An Alberta Health Services (AHS) and Bone and Joint Health Strategic Clinical Network (BJH SCN) and Seniors Strategic Clinical Network (Seniors SCN) Workshop

Optimizing the Post-Acute Continuum of Care Following a Hip Fracture

A knowledge synthesis of clinical research interventions for post-acute care of hip fracture initiated within 14 days of surgical repair: A White Paper

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Executive Summary

Care of patients with hip fracture (HF) is a topic of significant importance. . Patients with HF experience high levels of continuing disability and mortality, leading some patients to refer to the break as a 'death sentence'. The gaps in care during transition from hospitals to post-acute care also has negative consequences on patients. Recommendations for clinical application of post-acute care strategies in Alberta are currently still in need of additional clarity and direction.

To address these challenges, the Alberta Health Services (AHS) Bone and Joint Health Strategic Clinical Network (BJH SCN), in partnership with the Seniors Health Strategic Clinical Network (SH SCN), hosted the Workshop "Optimizing the Post-acute Continuum of Care Following a Hip Fracture," which engaged a range of stakeholders to discuss current evidence and gaps in knowledge and treatment interventions.

Our goal: to contribute to the development of effective rehabilitation care strategies. The Workshop presentations and discussions resulted in the development of recommendations to inform practice, research, and/or policy.

This white paper provided the background and overview of the current research evidence regarding post-acute care strategies and interventions after surgery for people with HF. Broadly, results from this review and conclusions from recent systematic reviews suggest that personalized, intensive rehabilitation and/or exercise in conjunction with multi-disciplinary teams appear most effective in creating positive patient outcomes. The Workshop discussions involved a variety of stakeholders including healthcare professionals, researchers, and patients.

Future directions:

- Providing flexibility in patient pathways that would improve patient outcomes in distinct populations, such as those with cognitive impairment, and in locations with varying available resources.
- Creation of education and resources for both patients and healthcare providers that is accessible, relevant, and current has been emphasized.
- Recognition that this is shared responsibility among researchers, clinicians, and policy makers, with patients at the centre of the movement.

Introduction

Hip fractures are associated with long-term rehabilitation and high mortality (Ponten et al., 2015). Between 30% and 50% of patients do not return to their pre-fracture function level within two years, 10% to 20% are institutionalized following fracture, and up to 10% of patients die within one month after fracture (Dyer et al., 2016; Halbert et al., 2007; Pitzul et al., 2016). In Alberta, 3.3% of HF patients are readmitted within 30 days post-fracture (Alberta Bone and Joint Health Institute, 2018). In addition to these challenges, hip fractures are the most expensive fracture to the healthcare system, with over $600 million dollars in acute care costs in Canada in 2010 (Osteoporosis Canada, 2013). HF cost Alberta more than $25 million each year in acute care costs (Alberta Bone and Joint Health Institute, 2018). Estimates of the health cost per person in the first year after HF is between $36,927 and $39,479 (Schiller et al., 2015). However, with the post-acute complications and requirements for rehabilitation, estimated costs to the Canadian system are well over $1.1 billion per year (Pitzul et al., 2016). Over the 2017/2018 year, there were 2,843 hip fractures in Alberta (Alberta Bone and Joint Health Institute, 2018). By 2020, it's estimated 3,000 hip fractures per year will occur in Alberta, at a cost of $62 million in acute care to the province (Osteoporosis Canada, 2018b).

The majority of hip fractures occur in older people with osteoporosis after a fall from standing height or less (Beaupre et al., 2013). Seventy-two percent of HF patients in Alberta are over 72 years of age. A break caused by low-energy trauma, such as a fall from standing, is termed a fragility fracture (*Hip Fracture: Care for People with Fragility Fracture*, 2017). A 2009 Statistics Canada survey reported 31.1% of women and 6.4% of men age 70 and over have been diagnosed with osteoporosis, increasing their risk for fragility fractures (Statistics Canada, 2016). By 2036, more than 9.9 million people in Canada will be 65 years and older, dramatically increasing the demographic prone to HF (Statistics Canada, 2016).

Much of the current research to improve patient recovery after HF has focused on acute care, such as time to surgery and early mobilization (Beaupre et al., under review). However, attention is turning toward the link between HF and long term disability. It is now understood that recovery after HF extends well beyond the patient's time in acute hospital care.

The definition of post-acute care differs across the literature, across countries, and even across Canadian provinces, preventing the establishment of a description that is accepted across various platforms (Sutherland & Repin, 2014). Broadly, post-acute care has been defined as "continuing care," delivered by different strategies in locations ranging from inpatient rehabilitation wards, long-term care facilities, supportive or assisted living settings, community centres, and patients' home (Sutherland & Repin, 2014). Generally, these services are distributed under a mix of private and public funding (Sutherland & Repin, 2014). Post-acute care can be initiated in the surgical hospital, with regard to discharge preparation and planning, but the bulk of treatment is completed outside the acute care setting. Generally, the goal of post-acute care is to prevent further loss of function, promote functional abilities including endurance and strength, increase tolerance of physical activity, and maximize independence (*Rehabilitative Care Best Practices for Patients with Hip Fracture*, Revised September 2018).

Optimizing HF treatment can mean different things to different stakeholder groups. Researchers seek to understand what factors and interventions can contribute to patient improvement after surgery. Clinicians want to understand what strategies they can implement or prescribe to optimize patients' recovery. Patients desire to live independent and healthy lives after hip fracture. Governments have a vested interest in supporting research and the implementation of care pathways that use constrained health resources appropriately and efficiently. Therefore, a key question is how to address the needs of multiple stakeholders, define responsibilities for each stakeholder group, and determine effective and appropriate post-acute pathways for people with HF.

The Problem

The long term consequences of HF require care that extends after patients leave the surgical hospital. To address patient needs after discharge, appropriate support is required during the post-acute period to optimize recovery. In this paper, we are focused on post-acute care that begins within 14 days post-HF surgery. This timeframe is of particular importance as it encompasses the often fragmented period in the continuum of care when patients transition out of the acute care setting and into the community. Research indicates that active rehabilitation during the post-acute period after HF is critical to patient recovery (Beaupre et al., 2013; Seitz et al., 2016). However, a clear standard for the types of support(s) or intervention(s) has not been defined. There are a diversity of strategies currently being used in practice and investigated in research. There is also growing increasing awareness that the transition from acute care settings has a negative impact on the post-HF surgery recovery. There is a critical need to optimize care pathways to meet the demands and needs of patients, clinicians, and health policy makers within our fiscally constrained healthcare system.

Purpose of the Workshop

To address these challenges, the purpose of the AHS BJH and Seniors SCN Workshop on Optimizing the Post-acute Continuum of Care Following a Hip Fracture was to engage a range of stakeholders in an evidence-based discussion. The focus was on generating ideas on how to optimize care outside of the acute surgical hospital and practice, research, and/or policy. Using knowledgeable speakers and breakout session activities to engage participants, the Workshop sought to identify the support needed to develop care pathways for patients with HF to optimize recovery while balancing patient needs with system resources.

A key goal of the Workshop was to initiate the further development and implementation of care pathways. In addition, the workshop identified important outcome measures, including patient and clinician satisfaction, and developed research questions for future investigations. The objectives for the Workshop were to:

(1) Develop a common understanding for the current state of science and best evidence for early HF care

(2) Discuss barriers that exist to implementation of these best practices in HF care

(3) Begin the process of implementation planning to bring best practices to HF patients

(4) Revise the white paper to reflect the Workshop input before publication on the SCN website

We expect to expand on the work of the Workshop following the event. The Workshop is the beginning, not the conclusion, of the further development of post-acute pathways.

Purpose of this White Paper

This white paper provided the background and overview of the current knowledge on early post-acute care of hip fracture to enable an evidence-based foundation for discussion at the AHS BJH and Seniors SCN Hip Fracture Workshop. Previous systematic reviews have examined evidence on rehabilitation interventions after HF (Auais, Eilayyan, & Mayo, 2012; Crotty et al., 2010; Diong, Allen, & Sherrington, 2015; Handoll, Sherrington, & Mak, 2011). To our knowledge, this is the first work only to include interventions initiated within 14 days after surgery, while in transition from acute surgical ward care to post-acute care. This review provides the reader an overview of the current knowledge on the range of rehabilitation strategies during this timeframe.

Background

Types of Hip Fracture

Hip fractures are defined as those that occur at the proximal femur. There are two main types of fractures: intracapsular (within the joint capsule) and extracapsular (outside the joint capsule) fractures (Handoll et al., 2011). Extracapsular fractures primarily present as intertrochanteric or subtrochantric fractures (Handoll et al., 2011).

Acute Management of Hip Fracture

Although this paper focuses on post-acute care of HF, pre-operative management, in particular time to surgery after fracture, has great implications on patient outcomes in the following months. Hip fractures require surgical stabilization in order to achieve proper alignment for healing. For example, a retrospective cohort study of more than 40,000 patients with HF in 72 Ontario hospitals found risk for complications increases when time to surgery exceeded 24 hours (Pincus et al., 2017). In addition, patients who received surgery after 24 hours had increased risk of 30-day mortality (ibid). In post-operative care, there is increased focus on mobilizing patients early after surgery (within 24 hours) to reduce the incidence of

pressure ulcers, delirium, and muscle weakness (Beaupre et al., 2013). Patients are encouraged to be weight-bearing as soon as tolerated (Beaupre, 2005).

Surgical approaches can include internal fixation, which usually incorporates operative pinning and the use of plates, dynamic hip screws, cephalomedullary nails, or complete or hemi-arthroplasty (Handoll et al., 2011) Previous studies have indicated lower complications and revision rates for total hip arthroplasty; however dislocation can occur, and the procedure does not allow patients to retain their original bone structure (Carpintero et al., 2014). Internal fixation retains the original femoral head, and is a less invasive surgery with decreased blood loss and less risk of infection than arthroplasty. (Carpintero et al., 2014). However, the procedure has increased risk of surgical complications such as non-union and misalignment of the fracture (Carpintero et al., 2014). The goals of the surgeon, such as alignment of bone fragments and stability of the fixation, guide the management of the patients in the acute phase of rehabilitation (Handoll et al., 2011). Research to improve patient outcomes after HF has primarily focused on optimizing these surgical techniques, and has evaluated acute care strategies such as time to surgery or early mobilization after surgery (Beaupre et al., 2005; Beaupre et al., under review).

Post-Acute Rehabilitation Pathways

HF rehabilitation is aimed at preventing progression of disability and restoring patients to pre-fracture function (Röder et al., 2003). The Rehabilitative Care Alliance has published criteria to aid in determining if a patient is ready to progress to post-acute care after HF, and what type of care setting would be most appropriate (*Rehabilitative Care Best Practices for Patients with Hip Fracture*, Revised September 2018). This includes consideration of the patient's "restorative potential" or the ability of the patient to undergo functional improvements and benefit from rehabilitative care (ibid). In addition, the care setting must have the necessary resources to safely manage the patient's medical prognosis and comorbidities (ibid).

Several studies have highlighted the diversity in post- acute care pathways that exist in Canada (Beaupre et al., under review; Pitzul et al., 2016; Seitz et al., 2016). Patients with HF receive different levels of care depending on their province, their health region, and even individual characteristics such as mental status and living situation.

Beaupre et al. tracked the pathways of more than 100,000 previously community-dwelling patients with HF over the age of 65 after discharge from Canadian provincial hospitals, excluding Quebec (Beaupre et al., under review). Discharge destination from the surgical hospital was categorized as rehabilitation, home, acute care, continuing care, and other (ibid). Overall in Canada, 22.5% of patients with HF were discharged to rehabilitation and 31.6% were discharged home (which could entail receiving outpatient rehabilitation) (ibid). Of the remaining patients, 27% went to another setting for acute inpatient care, 18.2% received continuing care at another facility, and 0.8% were characterized as other (palliative care or hospice, signed out against medical advice, or did not return to hospital after discharge from a day pass) (ibid). In Alberta, the majority of patients with HF (58.2%) were discharged to other acute inpatient care settings (ibid).

Beaupre et al. uncovered vast differences between provinces in the proportion of patients discharged from the surgical hospital to rehabilitation (Beaupre et al., under review). In Ontario, 41.0% of individuals recovering from HF were discharged to rehabilitation facilities, while in British Columbia that fell to 2.4% (ibid). In Alberta, 3.5% of patients were discharged to rehabilitation settings (ibid). Compared to Ontario, all provinces discharged significantly fewer patients to rehabilitation (ibid). These variations existed even after the authors standardized for patient case characteristics (e.g. age, sex, comorbidity, fracture types etc.) and teaching versus community hospitals (ibid).

Despite leading the country in sending patients to rehabilitation after HF, Ontario has significant variability regarding post-acute discharge pathways, according to two Ontario studies published in 2016 (Pitzul et al., 2016; Seitz et al., 2016). The study by Pitzul et al. evaluated the discharge destination for community-dwelling patients over 66 years old recovering from HF in Ontario between April 2008 and March 2013 (Pitzul et al., 2016). Despite the fact that the baseline characteristics of the population were consistent, the authors found 49 unique post-acute pathways for 33,349 patients (ibid). These pathways were operationalized by the authors into four post-acute destinations: (1) long-term care facilities, (2) complex continuing care facilities for rehabilitation over 30 days or for patients with complicated comorbidities, (3) inpatient rehabilitation facilities for stays of less than 30 days, and (4) home care or community which may include home-based rehabilitation (ibid).

There was significant variation among health regions in the post-acute discharge destinations (ibid). Four health regions characterized by high proportions of inpatient rehabilitation facilities, discharged between 57.9% and 60.4% of their patients to inpatient rehabilitation facilities within seven days post- surgery (ibid). In those four regions, 27.7% of inpatient rehabilitation patients went into community-based rehabilitation programs after discharge (ibid). In the remaining 10 health regions (those with low proportions of inpatient rehabilitation facilities), the most common pathway (32.1% of patients) was immediate discharge to the community and then community-based rehabilitation (ibid).

Access to rehabilitation within Canada is in stark contrast to the delivery of rehabilitation in the United States (US), studies show.. In the US, 90% of patients with HF are discharged to post-acute care after an average of six days in hospital (Leland et al., 2018). The majority of patients are discharged to a skilled nursing facility (SNF) (64%), while other patients were admitted to inpatient rehabilitation facilities (IRF) (26%) or went home (10%). Of those that returned home, 65% used formal home healthcare services (Harada et al., 2000). IRF's are mandated to provide a minimum of three hours of combined physiotherapy and occupational therapy per day (Munin et al., 2005b). These facilities also coordinate daily care through a multidisciplinary team of nurses and physicians (ibid). SNFs are not required to provide specific intensities or types of therapy programs, and weekend therapy is usually not included in care (Ganz et al., 2007; Munin et al., 2005b). Ratios of staff to patients are lower, therefore patients have less contact with nurses and physicians (ibid).

Barriers to Return to Pre-Fracture Function

Several factors have been linked to delayed recovery or mortality after HF. Very simply, advanced age has been linked to an exponential rise in HF incidence, as well as increased mortality and morbidity after HF surgery (Pitzul et al., 2016). In a 2009 study by McGilton et al., four predictors were identified that were significantly associated with negative longitudinal outcomes were pre-fracture functional impairment, high pain rating at discharge, cognitive impairment at discharge, and gait aid use at discharge (McGilton et al., 2009). There is conclusive evidence that patients' health at time of the fracture has an impact on recovery (Pitzul et al., 2016). Those limited in their daily activities or ability to walk are more likely to experience increased functional loss in the first year after HF than those that were functionally independent (Beaupre et al., 2013). Comorbid conditions such as chronic obstructive pulmonary disease, cardiovascular disease, heart failure, and malignancy have been linked to increased mortality and decreased walking ability in the months and years after HF (Beaupre et al., 2013; Menzies, 2012; Smith, Smith, & Stanton, 2015). Patients in long-term residential care are also at high risk for poor outcomes (Dyer et al., 2016).

It is important to note that the patient's sex plays a role in HF recovery and associated healthcare costs. Hip fractures in males are associated with higher costs and higher mortality rates (Mizrahi et al., 2014; Sale et al., 2016). The reason for this sex discrepancy requires more research to fully elucidate, but may be linked to men's lack of awareness and acceptance of bone health and preventative health behaviours (ibid). A 2013 study from Israel reported that after identical acute and post-acute care of HF, males had lower functional outcomes than females (Mizrahi et al., 2014). This conclusion remained even after adjusting for the higher presence of comorbidities in the male patients, and cognitive status (ibid).

Deficient nutritional status, in particular insufficient energy and protein intake, is associated with delayed functional recovery after HF (Avenell, 2010; de Bustamante et al., 2018). Older adults who experience hip fractures are at increased risk of being malnourished at time of HF or becoming malnourished after the event (Avenell, 2010). A 2017 Spanish study that evaluated 509 patients with HF at hospital admission found 20.1% had a body mass index indicating energy malnutrition, 81.2% had a protein deficiency, and 17.1% had both conditions (de Bustamante et al., 2018). Vitamin D deficiency was seen in 93% of patients (ibid). In addition, previous studies have shown that dietary intake in individuals with HF while in hospital is sub-optimal, predominantly lacking in sufficient protein intake (Avenell, 2010).

Osteoporosis is a critical factor impacting the occurrence of HFs (Osteoporosis Canada, 2018b). In women, the majority of HFs result from a fall from standing height or less due to the presence of osteoporosis. Osteoporosis has been estimated to be present in 70% to 90% of HF annually (Osteoporosis Canada, 2018b). Osteoporosis occurs when bone loss or lack of bone synthesis decreases bone density and weakens the structure of bone (Osteoporosis Canada, 2018b). Risk factors include lack of exercise, genetics, calcium deficiency, lack of vitamin D, smoking, and low body weight (Osteoporosis Canada, 2018b). After menopause, women are at increased risk for osteoporosis due to decreased estrogen levels (Osteoporosis Canada, 2018b). However, men also can experience low bone density, and are often overlooked in screening and prevention protocols due to the ongoing stereotype that osteoporosis is a

'women's disease' (Sale et al., 2016). Approximately 90% of Canadian men who suffered a fragility fracture were not treated with pharmacotherapy for osteoporosis, and 81% of men over 65 were not screened (ibid). A 2016 study from Toronto found that after a fragility fracture, men did not show a good understanding of osteoporosis and continued to engage in behavior that put them at risk for falls, sometimes blatantly disregarding their healthcare professionals' bone health recommendations (ibid).

Patients' expectations and misconceptions about the road to recovery after HF can be a barrier to returning to post-fracture abilities (Sims-Gould et al., 2017). A 2017 study in British Columbia interviewed patients recovering from HF and found they fell into two groups: those who resumed pre-fracture activities, or adapted versions of their pre-fracture abilities, and those who felt they would never recover their pre-fracture functional abilities (Sims-Gould et al., 2017). Sims-Gould et al. described the misconceptions many patients had regarding the road to recovery (ibid). In their analysis, 62% of patients with HF found the recovery experience was not what they expected, citing the length of time required to recover and post-operative complications as the most unexpected factors of rehabilitation (ibid). Most participants expected to have returned to their pre-fracture levels of activity after six months (ibid). Common psychological reasons for avoiding mobility or rehabilitation exercises include fear of falling and fear of pain (Milte et al., 2013; Sims-Gould et al., 2017). In addition, patients felt uncertain about which movements were safe to perform (Sims-Gould et al., 2017). Participants who were highly engaged in physical activity six months post-fracture emphasized keeping a positive attitude to persevere through pain and slow progress (Sims-Gould et al., 2017). However, a number of the patients interviewed expressed frustration and apathy at their recovery process; they felt blindsided about how hard it was to regain their former abilities (ibid).

Cognitive Impairment in Patients with Hip Fracture

In the 2011 National Hip fracture Toolkit, Bone and Joint Canada identified "three Ds" in HF care: dementia, delirium, and depression (Bone and Joint Decade Canada, 2011). Post-operative delirium, a reversible state of confused cognition, has been reported in 16% to 62% of individuals with HF (Kyziridis, 2006). Alberta uses the Confusion Assessment Method (CAM) to screen and diagnose delirium. Adults with dementia are estimated to be three times more likely to experience hip fracture than age and sex matched controls (Kyziridis, 2006; Seitz et al., 2016). Depression occurs in 10-30% of older persons in hospital (Bone and Joint Decade Canada, 2011). All three Ds are commonly under-diagnosed or misdiagnosed, and are associated with poor functional outcomes after HF (Bone and Joint Decade Canada, 2011).

Patients with mild to moderate depressive symptoms were more likely to have mobility limitations, be institutionalized, or die within a year after HF (Beaupre et al., 2013). However, in a US study those with depression had significantly improved functional outcomes after intensive rehabilitation at an inpatient rehabilitation facility compared with those admitted to a skilled nursing facility (Lenze et al., 2007).

Often patients with dementia have poor access to rehabilitation either as inpatients or in the community (Seitz et al., 2016) Seitz et al. evaluated the post-acute pathways after HF for

previously community-dwelling patients with dementia in Ontario (Seitz et al., 2016). They named three possible rehabilitation pathways: (1) complex continuing care, which could include long-term care facilities, (2) inpatient rehabilitation, and (3) home care rehabilitation (ibid). After analyzing 11,200 individuals with HF who were diagnosed with dementia, they found 40.1% did not receive any rehabilitation, 22.1% were discharged to complex continuing care, 10.3% were set up with home care, and 27.4% received inpatient rehabilitation services (ibid). The patients who received no rehabilitation were predominately made up of older male patients (ibid). Individuals admitted into inpatient care had slighter more comorbidities or had received surgery at an academic or teaching hospital (ibid). Surgery at a non-teaching urban hospital was most commonly associated with discharge to complex continuing care, while surgery in a rural hospital was associated with home care rehabilitation (ibid).

Seitz et al. found that if a patient received any type rehabilitation, they had lower risk of mortality than if they did not complete a rehabilitation program (Seitz et al., 2016). Mortality at one year for patients who did not complete rehabilitation was 64.4% (ibid). This dropped to 55.7% for those in complex continuing care, 13.1% for inpatient care, and 14.6% for home care rehabilitation (ibid). Unfortunately, physiotherapists often reported feeling pressured to meet the guidelines and targets of regular treatment that can be inappropriate for these patients (ibid).

Overall, the study concluded that access to rehabilitation services is critical for older adults with dementia after HF and that rehabilitation can have substantial benefits for this group (Seitz et al., 2016). It is important to recall that they found almost half (40%) of these patients did not receive post-acute rehabilitative care (ibid). This points to a need to increase the accessibility and delivery of these services (ibid).

The results from this study were consistent with three systematic reviews that found individuals with HF and cognitive impairment can experience comparable gains in optimal outcomes after rehabilitation programs compared to patients without cognitive impairment (Beaupre et al., 2013; Resnick et al., 2016). Adaptations and individual tailoring of rehabilitation programs to accommodate those with cognitive impairment will continue to be an important piece of rehabilitation program as an older population will include increasing numbers of people with cognitive impairment (CI) (Seitz et al., 2016).

In another study worth noting, McGilton and her team investigated the contribution of cognitive impairment and pre-fracture functional impairment as predictors of functional status and mobility six months after discharge from rehabilitation for older adults with HF (McGilton et al., 2016). While CI and pre-functional impairment each contribute to poor outcomes, pre-functional impairment was more strongly associated with poor outcomes than CI. There is evidence to show that those with CI are able to regain their mobility. This suggests a need for post-discharge targeted interventions that include a focus on activities of daily living (ADLs) for older adults with CI and functional impairment to stabilize gains from inpatient rehabilitation. Importantly, this study also noted that personal and professional bias can be barriers to the rehabilitation of those with CI.

Knowledge Synthesis

Search

We conducted a review of the published literature with the objective of generating a knowledge synthesis on what current evidence exists for post-acute care of HF that begins within 14 days after surgical repair. A secondary objective of the search was to define the location, type, frequency, duration, and intensity of post-acute strategies that generated statistically significant positive outcomes in patients after hip fracture when compared to a control group. The systematic search focused on all articles published from database inception until May 2018. A wide timeframe was used to ensure that all studies within in the limited post-acute period were captured. Studies were included if the post-acute care strategy was initiated within 14 days of surgical repair of HF, and if the full text, English language study could be obtained. It should be noted that this review excluded studies where the post-acute strategy was not clearly defined, and those that focused exclusively on rehabilitation after total hip arthroplasty. Methods used in generating the knowledge synthesis are described in further detail in **Appendix 1**.

The search resulted in 49 studies that met our inclusion criteria. The studies were published between 1984 and 2018. Data extracted from the studies included author(s), year and location of publication, participant inclusion criteria, location of post-acute strategy (e.g., home, inpatient rehabilitation centre or ward, community, or nursing home), participant average age and percentage of female participants, follow-up time points, strategy description, control description (if applicable), outcomes, and results. A complete list of the studies, including data extraction results can be seen in Supplementary Document S1. Twenty-four of the investigations were randomized controlled trials (RCTs), 16 were prospective cohort studies, two were pilot studies, and two were retrospective cohort studies. The remaining studies were a pilot RCT, a retrospective chart review, a quasi-experimental study, and two publications that analyzed different results from one original RCT. The investigations were authored by research groups in Israel, the US, Ireland, Hong Kong, Sweden, Italy, Finland, the United Kingdom (UK), Australia, Denmark, Scotland, Spain, Switzerland, Taiwan, the Netherlands, Germany and Singapore. Four studies were conducted in Canada: one from British Columbia (Langford et al., 2015) and three from Toronto (McGilton et al., 2013; McGilton et al., 2009; Naglie et al., 2002).

In general, the study populations usually consisted of female participants without cognitive impairment, over the age of 65 and living in the community before HF. Only one study specifically recruited participants that had been living in nursing homes (Gregersen et al., 2011). All studies excluded those with multiple fractures, pathological hip fractures, or serious comorbidities or complications.

Outcomes used to assess patient status or effectiveness of the strategy were grouped into 31 different categories. The most common measures were used to assess physical function or functional performance (e.g. Instrumental Activities of Daily Living (IADL) and modified Barthel's Index (BI)). Please note, some of the outcomes could fit into more than one of the groups depending on the research objectives.

The diversity in study design prevented a quantitative analysis of the results from these individual studies. To conduct the knowledge synthesis, first the studies were sorted into the location(s) of the post-acute strategy, in order to create an overview of the types of therapy offered in that location. In an effort to determine specifics regarding the types of strategies that led to favourable patient results, studies that evaluated components of care against a control condition were examined to determine which elements led to statistically significant positive outcomes.

The studies implemented post-acute strategies in six settings:

1. Home (17 studies)
2. Care initiated at an acute hospital and continued home (four studies)
3. Inpatient rehabilitation unit (18 studies)
4. Care initiated as inpatient rehabilitation and continued at home (seven studies)
5. Nursing Home (two studies)
6. Community Care (one study)

The process of categorizing the components of the post-acute care strategies evaluated in each of the studies was more complex. Recently there have been efforts to define the components of care that should be included in an post-acute HF rehabilitation program, regardless of the patient's discharge location (BJHSCN, 2015; *Rehabilitative Care Best Practices for Patients with Hip Fracture*, Revised September 2018). Two notable resources are the Alberta Hip Fracture Restorative Care Pathway and the Rehabilitation Care Alliance Rehabilitative Care Best Practices for Patients with Hip Fracture developed by Health Quality Ontario (ibid). In this white paper review, the components of care included in the literature were identified and defined in a way that would most accurately capture the information as it was reported in the studies. The components of post-acute rehabilitative care that were common across post-acute strategies included in this knowledge synthesis were:

a. Multidisciplinary teams
b. Physiotherapy (PT)/occupational therapy (OT) programs
c. Progressive strengthening exercise programs
d. Motivation/goal setting
e. Patient education programs
f. Nutritional programs consultation
g. Consideration of patient caregiver status
h. Screening for management of cognitive impairment
i. Pain management programs
j. Discharge planning
k. Secondary prevention programs

Definitions used to classify the rehabilitation strategies as they appeared in the literature, within the context of this knowledge synthesis are presented in **Appendix 2.**

The elements of care in each study, as well as study location and significant positive outcomes are presented in **Appendix 3.**

The most common care components included in the trials were a PT/OT program (45/49) and patient care by a multidisciplinary team (30/49). This was followed by motivational/goal setting techniques (13/49) and discharge planning (15/49). Nutrition consultation or programs and screening for management of CI appeared 13 times across the studies, and consideration for patient caregiver status 10 times across the studies. Six studies had progressive strengthening exercise programs, six had pain management programs, and five had patient education programs.

Below are the results from the studies are grouped by location.

Home

Seventeen studies were conducted in patients' homes. The most common component of post-acute care incorporated into the trials were PT/OT programs (15/17). The supervised PT/OT sessions ranged from one time per day to once biweekly, for approximately 45 minutes to one hour (Jarnlo, 1984; Lamb et al., 2002; Peng et al., 2016). Most studies stated they recommended patients perform the exercises at least once a day, regardless of supervision. Therapy sessions typically tapered in frequency over the length of the study. Rehabilitation programs consisted of training for functional activities (e.g., stair climbing, transfers), mobility, range of motion, balance, physiotherapy, and neuromuscular stimulation. These exercises, as well as intensity and frequency were often described to be tailored to individual patient needs. There were only two investigations to implement a common program across the trial participants, and to explicitly list the exercises performed: a 2004 study from Australia that compared a weight-bearing rehabilitation program to a non-weight-bearing program and to a control group, as well as a 2005 study from the US from Tsauo et al. (Sherrington, Lord, & Herbert, 2004; Tsauo et al., 2005).

Program duration was most often described as tailored to individual patient needs, although one study continued therapy for a maximum of three weeks, one until the goal of previous functional status was achieved, one for a maximum of six months, and one for a maximum of 100 days, which is the period covered by Medicare in the US (Jarnlo, 1984; Tinetti et al., 1997; Tinetti et al., 1999; Ziden, Frandin, & Kreuter, 2008). In a 2002 study from the UK by Lamb et al., participants received neurostimulation of the quadriceps for three hours a day for six weeks, but this frequency of therapy was not typical in any of the other home care post-acute care strategies (Lamb et al., 2002).

The second most common care component implemented in the home strategies was patient supervision by a multidisciplinary team (nine studies). The definition of a multidisciplinary team varied in each study. In an Australian study by Crotty et al., the team included a team coordinator, a physiotherapist, an occupational therapist, a speech pathologist, a social worker, and a therapy aide (Crotty et al., 2002). In contrast, the healthcare team described by Ziden et al. in a study conducted in Sweden was comprised of a geriatrician, geriatric nurses, and a physiotherapist or occupational therapist (Ziden et al., 2008). A 2016 study by Williams et al. from the UK mentioned recruited 'carers' who were friends or family to help patients with activities of daily living most days of the week (Williams et al., 2016). Two studies reported

holding weekly team conferences to review patient care and revise treatment goals (Crotty et al., 2002; Mas et al., 2016).

It should be noted that the study by Orwig et al., which included a PT/OT program and progressive strengthening program experienced an adverse event (Orwig et al., 2011). A patient broke her ulna while completing a chest stretch (ibid). This was the only adverse event reported throughout all the studies included in this knowledge synthesis.

Three studies compared intervention groups who received care at home to control groups who continued rehabilitation at an inpatient facility (Giusti et al., 2006; Kuisma, 2002; Mas et al., 2016). The study by Kuisma et al. from Hong Kong compared patients receiving intermittent PT sessions at home to those in a rehabilitation hospital where PT was received daily (Kuisma, 2002). Patients at home received on average 4.6 PT sessions, while the control group stayed in rehabilitation an average of 36.2 days, with therapy sessions daily (ibid). Despite the discrepancy in therapy frequency, they found the intervention group had significantly higher community and household ambulation ability a year after fracture than those in the control group (ibid). The second study, from Mas et al. in Spain, found no significant differences in functional ability between two groups of complex care patients after two years of follow-up (Mas et al., 2016). However, they did note that the collaborative team work required to organize the care of patients with multiple conditions was intense; the average home patient required five physician visits, 15 nurse visits, and 19 PT sessions (ibid). Finally, the third study, which was by Giusti et al. and published in 2006, found patients (including those with CI) receiving individualized rehabilitation programs at home showed slightly lower functional declines and then higher rates of recovery after HF when compared to patients receiving comparable institutionalized care, after controlling for pre-fracture function and performance of activities of daily living, cognitive status, and age (Giusti et al., 2006). In this study, patients chose whether they would prefer home or inpatient rehabilitation (ibid).

A single 2018 cross-sectional study from Nardi et al. in Switzerland looked specifically at caretaker status of the patient with HF and short- and long-term functional recovery (Nardi et al., 2018). They found functional tests were significantly better at six months after surgery for caregivers of any kind than non-caregivers (ibid). At 12 months, only caregivers of persons had better functional performance compared to non-caregivers (ibid).

The outcome measures used to evaluate the effect of the post-acute strategies conducted at home were very diverse, however, they seemed to focus primarily on functional ability, Modified Barthel's Index, Timed Up and Go test, Katz Index, gait speed, grip strength, instrumental activities of daily living, physical performance and mobility examination, performance-oriented mobility assessment, Harris hip score, Functional Independent Measure motor scale, 30-second sit-to-stand, General Self-Efficacy Scale and Falls Efficacy Scale-International. Other measures included health related quality of life (Short form health survey (SF-36), assessment of quality of life, (World Health Organization Quality of Life Questionnaire, EQ5D-5L), balance (fall efficacy scale, Berg balance scale), cognitive status (mini-mental state examination (MMSE), short portable mental status questionnaire, the geriatric depression scale, Abbreviated Mental Test Score, Hospital Anxiety and Depression Scale, cost analysis, strength (extensor power, lower extremity gain scale, maximal voluntary strength,) pain (visual analogue

scale), and physical activity (Frenchay's Activity Index, Yale physical activity scale, Nottingham Extended Activities of Daily Living scale (NEADL)).

Fifteen of the 17 studies compared intervention groups to a control or comparison cohort that received a different level of care. There was high variability in the components of care that were altered or enhanced in the intervention versus control cohorts, as well as the study outcomes. Due to this variability, there was no clear combination of care components that resulted in significant positive patient outcomes. Generally, studies that combined multidisciplinary team care and a PT/OT program saw positive changes in activities of daily living (Crotty et al., 2002; Milte et al., 2016; Orwig et al., 2011; Ziden et al., 2008). However, this conclusion should be interpreted with caution due to the wide variability of execution of each of these approaches within the individual studies.

Inpatient Rehabilitation Unit

Eighteen studies occurred in inpatient rehabilitation settings. These facilities could be separate wards within the acute care hospital or rehabilitation centres at secondary locations. Three studies compared outcomes at IRF and SNF sites within the U.S.A. (Munin et al., 2005a; Munin et al., 2005b; Talkowski et al., 2009). The most common care process implemented across the studies in inpatient rehabilitation locations were PT/OT programs, which were part of the post-acute care strategy in all 15 post-acute care strategies. Frequency of supervised sessions ranged from two to three times a day, five to seven times per week. Sessions were 30-60 minutes in length, and incorporated activities of daily living retraining, OT, walking, stair climbing, joint range of motion, strengthening, balance exercise, and therapeutic exercises. Program duration, when defined, varied from 14 days to approximately one month (Adunsky et al., 2003; Asplin et al., 2017; McGilton et al., 2013; McGilton et al., 2009; Tan et al., 2014). More commonly, program duration was not defined, instead only referred to as being dependent on individual patient progress, and sometimes decided by the multidisciplinary teams overlooking patient care (Hershkovitz, Beloosesky, & Brill, 2012; Stenvall, 2007b). Only one of the studies that did not define a program duration indicated what outcomes would be used to determine termination of the intervention (Uy, Kurrle, & Cameron, 2008). In a 2008 Australian study with a small sample size by Uy et al., patients were discharged from inpatient rehabilitation when they could walk (even with the assistance of a walking aid) and toilet themselves independently (ibid).

The second most common component of post-acute care strategies staged in inpatient rehabilitation units was management under a multidisciplinary team (10 studies), followed closely by motivational/goal-setting elements (six studies). There was wide variability in the personnel involved in the multidisciplinary teams. In a 2000 study from Finland, Huusko et al. had a geriatrician intern, a specially trained general practitioner, nurses with training in the care of older patients, a social worker, a neuropsychologist, an occupational therapist, and physiotherapists assigned to each patient (Huusko et al., 2000). In contrast, the multidisciplinary coordination in a study by Asplin et al. in Sweden was between the occupational therapist and physiotherapist (Asplin et al., 2017). In a 1988 study in Scotland by Kennie et al., the multidisciplinary team was a collaboration between a general physician, and consulting orthopedic and geriatric physicians (Kennie et al., 1988). Team meetings were held between

once and twice a week. Motivational or goal-setting components included creation of patient-centred goals of rehabilitation with patient and family input, (Huusko et al., 2000; Jackson & Schkade, 2001; McGilton et al., 2013; McGilton et al., 2009), diary keeping (Asplin et al., 2017), and incorporation of patient-empowerment cognitive techniques into treatment (Louie et al., 2012).

There was great variability in the outcome measures used to evaluate the effect of the post-acute care strategies conducted in the inpatient settings, however, they commonly focused on evaluating functional abilities (TLS-Basic ADL, Short Physical Performance Battery (SPPB), TUG, MBI, six-minute walk test (6MWT), functional reach, Tinetti gait and balance assessment tool, gait speed, FIM, Kanz index, Hip Fracture Functional Recovery Scale, Swedish version of Clinical Outcome Variables (S-COVS)). Other outcome measures included health related quality of life (Spitzer's Quality of Life index), balance (Berg's balance scale), length of stay, number of falls, discharge setting, rehabilitation effectiveness, morbidity (Charlson Comorbidity Index (CCMI), and physical activity (accelerometer).

Eleven of the 18 studies were controlled trials. There was significant diversity in the components of care that were altered or enhanced in the intervention groups compared to the controls. The most common element that differed in the intervention condition was the addition of a motivational component or explicit goal-setting procedures. Augmenting usual care with multidisciplinary teams with defined meeting times for patient review was also common in the strategies. These two components, goal-setting and multidisciplinary teams, were also two elements likely to be associated with significantly positive changes in functional abilities over the course of the trials. Again, this conclusion should be regarded with caution due to the wide variability in the implementation of these two processes of care.

Two studies compared the effects of their interventions between those with cognitive impairment (CI) and those without CI (Huusko et al., 2000; McGilton et al., 2009). A 2009 study by McGilton et al. conducted in Toronto compared the outcomes of those with CI (MMSE score of less than 23) to those with intact cognition after a comprehensive post-acute care strategy that included multidisciplinary team care, a PT/OT program, goal-setting, screening and management of CI, and discharge planning (McGilton et al., 2009). Patients with CI experienced equal gains in functional motor abilities to those with intact cognition, with no significant differences in length of stay in the inpatient ward, or rehabilitation efficiency (ibid). In addition, those with CI were equally likely to be discharged into the community as their cognitively intact counterparts (ibid). The Finnish study by Huusko et al. implemented a twice a day intensive rehabilitation program under the supervision of a multidisciplinary team (Huusko et al., 2000). After a subgroup analysis, they found those with mild to moderate CI had significantly shorter median lengths of hospital stay if they participated in the intervention group (ibid). Three months after surgery, those with mild CI were equally as likely as those with no CI to return to independent living (ibid). However, severity of CI was still found to be positively associated with mortality and being less likely to return to independent living (ibid).

One study compared patients with cognitive impairment in intervention and control cohorts (Stenvall, 2012). This was a subgroup analysis of a larger study performed in Sweden by Stenvall et al. comparing inpatient care with a specially educated staff and enhanced PT and OT program

with the standard of care (Stenvall, 2007b). After four months, significantly more patients in the intervention group had regained their previous independent walking ability (Stenvall, 2012). Twelve months post-operatively, a larger proportion of the intervention group (10 individuals, 53%) had regained pre-fracture activity daily living performance in comparison to the control group (six individuals, 21%) (ibid). In the original study, those with CI were included in the cohort analysis and no subgroup analysis was undertaken isolating those with CI. (Stenvall, 2007b). Significantly more participants in the intervention group returned to the same living residence after discharge and experienced fewer postoperative complications (ibid). In addition, the intervention group experienced fewer falls, returned to the same level of activities of daily living, and could walk independently indoors at the end of the study period compared to the control cohort (Stenvall, 2007a, 2007b).

Care Initiated at an Acute Hospital and Continued at Home

Four studies began a post-acute care strategy in the hospital before the patients were discharged home. These studies were distinguished from 'home' trials as the research team made first contact with the patient immediately after surgery and began elements of the post-acute program in hospital that would be continued after discharge home. The care component most common within the studies was a nutritional program, however, two of the four studies, those from Flodin el al., 2014 and 2015, exclusively focused on trialing two different nutritional plans against control conditions (Flodin et al., 2015; Flodin et al., 2014). Multidisciplinary team care and a PT/OT program were the elements shared by the two remaining studies (Langford et al., 2015; Shyu et al., 2005).

The study by Langford et al. was the only study to utilize remote care after the patient returned home (Langford et al., 2015). Patients in the intervention and control group received an educational session with manuals and four videos while in hospital (ibid). In addition, patients in the intervention group received up to five phone calls from a physiotherapist to provide coaching during their recovery after they were discharged home (ibid). This study was investigating feasibility of this remote-care model (ibid). The authors did not report differences between the control and intervention group in health-related quality of life, gait speed, or psychosocial factors, however the study was not powered to detect significant differences in these outcomes (ibid).

The trials authored by Flodin et al.-compared three different nutritional plans (Flodin et al., 2015; Flodin et al., 2014). All three groups received calcium and vitamin D_3 (1 gram and 800IU daily, respectively) supplementation for 12 months (ibid). This was also the control condition (ibid). Another group also received bisphosphonates (risedronate 35 mg weekly) for 12 months (ibid).The final group received the vitamins, bisphosphonates, as well as six months of liquid nutritional supplementation twice a day (an additional 40g of protein and 600 kcal daily). Flodin et al. 2014 reported increased bone mineral density (BMD) in the group that received liquid supplementation after the first six months, while the other two groups had shown losses in BMD (Flodin et al., 2014). Total BMD did not change in the group that received nutritional supplementation over the 12 month follow-up of the study, while the other groups lost BMD (ibid). The patients who received only vitamin supplementation also lost significantly more BMD

after the first year than the other two groups (ibid). The follow-up analysis of the same cohorts in Flodin et al. 2015 showed that health-related quality of life decreased significantly by 12 months in all groups but those receiving liquid nutritional supplementation (Flodin et al., 2015). It should be noted that the authors reported low adherence to the liquid nutritional supplement: 7/18 patients self-reported compliance, while the remaining 11 only took one dose a day (ibid). Adherence to all three programs ranged from 39% to 72% (ibid).

One of the remaining two studies set in this location saw significant positive results from their post-acute care strategy (Shyu et al., 2005). A 2005 Taiwanese study by Shyu et al. tested the usual care pathway against a comprehensive post-acute care program that included multidisciplinary care by a geriatrician, physical therapist, geriatric nurses, and rehabilitation physician, a PT/OT program (4 x 30 minutes in hospital, 1-2x/week for first month after discharge, 1-2x/biweekly in second and third month after discharge), nutritional counselling, consideration for social support/caregiver status, pain management, screening for cognitive impairment, and discharge planning (ibid). Patients that were part of the intervention strategy had significantly better walking abilities at one and three months, improvement in activities of daily living at one and two months, and fewer depressive symptoms after three months (ibid).

As before, the range of treatment interventions evaluated does not allow for generalizations about which of these interventions are associated with significant positive outcomes after HF.

Care Initiated at inpatient Rehabilitation and Continued at Home

Seven studies began their post-acute care strategies while the patients were in inpatient rehabilitation centres and continued after they were discharged home. In studies that stated the duration of the intervention, the length ranged from six to 16 weeks (Huusko et al., 2002; Mitchell et al., 2001; Moseley, 2008). The other studies tailored interventions to patient needs, but did not state a definite endpoint for terminating therapy (Naglie et al., 2002; Shyu et al., 2013; Shyu et al., 2010; Tseng et al., 2016). As in the previous settings, the most common elements of care that were part of these trials were a PT/OT program (all seven studies), and a multidisciplinary team approach (six studies). The PT/OT sessions occurred at least once per day, five to seven times a week in all studies while the patients resided in inpatient rehabilitation units. After the patients returned home, sessions varied in frequency from a single discharge visit to weekly supervised sessions. Rehabilitation exercises varied across studies but generally included a focus on balance, strengthening, range of motion, early walking, aerobic capacity, and functional ability. Multidisciplinary teams varied and included members such as geriatric nurses, physiotherapists, geriatricians, nutritionists, psychiatrists, social workers, clinical nurse specialists, and occupational therapists.

Outcomes used to assess the effectiveness of the inpatient to home post-acute care strategies were variable, including measures of functional ability (gait velocity, ADL, IADL, elderly mobility scale, TUG, hand grip strength, sit-to-stand time, Barthel index), quality of life (Nottingham health profile, EQ5D-5L, SF-36), strength (leg extensor power), pain (visual analogue scale, five-point Likert scale), balance (modified falls efficacy scale, sway patterns,

step test), mortality, discharge location, healthcare utilization, nutritional status (mini-nutritional assessment), and depression (geriatric depression scale).

All seven studies were conducted with a control or comparison group. There seemed to be a relationship between the combination of PT/OT and multidisciplinary care processes, and significant positive outcomes in activities of daily living (Huusko et al., 2002; Mitchell et al., 2001; Moseley, 2008).

Within the inpatient to home trials there were three studies conducted in Taiwan (Shyu et al., 2013; Shyu et al., 2010; Tseng et al., 2016). The earliest study, published in 2010 by Shyu et al. ran an intervention group that received PT starting within 24 hours post-operative and continued in home for three months (1x/week for first month, 1x biweekly in second and third months), as well as discharge planning and assessment of caregiver status/social support (Shyu et al., 2010). This was compared to a control group that received usual care, which entailed PT beginning two to three days after HF surgery until discharge from the acute hospital, approximately five days later (ibid). No home care programs are provided (ibid). The authors found that the intervention group had significantly better outcomes in functional ability, pain, and mental health at any point during the 12-month follow-up when compared to controls (ibid).

The other Taiwanese studies by Shyu et al. in 2013 and Tseng et al. in 2016 used the same study cohort to analyze functional outcomes and health-related quality of life (Shyu et al., 2013; Tseng et al., 2016). These studies compared three post-acute care models referred to as comprehensive care, interdisciplinary care, and usual care (ibid). The interdisciplinary care models received PT starting within 24 hours post-operative and continued in home for four months (1x/week for first month, 1x biweekly in second to fourth months), as well as discharge planning and assessment of caregiver status/social support (ibid). The comprehensive care model incorporated all the components of interdisciplinary care but extended the rehabilitation for 12 months, plus fall prevention, nutritional consultation, and screening for depression (ibid). Usual care was as described in Shyu et al. 2010 (Shyu et al., 2010). Shyu et al., 2013 found the intervention groups had significantly higher health related quality of life and physical function scores than did the groups receiving usual care (Shyu et al., 2013; Shyu et al., 2010; Tseng et al., 2016). Tseng et al. found that the physical ability trajectory of the intervention groups was more positive when compared to the usual care cohort, with those receiving comprehensive care having the best trajectory (Tseng et al., 2016). However, they did not find any significant effects of the post-acute care strategies on mental trajectory when compared to usual care (ibid). Shyu et al., 2013 also reported that the intervention effects increased to six months and reached their maximum effects at 12 months (Shyu et al., 2013).

Two studies conducted subgroup analysis on participants that had CI (Moseley, 2008; Naglie et al., 2002). After a post-acute care strategy that included a multidisciplinary team and a weight-bearing PT/OT program that ran twice a day for a total of 60 minutes per day for 16 weeks, Moseley et al. found patients with CI improved significantly more in ADLs, walking, pain, and falls self-efficacy than participants with or without CI in the group that received usual care (Moseley, 2008). In the 2002 study from Naglie et al., those with mild to moderate CI had the most benefit from enhanced multidisciplinary care (Naglie et al., 2002).

Nursing Home

Two studies conducted trials in nursing homes. A 2011 study conducted in Denmark recruited patients with HF previously living in nursing homes (Gregersen et al., 2011). The second study, published by Ponten et al. did not specify criteria on previous residence for their study participants (Ponten et al., 2015). Both studies included a PT/OT program that differed between intervention and control cohorts (Gregersen et al., 2011; Ponten et al., 2015). Otherwise, both studies included multidisciplinary care for control and intervention participants consisting of a surgeon, nursing staff, social worker, and physical therapist in the trial by Ponten et al., and a physician, nurse, and physiotherapist in the study by Gregersen et al. (Gregersen et al., 2011; Ponten et al., 2015). In the investigation by Gregersen et al., goal-setting, nutritional consultation, pain management, discharge planning, and secondary prevention in the form of osteoporosis management were available to the intervention and control cohorts (Gregersen et al., 2011).

In Gregersen et al., the control PT/OT program included an initial visit two days post-discharge for mobilization, then a second visit a couple days later for a medical assessment and initiation of rehabilitation (Gregersen et al., 2011). Rehabilitation was not described. The average number of PT/OT visits was three in the first month after discharge (ibid). In the intervention group, the patients were visited for mobilization and a medical assessment the first day post-discharge, and further follow-up visits were individually dependent, averaging seven in the 30-day follow-up period (ibid). Ponten et al. compared usual care of a maximum of five PT/OT training sessions a week to an intensive rehabilitation program of PT twice a day (Ponten et al., 2015). Details of the rehabilitation program were not described.

Gregersen et al. found a significant decrease in 30-day mortality and Ponten et al. saw a significant decrease in rehabilitation length from 67.2 days to 42.0 days (Gregersen et al., 2011; Ponten et al., 2015). These results are preliminary, but indicate that nursing home residents can experience significant positive outcomes from a frequent rehabilitation program.

Community Care

One study implemented the post-acute care strategies completely within the community setting (Singh et al., 2012). Singh et al. conducted a controlled study in 2012 in Australia where both cohorts were exposed to a six- to eight-week rehabilitation program that began after discharge at a community outpatient clinic (ibid). Components of the rehabilitation program were not described. After the standard rehabilitation program ceased, approximately six to eight weeks after HF, the intervention group then began a high-intensity progressive resistance training program supervised two days per week for 12 months (ibid). The patient status was discussed in weekly interdisciplinary team meetings (ibid). Compared to usual care, the experimental groups averaged an additional 80 supervised exercise training sessions, 10 home visits, and 10 phone calls over 12 months (ibid). At the end of 12 months, the intervention group had significantly less decline in basic activities of daily living and less use of assistive devices (ibid). In addition, risk of mortality was reduced 81% and nursing home admissions reduced 84% compared to controls (ibid). Improvements in activities of daily living in the intervention group were linked to increases in upper body strength, balance abilities, cognition, physical

activity levels, and decreased depressive symptoms (ibid). It appears an extended rehabilitation program that implements strength training has the ability to promote long-term positive outcomes in patients living in the community after HF.

Discussion

In general, it appears post-acute care strategies that incorporated multidisciplinary teams and a PT/OT program produced significant improvements in functional performance and health related quality of life, regardless of location. It should be noted that PT/OT programs and multidisciplinary teams were also by far the most common elements of care incorporated in the post-acute care trials. Physiotherapists, occupational therapists, nurses, and geriatricians were the most common members in the multidisciplinary teams. The PT/OT programs included training for functional abilities, mobility, range of motion, balance, walking, stair climbing, and strengthening. Due to the diversity of the PT/OT programs, a minimum duration or frequency of sessions to obtain positive outcomes cannot be determined. Other components of care, such as motivation or goal setting and discharge planning were also associated with positive outcomes, however the diverse combinations and applications of these elements make it difficult to draw conclusions. Due to the variability of type, length, frequency, and setting of post-acute strategies, it is difficult to recommend a post-acute care pathway that optimizes patient outcomes.

It is important to note that in this review, all the studies that included or compared participants with CI found that they benefited from care in the post-acute period as much or greater than their non-CI or control counterparts. Such findings are consistent with previous systematic reviews and meta-analyses with a wider rehabilitation timeline (Chu et al., 2016; Crotty et al., 2010; Handoll et al., 2011).

It should be noted that, though nursing staff were mentioned as members of multidisciplinary teams, their roles caring for the patients after HF were seldom fully explained. In addition, their support as the primary staff assisting patients after surgery were often completely overlooked in description of patient care, which tended to focus on patient contact by physiotherapists, physicians, and other specialists. This omission obscures the nature of treatment patients are receiving after HF, especially regarding daily mobility and engagement outside of a formal rehabilitation program, and disregards the contribution of critical members of the healthcare team.

Previous systematic reviews by Handoll et al. (2011) and Crotty et al. (2010) that included a wide range of strategies encompassing a broad timeline post-fracture could not demonstrate statistically significant conclusions that specific rehabilitation programs or use of multidisciplinary teams improved mobility, quality of life, or physical functioning after HF (Crotty et al., 2010; Handoll et al., 2011). Handoll et al. concluded that most successful programs seem to involve intensive supervised exercise, although the timing, frequency, and type could not be established (Handoll et al., 2011)

A recent meta-analysis in 2016 by Diong et al. evaluating the effect of structured exercise interventions on overall mobility concurred with Handoll et al. (Diong et al., 2015). When the authors conducted meta-regression analysis, greater treatment effects were seen for

interventions that included progressive resistance exercise and that delivered the intervention in settings other than just the hospital alone (ibid). The authors noted the findings on setting of delivery could have been confounded by the length of interventions (ibid). However, as in previous systematic reviews, the study was unable to determine optimal timing and duration of exercise therapy (ibid). Finally, a 2012 meta-analysis by Auais et al. in the US evaluated the effect of exercise rehabilitation programs after hip fracture that extended past the "regular rehabilitation period" (Auais et al., 2012). Individual study programs ranged from one to 12 months and included progressive strengthening programs (ibid). The analysis concluded that extended exercise programs had modest effect on knee extension strength for the affected and non-affected sides, balance, physical performance tests, timed up and go tests, and increased gait speed (ibid). Community-based programs had larger effect sizes than home-based programs (ibid). The authors were unable to provide recommendations for the structure of the program frequency and type of exercise (ibid). They also indicated future investigations should include analysis for cost-effectiveness (ibid). The methods from both of these meta-analyses were designed to account for the diversity they discovered between individual studies' methods and outcomes (Auais et al., 2012; Diong et al., 2015). Both Diong et al. and Auis et al. mentioned the variability in the literature hindered the ability to make more conclusive recommendations (ibid).

The conclusions from the above systematic reviews and meta-analyses are drawn from individual investigations that included a fairly homogeneous, yet limited study sample. Most participants were women, Caucasian, and community dwelling prior to fracture. No studies were found that focused on rural, Indigenous, or other marginalized populations.

As mentioned previously, this white paper knowledge synthesis is unique as it captures only studies that began data collection within 14 days of surgery. Focusing on this timeframe provided the opportunity to note how researchers recruited participants quickly after surgery, often in the acute care setting, and retained them through the discharge process, through their return to communities or rehabilitation centres. At times, researchers made initial contact with participants while the patient was in acute care, even if the post-acute care strategies began at a secondary location, or sent study personnel to the participants' homes soon after discharge to assess for hazards or determine use of mobility aids. Early contact with the patient after surgery could be key to initiating a personal connection that will drive the recovery process. Patients have noted the first 72 hours after discharge are a critical window for healthcare providers to connect with them and their family (Leland et al., 2018). In addition, this contact could facilitate an easy transition of patient information. The pathways of contact that the researchers are creating as demanded by the specifications of their investigation could serve as an important learning tool for those wishing to enhance patient contact through the transfer from acute to post-acute care.

This review cannot attribute any significant positive outcomes to a single, essential component of post-acute care. This is due to the prevalence of multimodal strategies, as well as the diversity between studies in how the components of care were altered between intervention and comparison conditions. However, understanding the significance of each of the elements of care may be critical when implementing post-acute care pathways in locations with limited resources.

A prevailing theme in the studies included in this knowledge synthesis was the emphasis on a "person-centred" approach (McGilton et al., 2013). The focus of the post-acute care differs in a patient-centred model to fit the needs of the individual (*Rehabilitative Care Best Practices for Patients with Hip Fracture*, Revised September 2018). Throughout the individual studies included in this white paper, content and frequency of clinical sessions was often described as "individualized" and determined by each patient's needs or goals. While individualized care is likely the realistic approach for any rehabilitation program, its use within research limits the ability to determine efficacy of a certain approach and comparison of different investigations. In addition, there is a need to develop a firm understanding of the types and intensity of services that every patient should have available to them to optimize their post-acute care pathway.

Continuing Issues and Gaps in Knowledge

There is broad variation in the literature evaluating post-acute care of HF. Consistency is lacking in almost every aspect of study design. There are a number of details that need to be addressed in future research in order to clarify the effectiveness of post-acute pathways for care of HF. The following aims to summarize the main recommendation from the studies' authors, and from previous systematic reviews on HF rehabilitation:

Participants:

- Current study samples often contain women over the age of 65 without cognitive impairment who were previously living independently in urban settings. Effort needs to be taken to design studies for vulnerable populations that contribute disproportionately to the burden of HF. This includes men, those with pre-existing CI, nursing home or institution residents, indigenous populations, and rural populations.
- Future studies should include information on staff-to-patient ratios, including information on roles and number of nursing staff. This information will be critical when determining effective post-acute care strategies for people with CI.

Outcomes:

- Diversity prevent comparative analysis of investigations. A 2017 systematic review by Haywood et al. evaluated clearly defined outcomes used to assess patient outcomes after HF and found no widespread use of a single measure (Haywood et al., 2017). The most common measure to evaluate activities of daily living, the Functional Impact Measure (FIM), was lacking in evidence of responsiveness to change following surgical repair of HF (ibid). Several other measures of function, depression, and quality of life had limited evidence for reliability, validity, and responsiveness (ibid).
- There is a need for a standard definition of improvement in patients after HF, or (e.g. return to pre-fracture ability, >10% improvement in walking ability, etc.)

- There is a need for a standard endpoint for post-acute care strategies. A study currently in press by Sheehan and an international collaboration of authors has outlined a conceptual framework to define episodes of rehabilitative care after HF surgery (Sheehan et al., in press). They suggest the index event that begins this period of care is the surgical repair (ibid). As an endpoint, they recommended post-operative death, plateau in recovery, a return to baseline function, another healthcare event, or one year post-fracture, whichever comes first (ibid).
- Analysis of interactions between patient characteristics (e.g., age, sex, psychologic factors) and intervention outcomes should be incorporated into study designs
- Outcomes describing post-surgical behavior of patients, including sedentary and physical activity patterns, should be incorporated to create a complete picture of patient recovery (Zusman et al., 2018)

Study Design:

- Many studies combined several components of post-acute care. It will remain impossible to distinguish the effects of certain interventions without proper control reporting, or isolation of treatment.
- The intervention and control condition should be clearly defined in terms of components, intensity, duration, and frequency of treatment. Tools such as the TIDieR checklist for physiotherapy interventions should be utilized to reliably implement or replicate successful programs (Ashe et al., 2018b). 'Usual care' should not suffice for description of a control condition.
- The intervention should be applied as uniformly as possible across the study sample, or if programs are individualized, this decision process and subsequent alterations should be fully elucidated.
- Future studies must include adequate methods of collecting data on adherence and adverse events.
- Future studies should reflect on factors that prevented effective implementation. This will be essential to understand how program elements can be delivered and adapted for different settings and populations (Ashe et al., 2018b)
- There is a need to understand the economic cost and feasibility of proposed treatment pathways. Where applicable, studies should explain how patient information was handed off during care transitions.
- Psychosocial factors, such as patient motivation are key components to success in rehabilitation and post-fracture life (Sims-Gould et al., 2017). They should be considered when designing and implementing future investigations. A workshop bringing together international experts has recently identified future top research priorities to resolve the psycho-cognitive and social factors in the HF recovery process for community dwelling older adults (Auais et al., 2018). There was a common understanding that recovery from HF is comprised of many 'non-physical' factors that play a large role in patient outcome (ibid).
- Future studies should describe methods for educating staff on preventing, detecting, and treating patients with delirium and dementia.

- Once the patient leaves acute care, there are barriers to providing rehabilitation programs in person. A 2018 systematic review indicated that telehealth is underutilized for recovery after musculoskeletal trauma and its benefits should be explored further (Ashe et al., 2018a). This may have additional applications for patients in rural/remote environments.

In summary, the quality of investigation around post-acute treatment pathways for patients after HF must be elevated. There is great enthusiasm within the research and clinical community to find effective, cost-efficient methods for treating patients after HF. However, there remains a need within the literature for well-developed, standardized interventions with more diverse sample populations, consistent outcomes, and long-term follow-up to develop evidence-based guidelines.

National and Provincial Initiatives

Between 2010 and 2013, Bone and Joint Canada began work with the provinces to implement changes in HF care. The National Hip Fracture Toolkit, a guide for recommendations on preoperative, surgical, and postoperative care of HF, was released. http://boneandjointcanada.com/wp-content/uploads/2014/05/National-hip-fracture-toolkit-June-2011.pdf. Based on this guide, each province undertook its own initiatives to achieve the recommendations within, focusing on different areas along the continuum of care. However, all provinces made a concerted effort to reduce wait time to HF surgery to within 48 hours after fracture.

British Columbia has the Centre for Hip Health and Mobility, a research centre that is focused on active aging and bone and joint health. The Centre includes the Hip Fracture Redesign Project, which pursues research along the HF care continuum, implementation of best practices, and creation of patient resources. The Project established a minimum data set for judging pre- and post-fracture change and tracked patients from emergency to acute care to the rehabilitation phase of their HF. (http://www.hiphealth.ca/media/Summary%20of%20Key%20Achievements%20with%208%20Pilot%20Sites_SPREAD_Transferable%20Outcomes(1).pdf).

As part of the BC Hip Fracture Redesign Project, physiotherapists, nurses, surgeons, and patient partners informed the development of the FReSH Start Toolkit: Fracture Recovery for Seniors at Home. This guide provides patient information for what happens in hospital, best practices for recovery at home (including nutrition, safety, and sleep), fall prevention, how and when to resume activities, and recovery exercises. **The booklet is available in multiple languages and is freely available:** http://www.hiphealth.ca/blog/FReSHStart. In follow-up studies, many older adults with HF have described returning to the booklet numerous times (Langford et al., 2018). One older adult stated, “It’s my bible” (ibid). Patients have expressed a need for delivery and explanation of the manual by a healthcare team member (Tsui et al., 2015).

Ontario has established the Greater Toronto Area (GTA) REHAB Network, which is working to increase timely access to rehabilitation for HF patients. http://www.gtarehabnetwork.ca/hip-fracture. The goal is to implement rehabilitative care best practices, as released by the Rehabilitative Care Alliance, and quality standards for HF as published by The Quality-Based Procedures Clinical Handbook for Hip Fracture published in 2013. http://www.health.gov.on.ca/en/pro/programs/ecfa/docs/qbp_hipfracture.pdf. The Handbook recommends all patients with HF receive active rehabilitation within six days of surgery, but was unable to recommend intensity of rehabilitation due to insufficient evidence. Other post-acute rehabilitation components included improvement of independent activities of daily living, balance and gait training, education on falls, nutritional supplementation, and osteoporosis management. From 2014-2017, the REHAB Network initiated an early referral processes from 10 acute care hospitals to 10 rehabilitation hospital sites across five GTA local health networks following the Rehabilitation Care Alliance standards of care. The Functional Independence Measure (FIM) assess functional mobility of patients after rehabilitation. In 2017, Levy et al. reported that across all the participating hospitals, 53% of patients were discharged within six days post-surgery (Levy-2016).

In 2015, Alberta Health Services and the BJH SCN put together the Restorative Care Pathway information booklet. https://www.albertahealthservices.ca/assets/about/scn/ahs-scn-bjh-hf-restorative-care-pathway-hcp.pdf. This pamphlet aimed to provide patients with evidence-based, post-fracture care that would help them achieve their optimal quality of life, level of function, living environment, and integration into the community (BJHSCN, 2015). In the booklet, care pathways are divided into two time frames, acute (until post-operative Day 7), and post-acute (post-operative Day 8-28), and into specific living destinations (e.g. rural, long-term care, rehabilitation/ sub-acute care, supportive living, home). Briefly, all post-operative Day 8-28 pathways, regardless of living destination goal, suggested OT or PT assessments to implement strategies for improving activities of daily living that include dressing daily, bathing and showering, moving to dining area for meals, and getting up for the bathroom (halting bedpan or urinal use). In addition, mobility objectives should include mobilizing outside safely, the integration of strengthening and balance exercises, and walking a minimum of 50-100 metres. The Timed Up and Go (TUG) test and Barthel assessment should be used to track progress in mobility.

In addition to this detailed pathway booklet, each patient receives a booklet called “After Your Hip Fracture” after HF surgery with post-operative exercises to help recovery of strength and range of motion. Types of movement, and number of reps and sets are included in this information. This program was created by the Bone and Joint Canada, with Alberta Health resources, the Fragility and Stability Working Group and fragility and stability clinicians. This booklet is also available online at myhealth.alberta.ca.

The different provincial approaches provide a starting point for developing consistent, valid, and effective post-acute care strategies, analyzing gaps in care, and moving forward to produce effective, evidence-based, pathways for the future.

Secondary Prevention

Of those who experience a hip fracture, one in three will sustain another fracture within 12 months (Bone and Joint Decade Canada, 2011). Over half of patients will experience another fracture within five years (ibid). Although it lies beyond the focus of this paper, it is important to recognize secondary prevention efforts to reduce the risk of a second fracture (ibid). Secondary prevention methods usually concentrate on treating osteoporosis, as this is the most common comorbidity present in those who break their hip (ibid). Another focus of secondary prevention is on falls management (ibid). Management of other comorbidities, including dementia, stroke, and Parkinson's, is also vital to ensure the patient does not sustain another fracture (ibid).

Post-fracture treatment of osteoporosis begins with diagnosis, a step that is often missed with patients with HF (Leslie et al., 2011). A 2011 study found over 80% of osteoporotic fracture patients in Manitoba were not screened for bone mineral density nor received pharmacological treatment (ibid). Treatment and management of osteoporosis can include nutritional counselling, (usually targeting protein and calcium intake), vitamin D supplementation, regular bone mineral density scans, and, if required, initiation of pharmacological treatment (Bone and Joint Decade Canada, 2011). Pharmacological management has been demonstrated to be effective for reducing the risk of future fractures in those with osteoporosis in the form of bisphosphonates and hormone therapy (Beaupre et al., 2013; Osteoporosis Canada, 2018a).

As part of the treatment of osteoporosis, the 2010 Clinical Practice Guidelines for the Diagnosis and Management of Osteoporosis also recommend counselling on fall prevention (Bone and Joint Decade Canada, 2011). The National Hip Fracture Tool Kit recommends regular physical activity, environmental modifications (e.g. hand rails, removing carpets), and use of mobility aids as strategies to reduce falls (ibid). Other recommendations are those that could be enacted in the post-acute period (ibid). These include hospital and physical therapy staff education for fall prevention, management of medications for side effects that could bring about changes in balance (e.g. drowsiness or dizziness), and counselling on fear of falling (ibid). Many of these tactics can be part of a discharge plan as the patient leaves acute care (ibid). A 2016 qualitative study conducted in the UK found that most healthcare professionals agreed treatment initiation for osteoporosis was best done in the acute care setting, rather than attempting to follow up post-discharge (Drew et al., 2016).

Secondary prevention has been the focus of several initiatives within Canada, including within Alberta. Osteoporosis Canada offers education and resources for patients and clinicians on prevalence, detection, and treatment of osteoporosis (Osteoporosis Canada, 2018b). Under the umbrella of British Columbia's Centre for Hip Health and Mobility is the Centre of Excellence on Mobility, Fall Prevention, and Injury in Aging, to increase mobility in older adults and combat falls. (http://www.hiphealth.ca/research/research-projects/centre-of-excellence-on-mobility,-fall-prevention-and-injury-in-aging/). In addition, the Vancouver Fall Prevention Clinic at Vancouver General Hospital brings together primary care clinicians, researchers, and policy makers in a multidisciplinary environment to delivery interventions to reduce falls in high-risk patients. (http://www.hiphealth.ca/research/research-projects/falls-prevention-clinic/)

Manitoba Health has identified care gaps in optimizing post-fracture management regarding osteoporosis screening. From 2008-2011, a randomized control trial tested a notification system for those over 50 years of age who suffered fragility fractures, with a view to implementing bone mineral density screening, which would then lead to treatment of osteoporosis if required. (http://www.gov.mb.ca/health/primarycare/providers/chronicdisease/bonedensity/postfracture.html).

Alberta Health Services Bone and Joint Health Strategic Clinical Network (BJH SCN) has implemented two programs for secondary prevention of HF. In 2014, the Catch a Break program was initiated, in partnership with Health Link, to connect Albertans who may have experienced a fragility fracture with resources about osteoporosis, risk factors, and treatment. (https://myhealth.alberta.ca/alberta/Pages/Catch-a-break.aspx). In addition, the BJH SCN launched the Fracture Liaison Services (FLS) in accordance with Osteoporosis Canada's 3i model for identification, investigation, and initiation. (http://fls.osteoporosis.ca/what-is-fls/). The Alberta model assigns a registered nurse and care-of-the-elderly physician who identify patients after HF surgery and screen them for osteoporosis and geriatric-related medical conditions that could contribute to falls and hospital admissions. (https://albertaboneandjoint.com/osteoporosis-canada-abjhi-bjh-scn-fracture-liaison-services-hip/). Hospitals in Alberta that have met the Osteoporosis Canada standards for FLS include the Royal Alexandra, University of Alberta, and Misericordia Hospitals in Edmonton, the Peter Lougheed Centre and Foothills Medical Centre in Calgary, and Red Deer Regional Hospital,. In addition, as of fall 2018, the Rockyview General Hospital in Calgary and the Queen Elizabeth II Hospital in Grande Prairie will also be FLS facilities. (https://albertaboneandjoint.com/osteoporosis-canada-abjhi-bjh-scn-fracture-liaison-services-hip/).

Moving Forward – Future Directions

A total of 82 participants from all five of Alberta's health zones participated in the Workshop "Optimizing the Post-acute Continuum of Care Following a Hip Fracture," held November 2018 in Leduc, Alberta. Stakeholders representing the professions of nursing, physicians, physical therapists, occupational therapists, educators, researchers, SCN management and patient advisors were present. One limitation of this workshop was that the patient voice was not well represented and should be included in future consultations. The workshop highlighted researchers such as keynote speakers Drs Maureen Ashe (British Columbia) and Kathy McGilton (Ontario), as well as Dr. Zahra Goodarzi (Alberta) and Dr. Lauren Beaupre (Alberta). Dr. Cinzia Gaudelli addressed challenges for HF patients in the Central Zone and Ms. Jessica Richardson highlighted the success of the Grande Prairie Home Care PT Hip Fracture Rehabilitation program. The attendees spent time discussing challenges and possible solutions in breakout sessions, with contributors from different healthcare professional roles and different healthcare zones. The following reflects participant feedback and recommendations which were highly consistent across groups.

Participant Feedback from Breakout Sessions:

1. **Pathways are currently available and used, but an opportunity exists to improve patient outcomes by providing more flexibility to address specific patient needs and circumstances**. Many providers indicated that a culture of evidence-based practice and standardizing best care is embedded or developing. However, these pathways are sometimes too rigid, not flexible enough to address specific concerns, and not usable for collaborative decisions. As one participant indicated “one size does not fit all.” Pathways that build on the currently available research findings for patients who are cognitively impaired or the medically complex are needed. Additionally, some pathways do not reflect the local circumstances in terms of resources available. Finally, some participants indicated they would appreciate help on how to ‘operationalize’ available research findings.

2. **Education and resources are important but more needs to be done to keep information current, relevant and available through multimodal delivery methods for patients, families and staff**. Providers indicated that a wealth of resources and education material is available for providers and patients. However, these resources sometimes result in unintended consequences such as overloading patients or providers with too much information or using unfamiliar language. In an ever-evolving environment, it continues to be a challenge to ensure that resources are up to date and reflect the local context and circumstances. As with the provision of other healthcare services, it remains a challenge to ensure that the language used is clear and provides a common understanding. There is an important opportunity to become a trusted source of information for patients, caregivers, and healthcare professionals.

3. **More research is needed to inform pathway development for special populations such as indigenous people and to address gender issues.** There is currently a lack of knowledge around providing culturally sensitive care for special populations. In addition, more research that includes men, who are a significant minority of patients with HF, is required.

Discussion and Implications:

The workshop committee recognizes that the post-acute care environment is complicated with multiple providers whose support will be needed to create improved patient care, and that resources and priorities vary by Zone. The BJH SCN leadership is committed to exploring activities and providing support and connection opportunities to facilitate these discussions which will lead to better patient outcomes. Some of the specific activities that will be supported include:

1. **Shared Decision Making** - As AHS continues to explore and operationalize shared decision making models, it appears that hip fracture care in the community could be an ideal area to pilot such practices. The principle of patient-centred care is well embedded within this practitioner group and there appears to be a willingness by providers to extend these practices further. This approach could embrace some of the practitioner recommendations to allow for evidence-based care, which also allows for individual concerns and context. Shared decision-making for hip fracture care in the community would likely provide lessons that are highly transferrable to many other community care settings. The BJH SCN will continue to work to bring more patients and their providers into these discussions.

2. **Pathway Development for Special Patient Populations** – The research indicates that a significant number of hip fracture patients suffer from some form of cognitive decline and that this population also benefits from appropriate rehab services however often this group is not provided with sufficient services. Our current pathways do not specifically provide guidance to providers on how to better serve this group. The BJH SCN has begun work with the Seniors and Emergency SCNs to revise the geriatric dosing of various medications which may be contributing to delirium amongst seniors upon acute care admittance. The BJH SCN will continue to work with the Seniors SCN on items of common interest such as falls preventions and better dementia care. We will engage with structured Rehabilitation programs to learn how more support can be provided to patients with cognitive decline. Separately, the BJH SCN will coordinate with Alberta Bone and Joint Health Institute (ABJHI) as it analyzes the impact of medications on men, which has been an under researched group.

3. **Current Pathway gaps and disconnects need to be addressed to provide more continuous patient-centred care** – The Fragility and Stability committees will be provided with this evaluation and we will continue to work with their various committees to incorporate the learnings from the Workshop and to seek their input on how best to implement change in heterogeneous environments. For example, as the Acute Care Working Group revises care paths and orders, they will be encouraged to consider how to bridge the gaps identified by the workshop. BJH SCN and ABJHI staff will facilitate opportunities for discussions between acute care and post-acute care personnel including Rehabilitation staff to work on better bridging those gaps. Additionally, patients and their families will be involved in this work to ensure that patient needs drive the decision-making, and supports are provided to patients and their caregivers.

4. **Knowledge dissemination** -- Dr. Lauren Beaupre (University of Alberta) has a CIHR Dissemination grant which will fund a one-day meeting for provincial stakeholders to further the work associated with the Hip Fracture Liaison Service and Catch a Break Programs. In addition, over 2019, this grant will be used to further the work of these programs and will include updating and revising patient and provider

resources after examining the evidence regarding optimizing format and delivery modes to best reach the end-users. The work from this project will be shared with the both BJH and Senior's Health SCNs to work towards implementation of best practices. Further KT activities include preparation and submission of manuscripts using information derived from the HF databases.

5. **The workshop provided an opportunity for the leadership teams of two SCNs to work together which could serve as a model for future partnership work**. The BJH and Seniors SCNs leadership have agreed to work together to find better ways to support patients with cognitive decline who are experiencing a hip fracture. An initial meeting is expected to occur in 2019. We believe that the workshop was the beginning to move to optimal care for patients.

Major Takeaways

- The current literature on post-acute care strategies after hip fracture suggests a multidisciplinary team and a physiotherapy or occupational therapy program are important components of the care initiated seven to 14 days after repair of hip fracture in order to produce significant positive patient outcomes.
- The literature indicates a wide variety of programs are generally tolerated with few adverse outcomes. However, the diversity in approaches, as well as multimodal care strategies, individualized programs, and inconsistent use of outcome measures is hindering the ability to make conclusions about the effectiveness of rehabilitation strategies, and therefore hindering the implementation of current evidence into practice.
- There is great need for investigations into populations such as men, and rural and Indigenous communities. Very little, if any, research has addressed these populations. In addition, attention to psychosocial factors, such as motivation, family support, and caregiver roles are key in understanding the success of care strategies.
- Canadian provincial healthcare organizations are actively pursuing strategies in post-acute HF care and in the area of secondary prevention. Progress toward long-term, effective solutions is a responsibility that can be shared.
- Flexibility in patient pathways of care, and updated educational resources for patients, caregivers, and healthcare professionals are key areas of focus moving forward. Flexibility will be needed to address the varying needs of the patient populations, including those with cognitive impairment, and underrepresented groups such as Indigenous people. In addition, this allows for creation of relevant care pathways to health centres with different resource availability. Work to create relevant, accessible, and constructive resources and educational opportunities for stakeholders will serve to support the province's goals of patient empowerment, multidisciplinary healthcare teams, shared-decision making approaches, and patient-centred care.

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Appendix 1: Search Strategy

We conducted a scoping review to determine the current evidence specific to care for hip fracture initiated within 14 days post-hip fracture. As our goal was to identify the current state of knowledge, the search was focused on articles of randomized controlled trials, cohort studies, pilot studies, and case studies published from database inception to May 2018. Four databases were searched: OVID Medline, EMBASE, CINHAL, and PubMed. Studies were included if they focused on evaluating post-acute care of hip fracture that began within 14 days of surgery of femoral or trochanteric fracture, and were published in English. Articles were excluded if they did not report results of original research (e.g. editorial, commentaries etc.), the intervention was not initiated within 14 days of hip fracture repair or initiation period was not clearly defined, focused only on rehabilitation after total hip arthroplasty, and if the full article could not be accessed.

A broad search was used to capture investigations conducted with any population type (inclusive of those with cognitive impairment, rural populations, indigenous peoples etc.). The second search specifically sought out studies that included those with cognitive impairment. Reviews matching our criteria were identified through a systematic search of four databases: OVID Medline, EMBASE, CINHAL, and PubMed. The search of OVID Medline and EMBASE was conducted in May 2018. CINHAL and PubMed searches were conducted in September 2018, in response to committee suggestions to expand the search strategy. Keywords and subject headings [MeSH] used for each database are provided in the table below. Search terms were revised if database findings were too narrow. In addition, reference lists of included articles were reviewed to identify any articles that may have been missed. Articles recommended by members of the workshop planning committee were also gathered and screened for inclusion.

Data extracted from each review included: authors, year and location of publication, participant inclusion criteria, location of intervention (e.g., home, rehabilitation unit), participant average age and percentage of female participants, follow-up time points, intervention description, control description (if applicable), outcomes, and results.

In total 1,025 titles were identified from all sources based on the search terms. An additional 15 titles were found through independent searches and recommendations. In the abstract and title screening, 754 were excluded after they did not match the inclusion criteria. The remaining 286 studies were reviewed in detail; this was required to ensure the intervention

under investigation was initiated within 14 days of the hip fracture and included post-acute care strategies and locations. Forty-six full text records were included in the final analysis.

Keywords and MeSH terms used in the literature search

Database	Keywords	Subject Headings
OVID Medline	"Hip fracture" AND "Rehabilitation" OR "exercise*" OR "physical therapy" AND "community" OR "nursing home"	exp Hip Fractures/ exp REHABILITATION/ exp EXERCISE/ exp DEMENTIA/ exp Cognitive Dysfunction/
EMBASE	"Hip fracture" AND "Rehabilitation" OR "exercise*" OR "physical therapy" AND "community" OR "nursing home"	exp hip fracture/ exp rehabilitation/ exercise/ or physiology/ Physiotherapy/ Cognitive impairment/ or cognitive defect/ Dementia/
PubMed	"Rehabilitation" AND "hip fractures" AND "post-acute"	Rehabilitation/ hip fracture/
CINHAL	"Rehabilitation" AND "hip fracture"	Rehabilitation Hip fracture +diet therapy + drug therapy +rehabilitation +therapy

Appendix 2: Definitions of Components of Care Found in Literature

Component of Care	Definition within this White Paper
Multidisciplinary Team Care	Study explicitly lists multiple team members involved in patient care and lists them (e.g. geriatrician, physiotherapist etc.) and/or regular collaborative team meetings regarding patient care
Physiotherapy/ Occupational Therapy Program	Study implements a physiotherapy or occupational rehabilitation program to encourage mobility and functional activities of daily living.
Progressive Strengthening Exercise Program	Study implements an exercise program that involves resistance training that progresses over time
Motivation/ Goal Setting	Study explicitly mentions the use of goal setting, diaries, motivational phone calls/ follow-ups, or goal focused therapy
Patient Education Program	Patients are given a formal education program on the rehabilitative process and expectations after hip fracture
Nutrition Program/ Consultation	Study includes screening for nutritional status, contact with a dietician, and/or a nutritional supplement program
Patient Caregiver Status Considered	The patient's social caregiver role and/or familial/ social support is considered
Screening for/ Management for Cognitive Impairment	Study includes screening for delirium, depression, or dementia and could also include follow-up with proper mental health services
Pain Management Program	Study explicitly mentions consideration of pain management
Discharge Planning	Study implements consultation process before discharge and/or home visits to assess the environment
Secondary Prevention Program	Study explicitly mentions the implementation of a fall prevention program, education on fall risk, or screening/treatment for osteoporosis

Appendix 3: List of Studies Included in Knowledge Synthesis and the Components of Post-Acute Care Incorporated in Each Trial (Sorted by Location)

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Singh et al., 2012	Community	x	x	**X**	**X**		**X**	**X**				**X**	x	Mortality rate, Nursing home admissions, assistive device use, decline in ADLs
Crotty et al., 2002	Home	**X**	x		**X**				**X**		x		x	ADL ability
Giusti et al., 2006 -inpatient vs. at home rehab	Home		x										x	ADL scores; maintained at 3, 6, 12 months. number of participants with complete recovery
Jarnlo et al. 1984 -Trochanteric fracture vs cervical fracture some subgroup analyses	Home	x	x								x		x	Trochanteric fracture had 50% more home visits. 100% of patients regained stair climbing with support after 4 months. 81% regained walking with a walking stick after 4 months and outside

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Kusima, 2002 -home vs. inpatient	Home		**X**											□ community ambulation □ ambulation ability
Lamb et al., 2002 -neurostimulation	Home		**X**							x			x	□ Balance after 7 weeks, but not after 13 weeks □ mobility after 13 weeks
Mas et al., 2016 -home vs. inpatient rehab	Home	x	x										x	□Efficiency of rehabilitation □length of rehabilitation
Milte et al., 2016	Home	x	**X**				**X**	**X**				x	x	N/A
Nardi et al., 2018	Home							x						□Functional ability in caregiver of any kind, but only caregiver of persons held this significant difference at 12 months.
Orwig et al., 2011	Home		x	**X**	**X**								x	□ time in exercise activity in follow-up *Adverse event: fractured ulna while doing chest stretch in warm up.*
Peng et al., 2016 -home rehab vs. inpatient rehab vs. usual home care	Home	x	x						x				x	Home or inpatient care had better survival after 4 years than conventional home care

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Sherrington et al., 2004 -WBE vs NWBE vs control	Home			**X**									x	□ ambulation ability in WBE at 4 months versus NWBE and control
Tinetti et al., 1997	Home	x	x	x				x						□ADL over rehab program
Tinetti et al., 1999	Home		**X**										x	N/A
Tsauo et al., 2005	Home		**X**	**X**		**X**							x	□ Functional hip score, health related quality of life
Uy et al., 2008	Home	**X**	**X**										x	N/A
Williams et al., 2016	Home	**X**	**X**		**X**								x	N/A
Ziden et al., 2008	Home	**X**	**X**		**X**			**X**			**X**		x	□ Recovery in self-care, mobility, ambulation, ADL, balance
Flodin et al., 2014	Hospital to home						**X**					x	x	No □ in BMD for those with supplement. Groups w/o supplement saw significant □ in BMD; those who didn't receive bisphosphonate saw largest decrease
Flodin et al., 2015	Hospital to home						**X**					x	x	No□ in HRQoL for group receiving protein supplement

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Langford et al., 2015	Hospital to home	x	x		**X**	x						x	x	Cost of $125 per intervention participant
Shyu et al., 2005	Hospital to home	**X**	**X**				**X**	**X**	**X**	**X**	**X**		x	□walking ability after 1 month, ADL at 1 and 2 months, peak force in quadriceps, vitality, mental health, physical function at 3 months, bodily pain at 3 months
McGilton et al., 2009 -CI vs non-CI	Inpatient rehabilitation	x	x		x				x		x		x	Groups had equal gains in functional motor skills, length of stay, rehabilitation efficiency
Asplin et al., 2017	Inpatient rehabilitation	**X**	**X**		**X**			**X**	**X**		x		x	□ levels of participation □ independence in ADL
Ganz et al., 2007	Inpatient rehabilitation		x											Sig. improvement in TUG, Tinetti gait and balance, 6 min walk test
Hershkovitz et al., 2012	Inpatient rehabilitation	x	x											□rate of improvement in rehab correlated with □admission FIM and good 6MWT 84.7% achieved gait velocity needed for home ambulation

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Huusko et al., 2000	Inpatient rehabilitation	**x**	x		**X**						**X**			□ number with moderate CI living independently □ number with mild CI living independently
Jackson et al., 2001	Inpatient rehabilitation		x		**X**	x							x	□ rate of FIM change/day □ patient satisfaction
Kennie et al., 1998	Inpatient rehabilitation	**X**	x										x	□ physical independence □ discharge back home
Louie et al. 2012	Inpatient rehabilitation		x		**X**	**X**						**X**	x	N/A
McGilton et al., 2013	Inpatient rehabilitation	**X**	x		**X**				**X**				x	□discharge home
Munin et al, 2005a -IRF vs SNF treatment	Inpatient rehabilitation		x										x	□ functional motor skills in IRF, not maintained 12 weeks post-fracture □ return to post-fracture functional status in IRF
Munin et al, 2005b -IRF vs SNF treatment	Inpatient rehabilitation		x										x	□ functional motor skills in IRF □ return to post-fracture functional status in IRF

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Roder et al., 2003	Inpatient rehabilitation		**X**										x	□ ADL and IADL after 6, 12 months in rehabilitation groups All improvements visible within 6 months
Tan et al., 2014	Inpatient rehabilitation		x											□ functional ability at discharge and 4 months after discharge □ independent ambulation at 4 months post-discharge when compared to ability at discharge
Adunsky et al., 2003 -single inpatient setting vs two-step location	Inpatient rehabilitation	x	x			x			x				x	□in total FIM Those treated in single inpatient setting had better FIM outcomes
Stenvall et al. 2007a	Inpatient rehabilitation	x	**X**				**X**		**X**		**X**	**X**	x	□ in fall incidence rates in intervention group vs control
Stenvall et al. 2007b	Inpatient rehabilitation	x	**X**				**X**		**X**		**X**	**X**	x	□ ADL in intervention group at discharge and 12 months. Intervention group had more patients with ability to walk independently indoors at 12 months.

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Stenvall et al., 2012	Inpatient rehabilitation	x	**X**				**X**		**X**		**X**	**X**	x	□□proportion in intervention group that regained independent walking ability at 4 months vs. control □ proportion in intervention group that regained ADLs at 12 months vs. control
Talkowski et al., 2009 -SNF vs IRF	Inpatient rehabilitation		x											Being more active in rehab had better functional abilities at 3 and 6 months and recovered more of their pre-fracture ability
Mitchell et al., 2001	Inpatient rehabilitation to home		x	**X**									x	□leg extensor power □Disability □ Functional reach □ ADL, no difference at end of follow-up (16 weeks).
Moseley et al., 2009 -weightbearing vs. Low weightbearing program (usual care)	Inpatient rehabilitation to home	x	x										x	□ Functional abilities Patients with CI in intervention improved significantly more that anyone in control group in ADLs, pain, falls self-efficacy

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
Naglie et al., 2002	Inpatient rehabilitation to home	**X**	x				x						x	Patients with mild-moderate CI had no decline in ambulation, residential status at 6 months
Shyu et al., 2010	Inpatient rehabilitation to home	**X**	**X**				**X**	**X**	**X**	x	**X**		x	□ pain, □ vitality, mental health, physical function, physical role perception at any point in 1st year
Shyu et al., 2013 -4 month rehab vs. 12 month rehab vs. usual care	Inpatient rehabilitation to home	**X**	**X**				**X**	**X**	**X**	x	**X**	**X**	x	□ health related quality of life in both rehab groups Intervention group effects □ed to 6 months to max. at 12 month
Tseng et al., 2016 -4 month rehab vs. 12 month rehab vs. usual care	Inpatient rehabilitation to home	**X**	**X**				**X**	**X**	**X**	x	**X**	**X**	x	□ good projection of HRQoL with 12 or 4 month rehab □good projection of mental health with 4 month rehab
Huusko et al., 2002	Inpatient rehabilitation to home	**X**	**X**								**X**		x	Faster recovering of ADL No sig. difference between groups in ADL after 1 year.
Gregersen et al., 2011 -personalized	Nursing Home	x	**X**		x		x			x	x	x	x	□ readmission rate □ 30 day mortality

Study (author, year)	Location	Multidisciplinary Team Care	PT/OT Program	Progressive Strengthening Exercise Program	Motivation/Goal Setting	Patient Education Program	Nutrition Program/ Consultation	Patient Caregiver Status Considered	Screening for/ Management of Cognitive Impairment	Pain Management Program	Discharge Planning	Secondary Prevention Program	Control/Comparison Group	Significant Findings
rehab vs standard program														
Ponten et al., 2015	Nursing Home	x	**X**										x	Intervention group rehabilitation stay 42.0 days compared to 67.2 days

'X' (bolded or unbolded) indicates component of care was present in study

X' indicates component of care was altered or enhanced in the intervention group versus a comparison or control group

Bolded study author/year indicates the study included those with cognitive impairment

6MWT= 6 minute walk test, ADL= activities of daily living, CI= cognitive impairment, FIM= functional independence measure, HRQoL = health related quality of life, IADL= instrumental activities of daily living, IRF = inpatient rehabilitation facility, N/A= no significant difference found, NWBE= non-weightbearing exercise, OT= occupational therapy, PT= physiotherapy, rehab. = rehabilitation, sig. = significant, SNF = skilled nursing facility, WBE= weightbearing exercise