

# A Comparison of Brand-Name Drug Prices between Canadian-Based Internet Pharmacies and Major U.S. Drug Chain Pharmacies

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**Background:** Many Americans have been purchasing their medications from online Canadian pharmacies. Although it is commonly perceived that medications are less expensive in Canada than in the United States, little research has been done to quantify this difference.

**Objective:** To compare the prices of retail brand-name medications between Canadian Internet pharmacies and major U.S. drug chain pharmacies with online pricing.

**Design:** Cross-sectional study.

**Setting:** 12 Canadian Internet pharmacies and 3 major online U.S. drug chain pharmacies.

**Measurements:** The authors calculated the per unit and annual savings (in U.S. dollars) for an American if he or she were to buy the 44 brand-name medications most commonly purchased through the Internet from Canadian Internet pharmacies instead of from an online U.S. drug chain pharmacy.

**Results:** Americans can save a mean of approximately 24% per unit of drug if they purchase their medications from Canadian Internet pharmacies instead of from major online U.S. drug chain pharmacies. Forty-one of the 44 brand-name medications examined were less expensive in Canada. The medications offering the largest mean yearly savings were Zyprexa (olanzapine) (Eli Lilly, Indianapolis, Indiana) (\$1159), Actos (pioglitazone) (Eli Lilly, Indianapolis, Indiana) (\$852), and Nexium (esomeprazole) (AstraZeneca, Wilmington, Delaware) (\$772). Only 3 medications, all in the erectile dysfunction category, were more expensive in Canada.

**Limitations:** Potential savings may vary because of temporal fluctuations in drug prices.

**Conclusions:** Brand-name medications are often substantially less expensive when purchased from Canadian Internet pharmacies instead of from major online U.S. drug chain pharmacies.

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There has been substantial media coverage regarding Americans purchasing prescription medications from Canadian pharmacies. Cross-border shopping is fueled by the perception of less expensive prescription medications in Canada than in the United States (1). Although price differences between countries can create opportunities for substantial savings, U.S. law currently prohibits drug importation. However, individuals are allowed to import up to 90 days' worth of medications for personal use. Canadian Internet pharmacies have taken advantage of this policy by selling and exporting up to a 90-day supply to U.S. consumers through mail order. To our knowledge, few studies have systematically compared brand-name retail medication prices in Canada with those in the United States, and no studies have compared the prices charged by Canadian Internet pharmacies and by U.S. drug chain pharmacies (2-5). For this reason, we initiated a direct comparison of 12 Canadian Internet pharmacies with 3 major online U.S. drug chain pharmacies.

## METHODS

### Internet Pharmacy Selection

Canadian Internet pharmacies were identified on the basis of listings from Pharmacychecker.com that were accessed on 4 December 2004. This Web site has a price comparison tool designed to assist consumers in obtaining their prescription medications at the lowest possible prices (6) and provides detailed information profiles of online pharmacies. The Web site administrators are not affiliated with any individual pharmacy and evaluate Internet phar-

macies for inclusion on an ongoing basis. For a nominal charge, owners of online pharmacies can also request an evaluation to be added to the Web site. Pharmacychecker.com has developed an evaluation scale to rank Internet pharmacies. This tool rates Internet pharmacies on a scale of 0 to 5 using the following criteria: 1) Supplying pharmacies are licensed, 2) online personal financial information is secure, 3) privacy of the consumer's medical information is ensured, 4) contact address and phone number are provided, and 5) original prescription is necessary.

We examined 14 Canadian Internet pharmacies listed on Pharmacychecker.com on 4 December 2004. We included only Canadian Internet pharmacies that received a rating of 5 out of 5. All prices listed on Pharmacychecker.com were further verified on the vendors' Web sites. Two of the 14 Canadian Internet pharmacies we initially evaluated were subsequently excluded from the study. Abconlinepharmacy.com was excluded because the vendor's Web site was not accessible on the day of data collection. Canadameds.com was excluded because it is the same company as CrossBorderPharmacy.com, an Internet

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Conversion of figure and tables into slides

**Context**

Although many Americans use the Internet to purchase drugs from Canadian pharmacies, no study has systematically quantified the savings they achieve.

**Contribution**

This comparison of the charges for 44 common brand-name medications as posted on the Web sites of 12 Canadian pharmacies and 3 large American pharmacy chains showed that Americans can save approximately 24% by using Canadian pharmacies. Canadian pharmacies had lower prices for all but 3 of the 44 drugs.

**Cautions**

Savings may vary considerably with the individual drug and with fluctuations in supply and demand.

—The Editors

pharmacy already included in the study. The 12 remaining Canadian Internet pharmacies were included in the study (Table 1).

Internet pharmacies in the United States were identified from a list of the 30 largest drug stores based on 2003 sales revenue (7). To be included in the study, Internet pharmacies in the United States had to have a walk-in or “brick-and-mortar” presence to best reflect the prices available to the U.S. consumer at the retail level. In addition, the drug stores had to have pricing available online because these prices were to be compared with prices from Canadian Internet pharmacies. Only 3 U.S. pharmacies (CVS, Rite Aid, and Walgreens) met these criteria and were included in the study (Table 1). These 3 drug chains are the largest in the United States, representing 65% of total U.S. drug chain pharmacy sales revenue in 2003 (7). Although the prices offered by Internet pharmacies in the United States are not exactly the same as those prices offered to customers of walk-in retail outlets, they can serve as a proxy for calculating price differences between Canada and the United States. According to calculations from other published pricing data, the prices advertised on the Web sites of major U.S. drug chain pharmacies with online pricing are generally 10% to 15% lower than the prices of brick-and-mortar retail outlets (8–11).

**Internet Pharmacy Characteristics**

Canadian Internet pharmacies can be classified as actual, intermediary, or actual/intermediary (2). Eight of the 12 Canadian Internet pharmacies included in this study were classified as actual pharmacies with a real brick-and-mortar presence, making their supply available to walk-in and online mail-order customers. Two of the 12 Canadian Internet pharmacies were intermediary pharmacies, filling their orders through 1 or multiple independent pharmacies located domestically, internationally, or both. The 2 remaining Canadian Internet pharmacies were classified as

actual and intermediary pharmacies, receiving their medications either directly through their own suppliers or indirectly through independent pharmacies. For example, CrossBorderPharmacy.com fills its orders both from its own brick-and-mortar store and also from other suppliers located in Australia, Canada, Israel, and the United Kingdom.

Nine of the 12 Internet pharmacies charged a fixed shipping fee. This fee is charged per order and is independent of the number of prescriptions filled per order. Shipping prices vary between \$0 and \$15 U.S. per order for Canadian Internet pharmacies and between \$1 and \$1.95 U.S. per order for U.S. pharmacies. Assuming a 90-day supply rule, it is expected that an average U.S. consumer who shops online for his or her prescription medications will place 4 orders per year. Thus, the maximum shipping fee per year would be \$60 U.S. For the purposes of this study, shipping fees were excluded from the analysis because of the likelihood that these fees contribute minimally to the total purchase price. None of the 12 Internet pharmacies charged any additional fees, such as consultation fees or sales taxes.

**Drug and Pricing Selection**

To minimize the effect of daily pricing fluctuations, all pricing data were collected as listed on the vendors' Web sites on 4 December 2004. All Internet pharmacies included in the study listed their prices in U.S. dollars. When possible, the unit price calculated for each Internet pharmacy was based on a lot size of 100 units, recognizing that unit price decreases as the volume purchased increases. For purposes of comparison, it would not be fair to compare the unit price for a medication supplied in a lot of 100 units with that supplied in a lot of 1000 units. Such lot size differences often allow for substantial savings from bulk purchases. For approximately 25% of medications, the price for a lot size of 100 units was not available on the vendors' Web sites. Therefore, the next smallest available lot size was used in the calculations of the unit price. When a lot size smaller than 100 units was used, the same lot size was used in Canada and in the United States. In most cases, unit prices represent price per pill, but in some situations they represent price per inhaled dose (Advair Diskus [fluticasone propionate/salmeterol], GlaxoSmith-Kline, Philadelphia, Pennsylvania).

We first compared unit prices for common brand-name medications among Canadian Internet pharmacies and online U.S. drug chain pharmacies. Brand-name medications were chosen from the 50 most popular medications that were purchased over the Internet (based on sales volume) as listed on Pharmacychecker.com's Web site (2). Only brand-name medications were evaluated because some studies have found that the prices of generic medications are similar or more expensive in Canada than in the United States (2, 12). Four of the 50 medications were generic (atenolol, fluoxetine, lisinopril, metformin), and

Table 1. Pharmacies and Their Profiles\*

Name	Web Site Address	Location	Supplying Pharmacy	Licensing Organization	Pharmacy Type
<b>Canadian Internet pharmacies</b>					
Adv Care Pharmacy	www.adv-care.com	Markham, ON	Adv Care Pharmacy	Ontario College of Pharmacists	A
CanadaUSPharmacy	www.canadauspharmacy.com	Winnipeg, MB	Canada US Pharmacy	Manitoba Pharmaceutical Association	A
CanadaWebPharmacy	www.canadawebpharmacy.com	Burnaby, BC	Confidential	Licensed in Canada but undisclosed	I
CanadianMedService	www.canadianmedservice.com	Winnipeg, MB	Fort Garry Pharmacy	Manitoba Pharmaceutical Association	A
CrossBorderPharmacy	www.crossborderpharmacy.com	Calgary, AB	Total Care Pharmacy; pharmacies in Australia, Chile, Israel, UK	Alberta College of Pharmacists	A/I
Jan Drugs	www.jandrugs.com	Winnipeg, MB	Jan Drugs	Manitoba Pharmaceutical Association	A/I
LexiemPharmacyCanada	www.lexiempharmacycanada.com	Winnipeg, MB	Lexiem	Manitoba Pharmaceutical Association	A
Medications Canada	www.medicationscanada.com	Edmonton, AB	Elmwood Pharmacy	Alberta College of Pharmacists	A
PharmacyInCanada	www.pharmacyincanada.com	Edmonton, AB	Wellington Pharmacy	Alberta College of Pharmacists	A
PrescriptionPoint	www.prescriptionpoint.com	West Vancouver, BC	Agar Pharmacy	College of Pharmacists of BC	I
RxNorth	www.rxnorth.com	Minnedosa, MB	Mediplan Pharmacy	Manitoba Pharmaceutical Association	A
SmartChoicePharmacy	www.smartchoicepharmacy.com	Calgary, AB	United Prescription Services	Alberta College of Pharmacists	A
<b>U.S. retail pharmacies</b>					
CVS	www.cvs.com	Woonsocket, RI	CVS Pharmacy	Indiana State Board of Pharmacy	A
Rite Aid	www.drugstore.com	Bellevue, WA	Rite Aid Pharmacy	Washington State Board of Pharmacy	A
Walgreens	www.walgreens.com	Deerfield, IL	Walgreens Pharmacy	Illinois State Board of Pharmacy	A

\* A = actual; AB = Alberta; A/I = actual and intermediary; BC = British Columbia; I = intermediary; IL = Illinois; MB = Manitoba; ON = Ontario; RI = Rhode Island; WA = Washington State.

thus 46 brand-name medications were available for inclusion in the study. Flonase (fluticasone propionate), (GlaxoSmithKline, Philadelphia, Pennsylvania) and Toprol-XL (long-acting metoprolol succinate) (AstraZeneca, Wilmington, Delaware) were subsequently excluded. Flonase was excluded because of a lack of comparative pricing data. Toprol-XL was excluded because it is not available in Canada and therefore is not sold through its Internet pharmacies. Dosages for each medication were chosen on the basis of recommended daily dose ranges, daily frequencies of administration, and dose availabilities, as presented in the 2004 *Compendium of Pharmaceuticals and Specialties* (13), the Canadian analogue of the *Physicians' Desk Reference*. For example, although the daily dosage of Glucophage (metformin, Bristol-Myers Squibb, New York, New York) is 1500 mg, Glucophage is usually taken as a divided dose of 500 mg 3 times per day; therefore, unit pricing was calculated on the basis of a 500-mg dose.

Mean unit prices with standard deviations were calculated for each medication in Canada and the United States. The difference of the means was then calculated to derive the U.S. savings per unit. Savings per unit represents the amount saved per unit of medication if purchased from a Canadian Internet pharmacy instead of from a U.S. online drug chain pharmacy. Negative values for savings per unit represent the amount saved per unit of medication if purchased from a U.S. online drug chain pharmacy instead of from a Canadian In-

ternet pharmacy. We then calculated cost per year for a single patient by multiplying the mean unit prices by the number of units consumed per year. Unit price was defined as the dollar amount charged by a vendor for a single unit, and cost per year was defined as the dollar amount paid by a consumer for the purchase of an annual supply. For each medication, we then calculated the percentage amount by which an American could save when comparing the mean unit price offered by Canadian Internet pharmacies to U.S. online drug chain pharmacies. Finally, we derived an overall mean savings in U.S. dollars and percentage terms for the 44 medications and estimated 95% CIs using a variance estimate on the basis of a paired *t*-test. For the medications that were less expensive in Canada, we determined the number of Canadian Internet pharmacies offering less expensive prices than the least expensive U.S. online drug chain pharmacy. We also determined whether savings would still exist if Americans purchased their medications from the most expensive Canadian Internet pharmacy compared with the least expensive U.S. online drug chain pharmacy. We accomplished this by identifying the unit price of the most expensive Canadian Internet pharmacy and the unit price of the least expensive U.S. online drug chain pharmacy for each medication. We used the identified unit prices to derive an overall mean unit price for these medications when purchased at the most expensive Canadian Internet pharmacy or the least expensive U.S. online drug chain pharmacy.

## Role of the Funding Source

No funding was received for this study.

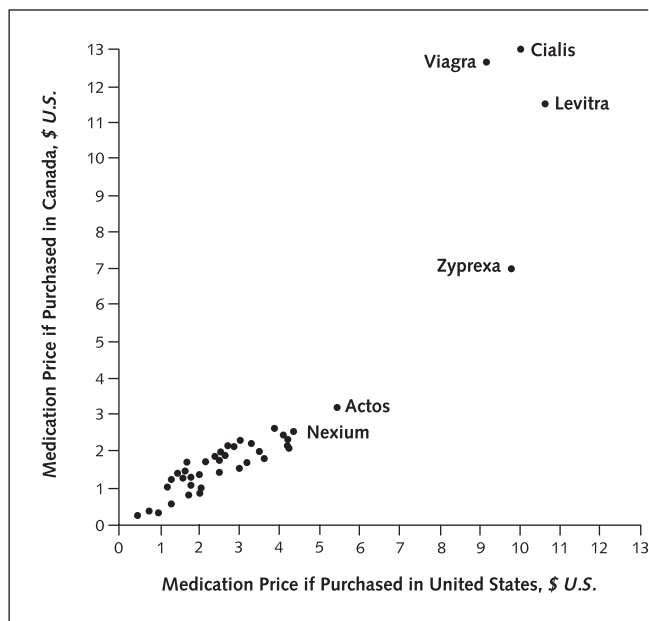
## RESULTS

Of the 44 brand-name medications examined (Table 2), the 3 largest therapeutic classes represented were the cardiovascular, alimentary/metabolism, and central nervous system classes, which included a total of 30 medications combined (68%). The cardiovascular class, which includes the statins, was the largest, with a total of 13 medications (30%). These results correspond closely to data published by Intercontinental Marketing Services Canada in 2003. When total Internet pharmacy sales were used, these 3 classes represented 57% of the studied drugs, with the cardiovascular class leading at 35% (14). Even though all medications were brand name, 36 of the 44 medications we examined were patented (15).

Americans can save approximately 24% on brand-name medications if purchased from Canadian Internet pharmacies instead of from major online U.S. drug chain pharmacies (Figure). The mean unit price difference was \$0.76 (95% CI, \$0.41 to \$1.11). Savings were evident for 41 of the 44 medications. The medications offering the largest mean yearly savings were Zyprexa (olanzapine)

(\$1159), followed by Actos (pioglitazone) (\$852), and Nexium (esomeprazole) (\$772). Three medications were more expensive in Canada; all 3 were from the erectile dysfunction category (Cialis [tadalafil], Eli Lilly, Indianapolis, Indiana; Levitra [vardenafil], GlaxoSmithKline, Philadelphia, Pennsylvania and Bayer, Pittsburgh, Pennsylvania; and Viagra [sildenafil], Pfizer, New York, New York). The medications for erectile dysfunction had an average annual cost of \$550 in Canada and \$476 in the United States based on the use of 4 pills per month, a difference of \$74. For 32 of 41 medications that were less expensive in Canada, all 12 Canadian Internet pharmacies offered the medication at a lower price than the least expensive U.S. online drug chain pharmacy. Therefore, for approximately 80% of medications studied, savings could still be realized even if Americans purchased their medications from the most expensive Canadian Internet pharmacy. Overall, for all 41 medications, the mean unit price was \$0.40 (CI, \$0.24 to \$0.56) less when comparing the most expensive Canadian Internet pharmacy with the least expensive U.S. online drug chain pharmacy.

**Figure.** Comparison of medication prices between Canadian Internet pharmacies and U.S. drug chain pharmacies with online pricing.



Each data point represents the average price of 1 unit dose of the same medication purchased in Canada and in the United States. Generic names and manufacturers are as follows: Actos (pioglitazone) (Eli Lilly, Indianapolis, Indiana); Cialis (tadalafil) (Eli Lilly, Indianapolis, Indiana); Levitra (vardenafil) (Bayer, Pittsburgh, Pennsylvania); Nexium (esomeprazole) (AstraZeneca, Wilmington, Delaware); Viagra (sildenafil) (Pfizer, New York, New York); and Zyprexa (olanzapine) (Eli Lilly, Indianapolis, Indiana).

## DISCUSSION

Many Americans have been purchasing prescription medications from Canadian pharmacies online (16). We performed this study because there have been few systematic comparisons of brand-name medication prices in Canada and those in the United States, and no studies, to our knowledge, have compared the prices charged by Canadian Internet pharmacies and by U.S. drug chain pharmacies with online pricing (2–5). Our study focused on brand-name medications. Generic medications were excluded because previous Canadian–American drug pricing studies found generic prices to be similar or higher in Canada (2, 12). A major reason cited in the literature to explain the higher generic drug prices in Canada is that there are fewer major manufacturers of generic medications in Canada than in the United States, which results in less price competition (12). Moreover, provincial-level price controls using reimbursement formularies discourage price competition among generic manufacturers (2). Consequently, we focused on brand-name medications because they represent an area of possible cost savings for Americans using Canadian Internet pharmacies. We found that Americans purchasing brand-name medications from Canadian Internet pharmacies can realize substantial savings. Most of the medications we examined were less expensive in Canada than in the United States. Three exceptions were medications in the erectile dysfunction category, possibly because the demand and price competition for these drugs are greater in the United States. When pharmaceutical companies have difficulty differentiating their medication from its competitors in terms of therapeutic benefits or side effect profile, they are forced to compete mostly on price to gain market share.

**Table 2. Price Comparison of Brand-Name Medications Purchased through Canadian Internet and U.S. Online Drug Chain Pharmacies\***

Drug Name	Generic Name	Manufacturer (City, State)	Dose, mg	Mean Unit Price (SD), \$ U.S.		Mean U.S. Savings per Unit, \$ U.S.	Units per Day, n	Cost Per Year, \$ U.S.†		U.S. Savings per Year, \$ U.S.
				Canada	United States			Canada	United States	
Accupril	Quinapril	Pfizer (New York, NY)	40	1.04 (0.13)	1.26 (0.13)	0.22	1	379.30	458.68	79.39
Actonel	Risedronate	Aventis (Bridgewater, NJ)	5	1.93 (0.22)	2.34 (0.30)	0.41	1	703.23	854.10	150.87
Actos	Pioglitazone	Eli Lilly (Indianapolis, IN)	30	3.20 (0.21)	5.54 (0.59)	2.34	1	1168.61	2020.88	852.28
Advair Diskus‡	Fluticasone/salmeterol	GlaxoSmithKline (Philadelphia, PA)	100/50	1.38 (0.12)	2.06 (0.24)	0.68	2	247.63	370.80	123.17
Allegra	Fexofenadine	Aventis (Bridgewater, NJ)	60	0.57 (0.11)	1.34 (0.12)	0.77	1	208.38	490.32	281.93
Altace	Ramipril	Wyeth (Madison, NJ)	10	1.07 (0.10)	1.79 (0.24)	0.72	1	390.55	653.35	262.80
Avandia	Rosiglitazone	GlaxoSmithKline (Philadelphia, PA)	4	2.13 (0.13)	2.92 (0.31)	0.79	1	777.15	1064.58	287.44
Bextra§	Valdecoxib	Pfizer (New York, NY)	10	1.51 (0.18)	3.08 (0.39)	1.57	1	551.15	1122.98	571.83
Celebrex	Celecoxib	Pfizer (New York, NY)	100	0.82 (0.06)	1.76 (0.20)	0.93	2	600.43	1282.37	681.94
Celexa	Citalopram	Forest Pharmaceuticals (St. Louis, MO)	20	1.44 (0.15)	2.57 (0.37)	1.13	1	523.78	936.83	413.06
Cialis	Tadalafil	Eli Lilly (Indianapolis, IN)	20	12.99 (2.33)	10.27 (1.45)	-2.72	1	623.46	492.80	-130.66
Coreg	Carvedilol	GlaxoSmithKline (Philadelphia, PA)	25	1.46 (0.08)	1.67 (0.24)	0.21	2	1067.13	1219.10	151.97
Cozaar	Losartan	Merck (Whitehouse Station, NJ)	50	1.26 (0.18)	1.65 (0.24)	0.38	1	461.42	601.03	139.61
Crestor	Rosuvastatin	AstraZeneca (Wilmington, DE)	20	2.07 (0.16)	2.62 (0.57)	0.55	1	754.46	956.30	201.85
Diovan	Valsartan	Novartis (East Hanover, NJ)	160	1.31 (0.14)	1.80 (0.24)	0.49	1	477.82	657.00	179.18
Effexor (extended release)	Venlafaxine	Wyeth (Madison, NJ)	75	1.69 (0.13)	3.29 (0.47)	1.60	1	615.63	1199.63	584.00
Evista	Raloxifene	Eli Lilly (Indianapolis, IN)	60	1.87 (0.21)	2.67 (0.18)	0.80	1	683.21	975.77	292.55
Flomax	Tamsulosin	Boehringer Ingelheim (Ridgefield, CT)	0.4	1.10 (0.11)	1.84 (0.17)	0.74	1	401.50	671.60	270.10
Fosamax	Alendronate	Merck (Whitehouse Station, NJ)	5	1.74 (0.24)	2.56 (0.24)	0.82	1	634.80	934.40	299.60
Glucophage	Metformin	Bristol-Myers Squibb (New York, NY)	500	0.35 (0.05)	0.78 (0.08)	0.43	3	382.34	848.63	466.29
Levitra	Vardenafil	Bayer (Pittsburgh, PA); GlaxoSmithKline (Philadelphia, PA)	10	11.47 (1.20)	9.91 (1.14)	-1.56	1	4184.93	3617.15	-567.78
Levothyrol¶	Levothyroxine	King Pharmaceuticals (Bristol, TN)	0.1	0.21 (0.10)	0.46 (0.06)	0.25	1	75.74	167.90	92.16
Lexapro	Escitalopram	Forest Pharmaceuticals (St. Louis, MO)	10	1.70 (0.07)	2.22 (0.23)	0.52	1	620.50	811.52	191.02
Lipitor	Atorvastatin	Pfizer (New York, NY)	20	2.22 (0.20)	3.36 (0.25)	1.14	1	810.00	1226.40	416.40
Neurontin	Gabapentin	Pfizer (New York, NY)	300	1.20 (0.10)	1.39 (0.12)	0.19	3	1309.62	1522.05	212.43
Nexium	Esomeprazole	AstraZeneca (Wilmington, DE)	20	2.53 (0.27)	4.65 (0.51)	2.12	1	924.78	1697.25	772.47
Norvasc	Amlodipine	Pfizer (New York, NY)	5	1.35 (0.12)	1.50 (0.10)	0.16	1	490.93	547.50	56.58
Paxil	Paroxetine	GlaxoSmithKline (Philadelphia, PA)	30	2.11 (0.22)	2.81 (0.42)	0.70	1	768.82	1025.65	256.83
Plavix	Clopidogrel	Bristol-Myers Squibb (New York, NY)	75	2.63 (0.20)	3.95 (0.27)	1.32	1	960.25	1441.75	481.50
Pravachol	Pravastatin	Bristol-Myers Squibb (New York, NY)	40	2.31 (0.20)	4.43 (0.33)	2.12	1	844.61	1616.95	772.34
Premarin	Estrogen	Wyeth (Madison, NJ)	0.625	0.30 (0.09)	1.04 (0.08)	0.74	1	111.02	379.60	268.58
Prevacid	Lansoprazole	TAP Pharmaceutical Products (Lake Forest, IL)	15	2.13 (0.19)	4.19 (0.46)	2.06	1	778.36	1529.35	750.99
Prilosec**	Omeprazole	AstraZeneca (Wilmington, DE)	20	2.22 (0.49)	4.19 (0.64)	1.97	1	808.64	1529.35	720.71
Propecia	Finasteride	Merck (Whitehouse Station, NJ)	1	1.68 (0.24)	1.68 (0.16)	0.00	1	611.98	613.20	1.22
Protonix††	Pantoprazole	Wyeth (Madison, NJ)	40	2.00 (0.14)	3.59 (0.36)	1.59	1	729.64	1310.35	580.72
Prozac	Fluoxetine	Eli Lilly (Indianapolis, IN)	20	1.82 (0.15)	3.64 (0.42)	1.82	1	663.64	1328.60	664.96
Singulair	Montelukast	Merck (Whitehouse Station, NJ)	10	2.29 (0.24)	3.32 (0.32)	1.03	1	835.24	1211.80	376.56
Viagra	Sildenafil	Pfizer (New York, NY)	50	12.66 (1.74)	9.26 (0.63)	-3.40	1	607.89	444.48	-163.41
Wellbutrin SR	Bupropion	GlaxoSmithKline (Philadelphia, PA)	150	0.98 (0.10)	2.22 (0.25)	1.24	1	358.31	810.30	451.99
Zetia	Ezetimibe	Merck (Whitehouse Station, NJ)	10	1.81 (0.13)	2.52 (0.25)	0.71	1	659.09	919.80	260.71
Zocor	Simvastatin	Merck (Whitehouse Station, NJ)	40	2.40 (0.22)	4.07 (0.28)	1.67	1	877.10	1485.55	608.46
Zoloft	Sertraline	Pfizer (New York, NY)	50	1.94 (0.10)	2.60 (0.30)	0.66	1	707.10	949.00	241.90
Zyprexa	Olanzapine	Eli Lilly (Indianapolis, IN)	10	6.98 (0.49)	10.16 (0.98)	3.18	1	2549.36	3708.40	1159.04
Zyrtec‡‡	Cetirizine	Pfizer (New York, NY)	10	0.88 (0.19)	2.10 (0.25)	1.22	1	321.61	766.50	444.89

\* As listed on Pharmacychecker.com on 4 December 2004. DE = Delaware; IL = Illinois; IN = Indiana; MO = Missouri; NJ = New Jersey; NY = New York; PA = Pennsylvania; TN = Tennessee.

† Cost per year based on mean unit price and units consumed per year unless otherwise indicated.

‡ Cost per year based on 90 days of annual consumption.

§ Removed from the market on 7 April 2005.

|| Cost per year based on 48 days of annual consumption.

¶ Pricing for Levoxyll was collected under the brand name Synthroid (Abbott Laboratories, Abbott Park, IL).

\*\* Prilosec is marketed under the brand name Losec in Canada.

†† Protonix is marketed under the brand name Pantoloc in Canada.

‡‡ Zyrtec is marketed under the brand name Reactine in Canada.

Thirty-six of the 44 medications we examined were patented (15). The Patented Medicines Price Review Board (PMPRB), established under the Canadian Ministry of Health, regulates the maximum prices at which manufacturers can sell patented medicines in Canada. The PMPRB ensures that consumer prices set by manufacturers for patented medicines are not excessive. The jurisdiction of the board is limited to drugs that are marketed as patented medicines; the PMPRB has no control over establishing the pricing of generic or brand-name off-patent medications. To determine drug price calculations, the PMPRB uses variables established in the Patent Act (17). For new drugs, prices are limited by the prices of similar drugs used to treat the same disease in patients in Canada and by the prices charged for the same drug in 7 other countries: France, Germany, Italy, Sweden, Switzerland, the United Kingdom, and the United States. Moreover, any price increases for existing drugs are limited to changes in the Consumer Price Index. In contrast with Canada, the United States operates mostly as a free market. Manufacturers are able to set prices as they choose, most often discriminating by charging higher prices to individual private consumers and lower prices to large purchasing groups. For example, manufacturers offer volume-driven price discounts to the U.S. government and large managed care organizations, such as health maintenance organizations and preferred purchaser organizations.

The introduction of Internet pharmacies has made it easier for Americans to compare prices between Canada and the United States. The relative ease with which a U.S. consumer can purchase medications over the Internet has contributed to an impressive increase in sales. In 2003, cross-border purchases of medications generated an estimated \$750 million U.S., or 0.5% of the total \$156 billion U.S. retail pharmaceutical market (18). According to Intercontinental Marketing Services health data, of this \$750 million in sales, approximately 64% is obtained through Internet pharmacies, with the balance of sales being made to consumers who physically drive across the border (14). Internet pharmacies are usually licensed pharmacies that market their medication prices on the Internet, which allows mail orders to be placed online.

Although the current market size of re-importation is small relative to the entire U.S. market, its impact is not. A poll taken in the United States in August 2004 found that 66% of Americans felt drug prices were "unreasonably" high and 60% were in favor of price controls similar to those enforced by the PMPRB in Canada (19). In response, many U.S. officials are considering purchasing medications from Canada for senior citizens and government employees (20, 21). Cross-border medication purchases have generated a considerable amount of public policy controversy in Canada and the United States. Five major pharmaceutical manufacturers (GlaxoSmithKline, AstraZeneca, Wyeth, Pfizer, and Eli Lilly) have responded to cross-border purchases by reducing their supply to Ca-

nadian Internet pharmacy retailers, in an attempt to curtail re-importation into the United States (16).

A contentious issue regarding the re-importation of medications is concern about the safety of purchasing medications through the Internet. Most of these concerns center on the storing and handling of medications. If a medication is manufactured outside of the United States, it has been claimed that there might not be appropriate standards in place to ensure proper storage and handling conditions (22). However, many U.S. pharmaceutical companies outsource their production to other countries, and these drugs also need to be shipped and handled over long distances on their way back to the United States. In addition, Canada has one of the most rigorous drug approval systems in the world, and most of the drugs that are approved in Canada are also approved by the U.S. Food and Drug Administration (23).

Another safety concern centers on selling medications over the Internet to patients without a proper prescription. Some Internet pharmacies do not require a prescription from the patient, as long as the patient completes an online consultation with a doctor or a pharmacist. Without a proper assessment, patients may not receive the correct medication. Although this concern may be valid, U.S. officials could endorse those Internet pharmacies that operate legitimately and require appropriate documentation before allowing U.S. customers to purchase medications safely over the Internet. For example, through Minnesota Governor Tim Pawlenty's Web site Minnesota RxConnect, Americans can receive the names of Canadian Internet pharmacies that have been endorsed by Minnesota state officials (21).

### Limitations

Our study has several potential limitations. First, potential savings may vary with time because of temporal fluctuations in drug prices. The savings presented in this study apply to prices collected on 4 December 2004. To determine the time sensitivity of price differences, all 44 medications were reexamined on 26 May 2005. On the basis of this analysis, the price savings offered to U.S. consumers purchasing their medications from Canadian Internet pharmacies decreased from a mean unit savings of \$0.76 (CI, \$0.41 to \$1.11) on 4 December 2004 to \$0.67 (CI, \$0.30 to \$1.04) on 26 May 2005. This represents a decrease in savings from 23.6% to 20.3% during the 6-month period. Even though Canadian Internet pharmacy prices have increased by 7% (compared with 2% at U.S. online drug chain pharmacies), they still offer considerable savings. Second, because of availability, the online prices for each U.S. pharmacy were used to proxy the brick-and-mortar prices (8–10). According to a study conducted by Consumers' Checkbook, online prices are approximately 10% to 15% less than brick-and-mortar prices (24). As a result, the overall mean savings of 24% found in our study may be underestimated by 10% to 15%. Third, shipping fees were excluded from the overall analysis. We

chose to exclude these fees because they represent a small percentage of the potential annual savings. For example, the maximum yearly shipping fee of \$60 is likely to be minimal in comparison with the average annual cost savings. Based on a calculated average annual savings of approximately \$400 per medication and assuming the regular purchases of 3 medications, shipping fees would represent just 5% of annual savings. Finally, we examined 44 of the most popular brand-name medications purchased over the Internet based on sales volume. Analyzing these medications may have introduced bias because the most commonly purchased medications may represent those with the largest savings. However, the 44 medications we examined represent 75% of the overall top 50 medications and 87% of the top 100 medications prescribed in the United States (25). Therefore, the most popular medications purchased over the Internet are similar to the most prescribed medications in the United States.

### Conclusion

Our study was designed to compare medication prices between Canadian Internet pharmacies and U.S. drug chain pharmacies with online pricing. We found that Americans purchasing brand-name medications from Canadian Internet pharmacies can realize substantial savings with most medications. Because of the enormous cost of prescription medications in the United States, individual Americans are likely to financially benefit by purchasing their medications from Canadian Internet pharmacies.

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