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The Impact of Severity, Timing, and Sex on Outcomes of Inpatient Stroke Rehabilitation

Tanlaka, Eric Fover

UNIVERSITY OF CALGARY

The Impact of Severity, Timing, and Sex on Outcomes of Inpatient Stroke Rehabilitation

by

Eric Fover Tanlaka

A THESIS

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Abstract

Stroke severity and time to rehabilitation admission are important factors in influencing stroke rehabilitation outcomes. We aimed to determine the impact of: (1) stroke severity and timing to inpatient rehabilitation admission on length of stay, functional gains, and discharge destination; and (2) age and sex differences in time to rehabilitation, length of stay in rehabilitation, and discharge destination for stroke patients in Alberta.

The first manuscript offers a discussion of post-positivist critical multiplism and its value for nursing research and describes the steps for conducting critical multiplist nursing research using stroke rehabilitation as an example. We identify that post-positivist critical multiplism offers a useful, rigorous approach that relies on a step by step method and a collaboration with a team of scholars who offer different perspectives, open questioning and critique, and rigorous attention to minimize biases throughout the research process.

We examined a large retrospective cohort to address the research aims. In the second paper, we identified that length of time to rehabilitation admission was not significantly different between stroke severities. Individuals with moderate and severe stroke made significantly larger FIM gains than mild stroke during inpatient rehabilitation. LOS was longer with increasing stroke severity. Time to inpatient rehabilitation admission had small, but significant impacts on functional gains and LOS. Patients with shorter times to rehabilitation admission and those with mild stroke were more likely to be discharged home without needing health services.

In the third paper, we identified that mean length of time from acute care admission to inpatient rehabilitation admission was not significantly different between males and females. There was no significant difference in mean FIM change between males and females during inpatient rehabilitation. Mean LOS in rehabilitation was slightly longer among females compared to males. Male patients and those of younger age were more likely than females and those of older age to be discharged home without needing homecare.

In conclusion, stroke severity had a significant impact on the conduct of inpatient rehabilitation. The impact of timing on functional gains and LOS was small. Differences in LOS and discharge destination based on sex and age were significant.

Preface

From the work in this thesis, the following manuscripts were either published or will be submitted to peer reviewed journals. For each of the manuscripts, Eric F. Tanlaka led the design, data analysis, interpretation, and writing of the manuscripts. Each step of the research process was conducted with guidance from the thesis committee (Drs. Kathryn King-Shier, Theresa Green, Cydnee Seneviratne, and Sean Dukelow). All authors named in the manuscripts contributed important intellectual content and provided critical review of the manuscripts.

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Permission to reproduce these papers was obtained from the publishers.

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A special thank you to my wife, Irene, for your love, support, and encouragement throughout my studies. Your understanding and cooperation contributed significantly to my success. To my children, Leroy, Ciel, Halle, and Axel, you were my greatest joy. I thank you for your love and for being great kids. To my parents, brothers, and sisters, I thank you for being a wonderful supportive family.

Dedication

This Thesis is dedicated to my children, Leroy Tanlaka, Ciel Tanlaka, Halle Tanlaka, and Axel Tanlaka. You all are the joy of my life and the greatest gift I could ever hope for. Your coming to this world completed my life story.

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List of Abbreviations

ADL	Activities of Daily Living
AHS	Alberta Health Services
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
AVERT	A Very Early Rehabilitation Trial
BCMA	British Columbia Medical Association
BI	Barthel Index
CI	Confidence Interval (95%)
CIHI	Canadian Institute of Health Information
CT	Computed Tomography
DAD	Discharge Abstract Database
ESD	Early Supported Discharge
FIM	Functional Independence Measure
FMC	Foothills Medical Centre
LOS	Length of Stay
MRI	Magnetic Resonance Imaging
mRS	Modified Rankin Scale
NIHSS	National Institutes of Health Stroke Scale
NINDS	National Institutes of Neurological Disorders and Stroke
NRS	National Rehabilitation System
OAI	Onset to Admission Interval
OR	Odds Ratio
OSN	Ontario Stroke Network
RMI	Rivermead Mobility Index
SD	Standard Deviation
tPA	Tissue Plasminogen Activator
UDSMR	Uniform Data System for Medical Rehabilitation
VEI	Very Early Intervention

Epigraph

"Access to a waiting list is not access to health care".

~ Chief Justice Beverley McLachlin

Chapter 1 Introduction

1.1 An Overview of Stroke in Canada

Stroke is the third leading cause of death and leading cause of adult disability in Canada. Approximately 50,000 Canadians suffer a stroke each year with an annual mortality rate of 17.9/100,000 individuals (Heart & Stroke Foundation, 2014). In the province of Alberta, approximately 4,500 people suffer a stroke annually (Jeerakathil, Thomson, & Hill, 2010). The prevalence of stroke rises sharply after the age of 55 and one quarter of Canadians who suffer stroke are under the age of 65 (Heart and Stroke Foundation, 2014). Stroke costs the Canadian economy $3.6 billion ($200-$300 million in Alberta) per year in direct and indirect medical expenses (Heart & Stroke Foundation, 2014; Jeerakathil et al., 2010). Direct medical costs associated with stroke include: emergency services, hospitalizations, rehabilitation, physician services, diagnostics, medications, allied health professional services, homecare, medical/assistive devices, and changes to residence and paid caregivers, and indirect costs associated with stroke are lost wages and decrease productivity (Mittmann et al., 2012). The financial burden of ischemic stroke in Canada includes an average cost of $74,353 per patient per year, with a two-fold increase in cost for patients with disabling stroke compared to those with non-disabling stroke (Mittmann et al., 2012). Approximately 741,800 Canadian adults aged 20 or older (25,000 Albertans) are currently living with the effects of stroke which may include physical, cognitive, emotional, and behavioural problems that limit their ability to live independently and/or return to activities they once enjoyed (Heart & Stroke Foundation, 2014).

Due to physical (e.g., limited mobility) and cognitive (e.g., decreased memory, confusion, and communication difficulty) impairments, initial assessment is necessary to determine the need for or type of ongoing rehabilitation services. Services that may be needed by stroke survivors include occupational therapy, physical therapy, speech and language pathology, recreational therapy, social work, and nursing. These can be delivered in hospital, in outpatient settings or in the home. About 20-30% of patients admitted to acute care hospitals for stroke are referred to rehabilitation units (located within the same facility as the acute care unit or in a different facility), following the acute stroke phase, to improve their functional (motor or physical) and cognitive recovery. In Canada, stroke patients are admitted to rehabilitation units in a median of 12 days from stroke onset with a median total admission Functional Independence Measure (FIM; measure of physical and cognitive disability with a focus on burden of care) score of 74 points (IQR 56–91 points; Hebert et al., 2016).

The FIM consists of eighteen items made up of thirteen motor items and five cognitive items. The motor items are subdivided into four subscales: self-care, sphincter control, transfers, and locomotion. Cognitive items are classified under two subscales: communication and social cognition. Individual functional levels are described as independent (no helper required), modified dependence (helper), and complete dependence (helper). Items are rated on a 7-point ordinal scale. The assessor has the option of choosing from total assist (1) to complete independence (7). The sum of the item scores indicates the severity of patient's functional or cognitive disability and reflects the amount of assistance that is required for an individual to complete daily living activities. The total scores range from 18 to 126 points, with higher scores representing

greater functional independence. Cognitive FIM scores (the sum of individual cognitive subscale items) range from 5 to 35, and motor FIM scores (the sum of individual motor subscale items) range from 13-91.

Stroke severity has historically been classified based on total FIM admission scores. Scores of <40 were considered severe, 40-80 were considered moderate and >80 were considered mild (Stineman et al., 1998; Ween et al., 1996). The FIM has been tested for reliability, validity, responsiveness to change, feasibility for use, and meaningfulness in clinical settings when administered by trained and tested personnel (UDSMR, 2015). The FIM is associated with the number of hours someone would require from another person for personal care on a daily basis in the home setting (UDSMR, 2012).

The length of time stroke patients wait for a rehabilitation unit program influences their rehabilitation outcomes. Indeed, several investigators have found that stroke patients who are transferred sooner to a rehabilitation program have improved functional outcomes (Horn et al., 2005; Hu, Hsu, Yip, Jeng, & Wang, 2010; Huang, Chung, Lai & Sung, 2009; Kim & Paik, 2012; Massucci et al., 2006; Maulden, Gassaway, Horn, Smout, & DeJong, 2005; Paolucci et al., 2003; Paolucci et al., 2000; Salter, Hartley & Foley, 2006; Scrutinio et al., 2015; Wang, Camicia, DiVita, Mix & Niewczyk, 2015; Wang, Camicia, Terdiman, Hung, & Sandel, 2011). These outcomes are most often measured by discharge FIM scores (motor and cognitive scores), length of stay in rehabilitation unit, discharge destination, Barthel Index (BI) scores (activities of daily living and mobility scores), modified Rankin Scale (mRS) scores (disability or dependence in daily activities scores), and Rivermaid Mobility Index (RMI) scores (mobility in gait, balance, and transfers scores). Most researchers have found an increase in motor and cognitive gains in

function for both moderate and severe stroke patients who are admitted earlier to a rehabilitation unit (Ancheta, Husband, Law & Reding, 2000; Scrutinio et al., 2015; Wang et al., 2011). It is entirely possible that moderate (admission FIM score range of 40-80) and severely impaired (admission FIM score less than 40) stroke patients respond differently to rehabilitation with respect to motor and cognitive gains in their recovery.

1.2 Background/Literature Review

1.2.1 Effects of early and late initiation of rehabilitation on functional outcomes.

Animal studies reveal that the injured brain begins self-repair processes (e.g., angiogenesis, neurogenesis, and axonal sprouting) within hours to days after ischemic stroke (Bix, Gowing, & Clarkson, 2013; Ohab, Fleming, Blesch & Carmichael, 2006). The self-repair mechanisms include: resolution of edema surrounding the infarcted area of the brain, reperfusion of ischemic penumbra causing non-functioning neurons to resume functioning with subsequent clinical improvement, and the resolution of diaschisis leading to the return of neuronal function in the portion of the brain connected to the damaged area (Teasell & Hussein, 2016). These self-repair processes are however limited and require other forms of intervention to overcome the physical and cognitive impairment that may be suffered after stroke. Investigators found that rats exposed to an enriched rehabilitation environment beginning on day 5 following a stroke event experienced significantly greater recovery compared to rats whose rehabilitation started on day 14 and day 30 following a stroke event (Biernaskie et al., 2004). Further, there was no significant difference in recovery between rats that began rehabilitation 30 days

post stroke compared to controls (Biernaskie et al., 2004). Early rehabilitation is critical in maximizing post-stroke recovery in an animal model.

In human studies, investigators have demonstrated that early initiation of rehabilitation after stroke events improved functional outcomes of patients at discharge from the rehabilitation unit (Horn et al., 2005; Hu et al., 2010; Huang et al., 2009; Matsui et al., 2010; Musicco et al., 2003). In a study that focused on the influence of time to rehabilitation initiation on short and long term outcomes of stroke patients, researchers found that patients whose rehabilitation was initiated early (0-7 days post stroke) had better long-term outcomes (increase in quality of life and decrease in disability) compared to those whose rehabilitation was initiated 15-30 days later or more than 30 days later (Musicco et al., 2003). When researchers examined associations between rehabilitation commencement time and walking and toilet transfer function in stroke patients, results indicated that initiating gait training within 3-77 hours of stroke was significantly ($p<0.001$) associated with higher discharge walking FIM and higher discharge toilet transfer FIM (Horn et al., 2005). Further, a retrospective cohort study of 154 patients with ischemic stroke revealed that patients who received very early intervention (VEI; occupational therapy and physical therapy) had a significantly ($p<0.001$) lesser degree of disability at discharge from rehabilitation unit (Matsui et al. 2010).

Investigators also studied multidisciplinary rehabilitation (occupational and physiotherapy) commencement times to determine their effects on functional recovery of stroke patients. The authors found a negative correlation between time to rehabilitation initiation and BI improvement at 1 month and at 1 year suggesting that early initiation of

rehabilitation improves self-care abilities, leads to better performance of daily activities, and provides lasting effects on functional recovery of stroke patients up to 1 year (Huang et al., 2009). In a case-control study of 135 consecutive patients with ischemic and hemorrhagic stroke, researchers found that starting treatment within 20 days after stroke occurs is significantly associated with a six times greater probability of a high therapeutic response ($p<0.005$), and initiating treatment after 20 days is significantly associated with a five times greater probability of a risk of a poor response ($p<0.05$; Paolucci et al., 2000). According to these authors, the proportion of patients having a low therapeutic response increased with increases in OAI, and the proportion of patients having a high therapeutic response decreased with increases in OAI. This suggests that early initiation of rehabilitation leads to greater improvement in performance of activities of daily living, with greatest improvement in motor and cognitive function occurring within early weeks of initiating rehabilitation.

However, when researchers compared the effects of high dose, frequent, and very early mobilization (out of bed sessions starting within 24 hours of stroke onset) with usual care, findings from the ‘A Very Early Rehabilitation Trial’ (AVERT) were somewhat surprising. Patients who received very early and frequent mobilization had reduced odds (OR = 0·73; 95% CI; 0·59-0·90; p=0·004) of a favorable outcome (mRS score of 0-2) 3 months after stroke compared to those who received usual care, after controlling for age and stroke severity (Bernhardt et al., 2015). The reasons for this reduction in odds of a favorable outcome remain unclear and need further investigation. However, some authors suggest that very early mobilization of patients with severe stroke may enhance blood flow to the fragile ischemic penumbra (resulting to oxidative

stress and platelet adhesion and aggregation; Lin, Wang, & Yu, 2016), cause brain edema, and increase brain infarct (Bernhardt et al., 2015).

1.2.2 Factors that prolong length of time to rehabilitation.

Multiple factors prolong length of time from stroke symptom onset to rehabilitation unit admission for many stroke patients. These factors include: (a) stroke characteristics (e.g., hemorrhagic stroke, cortical stroke, bilateral stroke), history of prior stroke, NIHSS admission score; Roth et al., 2007; Salter et al., 2006), (b) severity of illness and medical complications (e.g., presence of enteral feeding tube, tracheostomy, pneumonia, and urinary tract infection; Ancheta et al., 2000; Roth et al., 2007), (c) discharge patterns and lack of post-acute care services (e.g., lack of rehabilitation units, nursing homes, assisted living facilities, and home care services), (d) lack of insurance coverage (Gezmu, Gizzi, Kirmani, Schneider, & Moussavi, 2014), (e) lack of readiness to engage in rehabilitation program (Hakkennes, Brock & Hill, 2011; Roth, Lovell, Harvey & Bode, 2007; Willems et al., 2012), (f) shortage of staff (e.g., nurses, occupational therapists, physical therapists) in rehabilitation units, (g), poor communication and cooperation among health professionals and among rehabilitation units/facilities, (h) lack of public education regarding stroke symptoms and the seriousness of the disease (Mache et al., 2014), and (i) socioeconomic characteristics (e.g., married, African American race, and younger age; Roth et al., 2007; Salter et al., 2006).

Variation in length of time to rehabilitation due to medical complications has also been observed between moderate and severe stroke patients. Researchers found a significant difference in the mean number of medical complications among severe stroke patients admitted to a rehabilitation unit within 29-42 days (4.1 ± 0.35; $p < 0.0001$)

compared to moderate stroke patients admitted within 29-42 days (2.67±0.89; $p<0.0001$; Ancheta et al., 2000). Based on these findings, researchers suggest that medical complications increase with severity of stroke and delays in transfer to rehabilitation unit (Ancheta et al., 2000). In another cohort of 2,457 patients consecutively admitted to rehabilitation unit, stroke patients with tracheostomy had a mean onset to rehabilitation unit admission days of 39 compared to 15 days for patients without a tracheostomy (Roth et al., 2007). When researchers analysed stroke characteristics, patients with hemorrhagic stroke had a mean onset to rehabilitation unit admission days of 24 days compared with 14 days for patients with ischemic stroke (Roth et al., 2007), suggesting that patients who suffer hemorrhagic stroke experience more delays in admission to rehabilitation unit relative to those with ischemic stroke (Roth et al., 2007; Salter et al). Salter et al. (2006) found no significant association between age, side of stroke, risk factors, and time to rehabilitation unit admission.

1.2.3 Strategies for reducing length of time to rehabilitation.

Canada is one of many countries where there are issues with access to inpatient rehabilitation programs for stroke. Several strategies have been recommended by the Ontario Stroke Network (OSN), the Canadian Institute of Health Information, and the British Columbia Medical Association (BCMA) as best practice guidelines for reducing wait times for admission to a rehabilitation unit program (BCMA 2006; CIHI, 2014; Hall et al, 2013). These strategies are summarized below.

1.2.4 List of recommendations for reducing wait times adapted from BCMA 2006; CIHI, 2014; Hall et al, 2013.

1) Use of standardized assessment tool (the AlphaFIM assessment tool) to identify and quickly transfer patients in greatest need, who would benefit the most from early rehabilitation. With the use of AlphaFIM, patients are assessed on day 3 post stroke and a decision is made whether or not to transfer the patient to a rehabilitation unit (Hall et al., 2013; Willems et al., 2012).
2) Collaboration between rehabilitation programs and acute stroke care providers to transfer patients to rehabilitation units as soon as they are medically stable (New & Poulos, 2008; New, 2009).
3) Discharge of patients with mild stroke to outpatient rehabilitation programs and transfer patients with moderate and severe stroke to rehabilitation unit programs (Hall et al., 2013; New, Andrianopoulos, Cameron, Olver & Stoelwinder, 2013).
4) Identification and reduction of barriers to admission for patients with severe stroke as evidence indicates severely impaired patients benefit from rehabilitation (Hall et al., 2013; Rabadi, H., Rabadi, F, Edelstein, Peterson, 2008).
5) Multidisciplinary team assessment to identify rehabilitation needs and implement treatment early to prevent medical complications (Teasell et al., 2008; New et al., 2013). Preventing complications like pneumonia and urinary tract infection reduces length of stay in acute care and consequently reduces length of time patients have to wait to be admitted to rehabilitation unit (Roth et al., 2007).
6) Increase in number of rehabilitation beds would increase the capacity of a rehabilitation unit and reduce wait times (Teasell et al., 2008; Willems et al., 2012).

7) Implementation of early supported discharge (ESD) program to improve efficiency, reduce length of stay in acute care, and reduce length of time stroke patients requiring inpatient rehabilitation are transferred to rehabilitation unit programs.
8) Increase in funding to cover costs associated with early identification of eligible candidates, and treatment of medically complex and disabled patients (Teasell, et al., 2008).
9) Use of emergency department wait times reduction strategy to reduce backlog in the system.
10) Use of wait list management strategy which allows for the prioritization of wait lists to provide timely care. (CIHI, 2014; BCMA, 2006).
11) Use of operating room efficiency strategy which enables more patients to be treated in less time (CIHI, 2014).
12) Use of central intake models which provide one location for patients to access care. The central intake office coordinator determines eligibility for rehabilitation and arranges admission to rehabilitation programs based on bed availability and priority (CIHI, 2014; BCMA, 2006).
13) Use of LEAN programs which systematically eliminate inefficiencies in health care, and operating room efficiency which allows more patients to be treated in less time (CIHI, 2014; CFHI, 2014).

14) Primary health care improvement strategy which prevents and treats conditions before they require acute care, thus increasing capacity (CIHI, 2014; BCMA, 2006).

A few of these suggested strategies to reduce rehabilitation wait times are highlighted here. Extra funding covers costs associated with early identification of stroke patients with rehabilitation needs and treatment of those with medical complications. However, this measure serves as a short-term wait time reduction strategy as it ceases to be effective when funding ends. Wait list management is expected to ease prioritization of stroke patients to ensure timely care is provided to those with greatest needs who are likely to benefit most from rehabilitation. But, the lack of a valid and reliable means to measure rehabilitation needs and potential benefits from early rehabilitation makes it difficult to achieve this objective (Borowitz, Moran, & Siciliani, 2013). In addition, stroke patients who are deemed to benefit less from rehabilitation end up waiting longer to be admitted to a rehabilitation program. Regarding wait time guarantees, clinicians are required to provide care within a given time frame, sanctions are given if the targets are not met, and financial incentives are offered for working hard to reduce wait times (CIHI, 2014; BCMA, 2006). With the wait time guarantees strategy, wait times reduce when fines are threatened but increases when the threat is removed and supervision of times slackens (Jonsson et al., 2013). The wait time guarantee strategy could also be interpreted as simply shifting the problem to other parts of the health care system.

1.2.5 Alberta health services practice model for reducing wait times.

The Stroke Patient Flow Model is the strategy used at Foothills Medical Centre (FMC) to reduce the average length of time stroke patients wait to be admitted to rehabilitation units. With this model, the average length of time stroke patients wait for admission to a rehabilitation unit program when referred from acute care unit at Foothills Medical Centre is one day (J. Knox, personal communication, February 16, 2016). This is certainly lower than the national average of 12 days from stroke symptoms onset (Herbert et al., 2016). Alberta Health Services is making other plans to reduce rehabilitation admission wait times. These include use of case managers in rehabilitation units, and expansion of the Electronic Health Record (J. Knox, personal communication, February 16, 2016). Creating more rehabilitation units in long-term care increases rehabilitation beds and solves the problem of large stroke patient volume experienced in Calgary seasonally (J. Knox, personal communication, February 16, 2016). Case management streamlines communication between units/facilities, assesses stroke patients' rehabilitation needs quickly, and facilitates admission and care. Other potential benefits of case management are decreased cost of care, reduced length of stay in acute care or rehabilitation unit, reduced length of time waiting for admission to rehabilitation unit, and increased patient satisfaction (Heart and Stroke Foundation of Ontario, 2004). Expanding the electronic health record enables authorized healthcare providers to have instant access to a wide network of electronic health information on individual patients when needed at the point of care (Herbert et al., 2016). This eliminates the length of time healthcare providers wait for medical records to be sent from other health institutions before making decisions related to care or transfer to rehabilitation programs.

1.2.6 Effects of length of time to rehabilitation unit on FIM scores for moderate and severe stroke patients.

Most research has revealed that moderate and severe stroke patients admitted to rehabilitation units early have improved mean discharge FIM scores compared to those with delayed admission, with greatest improvement noted among patients with moderate stroke than severe stroke (Ancheta et al., 2000; Maulden et al., 2005; Scrutinio et al., 2015; Wang et al., 2011; Wang et al., 2015). Changes in FIM score may be used to measure effectiveness of rehabilitation or recovery and evaluate the return of motor and cognitive function (shown by their ability to live independently and/or perform activities they once enjoyed). Researchers have noted differences in FIM gain between moderate and severe stroke patients. Ancheta et al. (2000) found that patients admitted 0-14 days post moderate stroke had the greatest improvement in functional and cognitive recovery (based on FIM scores), and that patients admitted 29-42 days post severe stroke had the least improvement in functional and cognitive recovery (Ancheta et al., 2000). Maulden et al. (2005) examined associations between time to rehabilitation unit admission from stroke onset and domains of impairment such as motor function, mobility function, and activities of daily living (ADL). These researchers found a significantly negative association between longer length of time to rehabilitation unit and lower discharge total FIM score, discharge motor FIM score, discharge mobility FIM score, and discharge ADL FIM score for both moderate and severe stroke patients. These authors imply that patients admitted to rehabilitation unit early would likely have better physical function, and increased ability to mobilize and perform activities of daily living. Other researchers found a negative association between time to rehabilitation unit admission and FIM gain

for both moderate and severe stroke patients suggesting that fewer days from stroke onset to rehabilitation unit admission improves functional and cognitive recovery of stroke patients (Salter et al., 2006; Wang et al., 2011).

Factors associated with functional outcomes and risk of mortality of stroke patients has also been investigated. Researchers found an independent negative association between time from stroke onset to rehabilitation unit and FIM gain ($p<0.001$) for all stroke patients (Scrutinio et al., 2015), suggesting that patients admitted to rehabilitation unit early experience higher gains in motor and cognitive function, and a lower risk of dying compared to patients with lower FIM gains. Analysis of time to rehabilitation unit admission as a predictor of functional and cognitive improvement revealed a significant increase in mean discharge FIM scores for all stroke patients ($p<0.001$), with the greatest improvement noted among patients admitted to rehabilitation unit within 1-14 days post stroke (Rossi et al., 1997). Based on these results, investigators suggest that patients admitted to rehabilitation unit early have greatest improvement in ability to perform daily activities independently compared to those with delayed admission.

1.2.7 Early rehabilitation and length of stay in rehabilitation unit for moderate and severe stroke patients.

Post stroke patients admitted to a rehabilitation unit early experience shorter length of stay compared to patients with delayed admission (Ancheta et al., 2000; Maulden et al., 2005; Rossi et al., 1997; Salter et al., 2006; Wang et al., 2011; Wang et al., 2015). This suggests that fewer days from stroke onset to rehabilitation unit admission leads to shorter length of stay in rehabilitation unit (Salter et al., 2006). The

effects of time to rehabilitation unit admission on length of stay vary by stroke severity (Ancheta et al., 2000; Wang et al., 2011; Maulden et al., 2005). Moderate stroke patients admitted to rehabilitation unit early have a significantly shorter length of stay relative to severe stroke patients (Ancheta et al., 2000; (Wang et al., 2011; Maulden et al., 2005). This difference in length of stay by stroke severity may be attributed to the fact that patients with less severe stroke and/or medical comorbidities are likely to begin rehabilitation sooner and progress faster, resulting in a shorter length of stay in rehabilitation unit. Initiating rehabilitation early (prior to transfer to rehabilitation unit) may give stroke patients a head start on entering a rehabilitation program and enable them to progress faster through rehabilitation. Additional stimulation from early rehabilitation may enhance blood flow to injured areas, promote clearance of toxic waste (e.g., free radicals) and stimulate healing and recovery, thus shortening stroke patients' length of stay in rehabilitation unit (Maulden et al., 2005).

1.2.8 Early rehabilitation and discharge destination for moderate and severe stroke patients.

Discharge destination is an important outcome of stroke rehabilitation, potentially influenced by time from stroke onset to rehabilitation unit admission and other factors like institutional policies, patient preferences, spouse/family preferences, lack of insurance coverage, socioeconomic status, rate of recovery, lack of rehabilitation beds (in case of discharge to nursing home), and lack of staff/caregivers (in case of discharge to home care or assisted living facility). Stroke patients admitted to a rehabilitation unit early are more likely to be discharged to community settings (i.e., to patient's home, group home, or an independent assisted living environment) compared to those with

delayed admission (Rossi et al., 1997; Wang et al., 2015). The difference in rate of discharge to the community between stroke patients admitted to a rehabilitation unit early and those with delayed admission to rehabilitation remains insignificant (Rossi et al., 1997), possibly due to the fact that patients with delayed admission to rehabilitation also experience spontaneous or natural recovery over time and are discharged to the community. However, analysis of time to rehabilitation unit admission and discharge destination based on stroke severity has shown that patients with delayed admission have an increased likelihood of transfer back to acute care with greatest likelihood seen among severely impaired stroke patients (Ancheta et al., 2000). Investigators therefore suggests that the greatest proportion of patients with longest stroke onset to rehabilitation unit admission interval require transfer back to acute care irrespective of stroke severity. The more medically complex patients such as, those with multiple comorbidities (e.g., renal failure, and symptomatic coronary artery diseases) and those with medical complications (listed earlier) often have longer acute care length of stay and are more likely to be transferred from rehabilitation units back to acute care.

1.2.9 Patient's sex and functional outcomes.

Differences in functional outcomes of male and female stroke patients have been reported in previous studies (Olsen, Andersen, & Andersen, 2012; Paolucci et al., 2006; Reeves et al., 2008; Sue-Min, Duncan, Dew, & Keighley, 2005). Researchers from other countries have suggested that female stroke patients experience poorer functional outcomes than male stroke patients following inpatient rehabilitation (Denti et al., 2013; Glader et al., 2002; Kapral et al., 2005; Olsen, Andersen, & Andersen, 2012; Paolucci et al., 2006; Reeves et al., 2008; Sue-Min, Duncan, Dew, & Keighley, 2005; Wu et al.,

2014). In previous large Canadian (n = 3,323) and Danish (n = 26,818) studies, examinations of sex differences in disability, length of stay (LOS) and discharge destination of post-stroke patients have shown that female stroke patients experience greater disability at 6 months post-stroke, have longer LOS in rehabilitation, and are more likely to be discharged to a long-term care facility compared to male stroke patients (Kapral et al., 2005; Olsen, Andersen, & Andersen, 2012). These differences were attributed to decreased physical function prior to rehabilitation admission, reduced independence in performance of daily living activities, lack of social support, lack of spouse/partner (Denti et al., 2013; Kapral et al., 2005), history of stroke, increased body mass index, increased stroke severity, and nursing home residence prior to stroke onset (Lisabeth et al., 2014).

1.2.10 Patient's age and discharge destination.

Patient's age at admission to inpatient rehabilitation has been found to predict their discharge home following rehabilitation (Freburger et al., 2006; Saposnik et al., 2008). Researchers have reported that patients under 65 years are three times more likely to be discharged home compared to those over 85 years who are more likely to be institutionalized (CIHI, 2009). Possible reasons why older patients are more likely to be institutionalized are increased age, general frailty, presence of comorbidities, and decreased support system essential for transitioning to home after discharge from rehabilitation (CIHI, 2009; Saposnik et al., 2008).

1.3 Objectives, Research Questions/Hypotheses

The objective for the second manuscript (severity and timing) was to evaluate the differences in stroke rehabilitation outcomes (functional gains, length of stay, discharge

destination) based on stroke severity, given known differences in Ontario (Hall et al., 2016). Further, we examined whether the time from acute care admission to inpatient rehabilitation admission had an influence on these same outcomes given suggestions from the literature on its importance. We hypothesized that increased stroke severity would be related to larger functional gains, longer lengths of stay and increased discharge to living environments that provided higher levels of assistance with daily activities. We also hypothesized that time spent waiting for entry to inpatient stroke rehabilitation care would lead to poorer outcomes.

The objective for the third manuscript (sex differences) was to examine the differences in functional gains, LOS, discharge destination based on patients' sex. We further determined whether patient's age at acute care admission had an influence on discharge destination, and whether living with a spouse or partner at discharge from rehabilitation had an influence on discharge destination. We hypothesized that female sex would be related to worse functional gains, longer LOS and higher rates of discharge to living environments that provided higher levels of assistance with daily activities. We also hypothesized that increased age and living without a spouse or partner would lead to discharge to living settings that provide additional care to patients.

1.4 Outline of the Thesis

The initial manuscript (Chapter Two) was a discussion of post-positivist critical multiplism, a philosophical perspective about undertaking research and its value for nursing research, using stroke rehabilitation research as an example. The term 'postpositivism' refers to a philosophy that considers human values, experiences, and limitations important in determining objective knowledge about reality, and that supports

the use of multiple perspectives and methods to generate knowledge (Tanlaka et al., 2019). The term ‘critical multiplism’ refers to the ability to use/combine both quantitative and qualitative methods when conducting research (Henderson, 2011). Included in this thesis are also two manuscripts describing studies conducted using quantitative methods to examine the impact of severity, timing, and sex on outcomes of inpatient stroke rehabilitation. The steps for conducting critical multiplist research were used to represent part of what critical multiplist stroke nurse researchers would do to generate knowledge and/or explain complex human phenomena. The manuscripts included in this document are formatted for independent publication as part of a manuscript-based thesis. The chapters are uniquely designed with specific objectives but are linked by a common objective of improving the quality of care of stroke patients undergoing rehabilitation in Alberta.

In Chapter Three, we describe a study of a retrospective cohort of stroke patients that uses a large sample to examine the impact of severity and timing to rehabilitation on functional outcomes (functional gains, LOS, and discharge destination) of stroke patients undergoing inpatient rehabilitation in Alberta. Further, we assess for associations between stroke severity and functional outcomes, and timing to rehabilitation admission and functional outcomes following inpatient rehabilitation. We also assess whether stroke etiology influences discharge destination.

In Chapter Four, we examine the differences in functional outcomes (mentioned above) between male and female stroke patients undergoing inpatient rehabilitation in Alberta. We further determine whether age has an influence on discharge destination, and whether living with a spouse or partner has an influence on discharge destination.

Finally in Chapter Five, we present a summary of findings from the three manuscripts, implications for practice as well as strengths and limitations identified for the second and third manuscripts, the impact of using a post-positivist critical multiplism perspective for this work identified (as well as implications for further research in this area), and conclusions.

Chapter 2 Postpositivist Critical Multiplism: Its Value for Nursing Research

Abstract

Aim

Following persistent criticisms of logical positivism, post-positivism emerged as a philosophy of science for developing nursing knowledge. Here, we offer a discussion of post-positivist critical multiplism and its value to nursing research.

Design

Discussion paper.

Methods

We searched relevant literature published between 1978-2018, indexed in CINAHL, Medline, PubMed, or PsychINFO. Findings are discussed in the context of stroke nursing research.

Results

Post-positivist critical multiplism acknowledges the importance of human influence on knowledge development and enables nurse researchers to use multiple approaches to address complex human phenomena. In doing so, the unique perspectives of stakeholder groups including patients, family members, knowledge users can be respected. There are certain steps that can be used by critical multiplist investigators to approach stroke nursing research. Using these steps and the critical multiplist approach may minimize preconceptions or biases associated with using one research method over another and maximize confidence in resultant research knowledge.

Key words

Post-positivism, philosophy, methodology, paradigms, research, critical multiplism, nursing, science.

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INTRODUCTION

Over the decades, scholars have expressed a variety of perspectives about the contribution of science to knowledge development. Some scholars (positivists) have emphasized that empirically derived data through application of rigorous scientific methods are legitimate scientific knowledge (Rutherford & Ahlgren, 1991). Others have argued that certain phenomena are unobservable and cannot be empirically tested (Gratton & Jones, 2010). Over time, positivism's characteristic confidence in the possibility of certain knowledge has yielded to a different approach to science. Post-positivist perspectives have arisen as an acknowledgement that human limitations interfere with the enactment of empirical observation, the application of reason and logic and, thus, in the pursuit of truth as certainty.

While positivism situates truth as being embedded in an objective reality somewhere *out there*, post-positivism positions truth as being bound by context (Panhwar, Ansari, & Shah, 2017), human action, and interaction (Heisenberg, 1930). Post-positivism is a contemporary philosophy of science that emerged from various critiques of logical positivism. Whereas traditional or logical positivist thinking infers detached observation and experimentation as a route to certainty, post-positivist thinking views truth as that which is left when alternative propositions cannot be shown to hold up in the face of the possibilities of an unpredictable world (Popper, 1963).

Nursing occupies a privileged position amid, even caught between, the worlds of so-called objective science and the flux of human experience. The practice of nursing cannot, therefore, be fully realized solely by relying on singular epistemological positions. Answers to questions of "how many?" and "how much?" offer only a partial

answer to complex nursing practice problems. Understanding experiences of health and illness seems meaningless without the knowledge that helps nurses to respond effectively to disease and suffering (e.g., acting with moral agency). In order to make sense of and engage in moral practice, nurses need access to complex knowledge for practice, derived from a multitude of perspectives and sources. In this article, we argue in support of the value of critical multiplism for nursing research. We briefly review how reality and truth are situated in post-positivism; the value of critical multiplism as an approach to nursing research; and posit what stroke nursing research based on critical multiplism might entail.

Data sources

Relevant articles were identified by searching CINAHL, Medline, PubMed, and PsychINFO databases published from 1978-2018. Keywords used in the search were post-positivism, philosophy, methodology, paradigms, research, critical multiplism, nursing, and science. Fundamental textbooks were also used to help develop arguments in this paper.

Ethics

Ethics approval was not required for this manuscript.

DISCUSSION

Postpositivism, Reality, and "Truth"

Post-positivism rejects the neutrality and human detachment that are characteristic of logical positivism. While truth may lie "out there," for post-positivists the limitations of humans to be able to observe and apprehend phenomena must be taken into account when making truth claims (Letourneau & Allen, 1999). Post-positivists assume then, that "reality" and "truth" are conditional and can be understood in different ways (Ryan,

2006). Unlike positivists who understand truth as *certainty*, post-positivists view certainty more cautiously, aware that aforementioned human limitations and characteristics interfere with the possibility of knowing things in the world as they are.

That is not to say that post-positivism arose as an outright rejection of scientific method. Post-positivist methods require accuracy, sound reasoning, and production of evidence. However, post-positivists consider some of the instruments of science, such as self-reports, interviews, and questionnaires as tools that increase researchers' abilities to infer, but not to know with certainty. Post-positivism is a challenge to empiricism, in that it allows for the possibility of good knowledge for practice that arises from engaging with phenomena that cannot be perceived through human senses (Gratton & Jones, 2010).

The post-positivist position recognizes that people approach questions of truth from multiple perspectives. These perspectives are historically influenced; and comparatively, as well as philosophically and experientially framed (Fischer, 1998). Researchers in the post-positivist tradition are critical realists in that they support the notion that objects exist, but this recognition is accompanied by an understanding that some cannot be observed by the senses or experimentally tested (Phillips, 1987). Knowledge is, then, always open to further investigation (Miller, 2000) and the truth of any matter is always forthcoming.

Linking postpositivism and critical multiplism

Post-positivists reject the assumption of value-free inquiry, or that there is a distinction between *knower* and *known*. Post-positivists assume that human limitations, experiences, and values make objective knowledge about reality—at the very least—a challenge. In fact, post-positivist truths are relative and provisional (Crotty, 1998). Post-

positivist knowledge endeavors are therefore guided by principles intended to minimize preconceptions or biases associated with using one research method over another, and to maximize confidence in resultant research knowledge (Miller, 2000).

If individual human beings and singular methods are unreliable sources of knowledge for practice, then post-positivist research requires more than one perspective and method. Simply, critical multiplism, a post-positive methodology (Guba, 1990), is the thoughtful use of multiple methods (Patry, 2013). Put another way, the researcher uses heterogeneous approaches to knowledge development, recognizing their strengths and weakness, to form a greater whole, often through triangulation (Shadish, 1993). While this is commonly read as a basis for mixed methods research, the concept of critical multiplism is, as Patry (2013) articulated, considerably more expansive, emphasizing multiple approaches (not necessarily used at the same time) to addressing questions about phenomena of interest.

A critical multiplist perspective necessitates that different theoretical perspectives are brought to bear upon the research endeavor. For the critical multiplist, knowledge arises in the midst of diverse engagement and interpretation of data. Interpretations are assessed as more or less plausible based on holding them up to the scrutiny of other existing and available evidence. It is by examining data through a variety of (sometimes conflicting) frameworks that meaningful presuppositions can be uncovered (Fischer, 1998). Within a post-positivist, critical multiplist research practice, the process of deriving knowledge is focused and systematic. Critical multiplism is not a “do every thing every way” approach. Importantly, processes of inquiry are systematic and rational (Herrington, 1997).

Henderson (2011) argued that a major distinguishing attribute of critical multiplism is the ability to use (and possibly combine) both quantitative and qualitative methods when conducting research. Indeed, both objective and subjective observations and inferences are valued in the critical multiplist perspective. Playle (1995) acknowledged the importance of subjective experience (influence of human values on knowledge development) and rejected the notion of objective supremacy (claims that valid scientific knowledge can only be generated through scientific experiment), as contributing to modern scientific knowledge.

Critical multiplism: benefits and limitations for nursing research

There are numerous benefits of taking a critical multiplist approach to nursing research. Seeking multiple perspectives, through stakeholder engagement (which may include other researchers, clinicians, patients) to pose and answer a research question is in keeping with contemporary thinking regarding patient-oriented research (Canadian Institutes of Health Research, 2019) and in nursing's moral imperative to respond effectively to persons in their care (LaSala, 2009). The most fundamental benefit is that it provides a solution to the problem that compels researchers to select either quantitative or qualitative methods when conducting research, by providing a methodology that accepts and values both quantitative and qualitative research methods. Further, using multiple research approaches, enables researchers to examine an issue/problem from multiple perspectives, thereby reducing the inherent bias of using only one particular method. This leads to having a broader, and perhaps more valid sense of what is really going on (Coward, 1990; Houtes et al., 1986; Sadish, 1993).

Scholars have also critiqued critical multiplism as merely a part of triangulation and have argued that it promotes relativism and may be too costly (Guba, 1990; Patry, 2013). Triangulation has been described as using one or more approaches to answer a research question (Heale & Forbes, 2013). This may involve the integration of theoretical perspectives, multiple methods, and data sources to study a single phenomenon (Kimchi, Polivka, & Stevenson, 1991). Critics have suggested that critical multiplism is merely another triangulation strategy, akin to mixed methods research, and it offers very little contribution as a research methodology. This claim has been disputed by critical multiplist researchers who argue that critical multiplism shares certain similarities with triangulation but offers a broader approach to research compared to triangulation (Coward, 1990, Letourneau & Allen, 1999). The aim of both critical multiplism and triangulation is to limit bias (or reduce the likelihood that a certain perspective, theory, methodology will direct the research findings) by gleaning data from multiple perspectives or sources. What differentiates critical multiplism from triangulation is the fact that, with critical multiplist research, phenomena are studied from multiple perspectives (e.g., stroke rehabilitation can be studied from patient's perspective, caregiver perspective, and clinician perspective), but with triangulation, a single phenomenon is studied using multiple methods (e.g., theoretical frameworks, data sources).

Some have claimed that critical multiplism (that acknowledges the existence of multiple truths/realities) promotes relativism by considering interpretations of all research findings relevant (Houts et al., 1986, Phillips, 1987, Smith, 1990). This claim has been disputed by other scholars who argue that critical multiplism uses objectivity (openness

to public scrutiny) to avoid relativism (Phillips, 1987). Through public challenge, analysis, and critique, researchers are assured that preconceptions related to personal views of one individual or group have been minimized (Phillips, 1990).

Critical multiplist studies often require that multiple researchers, data collection approaches, and analysis techniques, over different settings and times (Coward, 1990; Houts et al., 1986). The breadth of these requirements is associated with increased cost of conducting critical multiplism research. However, these costs are outweighed by the collaborative synergy that is inherent in critical multiplist research.

Steps for conducting critical multiplist stroke nursing research

Critical multiplist investigators may use certain steps as a guide to approach their research. As an example, Shadish (1993) recommended five steps. These steps are described below, using the first author's (ET) emerging program of stroke nursing research, to demonstrate a post-positivist critical multiplist approach to underpin nursing research.

Step #1. State the research problem/questions and select suitable methods for answering the questions

Stroke researchers may ask a question such as: What are the outcomes associated with inpatient stroke rehabilitation? This question is relevant to a variety of stakeholders (e.g., clinicians, administrators, patients) thus, may be answered from a variety of perspectives and methods. For example, clinicians may wish to examine return to function, administrators may be more interested in the costs associated with length of hospital stay, and the patient may be most concerned with the experience of undergoing inpatient stroke rehabilitation. Thus, researchers wishing to address this question would

select a variety of perspectives and methods that complement each other in a way that enables a breadth of 'views' to emerge. This might include measuring functional outcomes in stroke patients, using hospital databases to identify length of hospital stay, and interviewing patients about their experience. Further, the answer to this question (from whatever perspective is used) may depend on a variety of variables such as age, sex/gender, severity of stroke, marital status, and comorbid conditions (all of which could be identified by the multi-disciplinary and/or multi-stakeholder group approaching the research).

Step #2. Determine biases present in research methods and address them

Each research method has its biases (e.g., strengths and limitations), whether they are due to philosophical premises, or means by which the data are collected, analyzed, or interpreted. For example, the majority of stroke studies are randomized controlled trials aimed at treating stroke or based on large datasets that are 'mined' to address a research question. These approaches to research have an important inherent bias away from understanding why a certain intervention works or does not work or understanding what is important to the patient and/or family as they embark on the stroke journey. Thus, critical multiplist researchers benefit from using stakeholders' knowledge and understanding of the phenomenon in question to guide the team in determining which methods best address the question, and what other methods might be used to supplement or offer greater understanding.

Step #3. Analyze the data

There are often a variety of potential analytic methods that may be used for every dataset (whether quantitative or qualitative). Sometimes there is evidence that one

analytic technique is superior to others. For example, modern structural modeling techniques replaced analysis of covariance (ANCOVA) to adjust for group non-equivalence (Cook & Campbell, 1979). At other times, there is no clear preference. It is important to ensure that analytic techniques, whether quantitative or qualitative, are in keeping with the research question and level of data as well as other similar studies to enable 'head-to-head' comparisons. However, it is also important to determine whether alternative analysis methods render similar results (thereby reducing potential bias of use of one analytic method over another).

Step #4. Interpret the results

The goal of a critical multiplism approach to interpretation is to first generate a range of possible interpretations, then to assess those interpretations as more or less reasonable (Shadish, 1993). To accomplish this, critical multiplists use certain strategies when using either quantitative or qualitative methods. These may include enlisting the aid of multiple stakeholders in critiquing the results, sending a report of results to multiple interest groups who could point out hidden biases or assumptions, and noting convergence of results across the multiple methods chosen to answer research questions. If the use of multiple methods yields different results, the differences must be transparently explained.

Step #5. Disseminate the results

No single method would be sufficient to ensure that the results of research will be used either by researchers, by the community that shapes policy, clinicians or patients. Indeed, dissemination strategies need to be tailored to the intended audience and planned as early as possible in the research process—ideally as the research question is developed

(Canadian Institutes of Health Research, 2019; Reed, 2018). In addition to relying on traditional methods of research dissemination such as publications and presentation at conferences, researchers who want their work to be used use other dissemination mechanisms such as preparing executive summaries outlining major findings and recommendations in simple terms, and creating novel opportunities for end users to be appraised of the work (Shadish, 1993). In stroke rehabilitation, attending and speaking at stroke support groups or offering information through on-line blogs may be contemporary mechanisms to disseminate information to patients and their families.

CONCLUSION

Post-positivists encourage researchers to integrate multiple theories and methods in addressing complex human phenomena associated with nursing practice. The post-positivist philosophy and critical multiplist approach offers a participatory paradigm for developing scientific nursing knowledge that suitably addresses the complexities of human phenomena while respecting the uniqueness and perspectives of stakeholder groups (which include patients, family members, knowledge users).

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Chapter 3 Inpatient Rehabilitation Care in Alberta: How Much Does Stroke Severity and Timing Matter?

We examined the influence of severity and timing on functional gains, LOS, and discharge destination of stroke patients following inpatient rehabilitation in Alberta. We demonstrated both surprising and interesting findings. The overall mean time to rehabilitation admission was surprisingly longer in Alberta than the time reported in Ontario which was considerably shorter (Hall et al., 2016). The mean LOS in inpatient rehabilitation was also surprisingly longer in Alberta compared to other regions Canada (Grant, Goldsmith & Anton, 2014). Interestingly, with respect to discharge destination, the majority of stroke patients in Alberta returned home with no health services. This finding was inconsistent with a report from Ontario, where majority of stroke patients returned home with paid health services following inpatient rehabilitation (Hall et al., 2016). This study was limited by certain factors that may have increased the risk for bias in our research process. The accuracy of FIM scores recorded by therapy staff and the individuals who enter information at each hospital in Alberta could not be ascertained. Further, the ceiling effect had the potential to limit the ability to accurately measure patient improvement in the case of mild stroke patients. The fact that data were from a single province limited our ability to generalize findings to other provinces. Our finding about LOS in rehabilitation presented a unique contrast to the LOS in rehabilitation observed in provinces like Ontario.

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Abstract

Background.

We examined the impact of stroke severity and timing to inpatient rehabilitation admission on length of stay, functional gains, and discharge destination.

Methods.

Alberta inpatient stroke rehabilitation data between April 2013 and March 2017 were analyzed. We evaluated the impact of stroke severity, as measured by the FIM, on timing to inpatient rehabilitation, functional gains, length of stay (LOS), and discharge destination. Further, we examined whether timing to inpatient rehabilitation impacted the latter three factors.

Results.

The 2,404 adults were subcategorized as mild (1,237), moderate (1,031), or severe (136) based on FIM at inpatient rehabilitation admission. Length of time to rehabilitation admission was not significantly (p=.232) different between stroke severities. Mean length of time (days) to rehabilitation admission was 19.79 (20.3SD) for mild, 27.7 (35.7SD) for moderate, and 37.70 (56.8SD) for severe stroke. Mean FIM change for mild (M=16.3, 9.9SD) differed significantly ($p=5.1x10^{-9}$) from moderate (M=30.4, 16.4SD) and severe (M=31.0, 25.7SD) stroke. The mean LOS for mild stroke (M=41.3, 31.9SD) was significantly ($p=5.1x10^{-9}$) different than moderate stroke (M=86.8, 76.4SD) and severe stroke (M=126.1, 104.2SD). Time to inpatient rehabilitation admission showed a small, significant impact on FIM change ($p=1.4x10^{-9}$, partial eta squared .022) and LOS ($p=1.1x10^{-19}$, partial eta squared .042). Shorter times to rehabilitation admission and mild stroke were associated with discharging home without needing homecare.

Conclusion.

Stroke severity has a significant impact on the conduct of inpatient rehabilitation. Yet, despite suggestions shortening timing to rehabilitation should improve outcomes, the impact on functional gains and rehabilitation LOS was small.

Key Words.

Stroke, Inpatient rehabilitation, Outcomes, Length of time waiting.

INTRODUCTION

Stroke is the third leading cause of death and leading cause of adult disability in Canada. Approximately 50,000 Canadians and 4,500 Albertans suffer a stroke each year with an annual mortality rate of 17.9/100,000 individuals (Heart & Stroke Foundation, 2014; Jeerakathil, Thomson, & Hill, 2010). Stroke costs the Canadian economy $3.6 billion ($200-$300 million in Alberta) per year in direct and indirect medical expenses (Heart & Stroke Foundation, 2014; Jeerakathil et al., 2010). Approximately 741,800 Canadian adults aged 20 or older (25,000 Albertans) are currently living with the effects of stroke which may include physical, emotional, and behavioural problems that limit their ability to live independently and/or return to activities they once enjoyed (Heart & Stroke Foundation, 2014).

Thousands of stroke survivors access inpatient rehabilitation services across Canada annually. Stroke rehabilitation typically involves a patient working with a team, which has diverse expertise, that often includes nurses, physicians including neurologists and physiatrists, occupational therapists, physical therapists, speech and language pathologists, recreational therapists, social workers and psychologists. The aim of rehabilitation is to optimize the functional and cognitive recovery of stroke patients and to increase their quality of life. About 20-30% of patients admitted to acute care hospitals for stroke are referred to rehabilitation units (located within the same facility as the acute care unit or in a different facility) following the acute stroke phase. In Canada, stroke patients are admitted to rehabilitation units in a median of 12 days from stroke onset with a median total admission Functional Independence Measure (FIM, measure of physical and cognitive disability with a focus on burden of care) score of 74 points for all

stroke (Hebert et al., 2016). Differences in FIM gain based on stroke severity have been reported previously in the literature (Scrutinio et al., 2015; Wang, Camicia, DiVita, Mix & Niewczyk, 2015; Wang, Camicia, Terdiman, Hung, & Sandel, 2011).

In Canada, length of stay (LOS) in rehabilitation varies by stroke severity, with a median LOS of 31 days (Hebert et al., 2016). In some studies, mild stroke patients experienced the shortest LOS and severe stroke patients experienced the longest LOS (Ancheta et al., 2000; Wang et al., 2011; Maulden et al., 2005). This variation may be attributed to the fact that patients with less severe stroke and/or medical comorbidities are likely to begin rehabilitation sooner and progress faster, resulting in a shorter length of stay in rehabilitation unit. Also, initiating rehabilitation early (prior to transfer to rehabilitation unit) may give stroke patients a head start on entering a rehabilitation program and enable them to progress faster through rehabilitation. Additional stimulation from early rehabilitation may enhance blood flow to injured areas, promote clearance of toxins (e.g., free radicals) and stimulate healing and recovery, thus improving functional outcomes and shortening stroke patients' LOS in the rehabilitation unit, (Teasell & Hussein, 2019; Maulden et al., 2005). The length of time stroke patients wait for inpatient rehabilitation may influence outcomes. Patients who are transferred sooner to a rehabilitation program may have improved functional outcomes (Horn et al., 2005; Hu, Hsu, Yip, Jeng, & Wang, 2010; Huang, Chung, Lai & Sung, 2009; Kim & Paik, 2012; Massucci et al., 2006; Maulden, Gassaway, Horn, Smout, & DeJong, 2005; Paolucci et al., 2003; Paolucci et al., 2000; Salter, Hartley & Foley, 2006; Scrutinio et al., 2015; Wang et al., 2015; Wang et al., 2011). These outcomes have most often been measured by discharge FIM scores (motor and cognitive scores), Barthel Index (BI) scores,

modified Rankin Scale (mRS) scores, and/or Rivermead Mobility Index (RMI) scores. Moderate and severe stroke patients who are admitted earlier to a rehabilitation unit have been shown to have larger motor and cognitive function gains (Ancheta, Husband, Law & Reding, 2000; Scrutinio et al., 2015; Wang et al., 2011). Patients admitted with moderate stroke have been found to experience greatest improvement in FIM scores when admitted 0-14 days post stroke compared to those with severe stroke, who experienced the worst FIM scores when admitted 29-42 days post stroke (Ancheta et al., 2000). Based on these findings, investigators have suggested that patients admitted to a rehabilitation unit early have the greatest improvement in the ability to perform daily activities independently compared to those with delayed admission. Also, delaying admission to a rehabilitation unit for both moderate and severe stroke patients increases their likelihood of being transferred back to acute care (Ancheta et al., 2000).

The analyses presented here provide a snapshot of inpatient stroke rehabilitation care in Alberta from 2013 to 2017. We evaluated differences in stroke rehabilitation outcomes (functional gains, length of stay, discharge destination) based on stroke severity, given known differences in other provinces in Canada (Hall et al., 2016). Further, we wondered whether the time from acute care admission to inpatient rehabilitation admission had an influence on these same outcomes as suggested in the literature. We hypothesized that increased stroke severity would be related to larger functional gains, longer lengths of stay and increased discharge to living environments that provided higher levels of assistance with daily activities. We also hypothesized that time spent waiting for entry to inpatient stroke rehabilitation care would lead to poorer outcomes.

METHODS

Research Design

We conducted an analysis of primary data from a cohort of patients admitted to and discharged from inpatient stroke rehabilitation units in Alberta between April 2013 and March 2017. Data were obtained from the Alberta Health Services' stroke rehabilitation database. The study was approved by the University of Calgary's Conjoint Health Research Ethics Board (REB17-1186).

Sample and Setting

We included all clinically diagnosed cases of adult stroke (hemorrhagic or ischemic) with a documented inpatient rehabilitation unit stay in Alberta. In cases when the type of stroke at initial acute care presentation was ischemic and there was an eventual hemorrhagic component, we considered 'hemorrhagic' as their stroke etiology. We excluded 321 cases from the original dataset provided by Alberta Health Services (n = 2725 cases) due to missing data (296); cases classified with a primary diagnosis of transient ischemic attack rather than stroke (15); or post discharge living arrangements listed as boarding house (5), shelter (3), or public place (2).

Instruments

The FIM was used to assess function at time of admission and discharge from the rehabilitation unit. FIMs were completed by rehabilitation unit staff at each of the nine centers providing data. Stroke severity was classified based on FIM admission scores (Teasell & Foley, 2008). Scores of <40 were considered severe, 40-80 were considered moderate and >80 were considered mild (Stineman et al., 1998; Ween et al., 1996). The FIM has been tested for reliability, validity, responsiveness to change, feasibility for use,

and meaningfulness in clinical settings when administered by trained and tested personnel (UDSMR, 2015). A ceiling effect on FIM scores for mild stroke patients (defined as the level at or above which a change in an independent variable no longer influences the FIM score) have been reported in the literature (Heart & Stroke Foundation, 2019; Prodinger, O'Connor, Stucki, & Tennant, 2017). We defined the ceiling effect as a FIM score of 126 at discharge from inpatient rehabilitation unit. We defined FIM change as the difference between total admission and discharge FIM scores. We defined FIM efficiency as the mean FIM change divided by the mean length of stay in days. Other information collected from the Alberta Stroke Rehabilitation database included: age, sex, patient's post-discharge living arrangement, length of stay in rehabilitation units, and pre-admission comorbid conditions. The post discharge living arrangements included: home (private house or apartment) without health services, home with paid health services (home care/support), assisted living (includes group home, supervised living setting), residential care (includes long-term care facility, continuing care, convalescent, nursing home, and home for the aged), and acute care.

Data Collection

Data for the Alberta Stroke Rehabilitation Databases were assembled from Alberta Health Services Provincial Inpatient Discharge Abstract Database (DAD), National Rehabilitation System (NRS), and Calgary Rehabilitation Database and then transferred to the authors following appropriate ethics and administrative approvals.

Data Analysis

The mean, median, and standard deviation were calculated for continuous variables, and frequency distribution and percentages for categorical variables. Pearson

correlations and standard multiple regression were used to examine relationships between variables. ANOVA was used to test main and interaction effects of the independent and dependent variables.

Chi-square tests were used to explore the relationship between days from acute care admission to inpatient rehabilitation admission and patients' post discharge living arrangement. We also explored the relationship between categories of functional impairment and post-discharge living arrangements. Mann Whitney U was used to examine the mean difference in length of stay and discharge motor/cognitive FIM score of mild, moderate, and severe stroke patients.

RESULTS

The sample consisted of 2404 male and female patients admitted to and discharged from inpatient stroke rehabilitation units in Alberta between April 2013 and March 2017 (see Table 1). These were clinically diagnosed cases of adult stroke (ischemic or hemorrhagic) subcategorized as mild, moderate, or severely impaired based on their initial FIM score at acute care admission. The mean age of participants was 68 years (69 median; 13.9 SD). The mean length of stay for active inpatient rehabilitation was 65.6 days (45 median; 65.9 SD), and the mean FIM change for all participants was 23.2 (21 median; 15.9 SD).

Are Stroke Severity and Time Between Stroke Onset And Rehabilitation Admission Related?

To better understand the impact of the time required to transfer to inpatient rehabilitation on functional outcomes, we first examined the relationship between the time since stroke (time from acute care admission to inpatient rehabilitation admission)

and admission to rehabilitation FIM score (see Figure 1). The mean time since stroke (in days) to rehabilitation admission was 19.79 (20.3 SD) for mild stroke, 27.7 (35.7 SD) for moderate stroke, and 37.70 (56.8 SD) for severe stroke, with overall mean time since stroke of 24.20 (31.1 SD) days. We first examined the relationship between stroke severity and time since stroke using regression analyses with patients grouped in stroke severity sub-types. As expected, we observed the strongest relationship for individuals with mild stroke (R^2=0.679; p = 1.6 x 10^{-5}) with this group tending to demonstrate shorter times to inpatient rehabilitation admission and higher admission FIM scores (by definition), in general. The weakest relationship observed was for severe stroke (R^2=0.267; p = 1.2 x 10^{-162}). Similar findings were observed for the relationship between time since stroke to rehabilitation admission and motor FIM scores. However, relationships were not as strong for time since stroke and the cognitive FIM scores.

We wanted to determine whether time to inpatient rehabilitation was significantly different between the stroke severity groups. We first used a two-way between-groups analysis of variance. We observed no significant interaction between time since stroke and stroke severity (F (11, 2384) = 0.66, p = .777) so we examined for main effects. Not surprisingly, we observed a statistically significant main effect for stroke severity (F (2, 2384) = 916.26, p = 6.4 x 10^{-296}) with a large effect size (partial eta squared = .435). However, we observed no main effect for time since stroke (F (6, 2384) = 1.35, p = .232), suggesting that time since stroke did not differ between stroke severities on admission to rehabilitation. Similar interaction and main effects on admission motor FIM scores were also observed when the above analysis was completed, with no main effect for time since stroke (F (6, 2384) = 0.624, p = .711). The analysis was repeated again to examine time

since stroke and admission cognitive FIM scores where main effects of stroke severity ($F(2, 2384) = 100.66$, $p = 1.1 \times 10^{-42}$) and time since stroke ($F(6, 2384) = 4.31$, $p = 2.5 \times 10^{-4}$) were found, although time since stroke demonstrated a small effect size (partial eta squared = .011).

How Are Stroke Severity and Time Since Stroke Related to Functional Gains During Rehabilitation?

We wished to determine whether time spent waiting for inpatient rehabilitation had a substantial impact on functional changes during rehabilitation. Mean FIM change during inpatient rehabilitation was 16.3 points for mild stroke (16 median; 9.9 SD), 30.4 points for moderate stroke (31 median; 16.4 SD) and 31.0 points for severe stroke (26 median; 25.7 SD), with a FIM efficiency of 0.4 for mild stroke, 0.3 for moderate stroke and 0.2 for severe stroke. We conducted a regression analysis to examine the relationship between FIM change and time since stroke with patients grouped in stroke severity sub-types. The strongest relationship we observed was for mild stroke ($R^2 = 0.22$; $p = 1.1 \times 10^{-126}$) (see Figure 2). Relationships for moderate ($R^2 = 0.17$; $p = 1.3 \times 10^{-94}$) and severe ($R^2 = 0.02$; $p = 7.4 \times 10^{-12}$) stroke were weaker. For the motor FIM change, we observed the strongest relationship for individuals with mild stroke ($R^2 = 0.224$; $p = 3.0 \times 10^{133}$). Relationships for moderate ($R^2 = 0.183$; $p = 5.2 \times 10^{-106}$) and severe ($R^2 = 0.019$; $p = 1.6 \times 10^{-10}$) stroke were also weaker. For the cognitive FIM change, we observed the strongest relationship for mild stroke ($R^2 = 0.040$; $p = 2.8 \times 10^{-22}$) and the weakest relationship for moderate stroke ($R^2 = 0.018$; $p = 2.9 \times 10^{-10}$).

Next, we wanted to determine whether FIM change was significantly different across stroke severities. Thus, we ran a two-way between-groups analysis of variance, which

demonstrated an interaction effect of FIM change ($F(11, 2384) = 2.71$, $p = .002$), a main effect for time since stroke ($F(6, 2384) = 8.87$, $p = 1.4 \times 10^{-9}$), and a main effect for stroke severity ($F(2, 2384) = 61.41$, $p = 9.9 \times 10^{-27}$). Post-hoc comparisons using the Tukey HSD test indicated that the mean FIM change for mild stroke was significantly different from the mean FIM change for moderate stroke and severe stroke. The mean FIM change for moderate stroke patients did not differ significantly ($p = .878$) from the mean FIM change for severe stroke patients.

Similar interaction and main effects on motor FIM change were observed. Regarding effects on cognitive FIM change, the interaction effect was not statistically significant ($F(11, 2384) = 0.86$, $p = .576$). The main effect for stroke severity on cognitive FIM change ($F(2, 2384) = 20.77$, $p = 1.1 \times 10^{-9}$) was statistically significant with a small effect size (partial eta squared = .017), but the main effect for time since stroke ($F(6, 2384) = 1.43$, $p = .198$) was not statistically significant.

Does Admission Stroke Severity Influence Rehabilitation Length of Stay?

We examined the relationship between admission FIM score and LOS in rehabilitation. We began examining the relationship within the different stroke severities using regression analyses. Mean lengths of stay were 41.3 days (35 median; 31.9 SD) for mild stroke, 86.8 (64 median; 76.4 SD) for moderate stroke and 126.1 (86.5 median; 104.2 SD) for severe stroke. We observed the strongest relationship between stroke severity and LOS for individuals with mild stroke ($R^2=0.696$; $p = 4.9 \times 10^{-34}$) with this group tending to demonstrate shorter LOS in rehabilitation and higher admission FIM scores (by definition), in general (see Figure 3). The weakest relationship observed was

for severe stroke (R^2=0.367; p = 6.1 x 10^{-239}). Similar findings were observed for motor FIM, but relationships were not as strong for the cognitive FIM scores.

To examine whether there were differences in length of stay across stroke severity, we conducted a two-way between-groups analysis of variance. The interaction effect on admission FIM score (F (9, 2386) = 2.93, p = .002), the main effect for LOS (F (6, 2386) = 6.77, p = 4.0 x 10^{-7}), and the main effect for stroke severity (F (2, 2386) = 553.13, p = 4.3 x 10^{-198}) were all statistically significant with small effect sizes for the interaction (partial eta squared = .011) and the main effects for LOS (partial eta squared = .017), and a large effect size for stroke severity (partial eta squared = .317). Post-hoc comparisons using the Tukey HSD test indicated that the mean LOS for mild stroke was significantly (p = 5.1 x 10^{-9}) different from the mean LOS for moderate stroke and severe stroke. The mean LOS for moderate stroke also differed significantly (p = 5.1 x 10^{-9}) from the mean LOS for severe group.

Is Time Since Stroke to Rehabilitation Admission Associated with Length of Stay?

We wished to determine whether time spent waiting for inpatient rehabilitation had a substantial impact on length of inpatient rehabilitation stay. Using regression analyses we explored the relationship between the time since stroke and LOS across the different stroke severity sub-types. We observed the strongest relationship for individuals with mild stroke (R^2 = 0.180; p = 3.2 x 10^{-104}) with this group tending to demonstrate shorter times to inpatient rehabilitation admission and shorter LOS. Relationships for moderate (R^2 = 0.124; p = 5.6 x 10^{-70}) and severe (R^2 = 0.099; p = 7.4 x 10^{-55}) stroke were weaker (see Figure 4).

Also, we were interested in determining if there were significant differences in LOS across these groups based on time since stroke. Using a two-way between-groups analysis of variance, the interaction effect on LOS ($F(11, 2384) = 3.61$, $p = 4.4 \times 10^{-5}$), the main effect for time since stroke ($F(6, 2384) = 17.30$, $p = 1.1 \times 10^{-19}$), and the main effect for stroke severity ($F(2, 2384) = 70.07$, $p = 2.7 \times 10^{-30}$) were all statistically significant. However, effect sizes for the interaction (partial eta squared = .016) and the main effect on LOS for time since stroke (partial eta squared = .042) were small, but the effect size for the main effect on LOS for severity of stroke was medium (partial eta squared = .056).

Is Time Since Stroke to Rehabilitation Admission Associated with Discharge Destination?

To better understand the impact of the time required to get to inpatient rehabilitation on patient's post discharge living arrangement, we analyzed and compared the different categories of post discharge living arrangements. In general, those individuals who came to inpatient rehabilitation sooner, were more likely to be discharged home without health services (see Figure 5). A chi-square test for independence indicated a statistically significant association between the time since stroke and post discharge living arrangement, $\chi^2(24, n = 2404) = 153.59$, $p = 7.1 \times 10^{-21}$, Cramer's v = .13, with a small effect size.

Is Stroke Severity Associated with Discharge Destination?

Finally, to determine whether stroke severity had a substantial influence on post discharge living arrangement, we examined the relationship between stroke severity and post discharge living arrangement (see Figure 6). We observed that individuals with mild

stroke were more likely to be discharged to home without health services compared to those with severe stroke. Conversely, individuals with severe stroke were more likely to be discharged to residential care or back to acute care. Individuals with moderate stroke were more likely to be discharge to home with paid health services (homecare) compared to those with mild and severe stroke. A chi-square test for independence indicated a statistically significant association between stroke severity and post discharge living arrangement, χ^2 (8, n = 2404) = 517.53, p = 1.2 x 10^{-106}, Cramer's v = .33, with a medium effect size.

Is Etiology of Stroke Associated with Stroke Severity at Admission to Inpatient Rehabilitation?

We wanted to determine whether patient's etiology of stroke impacted their stroke severity, so we examined the relationship between etiology of stroke and stroke severity. We observed that mild stroke patients were more likely to have ischemic stroke compared to moderate and severe stroke patients. Contrarily, severe stroke patients were more likely to have hemorrhagic stroke compared to mild and moderate stroke patients. A chi-square test for independence indicated a statistically significant association between etiology of stroke and stroke severity, χ^2 (2, n = 2404) = 16.83, p = 2.2 x 10^{-4}, Cramer's v = .084, with a small effect size.

DISCUSSION

Summary Key Points

We conducted a province wide analysis of primary data from a large sample of patients admitted to and discharged from inpatient stroke rehabilitation units in Alberta between April 2013 and March 2017. Stroke severity was significantly related to

functional gains in rehabilitation, LOS in rehabilitation, and discharge destination. Time since stroke had a small impact on LOS and patients who gained entry later to inpatient stroke rehabilitation tended to be discharged to locations other than their home. The relationship between stroke severity and rehabilitation timing was more complicated and is discussed below.

Comparison to the Rest of Canada

We observed certain differences when comparing findings from this study to those reported from other Canadian provinces. With respect to the time since stroke, the overall mean time to rehabilitation unit admission was 24.2 days (mild stroke 19.8 days; moderate stroke 27.7 days; severe stroke 37.7 days). The overall mean time to rehabilitation admission was longer than the time reported in Ontario which was considerably shorter at 15.9 days (9 median; Hall et al., 2016). The LOS in Alberta was also longer than in Ontario and other geographic regions with the overall mean LOS in Alberta of 65.6 days (mild stroke 41.3 days; moderate stroke 86.8 days; severe stroke 126.1 days). In Ontario, the overall mean LOS for active inpatient rehabilitation was 36.8 days (31 median), 47.4 days (42 median) in British Columbia, 53.0 days (44 median) in Saskatchewan and Manitoba, and 45.6 days (37 median) in Nova Scotia, Prince Edward Island, New Brunswick, and Newfoundland and Labrador (Grant, Goldsmith & Anton, 2014). Regarding post-discharge living arrangements, there is a marked difference between stroke patients residing in Alberta and Ontario with the majority in Alberta returning home with no health services and the majority in Ontario returning home with paid health services. This difference in post-discharge health service access may be due

to the length of time that stroke patients in Alberta spend in rehabilitation relative to those in Ontario.

Authors have suggested that a variety of factors can lead to delays to rehabilitation admission or longer LOS in rehabilitation. These include patients having medical complications (i.e., pneumonia or urinary tract infection) that tend to require more treatment time in acute care, or three medical tubes (i.e., tracheostomy, enteral feeding tube, and indwelling catheter) that have been associated with stroke patients staying 28 days longer in acute care and extending rehabilitation LOS by 20 days (Roth et al., 2002). Patients' lack of motivation to participate and lack of family support are psychosocial factors that can also contribute to delays in admission to a stroke rehabilitation program (Palmer & Thomas, 2003). There is no reason to believe that stroke patients in Alberta are substantially different than those in other provinces with respect to these factors.

Slow times to rehabilitation admission and long LOS can also be associated with factors that are not patient-related. Some of these factors include: (a) discharge patterns and lack of post-acute care services to allow timely discharge or transfer to rehabilitation (e.g., lack of rehabilitation units, nursing homes, assisted living facilities, and home care services), (b) lack of insurance coverage, (c) lack of readiness to engage in rehabilitation program (Hakkennes, Brock & Hill, 2011; Roth, Lovell, Harvey & Bode, 2007; Willems et al., 2012), (d) shortage of staff (e.g., nurses, occupational therapists, physical therapists) in rehabilitation units, (e), poor communication and cooperation among health professionals and among rehabilitation units/facilities, (f) lack of public education regarding stroke symptoms and the seriousness of the disease (Gache et al., 2014), and

(g) socioeconomic characteristics (e.g., married, African American race, and younger age; Roth et al., 2007; Salter et al., 2006). Other non patient-related factors that drive length of time to rehabilitation and LOS in Alberta system, in our opinion, are capacity issues and staff opinions around patients' readiness to return home or move onto the next phase of rehabilitation. Unlike the policy used in Ontario, Alberta does not have a similar policy for lengths of stay based on Rehabilitation Patient Group designations.

Impact of Stroke Severity

Stroke severity was linked to a number of the factors we explored. Severe stroke patients stayed longer in hospital but made functional gains similar to those of individuals with moderate stroke. Similar to a study by Ancheta et al (2000) in New York State, we also identified that severe stroke patients were more likely to be discharged to long-term care facilities or back to acute care than those with moderate or mild stroke. FIM efficiency was generally poor for all stroke severity categories, suggesting that stroke patients experienced poor improvement in their functional abilities during each day of rehabilitation. Mild stroke patients had the greatest FIM efficiency (0.4 points/day) and were more likely to be discharged to home without paid services, compared to severe stroke patients that had the least FIM efficiency (0.2) and were more likely to be discharged to long-term care facilities or back to acute care. This finding was consistent with the literature which indicates that patients with greater FIM efficiency are more likely to be discharged to home from inpatient rehabilitation (Bottemiller, Bieber, Basford, & Harris, 2006; Ween et al., 1996).

Of particular interest, 1237 individuals with mild stroke were admitted to hospital, despite suggestions that individuals with mild stroke can be managed safely and

effectively in the community (Teasell, Hussein, & Foley, 2008). In an effort to support mild stroke patients, Alberta Health services has an Early Supported Discharge Service which can provide in-home stroke rehabilitation for 1-2 hours, 5 days/week in many parts of the province. Further exploration is needed to better understand why individuals with mild stroke continue to be routinely admitted to Alberta's rehabilitation beds.

The Impact of Timing

Though several authors have identified the importance of early access to rehabilitation on outcomes (Ancheta et al., 2000; Maulden et al., 2005; Salter et al., 2006; Wang et al., 2011), the relationship we observed was more complicated. Length of time to rehabilitation admission was not significantly different between stroke severities. However, patients with moderate and severe stroke made significantly larger FIM gains than mild stroke during inpatient rehabilitation, possibly due to the ceiling effect of FIM for mild stroke patients (13 patients with mild stroke had a FIM score of 126 at discharge from inpatient rehabilitation). As expected, LOS in rehabilitation was longer with increasing stroke severity. Time to rehabilitation admission had small, but significant impacts on functional gains and LOS. Patients with shorter times to rehabilitation admission and those with mild stroke were more likely to be discharged home without needing health services.

Factors associated with length of time to get into rehabilitation are multiple and the observations of this study are unfortunately more likely related to process issues than the nature and severity of the stroke. Other jurisdictions such as Ontario (through the Ontario Stroke Network) have put rules in place to ensure that patients are moved

expediently into inpatient rehabilitation (Hall et al., 2016.). Processes such as this have yet to take hold in Alberta.

Opportunities for Change

This study has demonstrated that time since stroke influences rehabilitation LOS and FIM change. Stroke patients should be transferred to rehabilitation units early to shorten their LOS in rehabilitation and increase their physical and mobility function and performance of daily living activities. Mild stroke patients should be referred to Early Supported Discharge (ESD) services to reduce their LOS in acute care to decrease excessive costs.

Limitations of this Study

There were certain limitations to this study. The accuracy of FIM scores recorded by therapy staff and the individuals who enter information at each hospital in Alberta could be called into question. Further, a ceiling effect has been demonstrated for FIM Score (Kwong, Hartzema, Duncan, & Min-Lai, 2004) and has the potential to limit the ability to accurately measure patient improvement in the case of mild stroke patients. These data are from a single province which was also considered a limitation, but also provides unique contrast to other provinces such as Ontario where lengths of stay have been heavily influenced by provincial management of patient flow.

CONCLUSIONS

Our study provides a snapshot of inpatient stroke rehabilitation care in Alberta from 2013 to 2017. We evaluated whether there were differences in stroke rehabilitation outcomes (functional gains, length of stay, discharge destination) based on stroke severity and whether the time from acute care admission to inpatient rehabilitation admission had

an influence on these same outcomes. Despite suggestions that shortening the time to rehabilitation should improve outcomes, we observed only a small effect of timing on functional gains and rehabilitation LOS. Length of time to rehabilitation admission was not significantly different between stroke severities, and length of stay was longer with increasing stroke severity. Individuals with moderate and severe stroke made significantly larger FIM gains than mild stroke during inpatient rehabilitation. Patients with shorter times to rehabilitation admission and those with mild stroke were more likely to be discharged home without needing health services.

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Figures Legend

Figure 1. Scatter plots and trends illustrating relationships of functional scores at the time of admission and time to inpatient rehabilitation admission by impairment severity. The circles represent case numbers and R-squares (R^2) represent the variance in functional scores caused by time to inpatient rehabilitation admission.

Figure 2. Scatter plots and trends illustrating relationships of functional changes and time to inpatient rehabilitation admission by impairment severity. The circles represent case numbers and R-squares (R^2) represent the variance in functional changes caused by time to inpatient rehabilitation admission.

Figure 3. Scatter plots and trends illustrating relationships of functional scores at the time of admission and length of stay (LOS) in rehabilitation by impairment severity. The circles represent case numbers and R-squares (R^2) represent the variance in functional scores caused by LOS in rehabilitation.

Figure 4. Scatter plots and trends illustrating relationships of LOS in inpatient rehabilitation and time to inpatient rehabilitation admission by impairment severity. The circles represent case numbers and R-squares (R^2) represent the variance in LOS caused by time to inpatient rehabilitation admission. The lengths of stay and case numbers (CN) of moderate stroke not shown in the scatter plot were 471 days (1413 CN), 482 days (1758 CN), 507 days (1275 CN), 533 days (1512 CN), 535 days (1823 CN), and 717 days (2101 CN).

Figure 5. Bars chart of post discharge living arrangement by groups of days between acute care admission and inpatient rehabilitation admission. The height of the bar

represents percentage of cases that are likely to be discharged to the corresponding post discharge living arrangement, and the color of the bar represents the group of days between acute care admission and inpatient rehabilitation admission.

Figure 6. Bars chart of post discharge living arrangement by category of functional impairment. The height of the bar represents percentage of cases that are likely to be discharged to the corresponding post discharge living arrangement, and the color of the bar represents the category of functional impairment based on admission FIM score.

Tables

Table 3.10.1 Demographic Characteristics of Study Sample

Characteristic	Total	Mild stroke	Moderate stroke	Severe stroke
Age at acute care admission (yrs.)				
Median (IQR)	69(59-79)	67(58-77)	71(61-82)	72(60-84)
Sex, %				
Male	56.8	61.4	50.8	59.6
Female	43.2	38.6	49.2	40.4
Etiology of stroke, %				
Ischemic stroke	82.5	84.4	81.8	70.6
Hemorrhagic stroke	17.5	15.6	18.2	29.4

IQR = interquartile range.

Figures

Figure 3.11.1: Scatter plots and trends illustrating relationships of functional scores at the time of admission and time to inpatient rehabilitation admission by impairment severity

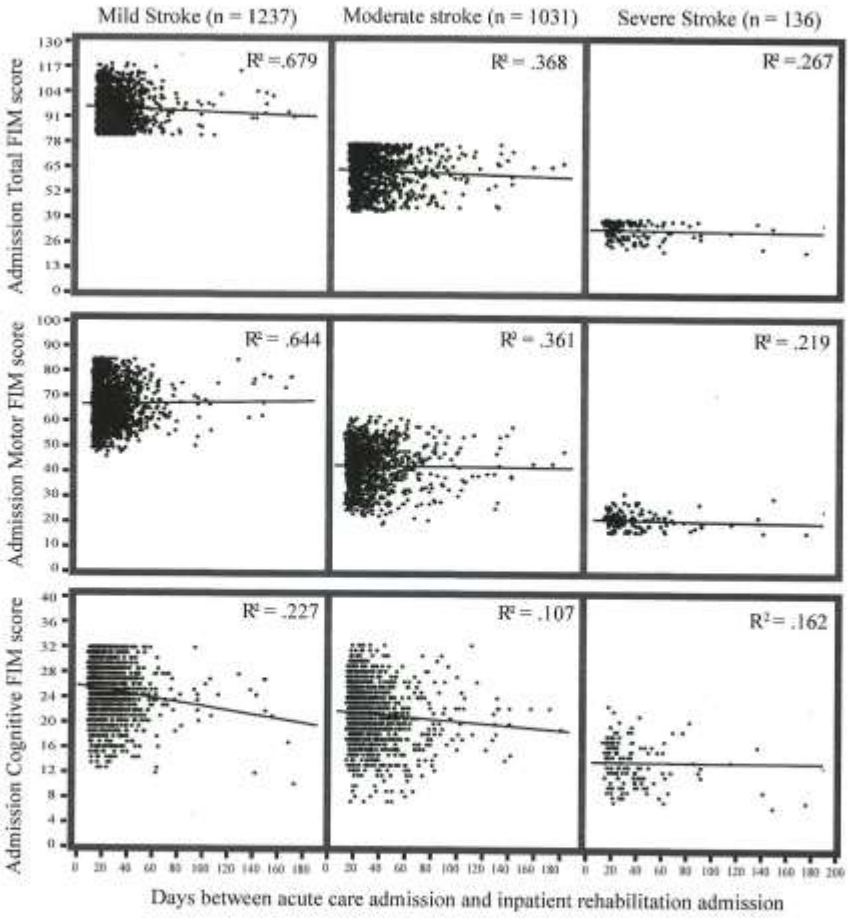

Figure 3.11.2: Scatter plots and trends illustrating relationships of functional changes and time to inpatient rehabilitation admission by impairment severity

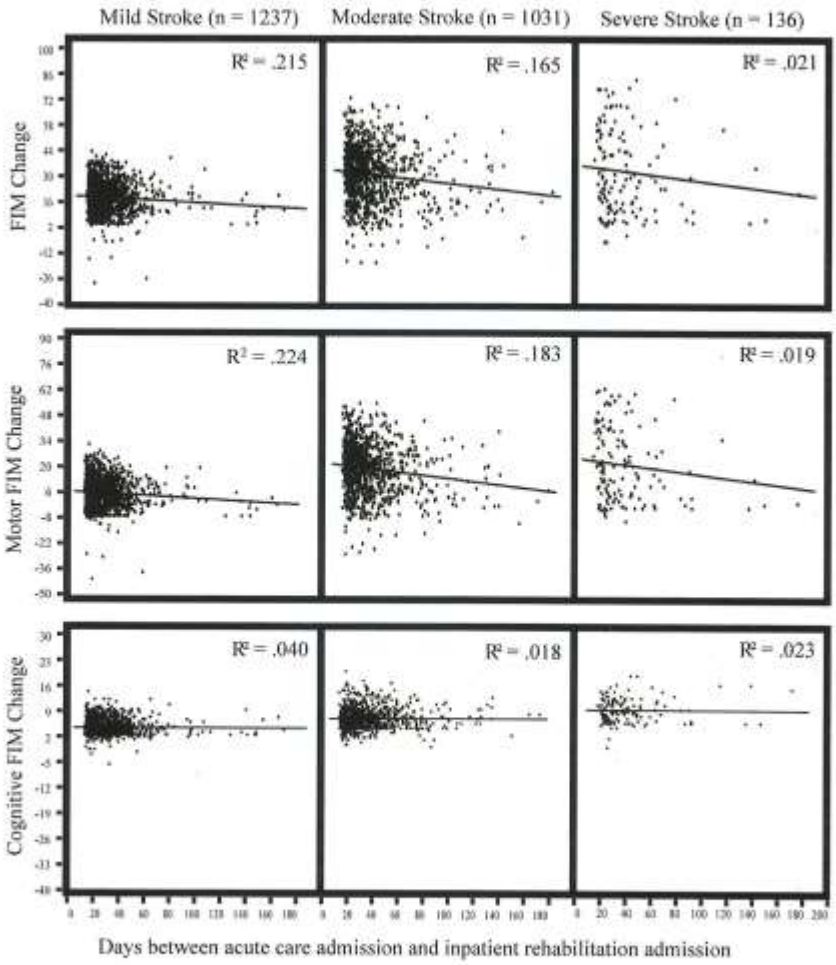

Figure 3.11.3: Scatter plots and trends illustrating relationships of functional scores at the time of admission and length of stay (LOS) in rehabilitation by impairment severity

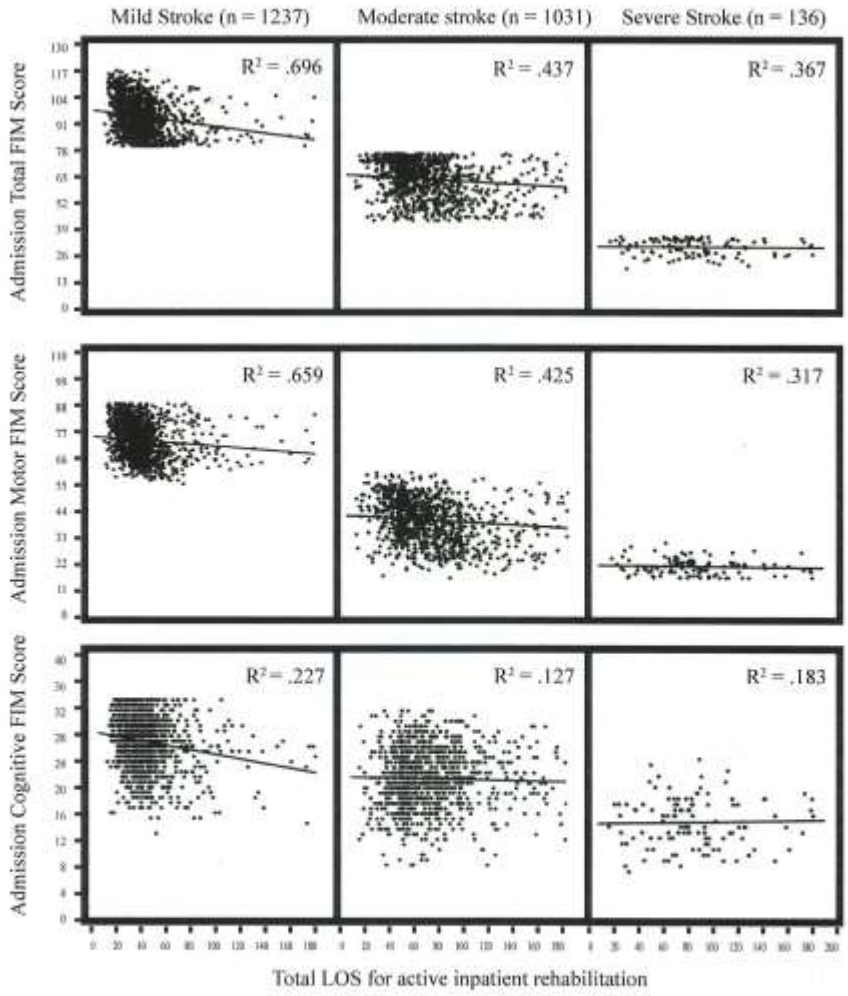

Figure 3.11.4: Scatter plots and trends illustrating relationships of LOS in inpatient rehabilitation and time to inpatient rehabilitation admission by impairment severity

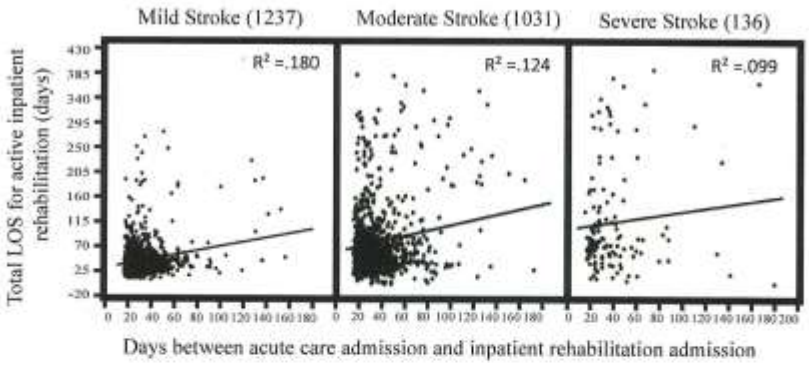

Figure 3.4.5: Bars chart of post discharge living arrangement by groups of days between acute care admission and inpatient rehabilitation admission

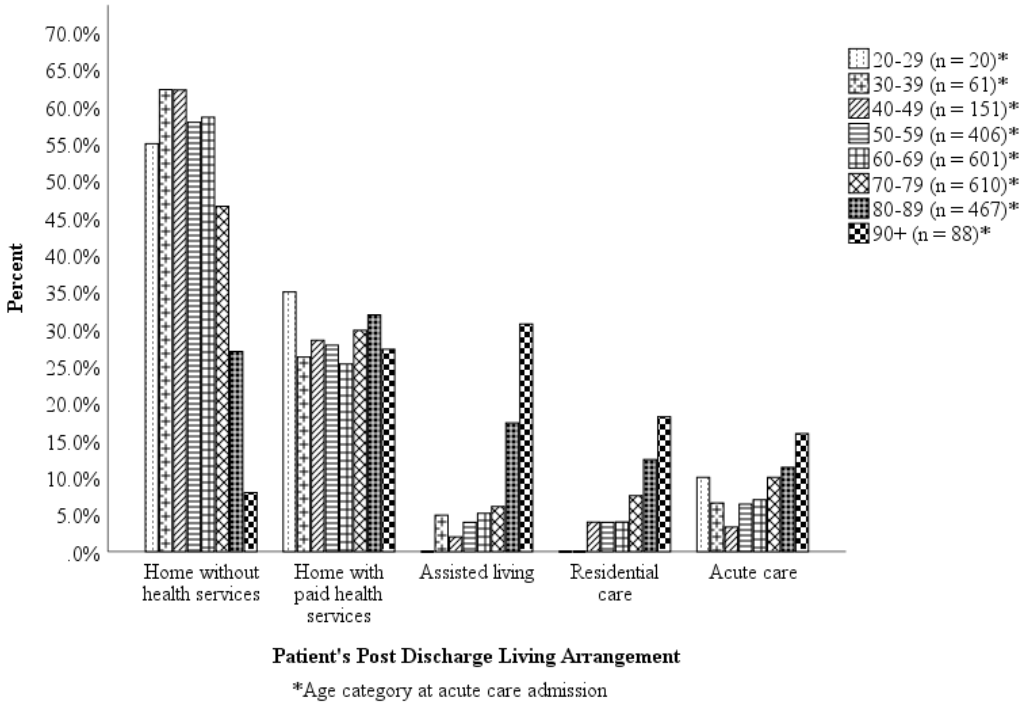

Figure 3.11.6: Bars chart of post discharge living arrangement by category of functional impairment

Chapter 4 Sex Differences in Rehabilitation Care in Alberta

We used the study described in Chapter Three as a basis for understanding the associations between sex and rehabilitation outcomes (functional gains, LOS, and discharge destination) of patients undergoing inpatient stroke rehabilitation in Alberta. The mean FIM change did not differ between males and females. Females had longer mean LOS in rehabilitation and were more likely to be discharged home with paid health services than males. Regarding age and discharge destination, female stroke patients were older at acute care admission, and patients <65 years were more likely to be discharged home without health services compared to those ≥65 years who were more likely to be discharged home with paid health services, or assisted living, residential care or acute care. Living with a spouse or partner prior to their stroke appeared to have an influence on patient's post discharge living setting (discharge destination). The majority of patients who were living alone prior to stroke were females and were more likely to be discharged home with paid health services, or to assisted living or residential care, compared to the majority of patients (males) who were living with a spouse/partner and were more likely to discharge home without needing health services. The impact of living with someone on functional recovery may be explained by the fact that stroke patients who are living with a spouse/partner or living with family/non-family (paid or unpaid) may receive help from these persons in performing daily living activities. The benefit of assisting stroke patients to perform these activities and ensuring their safety, increases the likelihood that rehabilitation professionals will discharge certain stroke patients home. Similar to the previous severity and timing study, this study was limited by factors that may have increased the risk for bias in the research process. The accuracy of FIM scores recorded

by therapy staff and individuals who enter information at each hospital in Alberta could not be established. The ceiling effect of the FIM also had the potential to limit the ability to accurately measure patient improvement in the case of mild stroke patients. Generalizability of findings to other provinces was limited by the fact that data were collected only in Alberta.

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Abstract

Background: Female stroke patients may experience poorer functional outcomes than males following inpatient rehabilitation, and this has been thought to occur because of higher levels of disability at admission to rehabilitation.

Methods: Data from Alberta inpatient stroke rehabilitation units was examined for: (1) the impact of sex on timing to inpatient rehabilitation, functional gains (using the Functional Independence Measure (FIM)), length of stay (LOS), and discharge destination; (2) if sex was related to age, stroke severity and living arrangement at discharge from rehabilitation; and (3) whether age and patient's pre-admission living arrangement had an influence on patient's LOS in rehabilitation or discharge destination.

Results: The sample consisted of 2,266 adult stroke patients (1283 males and 983 females) subcategorized as mild (1,155), moderate (994), or severe (117). Females (M=69, 15SD) were significantly older than males (M=67, 13SD) ($p=2.4x10^{-4}$). No difference existed between males and females in the time (days) from acute care to rehabilitation admissions (p=.73) or in mean FIM change (p=.294) during inpatient rehabilitation. The mean LOS (days) was longer for females (M=69.64, 68.48SD) than males (M=62.97, 64.28SD) (p=.018). Males were more likely than females to be discharged home ($p=1.8x10^{-13}$). Further, male patients ($p=6.4x10^{-7}$) and those <65 years ($p=1.4x10^{-23}$) were more likely to be discharged home without homecare.

Conclusion: Females experienced a slightly longer LOS in inpatient rehabilitation. However, time to rehabilitation admission and FIM gains were similar to males. Males and patients <65 years were more likely to be discharged home with no health services.

Key Words: stroke, sex differences, inpatient rehabilitation, functional outcomes.

INTRODUCTION

Males and females with stroke in Canada have equal access to rehabilitation services including physical therapy, occupational therapy, and speech therapy (Holroyd-Leduc, Kapral, Austin, & Tu, 2000; Kapral et al., 2005; Paolucci et al., 2006). Despite equal access to these services, differences in functional outcomes of male and female stroke patients have been previously reported (Olsen, Andersen, & Andersen, 2012; Paolucci et al., 2006; Reeves et al., 2008; Sue-Min, Duncan, Dew, & Keighley, 2005). Studies from other countries have suggested that female stroke patients experience poorer functional outcomes than male stroke patients following inpatient rehabilitation (Denti et al., 2013; Glader et al., 2002; Kapral et al., 2005; Olsen, Andersen, & Andersen, 2012; Paolucci et al., 2006; Reeves et al., 2008; Sue-Min, Duncan, Dew, & Keighley, 2005; Wu et al., 2014). Variations have been attributed to the fact that females with stroke have more physical impairments and limitations in performance of daily living activities after stroke relative to males (Glader et al., 2002; Kapral et al., 2005; Sue-Min, Duncan, Dew, & Keighley, 2005). Similarly, when males and females were matched for age, severity of stroke, and time to rehabilitation admission, males demonstrated greater independence in stair climbing and performance of daily living activities compared to females (Glader et al., 2002; Paolucci et al., 2006; Wu et al., 2014). This finding has been attributed to increased androgen receptors in the upper body of males, leading to higher levels of testosterone that stimulate upper body muscle development and increase upper body muscle mass in male compared to female patients (Gentil et al., 2016).

Certain factors may contribute to poorer functional outcomes in female stroke patients following rehabilitation. In previous large Canadian (n = 3,323) and Danish (n =

26,818) studies, examinations of sex differences in disability, length of stay (LOS) and discharge destination of post-stroke patients have shown that female stroke patients experience greater disability at 6 months post-stroke, have longer LOS in rehabilitation, and are more likely to be discharged to a long-term care facility compared to male stroke patients (Kapral et al., 2005; Olsen, Andersen, & Andersen, 2012). These differences were attributed to decreased physical function prior to rehabilitation admission, reduced independence in performance of daily living activities, lack of social support, lack of spouse/partner (Denti et al., 2013; Kapral et al., 2005), history of stroke, increased body mass index, increased stroke severity, and nursing home residence prior to stroke onset (Lisabeth et al., 2014).

In this study, we examined the differences in functional gains, LOS, and discharge destination of male and female stroke patients undergoing inpatient rehabilitation in Alberta. Further, we examined whether patient's age and living arrangement prior to stroke had an influence on their discharge destination, whether patient's sex was related to age at acute care admission, stroke severity, and living arrangement at discharge from rehabilitation, and whether age influenced LOS in rehabilitation. We hypothesized that female sex would be related to worse functional gains, longer LOS and higher rates of discharge to living environments that provided higher levels of assistance with daily activities. We also hypothesized that increased age and living without a spouse or partner at the time of admission would lead to discharge to living settings that provide additional care to patients.

METHODS

Research Design

We conducted an analysis of primary data from a cohort of patients admitted to and discharged from inpatient stroke rehabilitation units in Alberta between April 2013 and March 2017. Data were obtained from the Alberta Health Services' stroke rehabilitation database. The study was approved by the University of Calgary's Conjoint Health Research Ethics Board (REB17-1186).

Sample and Setting

We included all clinically diagnosed cases of adult stroke (hemorrhagic or ischemic) with a documented sex type and inpatient rehabilitation unit stay in Alberta. In cases when the type of stroke at initial acute care presentation was ischemic and there was an eventual hemorrhagic component, we considered 'hemorrhagic' as their stroke etiology. We excluded 454 cases from the original dataset provided by Alberta Health Services (n = 2720 cases) due to missing data (n = 204); cases classified with admission/ discharge living setting listed as boarding house (n = 13), shelter (n = 2), or public place (n = 63); and cases with unspecified pre/post discharge living arrangement (n = 172). Cases with these post discharge living settings were excluded because such discharge destinations were considered temporal and could be changing, thus preventing continuous follow-up of patients after discharge.

Instruments

The Functional Independence Measure (FIM) was used to assess function at time of admission and discharge from the rehabilitation unit. FIMs were completed by rehabilitation unit staff at each of the nine centers providing data. Stroke severity was classified based on FIM admission scores. Scores of <40 were considered severe, 40-80 were considered moderate and >80 were considered mild (Stineman et al., 1998; Ween et

al., 1996). The FIM has been tested for reliability, validity, responsiveness to change, feasibility for use, and meaningfulness in clinical settings when administered by trained and tested personnel (Graham et al., 2014). We defined FIM change as the difference between admission and discharge total FIM scores. We defined FIM efficiency as the mean FIM change divided by the mean length of stay in days. Other information collected from the Alberta Stroke Rehabilitation database included: age, sex, pre-admission comorbid conditions, patient's living arrangement at discharge from inpatient rehabilitation (living with spouse/partner, living with family, living with non-family - unpaid, living with paid attendant, living alone, living in facility, and living in acute care), LOS in rehabilitation units, and patient's post-discharge living setting (home without health services, home with paid health services, assisted living, residential care, and acute care).

Data Collection

Data for the Alberta Stroke Rehabilitation Databases were assembled from Alberta Health Services Provincial Inpatient Discharge Abstract Database (DAD), National Rehabilitation System (NRS), and Calgary Rehabilitation Database and then transferred to the authors following appropriate ethics and administrative approvals.

Data Analysis

The mean, median, and standard deviation were calculated for continuous variables, and frequency distribution and percentages for categorical variables. The independent-samples t-test was used to examine the difference in length of time since stroke, as well as the differences in FIM change and in LOS in inpatient rehabilitation for male and female stroke patients. Differences in LOS in rehabilitation for patients younger than 65

years and patients 65+ years were also examined. Analysis of Variance (ANOVA) was used to test main and interaction effects of time since stroke and patient's sex on FIM change (including motor and cognitive), and the main and interaction effects of age and patient's sex on LOS in inpatient rehabilitation. Chi-square tests were used to examine the relationship between patient's sex and stroke severity; patient's sex and patient's living arrangement at discharge from rehabilitation; patient's sex and post discharge living setting; and age and post discharge living setting.

RESULTS

The sample consisted of 2266 (male = 1283, female = 983) patients admitted to and discharged from inpatient stroke rehabilitation units in Alberta between April 2013 and March 2017. These were clinically diagnosed cases of adult stroke (ischemic or hemorrhagic) subcategorized as mild, moderate, or severe impaired based on their initial FIM score at acute care admission. The mean age of participants was 68 years (69 median; 13.9 SD). The mean length of stay for active inpatient rehabilitation was 65.9 days (45 median; 66.2 SD), and the mean FIM change for all participants was 23.7 (22 median; 15.8 SD). We examined the relationship between patient's sex and patient's age (in years) at acute care admission (see Figure 1). The mean age was 67 (13 SD) for male stroke patients and 69 (15 SD) for female stroke patients, with overall mean age at acute care admission across both males and females of 68 (14 SD). To determine whether the distribution of age was the same for both males and females, we performed a two samples Kolmogorov-Smirnov test. We observed a statistically significant difference ($p = 2.2 \times 10^{-4}$) in age distributions between male and female patients. To determine whether there were significant differences in age at acute care admission, we performed an

independent-samples t-test. We observed a significant difference in age for males and females (t (1999) = -3.69, p = 2.4 x 10^{-4}, two-tailed). The magnitude of the differences in the means (mean difference = -2.19, 95% CI: -3.36 to -1.03) was small (Cohen's d = -0.14). This finding implies that the age of male and female stroke patients differed slightly at the start of the acute stroke episode of care, with males being younger than females.

Is patient's sex associated with stroke severity at admission to inpatient rehabilitation?

We examined the relationship between patient's sex and stroke severity based on admission FIM score (see Figure 2). The mean admission FIM score was 81.46 (23.06 SD) for male stroke patients and 77.66 (21.64 SD) for female stroke patients, with overall mean admission FIM score of 79.81 (22.53 SD). At admission to inpatient rehabilitation, 55% of patients with mild stroke and 5.5% of patients with severe stroke were males compared to 45.7% (mild) and 4.8% (severe) for female stroke patients. Conversely, 49.5% of patients with moderate stroke at inpatient rehabilitation admission were female compared to 39.5% for male stroke patients. To determine whether these proportions of males and females (based on admission FIM scores) differed significantly, we used a chi-square test for independence which indicated a statistically significant association between sex and stroke severity, χ^2 (2, n = 2266) = 22.79, p = 0.000011, Cramer's v = .1, with a small effect size.

Is there an association between patient's sex and time between stroke onset and rehabilitation admission?

We examined the relationship between patient's sex and time since stroke (length of time from acute care admission to inpatient rehabilitation admission) (see Figure 3). The mean

time since stroke (in days) to rehabilitation admission was 22.48 (25.78 SD) for male stroke patients and 22.86 (26.33 SD) for female stroke patients, with overall mean time since stroke across both males and females of 22.64 (26.01 SD). To determine whether there were significant differences in time since stroke between male and female patients, we performed an independent-samples t-test. We observed no significant difference in time since stroke for males and females (t (2264) = -.35, p = .73, two-tailed). The magnitude of the differences in the means (mean difference = -.38, 95% CI: -2.54 to 1.78) was very small (Cohen's d = -0.01).

Are patient's sex and time between stroke onset and rehabilitation admission related to functional gains during rehabilitation?

We examined the impact of time from acute care admission to inpatient rehabilitation admission on functional changes during rehabilitation. The mean FIM change during inpatient rehabilitation was 23.39 points for male stroke patients (21 median; 15.78 SD), and 24.09 points for female stroke patients (22.0 median; 15.9 SD), with overall mean FIM change of 23.7 (15.83 SD). To further determine the differences in FIM change between male and female stroke patients, we conducted an independent-samples t-test to compare the mean FIM changes between male and female stroke patients. There was no significant difference in mean FIM change between males and females (t (2264) = -1.049, p = .294, two-tailed).

We further examined FIM efficiency to understand how male and female stroke patients were improving in their functional abilities during each day of rehabilitation. Male stroke patients had a larger FIM efficiency (0.4 points/day) compared to female stroke patients (0.3).

Does patient's sex influence rehabilitation length of stay?

We examined the relationship between patient's sex and LOS in inpatient rehabilitation (see Figure 4). The mean LOS (in days) in inpatient rehabilitation was 63.0 (44 median; 64.3 SD) for male stroke patients and 69.7 (47 median; 68.5 SD) for female stroke patients, with overall LOS of 65.9 (45 median; 66.2 SD). We observed a significant difference in mean LOS in rehabilitation for males (M = 63.0, 64.3 SD) and females (M = 69.7, 68.5 SD); t (2042) = -2.36, p = .02, two-tailed). The magnitude of the differences in the means (mean difference = -6.67, 95% CI: -12.21 to -1.13) was very small (Cohen's d = -0.1).

How are patient's sex and age at acute care admission related to length of stay in rehabilitation?

We wished to determine whether patient's age had a substantial impact on LOS in rehabilitation. The mean LOS (in days) in inpatient rehabilitation was significantly longer for those under 65 years (M = 78.56, 87.84 SD) than those over 65 years (M = 57.80, 45.84 SD; t (1187) = 6.47, p = 1.4×10^{-10}, two-tailed). The magnitude of the differences in the means (mean difference = 20.75, 95% CI: 14.46 to 20.05) was small (Cohen's d = 0.3). Further, we wanted to determine the effects of patient's sex and age on LOS in rehabilitation, and also determine whether these effects on LOS differed significantly between the different age groups. Thus, we ran a two-way between-groups analysis of variance, which demonstrated no interaction effect on LOS (F (7, 2250) = 1.051, p = .39) and no main effect for sex (F (1, 2250) = 0.721, p = .396). But, there was a significant main effect for age (F (7, 2250) = 10.80, p = 1.9×10^{-13}) with a very small effect size (partial eta squared = 0.03).

Is patient's sex associated with discharge destination?

We wanted to determine whether patient's sex had an influence on their post discharge living setting, so we examined the relationship between sex and post discharge living setting (see Figure 5). At discharge from inpatient rehabilitation, 55.5% of male stroke patients were discharged home with no health services compared to 44.6% of females. With regard to other dispositions, 32.3% of female stroke patients (28.4% males) were discharge home with paid health services, 10.4% (6.4% males) were discharged to assisted living, and 9.1% (5.9% males) were discharged to residential care. Results of Chi-square test for independence indicated a statistically significant association between patient's sex and post discharge living setting, χ^2 (4, n = 2266) = 34.31, p = 6.4 x 10^{-7}, Cramer's v = .12, with a small effect size. This finding implies that patient's sex had a small influence on their discharge destination.

To determine whether a patient's living setting prior to rehabilitation admission potentially influenced their post rehabilitation discharge living setting, we started by examining the relationship between patient's sex and patient's living setting at admission to inpatient rehabilitation. At acute care admission 58.7% of male compared to 41.3% of female stroke patients were living at home with no health services. With regard to other living settings, 40.3% of male stroke patients (49.7% females) were living at home with paid health services, 33.0% (67.0% females) were living in assisted living, and 36.4% (63.6% females) were living in residential care. From these findings, male stroke patients were more likely to be living at home without health services (homecare) compared to female stroke patients. Conversely, female stroke patients were more likely to be living at home with homecare or living in assisted living, and residential care compared to male

stroke patients. A chi-square test for independence indicated a statistically significant association between patient's sex and patient's living setting at inpatient rehabilitation admission, χ^2 (3, n = 2266) = 39.11, p = 1.6 x 10^{-8}, Cramer's v = .13, with a small to effect size. This finding implies that patient's sex had a small to moderate influence on their living setting at inpatient rehabilitation, and that living setting prior to rehabilitation admission differed between male and female stroke patients.

Is patient's sex associated with patients' living arrangement at discharge from inpatient rehabilitation?

We also wanted to determine whether patient's living arrangement at discharge from inpatient rehabilitation had an influence on their discharge destination. We started by examining the relationship between patient's sex and patient's living arrangement at discharge from inpatient rehabilitation (see Figure 6). At discharge from rehabilitation, 15.9% of male relative to 21.4% of female stroke patients were living alone. Conversely, 54.6% of male compared to 37.4% of female stroke patients were living with spouses/partners. Also, 14.5% of males (21.1% females) were living with family, and 9.1% of males (14.2% females) were living in a facility. A Chi-square test for independence indicated a statistically significant association between sex and patient's living arrangement at discharge from rehabilitation, χ^2 (6, n = 2266) = 71.72, p = 1.8 x 10^{-13}, Cramer's v = .18, with a medium to large effect size. These findings imply that patient's sex and their living arrangement are related as female stroke patients were discharged to situations where they were living alone, living with the family, or living in facility compared to male stroke patients who were more likely to be discharged to situations where they were living with spouse/partner.

Is age associated with discharge destination following inpatient stroke rehabilitation?

Finally, we examined the relationship between age and post discharge living setting (see Figure 7). We observed that 62.8% of patients younger than 65 years were more likely to be discharged home without health services compared to 43.1% of patients 65+ years. Conversely, 31.8% of patients 65+ years (27.5% younger than 65 years) were more likely to be discharged to home with paid health services, 11% (3.6% younger than 65 years) discharged to assisted living, 9.2% (4.3 younger than 65 years), discharge to residential care, and 5.0% (1.7% younger than 65 years) discharged back to acute care. A Chi-square test for independence indicated a statistically significant association between age and post discharge living setting, χ^2 (4, n = 2266) = 113.31, p = 1.4 x 10^{-23}, Cramer's v = .224, with a large effect size. This finding means that patient's age and discharge destination are related as patients under 65 years were more likely to be discharged home without needing health services and patients age 65 and older were more likely to be discharged home with paid health services or discharged to living settings where additional care is provided.

DISCUSSION

Summary of key points

We conducted a province wide analysis of primary data from a large sample of patients admitted to and discharged from inpatient stroke rehabilitation units in Alberta between April 2013 and March 2017. Female patients tended to have a longer LOS in rehabilitation compared to male stroke patients. Male stroke patients and patients <65 years were more likely to be discharged home without needing health services, while female stroke and patients ≥65 years were more likely to be discharged to home with paid

health services, assisted living, residential care, and back to acute care. There was no significant difference in time to rehabilitation admission and FIM gain between male and female stroke patients.

Impact of patient's sex on functional outcomes

Female stroke patients in Alberta had longer mean LOS in rehabilitation and were more likely to be discharged home with paid health services relative to males. This finding was similar to findings reported in Ontario (Hall et al., 2016) and could be attributed to the fact that female stroke patients are older, have more physical limitations, suffer depression, social isolation or lack of social support, and are more likely to be widowed (Kapral et al., 2005; Koton, Telman, Kimiagar, Tanne & NASIS Investigators, 2013). This difference between male and female stroke patients suggest that there is need for rehabilitation professionals to refine programs that provide social (pragmatic) support to female stroke patients.

Impact of patient's age on functional outcomes

Patients <65 years are more likely to be discharged to home without needing health services, while older patients ≥65 are more likely to be discharged home with paid health services, assisted living, residential care, and back to acute care. This finding may be attributed to the physical limitations, disability, and loss of independence experienced by older patients (Paterson & Warburton, 2010). Patients <65 years are more likely to have longer LOS in rehabilitation compared to those ≥65 years. This finding has been previously attributed to multiple factors including "performance bias", a situation where rehabilitation staff have lower expectations of functional gains for older patients, resulting in shorter LOS in rehabilitation for older patients (Elwood et al., 2009). Other

factors that may explain this finding are “premature discharge”, a situation whereby older patients are discharged from rehabilitation early due to decreased physical ability to participate in rehabilitation, a request by family for patient to be discharged, or transfer of patient back to acute care (Atalay & Turhan 2009).

Impact of patient’s living arrangement at discharge from rehabilitation on functional outcomes

Patient’s living arrangement prior to having the stroke had an influence on post discharge living setting. The majority of patients in this cohort who were living alone prior to stroke were females and were more likely to discharge to home with paid health services, assisted living, and residential care, compared to majority of patients (males) who were living with spouse/partner and were more likely to discharge home without needing health services. Differences between males and females with respect to living arrangement prior to stroke may be attributed to the fact that female stroke patients are more likely to be widowed or living without a spouse or partner. The impact of living with someone on functional recovery may be explained by the fact that stroke patients who are living with a spouse/partner or living with family/non-family (paid or unpaid) may receive help from these persons in performing daily living activities. This caregiver support ensures patient’s safety and increases the likelihood that rehabilitation professionals will discharge certain stroke patients home. Clinicians often consider the possibility that having someone at home who is willing to assume the caregiver role in discharge planning and this may increase the likelihood of discharging home without needed home health services.

Comparison to another province in Canada

When we compared findings from this study to those reported in other Canadian provinces, we observed certain similarities and differences. For the similarities, the majority of stroke patients admitted to inpatient rehabilitation units in both Ontario (Hall et al., 2016) and Alberta were males compared to females. Of those admitted to rehabilitation in both provinces, female stroke patients had a higher level of disability/dependence (based on admission FIM score) at the time of admission to rehabilitation compared to male stroke patients. With respect to age, female stroke patients in both Ontario and Alberta were older at the time of admission to inpatient rehabilitation. Further, significant differences in discharge destination of male and female patients were noted in the two provinces. In Ontario, male stroke patients were more likely to be discharged to home without health services compared to female stroke patients who were more likely to be discharged to home with community health services or to a long-term care facility (Hall et al., 2016). Similar to Ontario, our Alberta data demonstrate differences in discharge destination of male and female stroke patients where male stroke patients were more likely to be discharged home without needing health services and female stroke patients were more likely to be discharged to home with paid health services, assisted living, and residential care.

Opportunities for change

As demonstrated in this study, LOS in rehabilitation is generally long, with females and younger patients experiencing longer LOS. We hope that our findings will help clinicians reassess Alberta Health Services' stroke rehabilitation system/processes to determine specific factors that drive LOS in rehabilitation in Alberta and to make appropriate

changes to improve functional outcomes of stroke patients in Alberta. Potential factors, such as “performance bias” (lowering functional gains expectations for older stroke patients during rehabilitation), capacity issues, and staff opinions regarding patient’s readiness to return home or advance to the next phase of rehabilitation would need to be investigated and addressed.

Limitations of this study

There were certain limitations to this study. The accuracy of FIM scores recorded by therapy staff and the individuals who enter information at each hospital in Alberta could not be ascertained. Further, a ceiling effect has been demonstrated for FIM Score (Kwong, Hartzema, Duncan, & Min-Lai, 2004) and has the potential to limit the ability to accurately measure patient improvement in the case of mild stroke patients. The fact that data are from a single province limits generalizability of findings to other provinces.

CONCLUSIONS

Our study offers a clear picture of the influence of patient’s sex on inpatient stroke rehabilitation care in Alberta from 2013 to 2017. We evaluated whether there were differences in stroke rehabilitation outcomes (functional gains, length of stay, and discharge destination) based on patient’s sex and whether the time from acute care admission to inpatient rehabilitation differed between male and female stroke patients. Further, we examined whether patient’s sex, age, and patient’s living arrangement had an influence on discharge destination. Despite suggestions that female stroke patients experience poor functional outcomes during rehabilitation, we observed only a small effect of patient’s sex on rehabilitation LOS with no effect of patient’s sex on functional change. Length of time to rehabilitation admission and functional changes were not

significantly different between male and female stroke patients. Female stroke patients and patients younger than 65 years had significantly longer LOS in rehabilitation. Male stroke patients and patients younger than 65 years were more likely to be discharged home without needing health services.

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Figures legend

Figure 1. Bars chart of age category (in years) at acute care admission by patient's sex. The height of the bar represents percentage of cases that are likely to belong to the corresponding age category at acute care admission, and the color of the bar represents the sex of the patients.

Figure 2. Bars chart of category of functional impairment based on admission Functional Independence Measure score by patient's sex. The height of the bar represents percentage of cases that are likely to belong in the corresponding category of functional impairment, and the color of the bar represents the sex of the patients.

Figure 3. Bars chart of groups of days between acute care admission and inpatient rehabilitation admission by patient's sex. The height of the bar represents percentage of cases that are likely to wait for the corresponding number of days between acute care admission and impatient rehabilitation admission, and the color of the bar represents the sex of the patients.

Figure 4. Bars chart of groups of length of stay (days) for inpatient rehabilitation by patient's sex. The height of the bar represents percentage of cases that are likely to spend the corresponding number of days in inpatient rehabilitation, and the color of the bar represents the sex of the patients.

Figure 5. Bars chart of post discharge living settings by patient's sex. The height of the bar represents percentage of cases that are likely to be discharged to the corresponding post discharge living setting, and the color of the bar represents the sex of the patients.

Figure 6. Bars chart of living arrangements at discharge from inpatient rehabilitation facility by patient's sex. The height of the bar represents percentage of cases that are

likely to have the corresponding living arrangement, and the color of the bar represents the sex of the patients.

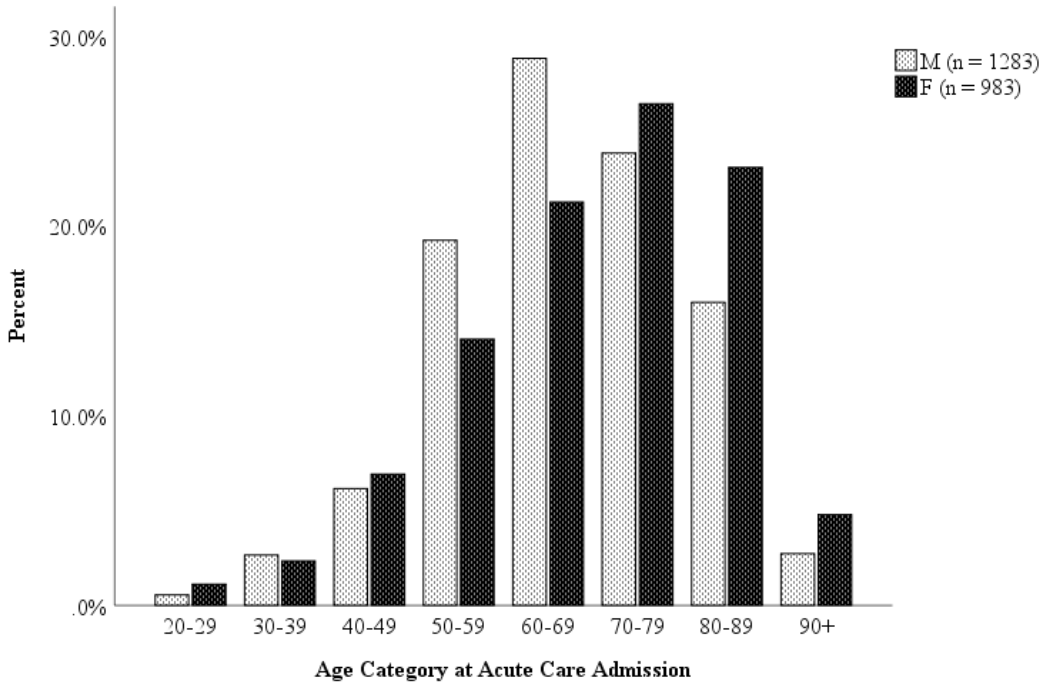
Figure 7. Bars chart of patient's post discharge living setting by patient's age category (in years) at acute care admission. The height of the bar represents percentage of cases that are likely to be discharged to the corresponding post discharge living setting, and the color of the bar represents the age category of the patients.

Table 4.10.1 Demographic characteristic of subjects

Characteristic	Total	Mild stroke	Moderate stroke	Severe stroke
Age at acute care admission (years)				
Median (IQR)	69(67-71)	67(58-76)	71(60-81)	71(59-82)
Sex, %				
Male	56.6	61.1	51.0	59.8
Female	43.4	38.9	49.0	40.2
Etiology of stroke, %				
Ischemic stroke	83.4	85.5	82.3	70.9
Hemorrhagic stroke	16.6	14.5	17.7	29.1

IQR = interquartile range.

Figure 4.11.1: Bars chart of age category at acute care admission by patient's sex



*Patients sex

FIGURES

Figure 4.11.2: Bars chart of category of functional impairment based on admission FIM score by patient's sex

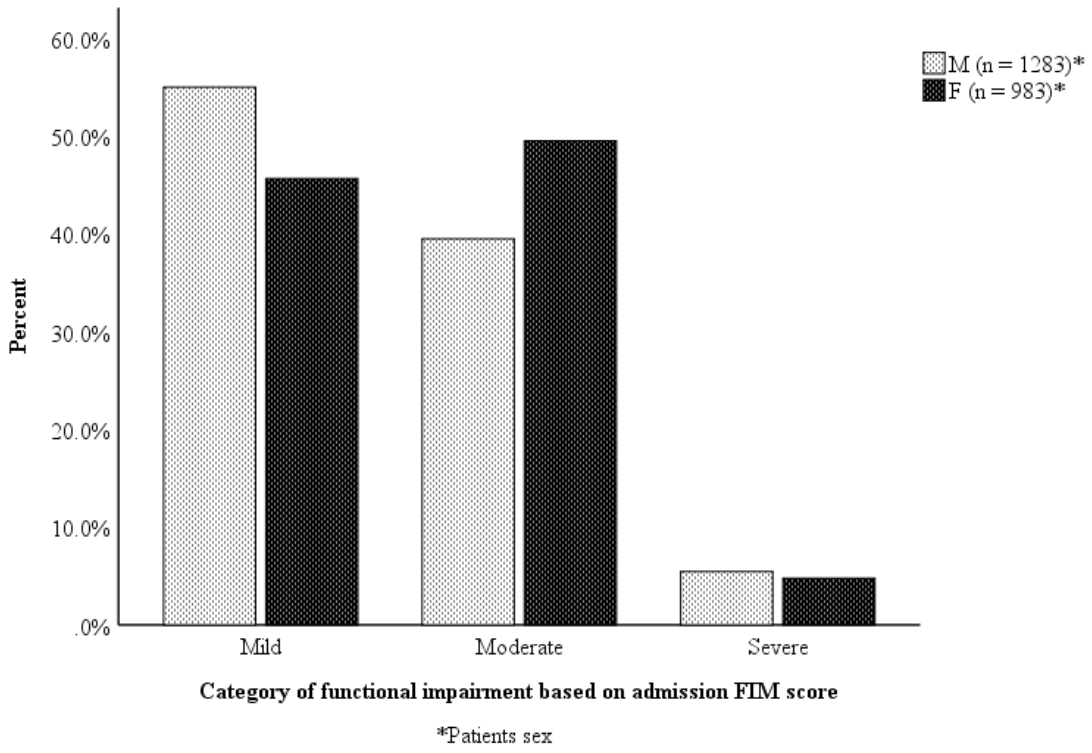


Figure 4.11.3: Bars chart of groups of days between acute care admission and inpatient rehabilitation admission by patient's sex

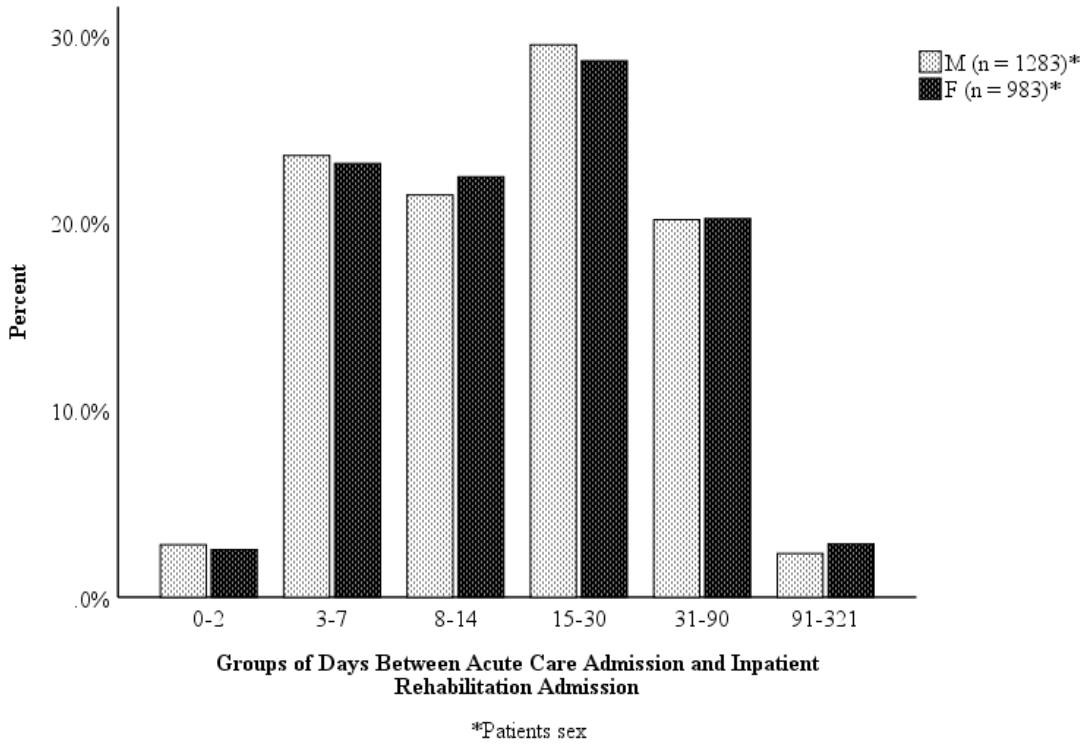


Figure 4.11.4: Bars chart of groups of days of LOS for inpatient rehabilitation by patient's sex

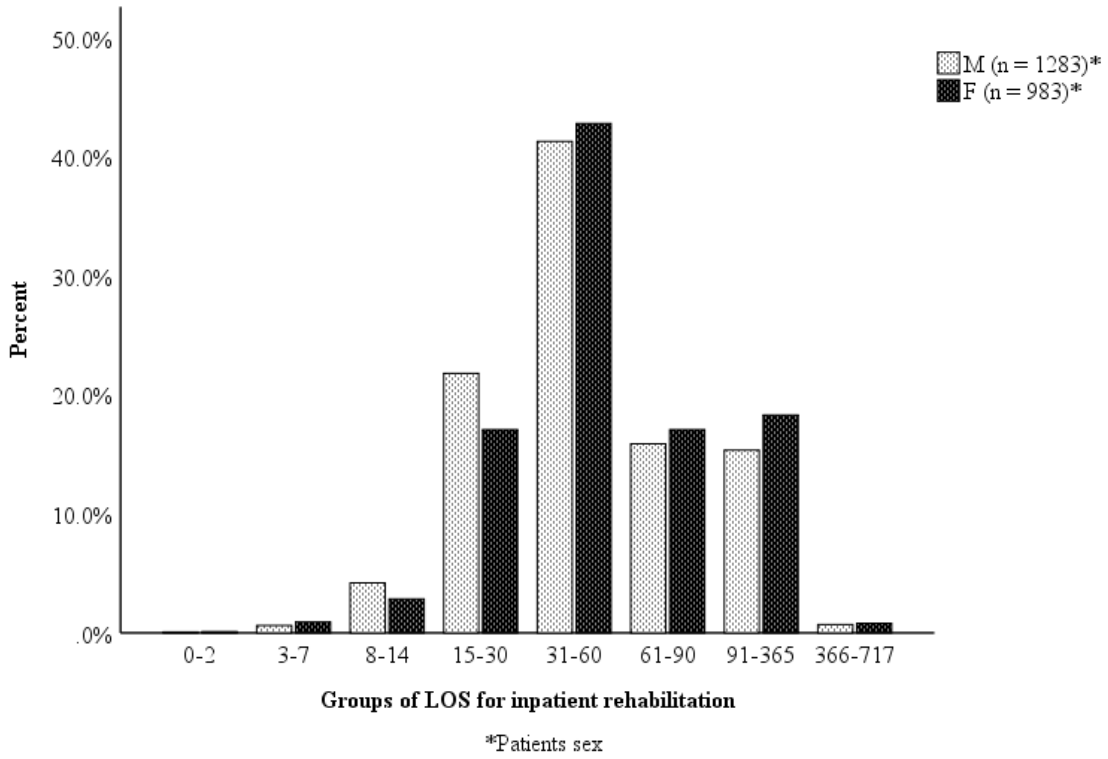


Figure 4.11.5: Bars chart of post discharge living settings by patient's sex

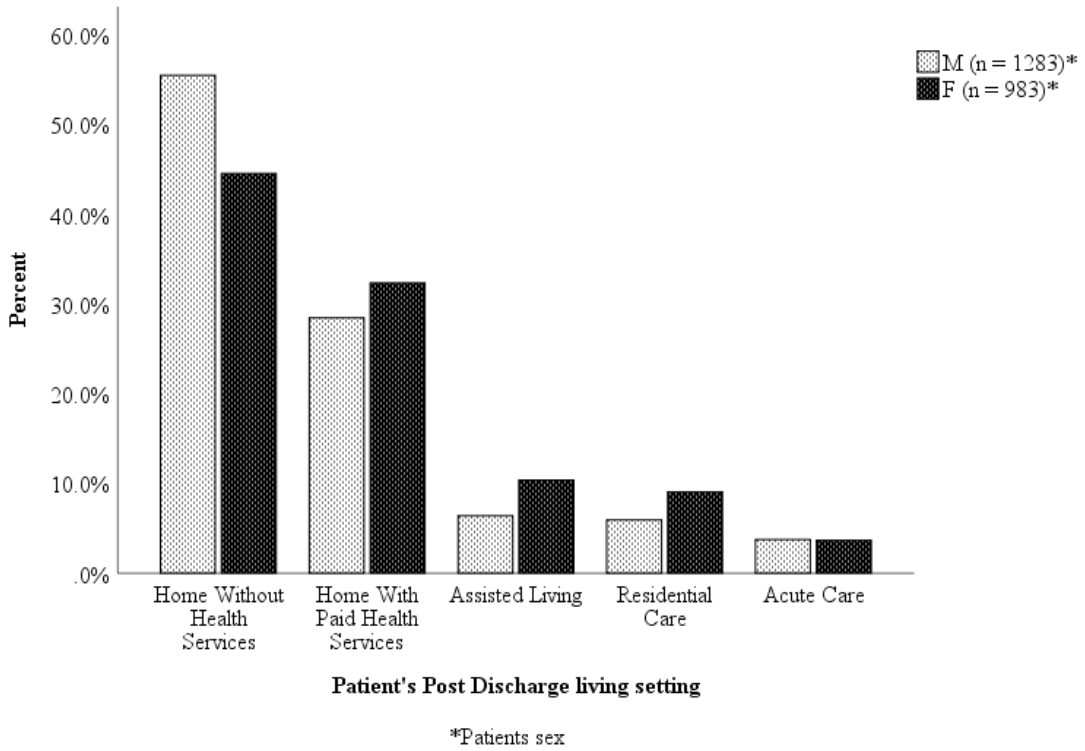


Figure 4.11.6: Bars chart of post discharge living arrangements by patient's sex

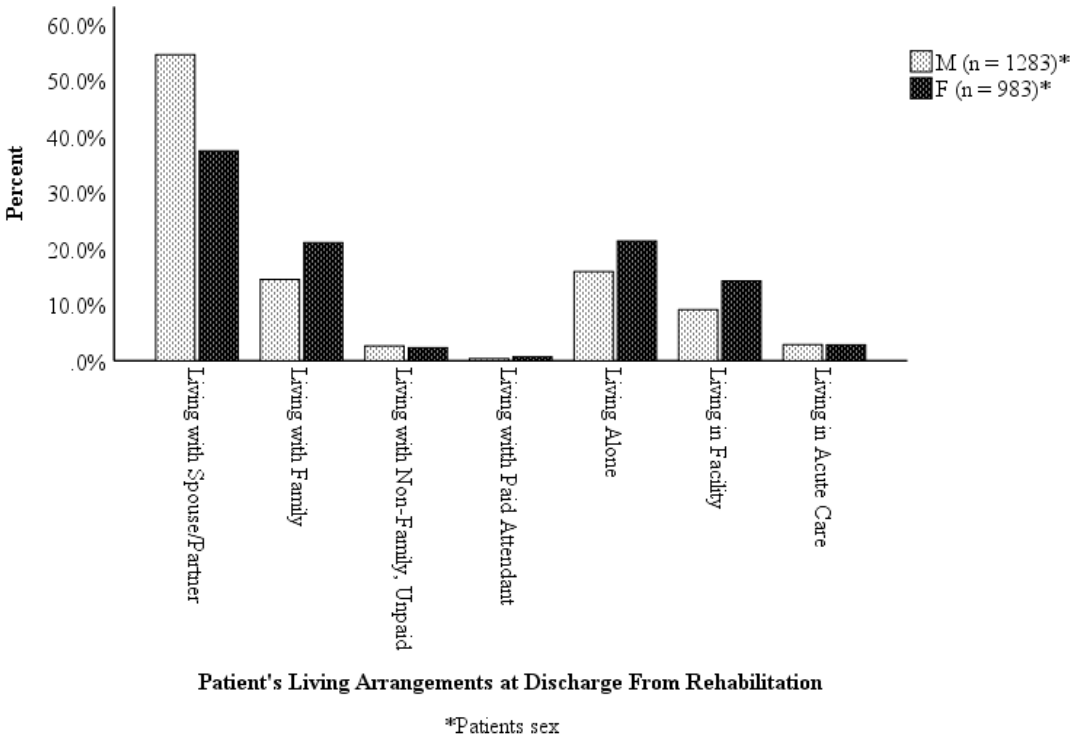
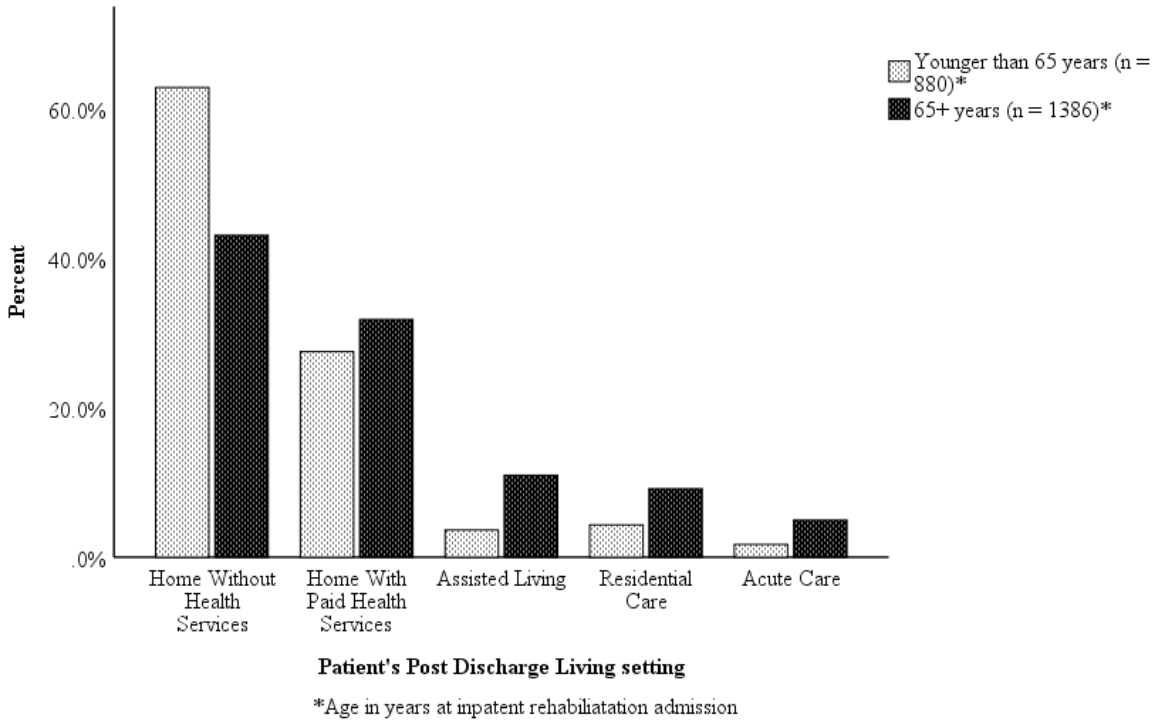


Figure 4.11.7: Bars chart of post discharge living settings by age category at acute care admission



Chapter 5 Discussion

5.1 Summary of Findings

This thesis consists of three manuscripts, one focused on a philosophical perspective for undertaking stroke research and the other two, on the influence of stroke severity and sex on stroke outcomes. The first manuscript (Chapter Two) offers a discussion of post-positivist critical multiplism, a philosophical perspective about undertaking research and its value for nursing research, using stroke rehabilitation research as an example. The second manuscript (Chapter Three) represents original research in which we examined the impact of stroke severity and timing to inpatient rehabilitation admission on length of stay, functional gains, and discharge destination. The third manuscript (Chapter Four) is also original research in which we examined the sex differences in stroke rehabilitation outcomes of patients undergoing inpatient rehabilitation in Alberta. This final chapter (Chapter Five) includes: a summary of findings from the three manuscripts (postpositivist critical multiplism, stroke severity and timing, sex differences) and impact of the second and third studies on practice and research; strengths and limitations identified for the second and third manuscripts; addressing the postpositivist critical multiplism perspective in this work; future directions in this research (based on using a postpositivist critical multiplism perspective); and conclusions.

5.1.1 Postpositivist critical multiplism.

We explored the value of postpositivist critical multiplism in developing (nursing) knowledge. The results of our literature search indicate that postpositivist critical multiplism acknowledges the importance of human influence on knowledge development

and enables researchers to use multiple approaches to address complex human phenomena, thereby respecting the unique perspectives of stakeholder groups including patients, family members, and knowledge users. There are certain steps that can be used by critical multiplist investigators to approach stroke research. Using these steps and the critical multiplist approach may minimize inherent biases associated with using one research method over another and maximize confidence in resultant research findings.

5.1.2 Stroke severity and rehabilitation outcomes.

We examined the impact of stroke severity and timing to inpatient rehabilitation admission on LOS, functional gains, and discharge destination. Our findings indicate that stroke severity was not significantly associated with length of time to rehabilitation admission. Patients with moderate and severe stroke made significantly larger FIM gains than those with mild stroke during inpatient rehabilitation. The mean LOS in rehabilitation for mild stroke was significantly shorter than that of moderate and severe stroke patients. Shorter time to inpatient rehabilitation admission was associated with small but significant FIM gains and a shorter LOS. Having a mild stroke and having a shorter time to rehabilitation admission were associated with being discharged home without needing homecare. Despite suggestions that shortening timing to rehabilitation should improve outcomes (Scrutinio et al., 2015; Wang et al., 2015), the impact on functional gains and rehabilitation LOS was small. The FIM efficiency was measured and was generally poor for all stroke severity categories, suggesting that stroke patients experienced poor improvement in their functional abilities during each day of rehabilitation. Mild stroke patients had the greatest FIM efficiency (0.4 points/day) and were more likely to be discharged to home without paid services, compared to severe

stroke patients that had the least FIM efficiency (0.2) and were more likely to be discharged to long-term care facilities or back to acute care. This finding was consistent with the literature which indicates that patients with greater FIM efficiency are more likely to be discharged to home from inpatient rehabilitation (Bottemiller, Bieber, Basford, & Harris, 2006; Ween et al., 1996).

5.1.2.1 Impact of the study.

Results from this study revealed surprising and interesting findings about rehabilitation care in Alberta. The sample was large and from a retrospective cohort of stroke patients who received inpatient rehabilitation in Alberta over a four-year period. Length of time to rehabilitation admission influenced rehabilitation LOS and FIM change. However, length of time to rehabilitation admission did not differ between stroke severities. This finding may be of interest to professionals who may be wondering whether a particular category of stroke patients (mild, moderate, or severe) should be transferred to inpatient rehabilitation units early. This finding may also be interesting to professionals interested in knowing whether stroke patients receive rehabilitation while in acute care, and whether they receive the same type and amount of rehabilitation if they do. To answer these questions, further research would need to be conducted to determine the type and amount of rehabilitation provided to stroke patients in acute care prior to their transfer to inpatient rehabilitation units.

We demonstrated that shorter times to rehabilitation admission leads to shorter LOS and higher FIM gains, however, the median LOS in rehabilitation (45 days) was much longer compared to the median LOS in Canada (31 days). Further investigation may be needed to determine specific factors that may be driving rehabilitation LOS in

Alberta. In addition to factors listed in Chapter Three, other non-patient related factors that may be driving LOS in Alberta are capacity issues and staff opinions around patients' readiness to return home or move onto the next phase of rehabilitation.

To shorten LOS in rehabilitation and increase physical/mobility function and performance of daily living activities, stroke patients should be transferred to rehabilitation units early. In the Ontario model, patients complete an Alpha FIM (Ontario Stroke Network, 2014) at 72 hours post-stroke which is used to determine stroke severity. The Alpha FIM is a abbreviated version of the FIM with 6 items (eating, grooming, bowel management, toilet transfers, expression and memory) which is used to predict what the full admission FIM for a patient (Ontario Stroke Network, 2014) would be. From the Ontario model, recommendations have been made that mild stroke patients could go home with appropriate supports and either be referred to Early Supported Discharge (ESD) services (a form of rehabilitation designed to accelerate the transition of stroke patients to home by providing rehabilitation therapies delivered by interprofessional teams in the community; Meyer et al., 2014) or outpatient rehabilitation to reduce their LOS in acute care to decrease excessive costs. It is important to recognize that the data we have analyzed are utilizing full FIM scores taken at admission to rehabilitation, which in Alberta occurred at a mean of 24.2 days post-stroke. Many of the patients who were categorized as mild by admission FIM in our study would have likely been moderate at 72 hours because of the significant amount of recovery that naturally occurs in the first few weeks after the stroke. So one must be a bit cautious in making direct comparisons between data from the two provinces given the large differences in the time that the AlphaFIM and FIM instruments were administered. Based on this, it is

unlikely that all patients in the mild category in our study could have gone home and been treated as per the recommendations coming out of Ontario.

Some centres in Alberta do collect 72 hour Alpha FIM data, although this information is not uploaded to any of the databases used in the present study. Future comparisons examining the fate of mild stroke would do well to obtain this data for the purpose of making direct comparisons with other provinces. Ultimately, provincial benchmarking may help to improve the length of time required to get patients to rehabilitation centres, and this has been seen in Ontario (Hall et al., 2016).

The mean LOS in inpatient rehabilitation was surprisingly longer in Alberta compared to Ontario. It is worth noting that, unlike the policy used in Ontario which sets target LOS in inpatient rehabilitation for stroke patients based on Rehabilitation Patient Group (RPG) designations for mild, moderate, and severe stroke, Alberta does not have a similar policy for LOS based on RPG designations. According to this policy, median LOS in inpatient rehabilitation for mild stroke (RPGs 1150 (target LOS 7.7 days) and 1160 (target LOS 0 days) is 13 days, 24 days for moderate stroke (RPGs 1120 (target LOS 35.8 days), 1130 (target LOS 25.2 days) and 1140 (target LOS 14.7 days), and 38 days for severe stroke (RPGs 1100 (target LOS 48.9 days) and 1110 (target LOS 41.8 days; Hall et al., 2016).

Interestingly, with respect to post-discharge living arrangement, most stroke patients in Alberta returned home with no health services. This finding was inconsistent with a report from Ontario, where the majority of stroke patients returned home with paid health services following inpatient rehabilitation (Hall et al., 2016). This difference in

post-discharge health service access may be due to the length of time that stroke patients in Alberta spend in rehabilitation relative to those in Ontario.

5.1.3 Sex differences in rehabilitation outcomes.

To better understand potential sex differences in stroke outcomes, we evaluated the impact of patients' sex on timing to inpatient rehabilitation, functional gains, LOS, and discharge destination. There was a significant, but small difference in mean LOS in rehabilitation between male and female stroke patients. Female patients tended to have longer LOS in rehabilitation compared to male stroke patients. Male stroke patients and patients younger than 65 years were more likely to be discharged home without needing health services, while female stroke and patients 65+ years were more likely to be discharged to home with paid health services, assisted living, residential care, and back to acute care. Both male and female stroke patients were equally likely to be transferred back to acute care. Regarding living arrangement, female stroke patients were more likely to be living alone, living with the family, or living in facility (including all levels of care except acute care) compared to male stroke patients. There was no significant difference in time to rehabilitation admission and FIM gain between male and female stroke patients.

5.1.3.1 Impact of the study.

Patient's sex had an influence on LOS and discharge destination. Female stroke patients in Alberta had longer rehabilitation LOS, and the majority of patients discharged home with paid health services were females. This finding was similar to the findings reported in Ontario and could be attributed to the fact that female stroke patients have been shown to have more physical limitations, suffer depression, social isolation or lack

of social support, and are more likely to be widowed (Kapral et al., 2005; Koton, Telman, Kimiagar, Tanne & NASIS Investigators, 2013). With these finding, rehabilitation professionals may need to re-evaluate the effectiveness of programs that provide pragmatic social support (emotional, informational, companionship, and financial support Blessing & Oluwagbemiga, 2017) particularly for female stroke survivors.

Patient's age also had an influence on LOS in rehabilitation. Surprisingly, younger stroke patients had longer LOS in rehabilitation and were more likely to be discharged home without needing health services compared to older patients. This finding calls for a need for clinicians to investigate and address factors that drive LOS in rehabilitation in Alberta, such as "performance bias" introduced by staff who tend to lower functional gains expectations of older stroke patients during rehabilitation, thus causing shorter LOS in rehabilitation for older patients (Elwood et al., 2009). Further studies could be conducted to examine specific factors that cause "premature discharge" of older stroke patients from inpatient rehabilitation, such as decreased physical ability to participate in rehabilitation, request for early discharge by family, and transfer of patient back to acute care (Atalay & Turhan, 2009).

Living with a spouse or partner also had an influence on patient's post discharge living setting. Most patients in this cohort who were living alone were females and were more likely to discharge to home with paid health services, assisted living, and residential care, compared to patients (males) who were living with a spouse/partner and were more likely to be discharged home without needing health services. Differences in functional recovery may be explained by the fact that female stroke patients are more likely to be widowed, leading to social isolation. This difference between male and female stroke

patients suggest that there is need for rehabilitation professionals to refine programs to provide social (pragmatic) support to female stroke patients.

5.2 Strengths and Limitations of the Cohort Studies

5.2.1 Strengths

The research described in this thesis had several strengths. The research was conceived following the author's clinical experiences with stroke patients in the neurorehabilitation unit at the Mayo Clinic in Rochester (Minnesota) and following personal consultations with the stroke rehabilitation care team at Foothills Medical Centre in Calgary (Alberta). During the author's encounters with patients and the rehabilitation care staff, stroke severity, access to rehabilitation care, and time to rehabilitation admission were identified as problems. The author's passion to contribute towards stroke recovery research and practice led to the design of this research. The studies included in this thesis were designed to complement and build on the methods or content of the preceding study.

The greatest strength was the knowledge and expertise of the co-supervisor, Dr. Sean Dukelow, regarding stroke data and the rehabilitation practice in Alberta. Data used in this research were gathered from administrative databases. Thus, the sample sizes were sufficiently large (i.e., ample statistical power) to carry out the planned analyses. Samples from administrative databases often represent a diverse proportion of the population of interest, which reduces sampling error, increases external validity, and ensures that there is sufficient power to reach statistical significance (Mazzali & Duca, 2015). Another strength of this study is that results can be generalized to the population of Alberta.

5.2.2 Limitations.

Administrative database research sometimes experiences certain limitations due to information bias (e.g., incorrect documentation, inaccurate classification of subjects, miscoding, misdiagnosis, and under-coding) introduced in the research design (Gavrielov-Yusim & Friger, 2014). The accuracy of FIM scores recorded by therapy staff and the individuals who enter information at each hospital in Alberta could be called into question. Further, a ceiling effect has been demonstrated for FIM scores (Kwong, Hartzema, Duncan, & Min-Lai, 2004) and thus has the potential to limit the ability to accurately measure patient improvement in the case of patients with mild stroke. This ceiling effect (noted in 13 mild stroke patients with discharge FIM score of 126) may have reduced variability in the sample, caused skewness of the data, and potentially influenced study findings. We therefore relied on the central limit theorem to assume normality of the data. These data are from a single province which was considered a limitation, but also provides unique contrast to other provinces such as Ontario where lengths of stay have been heavily influenced by provincial management of patient flow.

5.2.2.1 Managing the limitations.

To increase validity in the results, we first assessed the data for quality, completeness (rate of missing values), and correctness (invalid data, out of range data, and outliers; Mazzali & Duca, 2015). We determined whether data were missing at subject and/or at item level. Subject level missing data were likely due to patients who died during rehabilitation or were discharged to home against medical advice, but this information was not provided in the data we used. Item level missing data were likely due to the fact that Alberta Health Services coders failed to enter the information or that rehabilitation staff failed to enter the information into the system. We excluded all cases

with missing data from the original data provided by Alberta Health Services. We also excluded cases classified with a primary diagnosis of transient ischemic attack, cases with post discharge living arrangements(setting) listed as boarding house, shelter, or public place, and cases with unspecified pre/post discharge living arrangement/setting. We then used complete case analysis strategy (using only cases that have complete data on every variable of interest) to perform our analysis of the data**.**

5.3 Addressing Postpositivist Critical Multiplism.

The cohort studies included in this thesis were conducted from a critical multiplist perspective. We used the steps for conducting critical multiplist research as framework to build the stroke severity and timing study and the sex differences study. We used these steps to represent part of what critical multiplist stroke nurse researchers would do to generate knowledge and/or explain complex human phenomena. The qualitative component of the postpositivist critical multiplist approach was not used in this research.

In keeping with a critical multiplist approach, this research topic and objectives were discussed with stakeholders at Foothills Medical Centre (Calgary), including physician in charge of the stroke program, stroke unit nurse practitioner, stroke rehabilitation unit manager, nurses, occupational therapist, and physiotherapist involved with stroke rehabilitation program, prior to beginning the research. The information gathered from these individuals helped to refine and shape the research objectives.

Use of administrative data from Alberta Health Services stroke rehabilitation databases was considered the best option for addressing the research objectives as data were already available and would provide a large sample size and greater statistical power. During analysis, data were compared, multiple interpretations of results were

generated, similarities and differences in results were examined, reasons for the differences were explained, and convergence of the results noted.

Further, multiple actions were taken to disseminate the results. The manuscript on the value of postpositivist critical multiplism for nursing research was published in Nursing Open. A manuscript for the stroke severity and timing study was published in Canadian Journal of Neurological Sciences. This journal was chosen as a way of tailoring dissemination of results to the intended audience (Canadian patients, caregivers, clinicians, administrators, policy makers, government). Both works were disseminated in professional websites (e.g., LinkedIn, Research Gate), and social media forums (e.g., Tweeter, Facebook, WhatsApp, Yahoo groups, Google groups, and Online Blogs). The unpublished manuscript on sex differences in rehabilitation care of stroke patients in Alberta was digitally presented at the 2019 Canadian Stroke Congress in Ottawa and has been submitted for publication. We considered findings from these studies to be meaningful because they were similar to findings observed in Ontario and could be generalized to the population of Alberta.

5.4 Future Directions

5.4.1 Building a program of stroke nursing research using postpositivist critical multiplism.

The research conducted for this thesis demonstrates only a beginning to a rigorous approach for conducting stroke nursing research from a postpositivist critical multiplist perspective. Complex phenomena related to stroke or stroke nursing cannot be explained fully without complex knowledge derived from multiple sources and perspectives. Certain phenomena that are unobservable cannot be tested empirically using quantitative

approaches (Gratton & Jones, 2010). Postpositivist critical multiplism therefore provides an option that allows researchers to combine qualitative and quantitative methods when studying such complex phenomena. To better understand the meaning of quantitative findings discussed above, and to fully understand the extend to which the postpositivist critical multiplists approach helps to create a “greater”, and perhaps more valid picture of the experiences of stroke patients as they return home following inpatient rehabilitation, a qualitative perspective needs to be undertaken in future studies. This could be achieved using the steps for conducting critical multiplist stroke nursing research outlined in Chapter Two.

Returning home after inpatient rehabilitation is considered an ideal outcome for stroke patients. However, many have identified dissatisfaction with their quality of life after stroke and during reintegration into the community (Mayo, Wood-Dauphinee, Cote, Durcan, & Carlton, 2002). Some of their challenges include re-establishing themselves into the community, developing new roles, and developing new relationships. In addition to poor quality of life, many of these patients experience depression and social isolation (Cott, Wiles, & Devitt, 2007; Pang, Eng, & Miller, 2007). Stroke patients tend to have different expectations/priorities after stroke (e.g., return to normal life, resumption of previous roles, and reestablishment of self identity) compared to health care professionals whose priority for the patients often focus on performance of physical tasks (McKevitt, Redfern, Mold, & Wolfe, 2004). These differences in priorities of stroke patients and health care professionals leave many of the social needs of these patients unmet, leading to dissatisfaction with their quality of life as they reintegrate into the community. Stroke nurses are in an ideal position to assist patients with achieving their identified recovery

goals and to engage in research focused on how best to do it. Excellent examples of this kind of research come from Green & King's (2009, 2010) work focussed on marital relationships post stroke.

Thus, an example of a qualitative research topic would be to also examine the experiences of stroke patients following inpatient rehabilitation and post discharge to the community in Alberta. The constructivist paradigm for developing qualitative knowledge related to patient's experiences during rehabilitation and post discharge to the community would be applied when conducting this research. This future study could focus on patients' roles, as well as changes in their needs and relationships as they return to the community following inpatient rehabilitation. In addition, barriers/facilitators of community reintegration could be examined.

5.4.2 Additional future studies on stroke rehabilitation care in Alberta.

There are other studies that could be conducted using Alberta Health Services stroke rehabilitation data. First, the impact of comorbidities on rehabilitation outcomes (LOS, FIM gains, and discharge destination) in Alberta could be examined using quantitative methods. Previous studies have shown that comorbidities are important predictors of stroke rehabilitation outcomes (Berlowitz, Hoenig, Cowper, Duncan, & Vogel, 2008). Comorbidities that will be included in the model are diabetes type 2, hyperlipidemia, primary hypertension, hypertensive health failure, and atrial fibrillation. To better understand the influence of comorbidities on the experiences of stroke patients undergoing inpatient rehabilitation, a qualitative component of the postpositivist critical multiplist approach could be used to explore specific barriers and facilitators of greater functional outcomes of stroke patients receiving inpatient rehabilitation. Previous studies

have indicated that comorbidities cause fluctuating health status (due to concurrent medical problems), lead to numerous lengthy medical appointments, and delay progress in rehabilitation (Whitson et al., 2011). Findings from this study could further improve the quality of care of stroke patients in Alberta by prompting clinicians and researchers to develop better risk assessment and adjustment strategies to ensure that differences in outcomes are not influenced by risk factors like comorbidities, and to develop better methods for assessing outcomes, examining trends in care, and reviewing the models used to provide care (Berlowitz et al., 2006; Ottenbacher et al., 2004).

Secondly, zonal differences in rehabilitation outcomes could be examined to determine the differences in outcomes based on the zone (Calgary, South, Central, North, and Edmonton) in which stroke patients resided while undergoing inpatient rehabilitation. Previous studies have demonstrated zonal variations in LOS in rehabilitation and discharge to communities following inpatient stroke rehabilitation (Reistetter et al., 2014). This variation has been attributed to factors such as facility availability, rehabilitation styles, and regulation (Freburger et al., 2011). A qualitative approach from a postpositivist critical multiplist standpoint could be used to explore barriers and potential solutions for implementing the best practice recommendations for stroke in these regions in Alberta. In one Ontario study, investigators found regional variations in barriers categorized as patient related barriers (e.g., non-medical stability at discharge, lack of emotional readiness to transfer to rehabilitation), clinician related barriers (e.g., clinician's discomfort in early transfer of patients to rehabilitation), and resource and system related barriers (e.g., delays in completing laboratory tests/ assessments/medical procedures, shortage of staff, lack of rehabilitation beds, and lack of transportation;

Meyer et al., 2017). Information about zonal variations in Alberta would enable health care professionals to change certain structures and administrative processes that contribute to poor rehabilitation outcomes in identified zones and develop specific programs that minimize, or control factors associated with variations in rehabilitation outcomes in different zones.

Thirdly, differences in outcomes based on inpatient rehabilitation group (freestanding versus integrated centre) may also be examined. Integrated centres (non-freestanding) have reported shorter times to rehabilitation admission and shorter LOS in inpatient rehabilitation compared to freestanding facilities in Ontario (Hall et al., 2016). Determining specific differences that exist between freestanding and integrated centres in Alberta would enable rehabilitation professionals to influence policy (especially related to funding) and design programs that would optimize rehabilitation care of patients in all centres and ensure the best quality of care for stroke patients. Concurrently, a qualitative study could be conducted to explore perceptions of rehabilitation professionals regarding barriers and facilitators to implementing stroke rehabilitation guidelines in freestanding and integrated centres for stroke. Some of the barriers that have been reported in previous studies include lack of facilitation, lack of agreement and/or familiarity with certain interventions, shortage of staff, lack of space for exercises, lack of team communication and interdisciplinary collaboration, time pressure, and organizational constraints (Munce et al., 2017).

Fourthly, the impact of cognitive status at the time of admission (as measured by the FIM) on motor function, LOS, FIM gains, and discharge destination could be explored using quantitative methods as part of the postpositivist critical multiplist

approach. Having this information would prompt clinicians performing cognitive screening to use more sensitive tools for cognitive screening and pay attention to certain cognitive deficits areas (e.g. executive function deficits) that affect performance of instrumental daily living activities like managing finances. Researchers have suggested that executive function deficits are underdiagnosed, consequently, rehabilitation procedures that target those deficit areas are underused (Zinn et al., 2004). Further, a qualitative study could be undertaken to examine the factors that influence Alberta clinician's decision-making on whether to transfer cognitively impaired stroke patients to rehabilitation or to end their rehabilitation. Some of the factors identified in previous studies include lack of knowledge about cognitive impairment, reliance on personal knowledge (about cognitive impairment) to predict patient's rehabilitation potential, difficulties assessing patients with cognitive impairment, and clinician's perception of their role within the rehabilitation team (Longley, Peters, Swarbrick, & Bowen, 2018). Understanding these factors and their impact on functional outcomes would enable clinicians to develop better ways to accommodate stroke patients who are cognitively impaired.

5.5 Conclusions.

In this research, shorter time to rehabilitation admission was associated with shorter rehabilitation LOS, small significant increase in functional gains of moderate and severe stroke patients, and discharged home without needing health services for mild stroke patients. Time to access rehabilitation services was not associated with stroke severity. Stroke in male patients was associated with younger age (<65 years), shorter rehabilitation LOS, living with spouse/partner, and discharge home without needing

health services. Conversely, female stroke was associated with older age (65+ years), slightly longer rehabilitation LOS, living alone at discharge from rehabilitation, and discharged home with paid health services. Time to rehabilitation admission and FIM gain did not differ between male and female stroke patients. To better understand the meaning of these quantitative findings, and to fully understand the extent to which the postpositivist critical multiplists approach helps to create a greater and valid picture of the experiences of stroke patients as they return home following inpatient rehabilitation, a qualitative perspective needs to be undertaken future studies.

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DISCURSIVE ARTICLE

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Postpositivist critical multiplism: Its value for nursing research

Eric F. Tanlaka | Carol Ewashen | Kathryn King-Shier

Faculty of Nursing, University of Calgary, Calgary, Alberta, Canada

Correspondence
Eric F. Tanlaka, Faculty of Nursing, University of Calgary, 2500 University Drive NW, Calgary, AB T2N 1N4, Canada.
Email: tanlaka.erichover@ucalgary.ca

Abstract

Aim: Following persistent criticisms of logical positivism, postpositivism emerged as a philosophy of science for developing nursing knowledge. Here, we offer a discussion of postpositivist critical multiplism and its value to nursing research.

Design: Discussion paper.

Methods: We searched relevant literature published between 1978–2018, indexed in CINAHL, MEDLINE, PubMed or PsychINFO. Findings are discussed in the context of stroke nursing research.

Results: Postpositivist critical multiplism acknowledges the importance of human influence on knowledge development and enables nurse researchers to use multiple approaches to address complex human phenomena. In doing so, the unique perspectives of stakeholder groups including patients, family members, knowledge users can be respected. There are certain steps that can be used by critical multiplist investigators to approach stroke nursing research. Using these steps and the critical multiplist approach may minimize preconceptions or biases associated with using one research method over another and maximize confidence in resultant research knowledge.

KEYWORDS
critical multiplism, methodology, nursing, paradigms, philosophy, postpositivism, research, science

1 | INTRODUCTION

Over the decades, scholars have expressed a variety of perspectives about the contribution of science to knowledge development. Some scholars (positivists) have emphasized that empirically derived data through application of rigorous scientific methods are legitimate scientific knowledge (Rutherford & Ahlgren, 1991). Others have argued that certain phenomena are unobservable and cannot be empirically tested (Gratton & Jones, 2010). Over time, positivism's characteristic confidence in the possibility of certain knowledge has yielded to a different approach to science. Postpositivist perspectives have arisen as an acknowledgement that human limitations interfere with the enactment of empirical observation, the application of reason and logic and, thus, in the pursuit of truth as certainty.

While positivism situates truth as being embedded in an objective reality somewhere out there, postpositivism positions truth as being bound by context (Panhwar, Ansari, & Shah, 2017), human action and interaction (Heisenberg, 1930). Postpositivism is a contemporary philosophy of science that emerged from various critiques of logical positivism. Whereas traditional or logical positivist thinking infers detached observation and experimentation as a route to certainty, postpositivist thinking views truth as that which is left when alternative propositions cannot be shown to hold up in the face of the possibilities of an unpredictable world (Popper, 1963).

Nursing occupies a privileged position amid, even caught between, the worlds of so-called objective science and the flux of human experience. The practice of nursing cannot therefore, be fully realized solely by relying on singular epistemological positions.

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ORIGINAL ARTICLE

Inpatient Rehabilitation Care in Alberta: How Much Does Stroke Severity and Timing Matter?

Eric Tanlaka, Kathryn King-Shier, Theresa Green, Cydnee Seneviratne, Sean Dukelow

ABSTRACT: ***Background:*** We examined the impact of stroke severity and timing to inpatient rehabilitation admission on length of stay (LOS), functional gains, and discharge destination. ***Methods:*** Alberta inpatient stroke rehabilitation data between April 2013 and March 2017 were analyzed. We evaluated the impact of stroke severity, as measured by the Functional Independence Measure (FIM), on timing to inpatient rehabilitation, functional gains, LOS, and discharge destination. Further, we examined whether timing to inpatient rehabilitation impacted the latter three factors. ***Results:*** The 2404 adults were subcategorized as mild (1237), moderate (1031), or severe (136) based on FIM at inpatient rehabilitation admission. Length of time to rehabilitation admission was not significantly ($p = 0.232$) different between stroke severities. Mean length of time (days) to rehabilitation admission was 19.79 (20.3 SD) for mild, 27.7 (35.7 SD) for moderate, and 37.70 (56.8 SD) for severe stroke. Mean FIM change for mild ($M = 16.3$, 9.9 SD) differed significantly ($p = 5.1 \times 10^{-9}$) from moderate ($M = 30.4$, 16.4 SD) and severe ($M = 31.0$, 25.7 SD) stroke. The mean LOS for mild stroke ($M = 41.3$, 31.9 SD) was significantly ($p = 5.1 \times 10^{-9}$) different from moderate stroke ($M = 86.8$, 76.4 SD) and severe stroke ($M = 126.1$, 104.2 SD). Time to inpatient rehabilitation admission showed a small, significant impact on FIM change ($p = 1.4 \times 10^{-9}$, partial η^2 0.022) and LOS ($p = 1.1 \times 10^{-19}$, partial η^2 0.042). Shorter times to rehabilitation admission and mild stroke were associated with discharging home without needing homecare. ***Conclusion:*** Stroke severity has a significant impact on the conduct of inpatient rehabilitation. Yet, despite suggestions shortening timing to rehabilitation should improve outcomes, the impact on functional gains and rehabilitation LOS was small.

RÉSUMÉ: Les soins de réadaptation prodigués à des patients albertains hospitalisés: quelle est l'importance de la gravité des AVC et des délais d'admission en matière de réadaptation? ***Contexte:*** Nous nous sommes penchés sur l'impact que la gravité des AVC et les délais d'admission à des soins de réadaptation peuvent avoir sur la durée de séjour de patients hospitalisés, sur leurs gains fonctionnels et sur leur lieu de destination à la suite de leur congé. ***Méthodes:*** Nous avons analysé les données portant sur la réadaptation de patients albertains hospitalisés à la suite d'un AVC. Ces données couvraient la période allant d'avril 2013 à mars 2017. À l'aide de la mesure de l'indépendance fonctionnelle (MIF), nous avons ainsi évalué l'impact de la gravité des AVC sur les délais d'admission de patients hospitalisés à des soins de réadaptation, sur leurs gains fonctionnels, sur la durée de leur séjour et sur leur lieu de destination à la suite de leur congé. De plus, nous avons examiné dans quelle mesure les délais d'admission à des soins de réadaptation avaient un impact sur ces trois dernières variables. ***Résultats:*** Au total, 2 404 adultes ont été répartis en trois catégories en fonction de leur résultat à la MIF: AVC légers (1237), modérés (1031) ou graves (136). Mentionnons que les délais avant d'être admis à des soins de réadaptation ne se sont pas révélés notablement différents ($p = 0{,}232$) selon les niveaux de gravité des AVC. Les délais moyens (en jours) avant d'être admis à des soins de réadaptation ont été de 19,79 (σ 20,3) pour les AVC légers; de 27,7 (σ 35,7) pour les AVC modérés; et de 37,70 (σ 56,8) pour les AVC graves. En se basant sur la MIF, les changements moyens pour les AVC légers ($M = 16{,}3$; σ 9,9) ont différé de façon notable ($p = 5{,}1 \times 10^{-9}$) par rapport à ceux des AVC modérés ($M = 30{,}4$; σ 16,4) et des AVC graves ($M = 31{,}0$; σ 25,7). La durée moyenne de séjour dans le cas des AVC légers ($M = 41{,}3$; σ 31,9) s'est par ailleurs révélée significativement ($p = 5{,}1 \times 10^{-9}$) différente si on la compare aux autres catégories (AVC modérés $M = 86{,}8$; σ 76,4 ou AVC graves $M = 126{,}1$; σ 104,2). Les délais d'admission à des soins de réadaptation ont donné à voir un faible, quoique notable, impact sur les changements révélés par la MIF ($p = 1{,}4 \times 10^{-9}$, eta-carré partiel 0,022) et sur la durée des séjours ($p = 1{,}1 \times 10^{-19}$, eta-carré partiel 0,042). Enfin, des délais d'admission plus courts à des soins de réadaptation et des AVC légers ont été associés, à la suite d'un congé, à un retour à la maison sans devoir recourir à des soins à domicile. ***Conclusion:*** La gravité des AVC a un impact considérable sur la réadaptation de patients ayant été hospitalisés. Bien qu'il ait été suggéré que la réduction des délais d'admission à des soins de réadaptation devrait améliorer l'évolution de leur état de santé, l'impact quant à leurs gains fonctionnels et leur durée de séjour en réadaptation a toutefois été mineur.

From the Faculty of Nursing, University of Calgary, Calgary, Alberta, Canada (ET, KKS, CS); School of Nursing, Queensland University of Technology, Brisbane, Queensland, Australia (TG); Department of Clinical Neurosciences, Division of Physical Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada (SD)

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Correspondence to: Sean Dukelow, Department of Clinical Neurosciences, Division of Physical Medicine, Cumming School of Medicine, University of Calgary, 2500 University Dr. NW, Calgary, Alberta, Canada T2N 1N4. Email: sphdukelow@ucalgary.ca

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Student: Eric F. Tanlaka
Degree Plan: Doctor of Philosophy
Area of Study: Nursing

Authors

Mr. Eric F. Tanlaka
Dr. Kathryn M. King-Shier
Dr. Theresa L. Green
Dr. Cydnee C. Seneviratne
Dr. Sean P. Dukelow

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