Controlling the Cost of Drugs: the Canadian Experience

by Thomas K. Fulda and Paul F. Dickens III

In 1969 Canada began programs at both the national and provincial levels to lower prescription drug prices. These programs may have contributed to a significant decline between 1970 and 1974 of 39 percent in the average price of 16 drugs selected for study. During this time, the average price for the same drugs in the United States declined only 1.4 percent.

One major program, a change in the compulsory patent licensing, is described and analyzed. Other Canadian programs, designed to promote competition in the drug industry, and their effects are discussed.

Comparison of U.S. and Canadian prescription prices paid by the pharmacist reveals interesting similarities. According to one 1970 study of prices for 20 products in 8 countries, U.S. prices ranked highest for 12 products and second highest for 3 more (Jacoby, 1971). Canadian prices ranked highest for 3 products and second highest for 14. Also, both countries experienced significant increases in personal expenditures for prescription drugs between 1960 and 1970. U.S. expenditures jumped from $2.2 to 4.4 billion (USDHEW, 1972) and Canadian from $132.6 million to $360.4 million (Canadian Ministry of National Health and Welfare, 1973).

In the face of these increases, Canadian governments at the national and provincial levels have tried to encourage lower prescription drug prices. To foster competition in the pharmaceutical industry, Canadian patent laws have been amended to allow firms other than the patent holder to obtain a government license to manufacture, import, and sell a patented prescription drug. Also, to clarify the advantages of existing competitive opportunities, efforts have been made to (1) disseminate comparative price data; (2) demonstrate that chemically equivalent drugs are of acceptable quality; and (3) encourage pharmacists to dispense quality products at a reasonable cost.

A description of these Canadian programs and a preliminary evaluation of whether they have accomplished their objective follow.

This study of the Canadian experience reveals that no single program reduces retail drug costs. Rather, Canada's success was achieved through a series of interrelated steps aimed at stimulating price competition in drug manufacturing and encouraging prescribers, dispensers, and consumers of prescription drugs to take advantage of newly created opportunities.

Compulsory Patent Licensing

Prior to 1967, under existing Canadian law, licenses could only be granted to firms which manufactured the licensed product in Canada. In 1976, the Special Committee of the House of Commons on Drug Costs and Prices recommended that the law be broadened to allow, under certain circumstances, compulsory licenses covering imported drugs (Canadian House of Commons, 1966–67). What the Special Committee proposed was that, if the Canadian Patent Commission found a drug being sold at an unreasonably high price, compulsory licenses would also be available for firms wishing to import and sell products they do not manufacture in Canada.

As a result of the recommendations by the Special Committee on Drug Costs and Prices, the Canadian Parliament passed an amendment to the Patent Act in June 1969. It states:

> *Where, in the case of any patent for an invention intended or capable of being used for medicine or for the preparation or production of medicine, an application is made by any person for a license to do one or more of the following things . . .*
>
> *a. where the invention is a process, to use the invention for the preparation or production of medicine, import any medicine in the preparation or production of which the invention has been used or sell any medicine in the preparation or production of which the invention has been used, or*
>
> *b. where the invention is other than a process, to import, make, use or sell the invention for medicine or for the preparation or production of medicine, the Commissioner shall grant to the applicant a license to do things specified in the application except such, if any of those things*

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in respect to which he sees good reason not to grant such a license. . . .

The Patent Act, as amended, specifies that reducing the cost of drugs is a primary objective of compulsory licensing.

. . . in setting the terms of the license and fixing the amount of royalty or other consideration payable, the Commissioner shall have regard to the desirability of making the medicine available to the public at the lowest possible price consistent with giving to the patentee due reward for the research leading to the invention and other such factors as may be prescribed.

The legal instruction that the Commissioner of Patents "shall grant" compulsory licenses is reflected in the high rate of application approvals. Between June 1969 and June 1975, the period covered in this study, 109 licenses covering 41 drug products were approved. The following products are covered by compulsory patent licenses.

Issued June 1969 through June 1975

Acepromazine	Hydrocortisone Sodium Succinate
Amitriptyline	Hydroxyzine
Ampicillin	Imipramine HCl
Benzathine Penicillin G	Indomethacin
Bisacodyl	Lidocaine
Chlordiazepoxide	Methotrimeprazine
Chlorothiazide	Methyldopa
Chlorpromazine	Methylphenidate
Chlorthalidone	Metronidazole
Clofibrate	Nylidrin
Cloxacillin	Oxacillin
Cyproheptadine	Oxyphenbutazone
Diazepam	Oxytetracyline
Diethylpropion	Perphenazine
Erythromycin Estolate	Phenformin
Ethambutol	Primidone
Furazolidone	Propranolol
Furosemide	Thioridazine
Glutethimide	Trifluoperazine
Halothane	Triamcinolone Acetonide
Hydrochlorothiazide	

Issued July 1975 through June 1979

Allopurinol	Haloperdiol
Amoxicillin	Ibuprofen
Bethmethasone Valerate	Naproxen
Cephalexin	Oxazepar
Chlordiazepoxide w/Clidinium Bromide	Rifampin
	Salbutamol
Clofibrate	Spironolactone
Diatrizoate	Tolnaftate
Diphenozylate HCl	Triamterene
Fluocinolone Acetonide	Trimethoprim
Flurazepam	

[1] According to *Scrip*, between mid-1975 and mid-1978 an additional 92 licenses were issued. This brought the total number of products licensed to 54.

Many factors may influence drug firms' decisions about which drug entities they may try to obtain licenses for and, subsequently, market. Drugs licensed have primarily been those with large sales volumes, which are, naturally, more profitable. Technical and marketing considerations may also be a factor. Some firms may decide to obtain a license and market a product simply because their competitors are doing it. If, for example, its competitors begin marketing a product under a license, a firm that portrays itself as a full line manufacturer may decide also to license and market the product to maintain its competitive position and its full line image.

Royalty Payments

As indicated earlier, the Patent Act requires the Patent Commissioner to consider a patent holder's research development and other costs for a drug in determining the royalty to be paid by the licensee. The Commissioner must also consider the impact of that royalty payment on the selling price of the licensee's product.

In their presentations to the Commissioner of Patents with regard to the product diazepam, Frank W. Horner, Ltd., the license applicant, and Hoffman LaRoche, Ltd., the patent holder, both argued that royalties should be based on the net selling price of the bulk material form of diazepam.[2] However, they could not agree what this net selling price should be. Frank W. Horner, Ltd., favored paying a royalty based on the cost to it of $87 per kilo for the bulk form of the product which it imported. Roche sought royalty payments based on direct and allocated indirect costs equivalent to nearly $3,000 per kilo of bulk material.

The Commissioner of Patents accepted neither the Horner nor the Roche arguments. Instead he granted Roche a royalty on diazepam of 4 percent of the licensee's net selling price of the final dosage form of the product. Although it is not clear why the Commissioner set the royalty at 4 percent, the opinion he issued made clear the reasons for his basic decision:

I prefer not to use a 'base value' with respect to cost to produce the product of the patented process as I can foresee inevitable arguments and delay between Applicant and Patentee by so doing. Further, when royalty determinations are made with respect to licenses directed solely to the importation of medicines in their final dosage forms, it would be next to impossible to ascertain either the cost of production of the raw material upon which a 'variable percentage' might be based or, indeed, the net selling price of the raw material to the manufacturer of the final dosage

[2] Bulk material is the finished drug product in powdered form prior to tableting or encapsulation and bottling. The cost of bulk material tableting, and bottling is usually a small part of the cost of a drug to the pharmacist. Frank W. Horner indicated in its license application on diazepam that these costs including labor and factory overhead were $.30 per 100 2mg tablets, $.33 for 100 5 mg tablets, and $.37 per 100 10 mg tablets. Horner's selling price to the pharmacist per 100 tablets in 1969 ranged from $3.82 (2 mg) to $8.64 (10 mg).

forms. Nor do I see as practical . . . a royalty figure established at a fixed amount in dollars per kilogram of a product . . . in order to determine the Opponent's compensation; rather I prefer to use a variable percentage of a readily determinable amount . . . I have decided to fix the royalty herein as a percentage of the net selling price of Diazepam in its final dosage form . . . When sold to a third party at arms length.

The diazepam decision did not address how royalties for drugs involving patents held by more than one firm should be set. The issuance of licenses on two products—thioridazine and ampicillin—resolved this multiple patent issue. In the case of thioridazine, where two patent holders were involved, the royalty was split, with each firm receiving 2 percent of the net selling price of the product. In the case of ampicillin, where 4 patent holders were involved, the Commissioner of Patents again limited the total royalty to 4 percent (citing the requirement to ensure that the medicine be made available to the public at the lowest possible price) and allowed each patentee a 1 percent royalty on sales of the final form of ampicillin.

Other Programs to Promote Drug Price Competition

Canadian Government policy has been based on the premise that prescription drugs would not necessarily be offered to the public at the lowest possible price simply because of the availability of compulsory licenses. To accomplish the goal of lowering drug costs, Canadian officials decided it would be necessary to take additional steps. These have included providing aid programs to encourage development of Canadian pharmaceutical firms and providing quality data to physicians and pharmacists to establish that choices can be made between chemically identical products without sacrificing quality. Also involved have been efforts to show physicians, pharmacists, and the consumer the economic advantages and disadvantages involved in choices between competitive drugs which are chemically identical and of equivalent quality. This is done by publishing comparative prescription drug price data. Finally, provincial laws have been changed to allow pharmacists to select a lower priced brand of the product to be dispensed and to then pass the savings on to the consumer.

Manufacturer Assistance Programs

Just as the number of products on which licenses have been issued has been limited, so has been the number of firms obtaining licenses. Thirteen firms account for more than 80 percent of the licenses issued since June 1969. Interest in obtaining compulsory licenses is apparently conditioned by the firm's capacity to absorb the costs of clinical trials, advertising, and promotion of new products. Although some independent Canadian firms have this capacity, such firms increasingly have been acquired by American manufacturers.

To encourage the development of strong Canadian-owned firms, the Canadian Ministry of Industry, Trade, and Commerce has developed several relevant assistance programs. These include the Industrial Research and Development Incentives Act, the Program for the Advancement of Industrial Technology, and the Pharmaceutical Industry Development Assistance Program which began in 1968.

Under the Pharmaceutical Industry Development Assistance Program (PIDA), direct loans at commercial interest rates are available to implement approved development proposals. The objective of these loans is to enable the Canadian drug industry to compete in domestic and foreign markets. So that quality products can be offered at more competitive prices, drug firms are encouraged to "form corporate units able to employ competent personnel, perform suitable research and development and undertake effective marketing programs." To gain approval for a proposal, an applicant must demonstrate that his plan "will result in the manufacture and marketing of high quality, safe and effective prescription drugs at more competitive prices." (Dept. of Industry Trade and Commerce)

Drug Quality

Canadian Government effotrs to lower drug prices have been linked to providing assurance of high drug quality. In 1971, Minister of Natinal Health and Welfare John Munro (1971) described this link as follows:

I am fully aware of the fact that many physicians are reluctant to prescribe and dispense generic or other lower cost drugs, unless they can be assured that low cost drugs are of acceptable quality. Any program aimed at reducing drug costs must, therefore, recognize the need to provide objective information on drug quality to the professions of medicine and pharmacy.

Acting on this recognition, the Drug Quality Assessment Program, administered by the Department of National Health and Welfare, was announced in May 1971. The program presently evaluates selected drug products. Product evaluations involve submission of production records and stability studies which include physical and chemical analyses such as potency, content uniformity, weight variation, and disintegration time.

Product evaluations are supplemented by plant inspections. These inspections differ from regulatory inspections under the Food and Drugs Act. Inspections are voluntary, carried out at company request, and results are normally released for public inspection. Manufacturers are actively involved in the inspection process and "the standard used is that for the manufacturer control and distribution of drugs as laid down by the government specifications board (74 GP le). This standard is used both by manufacturers for their self inspection programs and by government inspectors to assess capability." (*Scrip*)

Quality assessment is also an important part of provincial drug programs.[3] The PARCOST program, administered since 1969 by the Ontario Ministry of Health, attempts to "encourage improvements in the overall quality of available pharmaceutical preparations by giving recognition to firms meeting high standards." (Ontario Ministry of Health, 1972) A Drug Quality and Therapeutics Committee, made up primarily of eminent pharmacologists teaching at Ontario's leading universities, is responsible for determining which drugs are of high quality and which firms deserve such recognition. Drugs deemed by the Committee to meet quality standards are included in the PARCOST *Comparative Drug Index* which is published semi-annually. Based on its experience, the Committee has concluded that "drug preparations formulated and produced in accordance with sound manufacturing principles, and found, on adequate testing to comply with official standards are with rare exceptions, therapeutically effective." (Ontario Ministry of Health, 1972)

Comparative Price Data

To stimulate price competition, comparative drug information is made available to physicians, hospitals, and pharmacists in an effort to encourage them to be more cost conscious in their prescribing and dispensing choices. *The Quebec Liste de Medicaments, Manitoba Drug Standards and Therapeutics Formulary, The Saskatchewan Formulary,* and the *Ontario Comparative Drug Index* are examples of Canadian publications which provide comparative drug cost data.

The PARCOST Program, in which pharmacies participate voluntarily, involves more than the provision of drug quailty assurance and comparative cost data. It also requires that participating pharmacists agree to accept three principles.[4] First, the maximum product cost used in pricing a prescription will be the amount listed in the current PARCOST *Comparative Drug Index.* Second, to compute the retail price of a prescription drug, the pharmacist will add to the prescription cost a professional fee. The maximum allowable fee is subject to periodic negotiations between the Province of Ontario and its pharmacists. Third, when the pharmacist may dispense an interchangeable chemical entity, he will choose only from those products listed in the *Comparative Drug Index.*

Drug benefit programs, by the late 1970s in all but one of the Canadian provinces, have also changed the role of comparative drug cost publications.[5] Ontario's Drug Benefit Program, which pays for prescription drugs provided to needy people over age 65 and Provincial Social Assistance recipients, is tied to PARCOST. Under the Drug Benefit Plan, the government will reimburse no more than the price quoted in the PARCOST *Comparative Drug Index* for the lowest priced interchangeable product plus a dispensing fee.[6]

Product Selection

Until the mid 1970s, the provincial laws in Canada and State laws in the United States required the pharmacist to fill a prescription written for a particular brand of a drug only with that brand, even where other forms offered chemically identical products at lower prices. In recent years these laws have been replaced by laws allowing pharmacists to engage in product selection. Forty States and 9 of 10 Canadian provinces now allow the pharmacist to choose the brand of a given chemical entity to be dispensed unless the physician indicates otherwise. This has increased the possibilities for dispensing lower cost drugs.

Product selection laws enacted in Ontario and Manitoba in 1972 typify this type of legislation. The Ontario Pharmacy Act, as amended, provides that "every person who dispenses a prescription *may,* unless otherwise directed by the prescriber, select and dispense an interchangeable pharmaceutical product o. er than the one prescribed, provided that the interchangeable pharmaceutical product dispensed is listed as interchangeable in the PARCOST *Comparative Drug Index,* and is lower in cost than the drug prescribed" (Ontario Legislature). In August 1975, after it was realized that the amendment to the Pharmacy Act did not apply to generically written prescriptions, the Pharmacy Act was replaced by the Health Disciplines Act which corrected this defect. The Manitoba law differs from the one in Ontario mainly in that Manitoba makes product selection mandatory (Manitoba Legislative Assembly).

The Canadian Experience: A Preliminary Evaluation

Have the broadening of compulsory licensing, quality assessment, assistance to manufacturers, comparative cost data, and product selection programs had an impact on Canadian drug prices? To assess this, it must be determined if Canadian prices to the pharmacy have declined and, if so, whether the decline is attributable to those programs. For the years 1970 through 1974, changes in the Canadian prices to the pharmacist and composition of the market of a selected group of drugs were analyzed and compared with price changes for the same drugs in the United States where such programs have not been adopted. It should be noted that because these programs were adopted over a relatively short period of time, it is not possible to assess them individually. We can only hope to determine their combined effect.

[3] The program in the Province of Ontario has served as a model for other provinces.

[4] In 1974 an estimated 55 percent of Ontario's pharmacies were PARCOST participants. They accounted for about 70 percent of prescriptions dispensed in the province.

[5] Except for Manitoba and Saskatchewan, drug benefits are limited to social assistance recipients and elderly beneficaries.

[6] In Saskatchewan, reimbursement is limited to the lesser of the lowest formulary cost of the product or actual acquisition cost.

Canadian Price Changes

New competitive forces, acting on the pharmaceutical market as a result of the Canadian programs described in this report, could influence drug prices in several ways. First, a price reduction by a major manufacturer in reaction to increased competition could result in reduction of the average acquisition price per dose of a drug. The average acquisition price can be calculated by dividing the dollar value of sales of all package sizes of a given dosage form and strength (e.g., 250 mg tablets) of a drug by quantity sold. Second, a major manufacturer might maintain or increase its price to maximize shortrun profits. This would probably occur where the major manufacturer of a product expected its share of the market of that product to significantly erode due to the entry of new manufacturers. The result of such price increases, particularly where little or no decline in market share has yet occurred, could be an increase in the average acquisition price per dose of that drug. Third, significant market penetration by new competitors offering a product at lower prices than those of the major manufacturer of the product could cause a reduction in the product's average acquisition price per dose.

What actually happened to the prices of prescription drugs in Canada between 1970 and 1974 is shown in Table 1, where the average prescription price per dose (tablet and capsule dosage forms only) is estimated for 16 of the 41 drugs for which compulsory licenses were issued between 1969 and 1975. These drugs were selected because they accounted for two thirds of all licenses issued during this period and because, among those licensed, they had the largest sales volumes. The average acquisition price per dose for the major manufacturer of each drug is presented separately from data showing the average price per dose for licensees marketing the drug and from aggregate data for all manufacturers of each drug. Percentage changes between 1970 and 1974 in the average acquisition price per dose for each drug in each of these three categories are also calculated. For 10 of the drugs in Table 1, the average price per dose (all manufacturers) declined between 1970 and 1974.[7] The price declines ranged from 4.3 to 64.7 percent. For 9 of the 10 drugs (the exception being thioridazine) the major manufacturer's price also declined. One cannot conclude from these findings whether or not licensee competition brought about the decline in the prices of the major manufacturers of each of the 9 drugs. One can, however, conclude that licensee competition did at least influence the rate of decline in the Canadian prices for 9 drugs, because the percentage decline in the average acquisition price per dose for all manufacturers of each drug exceeded the percentage decline in the average acquisition price per dose of the major manufacturer.

In addition to indicating price declines for 10 drugs, Table 1 shows an increase between 1970 and 1974 in the average acquisition price per dose (major and all manufacturers) for 5 of the remaining 6 drugs under consideration. In 3 of these 5 cases, there is no evidence of sales of the drug by licensees according to the market data examined.

Taking together drugs with a decline in the estimated average acquisition price per dose and those with an increase, the following results emerge. The average acquisition price per dose of the major manufacturers of the 16 drugs in Canada declined by 22.2 percent. At the same time, the average price of the licensees declined by 67.5 percent. The average price for all manufacturers of the 16 drugs declined by 39.1 percent.[8]

Canadian Market Share Changes

At least a partial explanation of the price changes shown in Table 1 can be obtained by examining changes in the shares of the market held by the major manufacturer and by the licensees of each of the 16 drugs in the table. Table 2 shows the relative shares of the total market (quantities sold) in 1970, 1972, and 1974 held by the major manufacturers and collectively by all licensees of each of these drugs. The market shares which are expressed in percentage terms have been calculated from the same Canadian market data which was the source of Table 1. In addition to market shares, the percentage changes betwen 1970 and 1974 in the total size of the market (number of units sold) for each of the 16 drugs and the major manufacturer's share of it is also shown.

At least for some of the drugs licensed by mid-1975, Table 2 shows that licensee firms had become increasingly successful at penetrating the markets for products on which they held licenses. Between 1970 and 1974, licensees increased their shares of the market for 10 of the 16 drugs under review.[9] In 1974, excluding ampicillin (a special case because of patent disputes), licensees held from 10 to 50 percent of the market for these drugs. For 8 of the 10 drugs (amitriptyline and chlorthalidone were exceptions) on which licensees increased their market shares, the average acquisition price per dose for all manufacturers (see Table 1) declined. In each of these eight cases, the major manufacturer's average price per dose also declined, but not as much as the average price per dose for all manufacturers. Thus, one can conclude that the increasing market share of the licensees explains the greater decline in the average acquisition price per dose for all manufacturers than in the average price per dose for the major manufacturers.

Two additional points pertaining to increases by licensees in their shares of the market for the above-mentioned drugs should be noted. First, for 6 of the 10 drugs where licensees increased their market shares, sales by the major manufacturer declined even though size of the total market (major manufacturer plus licensee sales), with one exception,

[7] Prices have been weighted by quantity sold.

[8] Includes both the mean percent change and the weighted mean price change.

[9] Amitryptyline, ampicillin, chlordiazepoxide, chlorthalidone, diazepam, erythromycin estolate, imipramine, metronidazole, thioridazine, and trifluoperazine.

Table 1

Estimated average price to the pharmacist for sixteen Canadian drugs in 1970, 1972 and 1974

Product and Dosage	Average Price Per Tablet or Capsule (Estimated)									Price Percent Change 1970–1974		
	Major Manufacturer			Licensees			All Manufacturers			Major Manufacturer	Licensees	All Manufacturers
	1970	1972	1974	1970	1972	1974	1970	1972	1974			
Amitriptyline 25 mg	4.2	5.6	5.6	5.7	3.5	1.9	4.2	5.2	4.2	+33.3	−66.7	0
Ampicillin 250 mg	16.8	10.0	9.3	17.1	9.0	5.9	17.0	9.1	6.0	−44.6	−65.5	−64.7
Chlordiazepoxide 10 mg	4.6	3.8	3.2	3.9	2.4	1.7	4.5	3.4	2.6	−30.4	−56.4	−42.2
Chlorothiazide 500 mg	3.4	3.8	3.7	..	..	..	3.4	3.8	3.7	+ 8.8	..	+ 8.8
Chlorpromazine 50 mg	4.5	4.8	5.3	2.7	1.7	2.0	4.4	4.6	5.2	+17.8	−25.9	+18.2
Chlorthalidone 100 mg	4.8	5.4	6.3	..	..	3.9	4.8	5.4	6.0	+31.3	..	+25.0
Diazepam 5 mg	5.2	4.0	3.4	4.0	3.2	1.7	5.1	3.8	2.7	−34.6	−57.5	−47.1
Erythromycin Estolate 250 mg	19.9	17.0	12.5	30.0	11.1	5.5	20.1	15.1	9.0	−37.2	−81.7	−55.2
Glutethimide 500 mg	4.3	4.2	4.7	..	..	..	4.3	4.2	4.7	+ 9.3	..	+ 9.3
Imipramine 25 mg	6.4	6.0	6.3	..	1.8	1.7	6.4	5.5	4.8	− 1.6	..	−25.0
Methylphenidate 10 mg	4.2	3.9	4.5	..	..	..	4.2	3.9	4.5	+ 7.1	..	+ 7.1
Metronidazole 250 mg	11.3	9.1	7.6	7.5	7.7	3.3	11.0	9.0	6.6	−32.7	−56.0	−40.0
Oxtetracycline 250 mg	19.9	18.0	18.4	..	..	..	19.9	18.0	18.4	− 7.5	..	− 7.5
Thioridazine 25 mg	4.7	5.1	5.6	..	1.8	2.3	4.7	4.7	4.5	+19.2	..	− 4.3
Triamcinolone 4 mg	21.2	24.2	20.6	24.6	16.0	12.0	22.0	22.4	18.7	− 9.9	−51.2	−15.0
Trifluoperazine 5 mg	8.9	10.2	8.3	9.3	6.0	3.7	8.9	9.7	7.5	− 6.8	−60.2	−15.7
Average price per dose [1]	5.4	4.8	4.2	7.7	4.4	2.5	5.8	4.7	3.5	−22.2	−67.5	−39.1

[1] This is an arithmetic mean price and does not take into account differences in the relative importance of the production of particular drugs by major manufacturers and by licensees. Ampicillin is an example of this.

Source: Calculated from market data made available by Canadian officials.

Table 2

Estimated Canadian market shares for major manufacturers and licensees of 16 drugs in 1970, 1972 and 1974

Product and Dosage	Share of Canadian Market						Change in Total Market Size	Major Manufacturer Market Size Change
	Major Manufacturer			Licensees				
	1970	1972	1974	1970	1972	1974	1970–1974	1970–1974
Amitriptyline, 25 mg	99%	82%	61%	1%	18%	39%	+ 8.7%	−32.6%
Ampicillin, 250 mg	21	8	4	79	92	96	+150.8	−58.3
Chlordiazepoxide, 10 mg	73	68	56	27	32	44	− 14.6	−34.3
Chlorothiazide, 500 mg	100	100	100	0	0	0	− 46.7	−46.7
Chlorpromazine, 50 mg	92	93	97	8	7	3	− 15.1	−10.5
Chlorthalidone, 100 mg	100	100	90	0	0	10	+ 3.7	− 6.5
Diazepam, 5 mg	93	74	57	7	26	43	+139.1	+46.0
Erythomycin Estolate, 250 mg	98	68	50	2	32	50	+ 73.5	−11.2
Glutethimide, 500 mg	100	100	100	0	0	0	− 36.5	−36.5
Imipramine, 25 mg	100	88	68	0	12	32	+ 57.7	+ 7.7
Methylphenidate, 10 mg	100	100	100	0	0	0	+ 46.1	+46.1
Metronidazole, 250 mg	92	94	77	8	6	23	+109.5	+75.8
Oxytetracycline, 250 mg	100	100	100	0	0	0	− 49.7	−49.7
Thioridazine, 25 mg	100	87	67	0	13	33	+ 15.6	−22.1
Triamcinolone, 4 mg	76	78	78	24	22	22	− 16.4	−14.3
Trifluoperazine, 5 mg	88	88	83	12	12	17	+ 38.0	+29.6

Source: Calculated from market data made available by Canadian officials.

increased. Second, with but one exception (Chlordiazepoxide), where licensee markets expanded, the size of the total market also increased. This might be because licensees are attracted to drugs with growing markets or because the availability of lower priced licensed drugs stimulates additional consumption of them.

Table 2 also shows that for four drugs there was no market penetration by licensees, and for two others such market penetration declined.[10] Some possible reasons for this are suggested by the data in the table. In most cases, licensees' lack of success in penetrating or increasing their penetration of the market between 1970 and 1974 was associated with a decline during that period in the size of the total market for them. Time may also have been a factor. Failure to penetrate the market may well have occurred because it often takes considerable time to gain market acceptance for a new product.

Comparing Canadian To U.S. Price Changes

Another way to test the proposition that the changes in Canadian prices are a result of the Canadian programs described in this study is to compare those price changes with changes in the prices of the same 16 drugs in the United States, where compulsory patent licensing and the other Canadian programs have not been attempted. To make such a comparison, the average U.S. acquisition prices per dose in 1970, 1972, and 1974 are estimated in Table 3 for each of these drugs. As for the Canadian drugs, the average price per dose is presented separately for the major manufacturer, other manufacturers, and all manufacturers of each drug. The average price per dose is calculated in the same manner as in Table 1, but by using available U.S. market data. The percentage changes between 1970 and 1974 in the average price per dose of the major manufacturer, other manufacturers, and all manufacturers of each drug are also shown in Table 3.

Of the 16 drugs in question, between 1970 and 1974, the average U.S. acquisition price per dose (all manufacturers) declined for 4, was unchanged for 1, and increased for 11 of them. With the exception of oxytetracycline, the changes in the direction of the average price per dose of the major manufacturers and of all manufacturers of these drugs were identical. Declines in the average price per dose for all manufacturers ranged from .6 to 56.6 percent and price increases from 1.0 to 32.4 percent. Unlike Canada, where all 16 drugs were available from more than one manufacturer, in 1970 only 3 and in 1974 only 5 of them were available in the United States from more than one source.

Calculation of changes in the average acquisition price per dose for the drugs in Table 3 yields the following results. Between 1970 and 1974, the average U.S. acquisition price of the major manufacturers of the 16 drugs increased by 2.8 percent. The average acquisition price of other manufacturers of these drugs declined by 57.1 percent. And the average acquisition price for all manufacturers declined by 1.4 percent.

To compare Canadian and American prices, Table 4 presents the average acquisition price per dose in 1970 and 1974 for all Canadian manufacturers of each of 16 drugs (from Table 1) and the same information on American prices of these drugs (from Table 3). Canadian prices in 1970 and 1974 have been adjusted to eliminate exchange rate differences between the Canadian and U.S. dollars. Data comparing the percentage change between 1970 and 1974 in the Canadian and U.S. average price per dose (all manufacturers) from Tables 1 and 3 is repeated. Also, Table 4 shows the Canadian price of each drug as a percentage of the U.S. price in 1970 and 1974. In addition, the change in the Canadian price of each drug between 1970 and 1974 is expressed as a percent of the U.S. price.

The Canadian average acquisition price per dose, according to Table 4 declined for 10 of the 16 drugs, while the U.S. average price per dose declined for only 4 of these 16 drugs during the 1970 to 1974 period. Increases between 1970 and 1974 in the period from Canadian average acquisition price per dose occurred for 6 of the 16 drugs, while the U.S. average acquisition price per dose increased for 11 drugs. Calculations of changes in the average price for all 16 drugs show that between 1970 and 1974 the Canadian prices declined by more than 39 percent, while U.S. prices declined by less than 2 percent.

The ratio of Canadian to American prices for individual drugs was also examined. In 1970, the Canadian acquisition price per dose was lower than the American price for 14 of the 16 drugs and, in 1974, lower than the American price for 13. Canadian prices for these drugs ranged from 58.6 to 97.3 percent of U.S. prices in 1970 and from 37.4 to 84.8 percent of U.S. prices in 1974. Between 1970 and 1974 the gap between Canadian and U.S. prices widened. Table 4 shows that in 1970 the average Canadian price of 5.74 cents for 16 drugs was 77.6 percent of the average U.S. acquisition price of 7.4 cents for them. In 1974 the Canadian average price of 3.46 cents was 47.4 percent of the U.S. average price of 7.3 cents. Thus, between 1970 and 1974 the average Canadian acquisition price as a percentage of the U.S. price declined by 30.2 percent.

On the basis of information presented in Table 4, is it reasonable to conclude that price behavior in Canada is significantly different from price behavior in the United States? The table shows declines between 1970 and 1974 in the Canadian prices of the majority of 16 drugs studied not matched by price declines for them in the U.S. A one-tailed T-test was used to determine whether the price changes were sufficiently different to conclude that they were drawn from different distributions. The results of tests using five different weighting schemes for 15 drugs (ampicillin was excluded for reasons indicated earlier) are

[10] Drugs with no market penetration by licensees were chlorothazide, glutethimide, methylphenidate, and oxytetracycline. Licensee share of the market declined for chlorpromazine and triamcinolone.

Table 3

Estimated average price to the pharmacist for 16 drugs in the United States 1970, 1972, and 1974

Product and Dosage	Average Price Per Tablet or Capsule (Estimate)									Percent Change 1970–1974		
	Major Manufacturers			Other Manufacturers			All Manufacturers					
	1970	1972	1974	1970	1972	1974	1970	1972	1974	Major	Other	All
Amitriptyline 25 mg	7.1	7.0	7.2	..	..	..	7.1	7.0	7.2	+ 1.4	..	+ 1.4
Ampicillin 250 mg	20.2	13.1	14.4	15.6	10.7	6.6	17.3	10.1	7.5	−28.7	−57.7	−56.6
Chlordiazepoxide 10 mg	5.9	6.1	6.0	..	..	..	5.9	6.1	6.0	+ 1.7	..	+ 1.7
Chlorothiazide 500 mg	4.9	4.9	4.9	..	..	..	4.9	4.9	4.9	0	..	0
Chlorpromazine 50 mg	4.8	4.2	4.2	..	..	12.7	4.8	4.2	4.3	−12.5	..	−10.4
Chlorthalidone 100 mg	6.9	7.5	7.7	..	..	..	6.9	7.5	7.7	+11.6	..	+11.6
Diazepam 5 mg	7.1	7.4	7.3	..	..	..	7.1	7.4	7.3	+ 2.8	..	+ 2.8
Erythromycin Estolate 250 mg	21.8	18.9	19.4	..	..	..	21.8	18.9	19.4	−11.0	..	−11.0
Glutethimide 500 mg	4.4	4.9	5.6	..	..	..	4.4	4.9	5.6	+27.3	..	+27.3
Imipramine 25 mg	7.1	8.4	9.4	..	7.7	8.2	7.1	8.4	9.4	+32.4	+ 6.5	+32.4
Methylphenidate 10 mg	5.1	5.7	6.0	..	..	..	5.1	5.7	6.0	+17.7	..	+17.7
Metronidazole 250 mg	13.7	13.4	14.3	..	..	..	13.7	13.4	14.3	+ 4.4	..	+ 4.4
Oxytetracycline 250 mg	17.6	17.9	17.9	6.7	4.5	3.8	17.6	17.7	17.5	+ 1.7	−43.3	− 0.6
Thioridazine 25 mg	7.6	7.7	8.0	..	..	..	7.6	7.7	8.0	+ 5.3	..	+ 5.3
Triamcinolone 4 mg	15.7	15.4	16.0	16.0	16.5	18.0	15.7	15.5	16.2	+ 1.9	+12.5	+ 3.2
Trifluoperazine 5 mg	9.6	9.3	9.7	..	..	..	9.6	9.3	9.7	+ 1.0	..	+ 1.0
Average price per dose	7.1	7.2	7.3	15.6	9.5	6.7	7.4	7.3	7.3	+ 2.8	−57.1	− 1.4

Source: Calculated from data in IMS America Ltd., *Pharmaceutical Market, U.S. Drug Stores,* 1970, 1972, and 1974. Ambler, Pennsylvania

Table 4

Comparison of U.S. and Canadian price changes for 16 drugs 1970–1974

Product and Dosage	All Manufacturers Price 1970		All Manufacturers Price 1974		Percentage Change 1970–1974		Canadian Price a Ratio of U.S. Price		Change in Canadian Price as a Ratio of U.S. Price 1970 to 1974
	Canada [1]	USA	Canada [1]	USA	Canada	USA			
Amitriptyline, 25 mg	4.16	7.1	4.24	7.2	+ 1.9%	+ 1.4%	58.6	58.9	+ .3
Ampicillin, 250 mg	16.83	17.3	6.06	7.5	−64.0	−56.6	97.3	80.8	−16.5
Chlordiazepoxide, 10 mg	4.46	5.9	2.63	6.0	−41.0	+ 1.7	75.6	43.8	−31.8
Chlorothiazide, 500 mg	3.37	4.9	3.74	4.9	+11.0	0	68.8	76.3	+ 7.5
Chlorpromazine, 50 mg	4.36	4.8	5.25	4.3	+20.4	−10.4	90.8	122.1	+31.3
Chlorthalidone, 100 mg	4.75	6.9	6.06	7.7	+27.6	+11.6	68.8	78.7	+ 9.9
Diazepam, 5 mg	5.05	7.1	2.73	7.3	−45.9	+ 2.8	71.1	37.4	−33.7
Erythromycin Estolate, 250 mg	19.90	21.8	9.09	19.4	−54.3	−11.0	91.3	46.9	−44.4
Glutethimide, 500 mg	4.26	4.4	4.75	5.6	+11.5	+27.3	96.8	84.8	−12.0
Imipramine, 25 mg	6.34	7.1	4.85	9.4	−23.5	+32.4	89.3	51.6	−37.7
Methylphenidate, 10 mg	4.16	5.1	4.55	6.0	+ 9.4	+17.7	81.6	75.8	− 5.8
Metronidazole, 250 mg	10.89	13.7	6.67	14.3	−38.8	+ 4.4	79.5	46.6	−32.9
Oxytetracycline, 250 mg	19.70	17.6	18.59	17.5	− 5.6	− 0.6	111.9	106.2	− 5.7
Thioridazine, 25 mg	4.65	7.6	4.55	8.0	− 2.2	+ 5.3	61.2	56.9	− 4.3
Triamcinolone, 4 mg	21.78	15.7	18.89	16.2	−13.3	+ 3.2	138.7	116.6	−22.1
Trifluoperazine, 5 mg	8.81	9.6	7.58	9.7	−14.0	+ 1.0	91.8	78.1	−13.7
Average price per dose	5.74	7.4	3.46	7.3	−39.72	− 1.4	77.6	47.4	−30.2

[1] Canadian prices adjusted to eliminate differences in exchange rates between U.S. and Canadian dollars.
Source: Table 1 and 3

reported in Table 5. One test assigns each drug equal weight (i.e., an unweighted test); two are calculated employing weights reflecting the relative importance of the drugs by number of doses of the material produced (relative physical volume) and their importance in a drug budget (relative sales volume).[11] In the remaining two tests, the U.S. market is adjusted to reflect somewhat different prescribing patterns that may exist in Canada.

Table 5

Probability That Canadian Drug Price Changes Were Greater Than U.S. Changes (1970–1974)

Weighting Scheme	*T-Value*	*Probability*
Equal Weight	2.5734	95.0%
Sales weight	17.1895	99.9
Physical volume weight	18.1291	99.9
Canadian sales weight	17.3398	99.9
Canadian volume weight (14 degrees of freedom)	17.8592	99.9

[12] The calculation of sample mean and variance for the weighted tests was based on
Mean=$\Sigma w_i P_i$
Variance=$w_i 2 (P_i - p)^2$
Where w_i represents weight (relative sales), P_i is the percentage price change between 1970 and 1974 of the ith drug, and p=the weighted mean percent price change. The standard test for differences between means was then employed, with 14 degrees of freedom.

The null hypothesis of no difference between net percentage change in price, using unweighted data, can be rejected at the 5 percent level. Also, the null hypothesis can be rejected at the .1 percent level when the 4 weighted measures are used. We may, therefore, conclude that drug prices in Canada during the period 1970 through 1974 have decreased relative to the United States.[12]

[13] The same set of tests with the same null hypothesis performed for the period 1970–72 over essentially the same sample of drugs (less amtriptyline) yielded much less conclusive results:

Weighting Scheme	*T-Value*	*Probability*
Equal weight	1.08	*
Sales weight	5.916	99%
Physical volume weight	6.126	99
Canadian sales weight	5.376	99
Canadian volume weight	5.676	99

* Not significant at 10 percent level.
Here the unweighted (equal weight) test could not reject the null hypothesis of no difference, although all of the weighted tests did so at the 1 percent level. Apparently the market adjustment period is sufficiently long that some of the markets were still in adjustment in 1972.

Summary and Conclusion

Since 1969, the Canadian Government has introduced a number of programs to reduce prescription drug prices. These have included a major change in the compulsory patent licensing law to permit the use of imported materials by licensees, financial aid to manufacturers, drug quailty assessment, dissemination of comparative price data, and product selection by the pharmacist. For the most part these programs are not being attempted in the U.S.[13]

To determine the effect of these Canadian programs on prescription drug prices, we examined Canadian and U.S. 1970 through 1974 sales data for 16 drugs marketed in both countries. The drugs selected for examination were those accounting for the largest number of compulsory licenses issued in Canada between June 1969 and June 1975.

The data indicates that Canadian prices declined between 1970 and 1974 for 10 of the 16 products examined The average acquisition price per dose in Canada for all 16 products fell by 39 percent. By comparison, U.S. prices increased between 1970 and 1974 for 11 of the products. The average acquisition price per dose in the United States for all 16 products fell by only 1.4 percent during this period.

It is clear that part of the significant decline in Canadian prices was due to price reductions by the major manufacturers of the 16 drugs in question. These price reductions may have been caused by increased licensee competition or by factors not related to the Canadian programs. The evidence also suggests that part of this price decline is directly attributable to the ability of the licensees marketing their products at prices below those of the major manufacturers, to obtain increasingly large shares of the market for licensed products and to expand existing markets.

The contrast between Canadian and American price changes between 1970 and 1974 supports the conclusion that, by increasing price competition, the Canadian programs are substantially responsible for the different pricing patterns observed. It should also be noted that, as a result of the Canadian innovations, the pharmaceutical market must be viewed as still being in the process of gradually adjusting to the changes which have taken place. Particularly in view of the current debate in Canada about the future of compulsory licensing, it remains to be determined whether price competition will continue and increase, and what the reaction of the Canadian pharmaceutical industry will be.

[13] By 1978 40 states had adopted product selection laws. In addition, in early 1980, HCFA will begin distribution of comparative price data.

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