Patented Medicine Prices Review Board
Conseil d'examen du prix des médicaments brevetés

Canada

Analyzing Drug Shortages and Pricing: Lessons from Canada

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Conflict of interest statement and disclaimer

- S. Rizzardo, K.R. Pothier and myself are employees of the Patented Medicine Prices Review Board (PMPRB), an independent quasi-judicial agency of the Federal Government of Canada. The views expressed today are mine alone and do not represent official views of the PMPRB and the Government of Canada.
- M. Tadrous has received consulting fees from Health Canada, CADTH and Green Shield Canada.
- The results shown in this presentation are preliminary and conclusions may differ in future versions and publications.

Introduction

Context

- Well-documented that shortages are more prevalent in low-priced drugs (typically older generics)
- Role of prices, if any, is unclear from an empirical perspective

Objectives

- Investigate associations between international prices and shortages
- Answer the question: “Were Canadian shortages associated with lower prices than in other countries from FY2017 to FY2022?”

Introduction
Hypothesis to test

- Higher prices could lead to lower shortage rates in two ways:
  1. Long-term global effect: higher profitability creates an incentive for manufacturers to invest to strengthen the supply chain
  2. Short-term national effect: manufacturers could favor countries with higher prices when there are production disruptions, leading to shortages in countries with lower prices

- This study investigates the second link using foreign-to-Canadian (FTC) price ratios:
  - $\text{FTC of medicine X} = \frac{\text{Price of medicine X}_{\text{Germany}}}{\text{Price of medicine X}_{\text{Canada}}}$

- If lower Canadian prices were associated with more shortages, we should find a positive and significant correlation between FTCs and shortages

Methods
Data and approach

Data

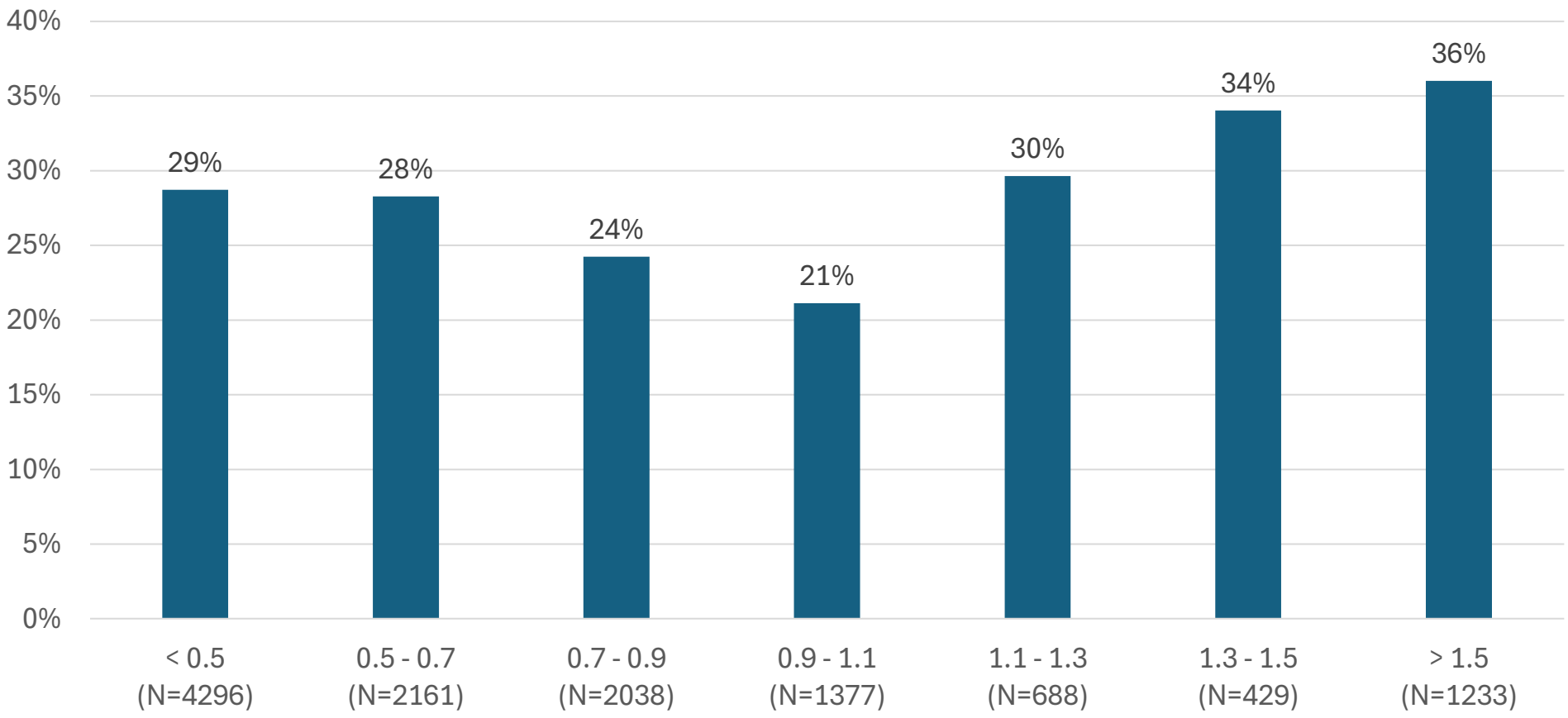
- International prices and drug characteristics were extracted from IQVIA MIDAS®
  - Canada's PMPRB11 comparator countries: SWE, AUS, NLD, BEL, ESP, DEU, GBR, NOR, ITA, FRA, JPN
  - USA
- Data were matched with drug shortages data from www.drugshortagescanada.ca
  - Mandatory industry self-reports
- Oral solid prescription drugs defined at the ingredient-strength-form-manufacturer level
- Fiscal years (April to March) 2017 to 2022
- N = 12,097 drug-year observations with price comparisons included

Approach

- Conduct multivariate fixed-effect logistic regression at the drug-year level
  - Dependent variable: drug reported in « actual shortage » during the year in Canada
- Determine whether FTCs are significantly associated with shortages

Results

Unadjusted shortage rates vs. foreign-to-Canadian price ratio (FTC)



Results

Sample characteristics by foreign-to-Canadian price ratio (FTC)

	FTC < 0.9 (high Canadian prices) N=8,495	0.9 ≤ FTC ≤1.1 (aligned prices) N=1,377	FTC > 1 .1 (low Canadian prices) N=2,350
Generic, %	52%	46%	74%
Canadian manufacturers selling the ingredient, n (SD)	8.7 (6.4)	6.4 (6.4)	9.0 (6.2)
Canadian market size, USD Millions (SD)	10.3 (33.0)	12.6 (33.8)	8.1 (23.2)
Countries with sales, n (SD)	5.1 (3.4)	6.2 (3.4)	4.4 (2.9)

Results

Adjusted odds ratios and significance tests

	N	% in shortage	OR	95% CI	
FTC bin					
< 0.5	4,296	29%	1.06	0.90	1.25
0.5 - 0.7	2,161	28%	1.13	0.95	1.35
0.7 - 0.9	2,038	24%	1.16	0.96	1.39
0.9 - 1.1	1,377	21%	1	[Reference]	
1.1 - 1.3	688	30%	1.24	0.98	1.56
1.3 - 1.5	429	34%	1.26	0.97	1.64
> 1.5	1,233	36%	**1.32**	**1.09**	**1.60**
Generic status					
Brand	5,292	11%	1	[Reference]	
Generic	6,805	41%	**3.419**	**3.02**	**3.88**
Year					
2017	2,193	24%	1	[Reference]	
2018	2,156	30%	**1.38**	**1.19**	**1.60**
2019	2,049	28%	**1.26**	**1.09**	**1.47**
2020	1,987	32%	**1.61**	**1.39**	**1.87**
2021	1,922	25%	1.12	0.96	1.31
2022	1,915	29%	**1.46**	**1.25**	**1.70**
Market size					
Less than USD 125K	1,902	22%	1	[Reference]	
USD 125K - 825K	2,750	20%	1.07	0.92	1.25
USD 825K - 4.25M	3,471	28%	**1.60**	**1.39**	**1.84**
More than USD 4.25M	4,099	36%	**2.59**	**2.26**	**2.97**
PMPRB11 countries with sales					
1	2,660	40%	1	[Reference]	
2-5	4,024	32%	**0.86**	**0.77**	**0.96**
6+	5,538	20%	**0.66**	**0.59**	**0.74**
Single-source generic in Canada					
No	11,896	28%	1	[Reference]	
Yes	326	19%	**3.022**	**1.04**	**8.79**
Manufacturers					
1	2,332	8%	**0.28**	**0.10**	**0.78**
2-5	4,541	36%	0.96	0.85	1.08
6-10	2,884	25%	**1.13**	**1.01**	**1.27**
11+	2,465	36%	1	[Reference]	
Int'l generic availability					
No	2,097	6%	1.26	0.46	3.45
Yes	10,125	33%	1	[Reference]	
12 therapeutic classes (ATC1) omitted from the table					

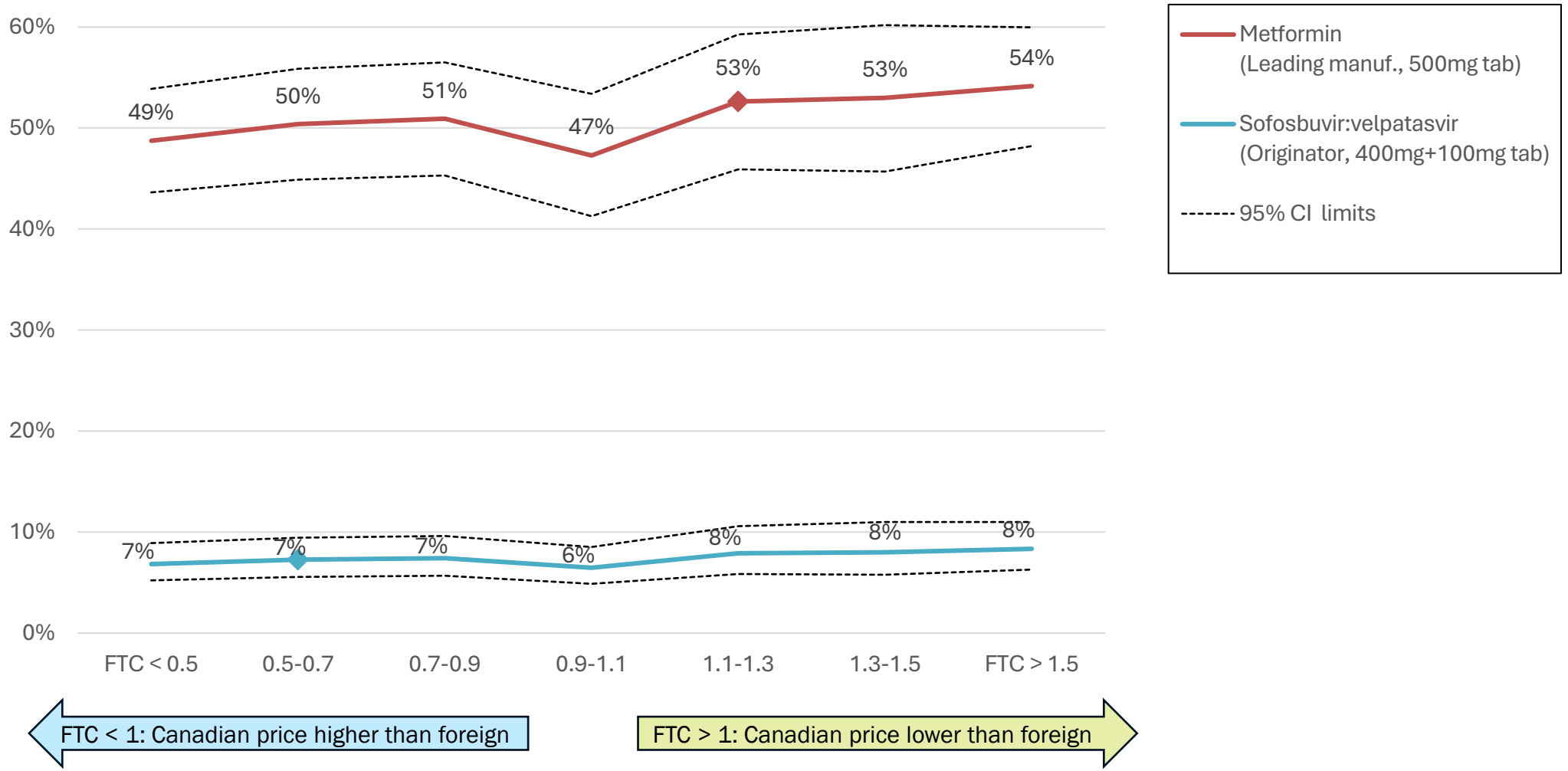
	Chi-square	p
FTC bin	12.6	0.0495
Generic status	370.1	<.0001
Therapeutic class (ATC1)	126.9	<.0001
Year	52.1	<.0001
Market size	287.5	<.0001
Countries with sales	49.7	<.0001
Single source status	4.1	0.042
Manufacturers	13.3	0.004
Int'l generic status	0.2	0.652

- A drug priced 50% higher in comparator countries than in Canada (FTC > 1.5) had an odds ratio of 1.32 of being in shortage in a given year relative to a drug for which the Canadian price was close to the international median (FTC between 0.9 and 1.1)

- A significance test for the FTC variable as a whole found it to be statistically significant (p=0.0495)

Results

Predicted probability of shortage vs FTC: case studies



Results

Only patented medicines (no intl. generics available)

	N	% in shortage	OR	95% CI	
FTC bin					
< 0.8	881	9%	**1.75**	**1.09**	**2.82**
0.8 - 1.2	903	3%	1	[Reference]	
> 1.2	192	4%	1.09	0.48	2.46
Year					
2017	356	4%	1	[Reference]	
2018	338	6%	1.95	0.94	4.06
2019	324	6%	2.06	0.99	4.29
2020	325	7%	**2.25**	**1.09**	**4.64**
2021	319	6%	1.92	0.91	4.07
2022	314	5%	1.55	0.71	3.38
Market size					
Less than USD 125K	237	6%	1	[Reference]	
USD 125K - 825K	388	6%	0.91	0.45	1.83
USD 825K - 4.25M	542	6%	1.24	0.64	2.44
More than USD 4.25M	809	5%	1.09	0.55	2.15
PMPRB11 countries with sales					
1	141	19%	1	[Reference]	
2-5	403	9%	**0.41**	**0.23**	**0.73**
6+	1,432	3%	**0.17**	**0.10**	**0.29**
6 therapeutic classes (ATC1) omitted from the table					

	Chi-square	p
FTC bin	5.9	0.053
Therapeutic class (ATC1)	26.7	0.000
Year	5.9	0.318
Countries with sales	39.9	<.0001
Int'l generic status	1.2	0.748

- A patented drug priced higher in Canada than in comparator countries (FTC < 0.8) had **greater odds** of being in shortage in a given year than one for which the Canadian price was close to the international median (FTC between 0.8 and 1.2)
- A significance test for the FTC variable as a whole did not find it to be statistically significant (p=0.0528)

Discussion

- The overall evidence does not show a strong relationship between drug prices and shortages
  - Does not support the hypothesis of higher drug prices decreasing the probability of a drug being in shortage

- The analysis is still preliminary. Next steps:
  - Conduct regressions with US prices
  - Add variables to the specification (drug age, flags for top manufacturers)
  - Add a year of data

- Key limitation: the analysis is observational
  - Causal methods should be used when feasible, but would require natural experiment
  - List prices were used to compute FTCs

National Prescription Drug Utilization Information System Research Initiative

THANK YOU

Appendix: Data retention and analytic sample