

Guidance Document for the
**Costing of Health Care
Resources in the
Canadian Setting**

Second Edition

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CADTH

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ABBREVIATIONS AND TERMINOLOGY

ALC	alternate level of care
ARP	alternative relationship plan
CACS	Comprehensive Ambulatory Care Classification System
CADTH	Canadian Agency for Drugs and Technologies in Health
CAT	Cost Analysis Tool
CIHI	Canadian Institute for Health Information
CMDB	Canadian Management Information System (MIS) Database
CMG	case mix group
CMI	case mix index
CPI	consumer price index
CSHS	cost of a standard hospital stay
DAD	Discharge Abstract Database
FFS	fee-for-service
ICD-10-CA	International Classifications of Diseases, version 10, Canada-specific
IHDA	Interactive Health Data Application
MOHLTC	Ministry of Health and Long-Term Care
MRDx	most responsible diagnosis
NACRS	National Ambulatory Care Reporting System
OHIP	Ontario Health Insurance Plan
OTC	over-the-counter
RIW	resource intensity weights
RUG	resource utilization group
RWPD	RUG-weighted patient day

FOREWORD TO THE SECOND EDITION

The intent of this document is to provide researchers with information on publicly available cost information, and to encourage transparency in use and determination of cost information. The document provides descriptions of costs and costing methods for commonly used health resources and briefly discusses circumstances in which the use of different costing approaches may be appropriate.

In 1996, the Canadian Coordinating Office for Health Technology Assessment (or CCOHTA) produced *A Guidance Document for the Costing Process*¹ (hereafter referred to as the *Guidance Document*), which detailed guidance on the costing process; provided information on how health care resources are measured and valued, and suggested sources of information; and also suggested a recommended format for reporting. Cost information has evolved since the publication of the *Guidance Document*. Information systems have further developed since the late 1990s, which allow for access to more accurate costing than was previously publicly available. Canada has since established case mix groups for in-patient, ambulatory, and long-term care. Based on a review of published economic evaluations to help inform how and what type of cost information is being used, CADTH, formerly CCOHTA, noted the use of a wide variety of costing sources and techniques. In many cases, the details of the costing approaches were not fully described and the uncertainty around the input parameters was not discussed. This highlighted the need for more transparent reporting of the methods and sources of cost information, and, combined with the availability of more comprehensive data sources and in the interest of promoting a more standardized use of cost information, led to this second edition of the *Guidance Document*, now entitled *Guidance Document for the Costing of Health Care Resources in the Canadian Setting: Second Edition*.

The document focuses on four key areas: identification, measurement, valuation, and reporting. While there are a number of different cost sources and methodologies used across Canada, the focus of this document is to provide consistent nomenclature, where possible, with the focus on national and publicly available data sources.

This document provides a guide to researchers for the costing of health resources and should be used with the most up-to-date version of the CADTH *Guidelines for the Economic Evaluation of Health Technologies* for guidance on the use of cost information in economic evaluations.

Costing methods continue to evolve and available information sources are subject to change. Consequently, this document is intended to be revised as information and methodologies develop. Throughout the document, various costing approaches have been identified. Decisions on which costing method should be used are the subject of ongoing and future research. This document is current to the date of publication. Readers are encouraged to access the online appendix for up-to-date references.

GENERAL GUIDANCE

This section provides general guidance for identifying and sourcing costs of health care resources to be used in economic studies.

Overview

Costs can be measured at different points in the health care system. Fees or charges for services can be used as a proxy for costs. Costs differ from fees in that a fee is the amount charged for a resource or service whereas a cost is the amount required to produce the resource or service. Fees may be set by a payer through schedules, such as a provincial schedule of medical benefits or a drug formulary. Alternatively, the providing unit (e.g., an optometrist) may set its own charges. Data on these charges may be available from the provider or direct from the payer. In some cases, professional associations will have recommended fees. The provider is not obligated to adhere to them. In all of these cases, there may also be a co-payment to the recipient, which may be included in an analysis depending on the perspective taken (e.g., patient or societal perspective).

Costs can also be measured by the providing units, based on their expenditures, as being either “top down” or “bottom up”. For example, hospitals collect data on expenditures and clinical outputs using their information systems. The Canadian Institute for Health Information (CIHI) combines this expenditure and clinical data to form unit (“top down”) costing data for case mix groups (CMGs). Using the same costing data, CIHI also conducts “bottom up” or micro-costing for individual patients in a small number of hospitals.

Additionally, unit cost data can be directly collected from operations data or surveys of resource units, such as caregivers or ambulance units. In this costing *Guidance Document*, we used all of these methods to obtain costs of health care resources and services.

Guidance

The following process is recommended when determining costs for a study:

- determine the decision problem
- identify all resources relevant for the analysis
- measure resources
- conduct valuation of resources
- report costs.

Determine the decision problem

The decision problem for which the economic evaluation is being conducted will define aspects such as the perspective, the time horizon of the analysis, target population, and setting. The problem should therefore be defined at the start of the project to ensure that all resources and costs are captured.

The perspective of the analysis (e.g., government payer, private payer, societal, public health care payer) will determine the scope of resources and costs considered. Where broader perspectives are considered, researchers should identify resources based on the audience that bears the costs. For example, when considering a health care payer perspective — defined as public and third-party payers — resources paid by the public payer should be considered and additional resources covered by the third-party payer should be added; whereas costs incurred by the patient should be excluded in this case.

Of note, transfer payments are made by governments based on health status but are not resource-related despite being reflected as part of a government payer; transfer payments should therefore not be included when considering a public or societal perspective.

The time horizon of the study defines the period in which costs are accounted for. Current CADTH guidelines recommend that the time horizon selected includes meaningful differences in downstream events and costs.² When the study is an economic model, time is broken down into discrete units (cycles), and the resources and costs that occur within each cycle must be identified.

The target population, as defined by the decision problem, must be considered when selecting costs for the analysis. Costs beyond the target population should not be included; for example, resource use for unrelated conditions.

The setting in which the economic evaluation is being undertaken should be accounted for to ensure the accuracy of the analysis. In the case where an economic evaluation is conducted to support a decision at a regional level, region-specific sources should be used. From a national perspective, Canada-wide costs are preferred; however, this information is not always available. The researcher should select an appropriate source, discuss any potential issues in applying the sources to other jurisdictions, and test the sensitivity of the results to the choice of cost information. Ideally, information should be obtained from a single source (payer or jurisdiction); information from other sources can be assessed in sensitivity analyses.

Identify all relevant resources and services

Researchers should ensure that all health care interventions relevant for the analysis are identified based on the perspective of the decision problem. This could be conducted by considering the clinical and care pathways of the disease condition. By doing so, the researcher should seek to identify all downstream events associated with managing the condition, relevant sequelae, and overall impact of the intervention.¹

Where multiple perspectives are considered, the researchers should note which resources and services apply to the respective perspectives in order to effectively report the results for each perspective under consideration. In doing so, the researcher should not double-count any resources or services.

The categories of health care resources described in this document are:

1. Pharmaceuticals (non-hospital prescription drugs, over-the-counter (OTC) drugs, drug delivery devices and associated monitoring tools, drug administration costs)
2. Physician services
3. Hospital services (in-patient hospital care, outpatient hospital care)
4. Diagnostic and investigational services (radiology services, laboratory testing/assays, medical devices)
5. Non-physician professional services (independent, non-physician professional services including pharmacists and nursing services)
6. Community-based services (residential care, home care, ambulance services)
7. Other services.

Measure resources

The quantities (or physical amounts) of resources or services required must be determined by the researcher. Although there are a number of approaches that may be used, they can be dichotomized into direct (or primary) measurement and indirect (secondary) measures. Primary

data collection requires the collection of resource use gathered directly as part of a clinical trial or as an observational study on its own;¹ whereas secondary data collection may be captured using administrative or clinical databases, chart reviews, and expert panels. Researchers should also note that various costing options entail a certain amount of complexity, time, and effort that correlate with the amount of precision associated with the estimate. Whereas the accuracy of the results is dependent on correct and precise estimates — favouring more detailed (micro) costing — in some instances, the use of less precise (cruder) estimates may be sufficient (see Table 2). The challenge is to strike the appropriate balance between the need for precision and the avoidance of bias with the resources required to collect data. While precise unbiased cost estimates are the ideal, and imprecise, biased estimates are the least valuable, the relative desirability of biased/precise estimates versus unbiased/imprecise estimates will, however, depend on the context to ensure effective decisions can be made. Part II of the document discusses the measurement of resources based on specific cost categories.

When obtaining resource use from clinical trials, there may be issues with external validity based on trial designs and resource use may be driven by research protocols.³⁻⁶ Resource use gathered as part of a clinical trial may therefore be more intensive than in routine clinical practice (e.g., increased monitoring/frequency of physician visits) and researchers using this information must establish the extent to which patient management and resource use reflect clinical practice.

It is suggested that researchers report resource use in physical units (e.g., number of physician visits, number of hospital days) in adherence to best practices for reporting.

Conduct a valuation of resources

The researcher must value the resources in monetary terms. In doing so, the principles for valuation of opportunity cost and marginal costs arise.

Opportunity cost is a key concept in economic evaluations, as decision makers are interested in determining the value of resources when used in the context under investigation compared with the next best alternative. The opportunity cost may reflect the prices paid to acquire the resources. When market prices are used, they should not include sales taxes, as taxes are not direct payments for resources and hence not included when taking a societal or government payer perspective.

The marginal cost is the cost of producing one extra unit of output (product/service). In those parts of this document which focus on fees, the concept of marginal costs will not apply. In other circumstances (hospital services, nursing homes, community services), marginal costs are relevant. For example, hospital costs derived from information systems should reflect the marginal cost. In addition, when considering expenditures on capital or public health initiatives, where an initial investment is required (e.g., purchasing an MRI machine or setting up a vaccination centre), the average cost per patient may be based on the expected use. However, where the resource/service is under-utilized, the marginal cost may exceed the expected cost.

In part II of this *Guidance Document*, alternative sources of cost information are provided by cost category. The researcher should consider the perspective and setting of their analysis when deciding which cost data to use — the data should be specific to the question and relevant to the setting. Where no data are available for the specific setting of interest, the researcher should select a similar setting, discuss possible issues with using data from another jurisdiction and its applicability in the current context, and examine potential implications in sensitivity analyses, where appropriate.

In some instances, where there are different methods to value resources (e.g., top-down versus bottom-up measures of in-patient hospital costs), the researcher must weigh the benefits and need for precision (e.g., micro-costing), with the potential benefits of having information on a “typical case” that may reflect an array of severities and/or complications.

Identify uncertainty and bias

When considering sources of cost information in an economic evaluation, it is important to identify potential sources of variability, uncertainty, and bias. *Variability* may be attributed to different costing information that is available in different geographical areas or settings, as well as specific to the component under consideration. *Uncertainty* occurs when the true value of the cost is unknown, thus reflecting the fact that knowledge or measurement is imperfect. It is important in these circumstances to be as precise as possible. In general, the greater impact the cost estimate will have on the result of the analysis, the more precise the estimate should be. *Bias* reflects the systematic divergence of the measured cost from the desired measure. Bias estimates should be avoided and, where this is not possible, direction of bias should be noted and the results discussed in the context of known biases.

Variability, uncertainty, and biases should be considered systematically and thoroughly assessed when undertaking sensitivity analyses and stating limitations with the economic analysis, such that the impact on the results can be fully assessed. Some suggestions are provided for sensitivity analyses around costs, but for more complete information, please refer to the most up-to-date version of the CADTH *Guidelines for the Economic Evaluation of Health Technologies*.

Reporting

The mean number (or volume) of physical units (e.g., number of in-patient days if per diem costing is used) and the unit price or cost for each resource or service included in the analysis should be presented separately. If there is considerable variation or uncertainty in the volume or unit cost, the CADTH *Guidelines for the Economic Evaluation of Health Technologies* suggests that the full range of plausible values be reported in sensitivity analyses.

When reporting the prices and costs for the included resources and services, the methodology, data sources, and calculations as to how the final cost was arrived at should be justified and transparently reported.

MEASUREMENT AND VALUATION

The following section provides information on the measurement (determining quantities of resource use) and valuation (costs applied to resources) for specific cost categories.

1. Pharmaceuticals

This category includes all prescription and non-prescription pharmaceuticals (drugs, medicines) including biologically derived products such as vaccines, serums, and blood-derived products; disinfectants; radiopharmaceuticals used within the treatment paradigm;⁷ drug delivery devices and associated monitoring tools; and drug administration costs associated with a pharmaceutical.

1.1 Prescription Drugs

A prescription drug is a licensed medicine that is regulated by legislation to require a medical prescription before it can be obtained.

1.1.1 Data sources

In Canada, prescription drugs can be paid through public or private drug plans, individual out-of-pocket payments, or a combination thereof. Each province, territory, or federal program maintains a public drug formulary (list of funded drugs), as do institutions (e.g., hospital formularies) and private insurers. In addition, certain public plans allow access to drugs through special (or extended) access programs. While wholesalers stock most drug products marketed in Canada, they currently do not make their prices publicly available, and thus wholesale prices are generally not appropriate. Public drug plan formularies are generally publicly available and easily accessible. Access to hospital and private insurer formularies is typically not publicly available. Specific formularies exist for oncology drugs that indicate which drugs are reimbursed and certain information related to the reimbursement — few formularies provide prices.

While publicly available drug formulary prices are preferred because they tend to broadly reflect wholesale prices and the markup is generally explicitly stated, not all public drug formularies provide prices for all marketed drugs (i.e., those which are not listed or accessed through special programs). The researcher should be transparent as to whether markups are included. Researchers should consult relevant formulary websites from each province to determine the relevant specific markups and dispensing fees. Information regarding dispensing fees may be found on some provincial drug plan websites, as well as retail pharmacies. The choice between the two should relate to the perspective of the analysis.

It should also be noted that payers may have product listing agreements (these may also be known as risk-sharing agreements/arrangements) or rebates in place, which are typically not known or publicized. In situations where negotiations have occurred but the details are unknown, this should be noted within the description of the data source. Publicly listed prices should be used and uncertainty tested considering a range of price reductions.

The quantity of drug dispensed should be based on the recommended dose from the product monograph. This information may be supplemented with information from drug utilization databases that provide information on how prescription drugs are used in real-world settings. Note that, depending on the perspective, there may be quantity limits per prescription (e.g., quantity restrictions for certain controlled drugs, or number of days supplied for drug plans). Where dosing is not uniform, appropriate ranges should be obtained from the published

literature (e.g., product monograph, observational studies). Any wastage of drug products (e.g., partially used vials) should be accounted for in the base-case analysis.

1.1.2 Costing considerations

- Each public plan stipulates allowable pharmacy markups and dispensing fees that will be reimbursed for different categories of products (e.g., oral agents, infusions), which are included in the price that the pharmacy charges to dispense these items. Pharmacies may have higher charges than what is reimbursed by the public payer. Consideration should therefore be given as to which values to use based on the perspective of the analysis.
- Where a relevant comparator in an economic evaluation is deemed to be a drug not currently marketed in Canada, an assumed price (based on comparators and foreign country prices) may be used, with the price assessed in sensitivity analyses.
- There are variable markups and pharmacy fees across jurisdictions. When undertaking an analysis from the national level, test the impact of the parameter on the results. Where results are sensitive to the parameter, consider conducting separate analyses for the jurisdictions covered by the analysis; for the national level, consider using a weighted average based on the population. Where results are not sensitive to the prescription drug-related costs, consider using a single source for all of these costs.
- When attempting to determine a weighted average price, and use of other drugs within the same disease area, prescription utilization data should be used.
- For most public and private drug plans, there is a co-payment charged to the consumer, which reduces the annual amount paid by the plan. When the perspective is that of the patient or society, co-payments should be included.

Example A-1

A researcher undertaking an analysis of onabotulinumtoxinA for overactive bladder from the perspective of the public payer in Saskatchewan would:

- Obtain the unit drug costs from the Saskatchewan drug formulary (<http://formulary.drugplan.health.gov.sk.ca/>). The acquisition cost of onabotulinumtoxinA in April 2015 is \$3.57 per unit (U). Saskatchewan prices do not contain wholesaler markup.
- Obtain information on minimum dispensable units from the product monograph (50, 100, and 200 U vials).
- Obtain information on the recommended administration from the product monograph (100 U injection).
- Calculate the acquisition cost based on administration ($\$3.57 \times 100 \text{ U} = \357.00).
- Saskatchewan prices do not include markup or dispensing fees (<http://formulary.drugplan.health.gov.sk.ca/>). The maximum pharmacy markup allowance calculated for onabotulinumtoxinA is \$20.00 given that its total cost is greater than \$200.00, and the dispensing fee is \$10.75 (<http://formulary.drugplan.health.gov.sk.ca/DrugPlanOverview.aspx>). Thus, the total drug cost for onabotulinumtoxinA is \$387.75 ($\$357.00 + \$20.00 + \10.75).

1.2 Over-the-Counter Drugs

Over-the-counter (OTC) drugs are those drugs for which no prescription is required. Of note, drug plans may cover OTC drugs, where they are prescribed by a physician. In these cases, for coverage, a prescription would be required and similar principles as discussed in section 1.1 apply. For this section — section 1.2 — drugs purchased without a prescription are described.

1.2.1 Data sources

Prices may be obtained from retailers and provincial drug formularies (as private drug plans formularies and wholesaler price lists are generally not publicly available). The sources for the prices used should be stated and justified, and reflective of the perspective of the analysis.

When considering the quantities of OTC drugs, considerations should be given for package sizes available.

1.2.2 Costing considerations

- As previously indicated, this section pertains to OTC drugs not dispensed by a pharmacist. Where the OTC drug is paid for by a private or public drug plan, wholesaler markup, pharmacy markup, and the pharmacy dispensing fee may need to be applied, and in these cases the guidance detailed in section 1.1 should be used.

1.3 Drug Delivery Devices and Associated Monitoring Tools

A drug delivery device refers specifically to delivery vehicles engineered for the targeted release of therapeutic agents (e.g., <http://www.nibib.nih.gov/science-education/science-topics/drug-delivery-systems-getting-drugs-their-targets-controlled-manner>). Examples of drug delivery devices include insulin pens, nebulizer units, syringes, and blood glucose indicator tests.

1.3.1 Data sources

Costs for drug delivery devices and associated monitoring tools may be obtained from provincial drug formularies (as private drug plans formularies are generally not publicly available), or through Canadian retailers.

Researchers should take into account the life span of the device/tool/system and time to replacement, to determine the quantity required depending on the time horizon of the economic analysis.

1.3.2 Cost considerations

- In some cases, the drug manufacturer will provide the drug delivery device free of charge or at a reduced rate. This should be accounted for in the analysis. Further, any issues with the timing of the offer (e.g., delivery device provided for a set period of time, or uncertainty as to how long the manufacturer will provide the delivery device or replacements) should be accounted for in the sensitivity analyses.

1.4 Drug Administration Costs

Drug administration costs are incurred where treatments require administration by a health professional (e.g., physicians or non-physicians via injections, infusions, etc.). This section pertains specifically to drug administration costs in the outpatient setting.

1.4.1 Data sources

For drugs administered in the in-patient setting, these costs will be covered through the CMG costing and patient costing methods (see section 3 – Hospital Services).

Where a drug is administered by a health professional in the outpatient setting, the medical services cost must be accounted for. The cost of administering a drug varies by treatment setting and the health professional administering the drug, and therefore different unit costs will have to be obtained. For drugs administered in the outpatient setting, the applicable provincial Schedule of Benefits should be used. If the relevant provincial Schedule of Benefits does not

report the requisite code or cost information, the fee from a similar jurisdiction may be used as a proxy.

There may be occasions for which the amount of resource or service units will need to be accounted for to appropriately estimate the cost of administration. If the administration time is not specified within publicly available Canadian documents (preferably the current Health Canada-authorized product monograph), the researcher may elicit this information from a targeted survey or a panel of health professionals likely to administer the drug. Additional information on determining appropriate costs may be found in section 3 (Hospital Services) and section 5 (Non-Physician Professional Services).

Example A-2

Following on from Example A-1, assuming onabotulinumtoxinA is administered by a specialist in an outpatient setting:

- Based on the Saskatchewan Medical Association fee guide (April 2015), the cost of administering onabotulinumtoxinA (code 199A) is \$372.00 per dose.
- Associated monitoring costs would be based on the health provider undertaking the monitoring. Where there is lack of information on monitoring, this could be elicited by expert opinion.

As noted in section 3 (Hospital Services), if administration occurs in a facility, there is a facility cost that is captured within the case mix and patient costing that is not captured within provincial schedules.

2. Physician Services

2.1 Physician Services

Physician services relate to professional services provided by a medical practitioner (i.e., family physician, primary care physician, specialist). This category excludes non-physician services that are provided in a hospital setting (see section 3, Hospital Services) and other non-physician professional services (e.g., nursing service costs, physiotherapist costs, residential care costs; see section 5, Non-Physician Professional Services, and section 6, Community-Based Services).

Since the introduction of the public medical care system in Canada, the majority of physicians in Canada are compensated through a fee-for-service (FFS) arrangement,⁸ although this varies by jurisdiction and has evolved over time. Alternative relationship plans (ARPs; otherwise known as alternative payment plans or APPs) are another method used by provinces to pay for physician services. The use of ARP costs may be appropriate in a setting where that payment method is used and the data are available. Physician fees are primarily covered by government payers.⁹

2.1.1 Data sources

Each province provides health care services access to its residents through a provincially based health insurance plan. These services are listed in a schedule of medical benefits and fees, with the listed fees paid by the plan. The provincial schedules contain considerable detail, distinguishing between various physician specialities and visit types. It should be noted that a single visit can generate more than one service. Although there is some overlap in fee categories among provinces, complete overlap does not exist; this makes it difficult to compare costs among provinces for the identical interventions and services. These fee schedules provide the best estimate of resource costs for physician services when costing these services on an individual basis. In cases where physicians are paid on a non-FFS basis (i.e., salary), fees can be used as a proxy cost. Information regarding the complexity of the service or intervention is included within the provincial fee schedules when assessing the amount of time for physician visit. Where ARPs are used, pricing based on published ARP data are appropriate (e.g., <http://www.arppmo.org/clinical-arp-rates/>).

It is important to appropriately distinguish between a visit and a consultation for costing purposes. A visit is generally stated to include the assessment of one or more conditions during the same patient contact at the time the service is rendered, while a consultation is based on a request from a physician, registered nurse, optometrist, or dentist for a second opinion. Consultations consist of reviewing the patient's medical history, a physical examination of the patient regarding the specific medical condition, a review of diagnostic data, and the provision of written opinion. This includes findings, and a recommendation of treatment and management of the condition to the health professional who requested the consultation. A general assessment, or "physical," relates to a service rendered at a place other than in a patient's home, and that requires a full patient history, and, with some exceptions, an examination of all body parts and systems. It may also include a detailed examination of one or more specific parts or systems. Physician schedules of benefits and fees generally provide wording of these terms and also indicate the setting in which the service is rendered. This is especially important when costing physician services provided in the hospital. (See section 3, Hospital Services, to determine when it is appropriate to include these costs.)

Physician services in the hospital should be determined in the same manner as in the community and added to the hospital cost. The number of requisite services per hospital stay should be captured from a survey or elicited from expert opinion or published literature.

For physician services, an initial service may be followed up with a subsequent service. Provincial medical benefit schedules generally identify four types of services — initial visit, subsequent visit, initial consultation, and subsequent consultation — along with guidance on the level of assessment within their guidance documents, with associated fees. There may be occasions for which the amount of resource or service units may be required to determine the appropriate fee or cost. If the visit time is not specified within publicly available Canadian documents (such as the clinical practice guidelines and the Health Canada-authorized product monograph, where details on drug administration or monitoring are provided), the researcher may obtain this information from a targeted survey of health professionals. Provincial schedules generally provide sufficiently detailed information such that the location of service is noted; otherwise, expert opinion may be required.

2.1.2 Cost considerations

- Schedules also distinguish between costs and descriptions for physician hospital visits and visits in the community. Researchers should review the relevant provincial schedules of benefits and fees to determine the appropriate code and associated fee to use or else consult someone who is knowledgeable about medical billing.
- Provincial schedules of benefits and fees are subject to periodic review and amendment; researchers should therefore ensure that they use the current version and reference it appropriately.
- Fee categories and fee levels differ by province; therefore, a fee schedule should only be used for the specific province for which the analysis is being conducted.
- The fees for interpretation of diagnostic and investigational tests (see Diagnostic and Investigational Services, section 4) by physicians can be found in provincial schedules of benefits. These fees should be added to the cost of the diagnostic and investigational intervention.

Example B

A researcher is calculating the cost of physician visits starting in the year of diagnosis, over a two-year time horizon, from the perspective of the public payer in Ontario.

- In this example, based on published Canadian guidelines, which have been validated by experts in Ontario, patients should be seen four times in the year of diagnosis, followed by two times a year thereafter.
- The Ontario Health Insurance Plan (OHIP) Schedule of Benefits (May 2015) indicates that a general practitioner may bill \$77.00 for a general practice consultation (A005) and \$45.90 for a repeat consultation.
(http://www.health.gov.on.ca/english/providers/program/ohip/sob/sob_mn.html).
- Over two-year time horizon, there will be one initial visit, and five subsequent visits (three in year 1 and two in year 2), which leads to physician visit costs of \$306.50 over two years.

3. Hospital Services

Hospital services are any services produced within a hospital on either an in-patient or an outpatient basis. They contain a wide variety of activities including nursing and other professional services, and laboratory and other diagnostic services, as well as dispensing and administration of drugs, housekeeping, and nutrition — all of which are captured within hospital costing approaches.

In the context of the hospital setting, physician services are typically paid directly by provincial medical plans and not the hospitals.¹⁰ Hospital physician costs are usually not included as part of hospital costs, but should be included separately to obtain the full cost of the episode when using a public health care system or a broader perspective. See section 2, Physician Services, regarding the inclusion of physician costs.

3.1 In-patient hospital care

In-patient hospital care is divided into acute care and alternate level of care (ALC) services. ALC refers to any days of stay beyond which a patient would normally be discharged from acute care to a facility associated with a less intensive level of care (such as rehabilitative care or continuing care), but where placement to a less intensive level of care outside of the hospital is unavailable. Thus acute and ALC care are often two components of the same stay. ALC is the lowest level of the hospital in-patient stay prior to discharge. Of course, many stays will not have an ALC component. Acute care and ALC vary by cost; therefore, it is important to distinguish between the two. Hospitals code in-patient hospital days into separate levels of care, which may assist in this categorization.¹¹

There are a number of approaches to in-patient costing, which vary based on the precision of the estimate (Table 1). Patient costing approaches provide precise cost estimates, but the primary data collection systems required to generate these estimates are expensive to establish and may not be publicly available. Case mix costing approaches provide estimates of “average” groups of cases, which may be sufficient for the purpose of the analysis. Per diem costs assume uniform care for all days in hospital and for all hospital stays.

TABLE 1: ALTERNATE LEVELS OF IN-PATIENT HOSPITAL COSTS

Method of Costing	Description	Where to Get Data
Per diem costs	A uniform daily cost is applied to all days of care.	Hospital stays for individual cases are obtained from the CIHI DAD. Cost per day is obtained from CIHI.
Case mix groups (basic CMG+) – basic values with age categories (called case mix costing or top-down costing)	Similar cases are placed CMGs. Resource use per case is measured in index terms by the RIW indicator. Within each CMG, cases are subdivided into typical (outcomes as expected) and atypical (long-stay outliers, deaths, transfer cases, and self sign-outs) groups. Days can be further subdivided into regular and ALC (which are low-severity) days. Typical cases are measured on a per case basis. Unadjusted for comorbidities and additional interventions, this method provides base RIW values for each CMG group. Costs are assigned to	Base RIWs for CMG/age group obtained from CIHI’s <i>DAD Resource Intensity Weights and Expected Length of Stay for CMG+ 2014</i> . Hospital- or province-specific CSHS is applied to the RIWs in order to obtain per case costs; these are obtained from CIHI’s <i>Hospital Financial Performance Indicators</i> .

Method of Costing	Description	Where to Get Data
	RIWs using a CSHS, formerly called the CPWC.	
Refined CMG + (refined CMG+) – adjusted base values applying RIW (called case mix costing or top-down costing)	Starting with base values, the RIW for each case within a CMG is further adjusted for co-morbidities and additional interventions. The CSHS is used to assign costs to the case.	RIWs for intensity-adjusted CMGs are obtained from DAD. The CSHS is obtained from CIHI's <i>Hospital Financial Performance Indicators</i> or CIHI's <i>Your Health System</i> website.
Patient costing (also called case costing, micro-costing, or bottom-up costing)	Each case is costed out separately according to services used and costs of services in the relevant hospital cost centres. Overhead costs can be added to the direct service costs to obtain a full cost per patient.	Cost by case, with patient identifiers, can only be obtained from specific health service organizations that have implemented patient-specific costing. Patient costing data from Ontario and Alberta is used to generate average base costs that inform CIHI's CMG+ groups and RIWs. Ontario data can be separately obtained online from the Ontario Case Costing Initiative's CAT. Alberta data can be obtained online from Alberta Health's Interactive Health Data Application.

ALC = alternate level of care; CAT = Costing Analysis Tool; CIHI = Canadian Institute for Health Information; CMG = case mix group; CPWC = cost per weighted case; CSHS = cost of a standard hospital stay; DAD = Discharge Abstract Database; RIW = Resource Intensity Weight.

The following sub-sections provide more information on these in-patient hospital costing categories.

3.1.1 Per diem costs

The per diem cost is the cost per in-patient day multiplied by the length of hospital stay. Each day of stay is costed the same based on the assumption that costs accrue at a stable rate during the hospital episode. Any differences in service intensity between cases or diagnoses will be captured only by differences in length of stay.

Although this approach is simplistic, there are times when a simple per diem cost is more appropriate than a per-case cost. This approach may be useful when looking at care over a longer period of time, where there are changes in costs or when assessing historic costs of care. There are limitations with per diem costs, as resource intensity between case types may differ and cannot be accounted for in length of stay alone. For example, CMG 315 (hip replacement) and CMG 136 (bacterial pneumonia) for the age group 18 to 59 have roughly the same expected length of stay (5.3 days versus 5.4 days) but have substantially different resource weightings (2.355 versus 0.127) — an average hip replacement requires more than twice the resource intensity as treatment for an average bout of bacterial pneumonia.

3.1.2 Case mix costing

CIHI collects in-patient discharge data from hospitals across the country on a common discharge abstract.¹² The hospital discharge abstract, coded by the hospitals, contains considerable clinical and administrative data for each discharge or case, including patient age and sex, diagnoses (using International Classifications of Diseases, version 10, Canada-specific [ICD-10-CA] diagnoses codes) and types of diagnoses (a system of ranking diagnoses), and

interventions. Diagnoses are coded using a Canadian adaptation of the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10-CA)*. The Most Responsible Diagnosis (MRDx) code in the hospital discharge abstract identifies the diagnosis that is deemed to be responsible for the longest portion of the patient's stay. Other diagnoses are also coded according to their contribution to the course of care.¹³ The discharge abstract also includes interventions (using the Canadian Classification of Health Interventions system) received by the patient during the stay. Hospitals send the reported abstracts to CIHI, which process the abstracts and incorporate them into the Discharge Abstract Database (DAD). A description of the data collection process and data content for DAD can be found on the CIHI website.¹⁴

The terms CMGs, resource intensity weights (RIWs), and cost of a standard hospital stay (CSHS) are important for understanding the case mix costing component. These terms are subsequently explained.

a) Case Mix Groups

A CMG is a collection of cases with similar characteristics, including diagnoses, interventions, and resource use. The CMG+ grouping methodology, developed by CIHI, first groups cases into 25 major clinical categories, which are for the most part based on the body system identified by the MRDx. Using the current CMG+ grouper, cases are then further subdivided into 528 medical and surgical CMGs.

The version of the CMG grouper used depends on the year. The methodology has now entered into a three-year update cycle. A description of the CMG grouping process is found at the CIHI website.¹⁵

In the basic CMG+ method, cases are divided into CMGs using CMG+ groupings, which are based on diagnosis and procedure data. Cases are also divided into typical (each case proceeds as expected) and atypical (long-stay outliers, deaths, patient self sign-outs, and inter-hospital transfers) groups.

b) Resource Intensity Weights

For each of the 528 CMGs, resource indicators called RIWs are produced. RIWs provide a standardized estimate of expected resource consumption. An average case is given a value of 1.00. A base RIW value is calculated for each CMG age-group combination. Different calculation methods are used for typical cases (outcome and length of stay is as expected), and atypicals (deaths, self sign-outs, long stay outliers, and transfers to/from another acute care hospital at discharge). The RIWs are calculated using patient costing data from a sample of hospitals. CIHI base estimates for typical RIWs by CMG+ groups are available online.¹⁴ Base RIW values for CMGs are subdivided by age categories to provide more precise estimates of RIW. Using daily data, RIWs are also reported for atypical cases and ALC, also by CMG+. The RIWs for atypical cases are estimated on a per diem basis, and so the longer the stay for each atypical case, the greater the RIW. The RIW for the typical CMG includes the average number of ALC days for that CMG.

The CMG+ classification system also provides a refinement to the base RIWs, to capture differences in service intensity within each CMG. In the refined CMG+ system, co-morbidities are identified, and specific procedures and interventions are flagged; when these are taken into account they will contribute to each patient's RIW. This refinement allows for a more precise description of the RIW of the case beyond the basic typical values with age categories. Since RIWs for the refined component of the refined CMG+ system are estimated using patient-

specific data, researchers must indicate the specific cases for which RIWs are required from the DAD database.

c) Cost of a Standard Hospital Stay

All hospitals outside of Quebec report in-patient discharge data to CIHI, which groups the cases by CMG and case status (e.g., typical and atypical) and assigns RIWs. The RIWs for all cases within a providing unit (hospital or province) can be tallied to obtain the total weighted in-patient case for the providing unit. Using its Canadian Management Information System (MIS) Database (CMDB) data, CIHI can also estimate total in-patient costs for each providing unit or province. When the tallied in-patient costs for the units are divided by their tallied RIWs for all cases, the resulting statistic is the cost of a CSHS. The CSHS is the dollar multiplier that can be applied to any RIW (index statistic) to generate the CMG-based cost. The CSHS by province is available from the CIHI website as part of the *Hospital Financial Performance Indicators* release (http://www.cihi.ca/CIHI-ext-portal/internet/EN/Quick_Stats/quick+stats/quick_stats_main?xTopic=Spending&pageNumber=1&resultCount=10&filterTypeBy=undefined&filterTopicBy=14&autorefresh=1). CIHI's *Your Health System* website (<http://yourhealthsystem.cihi.ca/>) also provides CSHS information, available at the Local Health Integration Network level.

3.1.3 Patient costing

Patient costing (also known as case costing, unit costing, micro-costing, or bottom-up costing) is the most specific, as each case is separately costed according to the individual services that the patient receives. To conduct patient costing, the researcher will need access to individual patient data, but even then only a small number of hospitals in Canada have capabilities to generate these costs. This form of costing is relevant when a researcher wants to compare alternate treatment strategies within a single CMG.

Some hospitals in Ontario, Alberta, Nova Scotia, and British Columbia support an enhanced management information system that can report patient-specific consumption for a number of individual services, such as in-patient nursing, laboratories, radiology, and pharmacy. For each of these services, the hospital typically uses an output measure, such as a workload unit specific to the service being costed, and tracks the number of workload units (e.g., units of lab services used) attributed to each patient. Further, the hospital can develop a department or functional centre cost by averaging the sum of all department or functional centre costs over all workload units produced in the centre. From this, a cost per workload unit for each service can be derived. Hospitals can estimate the cost per patient for each service by multiplying the unit cost assigned to the service by workload units consumed by patients. Using this approach, the hospital can tally the cost over all of the services to develop a direct service cost for each patient, hence the term “patient costing.”

While most hospital departments use workload or time-based costing, pharmacy is different. The professional component can be assigned on a workload or time basis, while any dispensed drugs need to be costed out separately. (See Pharmaceuticals, section 1, of this document.) The costs of medical devices also need to be added in separately.

Patient costing provides a measure of *direct* service costs for each case. Using cost allocation procedures outlined by CIHI,¹⁶ the indirect overhead costs can be allocated to each department and therefore onto each case, thus yielding a full cost for each patient, including the overheads. Note that CIHI does not include building depreciation in its overhead statistics; however, this omission may not influence the cost difference between interventions.

3.1.4 Data sources

a) Per diem costs

In order to calculate costs using the per diem approach, the researcher needs to have the patient's length of stay and the cost per day. The expected length of stay for typical cases can be found in the CIHI publication *DAD Resource Intensity Weights and Expected Length of Stay for CMG+ 2014*. This publication provides data by CMG. Data on length of stay of individual patients or groups of patients, when included in the DAD databases, can be obtained from health providers and provincial health departments. They can also be obtained manually from chart reviews and clinical studies.

The hospital cost per day is not published but can be obtained from CIHI by request.

b) Case mix costing data

Costs for each CMG, using RIWs and CSHS, can be estimated by using the data tables previously mentioned. Following, we use an example of the calculation of costs based on the RIW method.

Example C-1

Study problem: What is the cost of unilateral knee replacement in Ontario for a 50-year-old patient?

- First obtain the RIW for the hospital portion of the knee replacement. The base RIW for CMG 321 (unilateral knee replacement) for a person aged 18 to 59 is 1.43339 based on CIHI's *DAD Resource Intensity Weights and Expected Length of Stay for CMG+ 2014*, Appendix B, Base Table.
- The CSHS is obtained from CIHI's CMDB Hospital Financial Indicators (source: <https://secure.cihi.ca/estore/productFamily.htm?locale=en&pf=PFC2608>). This database is an MS Excel file. Ontario-wide data are obtained from the Provincial tab on the database. The Ontario-wide, weighted average, unadjusted CSHS, which is the raw figure, is \$5,317.
- The cost of a case for CMG 321 is \$7,620 (1.43339 x \$5,317). This should be updated to the most recent year using the methods indicated in Appendix 1. Thus, the hospital cost of a unilateral knee replacement in Ontario in 2015 is calculated to be \$7,834 (\$7,620 x 1.028 [1.028 is the Consumer Price Index or price-level adjustment]). These estimates were based on typical cases only.
- This statistic is an estimate of the in-patient component of cost. The physician fees must be added, as well as post-discharge rehabilitation costs.
- An example of rehabilitation costs are included later in the document. Using the OHIP *Schedule of Benefits* (May 2015), physician procedure costs are indicated to be \$838.00 (#R248); the associated assistant fee (8 units x \$12.04 unit fee = \$96.32) and anesthesiologist fee (8 units x 15.01 = \$120.08) are also added. Thus, an additional in-hospital cost of \$1,054.40 (\$838.00 + \$96.32 + \$120.08) can reasonably be included.

c) Case mix data based on patient cost estimates

In addition to the RIW-based estimates, there are three additional sources of data for costs by CMG, but they are not estimated using the RIW method. Most are based on averages of individual patients' costs within a CMG group, where costs were estimated using the patient costing approach. The first source of data is the interactive CIHI Patient Cost Estimator. Using this tool, the researcher can retrieve average costs for CMGs that are based on the CMG+ classification system. Data are available by province for each CMG and age group. The data

can be obtained online at http://www.cihi.ca/CIHI-ext-portal/internet/en/documentfull/spending+and+health+workforce/spending/pce_application.

Alberta Health provides in-patient cost data for each CMG based on the CMG+ classification system. Costs were calculated using the patient costing method, and were aggregated to the CMG level, rather than being estimated using RIWs and CSHS. Alberta Health also provides some historical data on its website (http://www.ahw.gov.ab.ca/IHDA_Retrieval/). Alberta Health's Interactive Health Data Application (IHDA) estimates are available by Alberta region and year. IHDA provides current year and inflation-adjusted estimates for average costs, and current year estimates for median costs. For each CMG, data are available by age group for typical cases only, atypical cases only, or all cases combined. Both average and median costs are available, but when conducting an economic evaluation, average costs are preferred to median costs. The researcher has a choice of using typical, atypical, or all cases combined. The choice will depend on the target population for the economic analysis. If the hospitalized cases include all cases hospitalized, then the researcher should use the costs for all cases — typicals and atypicals — as typicals exclude the more severe cases.

Example C-2

Study problem: What is the cost of unilateral knee replacement in Alberta for a 50-year-old patient?

- Researchers can use the Alberta IHDA (Source: http://www.ahw.gov.ab.ca/IHDA_Retrieval/selectCategory.do), specifying the Health Costing category, the year of interest, the desired measure (average cost), the CMG+ category (321; unilateral knee replacement), and the case type — all cases, atypical cases, or typical cases.
- The most recent year for the IHDA cost data is 2012/13.
- Where the researcher is interested in “all cases,” the cost is \$10,263. This should be upgraded to the most recent year using the methods indicated in Appendix 1. Thus, the hospital cost of a unilateral knee replacement in Alberta in 2015 is calculated to be \$10,547 ($\$10,263 \times 1.028$ [1.028 is the Consumer Price Index or price-level adjustment])

These costs do not include post-hospital rehabilitation and physician costs, which must be estimated separately and added to obtain the total cost.

This cost is considerably greater than that calculated for Ontario using RIWs (Example C-1), which only included typical cases. CIHI data also indicates that the CSHS in Alberta was more expensive than the CSHS in Ontario in 2012/13.

The Ontario Ministry of Health and Long-Term Care (MOHLTC) previously maintained in-patient cost data on its Ontario Case Costing Initiative (OCCI) website as a publically available tool (Cost Analysis Tool; CAT). This tool is now housed within Ontario's Health Data Branch Web Portal (<https://hsimi.on.ca/hdbportal/>), but users must register to access the tool. Data within the CAT are also derived from patient-level costing data, rather than RIWs. In-patient data are available by fiscal year. Data can be sorted to provide cost estimates for average cost using the following data fields: hospital or Ontario-wide, age group, CMG (using CMG+ grouper), diagnosis code, and procedure. The CAT allows the researcher to generate average costs for the chosen subgroups.

d) Patient costing on a case-by-case basis

Patient-specific costs, as generated from CIHI's CMDB, are only available for some hospitals in four provinces (Alberta, Ontario, British Columbia, Nova Scotia) and can be obtained direct from provincial health departments of some health regions.

3.1.2 Cost considerations

- Hospital costs are often available in groups, and the researcher has a choice of statistics, including mean and median. For economic evaluation, a mean cost is appropriate.
- Case costs can be estimated using only direct service costs, or direct service and overhead costs. Some economists have stated a preference for "full" costs, including overheads, because these will reflect long-term marginal costs, including capital and overhead.¹⁷
- The researcher has a number of different approaches, including per diem costing, case mix costing, or more refined methods of patient costing. In general, grouped costs such as case mix costs are more easily attainable. However, certain interventions have a differential effect on cases with similar diagnoses, and costs for individual patients are preferred although they may not be available.
- CIHI's *Your Health System* website (<http://yourhealthsystem.cihi.ca/>) provides access to information at a Local Health Integration Network level, however the data is provided at an overview level, not disease-specific.
- In summary, the strengths and weaknesses of costing methods are presented in Table 2. Per diem costs are useful when the researcher wants to estimate a longer-term, historical series of costs. There are many shortcomings in using this costing method, and usually case mix or patient-specific costing is preferred. Case mix costs are generally the most useful costs, in that the RIWs reflect resource use differences between CMGs. However, the RIWs have been derived from a small number of hospitals and so will reflect service use patterns in those hospitals. Finally, person-level costs are the most precise but are very limited in their availability.

TABLE 2: KEY STRENGTHS AND WEAKNESSES OF ALTERNATIVE IN-PATIENT HOSPITAL COSTING APPROACHES

Approach	Strengths	Weaknesses
Per diem costing	Provides a consistent measure over an historical period	<ul style="list-style-type: none">• Does not distinguish between (higher cost) early days and later days of a hospital stay• Does not address differences in resource use between different types of cases
CMG	Addresses differences in resource use between different types of cases	<ul style="list-style-type: none">• Does not capture historical differences in resource use per case• RIWs are not hospital-specific; based on data for a small number of hospitals
Patient costing	Allows for a more precise comparison between identified cases within a single diagnostic group	<ul style="list-style-type: none">• Limited availability of data• Expensive to establish databases and collect data

CMG = case mix group; RIWs = resource intensity weights.

3.2 Outpatient Hospital Care

Outpatient (or ambulatory) hospital care consists of patient visits to a hospital, where the patients are not admitted. These visits can include diagnostic services, clinic care, outpatient surgery, and emergency department visits. Many services will include a physician's intervention

or consultation, but these costs are usually counted separately from the hospital facility component of care.

When a patient visits the hospital, the characteristics of the visit are recorded using a nationwide, standardized format overseen by CIHI called the National Ambulatory Care Reporting System (NACRS).¹⁸ Hospitals collect and report data in varying levels of detail. These data have enabled CIHI or provinces to develop an outpatient classification system called the Comprehensive Ambulatory Care Classification System (CACS).¹⁹ Only a small number of hospitals in Ontario, Alberta, and British Columbia collect outpatient costs — that is, associated costs with NACRS records. Associated resource use data has been used by CIHI to develop RIWs for outpatients.

The data elements that are collected in the NACRS database includes patient identifiers, mode of care (emergency department, surgery, clinics, diagnostic imaging), diagnoses, interventions, time elements (time of arrival, time seen by clinician), and disposition of patient (discharged, admitted).¹⁸ CACS cases are divided into broad categories, including: telephone consultations, emergency department visits, ambulatory interventions, direct diagnostic imaging, rehabilitation, and medical clinics. Using data such as diagnoses, interventions, and age, CIHI groups cases into diagnostic and intervention groups in the CACS.

Cost data, which is collected by only a few hospitals, includes direct costs (nursing, diagnostic tests, operating, and recovery room), functional centre indirect costs (meals, facilities management, plant operation), and costs for patient-specific drugs and supplies. CIHI estimates a series of resource weights for each of these CACS groups that have been developed in tandem with in-patient RIWs. For example, using the CACS 2014 Client Tables, which are based on 2010 NACRS data, code A101 – nuclear imaging, the RIW is 0.1883. This is interpreted the same as in-patient RIWs.

3.2.1 Data sources

Both Alberta and Ontario make their provincial costs available on interactive websites. Alberta classes its data into CACS groupings in its IHDA (http://www.ahw.gov.ab.ca/IHDA_Retrieval/selectCategory.do?dataBean.id=201&command=doSelectSubCategory&cid=201). By choosing the CACS category on this website, investigators can then select the desired data according to health region, year, the desired CACS category, and the location of service (emergency department or other). The site provides estimates for each CACS category for average and median cost, inflation-adjusted, or current period costs. As in the case of in-patient care, physician fees are not in these estimates, and so for a public health care system perspective they should be added in.

Ambulatory care cost data are available for Ontario from the Ontario Case Costing Initiative CAT (now located within the Ontario Health Data Branch web portal (<https://hsimi.on.ca/hdbportal/>)). Using the CAT, Day Surgery or Ambulatory Care can be selected, for a specific year and hospital (or all hospitals), the CACS group, and the patient age group. The researcher can further drill down by procedures and diagnoses to get more specific estimates. The resulting report will provide an average cost for the group, for the year selected.

Actual data which assigns CACS categories are obtained from provincial health departments or CIHI, although the identification of patients can only be done at the provincial level. CIHI's CACS categories and RIWs are available here: (<https://secure.cihi.ca/estore/productSeries.htm?pc=PCC565>). The table "Functional Area RIW Proportions CACS 14" contains the 2014 RIWs for the CACS groups and the breakdown of

these weights by clinical area. For example, the CACS group C212 provides data for varicose vein stripping and ligation. The RIW for this group is 0.3731. The functional area “Operating and recovery room nursing services” comprises 60% of this RIW. Outpatient nursing services comprises 9%, and indirect costs comprise 29%. Using these figures, the portion of the RIW attributable to the operating room, outpatient nursing services, and indirect areas can be determined. To transform the RIW (and its subcomponents) into costs, the RIW can be multiplied by the relevant CSHS, which is obtained from CIHI Hospital Financial Performance Indicators (https://secure.cihi.ca/free_products/HFP_Indicators_Methodological_Notes2014_EN.pdf) on a per hospital or provincial level.

3.2.2 Cost considerations

- Costs by CACS group are available from CIHI; however, there is generally a charge for obtaining them. Alberta-specific average patient costs are publicly available, with unit cost data for a five- year period (2005/6 to 2010/11). The Ontario OCCI CAT also includes outpatient and day surgery costing, and may be used similarly to the Alberta IHDA tool.
- Alberta Health allows viewers to obtain the median cost and the average cost, year-by-year or inflation-adjusted. For an economic evaluation, we suggest that the average cost is used.
- Medical devices are included in the CACS cost whenever the hospital pays. In certain circumstances (e.g., cochlear implants in some instances), payment for supplies may be through other sources and thus may be costed separately (see section 4. Medical Devices).

4. Diagnostic and Investigational Services

Diagnostic and investigational services include imaging procedures, laboratory and pathology tests, and other investigational procedures. This section describes diagnostic and investigational services that are not undertaken within the hospital setting or where costing is required at the patient-level. Costing of interventional medical devices is also included in this section. Costs of hospital-based diagnostic and investigational services are included within section 3, Hospital Services.

4.1 Radiology Services

Radiology services are used by medical practitioners outside the hospital setting for both diagnosis and treatment, which include an array of imaging technologies such as X-ray radiography, ultrasound, computed tomography, nuclear medicine, positron emission tomography, myocardial perfusion imaging, and magnetic resonance imaging.

In the outpatient setting, diagnostic radiology services have separate costing components: technical (institutional/facility) fees; and professional (interpretational) fees. Facility fees include preparation for interventions, and provision of information and records. Professional fees are those charged by the physician for the interpretation of the results. For more detailed information on facility and professional fees, researchers should consult province-specific information (such as the OHIP *Schedule of Facility Fees for Independent Health Facilities*),²⁰ as the fees and services descriptions may vary substantially between provinces. Another method is to directly cost physicians' time and the time required for other services to facilitate the radiology service (e.g., cost of equipment and technicians).

4.1.1 Data sources

Given the paucity of patient data to measure the detailed costs associated with radiology services, radiology fees should be used as a proxy for the cost. The fees for radiology services are not uniform across Canada and often vary within different regions of a province. Some provinces include radiology fees within their provincial schedules of fees and benefits; however, radiology fees may be included in other provincial-based fee guides, such as the Saskatchewan Medical Association guide (<http://www.sma.sk.ca/105/sma-fee-guide.html>) and *Manitoba Physician's Manual* (<http://www.gov.mb.ca/health/documents/physmanual.pdf>). Documents providing fees for radiology services often provide fees for both the professional and technical components. Where fees are not available from a provincial government or medical association website, the researcher should undertake a web-based grey literature search to identify a small sample of cost sources from the appropriate province. Any required labour costs and monitoring time should be captured as per the guidance provided in the physician services (section 2) for doctors, and non-physician service sections (section 5) for nurses and technicians. The measurement of resources and services requiring costing may be informed by publicly available Canadian documents (such as product monographs and clinical practice guidelines), but may also be informed through surveys of health professionals.

4.1.2 Cost considerations

- Where multiple sources report varying fees for the same service, the mean cost should be used, with the plausible ranges tested in sensitivity analyses to reflect the uncertainty.
- Some provincial fee schedules provide units instead of costs. These schedules will have a unit multiplier to apply to the number of units to determine the cost for the service.

Example D

The cost of a bone mineral density —or BMD — test using Dual-energy X-ray absorptiometry — or DEXA — from the perspective of the public payer in Manitoba can be obtained from the Manitoba *Physician's Manual*. From the April 2014 *Manual*, using code 7100, the DEXA scan is \$54.85. It should be noted that the fee is only listed for the professional component of the service and thus not all relevant costs are included.

4.2 Laboratory Testing/Assays

Laboratory tests and assays are diagnostic and/or investigative services that are often ordered by medical practitioners to assist in diagnosing or monitoring. This category applies to services that are undertaken in a non-hospital setting, as costs of tests that are undertaken in the hospital setting are included in the cost estimate methods described in section 3. Tests may be available individually or as part of a panel/combination testing. As per radiology services, there are two methods of costing for laboratory tests: an FFS method and a direct-cost method. Generally, direct costs associated with testing are not available and thus the relevant fee associated with the test is appropriate to use.

4.2.1 Data sources

As noted in section 4.1, Radiology services, because of the paucity of patient level costing data, a FFS should be used as a proxy for the cost. Fees for laboratory tests and assays may be found in provincial government-based schedules of fees and benefits. Some provincial fee schedules provide units instead of costs. These schedules will have a unit multiplier to apply to the number of units to determine the cost for the service. Private facilities may also supply a list of fees. Few laboratory schedules or fee lists indicate what is included in the fee. Where the cost components are listed, the researcher should indicate the cost components included.

The measurement of resources and services that are required to be costed may be informed by publicly available Canadian documents (e.g., provincial schedules of benefits, laboratory fee guides, product monographs, clinical practice guidelines), but may also be informed through surveys of health professionals.

4.2.2 Cost considerations

Determine whether the laboratory tests and assays are single services or part of combination testing. Expert opinion may be required. Where the tests are only available as a panel/combination test, the cost for the full test should be included. The methodology to address costs associated with the interpretation of the tests is captured within the data sources subsection of section 2, Physician Services (also found in the provincial Schedule of Benefits), or in section 3, Hospital Services.

Example E

A researcher is undertaking an economic evaluation including hemoglobin and hematocrit tests from the perspective of the public payer in Manitoba.

The fee should be determined by the breadth of testing required: are the tests offered separately or as a panel. The April 2015 *Manitoba Physician's Manual* indicates that for automated hematology, "for two or more of the following hematology procedures done on automated equipment and on one sample of blood — white blood cell count, red blood cell count, hemoglobin, hematocrit, and indices — the fee for each procedure shall be the same as the comparable manual test, to an accrued maximum of \$5.65". Individually, the fee for a hemoglobin test is \$3.60 (code 9150), whereas the fee associated with a hematocrit test is \$3.30 (code 9147); a total of \$6.90 when combined. If the researcher is interested in only one test, or determining the costs and benefits of each test separately and combined, then the use of the individual test fees may be more appropriate. If the researcher is interested in both tests done concurrently, then the panel test fee may be more appropriate. The researcher should note where there is a lack of clarity as to what is included in the test cost (reagent, supplies, interpretation, etc.).

4.3 Medical Devices

Medical devices cover a wide range of health or medical instruments used in the treatment, prevention, or diagnosis of a condition.²¹ As noted in Hospital Services, section 3, medical devices may be costed within the CMG cost weights associated with an in-patient hospital stay. However, there may be circumstances where the cost of a medical device may not be presented in the CMG cost weight (e.g., cochlear implants). Guidance in this section is primarily intended for use in situations where medical devices are required to be costed separately, as they are not included in other cost components.

4.3.1 Data sources

Medical device costs can either be obtained from manufacturers or purchasers (e.g., health regions, hospitals). Most medical device costs are not publicly reported. Where the price is obtained directly from the manufacturer, this would typically reflect the list price, as details on any negotiated discounts are rarely disclosed. A purchaser, however, may disclose a negotiated price where they are not bound by confidentiality of the agreement.

The measurement of resources/services required may be informed by Canadian guidelines or through a survey of health professionals.

4.3.2 Cost considerations

- As noted earlier in this section, this guidance should be used when costing medical devices on an individual basis. Examples of appropriate costing can be seen through some of the previously published literature, which include the cost of medical devices.²²⁻³²
- When the device lasts more than one year, appropriate discounting methods should be used.

5. Non-Physician Professional Services

Non-physician professional services are provided both within health facilities and in the community by independent practitioners, such as allied health professionals. This section refers primarily to the independent provision of these services in the community setting.

5.1 Independent Non-physician Professional Services

Non-physician health professionals include pharmacists, physiotherapists, optometrists, chiropractors, and dentists. Several provinces have begun increasing the number of pharmacist services that they will pay for. In certain provinces, pharmacists can administer vaccinations and provide consultations to patients (e.g., Ontario MedsChecks, flu shots). These professionals can provide services within a facility setting or in the community. This section focused on the community setting.

When these services are provided in the community, the government may pay only a portion of the cost of the services, and the patients (directly) or their third-party payers (insurers) will pay the remainder.

5.1.1 Data sources

For non-physician services covered by the government payer, provincial fee lists available on health ministry web pages should be used when considering that perspective. For example, pharmacist services for consultations at the time of dispensing a new or repeat prescription and for conducting medication reviews (e.g., Ontario's MedCheck) are listed in the Ontario MOHLTC documents³³ and Alberta Health documents.³⁴

The reported fees may not reflect the full cost of service, for which the remainder may be paid by patients (through copayments) or private insurance (partial coverage). While this is not relevant when considering a public payer perspective, as the listed government fee is the most appropriate data source, consideration of the full cost of the service may need to be considered when broader perspectives are adopted. There is no information on whether government fees fully cover the cost of providing the service and so amounts paid out of pocket by the individual or by a private insurer are typically not readily available. When considering a broader perspective (such as a societal perspective), a literature search for a Canadian source that provides the full cost of the service should be undertaken, especially when there are likely to be private copayments. Fees recommended by professional bodies, or elicited through surveys of patients or practitioners, may be required.

Where the abovementioned data sources on fees paid do not provide the requisite information, an option would be estimating the cost using the hourly rate paid to the practitioner adjusted according to the time spent on the service. Benefits should be added to this rate if they are not already included. See Appendix 1 for a source of estimates for employment benefits.

5.1.2 Cost considerations

There is some uncertainty as to the appropriateness of fee lists. As an example of costs, chiropractic fees are recommended by the Ontario Chiropractic Association (<https://www.chiropractic.on.ca/fee-schedule>). As these are recommended, they represent full payment, though there is no evidence that they are the fees charged. The Ontario MOHLTC has a fee schedule for optometrists (http://www.health.gov.on.ca/english/providers/program/ohip/sob/optometry_schedule_master.html). As long as optometrists do not charge patients additional fees, then these would be a good representation of costs. There are several different lists of dentist fees in Ontario. The Ontario

Dental Association has a dental fee guide, available only on paper (<http://www.oda.on.ca/you-your-dentist/dental-benefits-explained91#FeeGuide>). This would be a good source, as long as the dentists charge no more than the stipulated amount. The Ontario MOHLTC also has a dentists' fee guide (http://www.health.gov.on.ca/en/pro/programs/dental/docs/hso_services_fees_dentist.pdf), which would be accurate to use if there are no additional fees paid by the patients. Finally, the Financial Services Commission of Ontario publishes a fee guide for physiotherapists, to be used when treating automobile accident patients (https://www.fsco.gov.on.ca/en/auto/autobulletins/archives/Pages/a-12_97.aspx). These would be suitable indicators if these fees are also charged to other patients.

5.2 Nursing Services

Nursing service costs are included in in-patient, outpatient, and community care (e.g., home care, assisted living) sections of this report. In addition, nurses can provide care as independent practitioners. There is no fee schedule or recommended fees for private nursing.³⁵ Nursing fees can be estimated by directly valuing the time spent in practice (i.e., hourly wages).

5.2.1 Data sources

Nursing costs are estimated on an hourly basis. As there is no fee schedule for private nursing (e.g., home care), nursing wages in the public sector can be approximated using annual wage agreements between the nursing unions in each province and the provincial governments. For example, the Ontario wage agreement can be found in the Ontario Nurses' Association collective agreement.³⁶ However, the wage varies by years of service, so the seniority of the nurse (in years) must be reflected. In the Ontario Nurses' Association collective agreement, the wage is expressed in terms of hours worked. The agreement has a provision for 12 days a year of paid vacation. Information on costing of fringe benefits can be found in Appendix 1 of this document. To estimate the payment for a private nurse, assume that they can charge the equivalent rate as a public nurse. This may be an underestimation when the private nurse works for an agency which charges overhead to account for the profit margin.

Using hourly nursing fees requires an estimate of the total nursing time used for the service. This information is not generally available. Eliciting the information through questionnaires and surveys may be required, where guidelines or publicly available documents are not available. In the case of any administrations or monitoring that requires nurse presence, the estimated time of administration and monitoring should be multiplied by the appropriate hourly nursing rate.

Example F

A private nurse with requisite experience (eight years, based on assumption) is hired for seven hours:

- The cost per hour, obtained from the 2014 Ontario collective agreement, is \$43.45 for a nurse with eight years' experience.³⁶
- To this, 13% is added for benefits and 4.8% for vacation pay.
- Total hourly cost is estimated to be \$51.18. As a result, the total cost of care for this session is \$358.26.

6. Community-Based Services

Community care (or continuing care) services include some allied professional services, non-professional, and other services that are provided in an organizational but non-hospital setting, on a post-acute care or continuing basis. Settings may include nursing homes, assisted-living, and home care. The cost of physicians treating patients in these settings must be added separately, as discussed in previous sections.

6.1 Residential Care

Residential care is the joint provision of longer-term accommodation and health care services in a facility. Both the length of accommodation (which includes room and board and some living assistance) and the degree of the intensity of the health care intervention (which includes nursing and rehabilitation) will vary. Facilities with higher levels of health care interventions include nursing homes, assisted living arrangements, or long-term facility-based care. Generally, residents are responsible for the cost of accommodation, whereas the government pays for the health care components. However, Canadians on social assistance may receive government subsidies.

Stays in long-term care vary widely and so there is no standard or expected length of stay, as in the case with hospitalization groups. The costed unit is therefore a day of stay. The resources required for a day of stay can vary based on the complexity of the case or the condition of the resident.

The resource utilization group (RUG) is a case mix classification system that uses data from the Resident Assessment Instrument – Minimum Data Set 2.0 (RAI-MDS 2.0), which contains data collected from residents on cognition, degree of disability, and care received (http://www.cihi.ca/CIHI-ext-portal/pdf/internet/CCRS_OVERVIEW2012_PDF_ENI). Version III (RUG-III) grouping methodology was updated and implemented in the US between 1997 and 1998.³⁷ The Ontario MOHLTC adopted the methodology to inform funding of complex continuing care beds in Ontario, beginning April 1, 2000. In addition, the Ontario MOHLTC is using RUGs to allocate funding to long-term care homes. The RUG-III classification system groups residents into seven RUG categories based on resource intensity, prioritized from the most resource intensive to the least. Within each of the RUG categories, there are a number of more precisely defined RUG groups. CIHI's Canadian standard is the RUG-III 44-group methodology, while the Ontario long-term care facilities use a different version of RUG-III that has 34 rather than 44 groups. The differences between these two grouping methodologies are largely related to the Special Rehabilitation category. Each RUG-III group is also assigned a case mix index (CMI) that provides an indication of the average daily resource use for individuals assigned to a particular group. CIHI summarizes these clinical and resource characteristics of individuals and facilities and produces quarterly RUG-weighted patient days reports. RUG-III methodology and CMI values are available through the CIHI website (<http://www.cihi.ca/CIHI-ext-portal/internet/EN/TabbedContent/types+of+care/community+care/home+care/cihi021338>). The RUG-weighted patient days reports are available to long-term care homes, and facilities with complex continuing care beds in Ontario through CIHI's eReporting portal (www.cihi.ca). Unit costs per RUG-III group are publicly available for Ontario through a document issued by the Health System Performance Research Network.³⁸

The cost of each long-term care day for Ontario has been estimated by the Ontario MOHLTC. Long-term care costs in Ontario, as in all provinces, are shared between the government and residents. The government pays for the health care portion and the residents pay for the accommodation component. Therefore, if a researcher is estimating the cost per day using a

ministry of health perspective, the accommodation fee would be excluded in most cases. The accommodation fee should be included if the researcher is using a broader perspective (e.g., societal), so that all of the payments would add up to the provider's receipts. In the Health System Performance Research Network (HSPRN) document, Wodchis et al. present the per diem Ontario long-term care cost for four service categories: nursing and personal care, programmes and support, raw food, and accommodations.³⁸ In this case, only the unit cost for the first category nursing and personal care (which includes other ancillary health care services such as occupational and physical therapy) should be multiplied by the RUG III weight to get the health care cost for a patient. The other categories are daily accommodation costs that do not vary with case mix.

Where researchers are conducting an analysis specific to a province, they should consult with their ministry of health to request information on long-term care costs, as they are not publicly available. Otherwise, researchers may request information from CIHI for national level estimates. Researchers should note that while Ontario delineates residential care and chronic continuous care, other jurisdictions may not. Thus, the researcher should use the appropriate data based on the perspective being considered. A description of the Residential Assessment Instrument Minimum Data Set can be found on the InterRAI website (<http://www.interrai.org/>).

Example G

Cost of a rehabilitation at a residential care facility in Ontario:

- Based on data from clinical studies, it is estimated that rehabilitation for a knee replacement would require a mean of 10 days stay.
- The cost per day for special rehabilitation is the sum of the costs of the four service categories identified — nursing and personal care (including all clinical services), programmes and support, raw food, and accommodations. In Table 2 of Wodchis et al., 2011-2012 programs and support cost \$8.35 per day, raw food costs \$7.33, and accommodation costs is \$50.30. The costs of both nursing and personal care (the only cost that varies with case mix) with a RUG III index value of 1.0 is \$86.05. This particular case (level RAA) has a per diem weight of 1.0167 (Wodchis, et al., Table 6), and so the per diem cost of the case for nursing service is $\$86.05 \times 1.0167$, or \$87.49. The total daily cost for long-term care for this patient is the sum of all costs, which is \$153.47. This should be updated to the most recent year using the methods indicated in Appendix 1 of this document. Thus, the rehabilitation cost for a unilateral knee replacement in Ontario in 2015 is calculated to be \$159.27 ($\153.47×1.038 [1.038 is the Consumer Price Index or price level adjustment]).
- The ten-day institutional costs from a societal perspective are \$1,592.70 based on the assumption that the patient is classed as RAA severity for all days. The *public* portion of the daily cost is estimated at \$90.80 ($\87.49×1.038), and the private pay portion is the remainder. This is because the government only pays for the clinical or rehabilitation component. Because assessments are completed at different points in time throughout a resident's stay, the RUG group associated with each assessment may change during the episode of care. We assumed that the CMI remained constant for the entire stay.

6.1.2 Cost considerations

- There is considerable physician activity in long-term care facilities; however, physician services are costed separately from the facility component.
- When the public payer perspective is being used, only the government payer component is included. If a societal perspective is taken, the self-pay residential fees and any government accommodation subsidies should be included, as well.
- In the RUG III CMI, the patient is classified on a per-day basis. The CMI can change if the resident's needs change during a stay.
- Some long-term care information is available on CIHI's *Your Health System* website (<http://yourhealthsystem.cihi.ca/>), but given the lack of specificity should be used with care.

6.2 Home Care

Home care, which may be referred to by other terms in different regions of Canada, is composed of visits made by a professional provider (e.g., a home care nurse or a physiotherapist) or personal support worker to patients in their homes. Home care, as described in this section, is distinguished from home support, which includes (non-professional) housekeeping; however, this may vary between jurisdictions. The cost of physician home visits should be included separately, as per guidance provided in Physician Services (section 2), and based on the provincial fee schedules.

6.2.1 Data sources

All provinces provide professional home care, but cost and utilization data are not easily obtainable. Provinces, such as Ontario, have community support service programs, such as Home First, which provides services to geriatric patients recently discharged from the hospital; however, costs or fees associated with the provision of these programs are generally not available without a request. Wodchis et al. estimated fees paid to professional home care visitors by the government in Ontario for a wide range of home care services by different professionals.³⁸

The following data sources are suggested as most appropriate for home care costs:

- cost or fee directly obtained from the province (Wodchis et al.)
- fees paid by other sources in Ontario (where the perspective is a jurisdiction other than Ontario)
- direct hourly costs for nursing and other services based on hours per visit and compensation per hour; a travel payment should be included, including mileage rates.
- fees or costs obtained from the literature for Canada.

More specific data may be obtained from provincial ministries or home care providers.

6.3 Ambulance Services

Ambulance services include ground and air transport, specifically:

- community services
- inter-hospital transfers
- transfers from a hospital to a lower-level facility
- transportation
- dispatch administration
- paramedical support.

6.3.1 Data sources

The cost of ground ambulance services in Canada is not well-reported. Fees are set at various levels in different jurisdictions but do not cover the full operating costs. Ontario has two levels of fees: \$45 for resident emergencies and \$240 for non-residents (<http://torontoparamedicservices.ca/frequently-asked-questions/>). However, the \$45 or \$240 fee charged to the patient does not cover full operating costs; these are essentially co-payments. As well, full operating costs will differ widely by region. The researcher should use fees paid by the consumer only if the analysis is being conducted from a personal or private perspective. When taking a broader health care perspective, the researcher should use the full cost of services. The Toronto paramedic services is the only public unit the authors of this document found that provides information on the full cost. Unless the researcher can obtain an equivalent full cost locally, the Toronto paramedic services fee is suggested as the most appropriate source to use in Canada. The Toronto fee (\$928 in 2014) can be found in each annual report and the most recent version should be used. This fee is the total operating cost of the service, including overhead, divided by the number of rides (<http://torontoparamedicservices.ca/?wpdmact=process&did=MjluaG90bGluaw>). This statistic captures all resources associated with the service. It would be used in its entirety for a fully covered patient. Any patient fee would be deducted from the government portion if the researcher was using a government perspective.

Air ambulance services also vary widely and data should be obtained from provincial or local air ambulance services. However, the researcher should confirm the sourced cost is the full cost associated with the service.

6.3.2 Cost considerations

The cost of an ambulance ride varies considerably among jurisdictions. The cost of an ambulance ride in Toronto was \$928 in 2014, which includes all resources related to the ambulance ride and is well- documented. Most other quoted costs that were identified, even those which claim to cover “costs,” did not document their estimates. Researchers should approximate the full cost, which may be obtainable from an ambulance service within the jurisdiction of interest.

TABLE 3: SUMMARY OF DATA SOURCES

Cost Category	Sources of Information
Pharmaceuticals	
Prescription drugs	<ul style="list-style-type: none">• Provincial public drug plan formulary for relevant jurisdiction (preferred from perspective of public drug plan)• Provincial public drug plan formulary for a similar jurisdiction (any differences in markup and fees must be noted)• Hospital formulary
Over-the-counter drugs	<ul style="list-style-type: none">• Wholesaler price lists (wholesaler markups should be noted)• Retailer price lists• Provincial public drug plan formulary for the relevant jurisdiction• Provincial public drug plan formulary for a similar jurisdiction
Drug delivery systems	<ul style="list-style-type: none">• Canadian wholesaler price lists (wholesaler markups should be noted) or through Canadian retailers
Drug administration costs	<ul style="list-style-type: none">• Provincial schedule of benefits for relevant jurisdiction• Provincial schedule of benefits for a similar jurisdiction, with any regional variation accounted for in sensitivity analyses• Assumed price (based on other similar medications)
Physician services	<ul style="list-style-type: none">• Provincial schedule of medical benefits for relevant jurisdiction• Physician time per service, with an hourly compensation rate applied

Cost Category	Sources of Information
	<ul style="list-style-type: none"> Provincial schedule of medical benefits for a similar jurisdiction, with estimate tested in sensitivity analyses Assumed price (based on similar services)
Hospital services	
In-patient hospital care	See Table 1
Outpatient hospital care	<ul style="list-style-type: none"> Costed outpatient records based on comprehensive information systems, available in a small number of Canadian health service organizations (patient costing) Case mix adjusted outputs (using CACS) Generic costs, not adjusted for case mix
Diagnostic and investigational services	
Radiologic services	<ul style="list-style-type: none"> Provincial government-based schedule of benefits and fees for relevant jurisdiction Provincial association-based fee formulary or schedule for relevant jurisdiction Provincial schedule of benefits and fees from a similar jurisdiction Published literature of Canadian radiology costs Assumed similar costs (based on similar services)
Laboratory testing	<ul style="list-style-type: none"> Provincial government-based schedule of benefits and fees for relevant jurisdiction Provincial schedule of benefits and fees from a similar jurisdiction Private fee schedules or fee lists for relevant jurisdiction Published literature of Canadian laboratory costs Assumed similar costs (based on similar services)
Medical devices	<ul style="list-style-type: none"> Purchaser costs Manufacturer list prices Published Canadian literature Assumption based on similar products or foreign sources
Non-physician professional services	
Independent non-physician services	<ul style="list-style-type: none"> Recommended fees by professional bodies or Canadian published fees that are charged by the practitioner Government fees plus an estimate for private payment (if appropriate for the perspective) Hourly rate earned applied to time spent on the service Fees obtained from similar types of services
Nursing services	<ul style="list-style-type: none"> Obtained an estimate of the time spent by nurse to provide service multiplied by the hourly provincial wage rate, adjusted for any additional costs (i.e., fringe benefits) Published literature of Canadian nursing costs
Community-based services	
Residential care	<ul style="list-style-type: none"> Canadian RUG III costs (Wodchis et al., request to CIHI, or province-specific costs) Canadian straight cost per diem
Home care	<ul style="list-style-type: none"> Cost or fee directly obtained from the province (Wodchis et al.) Fees paid by other sources in Ontario (where the perspective is a jurisdiction other than Ontario) Direct hourly costs for nursing and other services, based on hours per visit and compensation per hour. A travel payment should be included, with mileage rates. Fees or costs obtained from the literature for Canada
Ambulance services	<ul style="list-style-type: none"> Cost from local ambulance authority (only where full costs are able to be sourced) Toronto paramedic service fee for full cost, less patient payment fee to obtain government cost

Cost Category	Sources of Information
	<ul style="list-style-type: none"> • Patient fees • Fees obtained from a literature search

CACs= Comprehensive Ambulatory Care Classification; CIHI = Canadian Institute for Health Information; RUG = resource utilization group.

7. Other Information

7.1 Public Health

In line with the Canada *Department of Health Act*, public health activities include population-wide health promotion, protection against disease, as well as public health research and surveillance (e.g., screening, immunization).

Public health costs include the cost of population-based screening and laboratory procedures, health education, health promotional material, and vaccinations. Data on the cost of public health activities may be less uniformly available, as the data collection may not be centralized. Further, unlike hospital and physician services, there are no standardized bundles of services such as hospital admissions, CMGs, and physician services. Researchers can obtain costs from local public health units (primary data collection) for public health activities and/or manufacturers for supplies for interventions. Cost information may be obtained or estimated from local public health units; estimated from budgeted costs from a local public health unit; extrapolated from another (similar) Canadian public health unit; or, if the information is not available from the previously mentioned sources, cost information may be obtained from surveys or from the literature.

When considering costs for public health activities, consider:

- Researchers should report units of resources and costs separately. The expected number in the population likely to access the intervention should be explicitly stated, with any assumptions or uncertainty around the estimates provided and tested.
- Researchers should include both direct and indirect costs assuming this does not conflict with the perspective or decision problem. Direct costs of public health activities include the cost of any interventions (e.g., screening tests, vaccines, laboratory tests, and personnel costs), whereas indirect (administrative) costs include program-level management costs, travel costs, and overheads. Total direct and indirect costs should be divided by the number of people covered under the public health initiative to obtain a unit cost per person, in addition to a total cost for the program.
- In the case of vaccines, the costs should be either the price paid by the public health unit (preferred) or the manufacturer's list price assuming the product is currently approved and marketed. Public health intervention jurisdictions may negotiate volume-based discounts, which may not be disclosed. In these cases, the researcher may test the sensitivity of the price of the vaccine to determine how sensitive the results are to changes and the impact of different levels of potential discounts. The date of the base price should be stated, as tendering processes usually results in price decreases once newer vaccines are funded.
- Note, as with pharmaceuticals, vaccine costs will vary over time according to the availability of new vaccines. This should be taken into consideration in sensitivity analyses when conducting studies which have long time horizons.

7.2 Personal Travel Costs

Personal travel costs are commonly incurred when seeking medical care. Personal travel costs should be included when a societal perspective is taken.

The most common form of personal travel is by car. The Government of Canada issues annual estimated costs for private automobile travel. The cost per kilometre is listed by province (www.cra-arc.gc.ca/travelcosts/). Use of the cost per kilometre for the relevant province is suggested as the most appropriate estimate of travel costs. Parking costs may also be included and should reflect the actual cost paid by patients. Where more extensive travel is required (e.g., air travel), the cost should reflect the average fare.

7.3 Caregiver Costs

In recent years, there has been more attention paid to caregiver losses. Caregivers are unpaid, informal care providers and often serve as substitutes for long-term care.

7.3.1 Estimated lost time

Caregivers often have to give up work, and there are two ways to measure lost time: the human capital approach and the friction cost approach.

a) Human capital

From the caregiver's perspective, the loss of labour time can be directly translated into a loss of productivity. The simplest approach to measuring the cost of caregiving, known as the "human capital" approach, is to multiply the amount of time off work by the lost compensation rate.^{39,40} The compensation rate is the wage rate plus any benefits added on, such as pension benefits, health insurance, and life insurance. The average wage can be obtained from Statistics Canada (see 7.2.3.2), although fringe benefits should also be added (see Appendix 1 of this document).

b) Friction cost approach

The caregiver might be replaced by another worker after a period of time. During the period of absence from work, the caregiver would lose wages for the period during which they are replaced. At the same time, the replacement worker gains income and production continues on. The costs for the period of lost and unreplaced work has been called "friction costs." A statistic for the friction period or time to replacement is suggested, such as that found in Hopkins et al.,⁴¹ Hanly et al.,⁴² and Koopmanschap et al.⁴³ These authors suggest a period of between 11.3 weeks to 14.6 weeks. However, Koopmanschap notes that, if unemployment is low, the friction period is longer.⁴³

7.3.2 Valuing the lost time

There are two ways of placing a value on the caregivers' lost employment time. These are the opportunity cost approach and the replacement wage approach.

a) Opportunity cost approach

Using the opportunity cost approach, one measures the foregone wage that would have been earned by the caregiver. Thus, whatever the occupation of the caregiver was, the foregone wage is what they earned in that occupation.

b) Replacement cost approach

An alternative way to measure the caregiver wage is to use the wage of persons who would do what the caregiver is doing. That is, the value is what the caregiver would have to compensate the paid housekeeper. If the caregiver is doing homemaking, then the analyst would use the wage of a home-maker.

c) Data

Hourly wage data can be obtained on a monthly basis from the Statistic Canada data table, Table 282-0069: Labour force survey estimates, wages of employees by type of work, National Occupational Classification for Statistics (NOC-S), sex and age group, unadjusted for seasonality. This data can be obtained online at <http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=2820069&paSer=&pattern=&stByVal=1&p1=1&p2=37&tabMode=dataTable&csid=>.

REPORTING

General Principles

The following points represent good reporting principles to follow regardless of the category of cost or resource that is being measured or valued:

- Each cost component should be reported separately.
- The costs and resources should be reported separately but ultimately aggregated to determine a total cost.
- Adequate sourcing of information should be provided to allow reviewers to verify and validate the analysis.

It is recommended that researchers clearly indicate the number or volume of resources/services being consumed, as well as any differences between interventions being analyzed. The information should be clearly defined as to where it is being assigned (e.g., physician services may be related to both general physician visits, as well as for interpretation of diagnostic or investigational services). Tables are suggested as the clearest way to present this information, where the structure and elements included will depend on the cost information (Table 4). When reporting on resources that are bundled (e.g., hospital costs, community care costs), the use of the mean cost as the base case is generally accepted to be appropriate. When assessing uncertainty and variability, most identified data sources report standard deviations or 95% confidence intervals around the costs or resources included, and these should be reported in sensitivity analyses.

TABLE 4: EXAMPLE OF REPORTING RESOURCES

Parameter	Resource	Volume (Units)	Source	SA values	Source/s
Monitoring	General family practice consultation	4 consultations (per year)	Product Monograph/ Guidelines	2 – 6 visits (per year)	Expert opinion
Diagnostic test A	Diagnostic test	2 times per year	Guidelines	Diagnostic test B once per year	Expert opinion
Diagnostic test A	Clinical interpretation by an immunologist	2 times per year	Guidelines	Diagnostic test B once per year	Expert opinion
Adverse event B	General family practice consultation	1 per event ^a annual adverse event rate	Literature/Product Monograph	No consultation	Expert opinion
Adverse event C	General family practice consultation	1 per event ^a annual adverse event rate	Literature/Product Monograph	No consultation	Expert opinion
Adverse event C	CBC	16 LMS units per event	Literature/Product Monograph	Addition of Liver Function and Kidney function tests	Expert opinion
Cost of hospitalization	For knee replacement (CMG+ 321)	CMG+ ^a RIW	Literature/Product Monograph	OCCI CAT	OCCI CAT

CBC = complete blood count; CMG = case mix group; LMS = labour, materials, supervision; OCCI CAT = Ontario Case Costing Initiative Cost Analysis Tool; RIW = resource intensity weight; SA = sensitivity analysis

* Note, in this example, treatment is assumed to be in the outpatient setting

It is recommended that researchers separately report cost valuations for each of the various parameters included in the analysis. When reporting the prices and costs for resources and services included, the methodology and calculations as to how the final cost was arrived at

should be justified and transparently reported. Any relevant variations in cost should be reported and assessed in sensitivity analyses. If there is considerable variation or uncertainty in the volume or unit cost, this should be reported, as well.

An example is provided in Table 5 of how information can be presented.

TABLE 5: EXAMPLE OF REPORTING COST VALUATIONS

Parameter	Resource Requirement	Unit of Measure	Resource Cost	Source	SA Values	Source/s
Monitoring	General family practice consultation	Consultation	\$77.20	OHIP Schedule of Benefits (Code A005)		
Diagnostic test A	Diagnostic test	Test				
Diagnostic test A	Clinical interpretation by an immunologist	Interpretation/consultation/visit	\$29.05	OHIP Schedule of Benefits (Code K399)		
Adverse event C	General family practice consultation	Consultation	\$77.20	OHIP Schedule of Benefits (Code A005)		
Adverse event C	CBC (any method)	Test	\$8.27 ^a	OHIP Schedule of Benefits for Laboratory Services (Code L393)		
Cost of hospitalization	For knee replacement (CMG 321)	CMG x RIW	\$5,566 x 1.43339	CIHI: DAD RIW and Expected LOS for CMG+ 2014 & CMDB Hospital Financial Indicator		

CBC = complete blood count; CMDB = Canadian MIS database; CMG = case mix group; DAD = Discharge Abstract Database; OHIP = Ontario Health Insurance Plan; LOS = length of stay; RIW = resource intensity weight; SA = sensitivity analysis
 Note: in this example, treatment is assumed to be in the outpatient setting

^a Calculated based on Ontario Schedule of Benefits multiplier per LMS Unit (\$0.517); 16 x \$0.517 = \$8.272

APPENDIX 1: ADJUSTMENT FACTORS

Aside from adjustment factors, this section provides guidance on methods to convert changes in prices over time. It also provides information to convert wages to full compensation by adding benefits and adjusting for worked hours compared with total compensated hours, which is primarily relevant to the societal perspective.

Fringe benefits: Workers are paid fringe benefits (pensions, supplemental health insurance, life, and disability insurance) in addition to a wage. According to The Conference Board of Canada (2012), benefits are 10% of all compensation (wages plus benefits) on a Canada-wide basis.⁴⁴ This means a researcher should add 11% onto *monetary wages* to determine an all-sector, Canada-wide compensation rate.

Inflation: As price levels change over time, it is necessary to adjust all prices to a given time period. There are two price indexes that have been used — the general consumer price index (CPI) for health and personal care products and the general CPI for all goods and services.⁴⁵ The use of general CPI for all items is recommended, as the CPI for health and personal services is confined to marketed pharmaceuticals and health products (toothpaste, shampoo). There is no health care CPI that incorporates physician and hospital services.⁴⁶ We therefore suggest using the general CPI as a deflator. This data by province or at the national level is available from the Statistics Canada website (www.statcan.ca) or nationally from the Bank of Canada website (<http://www.bankofcanada.ca/rates/related/inflation-calculator/>).

Specific employment benefits: Employed workers receive compensation for vacation time and also for sick leave; Guerriere et al. estimates that adds about 13% to the total compensation.⁴⁷ However, the Ontario nurses' Collective Agreement adds only 4.8%. Thus, an additional amount in the range of 5% to 13% should be added to hourly wages for time *actually worked* to estimate total wages for time *employed*.

APPENDIX 2: COSTING PRACTICES FOR WHICH CAUTION SHOULD BE EXERTED

Protocol-driven costs: Cost estimates based on data gathered as part of a clinical trial designed for clinical evaluation may not capture the true costs of an intervention (i.e., the costs of doing the research may be included). Resources consumed within the trial may be more intensive than in routine clinical practice; e.g., increased monitoring of physician visits. Researchers using resource use collected within a clinical trial must establish the extent to which patient management and resource use reflect clinical practice.⁴⁸

International costs: In general, the use of international costs is not recommended when Canadian-specific data are available. There are often substantial generalizability issues regarding methods, practices, fee/cost structures, and prices across countries.

Historical costs: It is advisable to use the most recent cost information available. If only older information is available, it is advisable to note important developments that have occurred that may provide context to the use of historic estimates.

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