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The impact of innovative medicines on healthcare costs in Canada 1990 to 2024: $20 billion cumulative annual variation in spending on patent drugs saved $70 billion in overall public healthcare expenditure.

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ABSTRACT – Few new medicines are covered on federal and provincial formularies within a reasonable timeframe. Research suggests that expediting insurance coverage for new drugs is likely to reduce costs more effectively than rationing – after accounting for patient health outcomes, overall healthcare costs, and economic productivity. A multi-variable linear regression was used to test the correlations between overall public healthcare spending and a set of explanatory variables comprised of sub-components of healthcare spending including patented medicines expenditures (PMEX). Changes in annual spending on patent medicines were negatively correlated with overall public healthcare expenditure, such that over the period 1990 to 2024, every $1 million increase in spending on patent medicines was offset by a $3.4 million decrease in overall spending on public healthcare. The relationship holds after controlling for variation in spending on hospitals and physicians, changes in the economy and population, and the advancement of time. The analysis supports the value proposition in favour of early adoption of pharmaceutical innovation. The cumulative incremental annual changes in the level of national direct spending on patent medicines were $20.4 billion, but were very likely offset by $69.3 billion in overall public healthcare cost savings accumulated over the same timeframe, as a result of the increased spending on innovative pharmaceuticals. The findings are consistent with the conclusion that there was a virtuous technological substitution of innovative medicines for other component uses of healthcare resources.

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INTRODUCTION

Pharmaceutical policy in Canada is based on the assumption that the cost of new medicines threatens the financial sustainability of public healthcare programs. Healthcare policy makers tend to focus on controlling prices and mitigating the budget impact of new drugs on publicly funded drug plans, and consequently few new medicines are covered on federal and provincial formularies within a reasonable timeframe (Skinner OCT 2025).

The opposing policy argument favours immediate insurance coverage for all drugs approved by Health Canada. One justification for this argument is a value proposition – that restricting or delaying access to new medicines is actually counterproductive regarding cost control, and that expediting insurance coverage for new drugs is likely to reduce costs more effectively than rationing – after accounting for patient health outcomes, overall healthcare costs, and economic productivity.

There is substantial evidence to support the value proposition for early adoption of pharmaceutical innovation. A systematic literature review published by the Canadian Health Policy Institute found 68 studies published in peer-reviewed academic journals from 1990 to 2018 confirming that greater use of innovative pharmaceuticals is empirically associated with treatment efficiencies and net societal health and economic benefits (CHPI 2019). Several prominent studies empirically demonstrate the value of pharmaceutical innovation in the Canadian context (Cremieux et al 2005; Hermus et al 2013; Lichtenberg 2009 2012, 2015, 2016; Lichtenberg et al 2019).

Most recently, Lichtenberg (2025) examined whether the new drugs that were approved by government regulators in earlier years had any impact on Canadian mortality rates or use of hospital services in later years. Using publicly available data spanning from 1970 to 2022, Lichtenberg estimated that if those innovative medicines had not been available in Canada, the number of life-years lost before age 75 would have been 49 percent higher by 2022. Pharmaceutical innovation that occurred in the earlier years saved 847 thousand Canadian life-years. In a separate analysis of hospital utilization, he estimated that without access to the new drugs that were released during 1970-1991, the total number of hospital days used by Canadians would have been 55 percent higher in 2022. Total national spending on hospitals in 2022 was $143 billion CAD – almost all of it paid by governments, so lower utilization avoided significant costs for taxpayers. Pharmaceutical innovation occurring in earlier years saved 14.2 million hospital days that otherwise would have been used. The estimated reduction in 2022 hospital expenditure attributable to drug innovation during 1970-1991 was $78.7 billion CAD – twice as large as 2022 national expenditure on all prescribed medicines and related supply chain costs totaling $37.4 billion CAD.

To further test the value proposition for the early adoption of new drugs, this paper analyzed the impact of pharmaceutical innovation on overall healthcare costs in Canada. An operational definition for pharmaceutical innovation includes the following functions:

- Development of a new treatment for a disease, where none previously existed.
- Cost-efficient technological substitution of innovative medicines for nonpharmaceutical types of treatment.
- Improvement of clinical effectiveness versus other products within a therapeutic class.
- Complementary improvement on the outcomes associated with nonpharmaceutical types of treatment.
- Increasing treatment options to accommodate heterogeneous patient responses to other products in a therapeutic class.

The analysis examined macro-level healthcare spending data in Canada, to see if there is statistical evidence of efficiency gains associated with pharmaceutical innovation. Specifically, the analysis looks at whether changes in national public healthcare costs over time, were dependent on changes in spending on patent medicines (a.k.a. new drugs), accounting for changes in spending on other healthcare components. Spending is used as a proxy for utilization in this analysis.

A multi-variable linear regression was used to test the statistical significance correlations between overall public healthcare spending and a set of explanatory variables (a.k.a. model) comprised of sub-components of healthcare spending. The regression model included a dependent variable for overall public healthcare expenditures (PUBHEX); three independent variables for total hospital expenditures (HOSPEX), total physician expenditures (PHYSEX), and patented medicines expenditures (PMEX); and three control variables for gross domestic product (GDP), and population (POP), and year (YR). The model assumed patented medicines (a.k.a. new drugs) represent therapeutic innovation that can substitute for, or complement hospital and physician services; and that this is how the use of (or spending on) innovative pharmaceuticals effects overall PUBHEX.

Data for PUBHEX, HOSPEX, PHYSEX, GDP, and POP were obtained from the Canadian Institute for Health Information (CIHI) national health expenditures database. The only source of data for PMEX is the Patented Medicine Prices Review Board (PMPRB) 2024 Annual Report. The data for all variables cover a time period of 35 years from 1990 to 2024. The data are displayed in **APPENDIX TABLE 3**.

Overall healthcare expenditure focused on national total public spending because this represents the maximum fiscal responsibility of governments. Hospital and physician expenditures were almost entirely funded by government and therefore, their impact on PUBHEX is wholly accounted for. The PMEX data represent all sales of patented drugs at the national level including publicly funded and private transactions accounting for the whole impact on PUBHEX.

RESULTS

Regression Statistics

The result of the multi-variable linear regression analysis are shown in **TABLE 1**. The statistically significant results are highlighted and briefly explained in detail below.

Multiple R estimates the strength of the linear relationship between the independent variables in the model and the dependent variable. A value of 1.000 means a perfect positive relationship and a value of zero means no relationship. Values that are close to 1.000 indicate the model reflects a strong relationship. In this case, the multiple R value (0.999) indicates that the model is very strongly correlated with the dependent variable.

R squared measures the fit between the data and the regression line, or the percentage of the variation of values around the mean for the dependent variable that are explained by the values for the independent variables. In this case, R squared estimates 0.997 or 99.7 percent of the values fit the regression line.

Adjusted R-square adjusts for the number of variables in a model. It is a more exact metric than R squared. In this case, Adjusted R estimates that the variation observed in the independent variables in the model explain 0.962 or 96.2 percent of the variation observed in the dependent variable.

Significance F is the estimate of the statistical significance of the correlation between the model and the dependent variable. It is stated as the probability that the results are due to chance, and is stated as a P-Value. The model is considered statistically significant if it exceeds the 95 percent confidence interval, or P-Value < 0.050. In this case, Significance F is 0.000, meaning the overall result is statistically significant, and there is near zero probability that the regression statistics are merely a random coincidence.

The bottom section of the table contains statistics for each of the independent variables, while controlling for variation in the other independent variables. P-Values confirm that variation in PMEX, is in a statistically significant relationship with the dependent variable PUBHEX (P-Value = 0.006). Coefficients represent the estimated amount of change in the dependent variable for a one-unit change in the independent variable. In this case, a single unit change in PMEX is associated with an inverse change of -3.395 in PUBHEX. It is a negative relationship, which means variation in the independent variable moves in the opposite direction from the change in the dependent variable. In this case, the coefficient can be interpreted as an increase of one unit in PMEX is associated with a decrease in PUBHEX of 3.395.

Together the statistics confirm that the analytical model explained nearly all variation in the dependent variable PUBHEX, and that the variation in the independent variable PMEX is associated with offsetting variation in the dependent variable PUBHEX by a ratio of 1:3.4.

TABLE 1. Linear regression, multi-variable analysis of the statistical relationship between variation in national expenditure on patent medicines (PMEX) and national public healthcare expenditure (PUBHEX), controlling for variation in national expenditure on hospitals (HOSPEX) and physicians (PHYSEX), gross domestic product (GDP), year (YR), and population (POP), Canada, 1990 to 2024.

DEPENDENT VARIABLE – PUBHEX						
Regression Statistics						
Multiple R	0.999					
R Square	0.997					
Adjusted R Square	0.962					
Standard Error	8087.506					
Observations	35.000					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	6.000	692523866565.060	115420644427.510	1764.632	0.000	
Residual	29.000	1896824897.930	65407755.101			
Total	35.000	694420691462.990				
INDEPENDENT VARIABLES						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.000	#N/A	#N/A	#N/A	#N/A	#N/A
HOSPEX	2.754	0.864	3.188	0.003	0.987	4.521
PHYSEX	-2.049	1.349	-1.518	0.140	-4.808	0.711
PMEX	-3.395	1.156	-2.936	0.006	-5.760	-1.030
GDP	0.004	0.023	0.152	0.880	-0.044	0.051
YR	-197.924	60.776	-3.257	0.003	-322.226	-73.622
POP	14035.879	4669.888	3.006	0.005	4484.886	23586.873

Monetizing the regression results

Variable values are stated in millions, except for YR which is stated in yyyy four digit format. All variables except YR and POP are denominated in current Canadian dollars (CAD). This means that the coefficient for the expenditure variables can be interpreted as the millions of dollars change in the dependent variable per $1 million change in the independent variable.

The multi-variable regression analysis revealed that spending on patent medicines was negatively correlated with spending on public healthcare overall such that over the period 1990 to 2024, every $1 million increase in spending on patent medicines was offset by a $3.4 million decrease in overall spending on public healthcare. The relationship holds after controlling for variation in spending on hospitals and physicians, changes in the economy and population, and the advancement of time.

The monetized coefficient ratio can be multiplied by the sum of the year-over-year change in actual spending on patent medicines and overall public healthcare costs to estimate the total savings that can be attributed to increased spending on innovative pharmaceuticals; and the total predicted expenditure that would otherwise have accrued in the absence of spending increases on patent medicines over the 35-year study period.

TABLE 2 shows the results of such a calculation. The sum of annual changes in PUBHEX amounted to almost $228 billion from 1990 to 2024. Over the same time frame, the sum of annual changes in PMEX totalled $20.4 billion. Applying the coefficient from the regression analysis allowed for a calculation of annual savings in PUBHEX, which were estimated to total $69.3 billion from 1990 to 2024. This calculation of savings implies that PUBHEX would have grown from $45.5 billion in 1990 to $296.9 billion in 2024, instead of $227.7 billion that was actually spent as a result of pharmaceutical innovation.

TABLE 2. National public healthcare expenditure (PUBHEX) savings implied by multi-variable regression analysis from the incremental annual change in national patented medicines expenditure (PMEX). (millions $) 1990–2024.

Year	PUBHEX Incremental annual change	PMEX Incremental annual change	PUBHEX Incremental annual savings	PUBHEX Incremental annual change predicted
1990	-	-	-	-
1991	$4,016	$300	-$1,019	$5,035
1992	$2,213	$200	-$679	$2,892
1993	$203	$200	-$679	$882
1994	$651	$0	$0	$651
1995	$278	$200	-$679	$957
1996	$320	$400	-$1,358	$1,678
1997	$2,044	$700	-$2,377	$4,420
1998	$3,962	$600	-$2,037	$5,999
1999	$4,138	$1,100	-$3,735	$7,872
2000	$6,034	$900	-$3,056	$9,089
2001	$5,733	$1,300	-$4,414	$10,147
2002	$4,907	$1,300	-$4,414	$9,320
2003	$6,674	$800	-$2,716	$9,390
2004	$5,475	$800	-$2,716	$8,191
2005	$6,211	$400	-$1,358	$7,569
2006	$6,659	$800	-$2,716	$9,375
2007	$9,332	$400	-$1,358	$10,690
2008	$6,731	$500	-$1,698	$8,428
2009	$7,878	$400	-$1,358	$9,236
2010	$7,103	-$600	$2,037	$5,066
2011	$5,054	$500	-$1,698	$6,752
2012	$6,464	$0	$0	$6,464
2013	$4,325	$500	-$1,698	$6,023
2014	$3,919	$400	-$1,358	$5,277
2015	$6,605	$1,300	-$4,414	$11,018
2016	$4,285	$500	-$1,698	$5,982
2017	$6,287	$1,200	-$4,074	$10,361
2018	$7,399	-$100	$340	$7,060
2019	$7,989	$500	-$1,698	$9,687
2020	$37,828	$500	-$1,698	$39,526
2021	$15,211	-$300	$1,019	$14,192
2022	-$734	$1,000	-$3,395	$2,662
2023	$15,658	$1,500	-$5,093	$20,751
2024	$16,853	$2,200	-$7,469	$24,322
1990-2024	$227,705	$20,400	-$69,258	$296,963

DISCUSSION

The analysis presented in this paper, represents additional empirical evidence that supports the value proposition in favour of early adoption of pharmaceutical innovation. A multi-variable regression model comprised of macro-level healthcare expenditure data covering 35 years from 1990 to 2024, revealed that the cumulative incremental annual changes in the level of national direct spending on patent medicines, which was valued at $20.4 billion, were very likely offset by $69.3 billion in overall public healthcare cost savings accumulated over the same timeframe, and that this was a result of the increased spending on innovative pharmaceuticals. If spending variables can conceptually serve as proxies for utilization, then the analysis confirms a virtuous technological substitution of innovative medicines for other component uses of healthcare resources.

This analysis uses data representing sales of patent drugs, designated at manufacturers gross or list prices. Accounting for rebates to public drug plans from manufacturers, and assuming that the rebates were the same percentage of total sales across the entire 35 year period, could reduce the estimate of PUBHEX savings accumulated over the years 1990 to 2024, from approximately $70 billion to $52.5 billion.

While the analysis allowed an estimate of the healthcare system savings associated with pharmaceutical innovation from 1990 to 2024, it did not capture the additional health and economic benefits that occurred during the 35-year period. Innovation would be associated with improvement in patient health outcomes and with reductions in productivity losses which represents economic gains that otherwise would not have accrued.

Findings of this analysis have implications for the formulary policies of Canada's prescription drug insurance system. The Canadian market for prescription drug insurance is comprised of both private sector and public sector payers. Of a national population of 40 million in 2025, 27 million people were active or eligible beneficiaries (or dependents of beneficiaries) of a private sector drug insurance plan. The remaining 13 million people were active or eligible beneficiaries of regular drug benefits covering defined populations, or were covered under safety net programs funded by federal, and provincial/territorial governments. Both private and public insurance use formularies to define the limits of the drugs covered. Private insurance plans typically have open formularies, which by default cover all drugs approved for marketing by Health Canada and specify only the drugs that are ineligible for coverage. By contrast, public drug plans typically have managed formularies that specify the drugs that are eligible for coverage – i.e. only the drugs listed on the formulary are reimbursable.

Canada has constructed a complex, onerous, and expensive system for controlling the cost of patented drugs. Before the government grants marketing authorization for a new drug product, its safety and effectiveness must be certified by Health Canada. Then they are subject to price regulation by the Patented Medicine Prices Review Board (PMPRB) and health technology assessment (HTA) conducted by Canada's Drug Agency (CDA). CDA makes recommendations that influence the pan-Canadian Pharmaceutical Alliance (pCPA) in negotiations with pharmaceutical manufacturers on behalf of the country's public drug programs.

As a consequence of this pharmaceutical policy framework, coverage for new medicines is very limited in Canada's public drug plans. A recent analysis compared access to new drugs on the formularies of the public drug plans in 10 Canadian provinces according to the rates of coverage versus a cohort of available products approved by Health Canada; and wait times associated with listing these products on public formularies. Health Canada authorized 196 new active substances for marketing between 1 January 2019 and 31 December 2023. The number of these drugs that were covered in any public drug program as of 31 December 2024, ranged from 22 (11 percent) in British Columbia, up to 52 (27 percent) in Ontario and Quebec. For the few drugs that were covered, the number of days from marketing authorization to formulary listing in any public drug plan ranged from 566 days in Alberta up to 816 days in Prince Edward Island. (Skinner 0CT 2025)

Cost is not a barrier to adopting open formularies in public drug plans. The findings of this research suggest that the total healthcare costs avoided from early adoption of new drugs, outweigh the costs avoided by public drug plans from rationing. Moreover, recent research confirms that after accounting for indirect costs and manufacturers rebates, the net direct expenditure per capita by provincial public drug plans on patented drugs averaged 1.0 percent of total public healthcare expenditure per capita. (Skinner DEC 2025) Canadian healthcare policy makers need to focus less on controlling the prices of new medicines and more on capturing value from utilization of innovative pharmaceuticals – better patient health outcomes, avoided healthcare costs, and reduced productivity losses.

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APPENDIX

TABLE 3. Regression variables – (MILLIONS except YR).

PUBHEX	HOSPEX	PHYSEX	PMEX	GDP	YR	POP
$45,523	$22,768	$9,179	$1,700	$695,501	1990	27.7
$49,539	$24,205	$10,105	$2,000	$701,774	1991	28.0
$51,752	$25,190	$10,343	$2,200	$718,436	1992	28.4
$51,955	$25,289	$10,404	$2,400	$747,036	1993	28.7
$52,606	$24,757	$10,635	$2,400	$791,971	1994	29.0
$52,885	$24,231	$10,616	$2,600	$831,621	1995	29.3
$53,205	$24,245	$10,771	$3,000	$859,834	1996	29.6
$55,248	$24,635	$11,225	$3,700	$906,925	1997	29.9
$59,211	$25,866	$11,771	$4,300	$940,550	1998	30.2
$63,348	$27,229	$12,408	$5,400	$1,007,926	1999	30.4
$69,382	$29,615	$13,221	$6,300	$1,106,072	2000	30.7
$75,115	$31,532	$14,150	$7,600	$1,144,542	2001	31.0
$80,022	$33,963	$15,199	$8,900	$1,193,695	2002	31.4
$86,696	$36,231	$16,281	$9,700	$1,254,747	2003	31.6
$92,171	$38,899	$17,316	$10,500	$1,335,732	2004	31.9
$98,382	$41,218	$18,556	$10,900	$1,421,591	2005	32.2
$105,041	$44,071	$20,047	$11,700	$1,496,605	2006	32.6
$114,373	$46,931	$21,553	$12,100	$1,577,659	2007	32.9
$121,104	$50,038	$23,761	$12,600	$1,657,040	2008	33.2
$128,981	$53,018	$25,648	$13,000	$1,571,336	2009	33.6
$136,084	$56,241	$27,403	$12,400	$1,666,045	2010	34.0
$141,138	$57,676	$29,177	$12,900	$1,774,062	2011	34.3
$147,602	$58,721	$30,246	$12,900	$1,827,203	2012	34.7
$151,928	$60,464	$31,588	$13,400	$1,902,248	2013	35.1
$155,847	$61,845	$32,900	$13,800	$1,994,897	2014	35.4
$162,451	$63,440	$34,350	$15,100	$1,990,440	2015	35.7
$166,736	$64,474	$35,907	$15,600	$2,025,535	2016	36.1
$173,023	$66,507	$37,044	$16,800	$2,140,643	2017	36.5
$180,422	$69,325	$38,014	$16,700	$2,235,677	2018	37.1
$188,411	$71,889	$39,496	$17,200	$2,313,562	2019	37.6
$226,239	$73,215	$37,998	$17,700	$2,220,528	2020	38.0
$241,450	$75,968	$40,430	$17,400	$2,535,819	2021	38.2
$240,717	$84,902	$43,984	$18,400	$2,850,942	2022	38.9
$256,375	$94,471	$48,021	$19,900	$2,933,814	2023	40.1
$273,228	$99,816	$53,313	$22,100	$3,069,086	2024	41.3

Sources: Canadian Institute for Health Information (CIHI), Patented Medicine Prices Review Board (PMPRB).

PUBHEX = public healthcare expenditures; HOSPEX = hospital expenditures; PHYSEX = physician expenditures; PMEX = patented medicines expenditures; GDP = gross domestic product; YR = year; POP = population.