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Drug Claims by Seniors: An Analysis Focusing on Potentially Inappropriate Medication Use, 2000 to 2006

Executive Summary

It is important that Canadians have access to safe, appropriate and effective drug therapies; the right drug, for the right condition, for the right person, at the right time. It is also recognized that drugs can lead to adverse drug reactions regardless of appropriate use. Adverse reactions not only lead to an increased risk of morbidity and mortality, but can also lead to an increased economic burden through additional drug use, hospitalization and repeated physician visits.¹

This analysis examines claims trends of seniors on public drug programs in Alberta, Saskatchewan, Manitoba and New Brunswickⁱ from 2000 to 2006, with a focus on seniors who made claims for a drug from “the Beers list”—an internationally recognized list of drugs that are identified as “potentially inappropriate” to prescribe to seniors due to an elevated risk of adverse effects, developed by Dr. Mark H. Beers.¹ The drug claims data used in this analysis come from CIHI’s National Prescription Drug Utilization Information System (NPDUIS) database.

Highlights

- The standardized proportion of seniors on public drug programs with at least one drug claim, who made a claim for a drug from the Beers list, dropped in all four provinces between 2000–2001 and 2005–2006.
- In 2000–2001, among seniors on public drug programs, the rate of Beers drug use varied from 30.6% in Manitoba to 41.2% in New Brunswick. In 2005–2006, the rate varied from 25.2% in Manitoba to 31.3% in New Brunswick.
- Between 2000–2001 and 2005–2006, the standardized rate of use of drugs considered to be “high-risk” on the Beers list remained relatively stable in all four provinces, with a slight increase between 2004–2005 and 2005–2006.

i. As of June 2007, these are the only four provinces submitting claims data to the NPDUIS database. See the methods section for more information regarding definitions and exclusions.

- In 2005–2006, the standardized rate of chronic use of drugs from the Beers list among senior claimants on public drug programs varied from 12.9% in Alberta to 18.8% in New Brunswick.
- In all four provinces, the rate of chronic use of Beers drugs was highest among females, and seniors aged 85 and older.
- In 2005–2006, 1.9% of senior claimants in the four provinces were chronically dispensed more than one Beers drug.
- Between 2000–2001 and 2005–2006, the rate of chronic use of drugs considered to be “high-risk” on the Beers list decreased in all four provinces.
- The top five Beers drugs, by number of chronic users, were similar between the four provincial public drug programs. Overall the top five were:
 - Oral conjugated estrogens, used for hormone replacement;
 - Amitriptyline, an antidepressant;
 - Digoxin, used to treat congestive heart failure;
 - Oxybutynin, used to treat overactive bladders (incontinence); and
 - Temazepam, a benzodiazepine, used to treat sleep disorders.
- In all four provinces, in terms of the number of claimants on public drug programs chronically using Beers drugs, amitriptyline was one of the fastest-growing, while oral conjugated estrogens, used for hormone replacement, were one of the fastest-declining Beers drugs.

Claims Data Source

The drug claims data used in this analysis come from the NPDUIS database, as submitted by the Alberta, Saskatchewan, Manitoba and New Brunswick provincial public drug programs.ⁱⁱ The NPDUIS database is pan-Canadian, housing information related to public program formularies, drug claims, policies and population statistics. Due to the lack of detailed clinical information available from drug claims data, this analysis does not infer the appropriateness or inappropriateness of each claim for a Beers drug. It is recognized that there are cases where it is necessary to prescribe Beers drugs to seniors.

ii. Drug claims for First Nations people and Inuit living in Alberta, Saskatchewan, Manitoba and New Brunswick are not included as these benefits are provided by Health Canada’s Non-Insured Health Benefits (NIHB) Program.

Acknowledgements

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- Lisa Clatney, Researcher, Health Quality Council, Saskatchewan; and
- Steve Morgan, Assistant Professor, Centre for Health Services and Policy Research, University of British Columbia.

Please note that the analyses and conclusions in the present document do not necessarily reflect those of the individuals or organizations mentioned above.

Introduction

It is important that Canadians have access to safe, appropriate and effective drug therapies; the right drug, for the right condition, for the right person, at the right time. It is also recognized that drugs can lead to adverse drug reactions regardless of appropriate use. Adverse reactions not only lead to an increased risk of morbidity and mortality, but can also lead to an increased economic burden through additional drug use, hospitalization and repeated physician visits.¹

Evidence shows that older adults (65 years and older, hereafter referred to as “seniors”) are more at risk for adverse effects due to complex drug therapies and age-related changes to the way drugs are processed by the body.² A 2002 literature review noted that “28% of all emergency department visits were drug related, of which as many as 24% resulted in hospital admission.”³ The study showed that 70% of the drug-related emergency visits are preventable and that, “women and elderly individuals seemed to be at greatest risk.”³

Although prescribing information is not readily available, drug claims data can provide insight into prescribing trends of drugs in seniors. Making use of some of the methods developed by the Health Quality Council in Saskatchewan for its 2005 report, *Improving the Quality of Drug Management of Saskatchewan Seniors Living in the Community*,^{4, 5} this analysis will examine claims trends of seniors in Alberta, Saskatchewan, Manitoba and New Brunswickⁱⁱⁱ from 2000 to 2006. Specifically, it will look at drugs identified by Dr. Mark H. Beers as drugs that are “potentially inappropriate” to prescribe to seniors due to an elevated risk of adverse effects.¹ This list of drugs has become internationally recognized as the “Beers list.” This analysis examines seniors who made at least one claim for a drug from the Beers list (“Beers users”), as well as seniors who made claims for a drug from the Beers list on a regular basis (“chronic Beers users”).

iii. As of June 2007, these are the only four provinces submitting claims data to the NPDUIS database. See the methods section for more information regarding definitions and exclusions.

Methods

Claims Data Source

The drug claims data used in this analysis come from CIHI's National Prescription Drug Utilization Information System (NPDUIS) database, as submitted by the Alberta, Saskatchewan, Manitoba and New Brunswick provincial public drug programs.^{iv} The NPDUIS database is pan-Canadian, housing information related to public program formularies, drug claims, policies and population statistics. The NPDUIS database is designed to provide information that supports accurate, timely and comparative analytical and reporting requirements for the establishment of sound pharmaceutical policies and the effective management of Canada's public drug benefit programs. The NPDUIS database does not contain information regarding prescriptions that were written but never dispensed, or those that were dispensed but for which the associated drug costs were not submitted to, or not accepted by the public programs. The NPDUIS database does not contain information regarding diagnosis or condition for which prescriptions were written. Information regarding prescriptions that were claimed is included, regardless of whether or not the patient actually used the drugs.

Data Comparability

Age–Sex Standardization:

Standardized rates are age–sex adjusted using a direct method of standardization based on the October 1, 2006, Canadian senior population. The age groups shown in figures 1 and 6 were used for standardization.

Formulary Comparison:

Differences in the coverage of drugs on provincial formularies can lead to differences in drug utilization, and, therefore, should be identified to provide context when conducting interprovincial comparisons. In the case of this analysis, not only were the formulary listings of Beers drugs considered, but also those of any possible alternate drugs. In general, the benefit status of Beers drugs and their alternates are quite similar across provinces, with few exceptions. Any notable differences in the formulary listings of relevant drugs were found in products with relatively low use. It was therefore determined that differences in provincial formularies had little impact on the use of Beers drugs, as a whole, in these four provinces.

iv. Drug claims for First Nations people and Inuit living in Alberta, Saskatchewan, Manitoba and New Brunswick are not included as these benefits are provided by Health Canada's Non-Insured Health Benefits (NIHB) Program.

Nursing Home Residents:

Claims for nursing home residents are included in all provinces except for Alberta. Removing these claims would reduce the crude rate of Beers use in 2005–2006 by 0.9% in Manitoba and 0.6% in New Brunswick. The effect of claims for nursing home residents on Beers drugs in Saskatchewan is unknown, as these claims cannot be identified in the NPDUIS database.

Drugs of Interest

First developed in 1991 by Dr. Mark H. Beers,⁶ the Beers list is a list of drugs that are potentially inappropriate to prescribe to seniors because:

1. They “are either ineffective or they pose unnecessarily high risk for older persons and a safer alternative is available”¹; or
2. They “should not be used in older persons known to have specific medical conditions.”¹

Drugs on the Beers list are broken into two categories:¹

1. Drugs that are potentially inappropriate independent of diagnoses or conditions; and
2. Drugs that are potentially inappropriate when used for certain diagnoses or conditions.

Drugs may be identified on the Beers list in a number of ways:¹

1. A specific drug is listed (for example, digoxin);
2. Entire classes of drugs are listed (for example, antihistamines); or
3. Some drugs are identified as being inappropriate when administered:
 - a. above certain doses (for example, lorazepam > 3 mg);
 - b. by specific routes of administration (for example, orally administered estrogens); or
 - c. for greater than specified durations (for example, long-term naproxen use).

The original Beers list applied particularly to nursing home residents and was updated in 1997 to apply to all seniors.^{6, 7} The most recent update to the Beers list was published in 2003¹ (see Appendix A).

The drugs used in this analysis were identified from the 2003 Beers list as follows:

- Only drugs not dependent on diagnosis were included in this analysis, as information related to the reason for the prescription is not available in the NPDUIS database.

- The 2003 version of the Beers list was used for this analysis, after a comparison of the lists from 1997 and 2003 (see Appendix B) showed very little change in the drugs that were not dependent on diagnosis.
- These drugs were then assigned a World Health Organization (WHO) Anatomical Therapeutic Chemical (ATC) classification⁸ code (see Appendix C). A drug with a particular ATC code was considered to be available in Canada when a drug identification number (DIN) associated with this ATC code was listed by Health Canada as being on the market as of April 2006. Once a drug with an ATC code was established to be on the market, then all DINs (active or inactive) with this ATC code were identified and included in the analysis.
- The Beers list contains benzodiazepines as a broad category accompanied by a list of specific drugs that should be avoided in seniors. As a result, this analysis includes all benzodiazepines available in Canada, regardless of whether or not they were explicitly listed by Beers.
- Where required, the maximum recommended daily doses for benzodiazepines not explicitly listed by Beers were calculated by multiplying the defined daily dose (DDD) assigned by the WHO by a conversion factor of 1.2.⁵ The conversion factor is equal to the ratio of the maximum recommended daily dose for lorazepam, as defined in the Beers list, and its DDD.

Definitions

1. “Beers users” refers to seniors who claimed a drug from the Beers list at least once during a given year. Users for whom the average daily dose did not exceed the maximum recommended daily dose, as defined in the Beers list, are excluded. In cases where there was only one claim for a dosage-specific drug, and the average dose could not be calculated as defined, the claimant was excluded^v (even though the actual daily dose may have exceeded the recommended maximum).
2. “Average daily dose” was calculated on a per-claimant basis. For a given fiscal year, the drug quantity for all claims for the same drug for an individual, with the exception of the final claim, was summed and then divided by the number of days between the first and last claim—providing an average daily quantity. The average daily quantity was then multiplied by the strength of the drug, resulting in an average daily dose. This calculation assumes that the last claim was filled at the appropriate time interval and was not considered to be an “early refill.”
3. “Chronic users” refers to seniors who claimed a drug from the Beers list on a regular basis, as opposed to users who claimed infrequently. The calculation used is based on the definition set out in a 2005 study published by the Health Quality

v. In 2005–2006, there were 22,152 such users. Including these users would increase the crude rate of Beers use in this year from 27.3% to 30.7%. Provincially, the effect of including these users varies from increasing the rate of Beers use by 2.9% in Saskatchewan to increasing it by 4.1% increase in New Brunswick.

Analysis in Brief

Taking health information further

Council in Saskatchewan,⁵ whereby a chronic user has a minimum of three prescriptions and a minimum of 100 solid dosage units^{vi} in a given year, for any Beers drug, except those appearing on Saskatchewan Health's Maintenance Drug Schedule. For Beers drugs appearing on Saskatchewan Health's Maintenance Drug Schedule, the minimum prescription requirement was reduced to two. Although Alberta, Manitoba and New Brunswick do not have a policy comparable to Saskatchewan Health's Maintenance Drug Schedule, it was not expected that this reduction in the minimum prescription requirement for these drugs would impact the estimate of the incidence of chronic use in these provinces any differently than in Saskatchewan.

Seniors whose average daily dose did not exceed the maximum recommended average daily dose (see Appendix A), as defined in the Beers list, were excluded.

4. "Drug claims" refers to prescription drug costs submitted to and accepted by a public drug program, either toward a deductible or for payment, and submitted to CIHI's NPDUIS database.
5. "High-risk Beers users" refers to seniors who claimed a drug from the Beers list that was identified as having the potential for "adverse outcomes of high severity" (see Appendix A).¹

vi. For products in non-solid dosage form, each product was reviewed and a conversion factor was determined to convert the dispensed quantity from millilitres to comparable solid dosage units (see Appendix D). An adjusted quantity was calculated by dividing the dispensed quantity by the conversion factor.

Profile of Seniors With Drug Claims

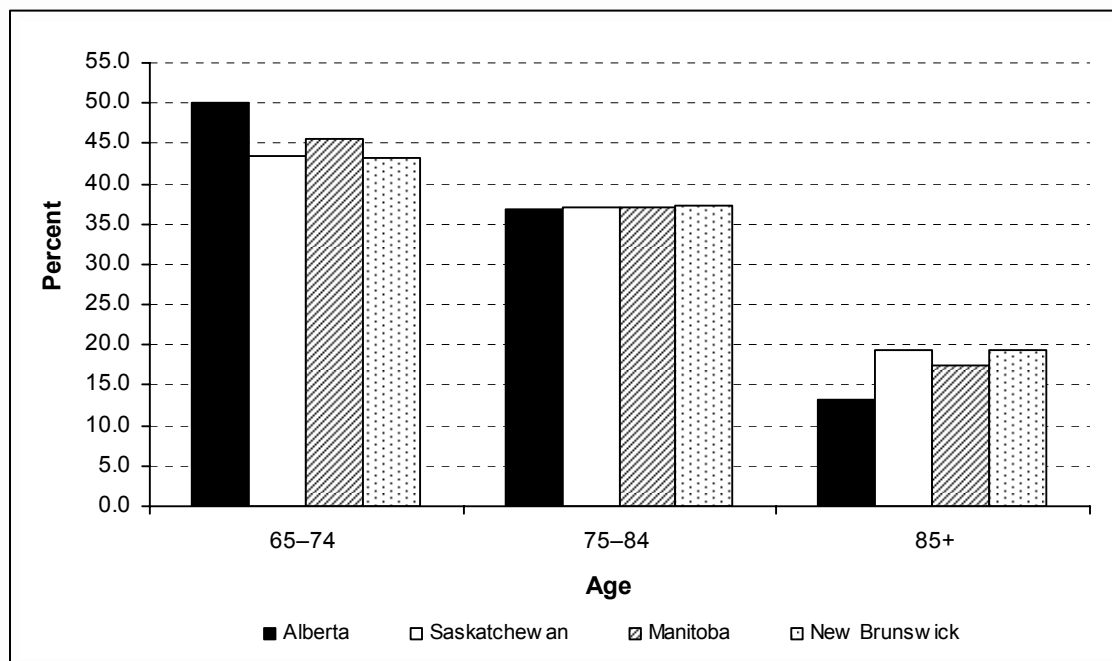
In 2005–2006, there were 343,682 seniors living in Alberta, 158,486 in Manitoba, 146,857 in Saskatchewan and 105,024 living in New Brunswick.^{vii, 9} The proportion of seniors who had drug claims accepted by the public drug programs in these provinces varied from 59.2% in New Brunswick to 95.4% in Manitoba (see Appendix E). The lower percentage in New Brunswick is related to plan design, as prescription coverage for seniors is not universal. All seniors not covered by the publicly funded drug plan may have a private drug plan or pay out of pocket.

Between 2000–2001 and 2005–2006, the senior populations grew in Alberta, Saskatchewan and New Brunswick, at average annual rates of 2.7%, 0.4% and 1.5%, respectively. The senior population in Manitoba fell at an average annual rate of 0.1%. During the same time period, the number of seniors who had drug claims accepted by the public drug programs in these provinces grew at an average annual rate higher than that of the population of seniors in Alberta (3.2%), Saskatchewan (0.7%) and Manitoba (1.2%), and at a lower rate in New Brunswick (1.0%). This indicates that the proportion of seniors making claims to public drug programs increased during the period of analysis in all provinces except for New Brunswick.

There is variation in both the age and gender distribution of the senior claimant population of the four provinces. In terms of age, Saskatchewan and New Brunswick have the oldest claimant populations, with 19.4% of their claimants being over 85 years old (Figure 1). Alberta has the smallest proportion of claimants over the age of 85, at 13.3%. The gender distribution of claimants in Manitoba and Saskatchewan is similar (58.5% and 58.2% female, respectively), while Alberta has a higher proportion of males, and New Brunswick a higher proportion of females (see Appendix E).

vii. Population data come from the Demography Division of Statistics Canada. The 2000–2001 and 2001–2002 population estimates are considered final, while interim population estimates were used for 2002–2003 to 2005–2006.

Figure 1. Distribution of Senior Claimant Population for Public Drug Programs in Select Provinces,* by Age Group, 2005–2006



* The four provinces submitting claims data to the NPDUIS database as of June 2007.

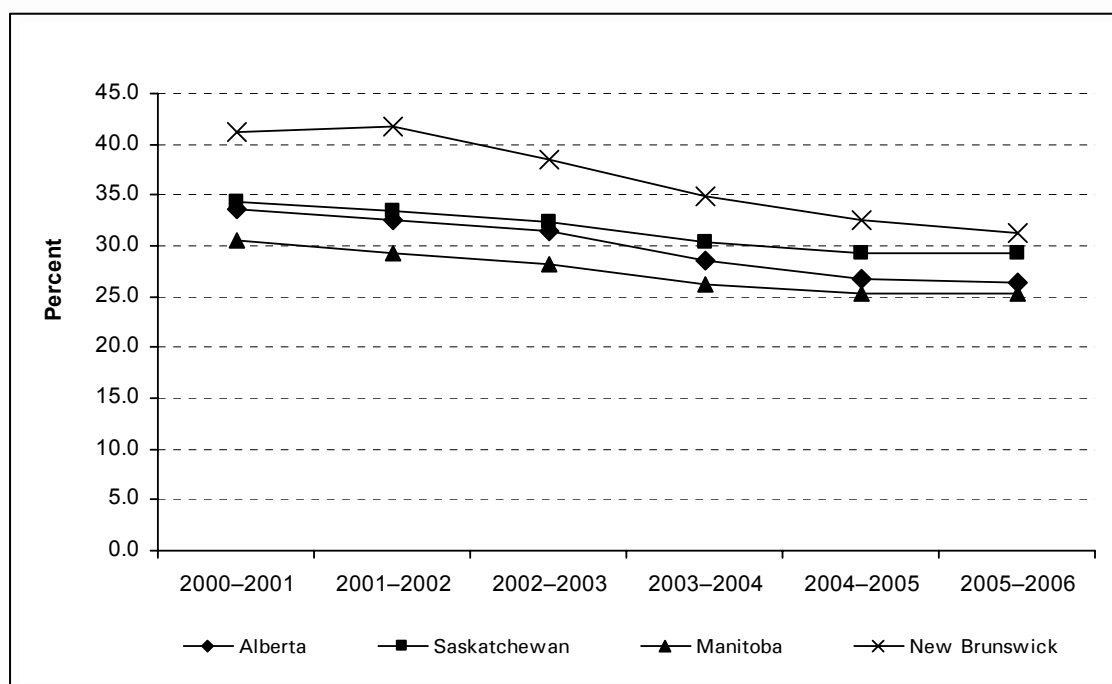
Source: NPDUIS Database, Canadian Institute for Health Information, 2007.

Although the demographics of the total senior population in these four provinces are similar to those of the senior claimant populations in 2005–2006 (see Appendix E), the proportion of females, as well as seniors over 75 years old, is higher in the claimant population. This is reflective of higher rates of drug use in both females and older seniors. The increased proportions of females and older seniors, particularly those over the age of 85, are further pronounced in New Brunswick.

Analysis Overview: Claims for Beers Drugs

When claims for Beers drugs by seniors in 2000–2001 are considered, standardized rates of use vary from 30.6% of seniors with at least one drug claim in Manitoba, to 41.2% in New Brunswick (see Figure 2). Aside from an increase between 2000–2001 and 2001–2002 in New Brunswick, the incidence of Beers drug use in seniors decreased every year in all four provinces. In 2005–2006, the rate of Beers use among seniors ranged from 25.2% in Manitoba to 31.3% in New Brunswick.

Figure 2. Age–Sex Standardized Rates of Beers Use Among Seniors on Public Drug Programs in Select Provinces,* 2000–2001 to 2005–2006

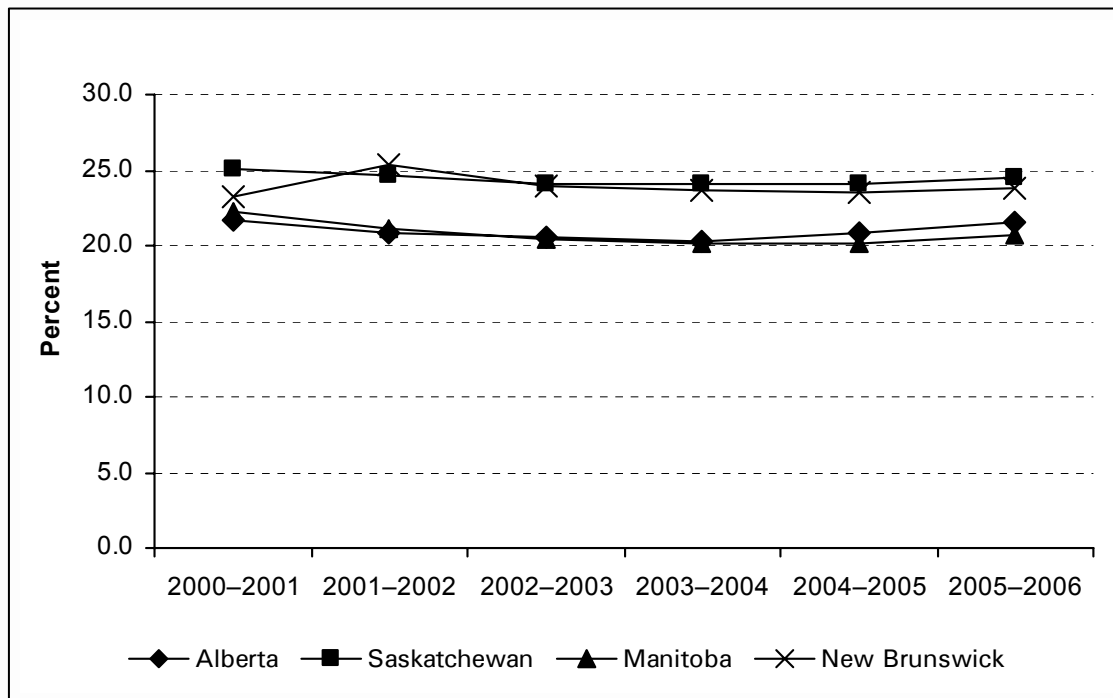


* The four provinces submitting claims data to the NPDUIS database as of June 2007.

Source: NPDUIS Database, Canadian Institute for Health Information, 2007.

When only high-risk Beers drugs are considered, standardized rates of use among seniors with at least one drug claim in 2000–2001 vary from 21.7% of senior claimants in Alberta to 25.1% in Saskatchewan. This remained relatively stable in all four provinces between 2000–2001 and 2005–2006 (Figure 3). In 2005–2006, rates of high-risk Beers use varied from 20.7% in Manitoba to 24.6% in Saskatchewan. There was a slight increase in the rate of high-risk Beers use among senior claimants on public drug programs in all four provinces between 2004–2005 and 2005–2006.

Figure 3. Age–Sex Standardized Rates of High-Risk Beers Use, Among Seniors on Public Drug Programs in Select Provinces,* 2000–2001 to 2005–2006



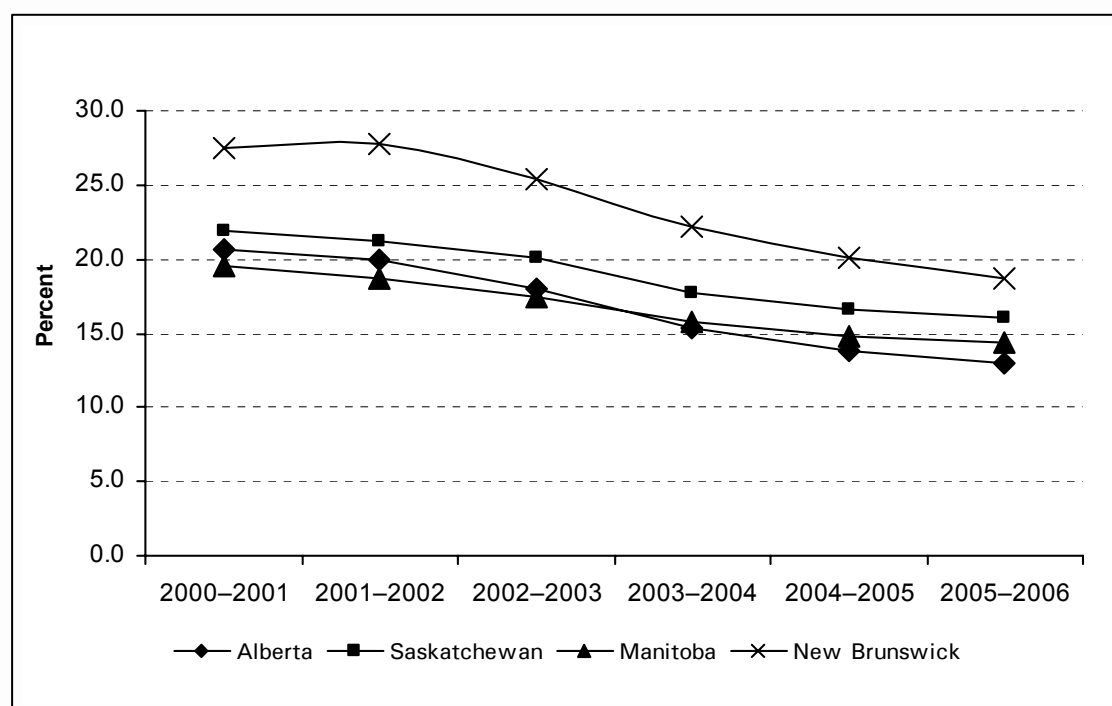
* The four provinces submitting claims data to the NPDUIS database as of June 2007.

Source: NPDUIS Database, Canadian Institute for Health Information, 2007.

Analysis Overview: Chronic Beers Use

In 2000–2001, rates of chronic Beers use varied from 19.5% in Manitoba to 27.5% in New Brunswick (see figure 4). Between 2000–2001 and 2005–2006, the rate of chronic Beers use declined in all four provinces. In 2005–2006, senior claimants in Alberta had the lowest rate of chronic Beers use at 12.9% and senior claimants in New Brunswick had the highest rate at 18.8%.

Figure 4. Age–Sex Standardized Rates of Chronic Beers Use, Among Seniors on Public Drug Programs in Select Provinces,* 2000–2001 to 2005–2006



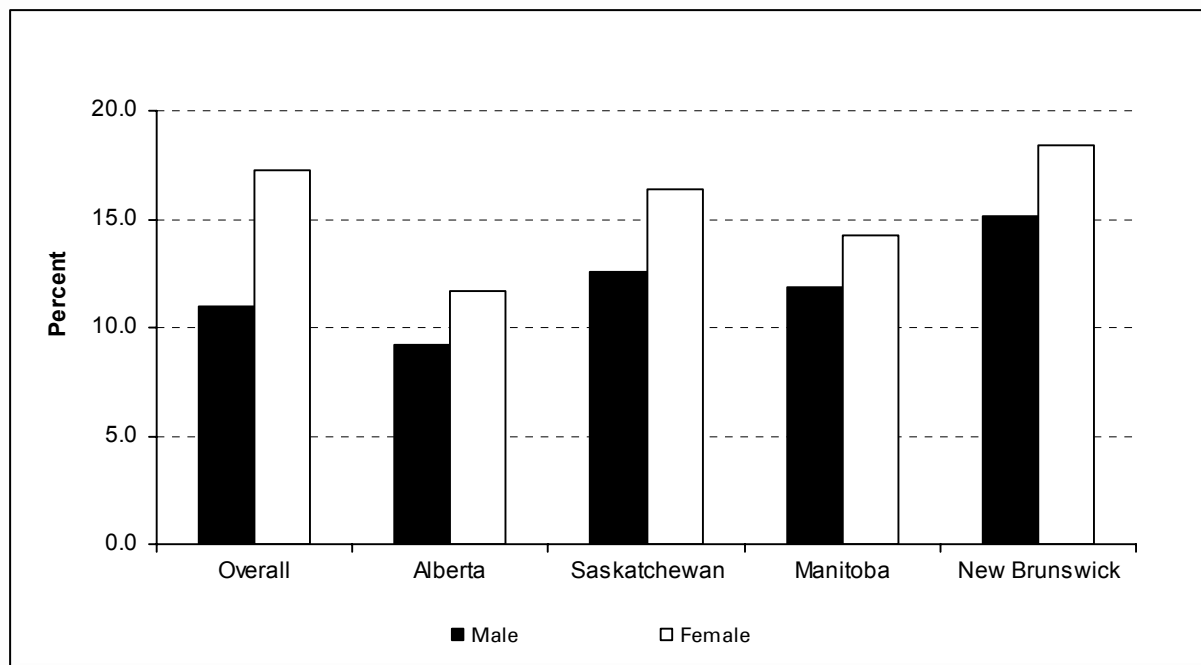
* The four provinces submitting claims data to the NPDUIS database as of June 2007.

Source: NPDUIS Database, Canadian Institute for Health Information, 2007.

The rate of chronic Beers use is higher among females than males in all four provinces (Figure 5). In 2005–2006, among seniors who made drug claims, the rate of chronic Beers use was 17.3% among females,^{viii} while only 11.0% of males were chronically dispensed a Beers drug.

viii. Excluding the use of estrogen (which is typically only prescribed to women) from this analysis reduces the rate of chronic Beers use among female seniors by 3.4%. Although reduced, the rate of chronic Beers use among female seniors is still higher than the rate for males.

Figure 5. Chronic Beers Use, Among Seniors on Public Drug Programs in Select Provinces,* by Gender, 2005–2006

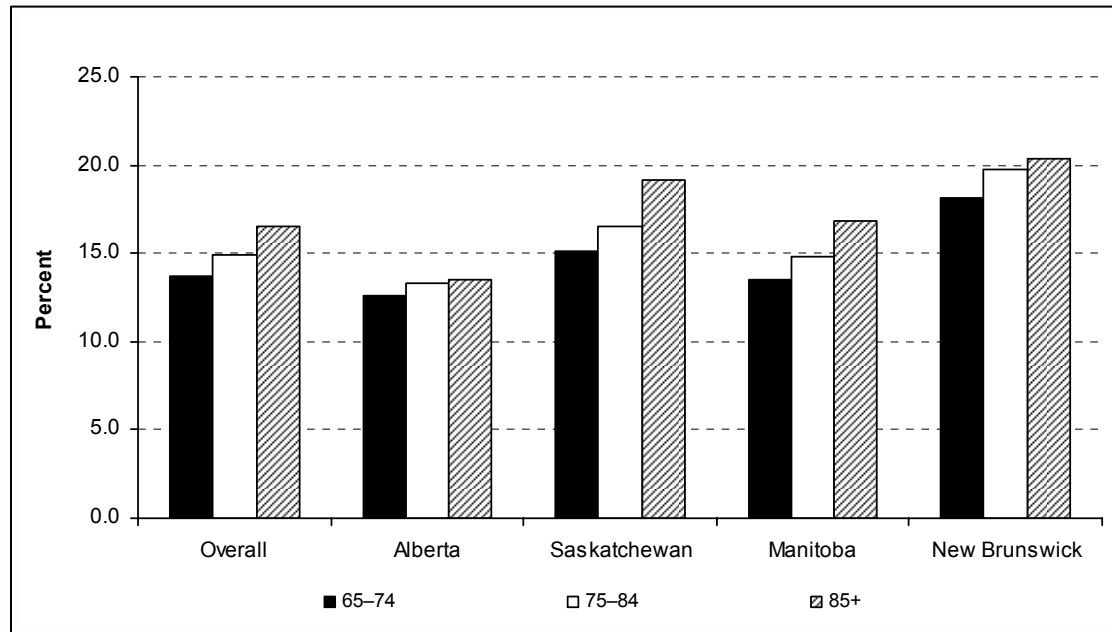


* The four provinces submitting claims data to the NPDUIS database as of June 2007.

Source: NPDUIS Database, Canadian Institute for Health Information, 2007.

The incidence of chronic Beers use increases with age in each of the four provinces (Figure 6). In 2005–2006, among seniors with drug claims, 13.7% of those between 65 and 74 years old, 14.9% of those between 75 and 84 years old and 16.5% of those aged 85 years or more were chronically dispensed at least one Beers drug. Among both men and women, those 85 years of age and older had the highest rates of chronic Beers use.

Figure 6. Chronic Beers Use, Among Seniors on Public Drug Programs in Select Provinces,* by Age Group, 2005–2006



* The four provinces submitting claims data to the NPDUIS database as of June 2007.

Source: NPDUIS Database, Canadian Institute for Health Information, 2007.

In all four provinces, the majority of chronic Beers users were chronically dispensed only one Beers drug during a year. The proportion of senior claimants being dispensed more than one Beers drug per year was similar in each province, ranging from 1.5% in Alberta, to 2.9% in New Brunswick (Table 1).

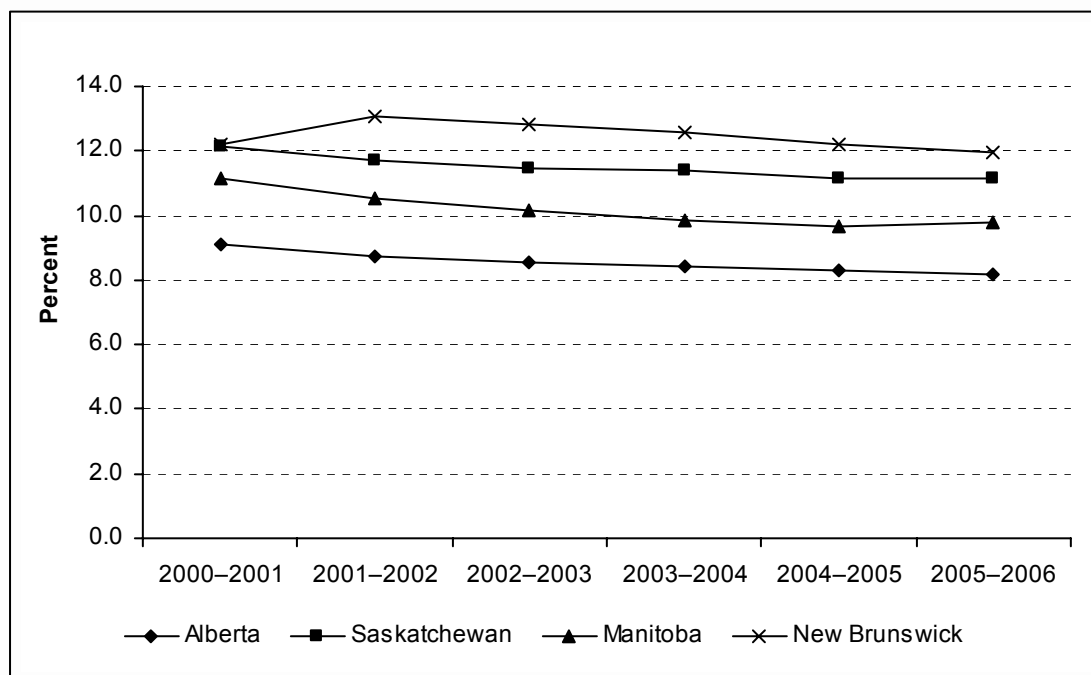
Table 1. Age–Sex Standardized Proportion of Senior Claimants on Public Drug Programs Being Chronically Dispensed Multiple Beers Drugs, in Select Provinces,* 2005–2006

No. of Beers Drugs	Percentage of Claimants on Public Drug Programs				
	Overall (n = 670,154)	Alberta (n = 318,749)	Saskatchewan (n = 137,979)	Manitoba (n = 151,271)	New Brunswick (n = 62,155)
1	12.6	11.4	13.9	12.5	15.8
2	1.6	1.4	1.9	1.6	2.5
3+	0.2	0.2	0.3	0.2	0.5

* The four provinces submitting claims data to the NPDUIS database as of June 2007.

When only high-risk Beers drugs are considered, standardized rates of chronic use among seniors with at least one drug claim in 2000–2001 varied from 9.1% of senior claimants in Alberta to 12.2% in New Brunswick. This rate decreased in all four provinces between 2000–2001 and 2005–2006 (Figure 7). In 2005–2006, rates of chronic high-risk Beers use varied from 8.2% in Alberta, to 12.0% in New Brunswick.

Figure 7. Age–Sex Standardized Rates of Chronic High–Risk Beers Use, Among Seniors on Public Drug Programs in Select Provinces,* 2000–2001 to 2005–2006



*The only provinces where public programs were submitting data to NPDUIS as of June 2007.

Source: NPDUIS Database, Canadian Institute for Health Information, 2007.

Analysis Overview: Select Beers Drugs

The top five Beers drugs, in terms of the number of chronic users, were quite similar between the public drug programs in the four provinces (Table 2). Looking at the top five drugs in terms of combined chronic users for all four provinces, all five drugs were in the top seven Beers drugs in each province. Conjugated estrogens had the highest rate of chronic use in Alberta (2.6% of senior claimants were chronically dispensed conjugated estrogens); amitriptyline had the highest rate of use in Saskatchewan and Manitoba. Although cimetidine, an antacid, is not in the top five in terms of chronic users for all four provinces, it had the highest use among senior claimants in New Brunswick. This is notably different from the remaining three provinces, where it did not appear in the top 15. Three high-risk Beers drugs—amitriptyline, oxybutynin and temazepam (above maximum dose)—appeared in the combined top five list.

Table 2. Top Five Beers Drugs, by Number of Chronic Beers Users as a Percentage of Senior Claimants on Public Drug Programs, in Select Provinces,* 2005–2006

Drug***	Alberta (n = 318,749)		Saskatchewan (n = 137,979)		Manitoba (n = 151,271)		New Brunswick (n = 62,155)	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
Conjugated estrogens	2.6	1	1.8	3	1.5	3	2.4	3
Amitriptyline	1.9	2	3.2	1	2.8	1	2.5	2
Digoxin	1.9	3	2.7	2	2.6	2	1.7	4
Oxybutynin	1.0	4	1.8	4	0.9	5	1.1	5
Temazepam	1.0	5	1.2	5	1.0	4	1.0	7

* The four provinces submitting claims data to the NPDUIS database as of June 2007.

** Cimetidine, an antacid, was the number one ranked drug in New Brunswick at 2.6%; it did not appear in the top 15 in the other three provinces.

*** See Appendix A for drug-specific notes.

There are similarities found when comparing increases and decreases in use, at the drug level, across provinces (Table 3). When drugs used by more than 1% of senior claimants are studied, amitriptyline is among the top two fastest-growing Beers drugs (in terms of use, in the public drug programs in all four provinces), though the average annual rate of growth varies substantially.

Oral conjugated estrogens are one of the two fastest-declining Beers drugs, in terms of use. This decrease could have been due, in part, to the *Journal of the American Medical Association* publishing a study on the safety and benefits of using estrogen in women in July 2002.¹⁰

Table 3. Top Two Fastest-Growing and Top Two Fastest-Declining Beers Drugs Between 2000–2001 and 2005–2006, by Number of Chronic Users on Public Drug Programs in Select Provinces* (Minimum of 1% of Senior Claimants in 2005–2006)

Province	Drug**	Percent Average Annual Growth, 2000–2001 to 2005–2006 (Growth From 2004–2005 to 2005–2006)	
Alberta	Oxybutynin	7.3	(7.5)
	Amitriptyline	4.8	(4.8)
	Digoxin	-7.2	(-8.3)
	Conjugated estrogens	-18.1	(-11.0)
Saskatchewan	Oxybutynin	3.9	(7.6)
	Amitriptyline	2.0	(1.3)
	Digoxin	-8.6	(-9.6)
	Conjugated estrogens	-18.2	(-14.4)
Manitoba	Amitriptyline	2.3	(5.1)
	Temazepam	0.6	(0.9)
	Digoxin	-7.0	(-9.9)
	Conjugated estrogens	-16.9	(-9.5)
New Brunswick	Amitriptyline	18.0	(4.5)
	Ferrous sulphate	11.2	(5.8)
	Conjugated estrogens	-18.3	(-12.7)
	Cimetidine	-19.1	(-23.0)

* The four provinces submitting claims data to the NPDUIS database as of June 2007.

** See Appendix A for drug-specific notes.

Conclusion

Seniors are at greater risk for adverse effects due to complex drug therapies and age-related changes to the body. Using data from the NPDUIS database, this analysis provides an overview of general claiming patterns for seniors on public drug programs in Alberta, Saskatchewan, Manitoba and New Brunswick, with a focus on claim trends for drugs that, according to Beers, should be avoided, when possible, in seniors. However, due to the lack of detailed clinical information available from drug claims data, this analysis does not infer the appropriateness or inappropriateness of each claim for a Beers drug in seniors. It is recognized that there are cases where it is necessary to prescribe Beers drugs to seniors. The senior population is at a particularly high risk of experiencing adverse drug reactions, which may result in an increased need for health care services. This analysis does not estimate the economic impact that may be incurred in the health care system, from activities such as the treatment of adverse reactions resulting from the use of drugs on the Beers list.

This analysis demonstrates that, in Alberta, Saskatchewan, Manitoba and New Brunswick, the rate of Beers drug use among seniors on public drug programs decreased between 2000–2001 and 2005–2006. In 2005–2006, the standardized rate of Beers use among seniors with drug claims varied from 25.2% in Manitoba to 31.3% in New Brunswick. In the same year, standardized rates of chronic Beers use varied from 12.9% in Alberta to 18.8% in New Brunswick. In all four provinces, among seniors with drug claims, the rate of chronic Beers use is highest among women and among seniors over the age of 85.

The *Improving the Quality of Drug Management of Saskatchewan Seniors Living in the Community* study examining seniors' drug claims in Saskatchewan for 2003–2004 found the rate of Beers use to be, ". . . highly suggestive that there is significant opportunity to reduce the dispensing rate of these drugs in Saskatchewan."⁴ This analysis indicates that the claim rate for Beers drugs by seniors has been declining over the past six years. However, as the seniors' population growth persists, so will the need to continue monitoring the claim trends for Beers drugs.

Appendix A—Drugs Used in Analysis

This analysis used the following drugs from the 2003 Beers list,¹ available in Canada and assigned to the following ATC codes. (Product-specific concerns identified by Dr Mark H. Beers, are available in the 2003 published article.¹)

ATC Code	ATC Description	Notes	Risk
A02BA01	Cimetidine		Low
A03AA07	Dicycloverine		High
A03AA57	Dicycloverine, combinations		High
A03AB05	Propantheline		High
A03BA03	Hyoscyamine		High
A03BA04	Belladonna total alkaloids		High
A03CA02	Clidinium and psycholeptics		High
A06AA01	Liquid paraffin		High
A06AB02	Bisacodyl	Long-term	High
A06AB07	Cascara	Long-term	High
A06AB52	Bisacodyl, combinations	Long-term	High
A06AB57	Cascara, combinations	Long-term	High
A08AA01	Phentermine		High
A08AA03	Amfepramone		High
A08AA10	Sibutramine		High
A10BB02	Chlorpropamide		High
B01AC05	Ticlopidine		High
B01AC07	Dipyridamole	Short-acting only	Low
B03AA07	Ferrous sulphate	> 325 mg/day	Low
B03AD03	Ferrous sulphate	> 325 mg/day	Low
C01AA05	Digoxin	> 0.125 mg/day	Low
C01BA03	Disopyramide		High
C01BD01	Amiodarone		High
C02AB02	Methyldopa (racemic)		High
C02AC01	Clonidine		Low
C02CA04	Doxazosin		Low
C02CC02	Guanethidine		High
C02LB01	Methyldopa (levorotatory) and diuretics		High
C03CC01	Etacrynic acid		Low
C04AE01	Ergoloid mesylates		Low
C08CA05	Nifedipine	Short-acting only	High
D04AA04	Tripelennamine		High
G03CA	Natural and semisynthetic estrogens, plain	Oral only	Low
G03CA03	Estradiol	Oral only	Low
G03CA57	Conjugated estrogens	Oral only	Low
G04BD04	Oxybutynin	Short-acting only	High
H03AA05	Thyroid gland preparations		High
J01XE01	Nitrofurantoin		High
M01AB01	Indometacin		High

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ATC Code	ATC Description	Notes	Risk
M01AB15	Ketorolac		High
M01AC01	Piroxicam	Long-term	High
M01AE02	Naproxen	Long-term	High
M01AE12	Oxaprozin	Long-term	High
M03BA03	Methocarbamol		High
M03BA53	Methocarbamol, combinations excl. psycholeptics		High
M03BB53	Chlorzoxazone, combinations excl. psycholeptics		High
M03BC01	Orphenadrine (citrate)		High
M03BC51	Orphenadrine, combinations		High
M03BX08	Cyclobenzaprine		High
N02AB02	Pethidine		High
N02AC04	Dextropropoxyphene		Low
N02AC54	Dextropropoxyphene, comb. excl. psycholeptics		Low
N02AD01	Pentazocine		High
N02CX02	Clonidine		Low
N03AE01	Clonazepam		High
N05AB03	Perphenazine		High
N05AC02	Thioridazine		High
N05BA01	Diazepam		High
N05BA02	Chlordiazepoxide		High
N05BA04	Oxazepam	> 60 mg/day	High
N05BA05	Clorazepate potassium		High
N05BA06	Lorazepam	> 3 mg/day	High
N05BA08	Bromazepam		High
N05BA12	Alprazolam	> 2 mg/day	High
N05BB01	Hydroxyzine		High
N05CD01	Flurazepam		High
N05CD02	Nitrazepam		High
N05CD05	Triazolam	> 0.25 mg/day	High
N05CD07	Temazepam	> 15 mg/day	High
N05CD08	Midazolam		High
N06AA09	Amitriptyline		High
N06AA12	Doxepin		High
N06AB03	Fluoxetine		High
N06BA01	Amphetamine		High
N06BA02	Dexamphetamine		High
N06CA01	Amitriptyline and psycholeptics		High
R06AA02	Diphenhydramine		High
R06AA52	Diphenhydramine, combinations		High
R06AD02	Promethazine		High
R06AX02	Cyproheptadine		High

Appendix B—Comparison Between 1997⁷ and 2003 Beers List¹

A comparison between the 1997 and 2003 Beers lists, for potentially inappropriate drugs independent of diagnosis or condition revealed the following differences. There was one drug (phenylbutazone [Butazolidin]) removed; the following 25 drugs or drug classes were added:

1. Amiodarone (Cordarone)
2. Amphetamines (excluding methylphenidate and anorexics)
3. Cimetidine (Tagamet)
4. Clonidine (Catapres)
5. Cyclandelate (Cyclospasmol)
6. Daily fluoxetine (Prozac)
7. Desiccated thyroid
8. Doxazosin (Cardura)
9. Estrogens in older women
10. Ethacrynic acid (Edecrin)
11. Ferrous sulfate > 325 mg
12. Guanadrel (Hylorel)
13. Guanethidine (Ismelin)
14. Isoxsuprine (Vasodilan)
15. Ketorolac tromethamine (Toradol)
16. Mesoridazine (Serentil)
17. Methyltestosterone (Android, Virilon and Testrad)
18. Mineral oil
19. Nitrofurantoin (Macrochantin)
20. Non-COX selective NSAIDs (naproxen [Naprosyn], oxaprozin and piroxicam)
21. Orphenadrine (Norflex)
22. Reserpine doses > 0.25 mg/day
23. Short-acting nifedipine (Procardia and Adalat)
24. Stimulant laxatives may exacerbate bowel dysfunction (except in presence of chronic pain requiring opiate analgesics)
25. Thioridazine (Mellaril)

As well, there were four drugs with modifications to when they should be considered potentially inappropriate:

1. Reserpine (Serpasil and Hydropres) doses > 0.25 mg.
2. Oxybutynin (Ditropan) was modified to refer to the immediate-release formulation only and not the extended release.
3. Iron supplements were modified to ferrous sulphate > 325 mg.
4. Dipyridamole (Persantine) was modified to consider only the short-acting versions, as the long-acting dipyridamole has better properties than the short-acting dipyridamole in older adults (except with patients with artificial heart valves).

Appendix C—Drug Classification Systems

Drugs can be analyzed using many different classification systems. For the purposes of this analysis, the following have been used:

- The drug identification number (DIN) as assigned by Health Canada. A DIN is specific to manufacturer, trade name, active ingredient(s), strength(s) of active ingredient(s) and pharmaceutical form. In this analysis, references to drug products are implied to be specific to DIN level.
- World Health Organization system of Anatomical Therapeutic Chemical (ATC) classifications as reported in the Health Canada Drug Product Database.^{ix}
 - In the ATC classification system, the drugs are divided into different groups according to the organ or system on which they act and their chemical, pharmacological and therapeutic properties.
 - The ATC does not distinguish between strength, dosage, route or form of drug, except as implied by the ATC code (for example, inhaled corticosteroid).
 - Drugs are classified in groups at five different levels.
 - The drugs are divided into 14 main groups (first level), with one pharmacological/therapeutic subgroup (second level).
 - The third and fourth levels are chemical/pharmacological/therapeutic subgroups.
 - The second, third and fourth levels are often used to identify pharmacological subgroups when that is considered more appropriate than therapeutic or chemical subgroups.
 - The fifth level is the chemical substance.

ix. Although typically Health Canada assigns drug products to a fifth-level ATC code, in some cases, it may assign an ATC at the fourth or even the third level.

Appendix D—Conversion Factors for Products in Non-Solid Dosage Forms

DIN	CIHI Uniform Description	Conversion Factor
00016314	Periactin 0.4 mg/mL Syrup	10
00022918	Benadryl 2.5 mg/mL Elixir	10
00024694	Atarax 2 mg/mL Syrup	10
00230197	Gravol 3 mg/mL Syrup	10
00232971	Novo Furan 5 mg/mL Susp	10
00583979	PMS Promethazine 2 mg/mL Syrup	10
00587923	Naprosyn 25 mg/mL Susp	10
00741817	PMS Hydroxyzine 2 mg/mL Syrup	10
00792705	PMS Diphenhydramine 2.5 mg/mL Elixir	10
00804193	Allernix 2.5 mg/mL Elixir	10
02019698	Benadryl Childrens 2.5 mg/mL Sol	10
02019736	Benadryl 2.5 mg/mL Elixir	10
02162431	Naprosyn 25 mg/mL Susp	10
00017841	Ferinsol 125 mg/mL Sol	5
00017884	Ferinsol 6 mg/mL Syrup	5
00018023	Bentylol 2 mg/mL Syrup	5
00027375	Mellaril 2 mg/mL Susp	5
00167681	Mineral Oil Sol	5
00179051	Mineral Oil Sol	5
00238643	Cascara Fluid Ext Sol	5
00242713	Lanoxin Pediatric 0.05 mg/mL Sol	5
00286265	Dulcolax Micro 2 mg/mL Susp	5
00392731	Dimenhydrinate Inj 10 mg/mL Sol	5
00481386	Huile Minerale 100% Sol	5
00485802	Mineral Oil 100% Sol	5
00704172	Huile Minerale Lourde USP 100% Sol	5
00758469	Ferodan 30 mg/mL Syrup	5
00762954	Fer In Sol 75 mg/mL Sol	5
00792675	PMS Ferrous Sulfate 30 mg/mL Sol	5
01916750	Tagamet 60 mg/mL Sol	5
01917021	Prozac 4 mg/mL Sol	5
01924753	Ditropan 1 mg/mL Syrup	5
01970461	Cascara Sagrada Arom. Fluid 83.2 mg/mL Sol	5
02102978	Bentylol 2 mg/mL Syrup	5
02177595	PMS Fluoxetine 4 mg/mL Sol	5
02222574	PMS Ferrous Sulfate Infant 15 mg/mL Sol	5
02223376	PMS Oxybutynin 1 mg/mL Syrup	5
02229553	Novo Ridazine Thioridazine Oral 2 mg/mL Susp	5
02231089	Apo Oxybutynin 1 mg/mL Syrup	5
02231328	Apo Fluoxetine Oral 4 mg/mL Sol	5
02242320	Lanoxin Digoxin C.S.D. Pediatric 0.05 mg/mL Sol	5

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DIN	CIHI Uniform Description	Conversion Factor
02243085	Apo Cimetidine Oral 60 mg/mL Sol	5
02162644	Toradol Im 10 mg/mL Sol	1
00012874	Valium Inj Roche 5 mg/mL Sol	1
00013579	Gravol Im 50 mg/mL Sol	1
00023205	Benadryl Inj 50 mg/mL Sol	1
00028002	Trilafon Inj 5 mg/mL Sol	1
00033308	Demerol Hcl 10% 100 mg/mL Sol	1
00036242	Demerol Hcl 5% 50 mg/mL Sol	1
00307181	Cascara Aromatic 250 mg/mL Sol	1
00399728	Diazepam Injection USP 5 mg/mL Sol	1
00497452	Meperidine Hcl Injection 50 mg/mL Sol	1
00497479	Meperidine Hcl Injection 100 mg/mL Sol	1
00557773	Ativan Inj 4 mg/mL Sol	1
00567434	Promethazine Hcl Inj USP 25 mg/mL Sol	1
00596612	Diphenhydramine Hydrochloride Injection USP 50 mg/mL Sol	1
00725749	Meperidine Hydrochloride Injection USP 100 mg/mL Sol	1
00725765	Meperidine Hydrochloride Injection USP 50 mg/mL Sol	1
00766011	Versed Inj 5 mg/mL Sol	1
00775320	PMS Thioridazine 30 mg/mL Sol	1
00784516	Versed Inj 1 mg/mL Sol	1
01927566	Phenergan Injectable 25 mg/mL Sol	1
01928368	Demerol Inj 50 mg/mL Sol	1
01928376	Demerol Inj 75 mg/mL Sol	1
01928384	Demerol Inj 100 mg/mL Sol	1
02041405	Ativan Injection 4 mg/mL Sol	1
02048264	Digoxin Injection C.S.D. 0.25 mg/mL Sol	1
02137992	Demerol Im Sc 50 mg/mL Sol	1
02139022	Demerol Im Iv Sc 50 mg/mL Sol	1
02139030	Demerol 10% Im Iv Sc 100 mg/mL Sol	1
02139049	Demerol Im Iv Sc 75 mg/mL Sol	1
02139715	Demerol 10% Im Sc 100 mg/mL Sol	1
02240286	Midazolam Injection 5 mg/mL Sol	1
02242002	Demerol 50 mg/mL Sol	1
02242003	Demerol 50 mg/mL Sol	1
02242005	Demerol 100 mg/mL Sol	1
02242006	Demerol 100 mg/mL Sol	1
02243253	Apo Midazolam Injectable 1 mg/mL Sol	1
02243278	Lorazepam Injection USP 4 mg/mL Sol	1
02162652	Toradol Im 30 mg/mL Sol	0.333
02239944	Ketorolac Tromethamine Injection USP 30 mg/mL Sol	0.333
02243989	Apo Ketorolac Injectable 30 mg/mL Sol	0.333

Appendix E – Distribution of Total Senior Population and Senior Claimants on Public Drug Programs in Select Provinces,^x by Age and Sex, 2005–2006

Alberta

Group	Senior Population (n = 343,682)	Senior Claimants (n = 318,749)
Male	44.7%	43.6%
Female	55.3%	56.4%
65–74	53.9%	50.0%
75–84	34.4%	36.7%
85 +	11.7%	13.3%

Saskatchewan

Group	Senior Population (n = 146,857)	Senior Claimants (n = 137,979)
Male	43.5%	41.8%
Female	56.5%	58.2%
65–74	47.2%	43.5%
75–84	36.7%	37.1%
85 +	16.1%	19.4%

Manitoba

Group	Senior Population (n = 158,486)	Senior Claimants (n = 151,271)
Male	42.7%	41.5%
Female	57.3%	58.5%
65–74	48.6%	45.5%
75–84	36.9%	37.0%
85 +	14.5%	17.6%

New Brunswick

Group	Senior Population (n = 105,024)	Senior Claimants (n = 62,155)
Male	42.9%	37.2%
Female	57.1%	62.8%
65–74	52.1%	43.3%
75–84	34.8%	37.4%
85 +	13.1%	19.4%

x. The four provinces submitting claims data to the NPDUIS database as of June 2007.

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