

## A PRACTICAL METHODOLOGY FOR DISAGGREGATING THE DRIVERS OF DRUG COSTS USING ADMINISTRATIVE DATA

Elena R. Lungu, Orlando J. Manti, Mitchell A.H. Levine, Douglas A. Clark, Tanya M. Potashnik, Carol I. McKinley

Patented Medicine Prices Review Board, Ottawa, ON

**Corresponding Author:** [elena.lungu@pmprb-cepmb.gc.ca](mailto:elena.lungu@pmprb-cepmb.gc.ca)

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### ABSTRACT

#### Background

Prescription drug expenditures represent a significant component of health care costs in Canada, with estimates of \$28.8 billion spent in 2014. Identifying the major cost drivers and the effect they have on prescription drug expenditures allows policy makers and researchers to interpret current cost pressures and anticipate future expenditure levels.

#### Objectives

To identify the major drivers of prescription drug costs and to develop a methodology to disaggregate the impact of each of the individual drivers.

#### Methods

The methodology proposed in this study uses the Laspeyres approach for cost decomposition. This approach isolates the effect of the change in a specific factor (e.g., price) by holding the other factor(s) (e.g., quantity) constant at the base-period value. The Laspeyres approach is expanded to a multi-factorial framework to isolate and quantify several factors that drive prescription drug cost. Three broad categories of effects are considered: volume, price and drug-mix effects. For each category, important sub-effects are quantified.

#### Results

This study presents a new and comprehensive methodology for decomposing the change in prescription drug costs over time including step-by-step demonstrations of how the formulas were derived.

#### Conclusions

This methodology has practical applications for health policy decision makers and can aid researchers in conducting cost driver analyses. The methodology can be adjusted depending on the purpose and analytical depth of the research and data availability.

**Key Words:** *cost driver analysis, drug costs, prescription drugs, health policy, health care costs*

Prescription drug expenditures represent a significant component of health care costs in Canada, with estimates of \$28.8 billion spent in 2014.<sup>1</sup> After several years of double-digit growth, the rates of change in these expenditures have gradually declined in recent years.

Changes in prescription drug expenditures are driven by many factors, such as the size and the age of the population, the volume and the type of drugs being used, and drug price levels. A change in any one

of these factors becomes a cost driver. For example, while the recent decline in the rate of expenditures has mainly been driven by the launch of generic products and generic price reforms, expensive emerging therapies, as well as increases in the volume of drug use, are expected to continue to fuel the upward pressures on costs.

This study provides the tools required for a complete analysis of the drivers of prescription drug cost, which represents the largest component of overall drug

expenditures, by developing the methodology and formulas required to decompose costs and conduct cost driver analyses.

Previous studies have discussed the factors contributing to the growth in health care costs<sup>2,3</sup> and, more specifically, to the growth in drug costs.<sup>4-8</sup> This report builds on this published work along with several Patented Medicine Prices Review reports.<sup>9-11</sup>

## METHODS

The methodology proposed in this report expands the Laspeyres cost-decomposition approach to a multi-factorial framework to isolate and quantify the factors that drive prescription drug cost. Three broad categories of effects are considered: volume, price and drug-mix effects. For each category, important sub-effects are quantified.

### DATA REQUIREMENTS

Administrative database information on drugs shipped, sold, dispensed and/or reimbursed in Canada can be used to tease out drug cost drivers. This includes private and public drug plan data, pharmacy sales data, drug shipment data, and hospital data. Many of the databases also contain the Drug Identification Number (DIN) issued by Health Canada. If the DIN is available, data can be linked across databases and to the Health Canada Drug Product Database (DPD). The DPD contains very detailed product-specific information on drugs approved for use in Canada including the trade name, molecule/ingredient name, strength, form, packaging, manufacturer, and therapeutic classification.

To conduct cost driver analyses, the following basic data elements are required for each of the 2 time periods being compared: (i) information on the individual drugs; (ii) the quantity and corresponding market shares of individual drugs; and (iii) corresponding drug costs or prices. The methodology proposed in this study requires the drug information at the following level: molecule/ingredient name, strength, form and brand-generic flag.

Drug quantity can be measured in various ways: the number of prescriptions, physical units or treatment days. The number of prescriptions has the advantage of being cumulative across drugs, but conceals the true

volume of the physical units (prescription size) as well as the unitary price/cost of the drugs (price of drugs). Therefore, although it has been used as a standalone measure of quantity in cost driver analyses, the number of prescriptions is generally used in conjunction with the number of physical units. The number of physical units identifies the price/cost at a unit level as well as the average number of units per prescription. Without information on the number of prescriptions, physical units may be used as a standalone measure of quantity. The number of treatment days (or day supply) may be available in some administrative databases and can be employed in the cost decomposition methodology to include a treatment intensity or length component. However, the reliability and consistency of the reporting of this data needs to be assessed before it is used. The World Health Organization Defined Daily Dose (DDD) has also been used to decompose drug spending increases.<sup>7</sup> However, previous studies have advised using caution when interpreting the average cost or price at the DDD level.<sup>12</sup>

Price or cost can include various measures of prescription drug sales or costs: drug prices at various sale points (manufacturer, wholesaler, pharmacy) or drug costs reimbursed by drug plans. These may reflect wholesale upcharges and pharmacy mark-ups.

### BASIC COST DECOMPOSITION

The Laspeyres approach decomposes cost into 2 determinants or factors: price and quantity. The basic underlying principle is applicable to many areas of economic analysis, and there is extensive literature on price and quantity indexes and how expenditure can be divided into a price and a quantity component.<sup>13-15</sup>

By comparing 2 time periods, the Laspeyres approach isolates the effect of the change in a specific factor (e.g., price) by holding the other factor (e.g., quantity) constant at the base-period value. The many factors that drive prescription drug expenditure can be isolated and quantified by expanding this approach to a multi-factorial framework.

The basic decomposition assumes some monetary variable  $X$  (e.g., drug expenditure) is the product of a price  $P$  and the measure of physical quantity  $Q$ . In algebraic terms:

$$(1) X = PQ$$

Then suppose that we have observations of X, P and Q for 2 periods, a current period (denoted by the index number “1”) and a base period (denoted by the index number “0”). It follows from (1) that:

$$(2.1) X(0) = P(0)Q(0)$$

$$(2.2) X(1) = P(1)Q(1)$$

Suppose, finally, that we are interested in knowing what part of the change in X that occurred between the base period and current period can be attributed to each of P and Q. One approach begins by noting that current-period price (or quantity) equals its base-period counterpart plus the change in price (or quantity) that occurred between the 2 periods:

$$(3.1) P(1) = P(0) + [P(1) - P(0)]$$

$$(3.2) Q(1) = Q(0) + [Q(1) - Q(0)]$$

Substituting (3.1) and (3.2) into (2.2) gives:

$$(4) X(1) = \{P(0) + [P(1) - P(0)]\} \{Q(0) + [Q(1) - Q(0)]\}$$

Expanding the right-hand side of (4) gives:

$$(5) X(1) = P(0)Q(0) + [P(1) - P(0)]Q(0) + P(0)[Q(1) - Q(0)] + [P(1) - P(0)][Q(1) - Q(0)]$$

Subtracting X(0) from both sides of (5) while noting (2.1) gives:

$$(6) X(1) - X(0) = [P(1) - P(0)]Q(0) \text{ (Price Effect)} + P(0)[Q(1) - Q(0)] \text{ (Quantity Effect)} + [P(1) - P(0)][Q(1) - Q(0)] \text{ (Cross Effect)}$$

The 3 terms on the right-hand side of (6) constitute the decomposition of cost change. The first term on the right-hand side of (6) is referred to as the price effect and is a Laspeyres type of price index expressed as a difference rather than in a ratio form. This measures the impact on X of the change in price that occurred between the base period and current period, with the impact evaluated at the base-period quantity Q(0). It employs a forward-looking approach by providing an exact answer to the question:

How much would X have changed between the base period and the current period had price changed but not quantity?

or in simpler terms

How much higher is the expenditure this year simply because of higher prices?

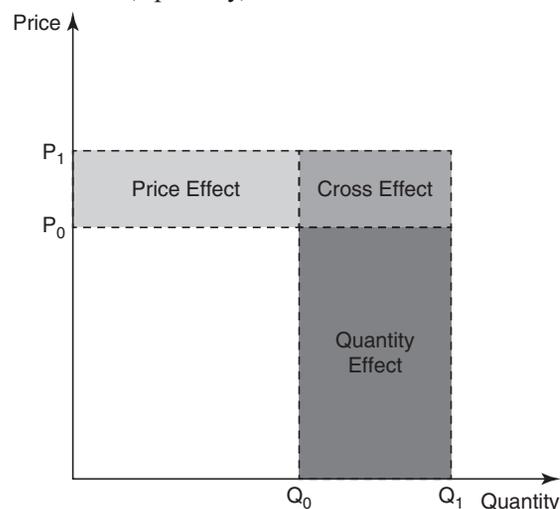
The second term on the right-hand side of (6) is referred to as the quantity effect and it is a Laspeyres type of quantity index expressed as a difference rather than in a ratio form. This measures the impact on X of the change in quantity that occurred between the base period and the current period, with the impact evaluated at the base-period price P(0). It employs a forward-looking approach by providing an exact answer to the question:

How much would X have changed between the base period and the current period had quantity changed but not price?

The third term on the right-hand side of (6) has a different form than the price and quantity effects, in that it involves changes in both P and Q. This is usually called the “Laspeyres cross effect” and measures the impact on X of the interaction between the change in price and the change in quantity. The cross effect is distinct from the price and quantity effects and must be included if the decomposition is to fully account for the change in X.

Figure 1 illustrates the price, quantity, and cross effects. In the base period, with price at P(0) and quantity at Q(0), expenditure is represented by the white rectangle. The price rises from P(0) to P(1) and quantity from Q(0) to Q(1) in the current period. The corresponding increase in X is represented by the coloured areas. The green rectangle represents the price effect [i.e., the impact on X of

FIG. 1 Price, quantity, and cross effects.



the change in price evaluated at  $Q(0)$ ). The purple rectangle represents the quantity effect (i.e., the impact on  $X$  of the change in quantity evaluated at  $P(0)$ ). The orange rectangle, with the base  $[Q(1) - Q(0)]$  and the height  $[P(1) - P(0)]$ , completes the expenditure change area. This last rectangle represents the cross effect (i.e., the impact on  $X$  of the interaction between the change in prices and the change in quantity).

The Laspeyres decomposition discussed above describes the simple case of one product for which the expenditure is a function of 2 factors: price and quantity. Real-world cost driver analyses typically encompass many products for which the drug expenditure is a function of multiple factors. In a complex multi-factorial cost decomposition methodology, such as the one proposed in this study, there will be a large number of interactions between the individual factors, corresponding to double, triple, quadruple, etc. cross effects. In this case, the total change in expenditure that is left unexplained due to the cross effects will be reported separately.

Note that while this study proposes an approach based on the Laspeyres decomposition, there are other valid approaches that may be employed in cost driver analyses, such as the Paasche or the Fisher ideal indices. These price and quantity indices have their own limitations, and the choice of approach should depend on the focus of the research as well as the proposed application of the results.

## RESULTS

The drivers of drug costs may be grouped into 3 broad categories: Price Effects, Volume Effects and Drug-Mix Effects. Each effect captures the impact of a change in a specific factor. Demographic Effects including changes in the size of the population and the age and gender distribution also play a role and will be discussed in future articles. A description of the individual effects follows.

### *Price Effects*

#### **1. Price Change Effect**

This effect captures the impact of changes in drug prices and is determined at the strength, form, and brand-name or generic level. For instance, the recent

generic price reforms that resulted in lower generic prices have a negative price change effect on drug costs.

#### **2. Generic Substitution Effect**

This effect captures the impact of shifting utilization from higher cost brand-name products to lower cost generic products. This effect is expected to have negative values when generic products are launched.

### *Volume Effects*

#### **3. Prescription Volume Effect**

This effect captures the impact of changes in the number of prescriptions dispensed to a standardized patient population over the 2 time periods analyzed. There are many factors that may influence this effect, including the increased use of multiple drugs, the presence of comorbidities, and the persistency of treatment and prescribing practices, among other things. Moreover, in the absence of demographic information, the Prescription Volume Effect also captures the aging of the population and changes in the gender split, as well as changes in the size of the population using the drugs.

#### **4. Prescription Size Effect**

This effect captures the impact of changes in the average number of units of a drug dispensed per prescription. An increase in this measure contributes positively to the increase in drug costs, unless it is offset by a reduction in the number of prescriptions (i.e., Prescription Volume Effect).

#### **5. Strength–Form Effect**

This effect captures the impact of shifting utilization toward different strengths or formulations of a molecule (active ingredient). Drugs are typically available in a variety of strength–form combinations for which the cost per unit can vary substantially. An increase in the use of the higher strength of drugs could contribute positively to the drug cost growth, as, generally, higher strengths are more expensive than the lower strengths.

### *Drug-Mix Effects*

#### **6. Existing Drug Effect**

This effect captures the impact of shifts in market shares between molecules (active ingredients) that are available in both time periods analyzed. This important driver may reflect changing treatment patterns,

physician prescribing practices and/or the prevalence of diseases in the population. This effect captures switching between drugs, as well as the shifts in market shares among the various therapeutic classes and subclasses. The proposed methodology can differentiate between these components by further decomposing this effect into therapeutic class and subclass level, as detailed in Section 5 of this report.

### 7. Exiting Drug Effect

This effect captures the impact of shifts in utilization away from drugs that are no longer utilized in the second time period. Its contribution is expected to be minimal, unless important drugs are withdrawn (e.g., Vioxx).

### 8. Entering Drug Effect

This effect captures the impact of shifts in utilization toward drugs that have entered the market in the second time period. With new drugs constantly being launched, this may be an important cost driver. Less expensive new drugs will offer savings and more expensive new drugs will result in cost increases. The value of this driver will represent the net effect of these 2 opposing forces.

While these effects account for the changes in drug cost, they may be influenced by factors that are not easily measured. These include disease prevalence, prescribing practices and socio-economic factors.

The metrics are aggregated at the attribute level, as opposed to the DIN level, to eliminate unnecessary

detail, such as packaging sizes and manufacturer information.

In addition, all molecules need to be assigned an existing–exiting–entering status based on whether they were utilized in both the time periods compared:

- Existing Drugs – molecules were utilized in both periods.
- Exiting Drugs – molecules were utilized in the first period but not in the second period.
- Entering Drugs – molecules were not utilized in the first period but were utilized in the second period.

Grouping the molecules by existing–exiting–entering status should be based on their actual utilization as observed in the data, as opposed to the Notice of Compliance date, launch date, formulary date or any other date.

Note that in the context of this analysis, a *product* refers to any unique combination of the following attributes: strength–form combination (*s*), brand–generic flag (*b*), molecule (*m*), and existing–exiting–entering status (*e*).

The drug costs or sales for a multi-product market in a given time period can be written as the product of the average cost per unit, average number of units per prescription, and the number of prescriptions for a product, summed up over all products:

$$(7) X(t) = \sum_{i_{s,b,m,e}} AC(i_{s,b,m,e},t) \times AU(i_{s,b,m,e},t) \times q(i_{s,b,m,e},t)$$

Where

$i_{s,b,m,e}$  is a product of a certain strength–form combination (*s*), brand–generic flag (*b*), molecule (*m*) and existing–exiting–entering status (*e*)

*t* is a constant value corresponding to the time period analyzed

$X(t)$  is the total drug expenditure or sales in time period *t*

$AC(i_{s,b,m,e},t)$  is the average cost or price per physical unit for product  $i_{s,b,m,e}$  in time period *t*

$AU(i_{s,b,m,e},t)$  is the average number of units (physical quantities) per number of prescriptions for product  $i_{s,b,m,e}$  in time period *t*

$q(i_{s,b,m,e},t)$  is the number of prescriptions for product  $i_{s,b,m,e}$  in time period *t*

**Table 1** List of the Minimum Data Elements that are Required for Two Time Periods

Molecule (active ingredient)	Drug Attributes
Brand–generic flag	
Strength and form*	
Drug costs, sales or drug prices	Metrics
Units (number of tablets, capsules, etc.)	
Number of prescriptions	

\*The strength and form should only be combined for products that are oral solids (tablets, capsules, extended release formulations, etc.). Other formulations (injectable, inhalers, patches, etc.) should be considered as distinct products.

$$q(i_{s,b,m,e},t) = w(i_{s,b,m,e},t) \times Q(t)$$

where

$w(i_{s,b,m,e},t)$  is the product's  $i_{s,b,m,e}$  share of total volume (expressed in prescriptions) in time period  $t$

$Q(t)$  is the total number of prescriptions in time period  $t$

$$(8) \quad Q(t) = \sum_{i_{s,b,m,e}} q(i_{s,b,m,e},t)$$

$$X(t) = \sum_{i_{s,b,m,e}} AC(i_{s,b,m,e},t) \times AU(i_{s,b,m,e},t) \times w(i_{s,b,m,e},t) \times Q(t)$$

Each individual share  $w(i_{s,b,m,e},t)$  can be decomposed into multiple shares, as follows:

$$(9) \quad w(i_{s,b,m,e},t) = \frac{q(i_{s,b,m,e},t)}{\sum_{i_{b,m,e}} q(i_{b,m,e},t)} \times \frac{\sum_{i_{b,m,e}} q(i_{b,m,e},t)}{\sum_{i_{m,e}} q(i_{m,e},t)} \times \frac{\sum_{i_{m,e}} q(i_{m,e},t)}{\sum_{i_e} q(i_e,t)} \times \frac{\sum_{i_e} q(i_e,t)}{Q(t)}$$

where

$\sum_{i_{b,m,e}}$  is the sum of the quantity of prescriptions for

all products  $i$  with the same brand–generic flag ( $b$ ), molecule ( $m$ ) and existing–exiting–entering status ( $e$ )

$\sum_{i_{m,e}}$  is the sum of quantity over all products  $i$  with

the same molecule ( $m$ ) and existing–exiting–entering status ( $e$ )

$\sum_{i_e}$  is the sum of quantity over all products  $i$  with

the same existing–exiting–entering status ( $e$ )

$\alpha(i_{s,b,m,e},t)$  is the share of the quantity for product  $i$  over the sum of quantities for all products with

the same brand–generic flag ( $b$ ), molecule ( $m$ ) and existing–exiting–entering status ( $e$ )

$\beta(i_{b,m,e},t)$  is the share of the sum of quantities for products  $i$  with the same brand–generic flag ( $b$ ), molecule ( $m$ ) and existing–exiting–entering status ( $e$ ) over the sum of quantities for all products with the same molecule ( $m$ ) and existing–exiting–entering status ( $e$ )

$\delta(i_{m,e},t)$  is the share of the sum of quantities for products  $i$  with the same molecule ( $m$ ) and existing–exiting–entering status ( $e$ ) over the sum of quantities for all products with the same and existing–exiting–entering status ( $e$ )

$\lambda(i_e,t)$  is the share of the sum of quantities for products  $i$  with the same existing–exiting–entering status ( $e$ ) over the total quantity for all products in that period

$$X(t) = \sum_{i_{s,b,m,e}} AC(i_{s,b,m,e},t) \times AU(i_{s,b,m,e},t) \times \alpha(i_{s,b,m,e},t) \times \beta(i_{b,m,e},t) \times \delta(i_{m,e},t) \times \lambda(i_e,t) \times Q(t)$$

The change in total drug costs in period 1 over period 0 is:

$$X(1) - X(0) = \sum_{i_{s,b,m,e}} AC(i_{s,b,m,e},1) \times AU(i_{s,b,m,e},1) \times \alpha(i_{s,b,m,e},1) \times \beta(i_{b,m,e},1) \times \delta(i_{m,e},1) \times \lambda(i_e,1) \times Q(1) - \sum_{i_{s,b,m,e}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \times \lambda(i_e,0) \times Q(0)$$

This formula can be written in the following form, isolating the following individual effects:

**Formula 1. Cost Decomposition Formula – Drivers of Drug Costs**

$$\begin{aligned}
 X(1) - X(0) = & \\
 & \sum_{\substack{i_{s,b,m,e} \\ e=\text{existing}}} [AC(i_{s,b,m,e},1) - AC(i_{s,b,m,e},0)] \times AU(i_{s,b,m,e},0) \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \times \lambda(i_e,0) \times Q(0) + && \text{Price Effect} \\
 & \sum_{\substack{i_{s,e,m,b} \\ e=\text{existing}}} AC(i_{s,b,m,e},0) \times [AU(i_{s,b,m,e},1) - AU(i_{s,b,m,e},0)] \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \times \lambda(i_e,0) \times Q(0) + && \text{Prescription Size Effect} \\
 & \sum_{\substack{i_{s,e,m,b} \\ e=\text{existing}}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \times [\alpha(i_{s,b,m,e},1) - \alpha(i_{s,b,m,e},0)] \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \times \lambda(i_e,0) \times Q(0) + && \text{Strength-Form Effect} \\
 & \sum_{\substack{i_{s,e,m,b} \\ e=\text{existing}}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \times \alpha(i_{s,b,m,e},0) \times [\beta(i_{b,m,e},1) - \beta(i_{b,m,e},0)] \times \delta(i_{m,e},0) \times \lambda(i_e,0) \times Q(0) + && \text{Generic Substitution Effect} \\
 & \sum_{\substack{i_{s,e,m,b} \\ e=\text{existing}}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times [\delta(i_{m,e},1) - \delta(i_{m,e},0)] \times \lambda(i_e,0) \times Q(0) + && \text{Existing Drug Effect} \\
 & \sum_{\substack{i_{s,e,m,b} \\ e=\text{existing, exiting}}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \times [\lambda(i_e,1) - \lambda(i_e,0)] \times Q(0) + && \text{Exiting Drug Effect} \\
 & \sum_{\substack{i_{s,e,m,b} \\ e=\text{existing, entering}}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \times [\lambda(i_e,1) - \lambda(i_e,0)] \times Q(0) + && \text{Entering Drug Effect} \\
 & \sum_{\substack{i_{s,e,m,b} \\ e=\text{existing, exiting, entering}}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \times \lambda(i_e,0) \times [Q(1) - Q(0)] + && \text{Prescription Volume Effect}
 \end{aligned}$$

**Drug Cross Effects**

Where

$$Q(t) = \sum_{i_{s,b,m,e}} q(i_{s,b,m,e}, t)$$

is calculated for all *existing, exiting and entering* drugs and  $q(i_{s,b,m,e}, t)$  is the number of prescriptions for product  $i_{s,b,m,e}$  in time period  $t$  where

$\sum_{\substack{i_{s,b,m,e} \\ e=\text{existing}}}$  is the sum of all *existing* drugs

$\sum_{\substack{i_{s,b,m,e} \\ e=\text{existing, exiting}}}$  is the sum of all *existing and exiting*

drugs, and

$\sum_{\substack{i_{s,b,m,e} \\ e=\text{existing, entering}}}$  is the sum of all *existing and entering* drugs

The first 5 effects in Formula 1 are calculated only for *existing* drugs, as they would take the value of zero for the *exiting* and *entering* drugs.

The Exiting Drug Effect and the Entering Drug Effect as seen in Formula 1 can be collapsed into one single Exiting–Entering Drug Effect, encompassing the 2:

$$\sum_{\substack{i,s,b,m,e \\ e=\text{existing, exiting, entering}}} AC(i_{s,b,m,e},0) \times AU(i_{s,b,m,e},0) \\ \times \alpha(i_{s,b,m,e},0) \times \beta(i_{b,m,e},0) \times \delta(i_{m,e},0) \\ \times [\lambda(i_e,1) - \lambda(i_e,0)] \times Q(0)$$

Note that the Exiting Drug Effect is limited to *existing* and *exiting* drugs. The term  $\lambda(i,1)$  takes the value of 1 for Existing drugs and the value of 0 for Exiting drugs, as there are no Exiting drugs in time period 1. Similarly, the Entering Drug Effect is limited to the *existing* and *entering* drugs. The term  $\lambda(i,1)$  takes the value of 1 for Existing drugs and the value of 0 for Entering drugs. Since the Entering drugs do not have values for time period 0, the values for time period 1 should be used instead.

Note that in Formula 1, when a required value for one time period is not available, the value from the other time period should be used instead. This may happen, as the strengths or forms of some of the existing molecules may be used sporadically in one period or another.

## DISCUSSION

A cost driver analysis can be an effective tool for understanding drug cost pressures and allows policy makers and researchers to analyze past trends and predict future outcomes. Furthermore, the methodology can also be employed in cross-jurisdictional analyses or international comparisons that break down the sources of differences in drug sales or expenditures.

This study identifies the major cost drivers of prescription drug expenditures and provides researchers with the formulas required to conduct cost driver analyses. The proposed methodology can be adjusted and enhanced based on data availability and the purpose and analytical depth of a particular research study. Using the standard methodology, it is possible to conduct specialized analyses of expenditure in particular therapeutic classes or market segments. Also, the methodology can be used in cross-jurisdictional

analyses that break down the sources of differences in per capita expenditure.

Note that the methodology described in this report proposes one way of conducting cost driver analyses. It will assist researchers in understanding the mechanics of the cost decomposition methodology and in designing their own methodology in line with their analytical interests.

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## REFERENCES

1. Canadian Institute for Health Information. Prescribed drug spending in Canada, 2013: A focus on public drug programs. Ottawa, ON: Author; 2015.
2. CBO. Technological change and the growth of health care spending. Washington, D.C.: Congressional Budget Office; 2008.
3. CIHI. Health care cost drivers: The facts. Ottawa: Author; 2011.
4. Morgan SG. Quantifying components of drug expenditure inflation: the British Columbia Seniors' Drug Benefit Plan. *Health Serv Res* 2002;37(5):1243–66.
5. Morgan SG. Drug spending in Canada: Recent trends and causes. *Med Care* 2004;42(7):635–42.
6. Morgan SG. Drug expenditure trends in the Canadian provinces: magnitude and causes from 1998 to 2004. *Health Policy* 2005;1(1): 85–99.
7. Gerdtham UG, Lundin D. Why did drug spending increase during the 1990s? *PharmacoEconomics* 2004;22(1):29–42.
8. CIHI. Drivers of prescription drug spending in Canada. Ottawa: Author; 2012.
9. Patented Medicine Prices Review Board. The pharmaceutical trends: Non-Insured Health Benefits (NIHB) Pharmacy Program 1999-2000 to 2001-2002. Ottawa: Author; 2004.

10. Patented Medicine Prices Review Board . Pharmaceutical trends overview report: Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia, and First Nations and Inuit Health Branch of Health Canada 1997-1998 to 2003-2004. Ottawa: Author; 2006.
11. Patented Medicine Prices Review Board. Public drug plan dispensing fees: a cost-driver analysis, 2001/02 to 2007/08. Ottawa: Author; 2011.
12. Patented Medicine Prices Review Board. Use of the World Health Organization Defined Daily Dose in Canadian drug utilization and cost analyses. Ottawa: Author; 2010.
13. Berndt ER, Cutler DM, Frank RG, Griliches Z, Newhouse JP, Triplett JE. Medical care prices and output. In: Culyer AJ, Newhouse JP, ed. Handbook of health economics. Amsterdam: Elsevier Science B.V.; 2000.
14. Diewert WE. The Consumer Price Index and the Index Number Theory: A survey. Vancouver: Vancouver School of Economics, The University of British Columbia, Discussion Paper 01-02; 2001.
15. United Nations Statistics Division. Price and volume measures. In: Updated System of National Accounts (SNA). New York: United Nations; 2008.

