younger residents. Table 2 describes measures of pharmaceutical use (access, intensity, and expenditure) by income quintile, including expenditures.

Conclusion and Discussion

These measures of a population's access to and intensity of use of pharmaceuticals provide powerful indicators of how a program functions across the province, while also providing a basis for benchmarking the use of pharmaceuticals. The administrative data are able to produce valid measures of utilization across the population. One of the more powerful limitations to the data is that we do not know the

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

Table 1: Population-based measures of pharmaceutical use (1996–2000)

		Residents			Pharmaceutical Users
		All	<65 Years Old	≥65 Years Old	
Access indicator	1996/97	66.0 *N* = 1,144,460	63.0 *N* = 89,8570	84.4 *N* = 154,890	N/A
Users of dispensed	1997/98	65.7 *N* = 1,143,117	62.6 N = 987,210	84.9 *N* = 155,907	
pharmaceuticals	1998/99	66.9 N = 1,143,614	63.9 *N* = 987,574	86.1 *N* = 156,040	
(per 100 residents)	1999/00	67.3 *N* = 1,148,074	64.2 *N* = 991,527	87.0 *N* = 156,547	
Intensity of Use Indicators					
Mean number of	1996/97	6.2	4.6	16.6	9.5
prescriptions per year	1997/98	6.6	4.8	17.9	10.1
	1998/99	7.0	5.1	19.1	10.5
	1999/00	7.6	5.5	21.1	11.4
Mean number of	1996/97	3.3	2.9	5.1	3.3
different drugs	1997/98	3.4	3.0	5.3	3.4
used per year (users)	1998/99	3.5	3.0	5.5	3.5
	1999/00	3.7	3.2	5.9	3.7
Mean number of	1996/97	120	76	405	223
defined daily	1997/98	133	83	447	247
doses (DDDs/year)*	1998/99	142	89	473	257
	1999/00	154	97	511	276
Expenditure Indicators					
Mean dollars ($)	1996/97	171	123	480	260
per year	1997/98	191	136	539	290
	1998/99	216	154	607	322
	1999/00	249	177	708	370
Mean dollars ($) per	1996/97	27.47	26.65	28.92	27.47
prescription	1997/98	28.75	27.96	30.09	28.75
	1998/99	30.63	29.97	31.76	30.63
	1999/00	32.61	32.02	33.58	32.61

*Based on approximately 65 per cent of total prescriptions dispensed (see text)

proportion of medications prescribed and not dispensed, or if the medication dispensed is actually taken.

Perhaps one of the most compelling ways of describing pharmaceutical use and the response of policy decisions to ensuring equitable distribution of pharmaceuticals is through an examination of the expenditures incurred by residents with different socio-economic characteristics. For example, the dispensation of pharmaceuticals according to a variety of utilization measures appears to be responsive to need as shown by the measures in the lowest income quintile compared to the other income quintiles.

This responsiveness is supported by previous work we have done with this population descriptor. We have compared the health and health care use patterns of Winnipeg residents according to the average household income in the neighbourhood of residence. There is a marked difference in health status as measured by age/sex standardized death rates across the Winnipeg population. Individuals in middle-income neighbourhoods (quintile 3)

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

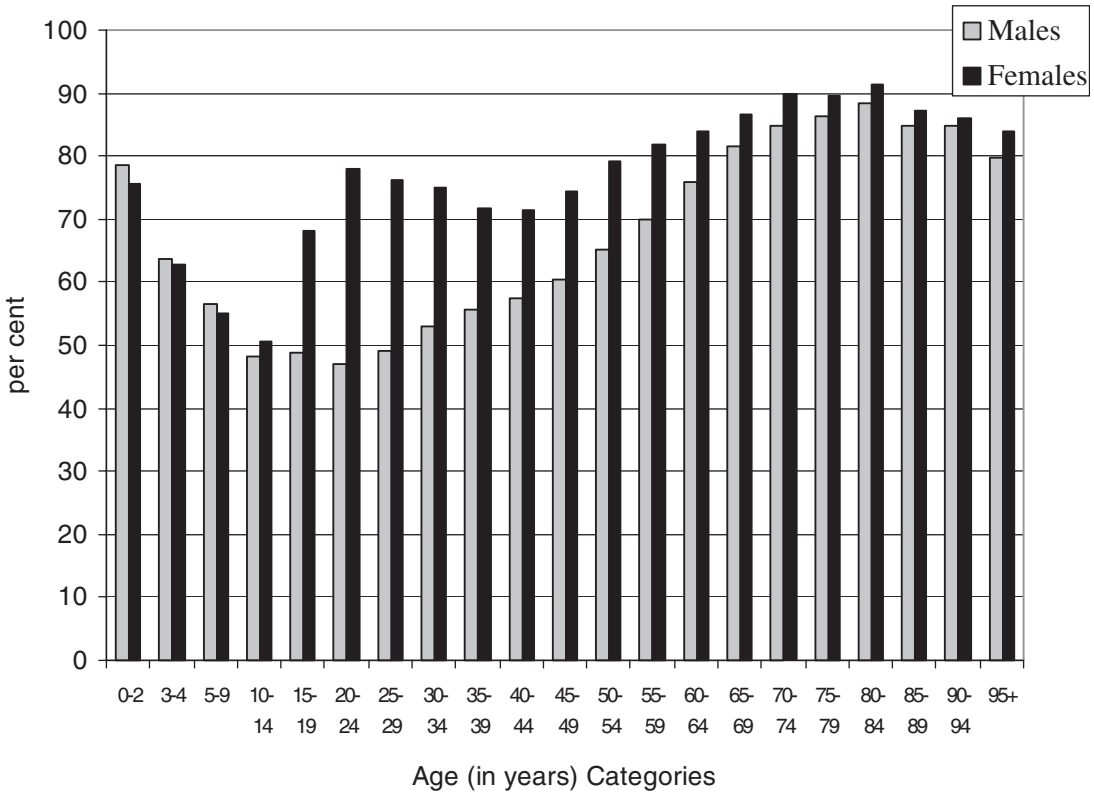

Figure 3: Per cent population with *access to at least one prescription* by age and sex in Manitoba, 1999/2000

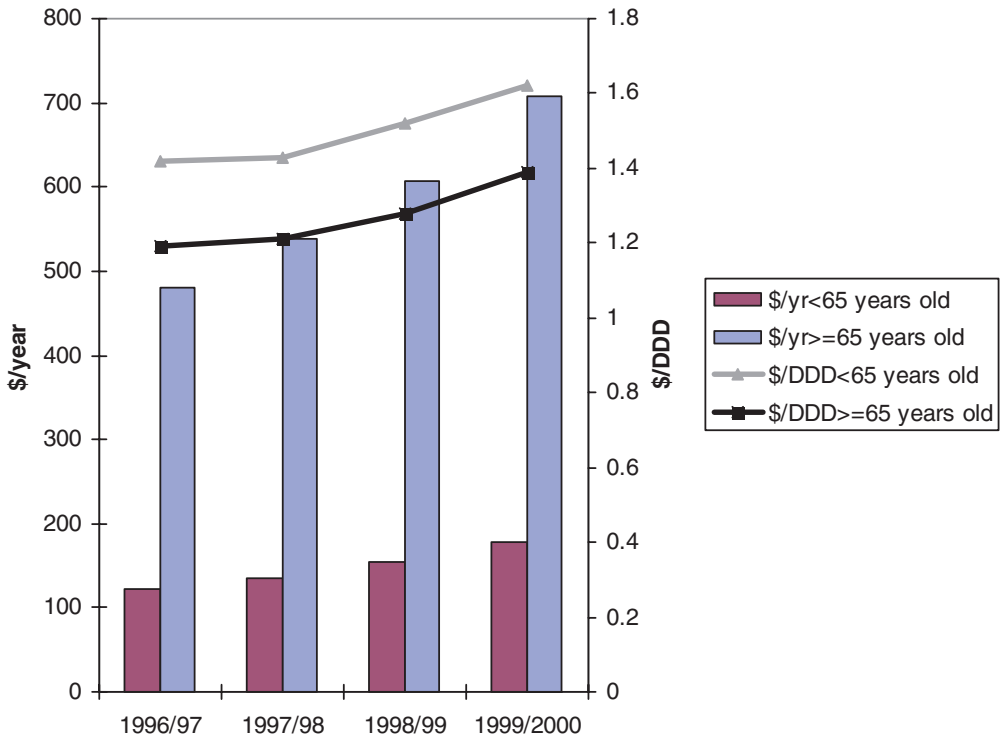

Figure 4: Dollars spent per younger Manitoba resident and per older resident per year and per defined daily dose, 1996–2000 (age- and sex-adjusted)

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

Table 2: Pharmaceutical use measures by income quintile, Winnipeg, 1999/2000 (age- and sex-adjusted)

	Access: % Using at Least One Prescription per Year	Use: # Different Drugs /User	Expenditures (in dollars)	
			/Resident	/User
Q5 (highest income)	66.4	3.0	223.17	306.43
Q4	68.0	3.2	228.41	309.25
Q3	68.5	3.3	239.15	318.11
Q2	68.9	3.4	252.67	335.62
Q1 (lowest income)	71.2	4.0	297.12	392.34

have higher mortality rates than do individuals in the highest-income neighbourhoods (quintile 5), whereas those in the poorest neighbourhoods demonstrate the highest rates (Metge et al., 2003; Metge et al., 1999).

Also, the finding that younger Manitobans take fewer medication doses but cost more than do older Manitobans may be explained by the types of drugs that are more likely to be prescribed when one is in either a younger or older age group. A national survey of prescribing done yearly in the United States found that the therapeutic class with the largest increase in drug use for older adults (65+) is for hematologic agents or blood-thinners, a class of drugs that has been on the market for many years (Burt, 2002). However, the largest increase in prescribing for younger adults was in new molecular entities like lipid-lowering drugs and selective serotonin reuptake inhibitors for depression; both are classes of drugs that are proportionately prescribed more infrequently in older adults but that cost more per dose (Metge et al., 2003; Metge et al., 1999). More study is required to determine if more expensive medications are being prescribed to younger people than those prescribed to those older persons within therapeutic classes and on a cost per dose basis.

What proportion of older adults are newly prescribed a long-acting benzodiazepine?

Appropriateness measures examine whether the right drug has been prescribed for the right indication, for the right person, and at the right time and dose, usually according to evidence-based guidelines. One top candidate for examining appropriate prescribing is the use of the anti-anxiety agents – benzodiazepines (e.g., Ativan®, Valium®) – particularly those that are long-acting and those that are prescribed for longer than safely indicated.

The benzodiazepines (Bz) rank among the most frequently prescribed medication class in the older population, being the agents of choice for the treatment of anxiety and acute insomnia (Kalvik, Isaac, & Janecek, 1996; Nowell et al., 1997). In 1989, 20 per cent of older women and 12 per cent of older men living in Saskatchewan received at least one prescription for a Bz (Quinn, Baker, & Evans, 1992). A 1996 study of pharmaceutical use in Manitoba suggests that this prevalence of use in the older population has been maintained (Metge et al., 1999). Use appears to be more prevalent in older persons taking multiple medications, placing them at an even greater risk for drug-related problems from this "high risk" drug category (Metge et al., 2003).

While these agents have a definite place in the treatment of anxiety and in the management of short-term (3–4 weeks) insomnia, it is suspected that a large proportion of patients use Bz for the management of long-term insomnia. At this time, there is a lack of evidence supporting the efficacy of chronic benzodiazepine use, and continuous use beyond 2–4 weeks is not recommended (Holbrook, Crowther, Lotter, Cheng, & King, 2000; Kupfer & Reynolds, 1997). One study conducted in 1994 found that 30.8 per cent of older persons in Quebec received a benzodiazepine for more than 30 consecutive days (Tamblyn et al., 1994). In a separate study, the prevalence of continuous, long-term (>180 days) Bz use in older community-dwelling persons (65+) in Quebec was 20 per cent (Egan, Moride, Wolfson, & Monette, 2000).

The association of Bz with potentially serious adverse effects calls the widespread chronic use of these agents in the older adult into question. Dose-related side effects most commonly affect the central nervous system and include unsteadiness, somnolence, fatigue, cognitive impairment, and difficulty concentrating (Salzman, 1999). The author suggested that

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

these responses are most likely due to a combination of increased receptor sensitivity and reduced metabolic clearance. Long-term use of Bz may exacerbate an underlying dementia and may often lead to the addition of a drug to treat Bz side effects – an undesirable consequence in a segment of the population already subject to polymedicine. Several studies found an improvement in measures of memory and cognition after discontinuation of Bz therapy (Larson, Kukull, Buchner, & Reifler, 1987; Salzman, 1999; Salzman, Nobel, Glassman, Wolson, & Kelley, 1992). Perhaps more alarming is the link between Bz use in older persons and an increased risk of falls and fractures, and motor vehicle accidents (Holbrook et al., 2000). The risk of being in an automobile accident is 50 per cent greater in older adults who use Bz versus those who do not use Bz, and older persons who take long-acting Bz have a 70 per cent higher risk of sustaining a hip fracture (Kalvik et al., 1996). As a result of these clinical findings, we were interested in assessing changes in the utilization and appropriateness of benzodiazepines in older Manitobans over time.

Methods

The data for this question were obtained from DPIN data using the fiscal years of April 1 to March 31, 1996/1997 to 1999/2000. The utilization rates for those newly prescribed benzodiazepines aged 65 and over (age as of December 31 in any fiscal year) are reported separately. New use was defined as no mention of a benzodiazepine dispensation in the first 4 months of a fiscal year (FY), April 1 to July 31, and at least one prescription for a benzodiazepine in the last 8 months of the fiscal year, August 1 to March 31. For example, if we found a first dispensation for diazepam for an individual dated September 20, 1998, ''new use'' was designated if there were no other dispensations for benzodiazepines from April 1, 1998, to July 31, 1998.

To analyse the appropriateness of any single group of drugs, one needs to separate them from all of the other drug products listed in the DPIN system; these number in excess of 5,000. To identify all of the benzodiazepine solid forms dispensed in Manitoba, we first grouped all products using the Anatomical-Chemical-Therapeutic classification system. For psycholeptics like benzodiazepines this would be all DINs with the designated code of (N05). Long-acting benzodiazepines like diazepam (N05BA01) and flurazepam (N05CD01) share the first two levels of the ATC code, but the third and subsequent levels are different (WHO Collaborating Centre for Drug Statistics Methodology). Therefore, we also generate an alphabetical list by generic or chemical name to ensure that no drugs have been missed because of miscoding by ATC grouping code. Once the DINs for the benzodiazepines were identified, we pulled all prescription claims, grouped them by claimant (using the scrambled personal health identification number), and applied our algorithm for ''new use.''

Once identification of ''new use'' was accomplished, we categorized new use by the pharmacological action of the benzodiazepine as short-acting, intermediate-acting, and long-acting. Long-acting benzodiazepines included diazepam (Valium®) and flurazepam (Dalmane®); intermediate-acting benzodiazepines included alprazolam (Xanax®) and lorazepam (Ativan®); and short-acting benzodiazepines included triazolam (Halcion®) and zopiclone (Imovane®).

Results

Table 3 shows that close to 6.5 per cent of persons 65 years of age and older resident in Manitoba in any single year are newly prescribed benzodiazepines. If we examine the distribution of type of benzodiazepine being newly prescribed, we observe a downward trend in new prescriptions for long-acting benzodiazepines as a proportion of all new benzodiazepines prescribed to this population. Figure 5 shows that while the rate of prescribing for long-acting benzodiazepines has fallen by about a quarter (23.3%) over the 4 years of analysis, this decrease has been taken up through an increased prescribing of short-acting benzodiazepines (e.g., triazolam, zopiclone) shown as a 29.7 per cent increase in the prescribing of these drugs over the same period. The significance of these changes has not been determined. A follow-up analysis to determine how long these new users are maintained on these anti-anxiety agents is underway.

Conclusion and Discussion

The data show us that long-acting benzodiazepines continue to be prescribed, perhaps inappropriately, in older adults resident in Manitoba. The rates of use in those persons aged 65 and older and ratio of intermediate/short-acting Bz use to long-acting Bz compares with those of other Canadian studies (Hogan, Maxwell, Fung, & Ebly, 2003; Laurier, Moride, & Kennedy, 2002; Tu, Mamdani, Hux, & Tu, 2001). Yet there currently appears to be limited evidence supporting the efficacy of chronic continuous benzodiazepine use in older adult insomniacs, as well as substantial evidence pointing to the risks associated with such therapy (Ashton, 1995). Across the world, working groups, task forces, and professional organizations have published guidelines and

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

Table 3: Distribution of benzodiazepine use in older Manitoba adults* by sex, 1996–2000 (age- and sex-adjusted)

		Long-Acting Benzodiazepines	Intermediate-Acting	Short-Acting Benzodiazepines	Total(s)
1996/1997 *N* = 10,130	Males	608 (6.0%)	2218 (21.9%)	529 (5.2%)	3355 (33.1%)
	Females	1210 (11.9%)	4625 (45.7%)	940 (9.3%)	6775 (66.9%)
1997/1998 *N* = 9754	Males	577 (5.9%)	2179 (22.3%)	532 (5.5%)	3288 (33.7%)
	Females	984 (10.1%)	4533 (46.5%)	949 (9.7%)	6466 (66.3%)
1998/1999 *N* = 9807	Males	518 (5.3%)	2182 (22.2%)	625 (6.4%)	3325 (33.9%)
	Females	948 (9.7%)	4472 (45.6%)	1062 (10.8%)	6482 (66.1%)
1999/2000 *N* = 9890	Males	488 (4.9%)	2149 (21.7%)	657 (6.6%)	3294 (33.3%)
	Females	880 (8.9%)	4519 (45.7%)	1197 (12.1%)	6596 (66.7%)

*Baseline population of Manitoba residents aged 65 and over: 154,890 (1996/97), 155,907 (1997/98), 156,040 (1998/99), and 156,547 (1999/2000)

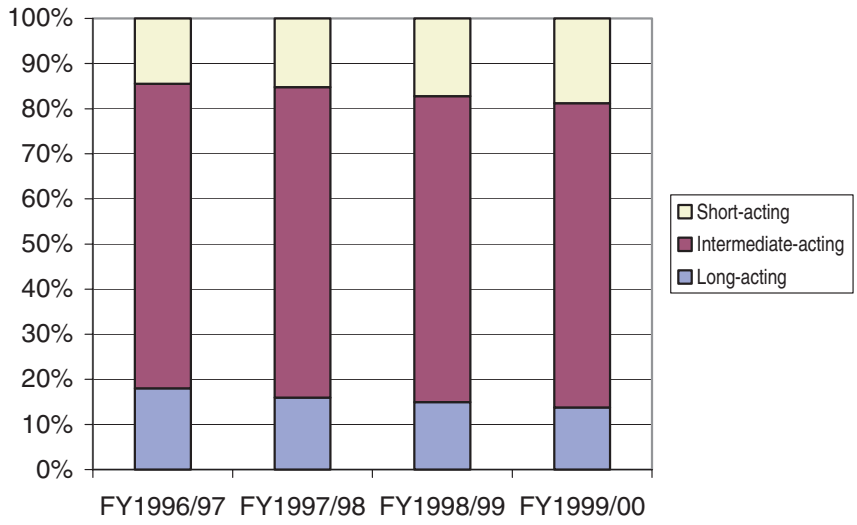

Figure 5: Per cent of new users by type of benzodiazepine prescribed, 1996–2000

consensus papers in an attempt to promote rational prescribing and outline strategies for Bz withdrawal (Health Care Committee Expert Advisory Panel on Alcohol and Drug Use, 1991; Holbrook et al., 2000; Marks, 1988; National Institutes of Health, 1990). Although these protocols emphasize the importance of gradual withdrawal to minimize symptoms that result from physiological dependence, the continued high prevalence of benzodiazepine prescribing in the older adult suggests that these recommendations are not being implemented in current medical practice.

Conclusion

Using a large administrative database and different attributes of utilization and appropriateness, we have demonstrated how the evaluation of the quality of pharmaceutical use in older adults might be undertaken. For example, pharmaceutical use data held by MCHP can describe population-based patterns of prescription drug utilization by Manitobans aged 65 years and more, from April 1, 1996 onwards. Indicators of utilization like access, intensity, and expenditure are reportable by age, sex, geographic region, income quintile, and co-morbidity status as described here.

However, there are limitations in the ability of this type of analysis to completely describe the utilization of pharmaceuticals. For example, from the perspective of access to pharmaceuticals, there is significant under-reporting in a least two northern regions of

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

the province. The amount of underreporting in the two areas (20%) would account for approximately 1 per cent of residents and prescription claims overall; the numbers of persons over age 65 is small in both these areas. The exclusion of unsolid dosage forms from the defined daily dose (DDD) rate calculations limits the full characterization of intensity of use of at least three classes of drugs, unless substantial recoding is done of the data: (1) those for asthma and other chronic respiratory conditions using an inhaler dosage form, (2) insulin for diabetics, and (3) oral liquid antibiotics, which are also commonly used for older adults. As well, expenditure data has to be imputed for 15 per cent of the prescription claims where the government has no fiduciary responsibility but the prescription claim information is captured in a compulsory drug utilization review query made by the pharmacist to the Drug Programs Information Network (DPIN) system at the time of dispensation (Metge et al., 1999).

Measuring the appropriateness of prescribing is also possible, using this data set. Our analyses suggest that long-acting benzodiazepines continue to be prescribed, perhaps inappropriately. The ''new'' use of benzodiazepines in older adults is unabated, despite a favourable decline in new prescriptions for long-acting benzodiazepines (Hogan et al., 2003; Laurier et al., 2002; Tu et al., 2001). Future analysis is required to understand how long and at what dose older adults in Manitoba are kept on all benzodiazepines. Access to this kind of systematic information about the extent to which standard processes of pharmaceutical care, like the prescribing of benzodiazepines, are being met (Institute of Medicine 2001) is essential to identifying where gaps are occurring between what we know ''works,'' or a standard process of care based on scientific evidence, and what is actually being done (McGlynn, Asch, & Adams, 2003). In addition, appropriate prescribing, as defined by applying evidence-based guidelines to actual patient care, has been linked to desirable therapeutic outcomes (Brook, McGlynn, & Shekelle, 2000). As such, potentially inappropriate prescribing could pose serious threats to the health and well-being of those treated with prescription medication.

The data are also able to describe some significant outcomes from the use of pharmaceuticals such as death, fracture, and some population-based clinical measures where available. Such ''effectiveness'' or outcome measures are currently being investigated by ongoing studies at MCHP (Ho, Hamilton, & Roos, 2000; Kaul et al., 2002; Martens, Brownell, & Kozyrskyj, 2002). One strength of the data received from Manitoba Health is the ability to link them with other population-based data of clinical measures, such as bone mineral density values (Leslie, Metge, & Ward, 2003), for analysis of appropriateness and effectiveness. A search for other population-based measures of clinical measures is ongoing; their use will help in describing more fully the quality of pharmaceutical use, particularly its effectiveness, using the Donabedian-like framework proposed earlier.

Finally, a call for the power of multiple data sources to inform on the quality of a health system has run into significant obstacles over the past 10 years (Berger, 2000; Fineberg, 2002; Willison, 2003; Wolfson, 1994). This is no less true with the kinds of data held by MCHP on pharmaceutical use. We have found that often the data are simply unavailable, especially for the determination of appropriateness and effectiveness, or confidentiality and privacy concerns over combining different data sources outweigh their usefulness as means to inform on quality. However, MCHP will continue to address issues surrounding the quality of pharmaceutical use, despite these limitations: a longitudinal analysis of drug utilization spanning 8 years is now possible (1996–2004); identification of medications used inappropriately is ongoing (Leslie et al., 2001; Metge et al., 2002); and using the data to inform on pharmaceutical outcomes or effectiveness – like care gaps and areas needing clinical intervention – promise contributions to identification of the harms and benefits of the use of pharmaceuticals in populations.

References

Ashton, H. (1995). Toxicity and adverse consequences of benzodiazepine use. *Psychiatric Annals*, *25*, 158–165.

Berger, E. (2002). Attitudes to privacy, health records and interconnection: Implications for healthcare organizations. *Hospital Quarterly*, *5*(4), 40–45.

Brook, R.H., McGlynn, E.A., & Shekelle, P.G. (2000). Defining and measuring quality of care: A perspective from U.S. researchers. *International Journal for Quality Health Care*, *12*(4), 281–295.

Burt, C.W. (2002). National trends in use of medications in office-based practices, 1998–1999. *Health Affairs*, *21*(4), 206–214.

Chutka, D.S., Takahashi, P.Y., & Hoel, R.W. (2004). Inappropriate medications for elderly patients. *Mayo Clinic Procedures*, *79*(1), 122–139.

Coambs, R., Jensen, P., Her, M.H., Ferguson, B.S., Jarry, J.L., Wong, J.S.W., & Abrahamsohn, R.V. (1995). *Review of the scientific literature on the prevalence, consequences, and health costs of noncompliance and inappropriate use of prescription medication in Canada*. Toronto: University of Toronto Press.

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press

Commission on the Future of Health Care in Canada. (2002). *Building on values: The future of health care in Canada – Final report*. Ottawa: Queen's Printer.

Donabedian, A. (1980). *Explorations in quality assessment and monitoring. Volume 1: The definition of quality and approaches to its assessment*. Chicago: Health Administration Press.

Egan, M.P., Moride, Y.P., Wolfson, C.P., & Monette, J. (2000). Long-term continuous use of benzodiazepines by older adults in Quebec: Prevalence, incidence and risk factors. *Journal of the American Geriatrics Society, 48*, 811–816.

Eyles, J., Birch, S., Chambers, J., Hurley, J., & Hutchinson, B. (1993). A needs-based methodology for allocating health care resources in Ontario, Canada: Development and an application. *Social Science and Medicine, 33*, 489–500.

Fineberg, A.D. (2002). The Personal Information Protection and Electronic Documents Act: Physician prescription data and Canadian health system reviews. *Health Law in Canada, 23*(1), 1–10.

Futterman, R., Fillit, H., & Roglieri, J.L. (1997). Use of ineffective or unsafe medications among members of a Medicare HMO compared to individuals in a Medicare fee-for-service program. *American Journal of Managed Care, 3*, 569–575.

George, M. (1994). *Population projections for Canada, province and territories 1993–2016*. Ottawa: Statistics Canada.

Grymonpre, R.E., Mitenko, P.A., Sitar, D.S., Aoki, F.Y., & Montgomery, P.R. (1988). Drug-associated hospital admissions in older medical patients. *Journal of the American Geriatrics Society, 36*, 1092–1098.

Grymonpre, R.E., Sitar, D.S., Montgomery, P.R., Mitenko, P.A., & Aoki, F.Y. (1991). Prescribing patterns for older heavy drug users living in the community. *Drug Intelligence and Clinical Pharmacy, 25*, 186–190.

Grymonpre, R.E., Williamson, D.A., Huynh, D.H., & Desilets, L.M. (1994). A community-based pharmaceutical care model for the elderly: Report on a pilot project**.** *International Journal of Pharmacy Practice*, (2), 229–234.

Hanlon, J.T., & Lewis, J.K. (1995). Adverse drug reactions. In J. Delafuente & R.B. Stewart (Eds.), *Therapeutics in the elderly.* Cincinnati: Harvey Whitney Books, 212–227.

Health Canada. (n.d.). *Drug product database.* Retrieved December 18, 2003, from http://www.hc-sc.gc.ca/hpb/drugs-dpd/

Health Care Committee Expert Advisory Panel on Alcohol and Drug Use. (1991). *Guidelines for the prevention and management of benzodiazepine dependence.* National Health and Medical Research Council. Canberra: Australian Government Publishing Service.

Ho, V., Hamilton, B.H., & Roos, L.L. (2000). Multiple approaches to assessing the effects of delays for hip fracture patients in the United States and Canada. *Health Services Research, 34*(7), 1499–1518.

Hogan, D.B., Maxwell, C.J., Fung, T.S., Ebly, E.M. (2003). Prevalence and potential consequences of benzodiazepine use in senior citizens: Results from the Canadian Study of Health and Aging. *Canadian Journal of Clinical Pharmacology, 10*(2), 72–77.

Holbrook, A.M., Crowther, R., Lotter, A., Cheng, C., & King, D. (2000). The diagnosis and management of insomnia in clinical practice: A practical evidence-based approach. *Canadian Medical Association Journal, 162*, 216–220.

Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century.* Washington, D.C.: National Academy Press.

Kalvik, A., Isaac, P., & Janecek, E. (1996). Benzodiazepines: Treatment of anxiety, insomnia and alcohol withdrawal. *Communications* (March/April), 7–24.

Kassam, R., Farris, K.B., Burback, L., Volume, C.I., Cox, C.E., & Cave, A. (2001). Pharmaceutical care research and education project: Pharmacists' interventions. *Journal of the American Pharmaceutical Association, 41*(3), 401–410.

Kaul, P., Saunders, L.D., Roos, L.L., Kephart, G., Ghali, W.A., Walld, R., & Warren, J. (2002). Trends in utilization of coronary artery bypass surgery and associated outcomes: Alberta, Manitoba, and Nova Scotia. *American Journal of Medical Quality, 17*(3), 103–112.

Kupfer, D.J., & Reynolds, C.F. (1997). Management of insomnia. *New England Journal of Medicine, 336*, 341–346.

Larson, E.B., Kukull, W.A., Buchner, D., & Reifler, B.V. (1987). Adverse drug reactions associated with global cognitive impairment in elderly persons. *Annals of Internal Medicine, 107*, 169–173.

Laupacis, A., Paterson, J.M., Mamdani, M., Rostom, A., & Anderson, G.M. (2003). Gaps in the evaluation and monitoring of new pharmaceuticals: Proposal for a different approach. *Canadian Medical Association Journal, 169*(11), 1170–1171.

Laurier, C., Moride, Y., & Kennedy, W.A. (2002). Health survey data on potentially inappropriate geriatric drug use. *Annals of Pharmacotherapy, 36*(3), 404–409.

Leslie, W.D., Metge, C.J., Kvern, B., Anderson, W.A., Manness, L.J., & Yuen, C.K. (2001). Population-based prevalence of clinical risk factors from the Maximizing Osteoporosis Management in Manitoba (MOMM) Project. *Journal of Bone and Mineral Research, 16*(Suppl. 1), S137–604.

Leslie, W.D., Metge, C., & Ward, L. (2003). Establishing a regional bone density program: Lessons from the

Manitoba experience. *Journal of Clinical Densitometry, 6*(3), 275–282.

Lipton, H.L., Bero, L.A., Bird, J.A., & McPhee, S.J. (1992). The impact of clinical pharmacists' consultations on physicians' geriatric drug prescribing: A randomized controlled trial. *Medical Care*, *30*, 646–658.

Lipton, H.L., & Bird, J.A. (1993). Drug utilization review in ambulatory settings: State of the science and directions for outcomes research. *Medical Care*, *31*, 1069–1082.

Liu, G.G., & Christensen, D.B. (2002). The continuing challenge of inappropriate prescribing in the elderly: An update of the evidence. *Journal of the American Pharmaceutical Association*, *42*(6), 847–857.

Lohr, K.N., & Donaldson, M.S. (1990). Assuring quality of care for the elderly. *Law Med Health Care*, *18*(3), 244–253.

MacWilliam, L. (1999). *Premature mortality.* Manitoba Centre for Health Policy, Concept Dictionary. Retrieved December 18, 2003, from http://www.umanitoba.ca/academic/centres/mchp/concept/dict/premature.mortality.html

Marks, J. (1988). Techniques of benzodiazepine withdrawal in clinical practice: A consensus workshop report. *Medical Toxicology and Adverse Drug Experience*, *3*, 324–333.

Martens, P.J., Brownell, M.D., & Kozyrskyj, A. (2002). The virtual classroom: A summary of child health indicators. *Canadian Journal of Public Health*, *93*(Suppl. 2), S77–S80.

McGlynn, E.A., Asch, S.M., & Adams, J. (2003). The quality of health care delivered to adults in the United States. *New England Journal of Medicine*, *348*(26), 2635–2645.

Medication Working Group. (1988). Surgeon general's workshop. *Health Promotion and Aging Proceedings*. Washington, D.C.: U.S. Department of Health and Human Services.

Metge, C.J., Black, C., Peterson, S., & Kozyrskyj, A.L. (1999). The population's use of pharmaceuticals. *Medical Care*, *37*, JS42–JS59.

Metge, C.J., Kozyrskyj, A., Dahl, M., Yogendran, M., & Roos, N.P. (2003). *Pharmaceuticals: A focus on appropriate use*. Winnipeg: Manitoba Centre for Health Policy.

Metge, C.J., Yogendran, M., Doupe, M., Katz, M., Kvern, B., & Thomson, G. (2002). Preparing administrative claims data for evaluation of limited use criteria: A case for nonsteroidal antiinflammatory drugs. *Canadian Journal of Clinical Pharmacology, 9*(1), 44.

Nowell, P.D., Mazumdar, S., Buysse, D.J., Dew, M.A., Reynolds, C.F., & Kupfer, D.J. (1997). Benzodiazepines and zolpidem for chronic insomnia: A meta-analysis of treatment efficacy. *Journal of the American Medical Association*, *278*, 2170–2177.

Quinn, K., Baker, M.J., & Evans, B. (1992). A population-wide profile of prescription drug use in Saskatchewan, 1989. *Canadian Medical Association Journal*, *146*, 2177–2186.

Rawson, N.S.B. (2001). ''Effectiveness'' in the evaluation of new drugs: A misunderstood concept? *Canadian Journal of Clinical Pharmacology, 8*(2), 61–62.

Reid, R., Roos, N.P., MacWilliam, L., Frohlich, N., & Black, C. (2002). Assessing population need using a claims-based ACG morbidity measure: A validation analysis in the province of Manitoba. *Health Services Research*, *37*(5), 1345–1364.

Roos, L.L., Sharp, S.M., & Wajda, A. (1989). Assessing data quality: A computerized approach. *Social Science and Medicine*, *28*, 175–182.

Roos, L.L., Walld, R.K., Romano, P.S., & Roberecki, S. (1996). Short-term mortality after repair of hip fracture: Do Manitoba elderly do worse? *Medical Care*, *34*, 310–326.

Roos, N.P., & Shapiro, E. (1999). Revisiting the Manitoba Centre for Health Policy and Evaluation and its population-based health information system. *Medical Care*, *37*, JS10–JS14.

Roos, N.P., Stranc, L., Peterson, S., Mitchell, L., Bogdanovic, B., & Shapiro, E. (2001). *A look at home care in Manitoba*. Retrieved December 18, 2003, from Manitoba Centre for Health Policy Web site: http://www.umanitoba.ca/centres/mchp/reports/reports_01/homecr.htm

Salzman, C. (1999). An 87-year-old woman taking a benzodiazepine. *Journal of the American Medical Association*, *281*, 1121–1125.

Salzman, C., Nobel, K., Glassman, R., Wolson, A., & Kelley, M. (1992). Cognitive improvement following benzodiazepine discontinuation in elderly nursing home residents. *International Journal of Geriatric Psychiatry, 7*, 89–93.

Sellors, J., Kaczorowski, J., Sellors, C., Dolovich, L., Woodward, C., Willan, A., Goeree, R., Cosby, R., Trim, K., Sebaldt, R., Howard, M., Hardcastle, L., & Poston, J. (2003). A randomized controlled trial of a pharmacist consultation program for family physicians and their elderly patients. *Canadian Medical Association Journal*, *169*(1), 30–31.

Shimp, L.A., Scione, F.J., Glazer, H.M., & Atwood, B.F. (1985). Potential medication-related problems in non-institutionalized elderly. *Drug Intelligence and Clinical Pharmacy Drug*, *19*, 766–772.

Sketris, I.S., Metge, C.J., Blackburn, J., & MacCara, M.E. (2004). Using the World Health Organization (WHO) ATC and DDD system in a Canadian context. *Drug Information Journal*, *38*(1), 15–28.

Spore, D.L., Mor, V., Larrat, P., Hawes, C., & Hiris, J. (1997). Inappropriate drug prescriptions for elderly residents of board and care facilities. *American Journal of Public Health*, *87*, 404–409.

Starfield, B., Egbuonu, L., Farfel, M., Hutton, N., Joffe, A., & Wissow, L.S. (1985). *The effectiveness of medical care: Validating medical wisdom*. Baltimore: Johns Hopkins University Press.

Starfield, B., Weiner, J., Mumford, L., & Steinwachs, D. (1991). Ambulatory care groups: A categorization of diagnoses for research and management. *Health Services Research*, *26*(1), 53–74.

Statistics Canada. (2003). Population by sex and age group 2003. Retrieved December 18, 2003, from http://www.statcan.ca/eeenglish/Pgdb/dem0311.htm

Stuck, A.E., Beers, M.H., Steiner, A., Aronow, H.U., Rubenstein, L.Z., & Beck, J.C. (1994). Inappropriate medication use in community-residing older persons. *Archives of Internal Medicine*, *154*, 2195–2200.

Tamblyn, R.M., McLeod, P.J., Abrahamowicz, M., Monette, J., Gayton, D.C., Berkson, L., Dauphinee, W.D., Grad, R.M., Huang, A.R., Isaac, L.M. (1994). Questionable prescribing for elderly patients in Quebec. *Canadian Medical Association Journal*, *150*, 1801–1809.

The treatment of sleep disorders of older people. (1990). *National Institutes of Health*, *8*, 1–22.

Tognoni, G. (1983). Drug use and monitoring. In W.W. Holland (Ed.), *Evaluation of health care* (p. 207). London: Oxford University Press.

Tu, K., Mamdani, M.M., Hux, J.E., & Tu, J.B. (2001). Progressive trends in the prevalence of benzodiazepine prescribing in older people in Ontario, Canada. *Journal of the American Geriatrics Society*, *49*(10), 1341–1345.

Willcox, S.M.M., Himmelstein, D.U., & Woolhandler, D. (1994). Inappropriate drug prescribing for the community-dwelling elderly. *Journal of the American Medical Association*, *272*(July 27), 292–296.

Willison, D.J. (2003). Privacy and the secondary use of data for health research: Experience in Canada and suggested directions forward. *Health Service Research and Policy*, *8*(Suppl. 1), S117–S123.

Wolfson, M. (1994). Social proprioception: Measurement, data and information from a population health perspective. In R.G. Evans, M.L. Barer, & T.R. Marmor (Eds.), *Why are some people healthy and others not? The determinants of health of populations*. New York: Aldine de Gruyter, 287–316.

World Health Organization. (1995). *WHO's Centre for Drug Statistics Methodology: Guidelines for ATC classification and DDD assignment*. Oslo: Author.

World Health Organization Collaborating Centre for Drug Statistics Methodology. (n.d.) Retrieved December 18, 2003, from http://www.whocc.no/atcddd/

https://doi.org/10.1353/cja.2005.0052 Published online by Cambridge University Press