Quality-Based Procedures: Clinical Handbook for **Hip Fracture**

Health Quality Ontario &
Ministry of Health and Long-Term Care

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Conflict of Interest Statement

All reports prepared by the Evidence Development and Standards Branch at Health Quality Ontario are impartial. There are no competing interests or conflicts of interest to declare.

Disclaimer

The content in this document has been developed through collaborative efforts between the Ministry of Health and Long-Term Care ("Ministry"), the Evidence Development and Standards Branch at Health Quality Ontario (HQO), and the Hip Fracture Expert Advisory Panel ("Expert Panel"). The template for the Quality-Based Procedures Clinical Handbook and all content in the "Purpose" and "Introduction to Quality-Based Procedures" sections were provided in standard form by the Ministry. All other content was developed by HQO with input from the Expert Panel. As it is based in part on rapid reviews and expert opinion, this handbook may not reflect all the available scientific research and is not intended as an exhaustive analysis. Health Quality Ontario assumes no responsibility for omissions or incomplete analysis resulting from its reports. In addition, it is possible that other relevant scientific findings may have been reported since completion of the handbook and/or rapid reviews. This report is current to the date of the literature search specified in the Research Methods section of each rapid review. This handbook may be superseded by an updated publication on the same topic.

Please check the Health Quality Ontario website for a list of all HQO's Quality-Based Procedures Clinical Handbooks: http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations.

About the Quality-Based Procedures Clinical Handbooks

As legislated in Ontario's *Excellent Care for All Act*, Health Quality Ontario's mandate includes the provision of objective, evidence-informed advice about health care funding mechanisms, incentives, and opportunities to improve quality and efficiency in the health care system. As part of its Quality-Based Funding initiative, Health Quality Ontario works with multidisciplinary expert panels (composed of leading clinicians, scientists, and administrators) to develop evidence-based practice recommendations and define episodes of care for selected disease areas or procedures. Health Quality Ontario's recommendations are intended to inform the Ministry of Health and Long-Term Care's Health System Funding Strategy.

For more information on Health Quality Ontario's Quality-Based Funding initiative, visit www.hqontario.ca.

About Health Quality Ontario

Health Quality Ontario is an arms-length agency of the Ontario government. It is a partner and leader in transforming Ontario's health care system so that it can deliver a better experience of care, better outcomes for Ontarians, and better value for money.

Health Quality Ontario strives to promote health care that is supported by the best available scientific evidence. Health Quality Ontario works with clinical experts, scientific collaborators, and field evaluation partners to develop and publish research that evaluates the effectiveness and cost-effectiveness of health technologies and services in Ontario.

Based on the research conducted by Health Quality Ontario and its partners, the Ontario Health Technology Advisory Committee (OHTAC)—a standing advisory subcommittee of the Health Quality Ontario Board—makes recommendations about the uptake, diffusion, distribution, or removal of health interventions to Ontario's Ministry of Health and Long-Term Care, clinicians, health system leaders, and policy makers.

Rapid reviews, evidence-based analyses and their corresponding OHTAC recommendations, and other associated reports are published on the Health Quality Ontario website. Visit http://www.hqontario.ca for more information.

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List of Abbreviations

ADL	Activities of daily living
ALC	Alternate level of care
ASA	American Society of Anesthesiologists
CAN	Clinical assessment node
CCC	Complex continuing care
CCRS	Continuing Care Reporting System
CHF	Congestive heart failure
CIHI	Canadian Institute for Health Information
COPD	Chronic obstructive pulmonary disease
DAD	Discharge Abstract Database
ED	Emergency department
Expert Panel	Hip Fracture Episode of Care Expert Advisory Panel
FIM	Functional Independence Measure
GRADE	Grades of Recommendation, Assessment, Development, and Evaluation
HBAM	Health-Based Allocation Model
HCD	Home Care Database
HIG	Health-Based Allocation Model Inpatient Grouper
HQO	Health Quality Ontario
HSFR	Health System Funding Reform
ICD-10-CA	International Classification of Diseases, 10th Revision, Canadian Edition
LHIN	Local Health Integration Network
LOS	Length of stay
LTC	Long-term care
Ministry	Ministry of Health and Long-Term Care
MRDx	Most responsible diagnosis
NACRS	National Ambulatory Care Reporting System
NRS	National Rehabilitation Reporting System
ODB	Ontario Drug Benefit database
OHTAC	Ontario Health Technology Advisory Committee
PBF	Patient-Based Funding
QBF	Quality-Based Funding
QBP	Quality-Based Procedure
RAI	Resident Assessment Instrument
RCT	Randomized controlled trial
RIW	Resource Intensity Weight
RPDB	Registered Persons Database
SIGN	Scottish Intercollegiate Guidelines Network

Preface

The content in this document has been developed through collaborative efforts between the Ministry of Health and Long-Term Care ("Ministry"), Health Quality Ontario (HQO), and the HQO Hip Fracture Episode of Care Expert Advisory Panel ("Expert Panel").

The template for the Quality-Based Procedures Clinical Handbook and all content in Section 1 ("Purpose") and Section 2 ("Introduction to Quality-Based Procedures") were provided in standard form by the Ministry. All other content was developed by HQO with input from the Expert Panel.

To consider the content of this document in the appropriate context, it is important to take note of the specific deliverables that the Ministry tasked HQO with developing for this Clinical Handbook. The following includes excerpts from the HQO–Ministry Accountability Agreement for fiscal year 2012/2013:

> *To guide HQO's support to the funding reform, HQO will:*
>
> 1. *Conduct analyses/consultation in the following priority areas in support of funding strategy implementation for the 2013/2014 fiscal year:*
>   a) *Chronic Obstructive Pulmonary Disease*
>   b) *Congestive Heart Failure*
>   c) *Stroke*
>   d) (Later added) *Hip Fracture.*
>
> 2. *Include in their analyses/consultation noted in clause 21, consultations with clinicians and scientists who have knowledge and expertise in the identified priority areas, either by convening a reference group or engaging an existing resource of clinicians/scientists.*
>
> 3. *Work with the reference group to:*
>   *a) Define the population/patient cohorts for analysis,*
>   *b) Define the appropriate episode of care for analysis in each cohort, and*
>   *c) Seek consensus on a set of evidence-based clinical pathways and standards of care for each episode of care.*

Following sign-off on the Accountability Agreement, the Ministry subsequently asked HQO to also develop the following additional content for each of the assigned clinical areas:

4. *Provide recommendations on performance indicators aligned with the recommended episodes of care, in order to inform the Ministry's Quality-Based Procedure (QBP) Integrated Scorecard.*

5. *Provide guidance on the real-world implementation of the recommended practices contained in the Clinical Handbook, with a focus on implications for multidisciplinary teams, service capacity planning considerations and new data collection requirements.*

HQO was asked to produce the deliverables described above using the Clinical Handbook template structure provided by the Ministry.

Key Principles

At the start of this project, a set of key principles or "ground rules" to guide this evolving work was established through discussions between HQO, the Expert Panels and the Ministry:

- **HQO's work does not involve costing or pricing.** All costing and pricing work related to the QBP funding methodology is to be completed by the Ministry using a standardized approach, informed by the content produced by HQO. This principle also extended to the deliberations of the Expert Panels, where discussions were steered away from considering the dollar cost of particular interventions or models of care and instead focused on quality considerations and non-cost measures of utilization, such as length of stay (LOS).
- **Recommended practices, supporting evidence, and policy applications will be reviewed and updated at least every 2 years.** The limited 5-month time frame provided for the completion of this work meant that many of the recommended practices in this document could not be assessed with the full rigour and depth of HQO's established evidence-based analysis process. Recognizing this limitation, HQO reserves the right to revisit the recommended practices and supporting evidence at a later date by conducting a full evidence-based analysis or to update this document with relevant newly published research. In cases where the episode of care models are updated, any policy applications informed by the models should also be similarly updated.

  Consistent with this principle, the Ministry has stated that the QBP models will be reviewed at least every 2 years.
- **Recommended practices should reflect the best patient care possible, regardless of cost or barriers to access.** HQO and the Expert Panels were instructed to focus on defining best practice for an *ideal* episode of care, regardless of cost implications or potential barriers to access. Hence, the resulting cost implications of the recommended episodes of care are unknown. However, the Expert Panels have discussed a number of barriers that will challenge implementation of their recommendations across the province. These include gaps in measurement capabilities for tracking many of the recommended practices, shortages in health human resources, and limitations in community-based care capacity across many parts of the province.

  Some of these barriers and challenges are briefly addressed in Section 9 ("Implementation Considerations") of this Clinical Handbook. However, the Expert Panels noted that with the limited time they were provided to address these issues, the considerations outlined here should only be viewed as an initial starting point toward a comprehensive analysis of these challenges.

Finally, HQO and the Expert Panel recognize that given the limitations of their mandate, much of the ultimate impact of this content will depend on subsequent work by the Ministry to incorporate the analysis and advice contained in this document into the Quality-Based Procedures policy framework and funding methodology. This will be complex work, and it will be imperative to ensure that any new funding mechanisms deployed are well-aligned with the recommendations of the Expert Panel.

Nevertheless, the Expert Panel believes that, regardless of the outcome of efforts to translate this content into hospital funding methodology, the recommended practices in this document can also provide the basis for setting broader provincial standards of care for managing hip fractures. These standards could be linked not only to funding mechanisms, but to other health system change levers such as guidelines and care pathways, performance measurement and reporting, program planning, and quality improvement activities.

1. Purpose

Provided by the Ministry of Health and Long-Term Care

This Clinical Handbook has been created to serve as a compendium of the evidence-based rationale and clinical consensus driving the development of the policy framework and implementation approach for hip fracture patients seen in hospitals.

This Clinical Handbook is intended for a clinical audience. It is not, however, intended to be used as a clinical reference guide by clinicians and will not be replacing existing guidelines and funding applied to clinicians. Evidence-informed pathways and resources have been included in this Clinical Handbook for your convenience.

2. Introduction to Quality-Based Procedures

Provided by the Ministry of Health and Long-Term Care

Quality-Based Procedures (QBPs) are an integral part of Ontario's Health System Funding Reform (HSFR) and a key component of Patient-Based Funding (PBF). This reform plays a key role in advancing the government's quality agenda and its *Action Plan for Health Care***.** The HSFR has been identified as an important mechanism to strengthen the link between the delivery of high quality care and fiscal sustainability.

Ontario's health care system has been living under global economic uncertainty for a considerable time. Simultaneously, the pace of growth in health care spending has been on a collision course with the provincial government's deficit recovery plan.

In response to these fiscal challenges and to strengthen the commitment toward the delivery of high quality care, the *Excellent Care for All Act* (*ECFAA*) received royal assent in June 2010. The *ECFAA* is a key component of a broad strategy that improves the quality and value of patients' experiences by providing them with the right evidence-informed health care at the right time and in the right place. The *ECFAA* positions Ontario to implement reforms and develop the levers needed to mobilize the delivery of high quality, patient-centred care.

Ontario's *Action Plan for Health Care* advances the principles of the *ECFAA*, reflecting quality as the primary driver to system solutions, value, and sustainability.

What Are We Moving Toward?

Before the introduction of HSFR, a significant proportion of hospital funding was allocated through a global funding approach, with specific funding for some select provincial programs and wait times services. However, a global funding approach reduces incentives for health service providers to adopt best practices that result in better patient outcomes in a cost-effective manner.

To support the paradigm shift from a culture of cost containment to that of quality improvement, the Ontario government is committed to moving toward a patient-centred, evidence-informed funding model that reflects local population needs and contributes to optimal patient outcomes (Figure 1).

PBF models have been implemented internationally since 1983. Ontario is one of the last leading jurisdictions to move down this path. This puts the province in a unique position to learn from international best practices and the lessons others learned during implementation, thus creating a funding model that is best suited for Ontario.

PBF supports system capacity planning and quality improvement through directly linking funding to patient outcomes. PBF provides an incentive to health care providers to become more efficient and effective in their patient management by accepting and adopting best practices that ensure Ontarians get the right care at the right time and in the right place.

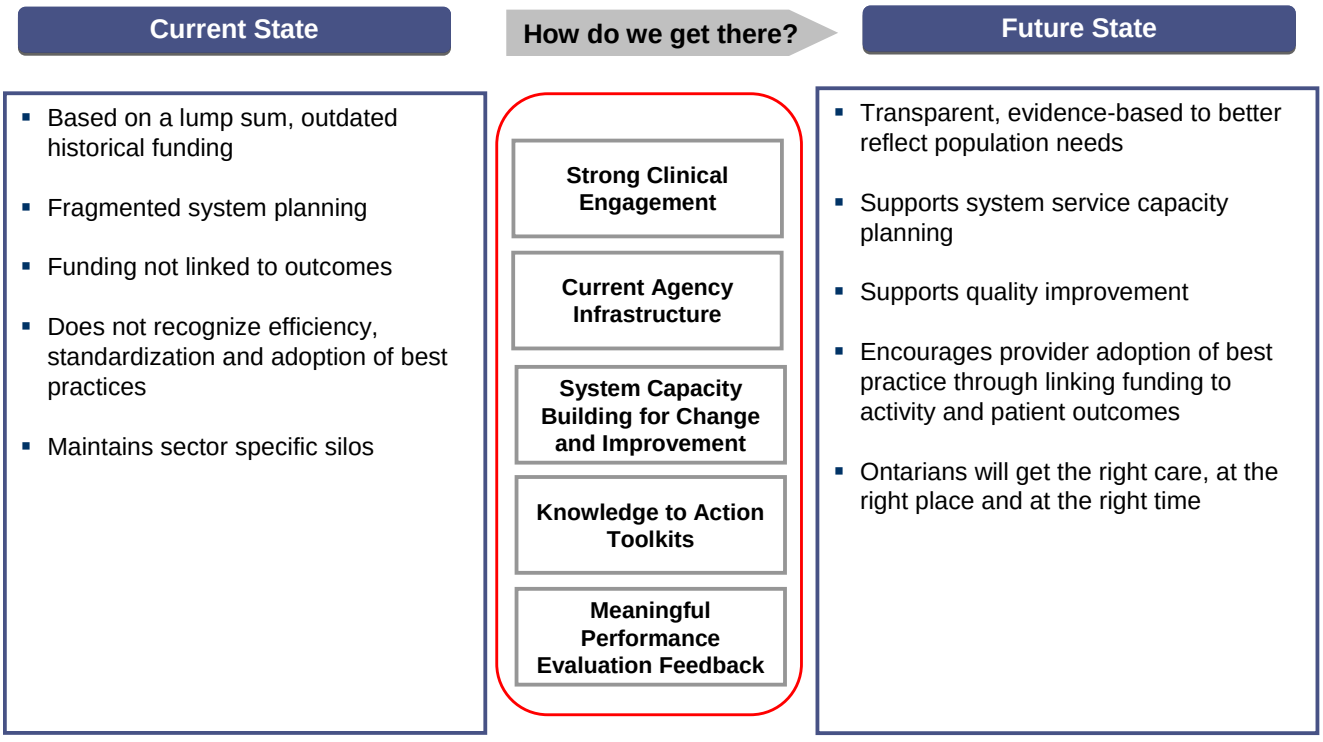

Figure 1: Current and Future States of Health System Funding

How Will We Get There?

The Ministry of Health and Long-Term Care has adopted a 3-year implementation strategy to phase in a PBF model and will make modest funding shifts starting in fiscal year 2012/2013. A 3-year outlook has been provided to support planning for upcoming funding policy changes.

The Ministry has released a set of tools and guiding documents to further support the field in adopting the funding model changes. For example, a QBP interim list has been published for stakeholder consultation and to promote transparency and sector readiness. The list is intended to encourage providers across the continuum to analyze their service provision and infrastructure in order to improve clinical processes and, where necessary, build local capacity.

The successful transition from the current, provider-centred funding model toward a patient-centred model will be catalyzed by a number of key enablers and field supports. These enablers translate to actual principles that guide the development of the funding reform implementation strategy related to QBPs. These principles further translate into operational goals and tactical implementation (Figure 2).

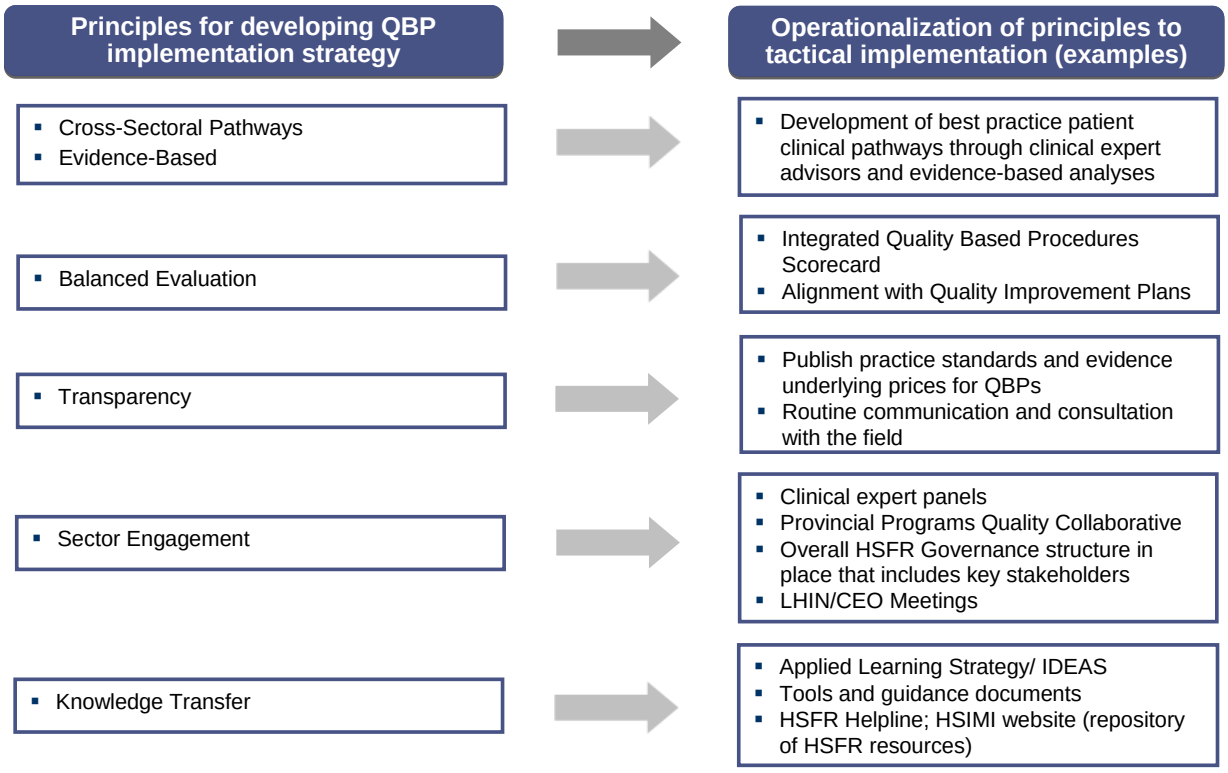

Figure 2: Principles Guiding Implementation of Quality-Based Procedures
Abbreviations: HSFR, Health System Funding Reform; HSIMI, Health System Information Management and Investment: IDEAS, Improving the Delivery of Excellence Across Sectors; LHIN, Local Health Integration Network; QBP. Quality-Based Procedures.

What Are Quality-Based Procedures?

QBPs involve clusters of patients with clinically related diagnoses or treatments. Hip fracture was chosen as a QBP using an evidence- and quality-based selection framework that identifies opportunities for process improvements, clinical redesign, improved patient outcomes, enhanced patient experience, and potential cost savings.

The evidence-based framework used data from the Discharge Abstract Database (DAD) adapted by the Ministry for its Health-Based Allocation Model (HBAM) repository. The HBAM Inpatient Grouper (HIG) groups inpatients based on their diagnosis or their treatment for the majority of their inpatient stay. Day surgery cases are grouped in the National Ambulatory Care Referral System (NACRS) by the principal procedure they received. Additional data were used from the Ontario Case Costing Initiative (OCCI). Evidence in publications from Canada and other jurisdictions and World Health Organization reports was also used to assist with the patient clusters and the assessment of potential opportunities.

The evidence-based framework assessed patients using 4 perspectives, as presented in Figure 3. This evidence-based framework has identified QBPs that have the potential to both improve quality outcomes and reduce costs.

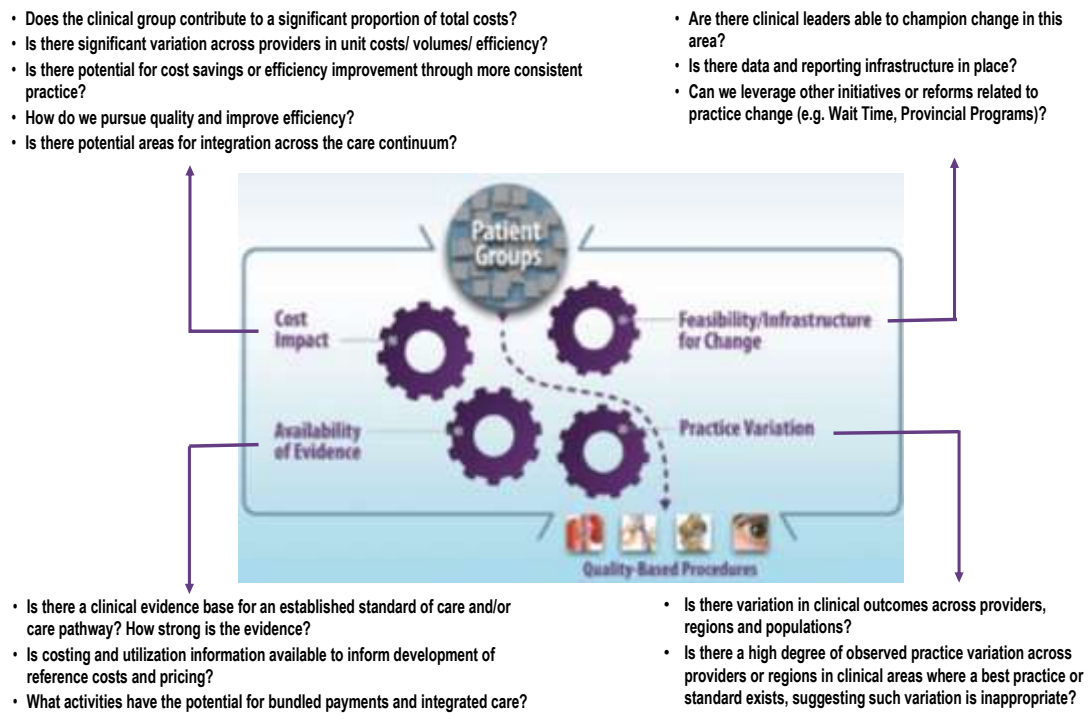

Figure 3: Evidence-Based Framework

Practice Variation

The DAD stores every Canadian patient discharge, coded and abstracted, for the past 50 years. This information is used to identify patient transition through the acute care sector, including discharge locations, expected lengths of stay (LOSs), and readmissions for each and every patient, based on their diagnosis and treatment, age, sex, comorbidities and complexities, and other condition-specific data. A demonstrated large practice or outcome variance may represent a significant opportunity to improve patient outcomes by reducing this practice variation and focusing on evidence-informed practice. A large number of "Beyond Expected Days" for LOS and a large standard deviation for LOS and costs are flags to such variation. Ontario has detailed case-costing data for all patients discharged from a case-costing hospital from as far back as 1991, as well as daily utilization and cost data by department, by day, and by admission.

Availability of Evidence

A significant amount of Canadian and international research has been undertaken to develop and guide clinical practice. Using these recommendations and working with the clinical experts, best practice guidelines and clinical pathways can be developed for these QBPs, and appropriate evidence-informed indicators can be established to measure performance.

Feasibility/Infrastructure for Change

Clinical leaders play an integral role in this process. Their knowledge of the patients and the care provided or required represents an invaluable component of assessing where improvements can and should be made. Many groups of clinicians have already provided evidence for rationale-for-care pathways and evidence-informed practice.

Cost Impact

The selected QBP should have no fewer than 1,000 cases per year in Ontario and represent at least 1% of the provincial direct cost budget. While cases that fall below these thresholds may, in fact, represent improvement opportunity, the resource requirements to implement a QBP may inhibit the effectiveness for such a small patient cluster, even if there are some cost efficiencies to be found. Clinicians may still work on implementing best practices for these patient subgroups, especially if they align with the change in similar groups. However, at this time, there will be no funding implications. The introduction of evidence into agreed-upon practice for a set of patient clusters that demonstrate opportunity as identified by the framework can directly link quality with funding.

QBP Evidence-Based Framework for Hip Fracture

- Each incident hip fracture in Ontario attributable to $37.5 K in total 1-year costs across sectors (5)
- Incident hip fractures in Ontario attributable to $282 million in total 1-year costs across sectors (5)
- Estimated 90 day average episode costs for hip fracture vary from $32,618 to $42,796 across LHINs; variation in post-acute care pathways contributes to a large share of variation in total episode costs (3)

- National Hip Fracture Toolkit has provided a Canadian guideline for hip fracture management (2)
- *Medical Journal of Australia* (6) and Scottish Intercollegiate Guidelines Network (4) have published comprehensive international evidence-based guidelines for hip fracture management
- Hip fracture identified as a leading candidate condition for Medicare bundled payment pilots in the United States (7)

- Ontario Orthopaedic Expert Panel and Bone and Joint Canada have provided provincial clinical leadership in improving hip fracture care
- *Hip Fracture Quality Scorecard* has built a performance measurement foundation to improve care (1)
- Percentage of patients receiving surgery within the recommended 48 hours ranges from 67% to 94% across LHINs (1)
- 90-day readmission rate ranges from 9.7% to 17.9% across LHINs (3)

Figure 4: Quality-Based Procedures Evidence-Based Framework for Hip Fracture
Abbreviation: LHIN, Local Health Integration Network
Note: All amounts in Canadian dollars.

How Will Quality-Based Procedures Encourage Innovation in Health Care Delivery?

Implementing evidence-informed pricing for the targeted QBPs will encourage health care providers to adopt best practices in their care delivery models and maximize their efficiency and effectiveness. Moreover, best practices that are defined by clinical consensus will be used to understand required resource utilization for the QBPs and further assist in developing evidence-informed pricing.

Implementation of a "price × volume" strategy for targeted clinical areas will motivate providers to:

- adopt best practice standards
- re-engineer their clinical processes to improve patient outcomes
- develop innovative care delivery models to enhance the experience of patients

Clinical process improvement may include better discharge planning, eliminating duplicate or unnecessary investigations, and paying greater attention to the prevention of adverse events, that is, post-operative complications. These practice changes, together with adoption of evidence-informed practices, will improve the overall patient experience and clinical outcomes and help create a sustainable model for health care delivery.

3. Methods

Overview of the HQO Episode of Care Analysis Approach

In order to produce this work, Health Quality Ontario (HQO) has developed a novel methodology known as an *episode of care analysis* that draws conceptually and methodologically from several of HQO's core areas of expertise:

- **Health technology assessment**: Recommended practices incorporate components of HQO's evidence-based analysis methodology and draw from the recommendations of the Ontario Health Technology Advisory Committee (OHTAC).
- **Case mix grouping and funding methodology:** Cohort and patient group definitions use clinical input to adapt and refine case mix methodologies from the Canadian Institute for Health Information (CIHI) and the Ontario Health-Based Allocation Model (HBAM).
- **Clinical practice guidelines and pathways:** Recommended practices synthesize guidance from credible national and international guideline bodies, with attention to the strength of evidence supporting each piece of guidance.
- **Analysis of empirical data:** Expert Panel recommendations are supported by descriptive and multivariate analysis of Ontario administrative data (e.g., Discharge Abstract Database [DAD] and National Ambulatory Care Reporting System [NACRS]) and data from disease-based clinical data sets (e.g., the Ontario Stroke Audit [OSA] and Enhanced Feedback For Effective Cardiac Treatment [EFFECT] databases). HQO works with researchers and Ministry analytic staff to develop analyses for the Expert Panel's review.
- **Clinical engagement**: All aspects of this work are guided and informed by leading clinicians, scientists, and administrators with a wealth of knowledge and expertise in the clinical area of focus.
- **Performance indicators**: HQO has been asked to leverage its expertise in performance indicators and public reporting to support the development of measurement frameworks to manage and track actual performance against the recommended practices in the episodes of care.

The development of the episode of care analysis involves the following key steps:

1. **Defining the cohort and patient stratification approach;**
2. **Defining the scope of the episode of care;**
3. **Developing the episode of care model;**
4. **Identifying recommended practices, including the rapid review process;**
5. **Supporting the development of performance indicators to measure the episode of care.**

The following sections describe each of these steps in further detail.

Defining the Cohort and Patient Stratification Approach

At the outset of this project, the Ministry of Health and Long-Term Care (the Ministry) provided HQO with a broad description of each assigned clinical population (e.g., "stroke"), and asked HQO to work with the Expert Panels to define inclusion and exclusion criteria for the cohort they would examine using data elements from routinely reported provincial administrative databases. It was also understood that each of these populations might encompass multiple distinct subpopulations (referred to as "patient groups") with significantly different clinical characteristics. For example, the congestive heart failure (CHF) population includes subpopulations with heart failure, myocarditis and cardiomyopathies. These patient groups each have very different levels of severity, different treatment pathways, and different distributions of expected resource utilization. Consequently, these groups may need to be reimbursed differently from a funding policy perspective.

Conceptually, the process employed here for defining cohorts and patient groups shares many similarities with methods used around the world for the development of case mix methodologies, such as Diagnosis-Related Groups (DRGs) or the Canadian Institute for Health Information's (CIHI) Case Mix Groups. Case mix methodologies have been used since the late 1970s to classify patients into groups that are similar in terms of both clinical characteristics and resource utilization for the purposes of payment, budgeting and performance measurement (8). Typically, these groups are developed using statistical methods such as classification and regression tree analysis to cluster patients with similar costs based on common diagnoses, procedures, age, and other variables. After the initial patient groups have been established based on statistical criteria, clinicians are often engaged to ensure that the groups are clinically meaningful. Patient groups are merged, split, and otherwise reconfigured until the grouping algorithm reaches a satisfactory compromise between cost prediction, clinical relevance, and usability. Most modern case mix methodologies and payment systems also include a final layer of patient complexity factors that modify the resource weight (or price) assigned to each group upward or downward. These can include comorbidities, use of selected interventions, long- or short-stay status, and social factors.

In contrast with these established methods for developing case mix systems, the patient classification approach that the Ministry asked HQO and the Expert Panels to undertake is unusual in that it *begins* with the input of clinicians rather than with statistical analysis of resource utilization. The Expert Panels were explicitly instructed not to focus on cost considerations, but instead to rely on their clinical knowledge of those patient characteristics that are commonly associated with differences in indicated treatments and expected resource utilization. Expert Panel discussions were also informed by summaries of relevant literature and descriptive tables containing Ontario administrative data.

Based on this information, the Expert Panels recommended a set of inclusion and exclusion criteria to define each disease cohort. Starting with identifying the International Classification of Diseases 10th Revision, Canadian Edition (ICD-10-CA) diagnosis codes included for the population, the Expert Panels then excluded diagnoses with significantly different treatment protocols from the general population, including pediatric cases and patients with very rare disorders. Next, the Expert Panels recommended definitions for major patient groups within the cohort. Finally, the Expert Panels identified patient characteristics that they believe would contribute to additional resource utilization for patients within each group. This process generated a list of factors ranging from commonly occurring comorbidities to social characteristics such as housing status.

In completing the process described above, the Expert Panel encountered some noteworthy challenges:

1. **Absence of clinical data elements capturing important patient complexity factors:** the Expert Panels quickly discovered that a number of important patient-based factors related to the severity

of patients' conditions or their expected utilization are not routinely collected in Ontario hospital administrative data. These include both key clinical measures (such as FEV_1 / FVC for chronic obstructive pulmonary disease [COPD] patients and AlphaFIM®[a] scores for stroke patients) as well as important social characteristics (such as caregiver status).[b] For stroke and CHF, some of these key clinical variables have been collected in the past through the OSA and EFFECT datasets, respectively. However, these datasets were limited to a group of participating hospitals and at this time are not funded for future data collection.

2. **Limited focus on a single disease or procedure grouping within a broader case mix system:** while the Expert Panels were asked to recommend inclusion/exclusion criteria only for the populations tasked to them, the patient populations assigned to HQO are a small subset of the many patient groups under consideration for Quality-Based Procedures (QBP). This introduced some additional complications when defining population cohorts; after the Expert Panels had recommended their initial patient cohort definitions (based largely on diagnosis), the Ministry informed the Expert Panels that there were a number of other patient groups planned for future Quality-Based Procedure (QBP) funding efforts that overlapped with the cohort definitions.

   For example, while the vast majority of patients discharged from hospital with a most responsible diagnosis (MRDx) of COPD receive largely ward-based medical care, a small group of COPD-diagnosed patients receive much more cost-intensive interventions such as lung transplants or resections. Based on their significantly different resource utilization, the Ministry's HBAM grouping algorithm assigns these patients to a different HBAM Inpatient Grouper (HIG) group from the general COPD population. Given this methodological challenge, the Ministry requested that the initial cohorts defined by the Expert Panels be modified to exclude patients that receive selected major interventions. It is expected that these patients may be assigned to other QBP patient groups in the future. This document presents both the initial cohort definition defined by the Expert Panel and the modified definition recommended by the Ministry.

In short, the final cohorts and patient groups described here should be viewed as a compromise solution based on currently available data sources and the parameters of the Ministry's HBAM grouping methodology.

[a] The Functional Independence Measure (FIM) is a composite measure consisting of 18 items assessing 6 areas of function. These fall into 2 basic domains; physical (13 items) and cognitive (5 items). Each item is scored on a 7-point Likert scale indicative of the amount of assistance required to perform each item (1 = total assistance, 7 = total independence). A simple summed score of 18–126 is obtained where 18 represents complete dependence / total assistance and 126 represents complete independence.

[b] For a comprehensive discussion of important data elements for capturing various patient risk factors, see Iezzoni LI, editor. Range of risk factors. In Iezzoni LI (Ed.) Risk adjustment for measuring health care outcomes, 4th ed. Chicago: Health Administration Press; 2012. p. 29-76.

Defining the Scope of the Episode of Care

HQO's episode of care analysis draws on conceptual theory from the emerging worldwide use of episode-based approaches for performance measurement and payment. Averill et al, (9) Hussey et al, (10) and Rosen and Borzecki (11) describe the key parameters required for defining an appropriate episode of care:

- **Index event:** The event or time point triggering the start of the episode. Examples of index events include admission for a particular intervention, presentation at the emergency department (ED), or the diagnosis of a particular condition.
- **Endpoint:** The event or time point triggering the end of the episode. Examples of endpoints include death, 30 days following hospital discharge, or a "clean period" with no relevant health care service utilization for a defined period.
- **Scope of services included:** Although an "ideal" episode of care might capture all health and social care interventions received by the patient from index event to endpoint, in reality not all these services may be relevant to the objectives of the analysis. Hence, the episode may exclude some types of services such as prescription drugs or services tied to other unrelated conditions.

Ideally, the parameters of an episode of care are defined based on the nature of the disease or health problem studied and the intended applications of the episode (e.g., performance measurement, planning, or payment). For HQO's initial work here, many of these key parameters were set in advance by the Ministry based on the government's QBP policy parameters. For example, in 2013/2014 the QBPs will focus on reimbursing acute care, and do not include payments for physicians or other non-hospital providers. These policy parameters resulted in there being limited flexibility to examine non-hospital elements such as community-based care or readmissions.

For hip fracture, the Ministry asked the Expert Panel to consider post-acute services received by patients following the acute hospitalization. The Expert Panel ultimately agreed on a definition of an episode of care that would encompass a period of 90 days following an index hospitalization for a hip fracture, focusing on all health care services received by the patient during this window of time.

Developing the Episode of Care Pathway Model

HQO has developed a model that brings together the key components of the episode of care analysis through an integrated schematic. The model is structured around the parameters defined for the episode of care, including boundaries set by the index event and endpoints, segmentation (or stratification) of patients into the defined patient groups, and relevant services included in the episode. The model describes the pathway of each patient case included in the defined cohort, from initial presentation through segmentation into one of the defined patient groups based on their characteristics, and finally through the subsequent components of care that they receive before reaching discharge or death.

Although the model bears some resemblance to a clinical pathway, it is not intended to be used as a traditional operational pathway for implementation in a particular care setting. Rather, the model presents the critical decision points and phases of treatment within the episode of care, referred to here as *clinical assessment nodes* and *care modules*, respectively. Clinical assessment nodes (CANs) provide patient-specific criteria for whether a particular case proceeds down one branch of the pathway or another. Once patients move down a particular branch, they then receive a set of recommended practices that are clustered together as a care module. Care modules represent the major phases of care that patients receive during a hospital episode, such as treatment in the ED, care on the ward, and discharge planning. The process for identifying the recommended practices within each CAN and care module is described in the next section.

Drawing from the concept of decision analytic modelling, the episode of care model includes crude counts (N) and proportions (Pr) of patients proceeding down each branch of the pathway model. For the 3 conditions studied in this exercise, these counts were determined based on annual utilization data from the DAD, NACRS, and (for CHF and stroke) clinical registry data.

Figure 5 provides an example of a care module and CAN:

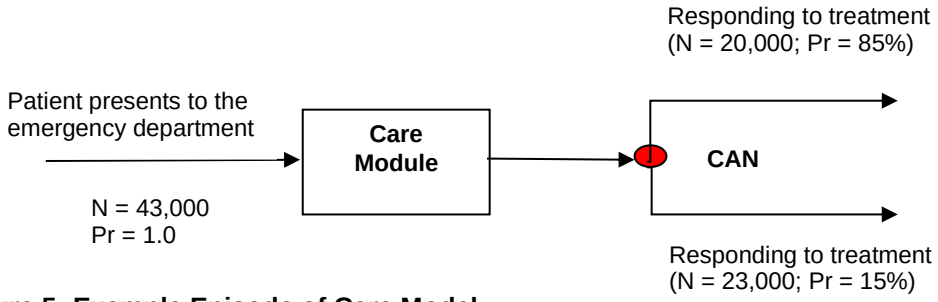

Figure 5: Example Episode of Care Model
Abbreviations: CAN, clinical assessment node; N, crude counts; Pr, proportions.

Identifying Recommended Practices

Each CAN and care module in the episode of care model contains a set of recommended practices reviewed and agreed upon through the Expert Panel. The end goal communicated by the Ministry for the QBP methodology is to develop cost estimates for the recommended practices and aggregate these to determine a total "best practice cost" for an ideal episode of care to inform the pricing of the QBP.

Consideration of OHTAC Recommendations

In keeping with HQO's mandate to support evidence-based care, considerable attention has been paid to ensure that the practices recommended here are supported by the best available evidence. For this process, HQO considers the highest quality of evidence to be official OHTAC recommendations. Although there are many other organizations that release high quality clinical guidance based on rigorous standards of evidence (and indeed, are used in this process), OHTAC recommendations are considered the gold standard of evidence for several reasons:

- **Consistency:** While many guidance bodies issue disease-specific recommendations, OHTAC provides a common evidence framework across all the clinical areas analyzed in all disease areas.
- **Economic modelling:** OHTAC recommendations are generally supported by economic modelling to determine the cost-effectiveness of an intervention, whereas many guidance bodies assess only effectiveness.
- **Contextualization:** In contrast with recommendations and analyses from international bodies, OHTAC recommendations are developed through the contextualization of evidence for Ontario. This ensures that the evidence is relevant to the Ontario health system.

Consideration of Other Types of Evidence

Notwithstanding these strengths, it is also crucial to note several important limitations in the mandate and capacity of OHTAC to provide a comprehensive and targeted range of evidence to support your cold.

- **Limited focus on non-drug technologies:** While evidence shows that various in-hospital drugs are effective in treating all of the patient populations analyzed, OHTAC traditionally does not consider pharmaceuticals under its mandate. However, OHTAC has recently reviewed some drug technologies in comparison with non-drug technologies for a given population as part of mega-analyses.
- **Capacity constraints:** OHTAC makes recommendations based on evidence-based analyses that can span 16 weeks or more, and may be limited in its capacity to undertake new reviews in all required areas. There are a considerable number of candidate practices and interventions that require consideration for each episode of care.
- **Focus on high quality evidence:** OHTAC uses the GRADE criteria (12) to assess the strength of evidence for an intervention, with randomized controlled trials (RCTs) considered the gold standard of evidence here. Not every practice within an episode of care may be appropriate or feasible to study through an RCT. For example, some interventions may be regarded as accepted clinical practice, whereas others may be unethical to evaluate as part of a clinical trial.

Types of Evidence

Thus, in situations where OHTAC recommendations do not exist, HQO's episode of care analysis makes use of other sources of evidence:

- **Guidance from other evidence-based organizations:** Each of the Expert Panels recommended credible existing sources of evidence-based guidance, such as the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines for COPD. (13) Recommendations from these bodies were included along with their assessment of the evidence supporting the recommendation.
- **Analysis of empirical data:** The Expert Panels reviewed the results of descriptive and multivariate analysis using empirical data, including administrative data sources and clinical data sources such as the EFFECT database.
- **Expert consensus:** In areas that the Expert Panels saw as important but where evidence was limited or nonexistent, the Expert Panels relied on consensus agreement while noting the need for further research in these areas.

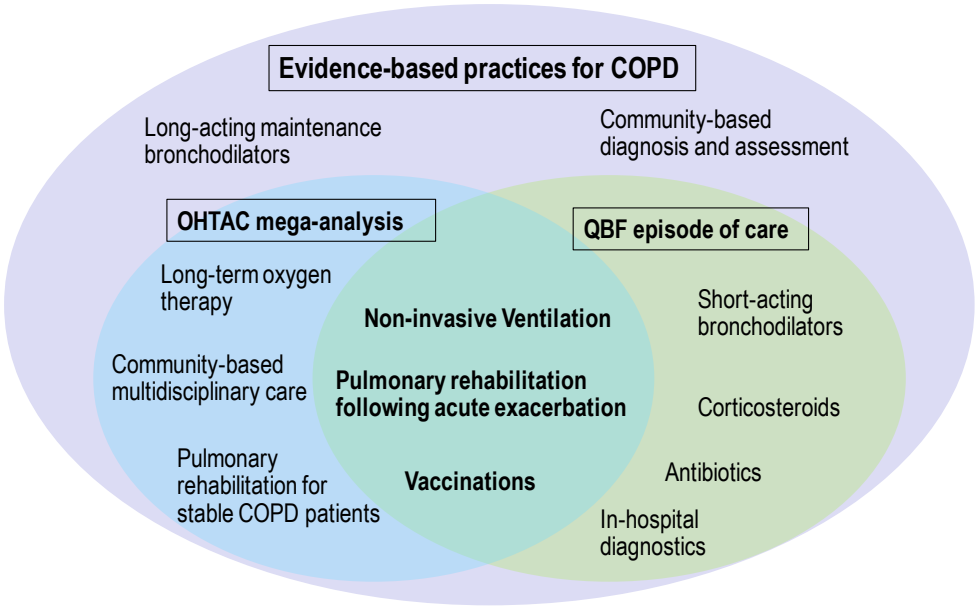

Figure 6: Example Illustrating the Alignment of OHTAC COPD Practice Recommendations with the Scope of Practices Reviewed Through the COPD Episode of Care

Abbreviations: COPD, chronic obstructive pulmonary disease; OHTAC. Ontario Health Technology Advisory Committee; QBF, Quality-Based Funding.

The process for identifying recommended practices involves the following steps:

1. Reviewing existing guidance from OHTAC and other selected evidence-based bodies and extracting all candidate practices for each care module and CAN;
2. Consulting with members of the Expert Panel for additional candidate interventions not included in the guidance reviewed;
3. Reviewing and summarizing the strength of evidence cited for each candidate intervention in the guidance literature, where it exists and is clearly stated;
4. Summarizing the results of steps 1 to 3 above for each phase of the episode of care model and presenting the summary to the Expert Panel for review;

5. Facilitating discussion by the Expert Panel members on contextualizing the candidate practices for the Ontario health system and arriving at a consensus recommendation; and
6. Identifying gaps in the evidence that the Expert Panel agreed are high value candidates for research questions for rapid reviews (see "Rapid Reviews" section below) and future evidence-based analyses.

Rapid Reviews

In order to address cases where a gap in the evidence is identified and prioritized for further analysis in step 6 (above), HQO has developed a rapid evidence review process that is able to operate within the compressed time frame of this exercise, recognizing that a full evidence-based analysis would be impractical given the short timelines.

For each question, the rapid review analysis begins with a literature review using OVID MEDLINE, OVID MEDLINE In-Process and Other Non-Indexed Citations, OVID EMBASE, EBSCO Cumulative Index to Nursing & Allied Health Literature (CINAHL), the Wiley Cochrane Library, and the Centre for Reviews and Dissemination database, for studies published from January 1, 2000, to October 2012. Abstracts were reviewed by a single reviewer and full-text articles were obtained for those studies meeting the eligibility criteria. Reference lists are also examined for any additional relevant studies not identified through the search.

Articles are reviewed if they are:

- English language full-text reports
- published between January 1, 2008, and October 2012
- health technology assessments, systematic reviews, and meta-analyses

If systematic reviews are unavailable, RCTs, observational studies, case reports, and editorials are selected.

The methodological quality of systematic reviews is assessed using the Assessment of Multiple Systematic Reviews (AMSTAR) measurement tool. (14) The quality of the body of evidence for each outcome is examined according to the GRADE Working Group criteria. (12) The overall quality is determined to be very low, low, moderate, or high using a step-wise, structural methodology.

Study design is the first consideration; the starting assumption is that RCTs are high quality, whereas observational studies are low quality. Five additional factors—risk of bias, inconsistency, indirectness, imprecision, and publication bias—are then taken into account. Limitations or serious limitations in these areas result in downgrading the quality of evidence. Finally, 3 factors that could raise the quality of evidence are considered: large magnitude of effect, dose response gradient, and accounting for all residual confounding. (12)

For more detailed information, please refer to the latest series of GRADE articles. (12)

As stated by the GRADE Working Group,[7] the final quality score can be interpreted using the following definitions:

High	Very confident that the true effect lies close to the estimate of the effect
Moderate	Moderately confident in the effect estimate—the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low	Confidence in the effect estimate is limited—the true effect may be substantially different from the estimate of the effect
Very Low	Very little confidence in the effect estimate—the true effect is likely to be substantially different from the estimate of effect

4. Description of Hip Fracture

A hip fracture is a femoral fracture that occurs in the proximal end of the femur, near the hip. The vast majority of hip fractures occur in the elderly population as a result of low energy trauma, with 90% resulting from simple falls. (15) Most hip fractures occur when these sorts of minor trauma cause damage to bones that are already weakened by osteoporosis. A much smaller percentage of hip fractures occur in younger populations due to higher energy trauma such as automobile collisions. In Ontario, the mean age of hip fracture patients admitted to hospital is about 80 years and approximately 70% are female. (16) Hip fracture incidence increases dramatically with age, rising from 22.5 and 23.9 per 100,000 population at age 50 years to 630.2 and 1289.3 per 100,000 population by age 80 years, for men and women, respectively. (17) Based on current population aging trends, the annual number of hip fractures in Canada is projected to increase from 23,375 in 1993/1994 to 88,124 in 2041. (18) There were 12,860 hospital admissions for hip fractures in Ontario in the 2011/12 fiscal year. (16)

For an elderly individual, a hip fracture is a catastrophic acute event that can result in serious morbidity, permanent disability, loss of independence, and for many, premature mortality. About 20% of people die within a year of a hip fracture (19) with risk of mortality higher for men, (20) people of more advanced age, (21) and for those living in nursing homes. (15) Among patients who were living independently before their hip fracture, only about half are able to walk unaided after the fracture and about one-fifth require placement in a long-term care (LTC) facility post-fracture. (22) As hip fractures often occur in individuals with a variety of pre-existing complex health conditions, it is unclear how much of this morbidity and mortality is directly attributable to the fracture versus individuals' underlying conditions. Hip fractures often represent sentinel events in the health trajectories of frail and chronically ill individuals, precipitating a steep functional decline and permanent disability.

Despite this high burden of illness, researchers around the world have highlighted that best practices for management of hip fracture are frequently inconsistently applied, and that outcomes for hip fracture patients could be improved through closer adherence to evidence-based best practices. (23;24) In Ontario, the wide regional variation observed on a number of measures hints at these opportunities to improve: the 2011/2012 *Hip Fracture Quality Scorecard* developed by the Ontario Orthopaedic Expert Panel found that across the 14 Local Health Integration Networks (LHINs), the percentage of hip fracture patients receiving surgery within the recommended 48 hours ranged from 67% to 94%, mean acute care length of stay (LOS) ranged from 8 to 13 days and the percentage of patients discharged from acute care to LTC ranged from 11% to 24%. (1) This extraordinary variation found within the same publicly funded health system suggests room for improvement by implementing consistent standards of practice.

Fortunately, there is a growing evidence base around a broad range of effective practices for managing hip fracture, spanning the continuum of care from the emergency department (ED) and acute hospital admission through rehabilitation to follow-up in the community. There exist several well-respected international guidelines that have been informed by methodologically rigorous systematic reviews, including the 2009 *Management of hip fracture in older people* guideline by the Scottish Intercollegiate Guidelines Network (SIGN), (4) the 2010 "Evidence-based guidelines for the management of hip fracture in older person" review by Mak et al in the *Medical Journal of Australia*, (6) and the National Institute for Health and Clinical Excellence (NICE)'s 2011 *Management of hip fracture in adults* guideline. (25) In Canada, a comprehensive national guideline for hip fracture management has been developed in the 2011 *National Hip Fracture Toolkit* (2) by the cross-provincial Bone and Joint Canada partnership.

5. Hip Fracture Cohort and Patient Stratification Approach

Hip Fracture Cohort Definition

As the hip fracture episode of care is drawn from the index event of an acute inpatient hospitalization for an incident hip fracture (see "Scope of the Hip Fracture Episode of Care"), the Expert Panel defined the hip fracture cohort based on patient characteristics recorded for acute inpatient hospitalizations in the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD).

The Expert Panel recommended the following definition for the hip fracture episode of care patient cohort:

A) **Diagnosis codes included**
Cases included in the cohort will have an index acute inpatient admission for an incident hip fracture, denoted by at least one of the ICD-10-CA diagnosis codes **S72.0***, **S72.1*** and **S72.2*** **with the exception of S72.00*** being recorded on the patient's acute inpatient abstract.

These diagnoses include the following codes and descriptions:

- **S72.0 Fracture of neck of femur** (includes fracture of hip, not otherwise specified [NOS])
    - **S72.01 Fracture of base of femoral neck** (cervicotrochanteric)
        - S72.010 (closed)
        - S72.011 (open)
    - **S72.08 Other fracture of femoral neck** (includes intracapsular and subcapital fracture of femur)
        - S72.080 (closed)
        - S72.081 (open
    - **S72.09 Unspecified fracture of neck of femur** (includes transcervical fracture of femur NOS)
        - S72.090 (closed)
        - S72.091 (open)
- **S72.1 Pertrochanteric fracture** (includes intertrochanteric, multiple pertrochanteric fractures, trochanteric fracture)
    - **S72.10 Intertrochanteric fracture**
        - S72.100 Intertrochanteric fracture (closed)
        - S72.101 Intertrochanteric fracture (open)
        - S72.19 Unspecified trochanteric fracture
        - S72.190 Unspecified trochanteric fracture (closed)
        - S72.191 Unspecified trochanteric fracture (open)
- **S72.2 Subtrochanteric fracture**
    - S72.200 Subtrochanteric fracture (closed)
    - S72.201 Subtrochanteric fracture (open)

The following codes are **excluded** from this cohort**:**

- **S72.00 Fracture of upper femoral epiphysis** (separation)
    - S72.000 (closed)
    - S72.001 (open)

Rationale: This definition is largely consistent with definitions used by the Medical Advisory Secretariat and the Ontario Health Technology Advisory Committee (OHTAC) for the *Aging in the Community* review (26) and by the Public Health Agency of Canada in reports on hip fracture. (27) From among the diagnosis codes used in these earlier reports, S72.00* (fracture of upper femoral epiphysis) was excluded from the cohort. Fractures of the upper femoral epiphysis develop almost exclusively in younger, most often teenage populations, and they are very different from the fragility fractures in the elderly that make up the vast majority of the hip fracture cohort.

Table 1 shows that 82.5% of cases in the recommended cohort have one of 2 diagnosis codes:

- S72.080: Other fracture of femoral neck, closed (5,261 cases or 41.2% of the total cohort), or
- S72.100: Intertrochanteric fracture, closed (5,286 cases or 41.4% of the total cohort).

Table 1: Hip Fracture Cohort Acute Inpatient Discharges by ICD-10-CA Diagnosis Code, Ontario, 2011/2012

	ICD-10-CA Diagnosis Code	Number of Cases, n	Mean Age, years	Mean LOS, days	Median LOS, days	Mean ALC, days	Mean HIG Weight
S72010	Fx bas fem neck/cervicotrochanteric clsd	235	78	16.6	8.0	3.9	3.24
S72080	Other fracture of femoral neck, closed	5,261	80	13.6	8.0	4.0	2.80
S72081	Other fracture of femoral neck, open	7	64	12.1	6.0	0.0	4.29
S72090	Unspec fracture of neck of femur, closed	850	78	14.1	8.0	4.5	2.82
S72091	Unspec fracture of neck of femur, open	5	55	17.2	7.0	4.4	5.46
S72100	Intertrochanteric fracture, closed	5,286	82	15.2	9.0	5.2	2.87
S72101	Intertrochanteric fracture, open	18	68	19.0	6.0	5.7	4.80
S72190	Unspecified trochanteric fracture closed	343	79	16.2	9.0	6.2	2.63
S72191	Unspecified trochanteric fracture, open	7	62	12.0	8.0	3.3	2.53
S72200	Subtrochanteric fracture, closed	726	76	14.2	9.0	3.8	2.76
S72201	Subtrochanteric fracture, open	6	43	12.0	9.5	1.2	3.88

Abbreviations: ALC, alternate level of care; Fx, fracture; HIG, Health-Based Allocation Model Inpatient Grouper; ICD-10-CA, International Classification of Diseases, 10th Revision, Canadian Edition; LOS, length of stay.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

In Table 1 and subsequent tables, each unit of HIG (HBAM Inpatient Grouper) weight represents an estimated cost of approximately $5,840 (CAN). For example, a case that was assigned 2.24 HIG weights would have an expected cost of 2.24 x $5,840 = $13,081.60. The HIG classification methodology assigns a standardized resource weight to each acute inpatient discharge using an algorithm that calculates an estimated cost for that case based on factors such as the HIG cell assigned, the patient's age, and presence of selected high-cost interventions (28).

Of the fractures of the upper femoral epiphysis recorded in 2011/2012, only 38 were inpatient admissions (see Table 2). The mean age of the 36 cases recorded as code S72.000 (fracture of upper femoral epiphysis – closed) was 73 years, which is inconsistent with the population susceptible to this type of fracture. It is believed that many of these diagnoses may be the product of coding or charting errors.

Table 2: Hip Fracture-related ICD-10-CA Diagnosis Codes Excluded from Cohort, Ontario, 2011/2012

	ICD-10-CA Diagnosis Code	Number of Cases, n	Mean Age, years	Mean LOS, days	Median LOS, days	Mean ALC, days	Mean HIG Weight
S72000	Fx upp femoral epiphysis/separation clsd	36	73	14.6	7.5	5.8	2.75
S72001	Fx upp femoral epiphysis/separation opn	2	28	6.0	6.0	0.5	1.72

Abbreviations: ALC, alternate level of care; Fx, fracture; HIG, Health-Based Allocation Model Inpatient Grouper; ICD-10-CA, International Classification of Diseases, 10th Revision, Canadian Edition; LOS, length of stay.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

B) Diagnosis types included

Acute inpatient cases included in the cohort have at least one of the above ICD-10-CA diagnosis codes recorded as at least one of the following:

- **Most Responsible Diagnosis (MRDx):** The condition that, upon creation of the discharge abstract, is deemed to be most responsible for resource utilization within the patient's hospital stay. Every case is assigned a single a MRDx.
- **Pre-admit Comorbidity:** A condition that existed prior to admission and satisfies the requirements for determining comorbidity, that is it demonstrates one of the following:
  - Requires treatment beyond maintenance of the pre-existing condition;
  - Increases the length of stay (LOS) by at least 24 hours;
  - Significantly affects the treatment received, by requiring at least one of the following: an additional consultation to assess either a previously undiagnosed condition or a previously diagnosed condition in which a new or amended course of treatment is recommended and instituted (excludes a pre-operative anesthetic assessment); a diagnostic or therapeutic intervention identified as mandatory for code assignment in the CIHI coding standards; or an extended length of stay (LOS) by at least 24 hours.
- **Post-admit Comorbidity:** A condition that arises post-admission (e.g. complication), has been assigned an ICD-10-CA code, and satisfies the requirements for determining comorbidity described above.
- **Admitting Diagnosis:** A condition identified on admission that may differ from the MRDx, depending on jurisdictional or facility policies.
- **Service Transfer Diagnosis:** A pre-admit comorbidity associated with a transfer between specialties within a facility, e.g. from cardiology to neurology. Service Transfer diagnoses are coded as Service Transfer Diagnosis Type (W), (X), or (Y), representing first, second, or third transfer, respectively. The use of this diagnosis type is determined at the jurisdictional or facility level. The use of the service transfer diagnosis type is optional; some facilities may code these diagnoses as Pre-admit Comorbidity instead (29).

The cohort does *not* include cases where one or more of the identified ICD-10-CA codes is present only as a Secondary Diagnosis (a condition for which a patient may or may not have received treatment, has been assigned an ICD-10-CA code, and does not satisfy the requirements for determining comorbidity).

Rationale: The Expert Panel recommended that the cohort use a broad definition of the hip fracture population, including post-admit hip fractures (typically resulting from in-hospital falls) and hip fractures that coexist with other conditions, including discharges where the other condition may have a larger contribution to hospital utilization than the hip fracture. Hence, the cohort includes cases where a hip fracture diagnosis is coded not only as MRDx, but also as Pre-admit Comorbidity and Post-admit Comorbidity. Also included are cases with hip fracture coded as Admitting Diagnosis and Service Transfer Diagnosis (both optionally coded variants of the comorbidity diagnosis type). See Table 3.

Table 3: Hip Fracture Cases by Diagnosis Type, Ontario, 2011/2012

Diagnosis Type	Number of cases, n	Mean Age, years	Mean LOS, days	Median LOS, days	Mean ALC LOS, days	Mean HIG Weight
Pre-admit Comorbidity	733	77	24.4	13.00	6.7	4.59
Post-admit Comorbidity	322	80	49.9	18.00	30.1	7.44
Secondary Diagnosis	976	80	18.1	9.00	8.5	2.18
Admitting Diagnosis	19	81	17.7	10.50	4.1	2.81
MRDx	11,556	80	12.5	7.00	3.7	2.55
Service Transfer Diagnosis (W)	138	83	32.5	24.00	6.0	5.68
Service Transfer Diagnosis (X)	32	82	66.8	57.50	34.8	9.04

Abbreviations: ALC, alternate level of care; Fx, fracture; HIG, Health-Based Allocation Model Inpatient Grouper; ICD-10-CA, International Classification of Diseases, 10th Revision, Canadian Edition; LOS, length of stay; MRDx, most responsible diagnosis.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.
Note: Diagnosis types are non-exclusive (a patient may have more than one fracture diagnosis recorded as 2 or more different diagnosis types).

Cases where hip fracture has only been coded as a Secondary Diagnosis are excluded from the cohort. These are cases where the hip fracture has been determined not to have contributed in any significant way to additional utilization in the hospital. Many of these cases are admissions where the patient had recently had a hip fracture and received fixation surgery: 53.2% of these cases have an MRDx of Convalescence, 17.7% have an MRDx of Physical Therapy or related, while a number of the remaining diagnoses are related to implant and device failures (see Table 4). These cases are unlikely to be incident hip fractures, and hence it would be inappropriate to include in the incident cohort. However, they may be included with the episode of care as health care encounter subsequent to the index admission for an incident fracture.

Table 4: Cases with Hip Fracture Recorded as a Secondary Diagnosis by Most Responsible Diagnosis Code, Ontario, 2011/2012

Most Responsible Diagnosis Code		Number of Cases, n
Z501	Other physical therapy	173
Z540	Convalescence following surgery	343
Z544	Convalescence foll treatment of fracture	178
Z509	Care inv use of rehab procedure NOS	22
Z515	Palliative care	22
Z751	Pers waiting admssn facility elsewhere	31
Z504	Other	210
Z508	Total	979

Abbreviations: NOS, not otherwise specified.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

C) Age range included

The cohort includes patients aged 18 years and over.

Rationale: The Panel recommended that the analysis include all adult hip fractures. The vast majority of the hip fracture population is elderly; in 2011/2012, the mean age was 80 years. Pediatric hip fractures are a significantly different population with very different clinical protocols and very low volumes: in Ontario in 2011/2012, there were only 61 acute inpatient discharges with hip fracture diagnoses for patients aged less than 18 years of age (see Table 5).

Table 5: Hip Fracture Cohort Cases by Sex and Age Group, Ontario, 2011/2012

Age Category, years	Sex	Number of Cases, n	Percentage of Cases, %	Mean LOS, days	Median LOS, days	Mean ALC, days	Mean HIG Weight
< 18 (not included in cohort)	Female	23	0.18	6.8	3.5	0.0	2.57
	Male	38	0.30	3.8	3.5	0.1	1.44
18–59	Female	369	2.87	9.0	7.0	1.4	2.20
	Male	561	4.37	11.3	6.0	2.0	2.87
60–79	Female	2,454	19.11	12.7	8.0	3.5	2.65
	Male	1,318	10.26	15.4	7.0	5.1	3.12
80+	Female	6,031	46.97	14.9	9.0	5.3	2.81
	Male	2,047	15.94	16.6	9.0	5.0	3.09

Abbreviations: ALC, alternate level of care; HIG, Health-Based Allocation Model Inpatient Grouper; LOS, length of stay.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

Table 6: Hip Fracture Cohort Descriptive Statistics, Ontario, 2011/2012

Patient counts and in-hospital mortality	
Total inpatient discharges, n	12,860
Mean age, years	80
Female, n (%)	8,908 (69.3)
Male, n (%)	3,952 (30.7)
Died in acute care	797 (6.2)
Age distribution in years, n (%)	
18–29	82 (0.6)
30–39	84 (0.6)
40–49	206 (1.6)
50–59	579 (4.5)
60–69	1,222 (9.5)
70–79	2,559 (19.9)
80–89	5,555 (43.2)
90+	2,572 (20.0)
Acute inpatient LOS and utilization	
Mean LOS, days	14.5
Median LOS, days	8
Mean ALC LOS, days	4.6
Mean HIG Weight	2.84
Type of fracture, n (%)	
Intertrochanteric	5,337 (41.5)
Subtrochanteric	733 (5.7)
Trochanteric	348 (2.7)
Other/unspecified	6,435 (50.0)
Hip fracture diagnosis type, n (%)	
MRDx	11,625 (90.4)
Pre-admit Comorbidity	733 (5.7)
Post-admit Comorbidity	322 (2.5)
Service Transfer Comorbidity	167 (1.3)
Comorbidities	
Mean (median) number of comorbidities	4.6 (5)

Abbreviations: ALC, alternate level of care; HIG, Health-Based Allocation Model Inpatient Group; LOS, length of stay.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

Ministry-Proposed Modified Hip Fracture Cohort Definition for Use With the QBP Funding Methodology

Although the Expert Panel was tasked with defining a hip fracture patient cohort for the purposes of analysis and defining best practice care, the Ministry of Health and Long-Term Care requires a cohort definition for the Quality-Based Procedure (QBP) funding model. This definition requires each hospital case to be assigned to a single grouping using the Ministry's Health-Based Allocation Model (HBAM) Inpatient Grouping (HIG) methodology, where each funded patient case must be assigned to a mutually exclusive HIG. Hence, the Ministry is concerned that the definition of the hip fracture patient cohort and definitions for other planned QBP patient cohorts could overlap.

This issue is not unique to hip fracture; the Ministry was concerned with similar overlap in the cohort definitions recommended by Health Quality Ontario's first 3 expert panels for episodes of care. For example, the Expert Advisory Panel on Episode of Care for Chronic Obstructive Pulmonary Disease (COPD) recommended a COPD cohort definition that included COPD-related diagnoses in both MRDx and comorbidity diagnosis types. Cases where COPD-related diagnoses are present as a comorbidity but not the MRDx are generally assigned to other non-COPD HIG groups by the HBAM algorithm, which is based largely on the MRDx. For example, it was found that approximately 15% of cases with a COPD comorbidity had an MRDx of congestive heart failure (CHF), which overlapped with the Ministry's CHF QBP.

The HBAM algorithm typically assigns cases to an HIG based on the patient's MRDx in cases involving largely medical treatment. In cases where a "qualifying intervention" (typically a major surgery) occurs, the case will often be assigned to a different (surgical) HIG. For example, a case with a COPD-related MRDx that receives a lung transplant would be assigned to the HIG for "Lung Transplant" rather than "COPD," which is largely made up of medical cases.

In the case of hip fracture, the **Ministry has proposed the following modifications to the original cohort parameters recommended by the Expert Panel** for the QBP funding methodology**:**

A) The Ministry proposes excluding cases from QBP definitions that do not have a MRDx of S72.0*, S72.1*, S72.2*. Doing so would exclude 1,128 cases (8.8% of the total cohort) without a hip fracture-related MRDx in 2011/12.

Rationale: Cases without a hip fracture –related MRDx (i.e., cases where hip fracture is coded as a comorbidity) are typically assigned by the default HBAM grouping algorithm to the HIG group that corresponds with the MRDx of the case. These cases are generally grouped based on another major condition, with hip fracture as the comorbidity; they tend to be significantly more complex than the average population (see Table 7).

Table 7: Hip Fracture Patient Characteristics by Diagnosis Type, Ontario, 2011/2012

Diagnosis Type	Number of Cases, n	Mean Age, years	Mean LOS, days	Median LOS, days	Mean ALC, days	Mean HIG Weight
All diagnosis types	12,782	80	14.5	8.00	4.6	2.84
MRDx	11,654	80	12.7	7.00	3.8	2.58
All other diagnosis types	1,317	79	33.2	15.00	13.6	5.58

Abbreviations: ALC, alternate level of care; HIG, Health-Based Allocation Model Inpatient Grouper; LOS, length of stay; MRDx, most responsible diagnosis.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

B) The Ministry proposes excluding from the QBP definition those cases with a "qualifying procedure" that assigns cases to other HIGs. In 2011/2012, 114 cases (0.89% of the total cohort) that had an MRDx of hip fracture would be assigned to other HIGs.

Rationale: Typically, these cases appear to have procedures unrelated to hip fracture: for example, "excision of the intestine with entercolostomy." However, some cases have other types of orthopedic procedures recorded such as hip and femur reductions, spinal surgery and removal of implant devices. These cases may demand further investigation with regard to the QBP definition.

Considerations Regarding the Ministry's "Modified" QBP Cohort Definition

The Expert Panel was not tasked with developing the actual QBP funding methodology for hip fracture; ultimately, the design of the payment methodology is a Ministry policy decision that may or may not be informed by the input of the Expert Panel. However, while the Expert Panel recognized the Ministry's technical challenges in mapping their original cohort definition to the HBAM methodology, the Ministry is advised to exercise caution in several areas:

- The determination of whether a hospital discharge is coded with an MRDx of hip fracture or a Pre-admit Comorbidity Diagnosis of hip fracture is a coding decision that is largely made retrospectively, based on a patient's cumulative utilization during their hospital stay. While the distinction is useful for utilization review and costing (in order to know which condition was seen as most responsible for the patient's stay), it may not be meaningful to clinicians.

  For example, a patient may present to hospital with a hip fracture, receive surgery and later experience an acute exacerbation of their underlying heart condition that prolongs their stay by 3 weeks. As a result, heart failure would be coded as the MRDx due to its greater impact on resource utilization. However, the case was initially treated as a hip fracture patient using a hip fracture care pathway, and clinicians may be confused as to why the case was no longer considered a hip fracture patient upon discharge.

- The exclusion of Pre-admit Comorbidity diagnoses of hip fracture (733 discharges or 5.7% of the total population in 2011/2012) from the cohort may have some perverse impacts on quality improvement. For example, a patient may be admitted for hip fracture, receive poor quality care, and eventually develop a severe pressure ulcer that prolongs the hospital stay by a month. On discharge, this case would be assigned a pressure ulcer-related MRDx. Thus, in terms of hip fracture performance measurement or any future performance-related funding, this case would be

excluded from the hip fracture cohort and any indicator denominators, and the hospital would essentially be given a "pass" on the poor quality care delivered for this patient.

- The exclusion of Post-admit Comorbidity (Complication) diagnoses of hip fracture (322 cases or 2.5% of the population in 2011/2012) may have perverse impacts where in-hospital fractures resulting from falls are not considered. These incidents represent important events from a quality of care perspective, and the Expert Panel recommended that these cases be included in the cohort.

- For the reasons described above, the Ministry is advised to exercise caution in using their modified hip fracture cohort definition. It should be noted that while the modified definition may simplify things from a case mix funding methodology perspective, the Expert Panel's original hip fracture cohort definition is likely to be better suited for defining hip fracture performance measures, particularly if they are intended to support quality improvement.

Scope of the Hip Fracture Episode of Care

Using the key parameters articulated by Averill et al, (9), Hussey et al, (10) and Rosen and Borzecki (11) (see the "Methods" section), the Expert Panel defined the scope of analysis for the hip fracture episode of care as follows:

- **Index event:** A patient's initial presentation to hospital with an incident hip fracture, as defined with the ICD-10-CA diagnosis codes and diagnosis types included in the hip fracture cohort (see "Hip Fracture Cohort Definition"). Only the patient's initial hospital presentation is considered an index event; any transfers (e.g., from a non-surgical to surgical hospital) within the episode window are linked back to the initial encounter rather than being considered separate episodes. It should be noted that in most cases the index event is thus the patient's visit to the emergency department (ED) as the first encounter with the hospital, rather than the inpatient admission.

- **Endpoint:** The hip fracture episode of care concludes at either 90 days following the initial hospital admission or death. While other endpoints were considered – including discharge home, different windows of time (including 30 days, 60 days and 1 year) and definitions that drew the window of time from the acute discharge rather than initial presentation – the 90 day window following the initial hospital admission was preferred for several reasons:
  - A "discharge home" endpoint (as employed in the initial HQO episode work for COPD, CHF, and stroke) would not capture community-based rehabilitation services received by over 20% of all patients after discharge home
  - 90 days is a sufficient period of time to allow for most cases to complete their acute care and rehabilitation services
  - A standard 90-day post-admission window allows for "apples to apples" comparisons between episodes of care on outcomes such as mortality and complications, whereas a 90-day window started at acute discharge will result in different timeframes

- **Types of services included:** While an "ideal" comprehensive episode of care for hip fracture might capture both health and social care services received by the patient, the Expert Panel recommended that analysis be limited to health care services due to the focus of their mandate

A typical patient with hip fracture receives services from multiple providers following the admission for their fracture. Coordination, integration, and communication between care providers is essential to provide high quality care for these patients. The Expert Panel-defined scope of the episode of care allows for a more comprehensive, integrated picture of these services, provides a more appropriate window of analysis for comparison across providers and regions, and can support the move to integrated payment models for hip fracture such as "bundled payments" for episodes of care.

Figure 7 illustrates how the episode of care can provide a useful window for looking at utilization, costs, and outcomes following hip fracture. Importantly, analysis performed at the provincial level may hide significant regional variation through aggregation. Appendix III presents the same episode of care analysis for residents of each of the 14 Local Health Integration Networks (LHINs) admitted to hospital (in any LHIN) for hip fracture during the 2007 to 2009 period. The episode of care approach reveals significant variation in the use of post-acute care services (compare 12.0% versus 59.6% of patients discharged to inpatient rehabilitation between North East and Toronto Central LHINs, respectively), which drives variation in total episode of care costs.

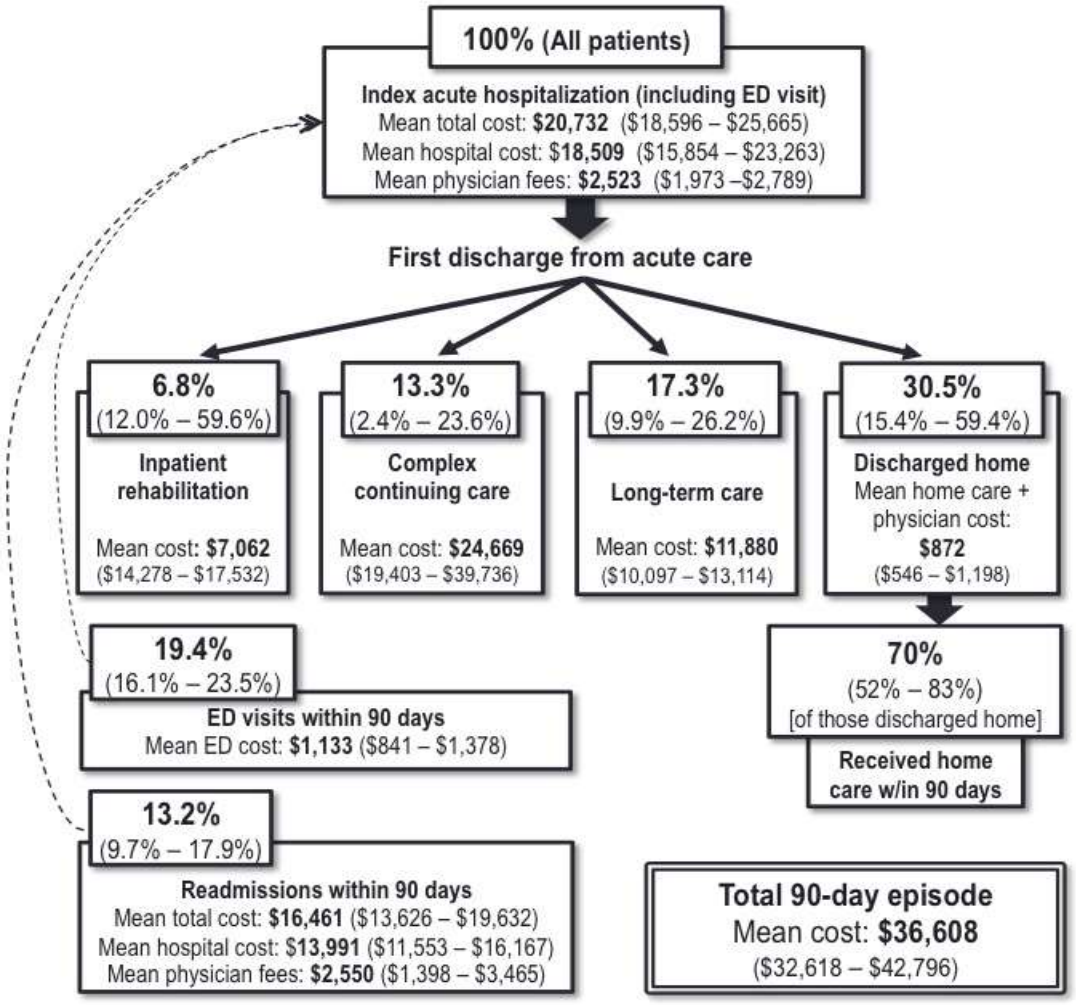

Figure 7: 90-day Hip Fracture Episode of Care Analysis – All Ontario Residents

Abbreviations: ED, emergency department.
All Ontario hip fracture patients discharged from acute care with hip fracture, 2007–2009.
Includes all hospital, physician and home care services recorded in 90 days following index admission, plus preceding ED visit (if present).
Includes only patients alive following conclusion of 90-day period. Index hospitalization.
Minimum and maximum values by Local Health Integration Networks (LHINs) are in parentheses.
Analysis by Jason Sutherland (University of British Columbia) and staff from the Ministry of Health and Long-Term Care Health System Information Management and Investment Division (2013).

Hip Fracture Patient Stratification Approach

The hip fracture population is extremely heterogeneous. Taking this into account, the Ministry requested that HQO define a methodology for stratifying the hip fracture population into major subpopulations (referred to here as "patient groups") with similar care pathways and expected resource utilization. HQO was further asked to identify patient characteristics that are associated with variation in patient complexity and resource utilization within these groups. From the QBP funding policy perspective, each patient group is to be assigned a separate base "price" whereas the identified complexity factors are used to further adjust prices of cases within the groups.

Iezzoni (30) proposes a set of key questions to guide the development any risk adjustment or patient stratification methodology:

1. ***Risk of what outcome?***

   The primary outcome of this analysis is the expected resource utilization incurred throughout a patient's episode of care. There is a particular focus on the hospitalization episode due to the hospital-focused scope of the QBP policy.

2. ***Over what time frame?***

   Consistent with the recommended parameters of the hip fracture episode of care (see the section "Scope of the Hip Fracture Episode of Care," above), the timeframe for risk adjustment is a 90-day period drawn from the patient's initial presentation at a hospital for hip fracture.

3. ***For what population?***

   The population for risk adjustment is the Expert Panel's defined hip fracture cohort (see the section "Hip Fracture Cohort Definition," above).

4. ***For what purpose?***

   For this analysis, the purpose of risk stratifying the hip fracture cohort population is to support comparison of cases on an "apples to apples" basis and adjust for relevant factors that are known to affect patient outcomes. This may include risk adjustment for hip fracture performance indicators at a later point. The Ministry's primary purpose for developing or selecting a method for risk adjustment is to incorporate the method as a patient-level complexity modifier for the QBP funding methodology.

5. ***With what data?***

   The Ministry requires that any methodology or definitions developed through this work must be able to be translated to the data elements in routinely collected provincial administrative databases. These databases may not currently capture many of the elements that are important for stratifying patients into meaningful groups that are able to accurately predict expected resource use.

Review of Options for Hip Fracture Patient Stratification Approaches

The Expert Panel reviewed a variety of potential patient characteristics that could assist in stratifying patients by their expected resource use: by ICD-10-CA diagnosis (see Table 1), by sex and age (see Table 5), by principal procedure (see Table 8), and by the Ministry's HIG groups (see Table 9). For the most part, diagnosis codes and HIGs did not appear to capture a great deal of meaningful variation in resource use, resulting in similar mean length of stay (LOS) and Resource Intensity Weight (RIW) estimates. 82.5% of cohort cases fall into only 2 ICD-10-CA diagnosis codes, whereas the remaining cases are spread across a wide range of codes.

Table 8: Hip Fracture Patient Characteristics by Principal Procedure, Ontario, 2011/2012

Principal Procedure	Number of Cases, n	Percentage of Cases, %	Mean Age, years	Mean LOS, days	Median LOS, days	Mean ALC, days	Mean HIG Weight
Fix femur OA &plate/scrw	1,902	14.88	81	14.8	9.0	4.6	2.91
Fix hip OA &plate/scrw	1,846	14.44	78	14.6	8.0	5.4	2.87
Implant sing comp prosth hip OA	1,808	14.14	82	13.5	8.0	3.5	2.93
NOT APPLICABLE (No principal procedure)	1,232	9.64	81	6.0	2.0	2.3	0.97
Fix femur OA &intramed nail	1,213	9.49	80	15.1	9.0	4.6	2.94
Implant dual comp prosth hip OA	713	5.58	79	14.3	9.0	4.1	2.95
Implant sing comp prosth hip OA &synth mat	667	5.22	83	15.2	10.0	4.1	3.18
Implant sing comp prosth hip OA &autogr	353	2.76	83	12.6	9.0	3.1	2.84
Implant dual comp prosth hip OA &synth mat	306	2.39	81	17.4	11.0	4.7	3.32
Fix hip OA &intramed nail	305	2.39	80	13.5	9.0	3.8	2.64
Fix femur perc app &intramed nail	304	2.38	79	12.7	8.0	3.4	2.59
Implant dual comp prosth hip OA &autogr	180	1.41	76	17.7	8.0	6.3	3.36
Fix hip OA &pin/nail	165	1.29	80	16.2	9.0	5.3	3.01
Fix femur OA &pin/nail	164	1.28	80	15.8	9.0	5.3	2.86
Fix hip perc app &plate/scrw	137	1.07	76	13.3	7.0	5.0	2.55
CT leg without enhancement	96	0.75	78	13.1	8.0	5.3	1.58
Fix femur perc app &plate/scrw	77	0.60	79	18.9	9.0	7.2	3.37
CT brain without enhancement	50	0.39	85	21.3	10.0	12.1	2.63
CT head without enhancement	41	0.32	83	15.8	12.0	7.4	2.29
Fix hip perc app &intramed nail	41	0.32	82	13.9	11.0	5.0	2.44

Abbreviations: ALC, alternate level of care; LOS, length of stay; HIG, Health-Based Allocation Model Inpatient Grouper.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

Similarly, 79.6% of cohort cases are grouped into one of 2 HIGs: "Hip Replacement with Trauma / Complication of Treatment" or "Fixation/Repair Hip/Femur," both of which have very similar costs and LOS (see Table 9). The third major HIG, "Fracture of Femur," with 10.3% of cohort cases, has a significantly lower cost and length of stay; this may be attributable to 69.6% of the cases in this HIG having no major principal procedure, implying they may be transfers or non-surgically managed cases.

Table 9: Hip Fracture Patient Characteristics by Case Mix Group, Ontario, 2010/2011

Case Mix Group		Number of Cases, n	Total Cost Per Case, $ (Cdn)				LOS, days		
			Mean	SD	Min	Max	Mean	SD	Max
726	Hip Rplc w Trauma/Compl Tx	1,477	18,084	17,704	2,926	245,341	15.4	21.5	355
727	Fixation/Repair Hip/Femur	2,481	16,428	19,598	2,662	318,345	15.1	26.8	487
766	Fracture of Femur	247	8,061	13,344	275	149,792	10.1	18.8	216

Abbreviations: HIG, Health-Based Allocation Model Inpatient Grouper; LOS, length of stay; Max, maximum; Min, minimum; SD, standard deviation.
Data source: Ontario Case Costing Initiative, 2010/11 Acute Inpatient Discharges. Available from: http://www.occp.com.

Literature Review of Stratification Approaches

The health services research literature provides some insights and examples of potential approaches for stratifying hip fracture patients by their expected resource utilization. Beck et al (31) reported that the strongest predictors of total hospital charges were length of hospital stay and the number of in-hospital complications. They also found that mean costs of treating patients by hemiarthroplasty were $17,775 (US), compared with $13,412 (US) for those treated with internal fixation. Similarly, Nurmi et al (32) reported a mean total hospital cost of $3,370 (US) or $3,933 (US) in Finnish patients with an intertrochanteric fracture treated with a sliding hip screw or a Gamma nail, respectively. Haentjens et al (33) concluded that while there is some evidence to support efforts to reduce operating room and surgical costs, such as device matching programs and bulk purchasing, the greatest sources of variation in hospital resource utilization for hip fracture care appear to be comorbidities and factors contributing to long LOS, irrespective of the cost of surgery. In a Swedish study, Zethraeus and Gerdtham (34) found age to be the most important determinant of increased costs, with a 1-year increase in patient age being associated with a 3% increase in costs. A Belgian study (35) found similar results, with a 1-year increase in age associated with a 1.6% increase in costs.

There are also some examples in the literature of studies that have attempted to create meaningful groups for hip fracture patients with a study cohort; however, as per Iezzoni (30) these groups are created to stratify patients for risk of a variety of non-resource utilization purposes and outcomes. The Garden scheme is a commonly used clinical classification system with 4 categories based on degree of displacement of the fracture, with the intended purpose of aiding clinical decision-making. (36) Haentjens et al (35) grouped patients into 3 cohorts based the type of surgical repair—hip arthroplasty, hemiarthroplasty and internal fixation—but found that cost distributions were similar across all 3 groups, with wider heterogeneity to be found within each group.

In a novel approach, Eastwood et al (37) used cluster analysis to stratify hip fracture patients into groups with similar outcomes in terms of long-term mortality and health care utilization. They created groups out of factors that included pre- and post-fracture functional status, age, nursing home residence and degree of independence. The 8 groups established ranged in complexity from younger, healthy patients living independently at home to older, functionally impaired and dependent patients living in nursing homes. In a German study, Heinrich et al (38) used the level of care (e.g., nursing home, assisted living) received by the patient before and following the fracture as proxies for frailty. Similarly, Wiktorowicz et al (39) and Nikitovic (5) found very different 1-year cost distributions for cohorts in Ontario that were admitted from home and from long-term care (LTC) settings.

Consistent with findings in the literature, the Expert Panel concluded that type of fracture and type of surgery performed generally have less of an impact on a patient's care pathway and their total hospital

utilization than the combination of the patient's condition and their living situation. Patients admitted from independent living in the community generally have trajectories significantly different to those of patients admitted from LTC homes, who are essentially guaranteed a bed to return to. In particular, cases admitted from residence in the community that require a post-fracture change in the level of care they are receiving compared to their pre-fracture setting are often associated with significantly longer LOS and a higher rate of alternate level of care (ALC) days. These cases are difficult to identify prospectively with current administrative data as they tend to be patients with some functional limitations who were managing poorly at home and had a period of decline before they experienced a fracture.

Analysis of Factors Associated with Hip Fracture Patient Resource Utilization

After reviewing published hip fracture stratification approaches, the Expert Panel identified factors that they felt were most strongly associated with increased resource utilization. HQO worked with the Ministry's Health Analytics Branch to model these factors as predictors for utilization-related outcomes, using Ontario administrative data for the years 2009/2010, 2010/2011, and 2011/2012 relating to cases with acute admissions during 2010/2011. This analysis has informed the development of a clinically meaningful approach toward grouping and stratifying hip fracture patients according to their expected resource consumption.

Data Sources Used

The cohort used for the analysis was the Ministry's proposed modified cohort for QBP funding, which consists of acute inpatient cases with a recorded MRDx of hip fracture (ICD-10-CA codes S72.0*, S72.1*, S72.2*). While the cohort does not include cases with a hip fracture diagnosis present only as a comorbidity diagnosis type (rather than MRDx), including Pre-admit Comorbidity, Post-admit Comorbidity / Complication, Admitting Diagnosis and Service Transfer (comorbidity) diagnoses, it is believed that relationships observed between outcome variables and patient factors in this cohort are likely to hold across the broader cohort recommended by the Expert Panel.

Dependent and Independent Variables

The outcomes of the analysis were restricted to the acute inpatient setting and included total acute inpatient LOS (includes ALC days), acute inpatient RIW **(**a standardized measure of expected cost), acute inpatient LOS (inpatient days only, excludes ALC days; see Appendix II**)** and in-hospital mortality (see Appendix II). The independent variables (predictive factors) analyzed include age (grouped into 4 categories: ≤ 49 years; 50–64 years; 65–74 years; 75+ years), sex, activities of daily living (ADL), ease of transfer, fracture location (e.g., head or neck of femur, subtrochanteric) and comorbidity score. These factors were selected for analysis based on the input of the Expert Panel and were informed by review of the literature around factors associated with variation in hip fracture resource utilization.

In contrast with the outcome variables analyzed, which were limited to the acute inpatient setting, two predictive factors—ADL and ease of transfer—are drawn from databases outside of the acute inpatient setting and look at utilization before and after the inpatient hospital episode.

Patients in an acute setting with hip fracture as MRDx were identified using the DAD. Information for these patients was then searched for in the Continuing Care Reporting System (CCRS) and the Home Care Database (HCD) to obtain relevant information in CCC, LTC, and home care settings. Across both databases, the records closest in time to the hip fracture treatment (as identified in the DAD) were retained.

The following independent variables were included in the analysis:

- The location_fracture variable represents the type of fracture as classified by ICD-10-CA diagnosis code for:
  - Head/Neck: Fracture of head or neck of femur (S72.0*)
  - Pert: Pertrochanteric fracture (includes intertrochanteric, multiple pertrochanteric fractures, trochanteric fracture) (S72.1*)
  - Sub: Subtrochanteric (S72.2*) fracture - open and closed

- BEFORE_ADL represents a composite score derived from the most recent ADL values (if any) recorded for a patient in the year before their index hospital admission for a hip fracture. AFTER_ADL represents the most recent ADL value (if any) recorded for a patient in the year following the index hospital admission. A value of 0 for BEFORE_ADL or AFTER_ADL represents the healthiest, most mobile population—cases where either no Resident Assessment Instrument (RAI) assessment was necessary or conducted or the patient was assessed as "functionally independent." The value of 1 is attributed to "moderately dependent" cases with the actual RAI ADL of 10 or less. The value of 2 is attributed to "highly functionally dependent" cases with an RAI ADL above 10.

- The comorbidity index used in this analysis is defined as follows:
  - Comorb_index = 0 for all patients with the Charlson Comorbidity Index score of 0;
  - Comorb_index = 1 for all patients with the Charlson Comorbidity Index score of 1 or 2;
  - Comorb_index = 2 for all patients with the Charlson Comorbidity Index score greater than 2 (see Table 10 for Charlson Comorbidity Index scores).

- The BEFORE_TRANS and AFTER_TRANS variables are measures of ease of transfer or how the resident moves between settings (i.e., to/from bed, chair, wheelchair, standing position, but excludes to/from bath/toilet). The value of 0 for both variables means either no RAI assessment was necessary or conducted, or the patient was assessed as "fully independent." The value of 1 indicates dependency.

- Other independent variables that were analyzed and not found to have a significant association with the outcomes of interest were:
  - Fracture type (whether the ICD-10-CA diagnosis was coded as "open" or "closed"), and
  - Bed Mobility value from the RAI assessment (how the resident moves to and from lying position and turns and positions, measured both before and after the fracture).

Table 10: Charlson Comorbidity Index Scores and Corresponding Comorbidity Indexes Allocated

Condition	Points	Comorbidity Index Allocated
Myocardial infarction	1	1
Congestive heart failure	1	1
Peripheral vascular disease	1	1
Cerebrovascular disease	1	1
Dementia	1	1
COPD	1	1
Connective tissue disease	1	1
Peptic ulcer disease	1	1
Diabetes mellitus	1 if uncomplicated, 2 if end-organ damage present	1
Chronic kidney disease	2 if moderate to severe	1
Hemiplegia	2	1
Leukemia	2	1
Malignant lymphoma	2	1
Solid tumour	2; 6 if metastatic	1 or 2
Liver disease	1 if mild; 3 if moderate to severe	1 or 2
AIDS	6	2

Abbreviations: AIDS, acquired immune deficiency syndrome; COPD, chronic obstructive pulmonary disease.

Statistical Methods

Using 2010/2011 Ontario patient-level data from the Discharge Abstract Database, generalized linear regression models were used to measure significance and influence of predictor variables on the outcome variable. The statistical package, SAS (SAS Institute Inc., Cary, NC, US), was used to perform all analysis. The Total LOS model assumed a negative binomial distribution for the outcome variable, and a natural log link function. The negative binomial distribution was chosen over the Poisson distribution because it gave a better fit. RIW assumed a gamma distribution and a natural log link function. Effects coding was used for categorical variables (−1, 1, 0) rather than dummy coding (0, 1). With this approach, the estimated effects for each variable are effects compared to the population mean, rather than a reference group as in dummy coding. Effects coding allows for calculation of percent increase/decrease in the outcome measure for each category, for each predictor variable.

First, the model was executed with all available predictor variables. Then, after identifying the significant predictor variables, the model was re-executed with only the significant predictors.

The percent change for a given predictor variable was calculated according to the following: Let B represent the parameter estimate for a predictor variable. Then:

$$\% \text{ change} = [\exp(B) - 1] * 100\%$$

SAS also produces 95% Wald confidence intervals for the parameter estimates. These intervals were used to calculate the confidence intervals for the percent changes using the same approach used to calculate the percent difference.

Results

The results for acute LOS, total LOS, and RIW show the percentage change in the outcome due to the presence of a given category for a given predictor variable. For example, a percentage change of 25.2% in Acute LOS among hip fracture patients aged 75 years and older shows that hip fracture patients in that age group have a 25.2% longer acute LOS than the rest of the population. The intercept, representing the mean of a given outcome measure, is also presented as a baseline value.

Consistent with results in the literature, the analysis found that increasing age, male sex, and increasing severity of comorbidity were associated with longer acute LOS and increased resource intensity (Table 11; Figure 8 and Figure 9). Of these variables, age and comorbidity were found to have the greatest effect sizes: a collapsed Charlson Comorbidity Index score of 2 was associated with a 50.3% longer acute LOS and a 47.2% increase in RIW compared with a score of 1. Conversely, a Charlson Comorbidity Index score of 0 was associated with a 40.5% shorter total LOS and a 35.8% lower RIW.

Evidence in the literature suggests a strong association between functional status and hip fracture costs and outcomes. Consistent with these findings, the 2 measures involving ADL variables measured before (BEFORE_ADL) and after (AFTER_ADL) the hospitalization were found to have significant effects on LOS and RIW. An AFTER_ADL score of 2 ("highly functionally dependent," with an RAI ADL > 10) was associated with a 32.4% increase in acute LOS and a 15.2% increase in RIW compared with a score of 0, while an AFTER_ADL score of 0 ("functionally independent") was associated with a 25.2% reduction in LOS and 10.9% reduction in RIW. The observed effects of BEFORE_ADL may be counterintuitive at first glance: BEFORE_ADL scores indicating higher functional dependency are associated with shorter total LOS (29.0% shorter for BEFORE_ADL of 2, 10.7% shorter for BEFORE_ADL of 1) with similar directionality for total RIW. While these patients have lower functional status than the mean, they are also more likely to be admitted as LTC residents or patients receiving home care or some other type of continuing care or social supports (and hence received an RAI assessment before hospitalization). It is expected that these patients are more likely to have a shorter LOS because they are already receiving ongoing services and are candidates for earlier discharge because they are able to return to this care.

Of note, although a 2009 review by the Agency for Healthcare Research and Quality (AHRQ) (40) found no strong evidence of differences in patient outcomes between different fracture types, this analysis found that the type of fracture classified into 3 groups based on ICD-10-CA diagnosis (femoral head or neck fractures, pertrochanteric fractures, and subtrochanteric fractures) were associated with significant differences in acute and total LOS, RIW, and risk of mortality. Presence of a subtrochanteric fracture was associated with a 11.5% longer total LOS and 11% greater RIW, whereas fractures of the femoral head or neck were associated with a decrease in total LOS of 9.6% and a decrease in RIW of 3.8%. Pertrochanteric fractures were associated with a 6.4% decrease in RIW.

Overall, these results confirm prior findings in the literature using Ontario administrative data, and point to both the feasibility and importance of incorporating the significant patient predictor variables identified into the Expert Panel's recommended hip fracture patient stratification approach.

Please see Appendix II of this document for the results of 2 additional models with dependent variables of acute (non-ALC) LOS and in-hospital mortality.

Table 11: Significant Predictor Variables for Acute Length of Stay and for HIG Resource Intensity Weight for Hip Fracture Patients, Ontario, 2010/2011

Parameter	Category	Variable	Change in Acute LOS % (95% CI)	Change in HIG RIW, % (95% CI)
ADL after index hospital admission[a]	0	AFTER_ADL_3 = 0	−25.2 (−27.5 to −22.9)	−10.9 (−13.1 to −8.7)
	1	AFTER_ADL_3 = 1	1.0 (−3.1 to 5.2)	−2.5 (−5.6 to 0.7)
	2	AFTER_ADL_3 = 2	32.4 (26.0 to 39.1)	15.2 (10.7 to 19.8)
Age, years	49	Age ≤ 49	−30.6 (−35.9 to −24.9)	−11.4 (−16.6 to −6.0)
	64	50–64	−4.9 (−9.8 to 0.2)	−2.6 (−6.4 to 1.5)
	74	65–74	**9.4 (4.6 to 14.5)**	−1.6 (−5.0 to 1.9)
	75	≥ 75	**38.6 (33.7 to 43.6)**	17.8 (14.6 to 21.1)
ADL before index hospital admission[b]	0	BEFORE_ADL_= 0	57.8 (49.5 to 66.6)	13.8 (11.4 to 16.3)
	1	BEFORE_ADL = 1	−10.7 (−14.1 to −7.2)	−4.8 (−7.6 to −2.0)
	2	BEFORE_ADL = 2	−29.0 (−33.4 to −24.3)	−7.7 (−10.4 to −4.8)
Ease of transfer[c]	**0**	**BEFORE_TRANS = 0**	−9.2 (−13.5 to −4.7)	—
	1	BEFORE_TRANS = 1	10.1 (4.9 to 15.5)	—
Comorbidity index[d]	0	Comorb_index = 0	−40.5 (−43.2 to −37.6)	−35.8 (−38.2 to −33.3)
	1	Comorb_index = 1	11.9 (6.2 to 17.8)	5.9 (1.5 to 10.4)
	2	Comorb_index = 2	50.3 (37.7 to 64.1)	47.2 (37.1 to 58.0)
Sex	F	Sex = F	−2.2 (−4.0 to −0.4)	−3.4 (−4.8 to −2.0)
	M	Sex = M	2.3 (0.4 to 4.1)	3.5 (2.1 to 5.0)
Fracture type[e]	Head	Location_fracture = Head/Neck	−9.6 (−12.2 to −6.9)	−3.8 (−6.0 to −1.6)
	Pert	Location_fracture = Pert	−0.8 (−3.7 to 2.3)	−6.4 (−8.5 to −4.1)
	Subt	Location_fracture = Subt	11.5 (6.1 to 17.1)	11.0 (6.8 to 15.4)
Intercept			14.32 (13.34 to 15.36)	**2.51 (2.71 to 2.33)**

Abbreviations: ADL, activities of daily living; HIG, Health-Based Allocation Model Inpatient Grouper; ICD-10-CA, International Classification of Diseases, 10th Revision, Canadian Edition; LOS, length of hospital stay; RIW, Resource Intensity Weight.

[a] AFTER_ADL represents the most recent ADL value recorded for a patient in the year following the index hospital admission.

[b] BEFORE_ADL represents a composite score derived from the most recent ADL values recorded for a patient in the year before their index hospital admission for a hip fracture.

[c] The BEFORE_TRANS and AFTER_TRANS variables are measures of ease of transfer, i.e., to/from bed, chair, wheelchair, standing position, but excludes to/from bath/toilet.

[d] The comorbidity index used in this analysis is defined by Charlson Comorbidity Index score.

[e] The location_fracture variable represents the type of fracture as classified by ICD-10-CA diagnosis code for the head or neck of the femur (S72.0*); a pertrochanteric (Pert) fracture (includes intertrochanteric, multiple pertrochanteric fractures, trochanteric fracture) (S72.1*); and an open or closed subtrochanteric (Subt) fracture (S72.2*).

Predictive factors analysis prepared by Andrew Tsegelsky, Saad Rais, and Kamil Malikov from the Health Analytics Branch of the Health System Information Management and Investment Division, Ministry of Health and Long-Term Care (2013).

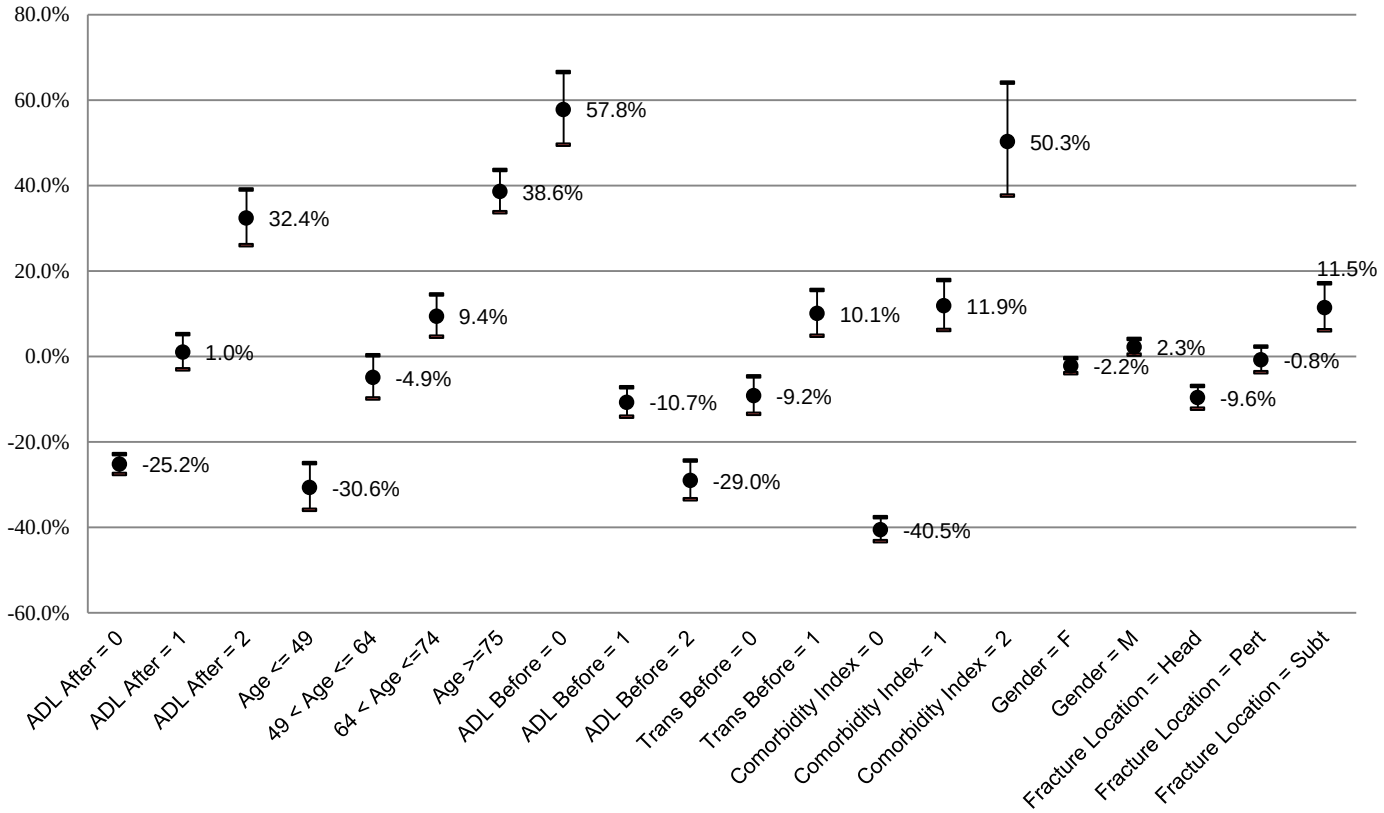

Figure 8: Percent Change in Acute Length of Stay Associated with Predictor Variables for Hip Fracture Patients, 2010/2011

Abbreviations: ADL, activities of daily living; F, female; ICD-10-CA, International Classification of Diseases, 10th Revision, Canadian Edition; LOS, length of hospital stay; M, male; pert, pertrochanteric fractures; subt, subtrochanteric fractures; trans, ease of transfer.

[a] AFTER_ADL represents the most recent ADL value recorded for a patient in the year following the index hospital admission.

[b] BEFORE_ADL represents a composite score derived from the most recent ADL values recorded for a patient in the year before their index hospital admission for a hip fracture.

[c] The BEFORE_TRANS and AFTER_TRANS variables are measures of ease of transfer, i.e., to/from bed, chair, wheelchair, standing position, but excludes to/from bath/toilet.

[d] The comorbidity index used in this analysis is defined by Charlson Comorbidity Index score.

[e] The location_fracture variable represents the type of fracture as classified by ICD-10-CA diagnosis code for the head or neck of the femur (S72.0*); a pertrochanteric (Pert) fracture (includes intertrochanteric, multiple pertrochanteric fractures, trochanteric fracture) (S72.1*); and an open or closed subtrochanteric (Subt) fracture (S72.2*).

Predictive factors analysis prepared by Andrew Tsegelsky, Saad Rais, and Kamil Malikov from the Health Analytics Branch of the Health System Information Management and Investment Division, Ministry of Health and Long-Term Care (2013).

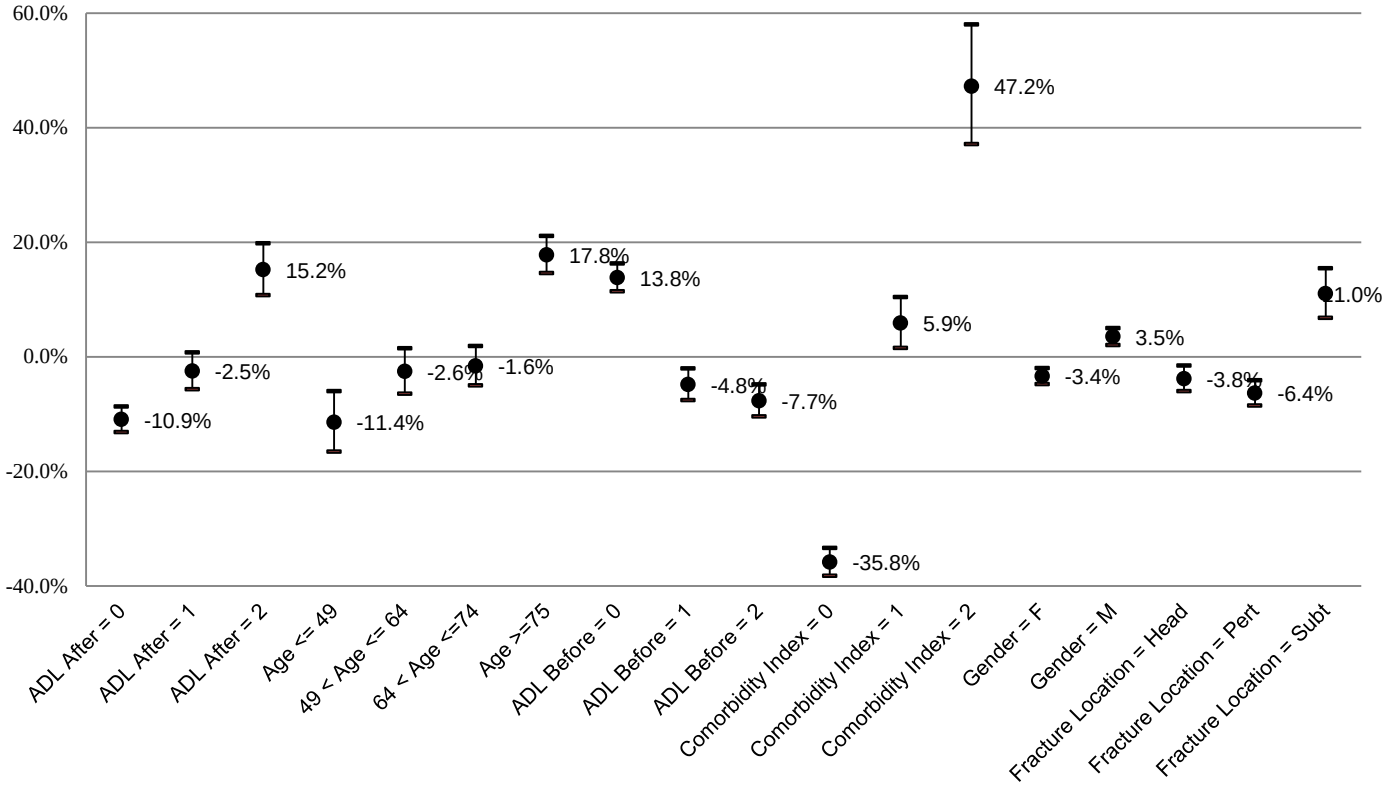

Figure 9: Percent Change in RIW Associated with Predictor Variables for Hip Fracture Patients, 2010/2011

Abbreviations: ADL, activities of daily living; F, female; ICD-10-CA, International Classification of Diseases, 10th Revision, Canadian Edition; LOS, length of hospital stay; M, male; RIW, Resource Intensity Weight; subt, subtrochanteric fractures; trans, ease of transfer.

[a] AFTER_ADL represents the most recent ADL value recorded for a patient in the year following the index hospital admission.

[b] BEFORE_ADL represents a composite score derived from the most recent ADL values recorded for a patient in the year before their index hospital admission for a hip fracture.

[c] The BEFORE_TRANS and AFTER_TRANS variables are measures of ease of transfer, i.e., to/from bed, chair, wheelchair, standing position, but excludes to/from bath/toilet.

[d] The comorbidity index used in this analysis is defined by Charlson Comorbidity Index score.

[e] The location_fracture variable represents the type of fracture as classified by ICD-10-CA diagnosis code for the head or neck of the femur (S72.0*); a pertrochanteric (Pert) fracture (includes intertrochanteric, multiple pertrochanteric fractures, trochanteric fracture) (S72.1*); and an open or closed subtrochanteric (Subt) fracture (S72.2*).

Predictive factors analysis prepared by Andrew Tsegelsky, Saad Rais, and Kamil Malikov from the Health Analytics Branch of the Health System Information Management and Investment Division, Ministry of Health and Long-Term Care (2013).

Recommended Hip Fracture Patient Stratification Approach

Based on their review of the literature and new empirical analysis performed with Ontario data, the Expert Panel came to several core conclusions around the development of an appropriate hip fracture patient stratification methodology:

1. In terms of risk stratifying the heterogenous hip fracture population, pre-fracture functional status and social factors are critically important variables and have been shown to consistently have a significant influence on hip fracture patients' hospital costs and LOS. They are strongly linked with other variables associated with greater complexity such as comorbidity level. They are also among the most significant factors in determining the clinical pathway and trajectory of care for a patient. For example, patients admitted from residence in LTC homes will have a very different trajectory and expected resource utilization compared with patients admitted from a fracture at home in the community who are then determined to require an additional level of care following discharge. These sorts of factors play the largest role in determining potential "groups" of hip fracture patients based on similar care paths.

2. There is currently a paucity of data collected in standard form at the provincial level on variables related to pre-fracture function or social circumstances for hip fracture patients. The DAD—the common denominator dataset for hip fracture admissions—contains very little information on social or functional factors for these patients. Hence, the Expert Panel emphasized the importance of collecting information beyond what is currently collected in the DAD on these types of factors.

3. Despite these significant gaps in Ontario data collection and the need for a strategy to begin to collect data on some of these important patient characteristics for hip fracture patients (through a questionnaire or other tool administered early in the patient's visit), there may be reasonable options for interim "proxy" approaches to capturing some of these characteristics through currently available administrative data. Although not captured in the DAD, patient-level data on pre-fracture functional status and living situation can be captured in other settings (e.g., LTC, home care) and used to stratify the acute admission by linking record-level information from other datasets (e.g., ADL variables captured in the CCRS) .

4. There are also a number of patient-level variables currently collected in the DAD that *do* influence resource utilization for hip fracture: age, sex, and comorbidities have all been shown in multiple studies around the world to have a significant impact on hip fracture patient costs and utilization. There is a smaller body of evidence for the effect of fracture location on hip fracture costs and LOS; however, the multivariate analysis using Ontario data completed for this review suggests that fracture location does have an impact on cost and acute inpatient LOS. These factors can be used to stratify patients by complexity within major subpopulations.

Thus, it is proposed that the Ministry consider 2 parallel approaches to hip fracture patient stratification: a long-term approach involving the collection of new data on important patient characteristics and an interim approach based on currently available data elements.

Recommended Long-Term ("Ideal") Patient Stratification Approach

It is proposed that any longer-term strategy for hip fracture patient stratification involve new data collection by developing a standard, validated questionnaire administered to patients in the early stages of their hospital admission and during the ED visit, if possible. The questionnaire should capture data elements on patients' pre-fracture functional status, pre-fracture cognitive status, pre-fracture living situation, caregiver status, and other factors that are important for determining the patient's trajectory of care following the acute discharge.

This information would allow for both the appropriate grouping of these patients in the QBP case mix funding methodology based on their expected costs as well as the ability both to establish baseline patient data on a range of important measures at the admission stage and to track changes in these measures over the course of the episode of care.

Options for the format of the questionnaire and the types of information collected should consider factors such as practicality and facilitating ease of data collection, validity of questions included, and the explanatory power of the data collected with respect to predicting hip fracture patient resource utilization and outcomes. This work should draw on prior research in the literature, potentially including work on Clinical Frailty Scales that have been shown to be valid predictors of outcomes in elderly patients. (41)

Recommended Interim Patient Stratification Approach Using Currently Available Administrative Data

In the absence of standardized provincial data on patients' functional status and information on relevant social factors being collected during the ED visit and acute admission, any hip fracture patient stratification approach will have to rely on proxy variables to capture these characteristics, as well as standard demographic and clinical variables such as age, sex, and comorbidity level.

For this analysis, a methodology has been developed that links hip fracture acute care discharges with data on the patient's pre- and post-fracture health care utilization (up to a year preceding and following the acute admission). Similar to approaches employed by Eastwood et al (37) and Heinrich et al (38), patients' health care utilization pre- and post-fracture will be assessed as a proxy indicator for their level of acute care resource utilization required, and have been employed to stratify patients into 3 major subpopulation groups:

Proposed Hip Fracture Patient Groups

- **Group #1: Admit from Community—Healthy:** These patients were living independently at home, with no observed community supports from the health care system, and are expected to return home to a similar situation following discharge. They tend to be younger and healthier, with higher functional status and fewer comorbidities.

  Technical definition: Patients admitted from home (flag in DAD) with no RAI data found for any setting (LTC, CCC, or home care) during the year before or after the fracture.

- **Group #2: Admit from LTC:** These patients tend to be the most complex and frail; a significant proportion is expected to die within the year. As they are living in LTC settings before the fracture, they are nearly always expected to return to LTC. Hence, although generally the sicker patients, their discharge pathways also tends to be fairly well-defined.

Technical definition: Patients admitted from LTC (flag in DAD); LTC RAI assessment data completed in the year before the fracture.

- **Group #3: Admit from Community—Complex:** These patients tend to have the greatest impact on hospital utilization, LOS, and ALC. These patients were living at home before the fracture but may be living with some sort of formal health care supports. After the fracture, they are expected to require a higher level of care than they were previously receiving. Thus, they may experience a prolonged LOS in the hospital before they are able to be transferred to an appropriate setting. Of the 3 groups, these patients are the most difficult to identify; work is currently underway to refine this aspect of the model.

  Technical definition: Patients admitted from home (flag in DAD), with RAI assessment data in either LTC, CCC, or home care during the year before and/or after the fracture.

Table 12 and Figure 10 clearly show that the 3 patient groups differ significantly in terms of their patient characteristics and patterns of utilization. While the "Admit from LTC" group is the most complex in terms of advanced age and frailty, they also have a much shorter mean LOS: 6.86 days, compared with 9.77 days for the "Admit from Community—Healthy" and 10.82 days for the "Admit from Community—Complex" group. The LTC group also has a much shorter mean ALC LOS than the other 2 groups. These data appear to confirm the Expert Panel's intuition: patients in the LTC group, while often frail and medically complex, are virtually guaranteed a bed they can return to in an institutional setting once they are discharged from acute care.

Table 12: Characteristics of Proposed Hip Fracture Patient Groups, Ontario, 2011/2012

	Group	Number of Cases, n (%)	Number of Female Cases and as Percentage of Total Cases, n (%)	Mean Age, years	Mean Acute LOS, days	Mean ALC, days	Mean HIG Weight
1	Admit from Community—Healthy	7,066 (54.8)	4,613 (65.3)	76.86	9.77	5.12	2.89
2	Admit from LTC	2,275 (17.6)	1,698 (74.6)	85.43	6.86	0.81	2.21
3	Admit from Community—Complex	3,557 (27.6)	2,649 (74.5)	82.46	10.82	7.29	3.01

Abbreviations: ALC, alternate level of care; HIG, Health-Based Allocation Model (HBAM) Inpatient Grouper; LOS, length of stay, LTC, long-term care.
Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

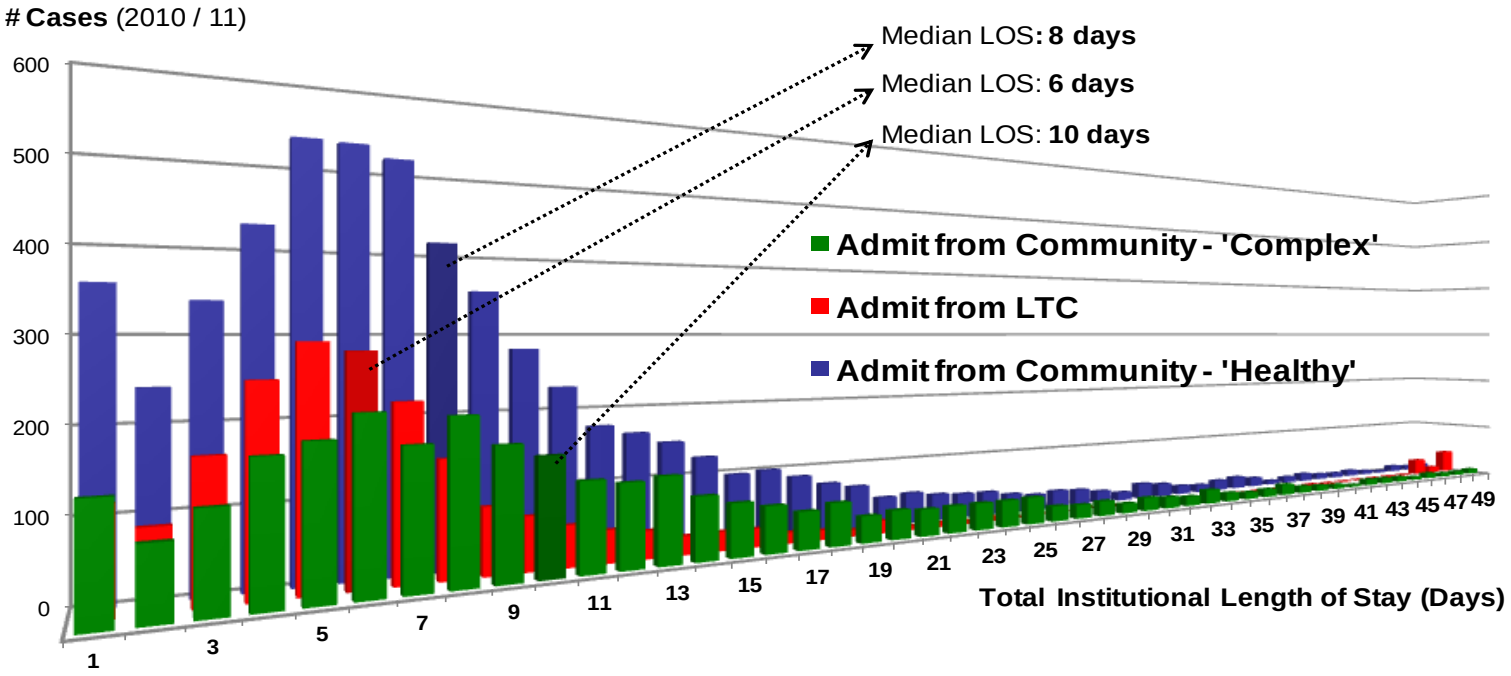

Figure 10: Distribution of Combined Acute Inpatient Plus Inpatient Rehabilitation (Where Relevant) Length of Stay for Hip Fracture Patients by Patient Subgroup

Abbreviations: LOS, length of stay, LTC, long-term care.

Data Source: Canadian Institute for Health Information Discharge Abstract Database and National Rehabilitation Reporting System, 2010/2011.

Patient Complexity Factors

Within each major patient group, there remains substantial heterogeneity in the level of complexity and expected resource utilization for the care of each type of patient. It will be important to consider factors for risk adjustment within groups for the QBP funding model. The literature reviewed above (see "Literature Review of Stratification Approaches") identifies a number of characteristics commonly associated with increased utilization (in terms of both cost and LOS), including age, sex, comorbid conditions (both the types of conditions and the number of concurrent conditions) and pre-fracture functional status. In the long-term approach to patient stratification, the proposed patient questionnaire will assist in capturing important baseline data on these factors (e.g., functional status on acute inpatient admission).

In the interim, the following factors are proposed for modelling variation in resource utilization within each of the 3 patient groups:

- **Age:** Age groups will be included in the model, as is currently done with the HIG groups. Cost and LOS are expected to increase with age.

- **Sex:** Male patients are expected to generate higher costs and longer LOS. A male/female variable will be considered in the model.

- **Comorbidity:** Hip fracture patients tend to carry a high burden of comorbidity; 2011/2012 admissions in the defined cohort had a mean of 4.6 and a median of 5 comorbidities recorded per case, with a rightward skewed distribution (see Figure 11). A wide range of studies have found comorbidities to be significantly associated with variation in cost and LOS for hip fracture patients. Studies use various means to adjust for comorbidities, including specifying a list of individual comorbidities (42;43) or specifying a simple count of comorbidities and using indices such as a Charlson Comorbidity Index score. (44;45)

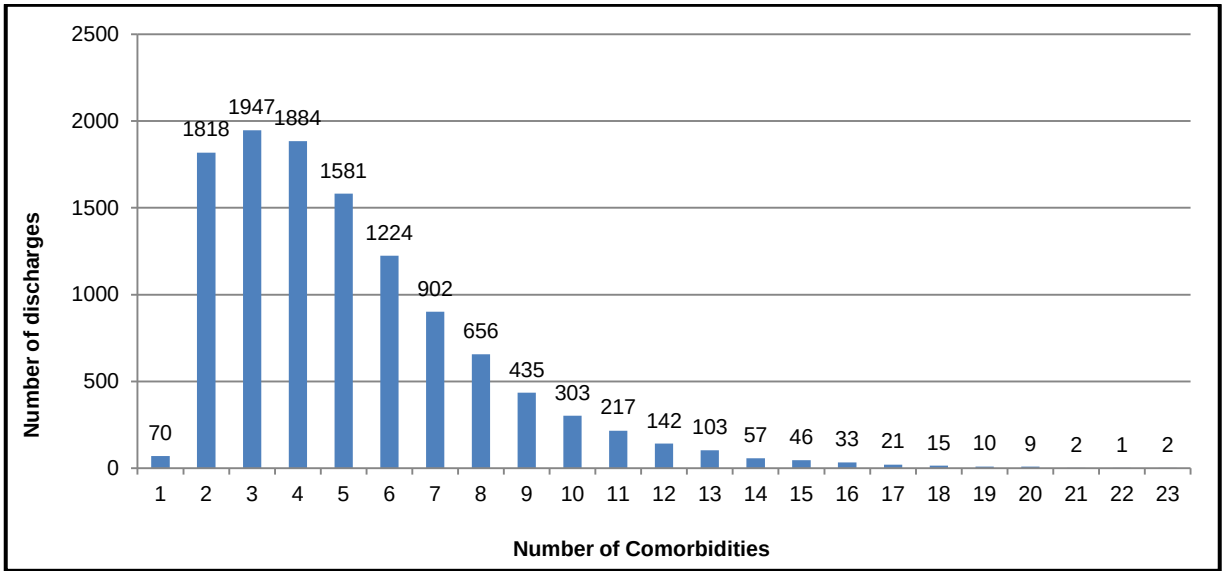

Figure 11: Distribution of Comorbidities Across Hip Fracture Cohort Cases, Ontario, 2011/2012

Data source: Canadian Institute for Health Information Discharge Abstract Database – Ontario acute inpatient cases, 2011/2012.

A collapsed, 3-group version of the Charlson Comorbidity Index (46) is proposed for use in this stratification model. The Charlson methodology assigns a score to each type of comorbidity diagnosis (see Table 10 for a list of included comorbidities and scoring), and aggregates these to create a total index for risk adjustment. The Charlson Comorbidity Index is a well-validated model in common use in a variety of risk adjustment applications.

Table 13 presents an example of the Ministry's working stratification approach applied to 2010/2011 female patients in the "Admit from Community—Complex" patient group.

Table 13: Patient Characteristics for the Female Group #3 "Admit From Community—Complex" by Charlson Comorbidity Index Score, Ontario, 2011/2012

Comorbidity Index Score[a]	0				1				2			
Age Group, years	Hip Fracture Events, n	Mean RIW	Mean LOS, days	Mean ALC, days	Hip Fracture Events, n	Mean RIW	Mean LOS, days	Mean ALC, days	Hip Fracture Events, n	Mean RIW	Mean LOS, days	Mean ALC, days
20–29	5	1.71	7.2	0.0	—	—	—	—	—	—	—	—
30–39	4	1.35	4.3	0.0	—	—	—	—	—	—	—	—
40–49	7	2.68	10.0	1.4	—	—	—	—	1	24.67	8.0	185
50–59	36	2.47	9.5	3.0	6	3.06	14.8	2.2	1	18.38	18.0	30
60–69	111	2.31	8.3	4.7	19	5.08	18.4	13.5	4	5.02	15.0	7.5
70–79	378	2.63	9.7	6.3	72	4.38	16.2	11.5	10	6.05	28.6	14.4
80–89	1213	2.61	9.4	6.3	158	4.34	15.4	13.0	13	4.51	13.9	17.5
90–99	534	2.59	10.0	5.9	64	5.17	18.1	20.0	3	4.72	21.0	9.33
100–109	8	2.26	11.3	4.1	2	6.38	22.5	0.0	—	—	—	—

Abbreviations: ALC, alternate level of care; LOS, length of stay; RIW, resource intensity weight.
[a] The comorbidity index used in this analysis was defined as follows: 0 for all patients with a Charlson Comorbidity Index score = 0; 1 for all patients with Charlson Comorbidity Index score = 1 or 2; 2 for all patients with a Charlson Comorbidity Index score > 2. See Table 9 for Charlson Comorbidity Index scores.
Analysis by Health Analytics Branch of the Health System Information Management and Investment Division, Ministry of Health and Long-Term Care (2013).

6. The Hip Fracture Episode of Care Model

The hip fracture episode of care model in Figure 12 has been developed through the input of the Expert Panel and has served as a working model throughout the process of developing the components of this Clinical Handbook. Beginning as a simplified clinical pathway sketching out the key phases of the hip fracture episode of care (e.g., admission, surgery, discharge), the model has been modified to reflect the elements of the pathway determined by the Expert Panel as of scope (such as pre-hospital or paramedic care, conservative/non-surgical treatment, and comprehensive osteoporosis management), the 3 patient subgroups identified, the variety of potential post-acute care discharge destinations within the 90-day episode time window, as well as other important branches of care that may happen within a hip fracture patient's trajectory such as transfers in and out of hospital.

In order to provide a high level picture of current hip fracture practice in the province, the model has been populated with administrative data describing the numbers and proportions of patients proceeding down each branch of the pathway, where such data is available. These numbers are based on current (as of 2011/2012) practice in Ontario as a whole and are not intended to represent targets or benchmarks for care; they also mask significant regional variation in these proportions at the LHIN level (see Appendix III).

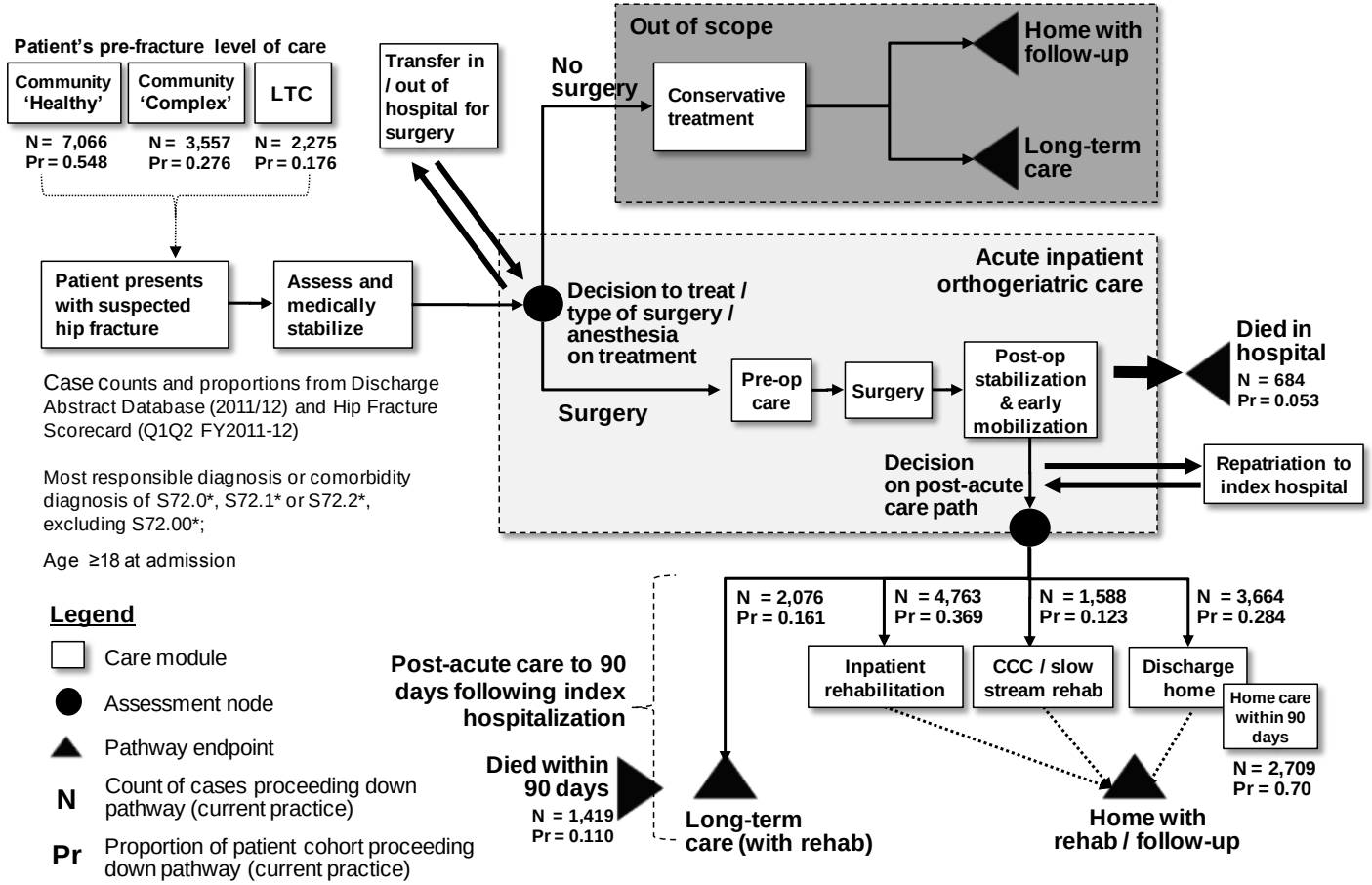

Figure 12: Episode of Care Model for Hip Fracture
Abbreviations: LTC, long-term care; CCC, complex continuing care; N, crude counts; Pr, proportions.

7. Recommended Practices for Hip Fracture

Evidence Sources Used to Develop Recommended Practices

The process for identifying recommended practices for episodes of care is described fully in the "Methods" section. The Hip Fracture Episode of Care Expert Panel used the following major sources to inform the development of their recommendations:

- Health Quality Ontario (HQO) Rapid Reviews
- HQO empirical analysis of administrative data, supported by staff from the Ministry of Health and Long-Term Care's Health Analytics Branch
- Bone and Joint Canada (2011) *National Hip Fracture Toolkit* (2)
- Scottish Intercollegiate Guidelines Network (SIGN) (2009) *Management of Hip Fracture in Older People: A National Clinical Guideline*
- The 2010 "Evidence-Based Guidelines for the Management of Hip Fractures in Older Persons: An Update" by Mak et al, published in the *Medical Journal of Australia* (6)
- The 2009 Ontario Health Technology Advisory Committee Recommendation on the prevention and management of pressure ulcers (47)
- Other *scientific literature and e*mpirical analysis brought to the Expert Panel's attention
- Expert Panel discussion and consensus

*Similar to the process appl*ied in previous HQO Episode of Care projects, at the onset of this project the Expert Panel selected 3 sets of hip fracture management guidelines to be synthesized. One of these guidelines, *National Hip Fracture Toolkit*, (2) is Canadian and was selected for its relevance to the local context, while the other 2 guidelines, SIGN (4) and Mak et al, (6) are international guidelines based on high-quality systematic reviews. HQO synthesized relevant recommendations and supporting evidence from the 3 guidelines for each care module and assessment node in the episode of care model. The Expert Panel reviewed this guideline synthesis to inform recommendations and identify gaps or inconsistencies in the evidence that would be good candidates for rapid review topics. Broadly speaking, the 3 guidelines shared common agreement on many recommendations at a high level. However, discrepancies were identified in recommendations across the 3 guidelines at a more detailed level in several areas; for example, while all of the guidelines emphasize the importance of timely surgery, specific targets for time to surgery vary.

Following the completion of the Expert Panel's work, HQO clinical epidemiologists also reviewed the Expert Panel's recommendations against the 2011 National Institute of Health and Clinical Excellence (NICE) guidelines for management of hip fracture (25) as an additional source of evidence. This review found broad agreement between the guidelines and the Expert Panel recommendations for the majority of practices included. In one clinical area where the NICE guidelines include a recommendation, cementing for arthroplasties, the Expert Panel decided not to issue a recommendation because of concerns about lack of quality evidence. This topic is now being considered as the subject matter for a future HQO evidence-based analysis.

Module 1: Care in the Emergency Department

This module identifies recommended practices for the early assessment of suspected hip fracture patients. Although patients typically present to the emergency department (ED), the same practices should be followed at an outpatient clinic or when patients are directly admitted to the acute care setting. The recommendations emphasize timely care from clinical staff and the importance of recording a comprehensive assessment of patient factors in order to inform clinical decision-making on the most appropriate pathway trajectory, plan discharge to the most appropriate setting and provide baseline values for performance measurement.

Recommendation	Guidelines/Evidence Considered
1. Care Pathway for Hip Fracture	
• Every hospital should have a hip fracture care pathway that clearly specifies perioperative patient goals by day of stay	***National Hip Fracture Toolkit***: Recommends the use of standardized tools such as clinical care maps and pathways as being effective in preventing complications and enhancing recovery
2. Rapid Medical Attention in the ED	
• 90% of patients arriving at the ED should be seen by a physician within 1 hour • 90% of patients should receive a consultation with an orthopedic surgeon within 2 hours (anesthesiologists / internist should be made aware of the patient and provide consultation as needed)	***National Hip Fracture Toolkit*:** Recommends patients be seen and fast tracked within 1 hour of arrival **SIGN:** Recommends patients be seen by medical staff within 1 hour of arrival at the ED *(Good Practice Point)*
3. ED Assessment and Diagnostics	
• Assess and document the following information while patient is in the ED to inform treatment and discharge decisions: - Reason for the fall - Fluid balance - Pressure sore risk - Hydration and nutrition - Pain - Temperature - Other collateral injuries - Tests for appropriate blood work - X-rays - Assess comorbid conditions - Current drug therapy, including any anticoagulants - Continence - Pre-fracture functional ability and mobility - Physical and functional level - Mental state based on pre-morbid functioning level, using a validated screening tool such as MMSE, MOCA, or CAM - Social circumstances, including caregiver status, existing community supports, family involvement	Recommended diagnostics and questions for patient are based on diagnostic tests recommended by ***National Hip Fracture Toolkit*, SIGN** *(Evidence Level D),* and **Expert Panel Consensus** **SIGN** recommends MRI as the investigation of choice where there is doubt regarding the diagnosis. If MRI is not available or feasible, a radioisotope bone scan or repeat plain radiographs (after a delay of 24-48 hours) should be performed *(Evidence Level D)* The **Expert Panel** felt that it was unlikely that an MRI would be required in these cases

Recommendation	Guidelines/Evidence Considered
4. Patient Management Within the ED • Medication reconciliation should be completed within the ED, using a standardized form • Steps should be taken within the ED to manage patients' hydration, pain, risk of delirium and risk of pressure sores	Based on ***National Hip Fracture Toolkit*** recommendations. Pain relief and hydration also included in **SIGN** *(Evidence Level D)*
5. Inpatient Admission • 90% of patients should be admitted within 4 hours spent in the ED	***National Hip Fracture Toolkit*** recommends patients be admitted within 4 hours **SIGN:** Patients should be admitted within 2 hours of ED arrival (*Evidence Level D)* 4 hour window was seen to be more feasible than 2 hours in Ontario and aligns with current ED wait time targets
6. Presenting to Non-Surgical Hospitals • Patients presenting to non-surgical hospitals should be medically stabilized while waiting for expeditious transfer to a surgical hospital for operation • Patients admitted to non-surgical hospitals should still receive surgery within 48 hours of their initial presentation • LHINs and hospitals should ensure that all non-surgical hospitals have formal protocols for timely transfer to surgical hospitals for surgery, followed by repatriation to patients' local hospitals	Similar recommendations to ***National Hip Fracture Toolkit***, also based on **Expert Panel Consensus**

Abbreviations: CAM, Confusion Assessment Method; ED, emergency department; LHINs, Local Health Integration Network; MMSE, Mini-Mental State Examination; MOCA, Montreal Cognitive Assessment; SIGN, Scottish Intercollegiate Guidelines Network.

Module 2: Pre-operative Management

This module describes recommended practices for the care of hip fracture patients awaiting surgery. These recommendations apply in the ED, inpatient ward, or other settings where patients may be waiting for their operation. Many of these recommendations—such as best practices for delirium and pressure ulcer prevention—should also be applied across the patient's entire hospital stay. The key objectives of this phase of care are to ensure that pain is properly managed, to prevent incidence of adverse events (including pressure sores, delirium, venous thromboembolism, and deep vein thrombosis) and to prepare patients of varying levels of complexity—including those on medications that may influence choice of anesthesia—for safe and timely surgery.

Recommendation	Guidelines/Evidence Considered
7. Pain Management	
• Evidence-based pain assessment tools and pain scales (including non-verbal scales) should be used to assess the patient's pain levels. Consider pre-hospital pain conditions and pain medications • Pre-hospital long acting pain medications should usually be continued to ensure adequate analgesia • Multimodal analgesia (e.g., acetaminophen in combination with opioids) should be considered whenever possible, as it may provide better pain relief with less side effects • Regional nerve blocks (i.e., fascia iliaca block) should be considered as an adjunct to analgesia, especially for those who poorly tolerate systemic analgesics or who are at high risk for delirium	**HQO Rapid Review: *Nerve Blocks for Pain Management in Patients With Hip Fractures*:** Significant reduction in post-operative pain for hip fracture patients who received a pre-operative nerve block versus systemic analgesic *(Low Quality Evidence)* No significant difference in additional pain medications required by patients who received nerve block compared to patients who did not *(Very Low Quality Evidence)* Significant difference in mental status in favour of patients who received a nerve block anywhere in their hip fracture care versus patients who did not *(Moderate Quality Evidence)* ***National Hip Fracture Toolkit*** recommends use of pain scales, continuation of long-term medications, consideration of multimodel analgesia and regional nerve blocks ***Medical Journal of Australia*** recommends use of 3-in-1 nerve blocks as an effective method of analgesia *(Evidence Level A)* **SIGN** emphasizes importance of appropriate pain relief before transfer (*Evidence Level D*), and if necessary, pain relief provided using IV opiate analgesia, titrated for effect. If this is impossible then consider analgesia using entonox *(Good Practice Point)*
8. Oxygen Therapy	
• Monitor oxygen through oximetry and vital signs and apply oxygen to maintain levels at 92% or higher, or as appropriate if patient has COPD	***National Hip Fracture Toolkit*** and ***Medical Journal of Australia*** *(Evidence* Level *B)* recommend oxygen therapy following admission. **SIGN** recommends oxygen for patients with hypoxemia *(Evidence Level C)*
9. Hydration	
• Intravascular intervention and hydration should be assessed carefully and continuously	From ***National Hip Fracture Toolkit***

Recommendation	Guidelines/Evidence Considered
10. Nutritional Status • The use of pre-operative protein and energy feeds may reduce unfavourable outcome. However, these may be considered a "light meal" therefore potential for delay of surgery needs to be considered • The Canadian Anesthesiologists' Society guidelines for pre-anesthesia fasting are: > 2 hours - Clear fluids > 6 hours - Light meals (e.g., toast, milk) > 8 hours - Heavy meals (e.g., meat, fried / fatty foods)	From ***National Hip Fracture Toolkit***
11. Delirium Prevention • Delirium prevention strategies should start in the ED, including the following: - Review of risk factors - Assessment of symptoms using a delirium screening tool - Assessment / management of underlying causes, in particular effective pain management - Prevention strategies targeted to: - Orientation - Early mobilization - Non-pharmacologic approaches to minimize the use of psychoactive drugs - Sleep hygiene - Adaptive equipment for vision and hearing impairment - Early intervention for volume depletion - Where necessary, geriatric consultation - Use of medication may be considered for some patients (caution should be exercised regarding potential side effects) • Presence of family members in the perioperative period may help to reduce risk of post-operative delirium	Similar to ***National Hip Fracture Toolkit*** recommendations **Expert Panel Consensus** ***Medical Journal of Australia*** finds that prophylactic low-dose haloperidol reduces severity and duration of delirium episodes as well as LOS *(Evidence Level B)*

Recommendation	Guidelines/Evidence Considered
12. Osteoporosis Assessment	
• Patients should be screened for osteoporosis and risk of fracture. The following investigations should be performed: - Complete blood count - Creatinine - Electrolytes - Alanine aminotransferase - Alkaline phosphatase - Calcium - Phosphorus - 25-OH vitamin D - Parathyroid hormone • These investigations should be ordered as early as possible during the patient's care in order to allow sufficient time to return results and modify care appropriately	Assessment investigations based on recommendations from ***National Hip Fracture Toolkit***
13. Osteoporosis Treatment	
• The following are recommended for treatment of osteoporosis in hip fracture patients: - Calcium - Vitamin D - Antiresorptive agents - Selective estrogen receptor modulator Rather than attempt to recommend a comprehensive range of therapies for management of osteoporosis in this Clinical Handbook, the Expert Panel recommends that providers refer to the 2010 Clinical Practice Guidelines for the Diagnosis and Management of Osteoporosis in Canada, available at http://www.osteoporosis.ca/health-care-professionals/guidelines/ • It is recommended that hip fracture patients be initiated on appropriate osteoporosis medication during their hospital stay in order to increase the likelihood of continuing therapy in the community and to reduce the risk of future fractures	**OHTAC Recommendation: *Aging in the Community* (2008)*:*** A combination of vitamin D and Calcium in elderly women is effective at reducing likelihood of falls *(Moderate Quality Evidence)* ***National Hip Fracture Toolkit*** recommends calcium, vitamin D, and bisphosphonate as effective treatments ***Medical Journal of Australia*** finds that effective treatments include vitamin D *(Evidence Level B)*, vitamin D with calcium supplements *(Evidence Level A),* annual infusion of zoledronic acid *(Evidence Level B),* oral alendronate and oral risedronate *(Evidence Level B),* strontium in women aged 74 years or older *(Evidence Level B)* and finds that a perioperative inpatient program, involving patient education and a list of questions for GP, may increase appropriate therapeutic intervention by GPs **Expert Panel Consensus** on importance of initiating osteoporosis medication during hospital stay
14. Urinary Catheterization	
• Avoid indwelling catheters (where possible) to decrease risk of urinary tract infections • Intermittent catheterization is preferable and has been shown not to increase incidence of urinary tract infections	**SIGN** *(Good Practice Point)* and ***National Hip Fracture Toolkit*** recommend avoiding indwelling catheters

Recommendation	Guidelines/Evidence Considered
15. Pressure Ulcer Prevention	
• Take Braden scores on admission and every 72 hours thereafter. Should a pressure sore be observed, daily Braden scores should be performed • Hip fracture patients, particularly those judged to be at high risk of pressure ulcers, should be nursed on a pressure-relieving foam mattress in all settings (including ED, inpatient acute, inpatient rehabilitation and LTC) • Techniques to alleviate pressure ulcers include: providing a bed with an air mattress, turning the patient every 2 hours, following good skin care, and providing fluids • Inspect and record condition of pressure points, perineum, and general skin condition on admission and at least twice daily • Ensure regular repositioning and early, frequent mobility. Stretchers and beds should have a pressure reduced surface from admission, to emergency, in transit, in the OR, and on the patient care unit. Consider using heel protective devices	**OHTAC Recommendation:** High quality foam mattresses should be provided to all patients in the ED, acute inpatient, and LTC settings For OR procedures longer than 90 minutes in duration, a high quality gel support surface should be used *(Moderate Quality Evidence)* Allocating the type of pressure-relieving equipment according to the person's level of pressure ulcer risk reduces the incidence of pressure ulcers *(Low Quality Evidence)* **SIGN:** Use a foam-based low-pressure mattress. Patients judged to be at very high risk of pressure sores should be nursed on a large-cell, alternating-pressure air mattress or similar surface *(Evidence Level B)* ***Medical Journal of Australia*****:** All patients should be nursed on a pressure-relieving mattress. Patients at very high risk of pressure sores should be nursed on a large-cell, alternating-pressure air mattress or similar device *(Evidence Level A)*
16. Inpatient Orthogeriatric Care	
• The patient's family and/or caregivers should be encouraged to stay and participate in the patient's pre-operative care for as long as possible • During the patient's inpatient stay, the patient's family and/or caregivers should be provided with appropriate education • Hospital care for hip fracture patients should follow the principles of good seniors / geriatric care	***National Hip Fracture Toolkit*** emphasizes support from family and/or caregivers **SIGN:** All patients presenting with a fragility fracture should be managed on an orthopedic ward with routine access to acute orthogeriatric medical support *(Evidence Level D)* ***Medical Journal of Australia*****: P**roactive geriatric consultation *(Evidence Level B)* Early multidisciplinary daily geriatric care reduces in-hospital mortality and medical complications *(Evidence Level B)*
17. Cardiac Investigations Before Surgery	
• Routine use of echocardiography for hip fracture patients is not recommended • Echocardiography may be used selectively if clinically indicated to investigate issues such as severity of aortic stenosis, but should not delay time to surgery. Higher intensity intraoperative monitoring may be considered	**HQO Rapid Review: *Clinical Utility of Echocardiography for Patients with Hip Fracture*:** No evidence identified. Guidelines do not recommend routine echocardiography, and recommend that pre-operative cardiac investigations should not delay time to surgery **SIGN** recommends against routine use of echocardiography *(Evidence Level C)* ***National Hip Fracture Toolkit*** recommends against routine echocardiography

Recommendation	Guidelines/Evidence Considered
18. Managing Patients on Anticoagulants	
• Surgery should be delayed as little as possible for patients on anticoagulants • First-line therapy for reversal of warfarin is vitamin K. For surgery anticipated to start in more than 6 hours, administration of intravenous vitamin K (5–10 mg) should be sufficient for reversal. If more urgent reversal is required (< 6 hours), compounds such as prothrombin complex concentrate (preferred) or fresh frozen plasma (FFP) may be considered along with the use of intravenous vitamin K	***National Hip Fracture Toolkit*** has similar recommendations around reversal of warfarin **SIGN** recommends vitamin K for warfarin reversal *(Evidence Level B),* use of fresh frozen plasma in accordance with national guidelines where it is appropriate to use *(Evidence Level C),* but with vitamin K as first-line therapy *(Good Practice Point)*
19. Managing Patients on Antiplatelet Therapy	
• Patient's use of antiplatelet agents should be considered in choice of appropriate anesthetic technique, but surgery should not be delayed because of the presence of these drugs	***National Hip Fracture Toolkit*****, SIGN** *(Good Practice Point)* and ***Medical Journal of Australia*** *(Evidence Level C)* recommend against delaying surgery due to antiplatelet use
20. Pre-operative Thromboprophylaxis	
• Refer to the most recent CHEST guidelines for guidance on use of anticoagulants (Available at: http://journal.publications.chestnet.org/ss/guidelines.aspx) • Thromboprophylaxis has been shown to be highly effective in preventing VTE and should be ordered at time of admission in preparation for surgery • Thromboprophylaxis should not occur within 12 hours of surgery • If surgery is likely to be delayed more than 24 hours, it is recommended to start thromboprophylaxis with an anticoagulant that has a short half-life so as not to interfere with regional anesthesia decisions or intraoperative bleeding • Options for thromboprophylaxis include: - LMWH (dalteparin, enoxaparin, tinzaparin) - Heparin (5000 units subcutaneously twice a day) • Use mechanical prophylaxis in patients for whom anticoagulants and antiplatelet agents are contraindicated • Do not use pressure gradient stockings	***National Hip Fracture Toolkit*** recommends thromboprophylaxis but does not specify type of medication **SIGN:** If surgery is delayed, patients should receive thromboprophylaxis with heparin *(Good Practice Point)* Fondaparinux should not be used before surgery because of the increased potential for spinal haematoma after spinal or epidural anesthesia *(Good Practice Point)* Mechanical prophylaxis should be considered in suitable patients to reduce the risk of DVT after hip fracture *(Evidence Level A)* Mechanical devices should be used for patients in whom anticoagulants and antiplatelet agents are contraindicated (*Evidence Level A)* There is no good evidence that graduated compression stockings prevent VTE *(Evidence Level A)* ***Medical Journal of Australia*****:** The substantial majority of patients should receive LMWH *(Evidence Level A)* Mechanical devices should be used for patients in whom anticoagulants and antiplatelet agents are contraindicated *(Evidence Level A)* Patients should be wearing pressure gradient stockings as soon as possible after admission *(Evidence Level A)*

Recommendation	Guidelines/Evidence Considered
21. Time to Surgery	
• Surgery should be performed as early as possible, not to exceed 48 hours of initial presentation	**HQO Rapid Review: *Optimal Timing of Hip Fracture Surgery*:** Evidence supports the current 48 hour time to surgery benchmark. Shorter wait time is associated with decreased risk of mortality ***National Hip Fracture Toolkit*** supports 48 hour target **SIGN** *(Evidence Level C)*and ***Medical Journal of Australia*** *(Evidence Level C)* recommend against delay of surgery and impact on patient mortality **Administrative data** shows that 82% of Ontario patients are still not being treated within the 48-hour benchmark, suggesting there is still room for improvement with this target
22. Pre-operative Traction	
• Routine use of pre-operative traction (either skin or skeletal) is inappropriate	***National Hip Fracture Toolkit*, SIGN** *(Evidence Level A)* and ***Medical Journal of Australia*** *(Evidence Level A)* all find that pre-operative traction is ineffective
23. Anesthesia	
• Regional anesthesia, where possible, is preferred over general anesthesia, in order to reduce risk of post-operative delirium • Patients should be offered choice of clinically acceptable methods of anesthesia after discussing the benefits and harms with them	**SIGN** *(Good Practice Point)* and ***Medical Journal of Australia*** *(Evidence Level A)* recommend use of regional anesthesia over general anesthesia
24. Antibiotic Prophylaxis	
• All hip fracture patients undergoing surgery should receive intravenous antibiotic prophylaxis • Antibiotic prophylaxis should be administered in a single dose at induction of anesthesia and 2 additional doses within 24 hours • Antibiotics should not be administered in the ED as prolonged use prior to surgery is of no proven benefit for preventing wound infection • Topical antibiotics are not recommended for preventing wound infection	***National Hip Fracture Toolkit*, SIGN** *(Evidence Level A),* and ***Medical Journal of Australia*** *(Evidence Level A)* all recommend use of antibiotic propyhlaxis ***Medical Journal of Australia*** (*Evidence Level A)* recommends administering antibiotics at induction of anesthesia ***National Hip Fracture Toolkit*** and ***Medical Journal of Australia*** (*Evidence Level C)* recommend against topical antibiotics for wound infection

Abbreviations: COPD, chronic obstructive pulmonary disease; DVT, deep vein thrombosis; ED, emergency department; GP, general practitioner; HQO, Health Quality Ontario; IV, intravenous; 25-OH, 25-hydroxy; OHTAC, Ontario Health Technology Advisory Committee; LMWH, low molecular weight heparin; LTC, long-term care; OR, operating room; SIGN, Scottish Intercollegiate Guidelines Network; VTE, venous thromboembolism.

Module 3: Surgery

This module identifies recommended practices for surgery for hip fracture patients. Recommendations focus on the appropriate type of surgery for different types of fractures. It should be noted that for many types of fractures, the evidence is not definitive with respect to the effectiveness of one type of surgery or device over another. In all cases, surgeons operating on patients who were previously mobile should select a type of surgery and device that offers the best chance of facilitating immediate weight bearing 24 hours following the surgery. Decisions over the best surgical approach may need to take into consideration the particular surgeon's level of experience with various techniques.

Recommendation	Guidelines/Evidence Considered
25. Surgical Safety	
• Skin around the surgical site should be cleaned with antiseptic • Minimize hair removal if possible • Maintain perioperative glucose control and normothermia • Restrict skin pressure during surgery • Ensure the correct surgical site is identified and initialed by the surgeon and confirmed by the patient before surgery	Recommendations from ***National Hip Fracture Toolkit***
26. Importance of Weight Bearing	
• Surgery for all previously ambulatory hip fracture patients should be planned to achieve immediate weight bearing after surgery. This may involve choice of surgical technique and/or implants that allow for stable fracture fixation or replacement arthroplasty to allow immediate weight bearing	The ***National Hip Fracture Toolkit*** and **Expert Panel Consensus** both emphasized the importance of surgery that allows for immediate weight bearing
27. Undisplaced Intracapsular Fractures	
• Undisplaced intracapsular fractures should have internal fixation	**SIGN** *(Evidence Level D)* and ***Medical Journal of Australia*** *(Evidence Level A*) both recommend internal fixation for undisplaced intracapsular fractures

Recommendation	Guidelines/Evidence Considered
28. Displaced Intracapsular Fractures • For displaced femoral neck fracture in patients over 65 years, arthroplasty (either total or hemiarthroplasty) is recommended over internal fixation • In general, total hip arthroplasty is preferred over hemiarthroplasty for younger, more cognitively intact patients • No recommendation can be made on use of cementing for hemiarthroplasty. Surgeons should choose whether or not to use cement based on the individual patient and their own experience	**HQO Rapid Review: *Total Hip Arthroplasty Versus Hemiarthroplasty for Displaced Femoral Neck Fractures*:** Based on studies involving primarily cognitively intact patients, total hip arthroplasty was found to be more effective than hemiarthroplasty *(Low Quality Evidence)* **SIGN** *(Evidence Level A)* consider closed reduction and internal fixation in 'young' fit patients and arthroplasty for 'older' biologically less fit patients Patients with pre-existing joint disease, medium/high activity levels and a reasonable life expectancy, should have total hip replacement over hemiarthroplasty as the primary treatment *(Evidence Level A)* ***Medical Journal of Australia*** *(Evidence Level B*) finds that for displaced intracapsular fractures there is no clearly superior type of surgery, and recommends selection of surgery based on patient age and surgeon experience *(Evidence Level B)* **SIGN** *(Evidence Level C)* recommends using cement when undertaking hemiarthroplasty, unless there are cardiorespiratory complications, particularly in frail older patients The **Expert Panel** felt the evidence for the effectiveness of cementing vs. not cementing was insufficient for them to make a recommendation
29. Extracapsular Fractures • For the fixation of extracapsular hip fractures excluding reverse obliquity, transverse or subtrochanteric fractures, sliding hip screws are recommended as evidence suggests they are equally as effective as intramedullary nails while also having a lower unit cost • Fractures with simple metaphyseal patterns should be treated by sliding hip screws. For fractures with extensive metaphyseal comminution, intramedullary nails are preferred • Fixed angle devices should not be used for intertrochanteric fractures • Subtrochanteric fractures, including reverse obliquity and transverse intertrochanteric fractures, should be treated with Intramedullary nails	**HQO Rapid Review: *Intramedullary Nails in Comparison with Sliding Hip Screws for Intertrochanteric Hip Fractures*:** For interotrochanteric fractures, no significant difference in effectiveness found with intramedullary nails in comparison with sliding hip screws *(High Quality Evidence)* **Expert Panel Consensus** on cheaper unit cost of sliding hip screws over intramedullary nails **SIGN** *(Evidence Level A)* recommends sliding hip screws except for exceptional circumstances (e.g., transverse and subtrochanteric fractures), where nails can be considered ***Medical Journal of Australia*** *(Evidence Level A)* recommends sliding hip screws over nails due to lower complication rates except for subtrochanteric fractures, where nails can be used (*Evidence Level C)*

Abbreviations: HQO, Health Quality Ontario; SIGN, Scottish Intercollegiate Guidelines Network.

Module 4: Post-operative Management

Following surgery, this module identifies recommended practices for post-operative management. A number of the recommended practices in areas such as pain management and thromboprophylaxis are similar to those in the Pre-operative Management module. A key area of emphasis in the post-operative management of hip fracture patients is early mobilization and the initiation of active rehabilitation. Early mobilization following surgery has been shown to reduce incidence of adverse events and may help patients achieve better functional outcomes through rehabilitation.

Recommendation	Guidelines/Evidence Considered
30. Post-operative Management (General) • Post-operative care should be provided by a multidisciplinary team in accordance with principles of appropriate geriatric care • A standardized care plan should be developed for the immediate post-operative period for patients following surgery • Functional status should be assessed 2 days post-operatively using standardized tools (e.g., FIM) • Mental status should continue to be assessed daily using a standard tool such as MMSE, CAM, or MOCA • Monitor and manage risk factors including cardiac instability, fluid overload, electrolyte disturbances, anemia, malnutrition, constipation	General recommendations from ***National Hip Fracture Toolkit*** and **Expert Panel Consensus**
31. Post-operative Pain Management • Analgesics are recommended for the first 72 hours post-operatively and thereafter as needed • Multimodal analgesia concepts should be employed. The goal of pain management is to make the patient comfortable and promote activity, not to sedate the patient and reduce activity levels • Intravenous Patient Controlled Analgesia (IVPCA) devices may be inappropriate in cases of delirium and dementia. If used, IVPCA devices should be used for a short time with patients transitioned from IV to oral opioid medications when tolerated • Regional anesthesia (i.e., fascia iliaca block, epidural anesthesia) should be considered for post-operative analgesia, especially for those who are at high risk for delirium	**HQO Rapid Review: *Nerve Blocks for Pain Management in Patients With Hip Fractures*:** Significant reduction in post-operative pain for hip fracture patients who received a pre-operative nerve block versus systemic analgesic *(Low Quality Evidence)* No significant difference in additional pain medications required by patients who received nerve block compared to patients who did not *(Very Low Quality Evidence)* Significant difference in mental status in favour of patients who received a nerve block anywhere in their hip fracture care versus patients who did not *(Moderate Quality Evidence)* ***National Hip Fracture Toolkit*** recommends use of multimodal analgesia, regional nerve blocks ***Medical Journal of Australia*** recommends use of 3-in-1 nerve blocks as an effective method of analgesia *(Evidence Level A)* **Expert Panel Consensus**

Recommendation	Guidelines/Evidence Considered
32. Post-operative Mobilization • Patients should be mobilized as soon as medically stable (i.e., within 12 to 24 hours of surgery) • Mobility should progress to standing within 24 hours of surgery • Weight-bearing status should be "as tolerated" • Patients should receive 7-day-a-week mobilization by all staff	**National Hip Fracture Toolkit** emphasizes important of early post-operative mobilization and weight bearing **SIGN** recommends mobilization within 24 hours post-operatively and immediate weight bearing *(Good Practice Point)* ***Medical Journal of Australia:*** Early assisted ambulation begun within 48 hours of surgery is effective *(Evidence Level B)* No particular mobilization strategies can be recommended over others *(Evidence Level A)*
33. Post-operative Oxygen Therapy • Supplementary oxygen should be provided post-operatively	**SIGN** *(Evidence Level C)* and **Medical Journal of Australia** *(Evidence Level B*) recommend post-operative oxygen therapy be provided
34. Post-operative Thromboprophylaxis • Following surgery, hip fracture patients should receive routine anticoagulation for 35 days or as per the most recent CHEST guidelines (available at: http://journal.publications.chestnet.org/ss/guidelines.aspx) • LMWH is effective in the prevention of DVT and should be used routinely after surgery. If the patient has a nerve block catheter in situ (i.e., epidural catheter), the anesthesiologist should be made aware prior to anticoagulation • Mechanical thromboprophylaxis should be restricted to patients where chemical anticoagulation is contraindicated	**National Hip Fracture Toolkit** recommends referring to the CHEST guidelines, use of LMWH and restriction of mechanical prophylaxis to patients where chemical coagulation is contraindicated **SIGN** recommends heparin (UFH or LMWH) or fondaparinux *(Evidence Level A)*. Patients without a contraindication should receive thromboprophylaxis using fondaparinux for 28 days, starting 6 hours after surgery *(Evidence Level A)*. Aspirin monotherapy is inappropriate pharmacologic prophylaxis for patients after hip fracture surgery *(Evidence Level D)*
35. Post-operative Nutrition • Patients' families and/or caregivers are encouraged to bring in patients' preferred foods in order to ease patients' nutritional intake • Provide high energy protein supplements if required	**Expert Panel Consensus** **SIGN:** Consider supplementing the diet of hip fracture patients with high energy protein preparations containing minerals and vitamins *(Evidence Level A)*
36. Patient and Caregiver Education • Provide the patient and family with education around optimal home environment, risk factors, mobilization, stairs, elimination of trip and slip hazards, ADL supports, how to foster health and avoid readmission • Educational information on medication, mobility, expected progress and pain control should be given to the patient, caregiver and families	Recommendations from ***National Hip Fracture Toolkit***

Abbreviations: ADL, activities of daily living; CAM, Confusion Assessment Method; FIM, Functional Independence Measure; HQO, Health Quality Ontario; IV, intravenous; LMWH, low molecular weight heparin; MMSE, Mini-Mental State Examination; MOCA, Montreal Cognitive Assessment; UFH, unfractionated heparin.

Module 5: Post-acute Care

Although many of the recommendations so far have focused on the acute care portion of the hip fracture pathway, the care that patients receive after their acute stay is equally important. It is recommended that all hip fracture patients receive an active rehabilitation program following their acute care; there are a number of settings where this may occur, including institutional settings, such as inpatient rehabilitation and complex continuing care, and community-based settings, such as rehabilitation in the home or through outpatient physiotherapy clinics.

Recommendation	Guidelines/Evidence Considered
37. Discharge, Repatriation and Referral for Rehabilitation • Patients who have been transferred out for surgery should be transferred back to their local hospital as soon as the patient is medically stable • All hip fracture patients, including patients admitted from LTC and patients with dementia, should receive an active rehabilitation program after their acute care. This program can be conducted in a hospital inpatient setting (inpatient rehabilitation or CCC), in the community (home- or outpatient-based) or from LTC homes (in the case of patients admitted from LTC)	***National Hip Fracture Toolkit*** recommends repatriation of transferred patients back to their hospital and the availability of rehabilitation for all patients **SIGN** and ***Medical Journal of Australia*** recommend use of early supported discharge programs (*Evidence Level B*) **SIGN** recommends patients with significant comorbidity, poor mental status / poor function to undergo rehabilitation in a special geriatric rehabilitation facility (*Evidence Level B*) **Expert Panel Consensus** on patient eligibility for rehabilitation **HQO Rapid Review: *Intensity of Rehabilitation After Hip Fracture*:** Insufficient evidence for effect of higher intensity of rehabilitation
38. Timing to Initiation of Rehabilitation • Hospital care pathways should adopt the goal of active rehabilitation commencing no later than Day 6 following the patient's surgery	**HQO Rapid Review: *Optimal Timing to Begin an Active Rehabilitation Program After a Hip Fracture*:** Insufficient evidence for optimal timing to begin rehabilitation Day 6 target from the ***National Hip Fracture Toolkit*** adopted as a goal for hospital care pathways in lieu of high quality evidence on optimal timing or consensus on organization performance targets

Recommendation	Guidelines/Evidence Considered
39. Location of Rehabilitation • Hip fracture patients who are medically stable, cognitively intact, and able to mobilize short distances benefit from early supportive discharge home to receive a community-based rehabilitation program • Discharge of hip fracture patients to community-based rehabilitation programs should not result in extended acute care LOS for these patients compared to discharge to inpatient rehabilitation • Further work should be conducted to define criteria for the appropriate post-acute care setting for the more complex (e.g., medically unstable and/or cognitively impaired) hip fracture patient population	**HQO Rapid Review: *Community Versus Inpatient Rehabilitation in Hip Fracture Patients*:** Healthier, cognitively intact hip fracture patients achieved better 1 month post-discharge FIM through home-based rehabilitation compared to inpatient rehabilitation *(High Quality Evidence)* **Expert Panel Consensus** on importance of home-based rehabilitation not extending acute LOS and further work required to define rehab criteria for more complex patients **Analysis of 90-day Hip Fracture Episodes of Care** (see **Appendix III)**: The degree of cross-LHIN variation observed in the use of post-acute care settings such as inpatient rehabilitation and complex continuing care is likely indicative of differences in regional capacities in these settings. The **Expert Panel** felt it was inappropriate to set specific targets for discharge to each setting when achieving such targets would be heavily dependent on the availability of regional capacity
40. Optimal Intensity and Key Components of Rehabilitation • No recommendation was made on optimal intensity of rehabilitation due to insufficient evidence • Regardless of setting, post-acute rehabilitation for hip fracture patients should be provided by a multidisciplinary team and include the following components: - Therapies to improve independence in self-care, transfers, ambulation, and ADLs (e.g., dressing, washing, toileting) to allow patients to return to their pre-fracture living environment - Balance and gait training and assessment - Nutritional supplementation (high energy protein, vitamins, and minerals) - Education on safety and falls prevention for patient, family, and caregivers - Provision of a maintenance exercise program - Environmental modification - Osteoporosis management and education - Medication management	**HQO Rapid Review: *Intensity of Rehabilitation After Hip Fracture*:** No evidence identified for optimal intensity of rehabilitation **OHTAC Recommendation: *Aging in the Community* (2008):** Long-term exercise programs for mobile seniors and environmental modifications to seniors' homes are effective in reducing falls *(High Quality Evidence)* A combination of vitamin D and Calcium in elderly women is effective at reducing likelihood of falls *(Moderate Quality Evidence)* **SIGN:** Supplementing the diet of hip fracture patients in rehabilitation with high energy protein preparations containing minerals and vitamins should be considered *(Evidence Level A)* A multidisciplinary rehabilitation program *(Evidence Level B)* that promotes independence, mobility and function, ADLs ***National Hip Fracture Toolkit*:** Recommended components of rehabilitation

Recommendation	Guidelines/Evidence Considered
41. Discharge Home and Follow-Up Care • Prior to a patient's discharge from hospital (whether acute or rehabilitation), services need to be coordinated in the community and sufficient notice must be given to allow patients and caregivers time to make arrangements and set up the care for patients to return home • Educational information on medication, mobility, expected progress, and pain control should be given to the patient, caregiver, and families • A schedule of appointments as well as relevant contact information needs to be provided to patients and caregivers • The family physician or community care provider should be informed about the pending discharge and a follow-up appointment made within 2 weeks of discharge • Patients without a regular primary care provider should be attached to one (e.g., through the hospital's CCAC care coordinator, HealthCare Connects, Health Links, local FHTs, CHC or NP-led clinics) • Patients should receive at least one follow-up appointment related to their orthopedic surgery	***National Hip Fracture Toolkit*** recommendations on coordination of post-discharge services, medication, appointments and follow-up care **Expert Panel Consensus** on 2-week follow-up with primary care, follow-up with orthopedic program, and need for hospitals to connect patients to a primary care provider if they do not have one

Abbreviations: ADL, activities of daily living; CCAC, Community Care Access Centre; CCC, complex continuing care; CHC, Community Health Centre; FHT, Family Health Team; FIM, Functional Independence Measure; HQO, Health Quality Ontario; LTC, long-term care; LHIN, Local Health Integration Network; OHTAC, Ontario Health Technology Advisory Committee; NP, nurse practitioner.

Data Collection, Reporting and Performance Targets

Moving beyond recommendations on best practices that should be performed within the hip fracture clinical pathway, the Expert Panel emphasized that making significant system-wide improvements in the quality of care received by these patients will require efforts to improve the provincial information management infrastructure around this population. This section includes recommendations for new provincial efforts in data collection, performance measurement, and reporting that will both improve quality of care and support a more effective funding model for hip fracture.

Recommendation	Guidelines/Evidence Considered
42. Provincial Hip Fracture Scorecard • The existing Ontario *Hip Fracture Quality Scorecard* should provide the foundation for performance measurement efforts focused on the Episode of Care and Quality-Based Procedure initiatives for hip fracture • Regular province-wide distribution of the *Hip Fracture Quality Scorecard* should be initiated as soon as possible, with a reporting schedule that supports timely monitoring of quality improvement efforts • The current set of indicators within the *Hip Fracture Quality Scorecard* should be expanded to include greater coverage of rehabilitation, post-acute care, and longer-term outcomes	**Expert Panel Consensus**
43. Outpatient Rehabilitation Reporting • The absence of standardized provincial reporting of outpatient rehabilitation clinic activity creates a void in understanding the pathway of hip fracture patients. The Ministry should implement mandatory standardized reporting of outpatient rehabilitation activity • Outpatient rehabilitation reporting should include collection of standard outcome measures collected at standard timeframes (e.g., FIM assessment 4 months after discharge)	**Expert Panel Consensus**
44. Hip Fracture Patient Intake Questionnaire • A validated standard provincial questionnaire should be developed and administered to hospitalized hip fracture patients to capture data elements on patients' pre-fracture functional status, pre-fracture cognitive status, pre-fracture living situation, caregiver status, and other factors that are important for determining the patient's trajectory of care following the acute discharge	**Expert Panel Consensus**

Recommendation	Guidelines/Evidence Considered
45. Coding and Data Collection • The American Society of Anesthesiologists (ASA) score provides valuable information for risk adjustment and analysis and should be collected as part of the discharge abstract • Orthopedic surgeons providing care to hip fracture patients should be involved in the reporting and coding of these cases to ensure greater accuracy • Options should be considered for establishing a provincial hip fracture patient registry, potentially as part of efforts to develop a national registry	**Expert Panel Consensus**
46. Performance Targets Considered • The Expert Panel has considered the following as potential performance targets. However, these need to be further validated against current performance before they can be adopted as feasible "best practice" targets: A. Mean acute inpatient LOS of 7 days B. 90% of all hip fracture patients discharged from acute care within 7 days of admission C. Mean inpatient rehabilitation LOS of 28 days D. 90% of all hip fracture patients discharged from inpatient rehabilitation within 28 days of admission Preliminary review of current hospital performance shows that no LHINs are achieving the 90% acute inpatient LOS target (see B above) There may also be challenges in achieving these targets for hospitals that provide both acute and rehabilitative care in the same setting. For these hospitals, a more inclusive performance measure (e.g., percentage of patients returned home in 30 days) may be more appropriate	**Expert Panel Consensus** **Review of *Hip Fracture Quality Scorecard* data on current hospital performance** **Review of additional Ministry data on current hospital performance**
47. Coding and Data Collection • The American Society of Anesthesiologists (ASA) score provides valuable information for risk adjustment and analysis that should be collected as part of the discharge abstract • Orthopedic surgeons providing care to hip fracture patients should be involved in the reporting and coding of these cases to ensure greater accuracy • Options should be considered for establishing a provincial hip fracture patient registry, potentially as part of efforts to develop a national registry	**Expert Panel Consensus**

Abbreviations: CCC, complex continuing care; FIM, Functional Independence Measure; LHIN, Local Health Integration Network; LOS, length of stay; LTC, long-term care.

8. Performance Measurement

Following the identification of a set of recommended practices for the hip fracture episode of care, the Hip Fracture Episode of Care Expert Advisory Panel was asked to provide recommendations around hip fracture performance measures aligned with the episode of care. For this task, the Expert Panel drew on 2 primary sources: the *Hip Fracture Quality Scorecard*, (1) developed by the Orthopaedic Expert Panel through Access to Care (Cancer Care Ontario) and now in transition to the Ministry, and the *National Hip Fracture Toolkit* (2), which in addition to its clinical recommendations, also contains recommendations around performance measures.

The Expert Panel recommends that the *Hip Fracture Quality Scorecard* be used as a foundation for future hip fracture performance measurement efforts. Whereas the *Scorecard* is largely limited to a focus on the acute care setting (a result of the limited availability of data from other care settings during the *Scorecard*'s initial development), it contains a number of measures that align closely with the Expert Panel's recommendations, including measures for the percentage of patients receiving surgery within 48 hours, acute length of stay (LOS) and the percentage of patients discharged to each post-acute care setting. The technical definitions for these measures should be aligned with the cohort definition recommended by the Expert Panel, and where appropriate, stratified by subgroup. For example, the mean acute LOS for patients admitted from long-term care (LTC) is considerably shorter than that of patients admitted from home, and relatively few are discharged to inpatient rehabilitation. Stratifying these measures by the recommended patients groups facilitates an "apples to apples" comparison of performance across different types of hip fracture patients.

In addition to the *Scorecard*, the *National Hip Fracture Toolkit* provides a comprehensive list of recommended national hip fracture performance measures, organized by quality domain (Access, Acceptability, Effectiveness, Efficiency, and Safety) with accompanying recommendations around the appropriate frequency of reporting (annual, quarterly, or as needed), data sources, and targets. Measures from this list were combined with additional measures recommended by the Expert Panel to generate a list of potential performance indicators relevant to the hip fracture episode of care organized in Table 14. Each recommended measure is organized by quality domain, attached to a rationale describing its linkage to the Expert Panel's recommendations, and assessed for its feasibility of reporting and required data sources. Measures that are currently reported in the *Hip Fracture Quality Scorecard* are described as such. For measures that are not currently reported in the *Scorecard* or other vehicles but theoretically should be able to be calculated using current administrative data, required data sources and high level technical considerations are highlighted.

While the majority of recommended measures described in Table 14 are theoretically feasible to calculate using current administrative data sources, a number of measures require the collection of new data. For example, collection of comprehensive data on patients' baseline function, cognition, and social circumstances will require the use of a patient questionnaire. The most expedient way to collect this data would be using the same patient questionnaire recommended in this Clinical Handbook (see Section 5, "Hip Fracture Cohort and Stratification Approach"**)**. Such a questionnaire could be administered in the emergency department (ED) or early in the patient's hospital admission and used to collect patient baseline data required for risk adjustment, clinical decision-making, and performance measurement. A similar post-discharge questionnaire could be applied to collect information on long-term function and patient-reported outcomes such as pain and quality of life.

Table 14: Recommended Hip Fracture Performance Measures

Recommended Measure	Domain	Rationale	Feasibility	Data Source	Reporting Frequency
Patient demographic information, including: **- Age** **- Sex** **- Residence** **- Fracture type** **- Income** **- Education**	Background/ baseline information	Required for background information, setting baseline for measurement, patient grouping/stratification and risk adjustment, other research and analysis	Some variables available through *Hip Fracture Quality Scorecard* Some variables calculated to support Expert Panel Other variables require additional data sources, survey data, etc.	DAD Potential linkage to other data sources such as census survey data, CCHS	As needed
Pre-fracture living situation, e.g., community dwelling (with or without home care and other supports) versus LTC	Background / baseline information	Required for setting baselines for performance measurement, patient grouping / stratification and risk adjustment	Calculated by Ministry HAB to support Expert Panel (Admit from Community—Healthy, Admit from Community—Complex, and Admit from LTC groups Potential to further develop HAB analysis to include more comprehensive capture of pre-fracture provider services Requires patient questionnaire for consistent and comprehensive capture of pre-fracture living situation (e.g., social care services)	DAD CCRS HCD Patient questionnaire	As needed
Pre-fracture comorbidities	Background / baseline information	Required for setting baselines for performance measurement, patient grouping / stratification and risk adjustment	Charlson Comorbidity Index calculated by Ministry HAB to support Expert Panel	DAD Linkage with other data sets required for comprehensive pre-admission comorbidity data	As needed
Pre-fracture cognition	Background / baseline information	Required for setting baselines for performance measurement, potentially risk adjustment	Only limited range of diagnosis-based data currently collected in DAD Could potentially collect cognition data for patients that have received pre-fracture RAI ADL assessment Will require patient questionnaire for consistent and comprehensive collection	DAD CCRS Patient questionnaire	As needed

Recommended Measure	Domain	Rationale	Feasibility	Data Source	Reporting Frequency
Pre-fracture function	Baseline information / Acceptability	Required for setting baselines for performance measurement, patient stratification and risk adjustment	ADL measures for patients receiving pre-fracture RAI assessment calculated by Ministry HAB to support Expert Panel Will require patient questionnaire for consistent and comprehensive collection	CCRS Patient questionnaire	As needed
Time spent in ED	Access	The Expert Panel recommends that patients are admitted from the ED within 4 hours	Can be calculated from NACRS data	NACRS	Quarterly
Percentage of patients waiting < 24 hours from index admission (any hospital) to surgery	Access	The Expert Panel recommends patients receive surgery as soon as possible	Can be calculated from DAD; 48 hour measure reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Percentage of patients waiting < 48 hours from index admission (any hospital) to surgery	Access	The Expert Panel recommends patients receive surgery as soon as possible, not to exceed 48 hours following index admission	Reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Percentage of patients waiting < 48 hours from admission (same hospital) to surgery	Access	The Expert Panel recommends patients receive surgery as soon as possible, not to exceed 48 hours following index admission	Reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Percentage of patients waiting < 48 hours from fracture to surgery	Access	The Expert Panel recommends patients receive surgery as soon as possible, not to exceed 48 hours following index admission	Not likely to be collected - would require data collection from ambulance	DAD	Quarterly
Reason for delay to surgery	Background information	Useful for context	Not likely to be collected - likely would require chart audit	Chart audit / local data collection	Quarterly
Patient self-efficacy	Effectiveness		Requires patient questionnaire	Patient questionnaire	As needed

Recommended Measure	Domain	Rationale	Feasibility	Data Source	Reporting Frequency
Compliance with care pathway	Quality / Efficiency / Acceptability	Measure of quality based on compliance with recommended practices	Some aspects of care path tracked through other recommended measures	Chart audit / local data collection	As needed
Type of surgery performed	Background / baseline information - also potentially quality (when matched with fracture type)	Understand surgery trends and whether recommended surgeries used for some specific fractures	Limited information on surgery type and fracture type in DAD; would require more detailed local data collection or chart audit	DAD Chart audit / local data collection	Annually
Total OR time	Efficiency	Assess efficiency	Not currently available	Chart audit / local data collection	Quarterly
Intraoperative adverse events	Safety	Important quality measure; understand in-hospital complications	Available in DAD; will require definitions for adverse events; can start with most common (e.g., pressure ulcers, infections, falls, delirium)	DAD	Quarterly
Osteoporosis treatment started in acute care	Access	Expert Panel recommends vitamin D, antiresorptives, calcium supplementation	Not likely to be collected - likely would require chart audit	Chart audit / local data collection	Quarterly
Percentage "weight bearing as tolerated" ordered post-surgery	Effectiveness	Expert Panel recommends all surgery be planned to achieve immediate weight bearing	Not likely to be collected - likely would require chart audit	Chart audit / local data collection	Quarterly
Discharge disposition of patients from acute care	Effectiveness	Understand post-acute care practices	Definition exists in *Hip Fracture Quality Scorecard* (may want to validate DAD discharge disposition with data linkage to post-discharge datasets)	DAD	Quarterly
Acute care LOS	Efficiency	Expert Panel recommends 5 day post-operative acute LOS; 7 day Acute LOS	Reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Acute care LOS if patients receive all care (including rehab) in acute care	Efficiency	Some hospitals provide rehabilitation care in acute setting	Can segregate acute LOS for hospitals providing rehabilitation in acute care	DAD Local data collection	Quarterly

Recommended Measure	Domain	Rationale	Feasibility	Data Source	Reporting Frequency
ALC designation	Efficiency	High ALC rates for hip fracture population; quality and system integration measure	Reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Percentage of cases with ALC days	Efficiency	High ALC rates for hip fracture population; quality and system integration measure	Reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Percentage of acute care LOS designated ALC	Efficiency	High ALC rates for hip fracture population; quality and system integration measure	Reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Percentage of patients mobilized on day 1 post-operation	Efficiency / Acceptability	Expert Panel recommends mobilization on day 1 following surgery	Not likely to be collected - likely would require chart audit	Chart audit / local data collection	Quarterly
Adverse events 30 / 90 days post discharge, including pressure sores; falls; infection; delirium	Safety	Important for measuring quality of care post-acute discharge	Could be calculated through data linkage to NACRS, CCRS, NCRS, HCD, potentially OHIP; would require definitions for adverse events	DAD NACRS CCRS NRS HCD OHIP	Quarterly
Readmission 30 / 90 days post-acute discharge	Safety	Important for measuring quality of care post-acute discharge	90-day readmissions reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
In-hospital mortality	Safety	Important for measuring acute care quality of care	Reported in *Hip Fracture Quality Scorecard*	DAD	Quarterly
Mortality 30 / 90 days / 1 year post-admission	Safety	Important for measuring quality of care post-acute discharge	Can be calculated by linking DAD with RPD	DAD RPDB	Quarterly
Physical and cognitive function at admission to rehabilitation	Access	Important for measuring access to rehab and understanding baseline function at admission to rehab	Available in NRS and CCRS (depending on rehab setting)	NRS CCRS	Quarterly
Physical and cognitive function at discharge from rehabilitation	Effectiveness	Important for measuring effectiveness of rehab	Available in NRS and CCRS (depending on rehab setting)	NRS CCRS	Quarterly

Recommended Measure	Domain	Rationale	Feasibility	Data Source	Reporting Frequency
Osteoporosis treatment started in rehabilitation	Effectiveness	Expert Panel recommends osteoporosis treatment; patient should receive in rehab if not in acute care	Not likely to be collected - likely would require chart audit	Chart audit / local data collection	As needed
Patient discharge destination from rehabilitation	Effectiveness	Important to understand post-rehab care and measure effectiveness of rehab in returning patients to pre-fracture living situation	Available in NRS (may require data linkage for validation and more comprehensive information)	NRS CCRS	Quarterly
Inpatient rehabilitation LOS	Efficiency	Expert Panel recommends a 28 day or less inpatient rehab length of stay	Available in NRS	NRS	Quarterly
Rehabilitation function gain per day (FIM efficiency)	Efficiency	Important for measuring efficiency/ effectiveness of rehab	Available in NRS	NRS	Quarterly
Compliance with rehabilitation care pathway	Quality / Efficiency / Acceptability	Measure of quality based on compliance with recommended practices	Some aspects of care path tracked through other recommended measures	Chart audit / local data collection	As needed
Patient satisfaction	Acceptability	Patient-reported measure of overall quality and effectiveness of care	Requires collection through patient questionnaire (sample of patients)	Patient questionnaire	As needed
Variance between discharge living situation and pre-fracture living situation	Effectiveness	Measure of overall effectiveness of care in returning patient to their pre-fracture level of function and independence	Can be calculated through linking pre- and post-admission data	DAD CCRS	Quarterly
Admission to LTC within 6 months (patients admitted from home)	Effectiveness	Measure of overall effectiveness of care in returning patient to their pre-fracture level of function and independence	Can be calculated through linking pre- and post-admission data	DAD CCRS	Quarterly
Osteoporosis treatment started post-inpatient	Effectiveness	Measure of whether patients fill prescriptions for osteoporosis treatment following inpatient stay	Can be calculated for patients age 65+ through ODB	DAD ODB	Quarterly
Refracture rate 1 year post-surgery	Effectiveness	Measure of longer-term effectiveness of care following patients' index fractures	Can be calculated by linking DAD records	DAD	Annually

Recommended Measure	Domain	Rationale	Feasibility	Data Source	Reporting Frequency
Patient-reported outcomes (function / pain improvement from pre-surgery)	Effectiveness	Important measures of patient outcomes	Will require collection through patient questionnaire	Patient questionnaire	Annually
Long-term patient function measure (e.g., 4 months post-discharge from rehabilitation)	Effectiveness	Measures whether patients retained gains in function from post-acute rehab	Field exists in the NRS; however, most Ontario hospitals do not currently submit data for this field	NRS	Annually

Abbreviations: ADL, activities of daily living; ALC, alternate level of care; CCHS, Canadian Community Health Survey; CCRS, Continuing Care Reporting System; DAD, Discharge Abstract Database; ED, emergency department; FIM, Functional Independence Measure; HAB, Health Analytics Branch; HCD, Home Care Database; LTC, long-term care; NACRS, National Ambulatory Care Reporting System; NRS, National Rehabilitation Reporting System; ODB, Ontario Drug Benefit database; OHIP, Ontario Health Insurance Plan; OR, operating room; RAI, Resident Assessment Instrument; RPDB, Registered Persons Database.

9. Implementation Considerations

As part of this Clinical Handbook, the Ministry of Health and Long-Term Care requested that high-level advice be provided about the challenges to and considerations regarding the implementation of the recommendations in this document. While by no means comprehensive, this section describes some crucial considerations for implementing the recommendations through local adoption, funding policy, capacity planning, and data collection.

Supporting Adoption of Recommended Practices

This document follows the standard Clinical Handbook template developed and issued by the Ministry for each Quality-Based Procedure (QBP) program area, with the primary purpose of compiling the specific types of information requested by the Ministry for informing the development of the QBP funding methodology for hip fracture (see the Preface for the list of specific deliverables tasked to HQO). While the evidence, analysis, and recommendations in this document can also support a variety of other mechanisms for system change beyond funding policy alone, such as the development of performance reporting systems and supporting on-the-ground quality improvement activities, the Clinical Handbook format is unlikely to be the most appropriate vehicle for all purposes and all audiences, particularly in supporting adoption of the recommended practices by hospitals and care providers.

To promote adoption of the recommended practices, more focused tools such as clinical pathways and best practice toolkits are likely to be appropriate. Such tools typically lay out the recommended practices in a more streamlined, easy-to-read format, without explicitly describing the supporting evidence. At the local level, hospitals can develop clinical pathways that adapt the recommendations contained here to their own local system protocols, care providers, and resources. Some of the previous pathways and toolkits developed by Bone and Joint Canada for orthopedic programs may provide a model for conducting this type of work.

It is also recognized that some sections of this Clinical Handbook will prove more useful to some audiences than others. For example, the recommendations in Section 5 ("Hip Fracture Cohort and Patient Stratification Approach") will be most useful for Ministry staff involved in development of the QBP funding methodology as well as decision support staff in hospitals involved in the production of data and analysis related to these populations, but they may not be particularly relevant for all front-line clinicians. Conversely, the recommended clinical practices described in Section 7 may be of interest to clinicians and program area staff, but perhaps not of as much interest to hospital finance managers.

Developing focused tools and supports would enable the information contained in this document to be channelled to the most relevant audiences in the most appropriate format.

Implications for Quality-Based Procedures Funding Policy

While the mandate of the Expert Panel excluded the development of pricing or payment methodology, the following section highlights some important considerations for the Ministry and other parties involved in translating the recommendations in this Clinical Handbook into the funding methodology for Quality-Based Procedures (QBP).

QBP funding should consider the scope of the entire hip fracture episode of care, including rehabilitation, post-acute care, and transfers: The episode of care for patients presenting to hospital with hip fracture spans several care settings, including the emergency department (ED), acute inpatient care and finally rehabilitation in an inpatient setting, the community, or some combination of both. The 90-day episode of care analysis of costs, utilization, and outcomes for patients with hip fracture residing in different Local Health Integration Networks (LHINs) shows the significant share of total episode costs attributable to post-acute care following the index hospitalization (see Appendix III). The same analysis also highlights wide regional variation seen in the use of different settings. For example, rates of patients discharged to inpatient rehabilitation following acute care ranges from 12.0% (North East LHIN) to 59.6% (Toronto Central LHIN) across residents of different LHINs. Similarly, the rate of hip fracture patients discharged from acute care to complex continuing care ranges from 2.4% (North East LHIN) to 23.6% (Waterloo Wellington LHIN).

Given the huge impact of post-acute care on both costs and outcomes of hip fracture patients, and the need for better coordination of care between providers in different settings, it would be inappropriate for any new funding model to focus on the acute care episode alone. QBP funding reforms for hip fracture care should include rehabilitation and community care, potentially as part of a single "bundled payment" for each case that promotes incentives for better coordination of care across multiple providers.

Finally, non-surgical hospitals that admit hip fracture cases and subsequently transfer these cases to other hospital corporations for surgery need to be considered differently within the funding model. It would be inappropriate for these hospitals to receive the same funding rate for hip fracture cases which may be transferred out in 1 or 2 days without surgery as hospitals that perform surgery.

QBP funding should incorporate the patient risk stratification approach recommended in this Clinical Handbook: The Expert Panel's analysis of factors that influence the cost and utilization of hip fracture patients has produced important recommendations around patient characteristics that influence the cost of care. The 3 patient subgroups recommended by the Expert Panel (Admit from Long-Term Care, Admit from Community—Healthy, Admit from the Community—Complex) should provide a starting point for considering the grouping of patients for pricing and funding, with the understanding that the "Complexity" stratification algorithm for patients admitted from the community is a working model that should be further tested and validated before being used for funding.

As the same analysis demonstrates, patient characteristics such as comorbidity level (e.g., through a Charlson Comorbidity Index score), age, sex, and fracture location are also highly influential on the expected resource utilization of hip fracture admissions and should be incorporated into the funding model. This may require some modifications to the Ministry's base Health-Based Allocation Model Inpatient Group (HIG) methodology, which (for example) does not adjust funding for comorbidities in all patient groups.

QBP funding should consider the implications of excluding cases with hip fracture not coded as most responsible diagnosis (MRDx): See the Expert Panel's considerations around the Ministry's proposed modified cohort definition in Section 5 ("Hip Fracture Cohort and Patient Stratification Approach") for further detail. It will be important that cases with hip fracture coded as either a pre-admit or post-admit comorbidity—accounting for a total of 1,055 cases (8.2% of the total cohort) in 2011/2012—do not become "orphan" patients that become cost drivers through their exclusion from the QBP funding policy.

QBP funding should consider the volume side of the funding equation: While the Expert Panel's recommendations centred around what constitutes high-quality care for an individual episode of care for hip fracture, under the Ministry direction that this would inform the definition and pricing of episode of care, the QBP policy is a "rate × volume" payment approach where the volume component is equally as important as the price. Hip fracture is a classic example of a "non-discretionary admission," where it is assumed that more or less every person that experiences a hip fracture should be hospitalized. This contrasts with some other QBP-targeted conditions such as chronic obstructive pulmonary disease (COPD), where admission practice may be somewhat discretionary and highly variable between hospitals. Hence, any concerns around QBP funding creating perverse incentives for increased rates of admissions are likely to be less relevant to hip fracture. However, hospital hip fracture volumes may vary considerably from year to year, and some surgical hospitals may receive a greater proportion of transferred cases from non-surgical hospitals. It is therefore imperative that the QBP funding model accommodate these shifts in volumes from year to year, and imposing a particular "target" volume for hip fractures on each hospital with no additional funding provided for cases in excess of this volume would likely be inappropriate.

Funding policy should consider the broader implications of QBP funding for hip fracture on non-QBP-funded orthopedic activity: With the implementation of QBP funding models for hip fracture and primary hip and knee replacement, approximately 40% of spending on provincial orthopedic acute care activity will be linked to QBPs. However, under the current QBP roll-out plan, the remaining 60% of orthopedic activity will continue to be globally budgeted and these cases will essentially be treated as "cost drivers." As most hospital orthopedic programs share the same staff, equipment, and overhead across different types of procedures, care must be taken to ensure that the partition of orthopedic programs into QBP- and non-QBP-funded activity does not create perverse impacts on patient care driven by financial considerations. For example, the cancellation or de-prioritization of non-QBP-funded orthopedic procedures in favour of those procedures that are linked to QBP revenue.

Implications for Local Capacity Planning

The need to consider implications of QBP funding for LHIN Orthopaedic Capacity Plans: Closely related to these considerations are the ongoing efforts of the LHINs to implement their Ministry-mandated Integrated Orthopaedic Capacity Plans. Each LHIN's plan outlines a multi-year strategy for provision of orthopedic services in the LHIN, which may include reallocation of procedure volumes across facilities and the consolidation of volumes for some procedures in particular "centres of excellence." With only 25% (moving to 40% with the implementation of hip fracture) of provincial orthopedic activity costs linked to provincial QBP prices and a standard funding methodology, LHINs and hospitals may struggle to implement their plans for the remaining 60% of orthopedic activity in the absence of a QBP funding methodology linked to these volumes.

Considerations for capacity planning in post-acute care: The episode of care analysis presented in Appendix III highlights the degree of regional variation seen in the types of post-acute care received by hip fracture patients residing in each LHIN. The Expert Panel interpreted much of this variation as being linked to existing physical capacity for each type of care in these regions of the province. For example, North East LHIN has relatively few inpatient rehabilitation or complex continuing care beds in comparison to other LHINs, and thus has among the lowest rates of hip fracture cases admitted to these settings following their acute care, with 59.4% of cases being discharged home.

This regional variation in capacities influenced the Expert Panel's decision not to make recommendations around fixed target proportions of hip fracture patients that should be discharged to each setting (e.g., inpatient rehabilitation, complex continuing care), because such targets would not likely be feasible in LHINs that have relatively small numbers of beds for these care types.

Further research is required to determine the optimal post-acute care settings for different subgroups of hip fracture patients based on their clinical characteristics. Results of this research could inform long-term capacity planning projections for beds in each setting. However, it is very unlikely that all LHINs could build the same level of capacity in inpatient settings that, for example, Toronto Central LHIN benefits from. Thus, future capacity planning for hip fracture patients needs to look pragmatically at how best to provide optimal rehabilitative care to these patients given current capacity restrictions and the need to share this capacity with other populations requiring rehabilitation, such as patients recovering from stroke.

The need for cooperation and coordination across LHINs, hospitals, Community Care Access Centres (CCACs), and other providers: Many of the recommendations contained in this document cannot be successfully implemented by a single hospital or orthopedic program acting in isolation. For example, the recommendation that hip fracture patients receive surgery within 48 hours requires hospitals to reconfigure their admission and operating room scheduling practices to support fast-tracking these patients within the hospital, and requires non-surgical hospitals to work with their LHIN and local surgical hospitals to ensure patients are transferred for surgery in a timely manner and repatriated to their home hospitals afterward. Recommendations around rehabilitation and post-acute care, in particular, require close coordination between acute hospitals, rehabilitation hospitals (where appropriate), CCACs and other providers to ensure that all patients undergo a timely transition from acute care to the most appropriate setting, without prolonging the patient's acute stay under an alternate level of care (ALC).

It is therefore recommended that this Clinical Handbook serve as the focus of discussion and system planning between LHINs, hospitals, CCACs, clinicians and other providers. High-quality care for patients with hip fracture can only be realized through a multidisciplinary, multi-provider approach to implementation.

Implications for health human resources: As the Expert Panel reviewed international guidance on hip fracture such as the SIGN guidelines, it quickly became clear that a number of recommendations in these guidelines were contingent on the availability of geriatricians and specialized orthogeriatric resources in hospital. The Expert Panel thus opted to take an approach to considering practice recommendations that was agnostic to the specialty of the care provider conducting the practice. However, the same concerns also factor into future capacity planning considerations for hip fracture: as the rate of incident hip fractures rises in the coming years with the aging population, a key challenge will be the shortage of specialized geriatric support to care for this complex elderly population.

Similarly, lack of access to primary care can have a significant negative impact on a patient's safe and effective recovery in the community following hospitalization for hip fracture. Patients in rural and northern communities with challenges in getting timely access to primary care are at particularly high risk

The need to align implementation of these recommendations with implementation of the Senior Friendly Hospital Strategy: Many of the recommendations contained in this Clinical Handbook relate to principles of good seniors' care such as delirium screening and ensuring care from staff with an interest in geriatrics. These recommendations are not specific to the hip fracture population but

cross all types of elderly patients; hence, implementation efforts for these recommendations should be aligned with the roll-out of the broader Senior Friend Hospital Strategy to ensure a common direction and reduce duplication.

Implications for Data Collection and Measurement

The need for improved hip fracture data collection and measurement infrastructure: As described in Section 5, current administrative datasets do not enable a full picture of the hip fracture population in terms of either the complexity of each patient (e.g., characteristics that are predictive of longer length of stay, increased cost or the need for institutional rehabilitation) or a longitudinal analysis of the care they receive (e.g., rehabilitation received in outpatient clinics). The highest priority issues in this respect are also likely the most feasible to address with practical solutions: mandating standardized reporting of outpatient rehabilitation clinic activity (including information on functional outcomes) and the development and reporting of a provincial hip fracture patient intake questionnaire.

Beyond these 2 issues, the Expert Panel also highlighted the need for the collection of consistent outcome data for hip fracture patients across the various post-acute care settings. Currently, patients are counted and measured differently depending on whether they receive their rehabilitation in inpatient rehabilitation, continuing care settings (either long-term care or complex continuing care) or community-based settings (either home care physiotherapy or outpatient clinics). This prohibits "apples to apples" comparisons of costs and outcomes for the same hip fracture populations to be made between settings, a particularly serious issue given the current wide regional variation seen in the use of different post-acute care settings, as shown in Appendix III.

Many of the recommended practices (Section 7) and their corresponding performance measures (Section 8) cannot be readily tracked in Ontario using current administrative datasets but instead require resource-intensive chart reviews. This lack of routine data collection will pose a significant challenge to the adoption of these best practices. Ontario may find a model here in the United Kingdom, where the National Hip Fracture Database (NHFD) collects enhanced clinical data such as surgery and implant information, type of anesthesia and patient characteristics such as ASA score. The NHFD has driven improvements in the quality of care for hip fracture across the United Kingdom through transparent performance reporting and comparison across hospitals and by supporting the development of the Hip Fracture Best Practice Tariff for England's Payment by Results hospital funding system (similar to the QBP).

Finally, in considering the implementation of the Hip Fracture Scorecard, a "perfect is the enemy of the good" principle should be adopted: there is a critical need to begin reporting on hip fracture performance measures across LHINs, hospitals, and CCACs as soon as the measures can be appropriately validated, regardless of their scope. Similar performance comparison and feedback through the Joint Replacement Quality Scorecard has driven impressive change in the delivery of primary hip and knee replacement in Ontario.

Expert Panel Membership

Name	Role	Organization
Chair		
Dr. James Waddell	Orthopedic Surgeon	St. Michael's Hospital
Orthopedic Surgery		
Dr. John P. Harrington	Orthopedic Surgeon	William Osler Health System
Dr. Mark Harrison	Orthopedic Surgeon	Queen's University
Dr. Hans J. Kreder	Professor, Orthopedic Surgery	University of Toronto
Dr. Allan Liew	Orthopedic Surgeon	Department of Surgery, University of Ottawa
Dr. Mark MacLeod	Orthopedic Surgeon	London Health Sciences Centre
Dr. Aaron Nauth	Orthopedic Surgeon	St. Michael's Hospital/University of Toronto
Dr. David Sanders	Orthopedic Surgeon	London Health Sciences Centre
Dr. Andrew Van Houwelingen	Orthopedic Surgeon	St. Thomas Elgin General Hospital
Anesthesiology		
Dr. Nick Lo	Staff Anesthesiologist	St. Michael's Hospital
Emergency Medicine		
Dr. Michael O'Connor	Emergency Medicine	Kingston General Hospital
Dr. Lisa Shepherd	Emergency Medicine	London Health Sciences Centre
Family Medicine		
Dr. Christopher Jyu	Physician Lead, Primary Healthcare	Central East LHIN
Geriatrics		
Dr. Anna Byszewski	Geriatrician	The Ottawa Hospital
Dr. Maria Zorzitto	Chief of Geriatric Medicine	St. Michael's Hospital
Physiotherapy		
Ruth Vallis	Physiotherapist	University Health Network
Rehabilitation		
Charissa Levy	Executive Director	GTA Rehab Network
Dr. Peter Nord	Vice President, Chief Medical Officer and Chief of Staff	Providence Healthcare
Research		
Dr. Susan Jaglal	Research Chair	Toronto Rehabilitation Institute, University of Toronto
Dr. Valerie Palda	Associate Professor, Department of Medicine and Institute of Health Policy, Management and Evaluation	University of Toronto
Administration		
Jane deLacy	Executive Director, Patient Services	William Osler Health System
Brenda Flaherty	Executive Vice President and Chief	Hamilton Health Sciences

	Operating Officer	
Jo-anne Marr	Executive Vice President and Chief Operating Officer	Mackenzie Health
Malcolm Moffat	Executive Vice President, Programs	Sunnybrook Health Sciences Centre
Kathy Sabo	Senior Vice President, Clinical Programs / Operations	University Health Network
Community Care Access Centres		
Patricia (Tricia) Khan	Senior Director, Client Services	Erie St. Clair Community Care Access Centre
Janet McMullan	Client Services Specialist	Ontario Association of Community Care Access Centres
Professional Organizations		
Ravi Jain	Director, Ontario Osteoporosis Strategy	Osteoporosis Canada
Rhona McGlasson	Executive Director	Bone and Joint Canada

Appendices

Appendix I: Rapid Review Methodology

Table A1 outlines the process and components comprising the Evidence Development and Standards Branch Rapid Review process.

Table A1: Rapid Review Methodology

Steps	Components
1. Develop research question	Develop PICOS in consultation with experts, end users, applicant, etc. Limited scoping of question (e.g., Blue Cross Blue Shield, AETNA, CIGNA) Determine study selection criteria (inclusion/exclusion) Determine a maximum of 2 outcomes to GRADE in step 5
2. Conduct literature search	5 years English MEDLINE, EMBASE, Cochrane, Centre for Reviews and Dissemination SRs, MAs, HTAs (establish in advance that these study designs exist for your topic. If not, request RCTs and guidelines as well)
3. Screen and select studies	Selection of SRs, MAs, HTAs Rate SRs with AMSTAR Retrieve primary studies from SRs, MAs, HTAs for step 4
4. Conduct data extraction and analysis[a]	Extract data on 2 outcomes from primary studies
5. Apply GRADE assessment outcomes[a]	GRADE maximum of 2 outcomes
6. Write up findings	Write findings using Rapid Review template

Abbreviations: AMSTAR, Assessing the Methodological Quality of Systematic Reviews; GRADE, Grades of Recommendation, Assessment, Development, and Evaluation; HTA, health technology assessment; MA, meta-analysis; PICOS, population, intervention, comparison, outcome, setting; RCT, randomized controlled trial; SR, systematic review.

[a]These steps are required if the identified SRs, MAs, and/or HTAs did not use GRADE to assess relevant outcomes.

Appendix II: Additional Predictive Factors Model Results

The following presents results for 2 additional models estimating the effect of patient characteristics on acute (non-alternate level of care) length of stay and mortality. See "Analysis of Factors Associated with Hip Fracture Patient Resource Utilization" for a description of the independent variables used for these models. Analysis completed by Andrew Tsegelsky, Saad Rais, and Kamil Malikov from the Ministry of Health and Long-Term Care, Health Analytics Branch.

The **acute length of stay** model is estimated using a generalized linear model, assuming negative binomial distribution, using the ln link function and applying effect coding to independent variables.

The **in-hospital mortality** model is estimated using logistic regression with profile likelihood to calculate confidence intervals

Table A2: Association of Patient Characteristics With Non-Alternate Level of Care Acute Inpatient Length of Stay, 2010/2011

Parameter	Category	Variable	% Change UCL	% Change LCL	% Change
AFTER_ADL_3	0	ADL After = 0	-0.1%	-10.2%	-5.3%
AFTER_ADL_3	1	ADL After = 1	-0.6%	-7.6%	-4.1%
AFTER_ADL_3	2	ADL After = 2	16.0%	4.6%	10.1%
AFTER_TRANS	0	Trans After = 0	-1.9%	-9.4%	-5.8%
AFTER_TRANS	1	Trans After = 1	10.4%	2.0%	6.1%
AGEGROUP	49	Age <= 49	-14.9%	-25.3%	-20.3%
AGEGROUP	64	49 < Age <= 64	-0.6%	-9.0%	-4.9%
AGEGROUP	74	64 < Age <=74	12.6%	4.5%	8.5%
AGEGROUP	75	Age >=75	25.2%	18.0%	21.6%
BEFORE_ADL_3	0	ADL Before = 0	33.8%	22.4%	28.0%
BEFORE_ADL_3	1	ADL Before = 1	-3.5%	-9.4%	-6.5%
BEFORE_ADL_3	2	ADL Before = 2	-11.9%	-20.7%	-16.4%
BEFORE_TRANS	0	Trans Before = 0	-2.4%	-9.8%	-6.2%
BEFORE_TRANS	1	Trans Before = 1	10.9%	2.4%	6.6%
Comorb_index	0	Comorbidity Index = 0	-31.7%	-36.7%	-34.2%
Comorb_index	1	Comorbidity Index = 1	7.1%	-1.5%	2.7%
Comorb_index	2	Comorbidity Index = 2	58.9%	38.0%	48.1%
Sex	F	Sex = F	-2.6%	-5.4%	-4.0%
Sex	M	Sex = M	5.7%	2.6%	4.2%
location_fracture	Head	Frac. Location = Head	-4.0%	-8.5%	-6.3%
location_fracture	Pert	Fracture Location = Pert	-1.2%	-6.0%	-3.6%
location_fracture	Subt	Fracture Location = Subt	15.3%	6.3%	10.7%
Intercept			**10.45**	**9.25**	**9.83**

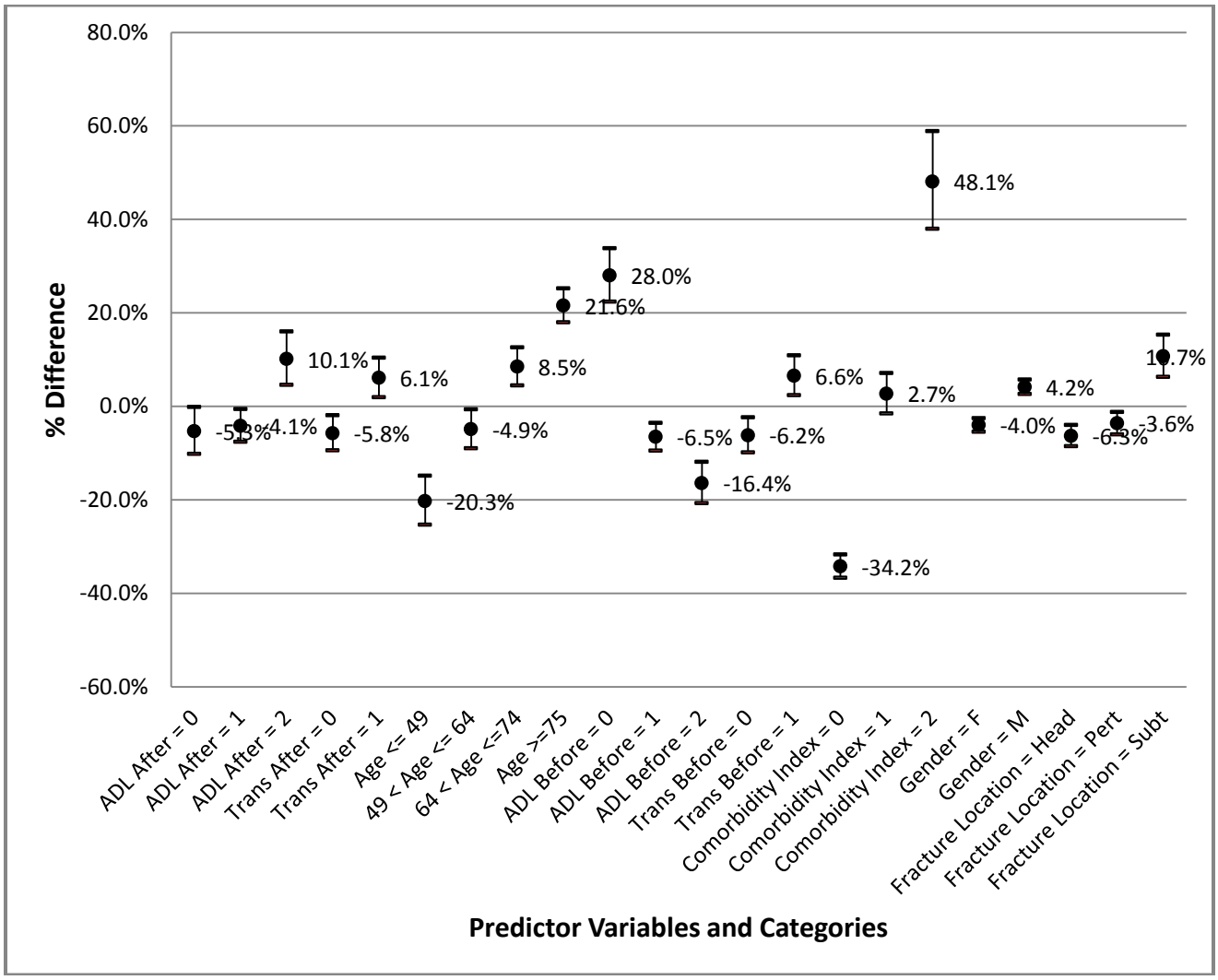

Figure A1: Association of Patient Characteristics and Non-ALC Acute Length of Stay

Table A3: Association of Patient Characteristics With In-hospital Mortality, Ontario, 2010/2011

Label	Variable	OR UCL	OR LCL	OR	Inverted
AGEGROUP 64 vs 75	Age 75+ vs 50-64	25.73	5.58	10.95	1
Comorb_index 0 vs 2	Comorbidity Index 2 vs 0	7.89	3.28	5.16	1
AFTER_ADL_3 0 vs 1	ADL After 0 vs 1	13.11	2.17	4.89	0
AFTER_TRANS 0 vs 1	Transfer After 0 vs 1	13.42	1.58	4.18	0
AFTER_ADL_3 1 vs 2	ADL After 2 vs 1	12.34	1.18	3.58	1
AGEGROUP 64 vs 74	Age 65-74 vs 50-64	8.20	1.55	3.32	1
AGEGROUP 74 vs 75	Age 75+ vs 65-74	4.78	2.36	3.30	1
Comorb_index 0 vs 1	Comorbidity Index 1 vs 0	3.49	2.38	2.89	1
Sex F vs M	Sex M vs F	2.60	1.84	2.19	1
Comorb_index 1 vs 2	Comorbidity Index 2 vs 1	2.78	1.12	1.79	1
location_fracture Head vs Subt	Fracture Subt vs Head	2.43	1.12	1.67	1
AFTER_ADL_3 0 vs 2	ADL After 0 vs 2	4.60	0.37	1.37	0
location_fracture Pert vs Subt	Fracture Subt vs Pert	1.96	1.11	1.35	1
location_fracture Head vs Pert	Fracture Pert vs Head	1.48	1.04	1.24	1
AGEGROUP 49 vs 64*	Age <49 vs 50-64				1
AGEGROUP 49 vs 74*	Age <49 vs 65-74				1
AGEGROUP 49 vs 75*	Age <49 vs 75+				1

Abbreviation: LCL, lower confidence limit; OR, odds ratio; UCL, upper confidence limit.

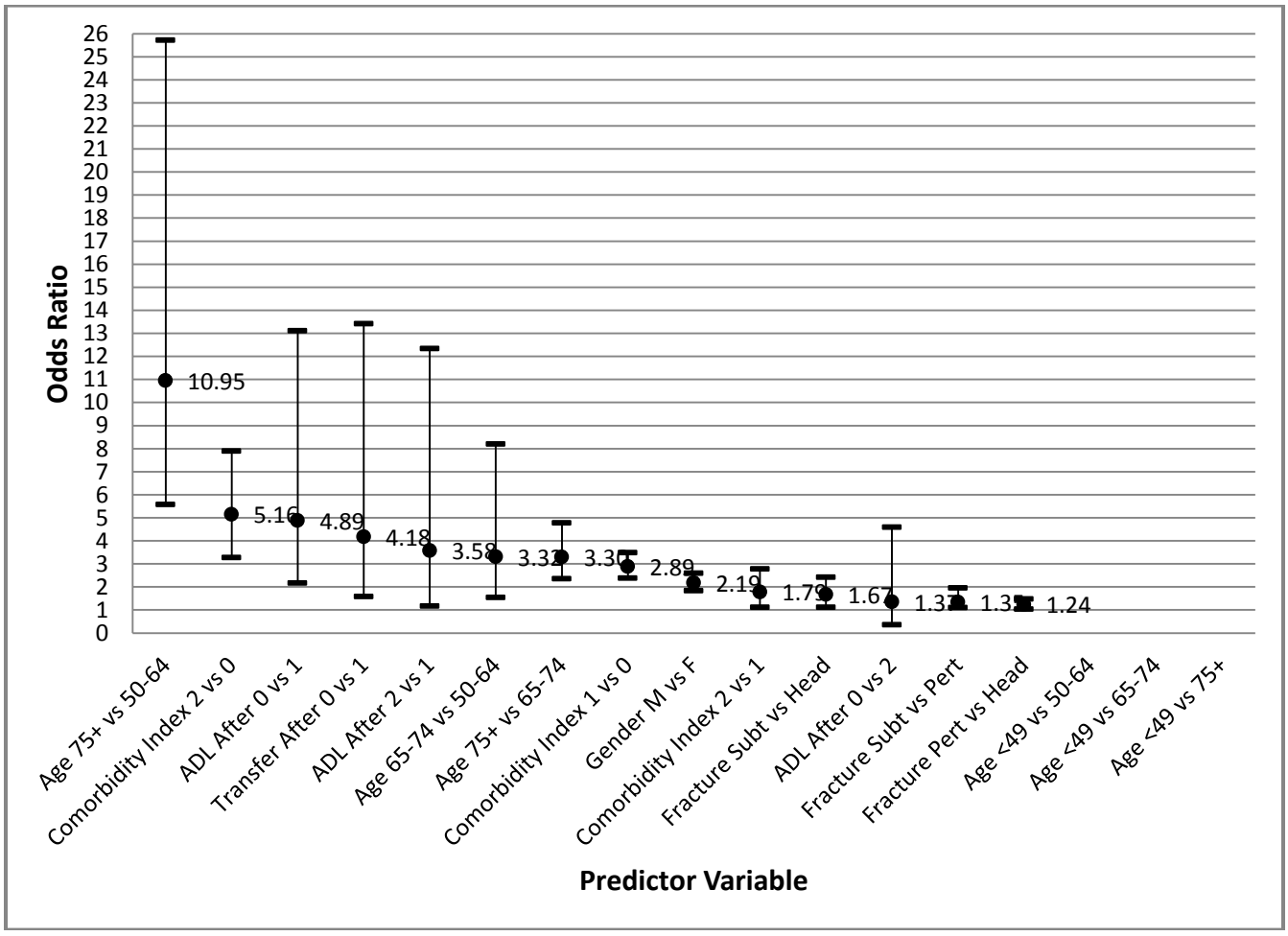

Figure A2: Association of Patient Characteristics and In-hospital Mortality

Appendix III: 90-Day Hip Fracture Episode, Analysis by LHIN of Patients' Residence

Table A4: Mean Costs and Utilization, 90-Day Episode of Care for Hip Fracture, 2007/2008–2008/2009

		Index Acute Hospitalization			Readmission Within 90 Days				ED Visits Within 90 Days		First Discharge Disposition					Cost of Post-Acute Care			
LHIN	90-Day Episode, Mean Total Cost ($)	Total, Mean Cost ($)	Hosp, Mean Cost ($)	Phys Fees, Mean ($)	% Re-admitted[a]	Total, Mean Cost ($)	Hosp, Mean Cost ($)	Phys Fees, Mean ($)	% With ED Visit[b]	ED, Mean Cost ($)	To CCC (%)	To IP Rehab (%)	To LTC (%)	To Home (%)	To Home With Home Care w/n 90 Days (%)[c]	CCC, Mean Cost ($)	IP Rehab, Mean Cost ($)	LTC, Mean Cost ($)	Home Care + Phys Fees, Mean Cost ($)
Ontario	**36,608**	**20,732**	**18,509**	**2,523**	**13.2**	**16,461**	**13,911**	**2,550**	**19.4**	**1,133**	**13.3**	**38.9**	**17.3**	**30.5**	**70.0**	**24,669**	**16,126**	**11,880**	**872**
Erie St. Clair	37,649	19,374	16,943	2,431	15.0	16,385	14,000	2,385	17.9	1,115	17.5	35.2	17.0	30.3	71.0	23,146	15,348	11,395	1,198
South West	34,433	22,197	19,852	2,345	13.4	14,839	12,839	2,000	18.8	1,157	12.5	25.7	16.7	45.1	72.0	19,403	16,196	11,096	955
Waterloo Wellington	36,575	19,275	17,024	2,251	10.3	15,908	13,649	2,259	18.0	841	23.6	22.7	18.5	35.2	83.0	35,180	14,278	12,351	793
HNHB	35,267	21,920	19,291	2,629	9.7	17,629	15,175	2,454	16.3	1,181	17.7	32.9	16.1	33.3	75.0	23,967	15,501	11,760	932
Central West	34,181	19,879	17,319	2,560	12.8	15,761	12,999	2,762	16.1	914	17.8	30.5	20.4	31.4	74.0	23,504	14,769	12,096	884
Mississauga Halton	37,808	18,883	16,249	2,634	15.1	16,653	13,952	2,701	19.4	1,092	11.2	54.4	13.7	20.6	77.0	21,018	17,532	12,677	1,023
Toronto Central	42,796	22,264	19,475	2,789	14.2	19,632	16,167	3,465	23.5	1,146	15.1	59.6	9.9	15.4	67.0	25,398	17,097	11,407	699
Central	37,132	18,596	15,854	2,742	15.0	16,375	13,253	3,122	19.3	1,356	10.3	56.3	15.5	17.9	66.0	24,164	16,197	12,311	806
Central East	36,621	18,765	16,319	2,446	13.9	14,851	12,486	2,365	19.0	992	7.5	53.5	19.1	19.9	76.0	22,972	16,796	13,144	983
South East	35,828	24,767	22,326	2,441	10.1	17,797	15,335	2,462	19.9	1,077	21.0	15.7	18.2	45.1	74.0	25,090	16,382	11,724	963
Champlain	35,983	23,402	20,934	2,468	12.7	16,668	14,042	2,626	20.0	1,084	7.8	35.2	22.0	35.0	52.0	22,082	14,826	11,474	725
North Simcoe Muskoka	34,946	20,954	18,494	2,460	14.1	13,626	11,553	2,073	20.8	1,269	15.8	22.2	24.6	37.4	70.0	23,746	14,690	10,097	758
North East	32,618	25,665	23,263	2,402	12.8	15,363	13,965	1,398	23.3	1,378	2.4	12.0	26.2	59.4	68.0	39,736	14,532	11,960	791
North West	36,452	19,377	17,404	1,973	17.9	17,986	16,104	1,882	22.8	945	22.3	21.8	13.1	42.8	65.0	31,601	14,863	11,464	546

Abbreviations: CCC, complex continuing care; ED, emergency department; HNHB, Hamilton Niagara Haldimand Brant; Hosp, hospital; IP Rehab, inpatient rehabilitation; LHIN, Local Health Integration Network; LTC, long-term care; Phys, physician;

[a] Percentage of patients readmitted within 90 days following index hospitalization.

[b] Percentage of patients with ED visits within 90 days following index hospitalization.

[c] Percentage of patients discharged home with home care services received within 90 days.

NOTES:

Patients discharged from acute care in 2007/2008–2008/2009 with most responsible diagnosis of hip fracture (ICD-10-CA codes S72.0*, S72.1*, S72.2*).

Follows all health care services received by patients in 90 days following index admission.

Includes only patients alive at the end of the 90-day period.

All costs and utilization attributed to LHIN of patient's residence, regardless of where they received treatment.

Index hospitalization includes preceding ED costs (if present) and transfers to other institutions.

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