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International patented medicine prices: how does Canada compare to the OECD? A descriptive analysis of list prices

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ABSTRACT

Background: Canada is known to have some of the highest patented medicine prices among high-income countries, yet few analyses have elucidated if prices are high across different subgroups of patented medicines. We conducted a comparative analysis of patented medicine list prices across the Organisation for Economic Co-operation and Development (OECD) member countries from the Canadian perspective.
Methods: A cohort of prescription patented medicine markets, defined as unique molecule, dosage form and strength level combinations, that had positive sales and sales volume in 2023, was defined for each of the 34 included OECD countries using IQVIA MIDAS quarterly sales data. We estimated bilateral price ratios between an OECD comparator country and Canada in 2023, weighted according to Canadian sales volumes.
Results: Overall, 1,722 markets in Canada were included and only a subset were present in comparator countries (range: 297–1,156). Canada had the 10th highest prices when accounting for purchasing power parity (PPP-USD). Canadian prices in the hospital sector were ranked 17th. Canada's price ranking for orphan patented medicines was relatively lower, regardless of whether they were biologics (16th) or not (13th). Prices were relatively higher in markets with no within-class competition (5th), markets in the top 50 by sales volume (6th), and markets older than 10 years (8th).
Conclusion: In certain market segments, patented medicine list prices in Canada tended to be positioned closer to the median of the included comparator countries; however, policymakers should be concerned with comparatively high prices in markets with no within-class competition and high sales volume.

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KEYWORDS
Medicine pricing; price comparison; medicine markets; OECD

Background

Canada has among the highest list prices for patented medicines across developed and high-income countries (Patented Medicine Prices Review Board, 2024b). The Patented Medicine Prices Review Board (PMPRB), Canada's price regulator, found Canada's list prices were the fourth highest across the 31 Organization for Economic Co-operation and Development (OECD) countries in the PMPRB 2023 annual report (Patented Medicine Prices Review Board, 2024b). Furthermore, the PMPRB reported Canada's list prices were the highest among the PMPRB11, the basket of 11 comparator countries (Australia, Belgium, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, and the United Kingdom [UK]) that the PMPRB will use for external price referencing in their price regulations and pending guidelines (Patented Medicine Prices Review Board, 2024c; Patented Medicines Regulations, Patent Act, 1994; Zhang, Sun, et al., 2024). While list prices are not same as the negotiated and confidential prices paid by public or private drug plans in Canada, high list prices still drive up patient expenses through co-insurance and other cost-sharing mechanisms (Campbell et al., 2017).

Other studies have compared drug prices across countries for specific segments of the market (Schneider & Vogler, 2019). For example, Young et al. (2017) calculated price ratios for 120 orphan drugs between six European countries and the UK. Average price ratios ranged from 0.88 (lower priced than the UK) in

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Norway to 1.13 (higher priced than the UK) in France. The average price ratios varied depending on the disease area, with the UK having prices lower than four comparator countries for treatments of circulatory diseases and the UK having prices higher than three comparator countries for treatments of blood and immune system diseases. In a price study of 28 European Union (EU) member states, Vogler et al. (2016) found Austrian prices for drugs used in the hospital setting were comparatively higher priced across the EU member states than drugs used in the outpatient setting. Using South Korea as the base country for price index comparisons, Jung et al. (2021) found prices of anticancer medicines in seven countries (the United States (US), UK, Germany, France, Italy, Switzerland, and Japan) were higher than in South Korea when prices were converted using market exchange rates but results differed when prices were adjusted using purchasing power parity (PPP). Identified price comparisons studies were more often US- or EU-centric and often did not include Canada in their comparisons (Schneider & Vogler, 2019). In addition to the paucity of studies that focus on Canada, evidence is limited on whether Canada's list prices consistently rank among the highest across medicine subgroups.

Accordingly, we sought to extend the evidence by examining international prescription medication prices from the Canadian perspective. The objective of our study was to conduct a comprehensive descriptive analysis of patented medicine list prices in 2023 in Canada compared to OECD member countries, including examining prices among subgroups of medicines to determine whether high prices are consistent or vary across those subgroups. Adapting the methodology from Mulcahy et al. (2024) the comparisons were made through a price ratio-based approach from a Canadian policy perspective.

Methods

Data source

We used IQVIA MIDAS quarterly sales data for the 34 OECD countries from Q4 2012 to Q4 2023. We did not have access to data from Iceland, Israel, Denmark, or Costa Rica in this dataset. The dollar sales in IQVIA MIDAS sales data were reported in both local currency and US dollars (USD) and the volume measure was the number of standard dose units sold. The sales and volumes reflect transactions from manufacturers or wholesalers to retail pharmacies and hospitals, including prescription bound registered medicines and some over-the-counter medicines sold through retail pharmacies. IQVIA MIDAS sales data are widely used in national and international studies for comparing prices, sales, volumes, and market shares (Habashy et al., 2023; Mulcahy et al., 2021; Peng et al., 2023; Tam et al., 2025). More details are in Supplemental Material - Methods S1.

Inclusion criteria and market definition

We selected patented medicines (i.e. innovative branded products and non-generic products) that were prescription-only in 2022, and defined our markets at the unique molecule, dosage form and strength levels. We further restricted to those markets that had positive sales and volume in 2023 for each country to ensure that our price outcome can be estimated. In addition to prescription status, we defined other market characteristics using 2022 data to ensure that these characteristics reflected the market structure *before* the 2023 price comparisons. This implies that for each country, the selected markets must be present in both 2022 and 2023.

Outcome: bilateral price ratio

To compare prices between Canada and other individual OECD countries, we calculated a price ratio defined as the bilateral ratio of the weighted price of the comparator country to that of Canada. Given that each country purchases and uses different volumes of patented medicine, we applied a volume-weighted approach using weights determined by Canadian sales volumes. For each bilateral comparison, we included only markets present in both the comparator country and Canada (i.e. 'common markets'). The volume weight for each common market was calculated as its proportion of standard units to the sum of all the standard units in Canada. The volume-weighted price of each country was then the sum of the product of the average price per standard unit of each market (manufacturer sales divided by sales volume) in the specific country and the corresponding Canadian volume weight. The resulting price ratio represents how many times more (or less) it would cost to buy the basket of patented medicines used in Canada, at the prices of the comparator country. A price ratio value greater than 1 indicates the prices in the comparator country are higher than in Canada for common markets; a value less than 1 indicates lower prices.

Primary analysis

For our primary analysis, we described the bilateral price ratios by plotting and ranking them from largest (highest prices relative to Canada) to smallest (lowest prices relative to Canada). Our primary analysis included all markets. We accounted for the influence of purchasing power of different currencies on price ratios by converting local currency sales into USD using 2023 PPP values (World Bank Group & ICP Global Office, 2020, 2024). This approach to currency conversion is consistent with other price comparison studies (Cameron et al., 2009; Iyengar et al., 2016; Pan et al., 2024; Patented Medicine Prices Review Board, 2024b).

Subgroups and market characteristics

Given that price differences may vary across different subgroups, we conducted further analyses based on several selected market characteristics, as described below. The selection of these market characteristics was guided by existing literature on medicine price comparisons.

Anatomical therapeutic chemical (ATC) class level 1

Prior price comparison studies have found that drug prices vary considerably across therapeutic classes (Wouters & Kanavos, 2017). We categorised each market according to the first level of the World Health Organization (WHO) ATC classification system associated with the molecule. ATC level 1 comprises 14 main anatomical or pharmacologic groups (World Health Organization, n.d.). For the subgroup bilateral comparison, we defined a four category therapeutic class variable: Nervous System (class N), Antineoplastic and immunomodulating agents (class L), Alimentary tract and metabolism (class A), and an 'other' category to capture the remaining classes. Classes N, L, and A were selected to be separate categories because they had enough markets to allow for bilateral comparisons.

Original orphan drug designation by the US Food and Drug Administration (FDA)

As orphan medicine products are often high-priced and constitute a significant portion of pharmaceutical expenditures (Schneider & Vogler, 2019), monitoring their prices and sales is of policy interest. We utilised the orphan drug dataset kindly provided by Miller and Lanthier (2024), which includes all drug designated as orphan by the FDA from 1990 to 2022, along with all subsequent indication expansions. A market was classified as 'orphan' if the molecule's first or subsequent FDA designation was orphan. Additionally, we further stratified orphan-designated molecules based on whether they were biologics, as defined by the IQVIA MIDAS data (i.e. a product must include at least one biologic active ingredient, and may be combined with other non-biologic active ingredients). This resulted in a four category variable: 'orphan and biologic', 'orphan and non-biologic', 'non-orphan and biologic', and 'non-orphan and non-biologic'.

Level of within-class competition in 2022

To assess market competition, we calculated the number of comparable molecules for each market in Canada in 2022, defined as the number of other molecules within the same WHO ATC4 that were sold in Canada during that year. Markets were then categorised based on the distribution of the number of comparable molecules into a four-category variable. The first category was those with no within-class competition (0 comparable molecules). For markets with one or more comparable molecules, we undertook a data-driven approach in the absence of established thresholds in the literature and stratified them based on the 33rd and 66th percentile: 'low within-class competition' (1–2 comparable molecules), 'moderate within-class competition' (3–4 comparable molecules), and 'high within-class competition' (>4 comparable molecules).

Generic competition in 2022

Generic products are widely studied in price comparisons due to their potential to introduce price competition (Schneider & Vogler, 2019). To assess generic competition, we identified whether any generic products (or biosimilar products for biologic markets) were present (with sales greater than zero) in the same market in Canada in 2022. Markets were then categorised as having or not having generic competition.

Top 50 molecules by sales volume

A recent PMPRB report noted two drivers of increased expenditure were increases in overall volume and shifts in treatment mix (Patented Medicine Prices Review Board, 2024b). To examine the influence of high-volume markets, we created a binary variable indicating whether markets were in the top 50 molecules by sales volume in Canada in 2022 or not, similar to Merkur and Mossialos (2007).

Market age

It is prudent to suggest that drug prices may change over time after launch (Vokinger et al., 2021). Markets were categorised based on their age, i.e. the number of years since a molecule's initial launch in Canada as of 2022. Three groups were defined: >0 to ≤5 years, >5 to ≤10 years, and >10 years. In addition, we looked back in time with markets ranging from Q1 2013 to Q4 2022 and analyzed the price ratio for each year since a given molecule's launch in Canada ranging from 4 years to 10 years. We examined this range to align with PMPRB proposed guidelines for examining international prices and to align with our data availability (Patented Medicine Prices Review Board, 2020). Given different launch years, we adjusted all prices into 2023 prices by using each country's Consumer Price Index.

Sensitivity analysis

To examine the influence of the PPP adjustment method, we employed two alternative approaches based on exchange rates (Mulcahy et al., 2024; Pan et al., 2024; Patented Medicine Prices Review Board, 2024b; Turner et al., 2019). Firstly, we used the sales data converted from the local currency to US dollars provided by IQVIA (IQVIA-USD) based on exchange rates at the time of sale. Secondly, we adopted a method similar to the approach used by PMPRB (Patented Medicine Prices Review Board, 2024b), converting local currency sales into Canadian dollars (CAD) using the 36-month trailing average exchange rate (FX) from 2020-08-01 to 2023-08-01 (36M FX CAD) (International Monetary Fund, n.d.). For each bilateral comparison, we calculated price ratios under these two alternative adjustment methods for the overall market and by sector (retail and hospital). A more detailed explanation of the changes in outcomes due to PPP adjustments is available in Supplemental Material - Methods S2 and Supplemental Material - Figure S1.

To examine the influence of adopting the Canadian perspective in the primary analysis, we conducted two additional analyses. First, we re-weighted each bilateral price ratio using the comparator country's sales volumes rather than Canada's. This illustrates how the different prescribing and utilisation patterns for the same basket of medicines between a comparator and Canada can affect price ratios. Second, we repeated the primary analysis from the perspective of each of the PMPRB11 countries used in Canada's reference pricing system. We identified the common markets between the reference country and each of the remaining 33 comparator countries and used the reference country's sales volumes to calculate price ratios. This results in 12 sets of price ratios, one per PMPRB11 country as the reference plus the primary analysis with Canada as the reference. We summarised the resulting distribution of rankings using boxplots, which illustrate both how the rankings changed across the 12 sets of ratios and how sensitive the primary analysis is to the choice of reference country.

Results

Overall sample and overall bilateral price comparisons

In total, 1,722 markets in Canada met our inclusion criteria (Table 1). The majority of the markets were patented medicines that had been on market for more than 10 years (71%) and that would be considered non-orphan

Table 1. Characteristics of the market base in Canada ($n = 1,722$).

Characteristic	Number of Markets (N)	Share of Market (%)	Share of Sales (%)	Share of Volume (%)
WHO ATC Level 1 Classification				
WHO-N Nervous system	350	20	9	15
WHO-L Antineoplastic and immunomodulating agents	317	18	41	2
WHO-A Alimentary tract and metabolism	166	10	16	15
Other Groups (including missing)	889	52	33	68
Orphan-Biologic Status				
Orphan-Non-Biologic	256	15	13	3
Neither Orphan nor Biologic	1139	66	35	95
Non-Orphan but Biologic	223	13	31	2
Orphan-Biologic	104	6	21	0
Comparable Molecules in the Market				
0	193	11	2	4
1–2	521	30	22	22
3–4	401	23	38	49
>4	427	25	29	14
Missing	180	10	8	10
Facing Generic/Biosimilar Competition				
Yes	671	39	32	81
No	1051	61	68	19
Top 50 Markets by Share of Sales				
Top 50	168	10	16	70
>50	1554	90	84	30
Time Since Launch				
>10 Years	1218	71	41	79
5–10 Years	294	17	36	17
0–5 Years	210	12	23	3

Abbreviations: WHO ATC = World Health Organization Anatomical Therapeutic Chemical. Notes: A complete list of market counts for each WHO ATC 1st level classes are available in Supplemental Material - Table S2.

under FDA designation (79%). Supplemental Material - Table S1 presents the number of markets in each of the OECD member countries with counts ranging from 618 in Colombia to 2,899 in Japan. For bilateral price comparisons, a market had to be present in both Canada and the comparator country (Supplemental Material - Figure S2).

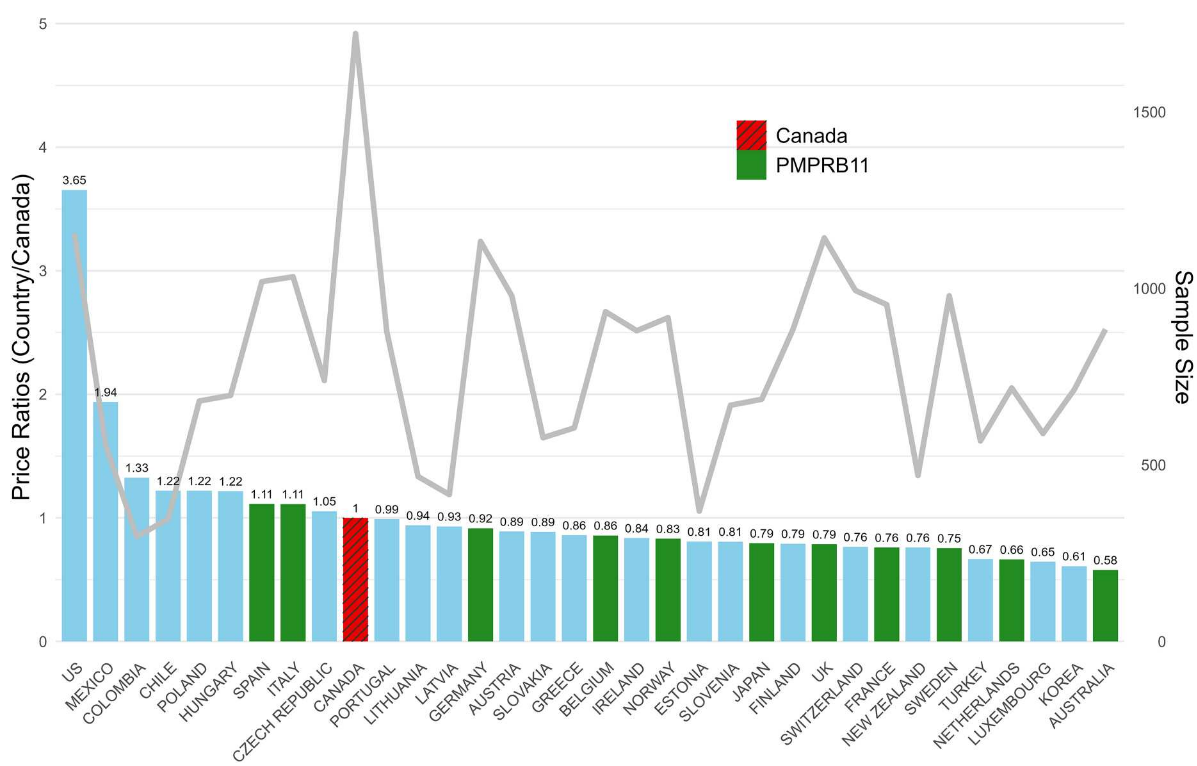

Figure 1. Bilateral price ratios between Canada and 33 OECD countries.

Notes: The grey line represents the shared market size eligible for the bilateral price ratio calculation as noted on the secondary Y-axis.

Figure 1 shows overall bilateral price comparisons following PPP adjustment. Canada ranked as having the 10th highest prices among the OECD member countries. In order from highest to lowest, the countries with higher prices and their price ratios were the US (3.65), Mexico (1.94), Colombia (1.33), Chile (1.22), Poland (1.22), Hungary (1.22), Spain (1.11), Italy (1.11), and Czech Republic (1.05). Table 2 presents the overall ranking of the countries according to the price ratios, alongside the rankings in the subgroups reported in the subsequent sections.

Bilateral price comparisons in the hospital and retail sectors

We then examined Canada's ranking in the hospital and retail sectors separately. Figure 2 shows bilateral price comparisons stratified by market sector. Among patented medicines sold in the retail sector, Canada's prices were higher than most OECD member countries, ranking 7th (Figure 2(B)). In contrast, Canadian prices in the hospital sector ranked 17th (Figure 2(A)). Ratios ranged from 1.07 in Ireland to 1.96 in the US among the comparators with higher prices, and they ranged from 0.66 in South Korea to 0.99 in Sweden among the comparators with lower prices (Figure 2(A)). Comparisons could not be made for 7 countries due to no data being available for hospital sales. The hospital sector price ratio between the US and Canada was also notably closer to 1, compared to the overall ratio for all markets described above (1.96 vs 3.65). The reduction in price ratio was driven predominantly by differences in *unit prices* (Supplemental Material - Text S1).

Bilateral price comparisons by other market characteristics

Canadian price rankings varied across ATC groups, ranging from 15th among OECD countries for antineoplastic and immunomodulating agents to 5th for the alimentary tract and metabolism agents (Supplemental Material - Figure S3).

Supplemental Material - Figure S4 shows price ratios by orphan and biologic status. Orphan patented medicines were relatively lower priced in Canada compared to other OECD countries regardless of

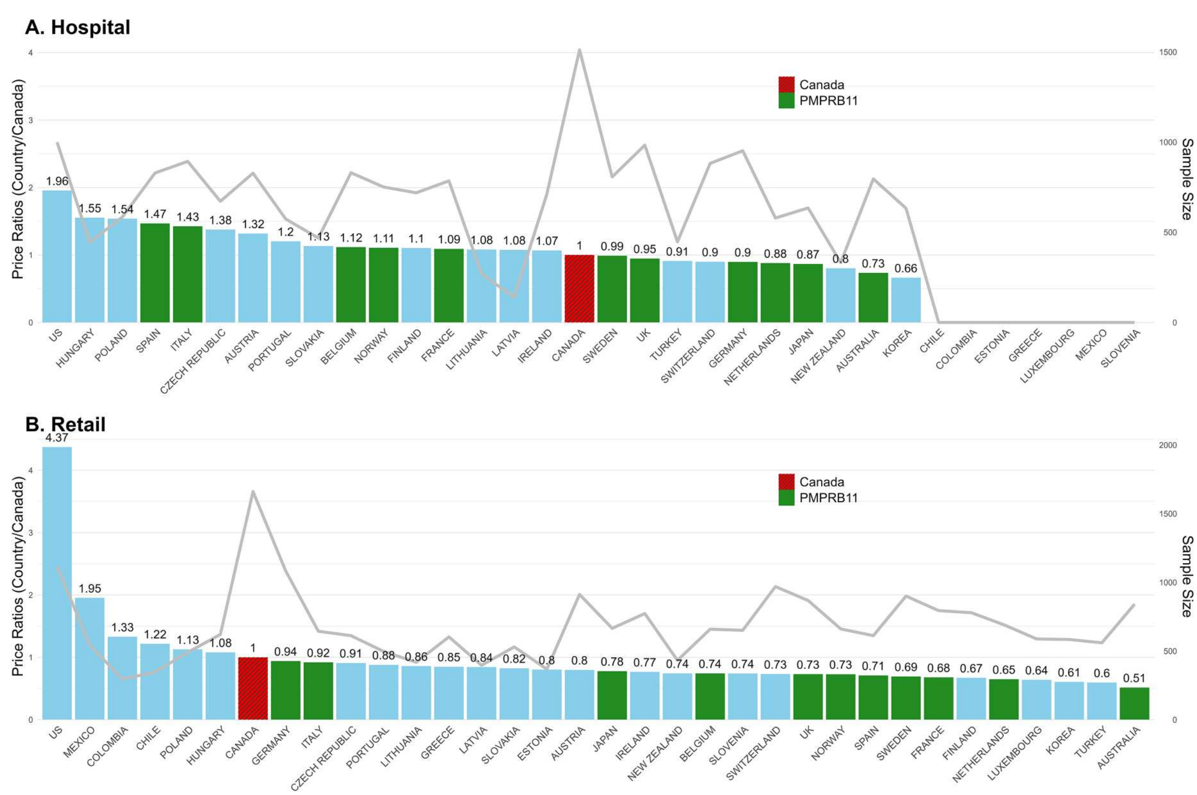

Figure 2. Bilateral price ratios between Canada and 33 OECD countries by sector.

Notes: The grey line represents the shared market size eligible for the bilateral price ratio calculation as noted on the secondary Y-axis. Hospital and retail sector categories were defined within the IQVIA MIDAS dataset.

Table 2. Rankings of each country in the 34 Organisation for Economic Co-operation and Development countries.

		Sector		WHO ATC Level 1				Orphan-Biologic Status			
Country	Overall	Hospital*	Retail	N	L	A	Others	Orphan-Non-Biologic	Neither Orphan nor Biologic	Non-Orphan but Biologic	Orphan-Biologic
CANADA	**10**	**17**	**7**	**12**	**15**	**5**	**7**	**13**	**6**	**9**	**16**
AUSTRALIA	34	26	34	33	33	34	32	33	32	34	34
AUSTRIA	15	7	17	14	13	22	19	16	21	19	10
BELGIUM	18	10	21	15	16	19	23	11	19	20	18
CHILE	4	NA	4	4	9	4	4	8	5	3	12
COLOMBIA	3	NA	3	5	6	3	3	24	3	4	3
CZECH REPUBLIC	9	6	10	9	8	11	11	7	13	11	6
ESTONIA	21	NA	16	3	27	20	25	28	16	18	31
FINLAND	24	12	29	21	22	33	20	15	26	28	15
FRANCE	27	13	28	30	24	30	27	23	29	29	21
GERMANY	14	22	8	10	17	16	13	12	10	12	23
GREECE	17	NA	13	28	18	10	16	14	15	13	27
HUNGARY	6	2	6	7	3	7	6	5	7	5	4
IRELAND	19	16	19	24	20	23	18	19	20	21	19
ITALY	8	5	9	8	7	9	8	4	8	8	7
JAPAN	23	24	18	13	29	24	15	18	12	27	30
KOREA	33	27	32	32	34	29	33	32	33	32	33
LATVIA	13	15	14	18	12	14	14	30	17	14	9
LITHUANIA	12	14	12	22	11	15	10	17	9	16	11
LUXEMBOURG	32	NA	31	31	31	32	31	34	31	31	32
MEXICO	2	NA	2	2	2	2	2	2	2	2	2
NETHERLANDS	31	23	30	25	30	27	29	31	27	33	28
NEW ZEALAND	28	25	20	29	25	21	30	26	30	22	25
NORWAY	20	11	25	27	19	17	22	20	25	17	17
POLAND	5	3	5	6	5	6	5	6	4	7	5
PORTUGAL	11	8	11	11	10	8	12	9	11	10	13
SLOVAKIA	16	9	15	26	14	13	17	10	18	15	14
SLOVENIA	22	NA	22	19	21	25	21	22	23	24	20
SPAIN	7	4	26	16	4	12	9	3	14	6	8
SWEDEN	29	18	27	23	26	26	28	29	28	23	22
SWITZERLAND	26	21	23	17	28	28	26	25	24	26	26
TURKEY	30	20	33	34	32	18	34	27	34	30	29
UK	25	19	24	20	23	31	24	21	22	25	24
US	1	1	1	1	1	1	1	1	1	1	1

	Comparable Molecules in the Market					Generic/ Biosimilar Competition		Top 50 Markets		Time Since Launch (in Years)		
Country	0	1–2	3–4	>4	Missing	Yes	No	Top 50	>50	0–5	5–10	>10
CANADA	**5**	**11**	**8**	**16**	**7**	**17**	**11**	**6**	**11**	**11**	**15**	**8**
AUSTRALIA	25	32	34	33	18	34	33	33	34	34	33	33
AUSTRIA	12	15	15	14	28	20	14	18	14	17	13	17
BELGIUM	23	18	19	17	16	22	15	19	18	13	16	25
CHILE	3	9	3	6	14	3	7	5	5	4	9	4
COLOMBIA	4	4	4	2	29	2	3	3	3	3	10	3
CZECH REPUBLIC	13	8	10	9	12	18	9	15	9	10	8	11
ESTONIA	7	29	17	19	32	11	26	13	24	30	31	10
FINLAND	32	28	25	22	8	31	23	28	21	21	22	28
FRANCE	28	23	30	26	20	29	25	31	26	24	23	29
GERMANY	15	12	18	11	27	15	16	7	16	23	21	7
GREECE	17	13	14	23	11	8	18	16	17	12	17	18
HUNGARY	6	7	6	4	4	5	5	8	4	5	5	5
IRELAND	20	24	21	20	6	23	20	23	20	18	18	22
ITALY	14	6	7	8	10	6	8	9	8	6	6	9
JAPAN	9	16	23	28	5	13	24	10	27	27	25	19
KOREA	19	33	32	34	34	7	34	32	33	28	34	32
LATVIA	21	14	12	12	30	14	13	14	13	15	12	13
LITHUANIA	11	21	13	10	22	21	12	11	12	22	7	15
LUXEMBOURG	33	31	33	32	33	25	32	29	32	32	32	30
MEXICO	2	2	2	3	3	1	2	2	2	2	2	2
NETHERLANDS	34	30	31	31	21	30	31	26	31	31	30	31
NEW ZEALAND	26	19	26	29	23	28	29	30	25	33	28	20
NORWAY	22	20	20	18	26	16	19	27	19	14	20	23
POLAND	8	3	5	7	2	9	4	4	6	9	3	6
PORTUGAL	18	10	9	13	25	19	10	12	10	8	11	14
SLOVAKIA	16	17	16	15	17	24	17	17	15	16	14	16
SLOVENIA	24	22	29	21	13	27	21	21	22	26	19	24

(*Continued*)

Table 2. Continued.

Country	Comparable Molecules in the Market					Generic/ Biosimilar Competition		Top 50 Markets		Time Since Launch (in Years)		
	0	1–2	3–4	>4	Missing	Yes	No	Top 50	>50	0–5	5–10	>10
SPAIN	10	5	11	5	9	12	6	20	7	7	4	12
SWEDEN	30	27	27	25	31	32	28	25	29	29	27	26
SWITZERLAND	27	26	22	27	19	10	27	22	28	25	29	21
TURKEY	29	34	28	30	24	33	30	34	30	20	26	34
UK	31	25	24	24	15	26	22	24	23	19	24	27
US	1	1	1	1	1	4	1	1	1	1	1	1

* Chile, Columbia, Luxembourg, Mexico, Greece, Estonia, and Slovenia did not have any data for the Hospital Sector. The total number of countries to be compared 27 instead of 34.

whether the medicine was a biologic or not (Supplemental Material - Figures S4A, S4D), ranking 16th (orphan and biologic) and 13th (orphan and non-biologic), respectively.

Bilateral price comparisons stratified by the number of comparable molecules, defined as the number of molecules within the same ATC level 4 classification, showed that Canadian prices were especially high in markets with no within-class competition, with only four countries having price ratios above 1: US, Mexico, Chile, and Colombia (Supplemental Material - Figure S5A). In contrast, among markets with high within-class competition (over 4 comparable molecules), 15 countries had price ratios exceeding 1 (Supplemental Material - Figure S5D).

When we stratified the markets by the presence of generic or biosimilar competition, Canadian prices were relatively lower in markets with such competition, with Canada ranking 17th (Supplemental Material - Figure S6A). A notable drop in the price ratio for markets with such competition was also observed for the US.

Price ratios stratified by market size (top 50 by molecule sales volume) and market age (time since the market launch and historic price ratios at each specific year post-launch) are presented in Supplemental Material - Figures S7–S9. Notable differences were observed between the top 50 markets and those outside of the top 50 (5 versus 10 countries with price ratios >1). The number of countries with prices higher than Canada also differed by market age: there were 7 countries in markets >10 years old; 14 in 5–10-year-old markets; and 10 in markets less than 5 years old. Price ratios calculated longitudinally showed a similar trend. In the 4th year since launch, there were 15 countries with prices above Canada. This remained steady until the 7th year, where it rose to 18 countries. The number then decreased in the 8th, 9th and 10th year (17, 14 and 13 countries).

Table 3 presents an alternative ranking of each country among the PMPRB11, across all markets, sectors and subgroups. The rankings among the PMPRB11 across the different market characteristics indicated Canadian list prices were relatively high, but the patterning of Canada's rank was similar to the patterning described above.

Sensitivity analysis

Price comparisons based on exchange rates without PPP adjustment differed compared to the primary analysis (Supplemental Material - Figure S10). While Canada had the 10th highest prices in the primary analysis, price ratios calculated using IQVIA-provided USD sales showed that only two countries (the US and Mexico) had prices higher than Canada with the ratio being 4.32 (up from 3.65 in the primary analysis) and 1.25 (down from 1.94), respectively (Supplemental Material - Figure S10B). When we used the trailing market exchange rates to convert local currencies to CAD (36M FX CAD), the overall ranking and magnitude of price ratios did not differ appreciably compared to those calculated using the IQVIA-provided USD sales values (Supplemental Material - Figure S10C. Without PPP adjustment, Canada's prices also ranked higher in both the hospital and retail sectors (Supplemental Material - Figure S11).

Supplemental Material - Table S3 shows the price ratios estimated using Canada's sales volumes as weights alongside those estimated using the comparator country's sales volumes as weights. Using the comparator's sales volumes generally resulted in lower price ratios than in the primary analysis, with two exceptions (Mexico and the Netherlands). Compared with the primary analysis, findings differed qualitatively in only four comparisons. In the primary analysis, bilateral comparisons with Czech Republic, Hungary, Italy,

Table 3. Rankings of each country among the 11 countries used for reference pricing by Canada's Patented Medicine Prices Review Board.

		Sector		WHO ATC Level 1				Orphan-Biologic Status			
Country	Overall	Hospital	Retail	N	L	A	Others	Orphan-Non-Biologic	Neither Orphan nor Biologic	Non-Orphan but Biologic	Orphan-Biologic
CANADA	**3**	**6**	**1**	**3**	**3**	**1**	**1**	**5**	**1**	**3**	**3**
AUSTRALIA	12	12	12	12	12	12	12	12	12	12	12
BELGIUM	5	3	5	5	4	6	7	3	6	6	5
FRANCE	9	5	10	11	8	10	9	9	11	10	6
GERMANY	4	9	2	2	5	4	4	4	3	4	8
ITALY	2	2	3	1	2	2	2	2	2	2	1
JAPAN	7	11	4	4	10	7	5	6	4	9	11
NETHERLANDS	11	10	11	9	11	9	11	11	9	11	10
NORWAY	6	4	7	10	6	5	6	7	8	5	4
SPAIN	1	1	8	6	1	3	3	1	5	1	2
SWEDEN	10	7	9	8	9	8	10	10	10	7	7
UK	8	8	6	7	7	11	8	8	7	8	9

	Comparable Molecules in the Market					Generic/ Biosimilar Competition		Top 50 Markets		Time Since Launch (in Years)		
Country	0	1–2	3–4	>4	Missing	Yes	No	Top 50	>50	0–5	5–10	>10
CANADA	**1**	**3**	**2**	**2**	**4**	**6**	**3**	**1**	**3**	**3**	**3**	**2**
AUSTRALIA	8	12	12	7	12	12	12	12	12	12	12	12
BELGIUM	7	6	5	6	5	7	4	5	5	4	4	7
FRANCE	9	8	10	8	9	9	9	11	8	8	7	10
GERMANY	5	4	4	11	3	4	5	2	4	7	6	1
ITALY	4	2	1	4	2	1	2	3	2	1	2	3
JAPAN	2	5	7	1	10	3	8	4	9	9	9	5
NETHERLANDS	12	11	11	9	11	10	11	9	11	11	11	11
NORWAY	6	7	6	10	6	5	6	10	6	5	5	6
SPAIN	3	1	3	3	1	2	1	6	1	2	1	4
SWEDEN	10	10	9	12	8	11	10	8	10	10	10	8
UK	11	9	8	5	7	8	7	7	7	6	8	9

and Spain indicated these countries had relatively higher prices compared to Canada (ratios >1); whereas, these countries had relatively lower prices compared to Canada when price ratios were weighted using their own sales volumes instead of Canada's.

In our final sensitivity analysis, we repeated the primary analysis using each of the 11 countries (PMPRB11) as the reference instead of Canada. Supplemental Material - Figure S12 and Supplemental Material - Table S4 show how each country's relative ranking varies across the 12 sets of price ratios (including the primary analysis). Canada's rank tended to be higher (i.e. prices were relatively higher) from the perspective of the other reference countries, varying from rank 10 (Japan as reference) to rank 3 (Australia as reference) with a median rank of 6.

Discussion

In the present descriptive analysis, we found that the prices of patented medicines in Canada are comparatively high across the OECD countries but they vary with the price adjustment methods and across different market segments. Canada ranked 10th highest out of the 34 OECD member countries based on price ratios calculated using the PPP adjustment method. Canadian prices were relatively lower for patented medicines used in hospital settings (rank 17), for antineoplastic and immunomodulating agents and nervous system agents (rank 15 and 12, respectively), and for FDA-designated orphan biologics (rank 16) and non-biologics (rank 13). Canadian prices tended to rank higher in markets with no within-class competition (rank 5), top selling markets (rank 6), and more mature markets (rank 8 for markets >10 years old) compared to the overall rankings.

In its 2023 report, the PMPRB found that Canada had the 4th highest price across 31 OECD member countries, behind the US (ratio = 3.65 vs. 4.32 in our analysis), Mexico (1.10 vs. 1.25), and Switzerland (1.06 vs. 0.96) using the prices reported in the IQVIA MIDAS database which corresponds to our IQVIA-USD method (Patented Medicine Prices Review Board, 2024b). We used the same year of data and also weighted our price ratios by Canadian sales volume. The differences in price ratios and ranking may be because the PMPRB used their own list of patented medicines that reported sales to the PMPRB and the PMPRB did not include Colombia, Latvia, and Lithuania in their analysis. The PMPRB also conducted PPP-adjusted list price analysis across the PMPRB11 countries. Their analysis showed five countries had price ratios over 1 in 2023: Germany (1.06), Italy (1.28), Japan (1.13), the Netherlands (1.07), and Spain (1.32) compared to our results of (0.92), (1.11), (0.79), (0.66), and (1.11), respectively. By contrast, when prices were converted using 36M FX CAD, none of the 11 comparator countries had prices higher than Canada: Italy (0.86), Germany (0.83), Spain (0.81), the UK (0.78), Sweden (0.78), Belgium (0.77), Norway (0.74), Japan (0.70), France (0.65), Australia (0.64), and the Netherlands (0.63).

Detailed comparisons of the present findings to literature on specific segments of the patented medicine are precluded by the lack of a comparable base country, medicine list, and weighting method across studies. We therefore focused on the studies identified in a systematic review that included Canada in comparisons and their results comparing Canada with the US and/or PMPRB11 countries (Schneider & Vogler, 2019). Blankart et al. (2011) examined 16 orphan drugs across 11 countries. The authors found Canada ranked 9th in terms of prices with only the UK and Australia having lower PPP-USD retail prices. The suggestion that Canada may have comparatively lower prices for orphan drugs is somewhat corroborated by our findings in a broader list of orphan markets. A report from RAND using the IQVIA-USD method prices and US sales patterns as weights showed that the US–Canada price ratios was 3.24 for brand-name originators, but 1.55 reference biologics in 2022 (Mulcahy et al., 2024). Their findings suggested that the prices in Canada and US are closer for biologics than for all drugs, which is consistent with our findings despite different methods. We found the PPP-adjusted price ratio for orphan biologics molecules was 1.84 and for non-orphan biologics was 3.40, compared to the overall price ratio of 3.65 for all patented medicines. We also found closer price differences between Canada and the US in specific market segments, including the hospital sector (1.96), antineoplastic and immunomodulating agents (2.58), 5–10-year-old markets (2.99), and markets outside the top 50 (3.04).

In contrast, we also found a number of market subgroups in which Canada's list prices ranked higher than in the primary analysis (10th). Specifically, Canada ranked 5th in markets with no within-class competition, 6th in top-selling markets, and 8th in more mature markets. A potential driver of these relatively higher prices may be the historical approach the PMPRB used to review and determine whether new patented medicines were priced excessively in Canada (Patented Medicine Prices Review Board, 2014). To determine the price ceiling, the PMPRB employs international price referencing (IPR) and the therapeutic Class Comparison (TCC) test, which considered the new patented medicine's prices relative to the prices of comparable drug products international and domestically. In the absence of comparable products, the PMPRB could instead rely on the median international price for the new patented medicine (see Zhang, Guh, et al., 2024 for a more nuanced discussion of the policy). Until recently, the US, where a greater proportion of new medicines are launched and where prices are substantially higher, was one of the IPR countries (Mulcahy et al., 2024; Zhang, Guh, et al., 2024). As a result, the initial prices at which new patented medicines entered the Canadian market may have been influenced by these higher US prices. Because Canadian list prices tend to remain stable following introduction, these higher initial price levels would persist over time. This mechanism may explain Canada's higher rank in mature markets (Patented Medicine Prices Review Board, 2024a).

Strengths and limitations

A major strength of this descriptive analysis was the use of the most up-to-date sales data from across the OECD, which permitted a comprehensive comparison of Canada's patented medicine list prices for patented medicine markets. Additionally, we employed three different methods to calculate price ratios, including the PPP-adjustment which accounts for cross-country differences in prevailing price levels and generally offers greater stability than market exchange rates (Jung et al., 2021; Shi et al., 2010). Guidance documents on costing healthcare interventions do not appear to strongly favour one price adjustment over the other in the context of making international comparisons (Turner et al., 2019; Vassall et al., 2017), only that costs should be presented in US dollars or 'international' dollars. However, PPP is favoured by the WHO for comparative analysis (Edejer, 2003; WHO Guide for Standardization of Economic Evaluations of Immunization Programmes, n.d.).

However, several limitations should be noted. First, the analysis was based on ex-factory manufacturer list prices rather than net prices as rebates and discounts were confidential. While list prices may overestimate actual transaction prices, list prices are the mainstay in international price comparisons, external reference pricing, and price monitoring as they are more widely available and standardised (Moens et al., 2024). Second, the comprehensiveness of the comparisons varied from country to country as price ratio calculations required the presence of a market in both Canada and the comparator country. Of the 1,722 markets identified in Canada, the proportion of matches in other countries varied from 17.2% to 67.1% (Supplemental Material - Table S1). However, the markets that overlapped with other countries tended to account for a much larger share of Canadian volume and sales, ranging from 38.5% to 75.5% and 32.0% to 86.9%, respectively. For example, although only 17.2% of Canadian markets were represented in the bilateral comparison with Colombia, these markets corresponded to 38.5% of Canadian volume and 32.0% of Canadian sales. Similarly, the proportion of Canadian markets represented in comparisons with Chile and Estonia were the next lowest at around 20%, but the corresponding Canadian volume and sales were over 40%. Nonetheless, the generalizability of our findings in these comparisons remain limited given that an appreciable proportion of sales and volume were not captured and that the prices of patented medicines with larger market shares may differ from those with smaller market shares. Third, using Canadian sales volumes as weights in the price ratio reflects the utilisation pattern of medications in Canada. While this strengthens the relevance of the findings for the Canadian context, it gives less weight to molecules that are lower priced in other countries and thus used more extensively relative to Canada. This pattern was evident in our sensitivity analysis: when we used each comparator country's sales volumes as weights, most price ratios were lower. This Canadian context lays the groundwork for future research to identify the drivers of higher priced medicines in Canada, whether they stem from the availability of lower priced medicines, prescribing behaviour, or regulatory factors.

Conclusions

When adjusted for differences in price levels across countries, Canadian list prices of patented medicines may be relatively lower in certain markets such as for FDA-designated orphan medicines and medicines used in the hospital setting. On the other hand, markets with no within-class competition, those that are more mature, and markets with top sales volume were relatively higher priced in Canada compared to other countries.

Author contributions

ND, DPG, AHA, and WZ made substantial contributions to the conception of the work. ND, DPG, and WZ made substantial contributions to the design of the work. AHA, DPG, and WZ made substantial contributions to the acquisition of data. ND and DPG conducted the analysis of data. ND, DPG, ACTT, and WZ made substantial contributions to the interpretation of data. ND, DPG, and ACTT made substantial contributions to the initial drafting of the work. DPG, AHA, and WZ made substantial contributions to reviewing the initial draft critically for important intellectual content. DPG, ACTT, and WZ made substantial contributions to subsequent drafts of the work. All authors provided their final approval of the version to be published, and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Ethics statement

Ethical approval was not required for this study of routinely collected sales data.

Disclaimers

This article is based on internal analysis by the authors using IQVIA MIDAS quarterly sales data for 2012–2023, which were obtained under license from IQVIA and reflect estimates of marketplace activity. Copyright IQVIA. All rights reserved. The statements, findings, conclusions, views, and opinions contained and expressed herein are not necessarily those of IQVIA.

Data availability statement

This study was an analysis using IQVIA MIDAS quarterly sales data for 2012–2023, which were obtained under licence from IQVIA. The data cannot be publicly shared as per signed agreement. Requests for data can be sent to IQVIA Canada.

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