

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

Second Edition

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About CADTH

CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

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ABBREVIATIONS

ALC	alternate level of care
ARP	alternative relationship plan
CACS	Comprehensive Ambulatory Care Classification System
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
IHDA	Interactive Health Data Application
MOHLTC	Ministry of Health and Long-Term Care
NACRS	National Ambulatory Care Reporting System
OHIP	Ontario Health Insurance Plan
OTC	over-the-counter
RIW	resource intensity weights
RUG	resource utilization group

FOREWORD TO THE SECOND EDITION

The purpose of this document is to guide researchers to publicly available cost information and to encourage transparency in the use of costs in economic evaluations for Canada. This document describes costs and costing methods for commonly used health resources and briefly discusses when different costing approaches may be appropriate. This document is not intended to be a comprehensive list of data sources or a cost accounting document. Researchers should use this document with the most up-to-date version of the CADTH *Guidelines for the Economic Evaluation of Health Technologies: Canada*.

In 1996, the Canadian Coordinating Office for Health Technology Assessment (CCOHTA, now CADTH) produced *A Guidance Document for the Costing Process*¹ (the *Guidance Document*), which detailed guidance on the costing process, described how health care resources are measured and valued and suggested sources of information, and recommended a format for reporting. Cost information has evolved since the publication of the *Guidance Document*. Information systems have further developed, allowing access to more accurate and publicly available costing information. Canada has since established case mix groups for in-patient, ambulatory, and long-term care. A review of published economic evaluations was conducted to help inform how and what type of cost information is being used, and a wide variety of costing sources and techniques were noted. In many cases, the details of the costing approaches were not fully described and the uncertainty associated with the cost parameters not discussed. To address both the availability of more comprehensive data sources and a shift to more standardized use of cost information, CADTH undertook an update to the *Guidance Document* and created this document, the *Guidance Document for the Costing of Health Care Resources in the Canadian Setting: Second Edition*.

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

Costing methods continue to evolve and information sources are subject to change. Consequently, this document will be revised as information and methodologies develop. Throughout the document, various costing approaches have been identified, and 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 selecting health care resource costs for use in economic studies.

Overview

Economic evaluations are conducted to determine the best use of scarce resources.

Opportunity cost is a guiding concept in the study of economics — used to understand alternative uses of resources — defined as the value of the resources in the next best use.² The concept of opportunity cost provides researchers with a consistent principle regarding how to cost (or value) resources under a variety of circumstances. This is further explained later in this report when considering cost information and how resources are measured and valued.

Guidance

The following steps are recommended to determine costs for a study:

1. Set the decision problem.
2. Identify all resources relevant for the analysis.
3. Measure resources.
4. Value resources.
5. Identify variability, uncertainty, and bias.
6. Report costs.

Each step is discussed briefly below.

Set the decision problem

In an economic evaluation, the decision problem defines aspects such as the perspective, time horizon of the analysis, target population, and setting. The decision problem should 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, or local health care authority) will determine the scope of resources and costs considered. Where broader perspectives are of interest, researchers should identify resources based on the groups that bear the costs. For example, when a broader health care payer perspective is used (defined as public payers and private insurers), resources paid by the public and private payers should be reported separately, whereas any costs not covered by either payer (e.g., incurred by the patient directly, out-of-pocket) can be excluded. In the case where an economic evaluation is conducted to support a decision at a regional level, region-specific sources should be used. Where the economic evaluation is conducted from a national perspective, Canada-wide costs are preferred; however, this information is not always available.

The time horizon of the analysis defines the period over which costs are accounted. The current edition of the CADTH *Guidelines for the Economic Evaluation of Health Technologies: Canada* recommends that the selected time horizon be *long enough to capture all relevant differences in future costs and outcomes*.³ In an economic model, time is often broken down into discrete units (cycles), and the resources and costs that occur within each cycle must be identified.

The target population must be considered when selecting costs for the analysis. Costs beyond the target population should not be included.

The setting in which the economic evaluation is being undertaken should be defined to ensure the correct cost information is used. For example, where an economic evaluation is conducted for in-hospital patients, health care resources and costs should reflect hospital-based care and costs, while economic evaluations conducted for an ambulatory setting should use outpatient sources.

Identify all resources relevant for the analysis

Researchers should ensure that all relevant health care resources for the analysis are identified; this is usually accomplished by considering the clinical and care pathways of the condition. Researchers should seek to identify all downstream events associated with managing the condition, relevant sequelae, and overall impact of the assessed interventions.¹

Based on how the clinical pathways are conceptualized, researchers must be mindful of the types of costs to be captured. For example, if the clinical pathway is conceptualized in terms of events or health states, researchers should identify costs that align with that structure.

Where multiple perspectives are of interest, researchers should determine which resources and services apply to each perspective and report these separately. Researchers 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, in-hospital 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 information (public health, personal costs).

Measure resources

A number of approaches can be used to measure resource use, but there are two main types of measures: direct (primary) and indirect (secondary). Primary measures require the collection of resource use data as part of a clinical trial or within an observational study;¹ secondary measures capture data using administrative or clinical databases, chart reviews, and expert panels.

When conceptualizing the clinical pathway, researchers should note that various costing options involve different levels of complexity, time, and effort; these varying levels correlate with the amount of precision associated with the estimate. Where the accuracy of the results is dependent on correct and precise cost estimates, more detailed (micro) costing approaches

may be more appropriate. Where similar resource use or events are likely among study interventions, the use of less precise (cruder) estimates may be sufficient (e.g., per diem costing). The challenge is to find the appropriate balance between the need for precision and the avoidance of bias with the resources required to collect data. While precise, unbiased estimates are ideal and imprecise, biased estimates are the least valuable, the relative desirability of each will depend on the context to ensure effective decisions can be made.

When obtaining resource use from clinical trials, researchers may encounter issues with external validity based on trial design, and resource use may be driven by research protocols.⁴⁻⁷ Researchers using this information must establish the extent to which patient management and resource use reflect clinical practice.⁸

Where feasible, resource use estimates should be based on Canadian information. Where Canadian information is not available, international sources may be used, but should be validated for the Canadian setting. Data should be reported in a manner that reflects the full population for which the decision problem relates. Thus, data should be presented in terms of means, not medians and modes.

Value resources

Resources are valued in monetary terms. As stated earlier, the concept of opportunity cost is used to determine the economic value of production in a variety of circumstances. A cost is the value of the resources used to produce a product (e.g., service, intervention); a fee is the amount charged for a resource or service; and a price is the amount charged for an item for sale. Costs may differ from fees or prices associated with a product. The decision to select costs or fees/prices will depend on the perspective of the analysis. For a public payer perspective, fees and prices may be most appropriate; however, if the perspective is the health care system, costs may be more reflective of the opportunity costs.

Fees may be set by a payer through schedules, such as a provincial schedule of medical benefits or a drug formulary. Data on these fees may be available from the provider or direct from the payer. There may also be a co-payment to the recipient, which would be included in the measure depending on the perspective taken (e.g., included if a patient or societal perspective is used).

The cost of a resource can be more directly measured at the level of the producing units based on expenditures, using either “top-down” or “bottom-up” costing approaches. For example, hospitals collect data on expenditures for resources using their information systems. The Canadian Institute for Health Information (CIHI) combines these expenditures with clinical and operating 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 by tracing services used. Additionally, unit cost data can be directly collected from operations data or surveys of resource units, such as caregivers or ambulance units.

Fees and prices tend to vary across jurisdictions in Canada. Where the analysis perspective is of a specific jurisdiction, local sources of information should be used. Where an analysis is conducted from a national perspective, cost information most representative of Canada should

be used — this might be the jurisdiction most representative of the national average. Where regional variation exists, this should be discussed and considered in sensitivity analyses.

It is advisable to use the most recent cost information available. If only older information is available, important developments that have occurred should be noted to provide context to the use of historic estimates. When using costs obtained from different time periods, all prices must be adjusted to a common time period. Two price indexes can be used: the general Consumer Price Index (CPI) for health and personal care products, and the general CPI for all goods and services.⁹ The use of general CPI for all good and services is recommended, as the CPI for health and personal care products is confined to prescribed and non-prescribed medicines as well as health products such as toothpaste and shampoo. As there is no health care CPI that incorporates physician and hospital services,⁹ it is appropriate to use the general CPI for all goods and services.¹⁰ These data are available by province, or at the national level from [Statistics Canada](#) or the [Bank of Canada](#).

Transfer payments are payments made in the absence of services by governments. These include unemployment insurance payments and disability payments. There is no provision of care (and no use of resources, hence no *quid pro quo*) for these payments, and thus they do not relate to resource use. While transfer payments are a cost from the payer perspective, they do not relate to health care production, and should not be included in an analysis.

Sales taxes are the reverse of transfer payments. They are paid by the purchaser of services to the government, but are not considered to be direct payments for services. Thus they should not be included in the measure of the opportunity cost, which should be calculated as the cost of resources purchased net of sales taxes.

The use of international costs is not recommended, as there are often substantial generalizability issues regarding methods, practices, fee/cost structures, and prices across countries.

Identify variability, 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 geographical areas or settings, or may be found among patients within a specific setting. For example, when conducting an economic evaluation for the Canadian health care payer, the cost of health care resources may vary across jurisdictions. As medical fees and schedules are specific to jurisdictions, researchers should be aware of this variability and account for this in sensitivity analyses. Variability may also exist among patients in a specific setting, in which health care costs may differ based on characteristics, which would warrant stratification.

Uncertainty can take various forms (e.g., parameter, stochastic, structural).¹¹ As this document deals with inputs — costs and resources — the focus here is on parameter uncertainty. This occurs when the true value of the cost is unknown, thus reflecting the fact that the knowledge or measurement is imperfect.^{12,13} In these circumstances, it is important that researchers be as

precise as possible. In general, the greater the impact the cost estimate may have on the results of the analysis, the more precise the estimate should be.

Bias reflects the systematic divergence of the measured cost from the desired measure.¹⁴ 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 assessed thoroughly when undertaking sensitivity analyses, and should be explicitly stated in the economic analysis. When conducting sensitivity analyses, researchers should select an appropriate source, discuss any potential issues in applying the source to other jurisdictions, and test the sensitivity of the results to the choice of cost information; in this way, the impact on the results can be fully assessed. For more complete information, please refer to the most up-to-date version of the CADTH *Guidelines for the Economic Evaluation of Health Technologies: Canada*.

Report costs

When reporting cost information, researchers should justify and transparently report the methodology, data sources, and calculations used to determine the final costs. Where there is considerable variation or uncertainty in the cost estimate, the full range of plausible values should be reported in sensitivity analyses. Depending on the level of detail required for the analysis, researchers may be able to report inputs by unit estimates or by health state. Researchers should provide the inputs and results in the greatest detail possible.

MEASUREMENT AND VALUATION

This 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 those used in-hospital and in the community, as well as biologically derived products such as vaccines, serums, and blood-derived products; disinfectants; radiopharmaceuticals used within the treatment paradigm;¹⁵ 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 are paid for by public payers (hospitals and jurisdictions), third-party insurers, individuals (e.g., out-of-pocket payments), or a combination of these. Each drug program or provider maintains a drug formulary (a list of funded drugs). In addition, certain public plans allow access to drugs through special (or extended/expanded) access programs. While wholesalers stock most drug products marketed in Canada, they currently do not make their prices publicly available, thus wholesale prices are generally not appropriate for use, given the difficulty in validating the estimates. Public drug plan formularies are generally publicly available and easily accessible, while hospital and private insurer formularies are typically not publicly available. Specific formularies exist for oncology drugs that indicate which drugs are reimbursed as well as certain information related to the reimbursement; however, 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 not listed, or accessed through special programs). Researchers should be transparent as to whether markups are included, and consult relevant formulary websites from each province or National Prescription Drug Utilization Information System (NPDUIS) CompassRx Annual Report publications¹⁶ to determine the relevant specific markups and dispensing fees. Researchers should note, however, that the CompassRx Annual Report publication may not be as up to date as the relevant formulary websites. Retail pharmacies also provide information on dispensing fees; the choice of dispensing fee will depend on 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 with drug manufacturers or wholesalers, which are typically not known or publicized. These product listing agreements may be in the form of rebates, pay for performance, or other types of schemes (e.g., based on market share). In situations where negotiations are likely to have occurred but the details are

unknown, this should be noted within the description of the data source. Publicly listed prices should be used in the base-case analyses, and uncertainty regarding the actual price considered within sensitivity analyses, considering a range of price reductions. Given that specifics regarding the product listing agreement are usually unknown, limitations around this approach should be discussed.

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 detail how prescription drugs are used in real-world settings, where accessible. The World Health Organization (WHO) Defined Daily Dose (DDD) is also a recognized unit of measurement in drug utilization studies and may be a useful tool in comparing drug exposure;¹⁷ however, Canadian-specific dosing is preferred. Researchers should 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). If there is any wastage of drug products (e.g., where the total dose prescribed is less than the amount provided in a single-use vial), the cost of the full dose should be accounted for in the base-case analysis.

In the event that organizations or departments provide or reimburse specialized services (e.g., oncology drugs, methadone clinics, etc.), these groups should be contacted directly to attempt to obtain costing information.

1.1.2 Costing considerations

- Each public plan details allowable pharmacy markups and dispensing fees that will be reimbursed for different categories of products (e.g., oral drugs, infusions); these are included in the price the pharmacy charges to dispense products. Pharmacies may have higher charges than what is reimbursed by the public payer. Researchers should consider 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 evaluated in sensitivity analyses.
- There are variable markups and pharmacy fees across jurisdictions. When undertaking an analysis from the national level, researchers should test the impact of the parameter on the results. Where results are sensitive to the parameter, researchers should conduct separate analyses for the jurisdictions covered by the analysis. For a national perspective, researchers should use a weighted average based on the population. If the results are not sensitive to the prescription drug-related costs, researchers should use a single source for all pharmaceutical costs, for consistency.
- 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, copayments should be included.
- Private insurers typically do not make their drug prices publicly available. As such, the prices listed on public formularies may be used as a proxy for private formulary prices.

- Hospitals purchase drugs for use within their institutions, separate from public drug plans. Hospital drug formulary lists are generally not publicly accessible. Public formularies may be used as a proxy for hospital drug prices; however, given purchasing agreements are often in place, extensive sensitivity analyses around these estimates should be conducted.

Example A-1

How would a researcher conduct an analysis of onabotulinumtoxinA for overactive bladder from the perspective of the public payer in Saskatchewan?

- Obtain the unit drug costs from the [Saskatchewan drug formulary](#). The acquisition cost of onabotulinumtoxinA in February 2016 is \$3.57 per unit (U). Saskatchewan prices do not contain wholesaler markup.
- Obtain information on minimum dispensable units from the product monograph (50 U, 100 U, and 200 U vials).
- Obtain information on the recommended administration from the product monograph (single 100 U injection).
- Calculate the acquisition cost based on administration:
 $A \times B = \$3.57 \text{ per U} \times 100 \text{ U} = \$357.00.$
- Note that Saskatchewan prices do not include markup or dispensing fees. The maximum pharmacy markup allowance is based on an [ordered scale reported by the province](#). For onabotulinumtoxinA, the pharmacy markup is \$20.00, given that its total cost is greater than \$200.00, and the dispensing fee is \$10.75.
- Determine the total drug cost per single injection (100 U) for onabotulinumtoxinA:
 $D + E = \$357.00 + \$20.00 + \$10.75 = \$387.75.$

Note: The values in Example A-1 are current to February 2016.

1.2 Over-the-Counter Drugs

OTC drugs are those 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 is required and similar principles as discussed in [section 1.1](#) apply. For this section, drugs purchased without a prescription are described.

1.2.1 Data sources

Prices may be obtained from retailers and public provincial drug formularies, as private drug plan formularies and wholesaler price lists are generally not publicly available. The sources for prices used should be stated and justified, and reflect 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

- Where an OTC drug is paid for by a private or public drug plan, the drug will need to be dispensed by a pharmacist; guidance on this is detailed in [section 1.1 Prescription Drugs](#).
- Researchers should note that there may be variation in price both across Canada and within jurisdictions. Also, there may be generic alternatives available for the OTC drugs.

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 drugs (see, for example, the [National Institute of Biomedical Imaging and Bioengineering](#)). 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 plan formularies are generally not publicly available), or through Canadian retailers.

Researchers should take into account the lifespan of the device, monitoring tool, or system (i.e., 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 device, tool, or system free of charge or at a reduced rate. This should be accounted for in the analysis via scenario analysis, sensitivity analysis, or (if appropriately justified) the base-case analysis. Should uncertainty exist as to whether the manufacturer will continue to provide the device or tool on an ongoing basis, this should be examined in sensitivity analyses.

1.4 Drug Administration Costs

Drug administration costs are incurred where treatments are administered by a health professional (e.g., physicians or non-physicians via injections, infusions, etc.). This section pertains specifically to physician and non-physician drug administration costs in the outpatient setting; it does not include information on supply costs. For drugs administered in the in-patient setting, these costs are addressed in the CMG costing and patient costing methods (see [section 3. Hospital Services](#)).

1.4.1 Data sources

Researchers should account for the medical service(s) required when administering a drug in an outpatient setting. Researchers must determine the health professional administering the treatment and the specific treatment setting. The relevant provincial Schedule of Benefits should be used to determine the fee for the health professional; if the Schedule of Benefits does not report the requisite code or cost information, the fee from a similar jurisdiction may be used as a proxy. Researchers should note that some provinces indicate separate technical (institutional/facility) and professional (interpretational) fee components that need to be taken into account for drug administration. If administration occurs in a facility, a facility cost captured within the case mix and patient costing will need to be applied (see [section 3. Hospital Services](#)).

There may be situations where the type and 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), researchers may elicit this information from a targeted

survey or a panel of health professionals likely to administer the drug. Additional information on determining appropriate administration costs can be found in [section 3. Hospital Services](#) and [section 5. Non-Physician Professional Services](#).

Example A-2

Continuing from Example A-1, how would a researcher determine costs for a patient with overactive bladder who requires treatment with onabotulinumtoxinA, to be administered by a specialist in an outpatient setting?

- Based on the Saskatchewan Medical Association fee guide (October 2015), the cost of administering onabotulinumtoxinA (code 199A) is \$189.60 per dose (in an outpatient visit).
- Consideration should be provided for patient monitoring, as identified based on clinical guidelines, product monograph, or expert opinion.

Note: The values in Example A-2 are current to February 2016.

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 services, physiotherapist services, 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,¹⁸ although this varies by jurisdiction and has evolved over time. Alternative relationship plans (ARPs; otherwise known as alternative payment plans [APPs]) are another method used by provinces to pay for physician services. In ARPs, physicians are paid on the basis of sessions worked, hours worked, or some basis other than volume of services provided. The use of ARP costs may be appropriate in a setting that uses this method of payment and where data are available. Physician fees are primarily covered by government payers.¹⁹

2.1.1 Data sources

Each province provides its residents with access to health care services 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 across provinces for identical interventions and services. Fee schedules provide the best estimate of costs for physician services, within a specific jurisdiction, when costing services on an individual basis. 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. In cases where physicians are paid on a non-FFS basis (i.e., salary), fees can be used as a proxy for the cost. Where ARPs are used, costs based on published ARP data are appropriate (e.g., [Alternative Relationship Plan Program Management Office](#)).

For physician services, an initial service may be followed by 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 and associated fees. There may be occasions where 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 clinical practice guidelines or Health Canada–authorized product monograph), researchers can obtain this information from a targeted survey of representative health professionals. Provincial schedules generally provide sufficiently detailed information where the location of service is noted; otherwise, expert opinion may be required.

It may be important to appropriately distinguish between a visit and a consultation for costing purposes. A visit typically includes 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.^{20,21} 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.^{20,21} 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 requires a full patient history, and, with some exceptions, an examination of all body parts and systems.^{20,21} 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 important when costing physician services provided in-hospital (see [section 3. Hospital Services](#) to determine when it is appropriate to include these costs). Some provinces also outline administrative (technical [institutional/facility] and professional [interpretational]) fee components that researchers should consider when costing in-hospital physician services, though provincial fee guides should be reviewed to clearly define the circumstances around inclusion or exclusion of these components.

Example B

How would a researcher calculate the fees for physician services in Ontario for a venography of the peripheral and superior vena cava?

- The Ontario *Schedule of Benefits* divides Nuclear Medicine procedures into technical (H) and professional (P) components.
- The researcher should review the preamble of the Nuclear Medicine section of the Ontario *Schedule of Benefits* to ensure the process has not changed.
- As of October 2015, the Ontario *Schedule of Benefits* indicates that a physician can claim the professional fee, as long as the physician interprets the results of the diagnostic procedure.

Cardiovascular system		H	P
J802	Venography – peripheral and superior vena cava	\$96.35	\$38.70

H = technical component; P = professional component.

Note: Researchers should consult the most recent Schedule to ensure the method suggested can still be applied. Source: Ontario *Schedule of Benefits*, October 1, 2015 (B3, page 217/747).²⁰

Note: The values in Example B are current to February 2016.

Fees for physician services in the hospital setting should be determined in the same manner, 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.

2.1.2 Cost considerations

- Schedules distinguish between physician hospital visits and visits in the community. Researchers should ensure the appropriate code and associated fee are used.
- Provincial schedules of benefits and fees are subject to periodic review and amendment; researchers should use the current version and reference it appropriately.
- Fee categories and levels differ by province; therefore, a fee schedule should be used only for the specific province for which the analysis is being conducted.

- The fees for interpretation of diagnostic and investigational tests (see [section 4. Diagnostic and Investigational Services](#)) 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 C

How would a researcher calculate the cost of physician visits (consultation or assessment) 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 that have been validated by experts in Ontario, patients should be seen four times in the year of diagnosis, and then two times a year thereafter.
- The Ontario Health Insurance Plan (OHIP) *Schedule of Benefits* (October 2015) indicates that a general practitioner may bill \$77.20 for a general practice consultation (A005) and \$45.90 for a repeat consultation (A006).²⁰
- Over a 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 the two-year period.

Note: The values in Example C are current to February 2016.

3. Hospital Services

Hospital services are those produced within a hospital, either on an in-patient or 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 by hospitals.²² As such, when a public health care system or broader perspective is used, physician costs incurred by patients within a hospital setting should be added to the hospital cost to obtain the full cost of the episode. See [section 2. Physician Services](#) for more information about determining 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 before discharge; as such, many stays will not have an ALC component. Hospitals code in-patient hospital days into separate levels of care, which may assist in the categorization of acute and ALC components.²³

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.	Total in-patient expenditures divided by in-patient days is obtainable 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 RIWs for CMG/age group obtained from CIHI's <i>DAD Resource Intensity Weights and Expected Length of Stay, CMG+ Client Tables 2015</i> . Hospital- or province-specific CSHS is applied to RIWs to obtain per-case costs; these are obtained from CIHI's <i>Your Health System</i> website

Method of Costing	Description	Where to Get Data
	base RIW values for each CMG group. Costs are assigned to RIWs using a CSHS, formerly called the CPWC.	
Refined case mix groups (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 comorbidities 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>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.	Costs by case, with patient identifiers, can be obtained only from specific health service organizations that have implemented patient-specific costing. Patient costing data from Ontario and Alberta are 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. ^a 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.

^a Use and distribution of data from the Ontario Case Costing Initiative (OCCI) CAT is described in [section 3.1.4](#).

3.1.1 Per diem costs

The per-case cost is the cost per in-patient day (set value) multiplied by the length of hospital stay. The per diem cost approach is the simplest to use.

This approach may be useful when looking at care over a longer period of time, when there are changes in costs, or when assessing historic costs of care. There are several limitations with per diem costs, as resource intensity between case types may differ and cannot be accounted for in length of stay alone.

3.1.2 Case mix costing

CIHI collects in-patient discharge data from hospitals across the country on a common discharge abstract.²⁴ 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 the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada-specific (ICD-10-CA)* diagnoses codes) and types of diagnoses (a system of ranking diagnoses) and interventions. The Most Responsible Diagnosis (MRDx) code in the hospital discharge abstract identifies the diagnosis 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.²⁵ 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 processes and incorporates 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.²⁶

The terms “case mix group” (CMG), “resource intensity weights” (RIWs), and “cost of a standard hospital stay” (CSHS) are important to understand the case mix costing component. These terms are subsequently explained.

a) Case mix group

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 that 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 a three-year update cycle. A description of the CMG grouping process is found at the CIHI website.²⁷

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 those that are typical (case proceeds as expected) and those that are atypical (long-stay outliers, deaths, patient self-sign-outs, and inter-hospital transfers). The refined CMG+ method builds on the basic CMG+ method but presents results adjusted for comorbidities and additional interventions, as well as the potential to split ALC and acute care measures.

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. A base RIW value is calculated for each CMG age group combination, and an average case is given a value of 1.00. Different calculation methods are used for typical cases (outcome and length of stay are as expected), and atypical cases (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](#). Base RIW values for CMGs are subdivided by age categories to provide more precise estimates. Using daily data, RIWs are also reported for atypical cases and ALC, also by CMG+. The RIW for atypical cases is estimated on a per diem basis, thus 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 RIW, to capture differences in service intensity within each CMG. In the refined CMG+ system, comorbidities are identified, and specific procedures and interventions are flagged; when these are taken into account, they contribute to each patient’s RIW. This refinement allows for a more precise description of the RIW for cases beyond the basic typical values with age categories. Since RIWs 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. The choice of whether to use the refined or basic CMG+ may depend on the level of evidence available and the precision required.

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 CSHS. The CSHS is the dollar multiplier that can be applied to any RIW (index statistic) to generate the CMG-based cost. CIHI's *Your Health System* website²⁸ provides CSHS information, available at the local health integration network level as well as provincial and national levels.

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, researchers will need access to individual patient data, but even then only a small number of hospitals in Canada have the capability to access and report these costs. This form of costing is relevant when researchers 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 of 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; any dispensed drugs need to be costed out separately (see [section 1. Pharmaceuticals](#)). The costs of medical devices should also be added in separately.

Patient costing provides a measure of direct service costs for each case. Using cost allocation procedures outlined by CIHI,²⁹ indirect overhead costs can be allocated to each department and therefore to each case, thus yielding a full cost for each patient, including overhead. 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

To calculate costs using the per diem approach, researchers should know the patient's length of stay and the cost per day. The hospital cost per day is not published, but can be obtained from CIHI by request.

The expected length of stay for typical cases can be found in CIHI's *DAD Resource Intensity Weights and Expected Length of Stay* for CMG+ 2015 client tables,³⁰ which provide data by CMG. Data on length of stay of individual patients or groups of patients, when included in the DAD, can be obtained from health providers and provincial health departments. They can also be obtained manually from chart reviews and clinical studies.

b) Case mix costing data

Costs for each CMG, using RIWs and CSHS, can be estimated by using the CIHI data tables previously mentioned.

Example D-1

How would a researcher calculate the cost of unilateral knee replacement in Ontario for a 50-year-old patient in 2015?

- 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 1.3006, based on CIHI's *DAD Resource Intensity Weights and Expected Length of Stay* for CMG+ 2015, Appendix B, Base Table.³⁰
- The CSHS can be obtained from CIHI's [Your Health System](#) website. Using the "In Brief" tab, enter "Ontario" into the bar. Once the page loads, the researcher will see at the bottom of the screen that the CSHS is reported (\$5,283).
- The cost of a case for CMG 321 is \$6,871 (1.3006 x \$5,283).
- When applicable, the value should be updated to the most recent year using the Canadian Consumer Price Index. These estimates are based on typical cases only.
- This is now an estimate of the in-patient component of cost. The physician fees must also be added, as well as post-discharge rehabilitation costs. An example of rehabilitation costs is included later in the document.
- Based on code #R248 (Total knee replacement with take down of fusion) of the OHIP *Schedule of Benefits* (October 2015), physician procedure costs are indicated to be \$838.00; 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 cost of \$1,054.40 (\$838.00 + \$96.32 + \$120.08), which captures procedure and physician costs, should be included, for a total cost of unilateral knee replacement.
- Thus, the overall cost of the procedure and physician cost would be \$6,871 + \$1,054 = \$7,925.

Note: The values used in Example D-1 are current to February 2016.

c) Case mix data based on patient cost estimates

There are three additional sources of data for costs by CMG that are not estimated using the RIW. Most are based on averages of individual patient 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, researchers 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.

Alberta Health provides in-patient cost data for each CMG based on the CMG+ classification system. Costs are calculated using the patient costing method and aggregated to the CMG level, rather than being estimated using RIWs and CSHS. Alberta Health also provides some historical data on its [website](#). Alberta Health's Interactive Health Data Application (IHDA) estimates are available by province 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 average costs are preferred for economic evaluations. When selecting typical, atypical, or all cases combined, researchers should consider the target population for the economic analysis. If the hospitalized cases include all cases hospitalized, researchers should use the costs for all cases — typical and atypical — as typical cases exclude the more severe cases.

Example D-2

How would a researcher calculate the cost of unilateral knee replacement in Alberta for a 50-year-old patient in 2015?

- The researcher can use the [Alberta IHDA](#), specifying the health costing category, year of interest, desired measure (average cost), CMG+ category (321; unilateral knee replacement), and case type (all cases, atypical cases, or typical cases).
- The most recent year for the IHDA cost data is 2013-2014.
- If the researcher is interested in “all cases”, the cost is \$11,043. This should be inflated to the most recent year using the Canadian or regional CPI, as obtained from Statistics Canada. Thus, the hospital cost of a unilateral knee replacement in Alberta in 2015 is calculated to be \$11,166 ($\$11,043 \times 1.011$ [1.011 is the CPI or price-level adjustment]).

These costs do not include post-hospital rehabilitation or 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 D-1), which included only typical cases. CIHI data also indicates that the CSHS in Alberta was more expensive than the CSHS in Ontario in 2013–14.²⁸

Note: The values in Example D-2 are current to February 2016.

The Ontario Ministry of Health and Long-Term Care (MOHLTC) allows access to in-patient cost data through the Ontario Case Costing Initiative (OCCI), which is accessed through the Cost Analysis Tool (CAT) available on Ontario's [Health Data Branch Web Portal](#). Users must register

to access the tool, from which cost information can be viewed and downloaded for personal and non-commercial purposes, as long as the copyright from the Queen's Printer is retained. To use CAT information for commercial purposes, researchers must seek a license to do so from the Queen's Printer directly (by contacting the Senior Copyright Analyst, Publications Ontario [416 326 5153, Copyright@ontario.ca]).

Data within the CAT are 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 researchers 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 available only for some hospitals in four provinces (Alberta, Ontario, British Columbia, and Nova Scotia) and can be obtained directly from provincial health departments in some health regions.

3.1.5 Cost considerations

- Hospital costs are often available in groups, and researchers have a choice of statistics, including mean and median. For an economic evaluation, a mean cost is the more appropriate approximation for the marginal cost. In some instances, however, the marginal cost may not equal the average cost.
- Case costs can be alternatively estimated using only direct service costs, or direct service and overhead costs. Some economists have stated a preference for "full" costs, including overhead, because these will reflect long-term marginal costs, including capital and overhead.³¹
- Researchers can choose from several 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 provides information at a local health integration network level; however, the data are provided at an overview level, not disease-specific.

The strengths and weaknesses of costing methods are presented in Table 2. Per diem costs are useful when researchers aim to estimate longer-term, historical series of costs, but there are shortcomings associated with this costing method that lead to a preference for case mix or patient-specific costing. Case mix costs are useful, as the RIWs reflect resource use differences between CMGs. RIWs have been derived from a small number of hospitals, and, as such, will reflect service use patterns specific to 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	<ul style="list-style-type: none"> • Simple measure • Provides a consistent measure over a historical period • Length of stay is the main cost driver 	<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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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).³² Hospitals collect and report data in varying levels of detail. These data have enabled CIHI and provinces to develop an outpatient classification system called the Comprehensive Ambulatory Care Classification System (CACS).³³ Only a small number of hospitals in Ontario, Alberta, and British Columbia collect outpatient costs with NACRS records. Associated resource use data has been used by CIHI to develop RIWs for outpatients.

The data elements collected in the NACRS database include 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).³² 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.

The cost data include 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, 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](#). Using this website and choosing the CACS category, researchers can then select the desired data according to health region, year, desired CACS category, and location of service (emergency department or other). The website also 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 included in these estimates; as such, for a public health care system perspective, physician fees must be added.

Ambulatory care cost data are available for Ontario from the [OCCI CAT](#). Using the CAT, Day Surgery or Ambulatory Care can be selected for a specific year and hospital (or all hospitals), CACS group, and patient age group. Researchers can further specify procedures and diagnoses to obtain more detailed estimates. The resulting report provides an average cost for the group, for the year selected. Restrictions on reporting data from the OCCI CAT are briefly described in [section 3.1.4](#).

Actual data used to determine CACS categories are obtained from provincial health departments or CIHI, although the identification of patients can be done only at the provincial level. CIHI's CACS categories and RIWs are available from the CIHI [website](#). Researchers should download the CACS Client Table for the year of interest; the Excel file *Functional Area RIW Proportions CACS 14* (for example) contains the 2014 RIWs for the CACS groups and a breakdown of these weights by clinical area. For example, 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" makes up 60% of this RIW, while outpatient nursing services represents 9%, and indirect costs make up 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, obtained from CIHI's [Your Health System](#) website on a per hospital, provincial, or national level.

3.2.2 Cost considerations

- Costs by CACS group are available from CIHI; however, there may be a charge associated with the request. Alberta-specific average patient costs are publicly available, with unit cost data for a five-year period (2005-2006 to 2010-2011). The Ontario OCCI CAT also includes outpatient and day surgery costing, similar to the Alberta IHDA tool, but use of the data should be considered as previously described in [section 3.1.4](#).
- Alberta Health allows researchers to obtain the median cost and the average cost, year by year or inflation-adjusted. For an economic evaluation, the average cost is most appropriate.
- Medical devices are included in the CACS cost whenever paid for by the hospital. In certain circumstances (e.g., cochlear implants in some instances), payment for supplies may be through other sources and must be costed separately (see [section 4.3 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 (patient level defined as cost for individual patients). Costing of interventional medical devices is also included in this section, while costing of hospital-based diagnostic and investigational services can be found in [section 3. Hospital Services](#).

4.1 Radiology Services

Radiology services are used by medical practitioners for both diagnosis and treatment, and 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 may have separate costing components: technical (institutional/facility) fees and professional (interpretational) fees, although this may not be the case in all provinces. Facility fees include preparation for interventions, and provision of information and records as well as equipment costs. Professional fees are those charged by the physician for interpretation of 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*),³⁴ as fees and services descriptions may vary substantially among 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 collected for radiology and related services, radiology fees could 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 schedules of fees and benefits; however, radiology fees may be included in other provincial-based fee guides, such as the [Saskatchewan Medical Association guide](#) and the [Manitoba Physician's Manual](#). Documents detailing fees for radiology services often indicate fees for both the professional and technical components. Where fees are not available from a provincial government or medical association, researchers should undertake a web-based grey literature search to identify a sample of cost sources from the appropriate province. Any required labour costs and monitoring time should be captured as per the guidance provided in [section 2. Physician Services](#) for doctors and in [section 5. Non-Physician Professional Services](#) 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 different 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 (see Reporting section).

- Some provincial fee schedules provide units instead of costs. These schedules will have a unit multiplier to apply to the number of units to calculate the cost for the service.

Example E

How would a researcher calculate the cost of an initial bone mineral density (BMD) test using dual-energy X-ray absorptiometry (DEXA) from the perspective of the public payer in Ontario?

- This information can be obtained from the Ontario *Schedule of Benefits*.²⁰ The *Schedule* provides both technical and professional fees for the DEXA scan.
- Using the October 2015 *Schedule*, code X145 (one site), the fee for the technical component (preparation for, performance, and reporting of the procedure) of the DEXA scan is \$42.85, while the fee for the professional component (clinical supervision, monitoring, and interpretation of results) is \$40.15. The decision problem will inform what is included, but in most circumstances, the researcher should include both costs.

Note: The values in Example E are current to February 2016.

4.2 Laboratory Testing/Assays

Laboratory tests and assays are diagnostic 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. Hospital Services](#). Tests may be available individually or as part of a panel/combination testing. Similar to 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 may be used. Provincial schedules may also state fees for patient documentation and specimen collection in certain circumstances (e.g. as seen in the *Ontario Schedule of Benefits for Laboratory Services*).³⁵ Researchers should note any specifications regarding the applicable settings. For example, in the *Ontario Schedule of Benefits*, the patient documentation and specimen handling benefit is applicable to all insured procedures, except for those listed under anatomical pathology, histology, and cytology, as those fees cover any administrative cost. The benefit is also not applicable to referred-in samples, since the collecting laboratory will already have claimed the patient documentation and specimen collection benefit.

4.2.1 Data sources

As noted in [section 4.1 Radiology Services](#), because of the paucity of patient-level costing data, an FFS may 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 calculate 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 cost components are listed, researchers should provide this information in their descriptions of costs.

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

- Researchers should determine whether laboratory tests and assays are single services or part of combination testing; expert opinion may be required. Where the tests are available only as panel/combo tests, the cost for the full test should be included.
- The methodology to address costs associated with the interpretation of the tests is addressed in [section 2.1.1 Data sources](#) (and in the provincial Schedule of Benefits), and in [section 3. Hospital Services](#).

Point-of-care (POC) testing is being adopted by a number of health care institutions, and has the potential to improve access to testing (e.g., time to testing, testing where a central lab is not available). There may be differences in fees where tests are conducted using a POC device; however, this information is not currently publicly available.

Example F

How would a researcher conduct 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, e.g., if the tests are 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 \$3.35 (code 9147), for a total of \$6.95. If the researcher is interested in only one test, or determining the costs and benefits of each test separately and combined, the use of the individual test fees may be more appropriate. If the researcher is interested in both tests done concurrently, the panel test fee may be more appropriate. The researcher should note what is included in the test cost or where there is a lack of clarity as to what is included in the test cost (e.g., reagent, supplies, interpretation, etc.).

Note: The values in Example F are current to February 2016.

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.³⁶ When used within a hospital setting, as noted in [section 3. Hospital Services](#), 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). The guidance provided in this section for medical devices is primarily intended for use in situations where medical devices are required to be costed separately, when they are not included in other cost components, such as in intervention or a service.

4.3.1 Data sources

Medical device costs can be obtained either 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, it typically reflects the list price, as details on any negotiated discounts are rarely disclosed. A purchaser, however, may disclose a negotiated price when 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 found in some of the previously published literature, which includes the cost of medical devices.³⁷⁻⁴⁷
- The lifespan of the device and whether or when it needs to be replaced should be considered within the analysis.
- Where the lifespan of the device exceeds one year, appropriate discounting methods should be used.
- Researchers should be mindful of the potential for double-counting in this area, as some CMG costing includes the cost of medical devices, while others do not. The provider (e.g., CIHI, Alberta Health) should be contacted if there is any uncertainty as to whether medical device costs are included in the total CMG costs.

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. These professionals can provide services within a facility setting or in the community.

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) pay the remainder.

5.1.1 Data sources

For non-physician services covered by the government payer, provincial fee lists available on health ministry websites should be used.

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), and these payments should be considered when broader perspectives are used. 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, as the amounts paid by individuals or private insurers are typically not readily available. Fees recommended by professional bodies or elicited through surveys of patients or practitioners may be required.

Where required cost information (depending on perspective) is not available, the cost of non-physician professional services may be estimated 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 [section 7.2.2 c](#) for estimates for employment benefits.

5.1.2 Cost considerations

- Several provinces have begun reimbursing a number of pharmacist services. In certain provinces, pharmacists can administer vaccinations and provide consultations to patients (e.g., Ontario MedChecks).^{48,49} There is some uncertainty as to the use of fee lists. For example, the [Ontario Chiropractic Association fee schedule](#) recommends chiropractic fees that represent full payment; however, there is no evidence that these fees are charged in practice. Examples of other fees schedules include:
 - Ontario MOHLTC's [fee schedule for optometrists](#)
 - Ontario Dental Association's [dental fee guide](#), available in hard-copy only
 - Ontario MOHLTC's [dentists' fee guide](#)
 - Financial Services Commission of Ontario's [fee guide for physiotherapists](#), for use when treating automobile accident patients.

5.2 Independent Non-Physician Professional Services — Nursing Services

Nursing service costs are included in in-patient, outpatient, and community care (e.g., home care, assisted living) sections of this report ([section 3. Hospital Services](#) and [section 6. Community-Based Services](#)). In addition, nurses can provide care as independent practitioners. There is no fee schedule or recommended fees for private nursing.⁵⁰ 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 unions representing nurses in each province and provincial governments. For example, the Ontario wage agreement can be found in the Ontario Nurses' Association collective agreement.⁵¹ 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. Information on costing of fringe benefits can be found in [section 7.2.2 c](#) of this document. To estimate the payment for a private nurse, researchers should assume that the rate charged is equivalent to that of a public nurse. This may, however, be an underestimation when a private nurse works for an agency that charges overhead to account for 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. Nursing service costs may be captured in outpatient service costs, or rehabilitation costs through CACS. Researchers need to be mindful of the setting to ensure that there is no double-counting when costing nursing services.

Example G

How would a researcher determine the cost for a private nurse with requisite experience (eight years, based on assumption) hired for seven hours?

- The cost per hour, obtained from the 2015 Ontario collective agreement, is \$44.06 for a nurse with eight years' experience.⁵¹
- 13% (\$5.73) is added for benefits and 4.8% (\$2.11) for vacation pay.
- Total hourly cost is estimated to be \$51.90. As a result, the total cost of care for this session is \$363.32 (i.e., \$51.90 x 7).

Note: The values in Example G are current to February 2016.

6. Community-Based Services

Community care (or continuing care) services include some allied professional services, non-professional services, 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 there is no standard or expected length of stay, as is the case with hospitalization groups. As such, the costed unit is 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.

6.1.1 Data sources

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. Version III (RUG-III) grouping methodology was updated and implemented in the US between 1997 and 1998.⁵² The Ontario MOHLTC adopted the methodology to inform payment of complex continuing care beds in Ontario, beginning April 1, 2000. In addition, the Ontario MOHLTC uses 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 RUG category 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 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](#). 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 (special access is required). Unit costs per RUG-III group are publicly available for Ontario through a document issued by the Health System Performance Research Network (HSPRN).⁵³

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 facility residents. The government pays for the health care portion and the residents pay for the accommodation component. Therefore, if researchers are estimating the cost per day using a Ministry of Health perspective, the accommodation fee would be excluded in most cases. If researchers are using a broader perspective (e.g., societal), the accommodation fee should be included, so that the total of all payments equals the provider's receipts. In the HSPRN document, Wodchis et al. present the per diem Ontario long-term care cost for four service categories: nursing and personal care, programs and support, raw food, and accommodations.⁵³ In this case, only the unit cost for the nursing and personal care category (which includes other ancillary health care services such as occupational and physical therapy) should be multiplied by the RUG-III weight to obtain the health care cost for a patient. The other categories are daily accommodation costs that do not vary with case mix.

For analyses specific to a province, researchers should consult with the province's Ministry of Health to request information on long-term care costs, as those are not publicly available. Alternatively, researchers may request information from CIHI for national estimates. Researchers should note that while Ontario delineates residential care and chronic continuous care, other jurisdictions may not. Thus, researchers 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](#).

Example H

How would a researcher calculate the cost of a rehabilitation case 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 length of stay of 10 days.
- 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), programs and support, raw food, and accommodations. In Table 2 of Wodchis et al., 2011-2012 programs and support cost \$8.35, raw food costs \$7.33, and accommodation costs \$50.30, all per day. 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: \$153.47. This should be updated to the most recent year using the CPI. Thus, the daily rehabilitation cost for a unilateral knee replacement in Ontario in 2015 is calculated to be \$159.27 ($\153.47×1.038 [1.038 is the CPI or price-level adjustment]).
- The 10-day institutional costs from a societal perspective are \$1,592.70, based on the assumption that the patient is classed as RAA severity for all days. The public portion of the daily cost is estimated at \$90.80 ($\87.49×1.038), and the private pay portion is the remainder. This is because the government pays only 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. The CMI was assumed to remain constant for the entire stay.

Note: The values in Example H are current to February 2016.

6.1.2 Cost considerations

- 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.
- 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](#), but given the lack of specificity, information from this source should be used with caution.
- Researchers need to be mindful to ensure there is no double-counting, as rehabilitation services may be provided both in the hospital setting or at associated facilities, or in the community (e.g., private physiotherapy clinics).

6.2 Home Care

Home care support programs provide care in a home setting and may include visits made by a professional provider (e.g., a home care nurse or a physiotherapist) or personal support worker. Home care, as described in this section, is distinguished from home support, which includes (non-professional) housekeeping services; however, this may vary between jurisdictions. The cost of physician home visits should be included separately, as per guidance provided in [section 2. Physician Services](#), and based on provincial fee schedules.

6.2.1 Data sources

All provinces provide professional home care, but cost and utilization data are difficult to obtain. Provinces have community support service programs, such as Ontario's Home First, which provides services to elderly patients recently discharged from the hospital;⁵⁴ however, costs or fees associated with the provision of these programs are generally not publicly available. Wodchis et al. estimated fees paid to professional home care workers by the Ontario government for a wide range of home care services provided by different professionals.⁵³

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. This is an emerging area, and the methods and sources of information will evolve. Further updates to the *Guidance Document* will address any changes in this area.

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. However, the \$45 or \$240 fee charged to the patient does not cover full operating costs; these are essentially copayments. As well, full operating costs differ widely by region. Researchers 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, researchers should use the full cost of services. Toronto Paramedic Services is the only public unit that provides information on the full cost. Unless researchers 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 can be found in each [annual report](#) (\$928 in 2014), 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. This statistic captures all resources associated with the service, and would be used in its entirety for a fully covered patient. Any patient fee would be deducted from the government portion if researchers were using a government perspective.

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

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 automated. Further, unlike hospital and physician services, there are no standardized bundles of services such as hospital admissions and physician services. Researchers can obtain costs from local public health units (primary data collection) for public health activities and from manufacturers for supplies for interventions. Cost information may be 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, obtained from surveys or from the literature.

7.1.1 Cost considerations

- Units of resources and costs should be reported separately. The expected number in the population likely to access the intervention should be explicitly stated, with any assumptions explicitly stated and uncertainty around the estimates tested.
- Researchers should include both direct and overhead costs in the analysis. Direct costs of public health activities include the cost of any interventions (e.g., screening tests, vaccines, laboratory tests, and personnel costs), whereas overhead (administrative) costs include program-level management costs, travel costs, and other overheads. Total direct and overhead 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 either be 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 agencies may negotiate volume-based discounts, which may not be disclosed. In these cases, researchers 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.

7.2 Personal Costs

Personal costs are those that are incurred by patients or their informal caregivers. These include out-of-pocket costs and costs associated with lost time. There are two categories of time costs: paid employment given up, and unpaid leisure activities given up. Both have associated values, but that of leisure time is more difficult to measure. In the following section, the focus is on employment costs and the value of lost work, for both care patients and informal caregivers. The valuation of foregone leisure is left to other references.² Lost leisure time may be important for the analysis and relevant for discussion; however, it is not recommended that any valuation be placed on this activity.

7.2.1 Personal travel costs

Personal travel costs are commonly incurred when patients seek medical care, and 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](#), with the cost per kilometre listed by province. 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.

7.2.2 Caregiver costs

Caregiving activity can be either paid or unpaid. The valuation of paid caregiving is straightforward, and follows the same principles as payment for other professional or community-based services, addressed in [sections 5. Non-Physician Professional Services](#) and [6. Community-Based Services](#). Informal caregivers (such as family members) are typically not paid for the care that they provide and often serve as substitutes for long-term nursing or paid homemaker care. In recent years, there has been more recognition for informal, unpaid caregiver losses.

a) Estimated lost time

Caregivers can give up paid work, unpaid (home-based) work, and leisure time.⁵⁵ The focus of this section is on lost work time. Historically there have been two primary ways to value lost time: the human capital approach, and the friction cost approach. Researchers should refer to the most current version of the CADTH *CADTH Guidelines for the Economic Evaluation of Health Technologies: Canada* for recommendations on which approach is most appropriate.

Friction cost approach

Caregivers absent from work might be replaced by other workers after a period of time. During the period of absence from work, caregivers would lose wages for the period during which they are replaced. At the same time, the replacement workers gain income and production continues. The costs for the period of lost and unreplaced work (which is the societal perspective) have been called “friction costs.” A statistic for the friction period or time to replacement is suggested, such as that found in Hopkins et al.,⁵⁶ Hanly et al.,⁵⁷ and Koopmanschap et al.⁵⁸ These authors suggest that there is a period of between 11.3 weeks to 14.6 weeks, after which the worker is replaced. However, Koopmanschap notes that if unemployment is low, the friction period is longer.⁵⁸

Human capital approach

Alternatively, the loss of labour time can be directly translated into a loss of productivity. The “human capital” approach is calculated by multiplying the amount of time off work by the lost compensation rate.^{59,60} 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, although fringe benefits should also be added (see [section 7.2.2 c](#)).

b) Valuing lost caregiver time

There are two ways of valuing a caregiver's lost employment time: the opportunity cost approach and the replacement wage approach.

Opportunity cost approach

The opportunity cost approach is based on the foregone wage that would have been earned by the caregiver, depending on the occupation of the caregiver.

Replacement cost approach

Alternatively, the value of the caregiver's lost time may be based on the wage of person(s) who would be employed to provide the services provided by the caregiver (i.e., the replacement worker). That is, it is the amount required to purchase the same services (e.g., housekeeper).

c) Data

Hourly wage data can be obtained on a monthly basis from Statistics Canada [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](#).

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.⁶¹ As such, researchers should add 11% onto monetary wages to determine an all-sector, Canada-wide compensation rate.

Employed workers receive compensation for vacation time and also for sick leave; Guerriere et al. estimate this adds about 13% to the total compensation.⁶² However, the Ontario Nurses' Association 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.

7.2.3 Patient costs

Researchers may also want to include costs for patients in their economic studies. The principles and data sources are similar to those described for caregiver costs.

7.3 Capital Costs

Capital costs are incurred for the purchase of capital assets, e.g., equipment, buildings, and land.⁸ Capital costs have several different components: providers forgo a return on the investment (typically referred to as "r") during the lifetime of the asset, the asset contributes to production in each year of use, and the asset is subject to capital depreciation until it is no longer used. To value capital assets, researchers should calculate the annualized cost of the asset. This is done by recognizing the initial acquisition and set-up cost, the time over which the asset will be used, the foregone return (r), and any realized residual value at the end of the asset's useful life — as described in Drummond (2005, section 4.2).⁸ For the appropriate discount rate, researchers should refer to the current edition of the CADTH *Guidelines for the Economic Evaluation of Health Technologies: Canada*.

The same method can be used for allocating the cost of medical devices over the lifetime of the device.

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.

Researchers should 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 and 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 3). 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.

TABLE 3: EXAMPLE OF REPORTING RESOURCES

Parameter	Resource	Volume (Units)	Source	SA values	Sources
Physician visit	General family practice consultation	4 consultations (per year)	Product Monograph/ Guidelines	2 to 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 annual adverse event rate	Literature/Product Monograph	No consultation	Expert opinion
Adverse event C	General family practice consultation	1 per event 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+ 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.

Researchers should 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.

When assessing uncertainty cost estimates, how this is considered should be explicitly stated. For example, if there is considerable variation or uncertainty in the volume or unit cost, this should be reported. Most identified data sources report standard deviations or 95% confidence intervals around the costs or resource units, and these are considered and the results reported in sensitivity analyses.

An example is provided in Table 4 of how information can be presented.

TABLE 4: EXAMPLE OF REPORTING COST VALUATIONS

Parameter	Resource Requirement	Unit of Measure	Resource Cost	Source	SA Values	Sources ^b
Physician visit	General family practice consultation	Consultation	\$77.20	OHIP <i>Schedule of Benefits</i> (Code A005)		
Diagnostic test A	Diagnostic test	Test				
Diagnostic test A	Clinical interpretation by an immunologist	Interpretation/consultation/visit	\$29.05	OHIP <i>Schedule of Benefits</i> (Code K399)		
Adverse event B	General family practice consultation	Consultation	\$77.20	OHIP <i>Schedule of Benefits</i> (Code A005)		
Adverse event C	General family practice consultation	Consultation	\$77.20	OHIP <i>Schedule of Benefits</i> (Code A005)		
Adverse event C	CBC (any method)	Test	\$8.27 ^a	OHIP <i>Schedule of Benefits</i> 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.

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

^b Where the analysis is being conducted for Canada as a whole, unit costs from other jurisdictions could be considered.

Note: In this example, treatment is assumed to be in the outpatient setting. The values are current to February 2016.

APPENDIX: SUMMARY OF DATA SOURCES

TABLE 5: 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 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"> Case mix adjusted costs (using CACS) obtained from several provincial websites 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

Cost Category	Sources of Information
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 can be sourced) • Toronto paramedic service fee for full cost, less patient payment fee to obtain government cost • Patient fees • Fees obtained from a literature search

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

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