The Evaluation of a Fall Management Program

In a Personal Care Home (PCH) Population

by

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ABSTRACT

Injurious falls are a common problem among older institutionalized adults, having serious physical, psychological and/or financial consequences for the fallers, their families, and personal care home (PCH)[1] staff (Tideiksaar, 2002). North Eastman Health Association (NEHA) introduced a Fall Management Program into its five PCHs in 2005 in an effort to keep residents active and mobile, while minimizing injuries if they fell.

The purpose of this research was to evaluate the Fall Management Program to determine if its goals of increased resident mobility and injury minimization were being met.

A quasi-experimental, pre-post, comparison group design triangulating different data sources was used to evaluate the effectiveness of the program. Fall Occurrence Report data were collected from all five NEHA PCHs, and from seven similar PCHs in the Interlake Regional Health Authority (IRHA) that did not have a fall program in place. Administrative data from the Manitoba Centre for Health Policy (MCHP) were also used to provide information about some explanatory variables. Comparisons were made between regional health authorities (RHAs) and over time, from the pre- to post- period.

Results indicate that NEHA's Fall Management Program had some benefits for residents – there was a trend towards an increase in mobility (i.e., a non-significant upward trend in falls) while overall injuries remained stable, and falls resulting in hospitalization decreased significantly. NEHA residents appear to have been protected from an increase in injuries despite an upward trend in falls.

[1] Personal care homes (PCHs), also known as nursing homes, are residential facilities for older persons with chronic illness and/or disability, whose care needs have come to exceed what can be provided in the community (Manitoba Centre for Health Policy, 2008); see section 1.7 for more information

Moreover, NEHA's residents had significantly better outcomes compared to similar residents in the non-program PCHs in IRHA. By the post-period, both RHAs had the same rate of falls, but NEHA had significantly fewer injurious falls and falls resulting in hospitalization than IRHA. This suggests that the non-program PCHs had more difficulty preventing resident injuries than the program PCHs in NEHA.

* * *

The results and conclusions presented are those of the author. No official endorsement by Manitoba Health or the Manitoba Centre for Health Policy is intended or should be inferred. Some of the data used in this study are from the Population Health Research Data Repository housed at the Manitoba Centre for Health Policy, University of Manitoba.

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DEDICATION

In memory of Mom, Dad, and Pop – you left us way too early. Without your love, support, understanding, and inspiration, I could not have done this. I love you and will always miss you.

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LIST OF ABBREVIATIONS

95% CI	95 percent confidence intervals
ACG	Adjusted Clinical Group
ATC Code	Anatomical Therapeutic Chemical Drug Classification System
CPSI	Canadian Patient Safety Institute
EM	Epidemiologic Model
GEE	Generalized estimating equation
GLM	Generalized linear model
GMIC	General Model of Injury Control
HIPC	Health Information and Privacy Committee
HM	Haddon's Matrix
HREB	Health Research Ethics Board
ICD Code	International Classification of Diseases
IPEC	Injury Prevention and Evaluation Cycle
IRHA	Interlake Regional Health Authority
LOC	Level of care
LTC	Long term care
MB	Manitoba
MCHP	Manitoba Centre for Health Policy
MDS	Minimum Data Set
Mgmt	Management
MIPS	Manitoba Institute of Patient Safety
NEHA	North Eastman Health Association (regional health authority)
PCH	Personal care home
PHIA	Personal Health Information Act
PHIN	Personal health information number
Ppd	Per person day
Ppy	Per person year
RHA	Regional Health Authority
RR_{adj}	Adjusted relative rate
SP	Spectrum of Prevention
TEP	Three E's of Prevention

CHAPTER 1: INTRODUCTION

1.1. Statement of the Problem

Falls and fall-related injuries among older, institutionalized adults are common problems, resulting in serious physical, psychological and financial consequences for the people who have fallen, their family and friends, personal care home (PCH) staff and administration and the larger community and region (Tideiksaar, 2002). Compared to older adults living in the community, PCH residents are at a much higher risk of falling (Hoffman, Powell-Cope, MacClellan, & Bero, 2003; Kannus et al., 2005). Because efforts are being made to delay institutionalization by keeping people in their homes longer (Mitchell, Roos, & Shapiro, 2005), people are being admitted to PCHs at older ages and higher levels of care (Sharkey et al. in (Przybysz, Dawson, & Leeb, 2009), and thus, are at a higher risk of falling (Lach, 2010; Krueger, Brazil, & Lohfeld, 2001).

1.2. Purpose of this Study

The purpose of this research was to evaluate the effectiveness of a Fall Management Program that was implemented in 2005 in the five PCHs in North Eastman, one of Manitoba's (MB) regional health authorities (RHA), to determine if its goals and objectives of injury minimization and proper program implementation were being met.

1.3. Rates / Burden of Problem

More than half of the residents living in PCHs fall each year, with many of them falling repeatedly (Kannus et al., 2005; Hofmann et al., 2003). Annual incidence rates for

falls range from 1.5 to 3.0 falls per bed (Cameron et al., 2010; Vu et al., 2004) with approximately 25% of falls resulting in a serious injury (Vu et al., 2004; Public Health Agency of Canada: Division of Aging and Seniors, 2005).

For those seniors who sustain a serious injury, many are hospitalized (Theodos, 2003), and then discharged to a PCH (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Hofmann et al., 2003). The risk of dying from fall complications increases with age (Theodos, 2003), with as many as 25% of the elderly dying within 6 months of a hip fracture (Hofmann et al., 2003; Cali & Kiel, 1995).

1.4. Risk Factors

There are innumerable risk factors identified in the research literature that are associated with PCH residents' falls and injuries [see *Appendix 1: Fall Risk Factors for Older Adults*]. As the number of risk factors increase, so does the risk of falling (Theodos, 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005). While some risk factors are not modifiable (e.g., resident's age, cognitive impairment, chronic disease), many are, such as hazardous environments, improper footwear, and polypharmacy.

Fortunately, many seniors' falls are preventable (Tideiksaar, 2002; JEL Health Education Ltd., 2002), including those that occur in PCHs (Ray et al., 1997). However, some efforts to prevent falls can actually increase the risk of falling (Tideiksaar, 2002; Kane, 2001), such as the use of physical and/or chemical restraints (Rubenstein, Josephson, & Robbins, 1994). The resulting decrease in residents' activity contributes to muscle atrophy, which, in turn, decreases residents' strength, balance, and ultimately

confidence, all of which increase the risk of falling (North Eastman Health Association Inc., 2005a; Komara, 2005; Takasaki, 1997). Moreover, many injuries are sustained by residents trying to escape from physical restraints (Tideiksaar, 2002).

1.5. Fall Management as a Response to the Problem of Falls

Fall management is a new approach to falls. It includes most of the principles of traditional fall prevention efforts. However, rather than focusing on the *prevention* of falls (e.g., by using restraints, limiting activity, etc.), the goal of fall *management* is to prevent, or at least minimize injuries while simultaneously encouraging mobility and functionality (North Eastman Health Association Inc., 2005c).

Fall management is consistent with the recognition that it is impossible to prevent every fall given that they result from a complex interaction of individual and environmental risk factors (Tideiksaar, 2002). It also acknowledges the fact that many seniors' conditions and disabilities are chronic and not likely to improve (Theodos, 2003). The goal should be to eliminate or reduce as many risk factors and negative consequences as possible (Komara, 2005; Theodos, 2003; Rubenstein et al., 1994) while maintaining and improving seniors' mobility, activity (Tideiksaar, 2002) and psychological well-being, as much as possible (Theodos, 2003). Falling is indicative of activity. Falling is also an inherent risk of this activity, but limiting activity actually increases fall risk, especially for older people (Lach, 2010). As inactivity increases, muscles atrophy, and balance and confidence erode, ultimately putting people at increased risk of falling. "[A] patient who is not allowed to walk alone will very quickly become a patient who is unable to walk alone" (Patient Safety First, 2009).

Fall management is also consistent with efforts to reduce and eventually eliminate the use of restraints. This started in the United States with the Omnibus Budget Reconciliation Act (OBRA) in 1987, which mandated PCHs to start finding alternatives to restraint use (Tideiksaar, 2002).

1.6. Description of the Fall Management Intervention

NEHA's Fall Management Program involves the implementation of multiple strategies designed to keep PCH residents active and mobile, while simultaneously reducing their risk of injurious falls. It is a collaborative and multi-disciplinary program involving a care team of nurses, aides, dieticians, recreation coordinators, occupational therapists, and other PCH staff (e.g., maintenance) who work together to provide the safest and highest quality of life for residents. Residents and their families are also encouraged to play an active role in this effort.

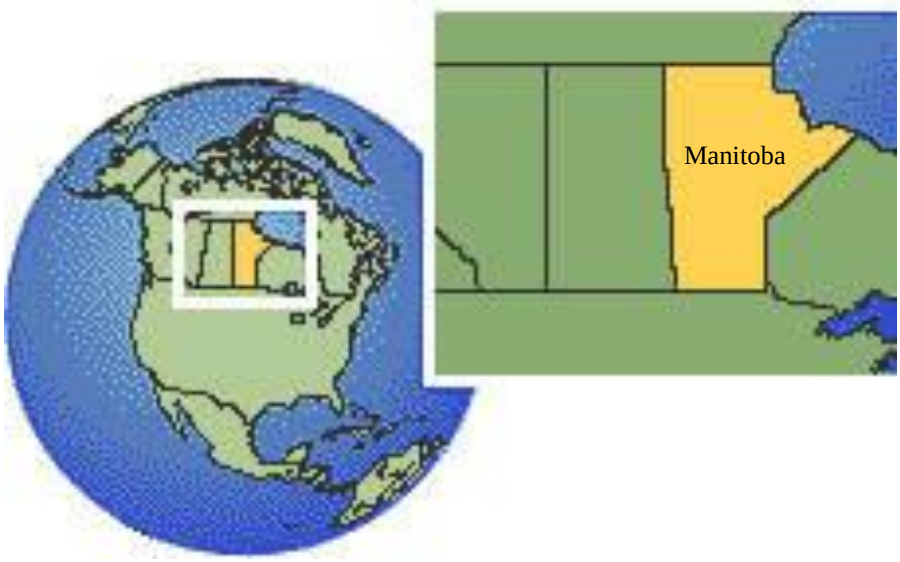
Program strategies include education for staff, residents, and families, as well as risk reduction strategies (e.g., proper nutrition, exercise), regular fall risk assessments and environmental audits, and a post-fall protocol.

1.7. Description of the Intervention and Comparison PCHs

This study takes place in two RHAs in Manitoba (MB), a province in Canada. [see *Map1.1: Location of Manitoba in Canada and North America*] All of the PCHs in one of these RHAs – North Eastman – constitute the intervention PCHs where the Fall Management program was implemented in 2005. This evaluation compares outcomes in the NEHA PCHs over time, and with similar PCHs in the adjacent Interlake RHA

(IRHA) [see *Map 1.2: Manitoba's RHAs and Study PCHs*]. Data were accessible in seven of the eleven total PCHs in IRHA, none of which has a formal fall program in place[2]. [see *Map 1.3: PCHs in this Research Study*] Both RHAs are adjacent to Manitoba's capital city Winnipeg, where roughly half of the province's population resides. Both NEHA and IRHA are rural RHAs, but not remote.

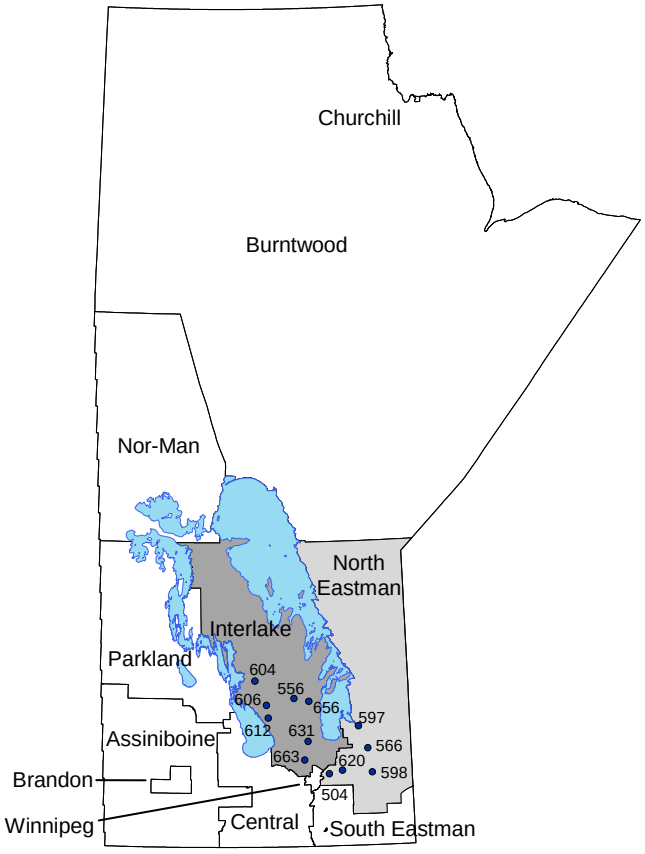
Figure 1.1: Location of Manitoba in Canada and North America



source: Microsoft Word clipart

[2] Note: Since the end of this study, IRHA has developed and implemented a fall prevention program

Figure 1.2: Manitoba's RHAs and PCHs Included in this Study



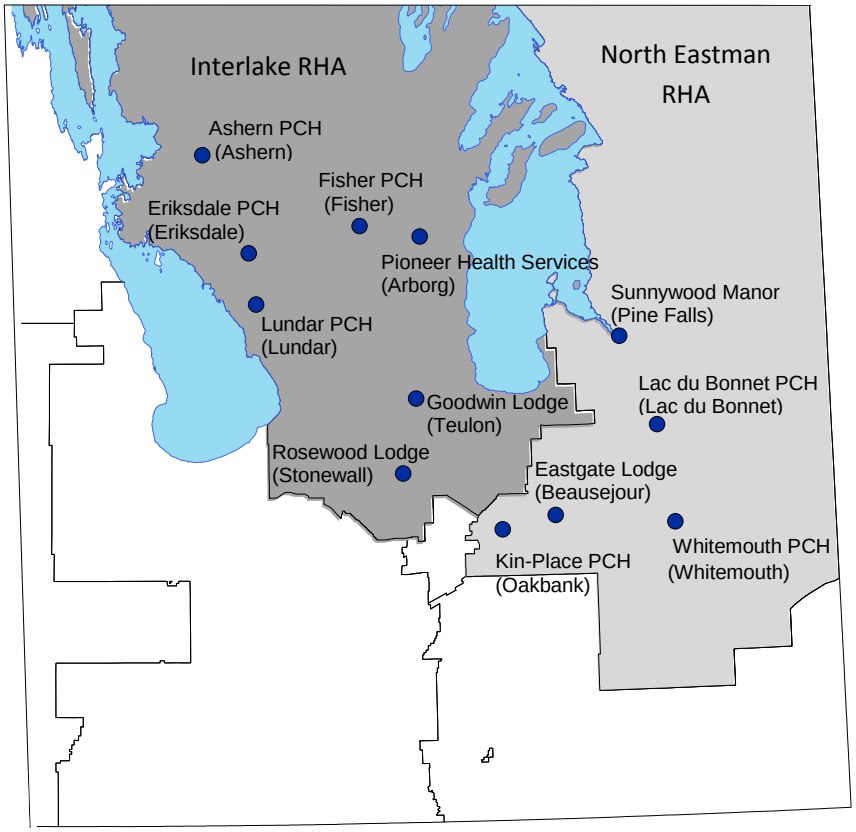
North Eastman RHA:

PCH ID	PCH Name
504	Kin-Place PCH (Oakbank)
566	Lac du Bonnet PCH (Lac du Bonnet)
597	Sunnywood Manor (Pine Falls)
598	Whitemouth PCH (Whitemouth)
620	Eastgate Lodge (Beausejour)

Interlake RHA:

PCH ID	PCH Name
556	Fisher PCH (Fisher)
604	Ashern PCH (Ashern)
606	Eriksdale PCH (Eriksdale)
612	Lundar PCH (Lundar)
631	Goodwin Lodge (Teulon)
656	Pioneer Health Services (Arborg)
663	Rosewood Lodge (Stonewall)

Figure 1.3: PCHs in This Study



In 1997, the Manitoba provincial government created 11 rural regional health authorities outside of Winnipeg to plan, manage and deliver health services to local residents (Fransoo et al., 2005). In 1999, the Winnipeg Regional Health Authority (WRHA) was established (Winnipeg Regional Health Authority, 2007). In 2002, two RHAs amalgamated to become Assiniboine RHA; the other RHAs are Brandon, Burntwood, Central, Churchill, Interlake, Nor-Man, North Eastman, Parkland, South Eastman. Most RHAs have between 3 and 11 districts, except for Churchill, which is too small to subdivide (just over 1000 residents) (Martens et al., 2008).

PCHs are residential facilities for predominantly older persons with chronic illness or disability, also known as nursing homes. They may be proprietary (for profit) or non-proprietary. Non-proprietary PCHs may further be classified as secular or ethno-cultural (associated with a particular religious faith or language other than English) as well as either freestanding or juxtaposed with an acute care facility. In order to be admitted to a PCH an application form must be completed and reviewed by a panel which determines whether the person requires admission. Many persons who apply to enter a PCH have been home care clients for a considerable period of time, but their care needs have become too great to manage in the community. They generally continue to receive home care until admitted to a PCH (Martens et al., 2010).

In *1973*, universal health coverage in Manitoba was extended to include *PCH care* (Management Committee of Cabinet, 1977 in (Frohlich, De Coster, & Dik, 2002)). PCH residents must pay a daily residential fee that is based on their net income (Doupe et al., 2006), with the remainder being funded by the provincial government according to level of care (LOC) required (DeCoster, Roos, & Bogdanovic, 1995).

1.8. Significance of this Study

The results of this research fill many gaps in the current literature. First, this research provides information about the effectiveness of fall management – an area that is currently lacking in the literature. Given that fall management is a relatively new approach, there is very little related literature or research. Most of the fall intervention-related literature that could be found focused on the *prevention* of *falls*, which is

fundamentally different from fall *management*, which strives to *prevent injuries* while *maintaining activity* and mobility (North Eastman Health Association Inc., 2005c).

Only three documents could be found that dealt with fall management specifically. One was a book that looked at fall prevention and management in older people (Tideiksaar, 2002). There was also a study that tested a content analysis procedure in order to develop a falls management audit tool (Wagner, Clark, Parmelee, Capezuti, & Ouslander, 2005). The third was an evaluation of a fall management program but its focus was still actually fall prevention (Rask et al., 2007). Programs were considered to be successful if falls decreased. [see *Appendix 2: Fall-Related Research References* and *Appendix 3: Review of Related Fall-Program Evaluations*]

Second, these results also contribute to other areas where there is need for more research – (i) patient safety in PCHs, especially in Canadian settings, and (ii) healthy aging in Canadian rural and remote communities. According to the Canadian Patient Safety Institute (CPSI) in 2007,"[d]espite the abundance of scientific literature examining quality and patient safety in long-term care, there are numerous limitations with existing studies and very few have been conducted in Canada.

It is important to study the PCH setting because most research has been conducted in the community – a group with a different risk profile than institutionalized adults (Cameron & Kurrie, 2007; Cusimano et al., 2008). Fall-related interventions tested in the PCH population have proven to be less effective than those tested in the community (Vu et al., 2004). While there is growing consensus that multifaceted interventions prevent falls in the community, there is not the same confidence that this applies in hospital and PCH settings. Strategies that have been found to be effective at reducing falls in the

community cannot necessarily be transferred to a residential care setting (Vu et al., 2004). Moreover, results from research that has been done in institutionalized settings is inconclusive – different interventions are studied, settings vary between countries, outcomes are measured differently (e.g., percent of people who fall, total falls, falls per resident, falls as time dependent, etc.) (Cameron et al., 2007).

As well, a recent Canadian Institutes of Health Research (CIHR) report on aging pointed out that there is "limited evidence on healthy aging in rural and remote communities" (Canadian Institutes of Health Research (CIHR), 2003)". This has left a considerable knowledge gap regarding patient safety in Canadian Long-term care." (Canadian Patient Safety Institute, 2007). According to Wagner and Rust (2008), this knowledge gap is especially wide in areas related to safety issues and innovative models of successful implementation of clinical practice guidelines (Wagner & Rust, 2008). Their literature review of English language publications from 1999-2007 in Medline, Embase, and CINAHL resulted in 121 articles selected for review, of which nine were from Canada. These Canadian studies focused mainly on medication errors and infection control issues (Wagner et al., 2008). The authors do note that an increased number of [Canadian] studies are being funded to examine safety issues in PCHs, primarily due to research grant initiatives from the Canadian Patient Safety Institute" (Wagner et al., 2008). The literature search for this current study resulted in 24 articles, (9 non-randomized studies, 9 RCTs, and 6 meta-analyses/systematic reviews), few of which were Canadian.

Third, this research adds to the general knowledge about the effectiveness of fall interventions. Current results are mixed - some non-randomized falls prevention

programs have reported a decrease in fall-related injuries of elderly adults (relative risks ranging from 6% to 33%), whereas some randomized trials have shown no difference (Kannus et al., 2005). This could be partially due to the fact that most randomized fall prevention programs have lacked adequate power to detect significant changes in the number of injuries (Kannus et al., 2005). More research on large, multi-factorial, multi-centre studies to detect injury and fracture rates are needed (Kannus et al., 2005). This current research provides additional information about the effectiveness of PCH fall programs.

Fourth, this study was sufficiently powered to detect a statistically significant decrease in the injurious fall rate. Many similar studies that could be found lacked sufficient power (Dempsey, 2004; Theodos, 2004; Hofmann et al., 2003; Hathaway et al., 2000). This current research had a longer study period, and/or a larger sample size than other research – roughly six years (22.2 in the months pre-period, and 35.8 months in the post-period) were used from all of the five PCHs in one RHA, and seven of 11 PCHs in a comparison RHA.

Fifth, the statistical analysis used in this study – generalized linear modeling (GLM) – is more appropriate than the analyses used in similar research (Hofmann et al., 2003; Theodos, 2003; Theodos, 2004; Dempsey, 2004; Hathaway et al., 2000). Previous studies employed basic statistical techniques including paired t-tests, chi-squared tests, and analysis of variance (ANOVA). However, these techniques do not account for the within-subject correlation that is likely to result from repeated measures in longitudinal studies. Moreover, these techniques assume that data are distributed normally, but count data of rare events (such as injurious falls) are more likely to follow a Poisson or negative

binomial distribution (Hassard, 1991). GLMs do not require randomization or normally distributed data (sfsu.edu, 2002), and can be used to analyze time series that are correlated (Ballinger, 2004) and not independent (StatSoft Inc., 2006). Failure to account for this correlation can lead to incorrect estimations of regression model parameters (Ballinger, 2004).

The greater the understanding of the complex phenomenon of seniors' falls, the better chance resources/interventions can be implemented that minimize seniors' injuries from falls, thus avoiding unnecessary suffering and cost. "Efforts aimed at reducing falls among older people are likely to lead to significant improvements in quality of life as well as to reduce health care costs (Butler, Norton, Lee-Joe, & Coggan, 1998)".

1.9. Research Hypotheses

This research involved the use of various sources of data and a mixed analytical design, to test if counts of falls and injurious falls were significantly different in the intervention versus the comparison environment, and how closely post-fall procedures follow care guidelines before and after program implementation.

Based on a review of the literature and preliminary analysis of existing data from the intervention PCHs, it was anticipated that (i) there would be an increase in falls over time in the intervention PCHs and (ii) the rate of falls in the intervention PCHs would be higher than the comparison PCHs after program implementation. Because of the intervention's emphasis on mobility and independence, it was considered likely that the rate of falls would rise. However, because it was also possible that falls would decrease, these two hypotheses were stated non-directionally (see below).

It was also expected that there would either be no change or a decrease in injurious falls in the intervention PCHs over time, and in relation to the comparison PCHs, because of fall management's greater focus on 'injury' prevention than 'fall' prevention.

Specifically, the research hypotheses were:

- there will be a ***change in the rate of falls*** from pre- to post-period in the intervention PCHs
- the ***rate of falls in the intervention PCHs will be different from the comparison PCHs*** in the post-period
- there will be either ***no change or a reduction in the rate of injurious falls and hospitalized falls*** from pre- to post-period in the intervention PCHs
- there will be a ***lower rate of injurious falls and hospitalized falls in the intervention PCHs than*** in the ***comparison PCHs*** in the post-period

[see also *Appendix 4: Hypotheses* for more detail]

1.10. Funding

Several contributors helped to fund this research, and I am extremely grateful for their assistance. A joint 2007 studentship from the Canadian Patient Safety Institute (CPSI) and Manitoba Institute of Patient Safety (MIPS) provided a salary supplement and the funds needed for data collection and access to data at MCHP. A 2009 Evelyn Shapiro Award also provided a salary supplement and funds to help cover the cost of data access at MCHP. Assistance from my advisor, Dr. Patricia Martens, through her CIHR/PHAC Applied Public Chair Award, also helped to provide a salary supplement while completing this research.

1.11. Study Timeline

Following academic committee and department approval of this proposal, ethical approval for this research was sought from the University Ethics Board (HREB) and the Health and Information Privacy Committee (HIPC). Data were collected during the summer of 2009. This involved hiring coders from each RHA, to go through the reports and extract the required information and converting it to an electronic format. These data were then forwarded to Manitoba Health for de-identification before being sent to MCHP and made available to the researcher for analysis. Analyses were conducted between January 2010 and March 2011.

CHAPTER 2: LITERATURE REVIEW

Because the focus of this proposed research is on the PCH population, this literature review focuses on information about falls and programs in long-term care institutions.

2.1. Related Research: Evaluation of Fall Programs

A literature search was conducted to find research studies similar to the proposed research – evaluations of non-randomized fall interventions in long-term care facilities for seniors (vs community-dwelling seniors). An extensive search of multiple databases included Pubmed, EMBASE, Scopus, CINAHL, PsychINFO, Medline, Cochrane Library, Ageline, Canada Health Research Collection, BISON Healthevidence.ca, and Google Scholar, and resulted in relatively few relevant studies. The search criteria were widened to include both randomized and non-randomized study designs. Nine non-randomized and nine randomized design studies were found, as well as six meta-analyses. The search language was English and there was no limit placed on date. Articles were found ranging from the mid-1990s to 2010 [see *Appendix 3: Review of Related Fall-Program Evaluations* for more details about each study]

2.1.1 Non-Randomized Research

The nine non-randomized studies that could be found focused evaluating the effectiveness of fall prevention or reduction interventions for seniors in various institutional settings (Beasley, 2009; Scott et al., 2008; Rask et al., 2007; Bonner et al., 2007; Dempsey, 2004; Theodos, 2004; Theodos, 2003; Hoffman et al., 2003; Barry et al., 2001; Hathaway et al., 2000). Only one study could be found on fall management (Rask

et al., 2007). A pre-/post-intervention design, deriving data from patient/resident charts and/or reports was used in all nine studies.

Decreases in falls and/or fractures were found after the introduction of a fall intervention in all of the studies. There were statistically significant decreases in falls (ranging from 38% to 55%) in five of the studies over varying follow-up periods (Beasley, 2009; Hofmann et al., 2003; Theodos, 2004; Dempsey, 2004; Barry et al., 2001). However, one study that initially found a significant decrease at the one-year follow-up, found that rates had increased beyond pre-program levels at the five-year follow-up (Dempsey, 2004). This increase may be explained by the fact that such interventions can be difficult to sustain over time (Rantz et al., 2001; Public Health Agency of Canada: Division of Aging and Seniors, 2005) and highlights the need to study program effects over longer periods to see if programs are being sustained, and to have the opportunity to take corrective action if they are not. The three studies that measured fractures found decreases, two of which were statistically significant (Scott et al., 2008; Barry et al., 2001).

Several studies were underpowered to detect differences in all variables of interest because of things such as small sample sizes, short follow-up periods, and/or the rarity of events such as fractures. Most studies had relatively short durations (from 1-month to 1-year pre-intervention, to 2-years post-intervention), and institutions ranged from 56 to 156 beds (Beasley, 2009; Scott et al., 2008; Rask et al., 2007; Bonner et al., 2007; Theodos, 2004; Theodos, 2003; Hoffman et al., 2003; Barry et al., 2001; Hathaway et al., 2000).

Four studies used basic statistics to analyze the pre-post-intervention data (i.e., a paired t-test, and/or some version of the Chi-square test) (Theodos, 2004; Dempsey, 2004; Hathaway et al., 2000; Barry et al., 2001) and the other studies did not provide any details about the analyses used. One study also employed ANOVA to examine the relationship between fall incidence and age, mobility, gender, mental status, time and place of falls, patient activity (Dempsey, 2004). However, given that these studies were not randomized and have relatively small samples sizes, it would have been more appropriate to analyze these data using GLMs. GLMs do not require randomization, large sample sizes or normally distributed data (sfsu.edu, 2002). Moreover, GLMs can also be used to analyze time series data that are not independent (StatSoft Inc., 2006). Failure to account for the dependence of repeated data underestimates the variance – confidence limits are too narrow and the significance test is too lenient, resulting in the rejection of the null hypothesis too often (Leclerc et al., 2008).

Most of the studies were based in a setting similar to the proposed research study (i.e., long-term care) (Beasley, 2009; Scott et al., 2008; Bonner et al., 2007; Rask et al., 2007; Hoffman et al., 2003; Theodos, 2003). Three were hospital-based, thus making comparability of these studies difficult given the different characteristics of these two populations and settings (e.g., types and severity of health conditions, types and ratios of staff) (Dempsey, 2004; Hathaway et al., 2000; Barry et al., 2001).

Similar to the program evaluated in this current research, most studies examined interventions that were multi-faceted, as opposed to single-component (e.g., exercise only, use of hip protectors only). However, there was no consistency across interventions in terms of program components. Five included education – two were for staff and

patients (Bonner et al., 2007; Dempsey, 2004; Barry et al., 2001) and three were for staff only (Bonner et al., 2007; Rask et al., 2007; Hathaway et al., 2000). Two conducted environmental audits (Hofmann et al., 2003; Barry et al., 2001), three included some form of risk factor assessment (Dempsey, 2004; Hathaway et al., 2000; Barry et al., 2001), and two used a graphic to identify high-risk fallers (Dempsey, 2004; Hathaway et al., 2000). One program pre-assessed clients (Theodos, 2003) and another made staffing changes and introduced activity programs (Hofmann et al., 2003). This variability in program content adds to the difficulty in comparing study results.

2.1.2. Randomized Research

Nine studies were found that evaluated the effectiveness of fall prevention or reduction interventions for seniors using a randomized study design (Ray et al., 1997; Ray et al., 2005; Jensen et al., 2002; Jensen et al., 2003; Becker et al., 2003; Haines et al., 2004; Kerse et al., 2004; Bouwen et al., 2008; Rapp et al., 2008). These are similar to the current research in so far as they compared intervention and comparison groups. While not identical in design, these results are still informative.

Eight studies (i) were in a seniors' PCH setting, (ii) had relatively short follow-up periods, ranging from 6 months to 1-year post-intervention, (iii) had relatively large sample populations from multiple sites, ranging from 6 to 112 facilities, and (iv) used more complex statistical techniques such as regression analysis (Ray et al., 1997; Ray et al., 2005; Jensen et al., 2002; Jensen et al., 2003; Becker et al., 2003; Kerse et al., 2004; Bouwen et al., 2008; Rapp et al., 2008), compared to the non-randomized studies. One

study took place in three sub-acute hospital wards (Haines et al., 2004), but these specialized in caring for elderly patients.

The majority of the randomized studies examined multi-faceted fall interventions. One looked at the effects of staff education only (Ray et al., 2005), and another the effects of individual risk factor assessment (Ray et al., 1997). The multi-faceted ones (Jensen et al., 2002; Becker et al., 2003; Haines et al., 2004; Kerse et al., 2004; Rapp et al., 2008; Bouwen et al., 2008) included components such as exercise, medication changes, hip protection, identifier logos, education, and fall risk assessment. However, as with the non-randomized studies, there was no consistency across interventions in terms of program components, thus making the comparison of results difficult.

In addition, results were mixed. Most studies found better results in the intervention groups compared to the control groups, but not all results were significant. Two studies found 30+% fewer falls in the intervention group (Ray et al., 1997; Haines et al., 2004), but only one was statistically significant ($p=0.045$) (Haines et al., 2004). Several found significantly lower risk and/or incidence of falls in the intervention groups (Jensen et al., 2002; Jensen et al., 2003; Becker et al., 2003; Bouwen et al., 2008; Rapp et al., 2008). Others found lower incidence rates of injuries in the intervention groups (Ray et al., 1997; Jensen et al., 2002; Jensen et al., 2003), but only some were significant (Jensen et al., 2002; Jensen et al., 2003). Two found no significant difference between intervention and control groups for injury rate (Ray et al., 1997; Ray et al., 2005; Haines et al., 2004), and one found a significantly higher rate of falls in the intervention group (Kerse et al., 2004).

While mixed results can be disconcerting, they still provide valuable information. These results provide support for the effectiveness of fall interventions – even though not all results are statistically significant, most falls and injuries were lower in the intervention groups. One study found a significantly higher rate of falls in the intervention groups (Kerse et al., 2004), but there was no significant difference between intervention and control groups in terms of injurious falls. In other words, even though more people were falling, they were not injuring themselves any more than the control group.

2.1.3. Meta-Analyses and Reviews

The six meta-analyses of fall prevention or reduction interventions for seniors all generally found favorable results supporting the effectiveness of fall interventions for seniors (Kannus et al., 2005; Chang et al., 2004; Moreland et al., 2003; Vu et al., 2004; Cusimano et al., 2008; Cameron et al., 2010). Five of the six concluded that multifaceted interventions were effective in reducing seniors' injurious falls even though not all results were significant (Chang et al., 2004; Moreland et al., 2003; Vu et al., 2004; Cameron et al., 2010; Cusimano et al., 2008). One review did caution about making recommendations about optimum interventions (Kannus et al., 2005) because of (i) the variability of the interventions studied, (ii) the lack of adequate power in many trials to detect significant changes in injury frequency, and (iii) the mixed results with some studies showing decreases in injuries and others showing no change.

2.2. Background / The Problem Of Falls

Falls are a public health problem all over the world, and older adults are at greater risk of injury from falls than younger people (Dykes et al., 2010). Falls and fall-related injuries among older, institutionalized adults are prevalent problems, resulting in serious physical, psychological and financial consequences for the people who have fallen, their family and friends, PCH staff and administration and the larger community and region (Tideiksaar, 2002). PCH residents are at a much greater risk of falling compared to their community counterparts (Handoll, 2010; Messigner-Rapport & Dumas, 2009; Poutney, 2009; Oliver, 2007; Kannus et al., 2005). They are also at an ever-increasing risk of falling because of the decline in physical functioning that accompanies aging (e.g., reduced strength, poor balance, and weakening bones) (Federal/Provincial/Territorial Committee of Officials (Seniors) for the Ministers Responsible for Seniors, 2001; Theodos, 2003).

Moreover, PCH residents are becoming increasingly older and medically complex (Sharkey; Wagner and Rust in (Przybysz et al., 2009). Efforts are increasing to keep older people in their homes longer, thus preventing unnecessarily early institutionalization. Not only do people want to stay in their homes longer (Mitchell et al., 2005), it is a major public health goal to prevent premature institutionalization (Sahyoun, Pratt, Lentzner, Dey, & Ribinson, 2001) and less expensive to provide home care compared to long-term care (Mitchell et al., 2005). As a consequence, people are entering long term care at higher levels of care, and thus higher fall risk.

The main concern with seniors' falls is not simply the high incidence - young children and athletes have even higher fall rates – it is seniors' high susceptibility to injury from

falls (American Geriatrics Society, British Geriatrics Society, & American Academy of Orthopaedic Surgeons Panel on Falls Prevention, 2001). In spite of efforts to keep people living at home, the proportion of older people living in PCHs is likely to increase (Oliver, 2007).

2.2.1. Rates

Fall rates vary according to case mix – for example, rates are likely to be different for mobile people with dementia compared with dependent people in high-level care (Australian Commission on Safety and Quality in Health Care, 2009). A 2007 WHO report found that 28%-35% of people aged 65+ fall each year, with fall frequency increasing with age and degree of frailty (World Health Organization, 2007).

Approximately 50%-60% of PCH residents fall each year, with half of them falling repeatedly (Kannus et al., 2005; Hofmann et al., 2003). Annual incidence rates in the literature range from 1.5 to 3.0 falls per bed per year (Perry Schoenfelder et al., 2004; Theodos, 2003; Vu et al., 2004; Becker et al., 2003; Rubenstein et al., 1994; Cameron et al., 2010), or 1.4 falls per person per year (ppy) (Nurmi in (Cameron et al., 2010). However, Vu et al. (2004) warn that this is likely an underestimate.

Reported rates of falls resulting in serious injuries, such as fractures and lacerations, range from 5% to 25% (Riefkohl et al., 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Vu et al., 2004). A yearly rate of 40-70 hip fractures per 1,000 residents has been reported in the literature (Theodos, 2003; Becker et al., 2003; Cameron et al., 2010; Australian Commission on Safety and Quality in Health Care, 2009).

Other research indicates that in 2007-08, 35% of hospitalizations in Canada were for people aged 75+, and 10% of these were for residents from PCHs (Przybysz et al., 2009). Falls were the third most common reason (12.3%) for transfer from PCHs (behind respiratory, 19.8% and circulatory, 17.7%) (Przybysz et al., 2009). A 2008 report by the Canadian Patient Safety Institute indicates that falls are one of the most prevalent adverse events in continuing care (Canadian Institute for Health Information, 2009), and one of the most common reasons for transfer from continuing care to the hospital - 90.3% of injuries among people admitted from continuing care were caused by falls (Canadian Institute for Health Information, 2009).

More than 40% of residents that fall are hospitalized at least once for at least 6 days (Theodos, 2003). Over 50% of seniors who survive a hip fracture are discharged to a PCH (Hofmann et al., 2003) and 40% of all PCH admissions are because of a fall (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Impact, 2005). The risk of dying from fall complications increases with age (Theodos, 2003; Impact, 2005), with as many as 25% of the elderly dying within 6 months of a hip fracture (Hofmann et al., 2003; Cali et al., 1995).

2.2.2. Negative Consequences

The difficulties that result from falling are far-reaching, extending well beyond the fallers themselves. Falls are one of the main causes of physical and psychological difficulties for seniors including hip fractures and various other injuries; fear of falling; loss of mobility; reduced activity; increased dependency; social isolation; depression; anxiety; confusion; and premature death/high mortality (Tideiksaar, 2002; Beasley, 2009;

Lach, 2010). Moreover, once seniors fall, they are at increased risk of subsequent falls, injuries and other complications (Perry Schoenfelder et al., 2004; Tideiksaar, 2002) and long recovery times (Cali et al., 1995). In short, falls can drastically increase the faller's dependence, decrease their quality of life, and often, even the length of their life.

When seniors fall, it is natural for family members to experience distress because of the pain and suffering their loved ones must endure. As well, some feel guilty for not having been there to help prevent the fall (Tideiksaar, 2002; Coussement et al., 2008). If adequate home- or long-term-care is not available, the burden of care increases for residents' families (Collopy & Boyles, 1991), and often results is lost productivity and wages (World Health Organization, 2007). The burden of cost also increases for uninsured items such as canes, walkers and other assistive devices.

If the faller is living in a PCH, there are greater physical demands on staff to care for the resident, which puts them at increased risk of jobs strain (North Eastman Health Association Inc., 2006b). As well, staff often experience difficulty attempting to balance injured residents' needs for safety and autonomy (Tideiksaar, 2002).

The institution must contend with higher resident health care costs (Coussement et al., 2008), greater demands on staff's time to care for the injured resident (Tideiksaar, 2002), greater risk of staff work strain (North Eastman Health Association Inc., 2006b) and time lost due to injury (Takasaki, 1997). In a 2005 report, the estimated annual direct treatment costs related to falls among the elderly in Manitoba was $164 million (compared to $31 million for children and $28 million for youth) (Impact, 2005).

2.2.3. Risk Factors

Rubenstein & Josephson (2006) define a risk factor as "a characteristic that is found significantly more often in individuals who subsequently experience an adverse event than in individuals who do not experience the event" (Rubenstein & Josephson, 2006).

There are innumerable risk factors identified in the research literature that are associated with PCH residents' falls and injuries, including debilitating conditions, disease, environmental hazards, age, mental status, poor vision and medications (Beasley, 2009) [see *Appendix 1: Fall Risk Factors for Older Adults*].

While some risk factors are not modifiable (e.g., resident's age, cognitive impairment, chronic disease), many are, such as hazardous environments, improper footwear, the use of certain high-risk drugs, and polypharmacy. Modifying risk factors has been found to reduce the risk of falls and improve quality of life (Nazarko, 2006). Thus, many seniors' falls are preventable (Tideiksaar, 2002; JEL Health Education Ltd., 2002), including those that occur in PCHs (Ray et al., 1997), but too often, these are regarded as untreatable (Voermans, Snijders, Schoon, & Bloem, 2007).

As the number of risk factors increase, so does the risk of falling (Bonner et al., 2007; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Theodos, 2003).

Specific drugs found to increase fall risk in the elderly include psychotropics, anti-Parkinsonian agents, anti-hypertensives, and narcotics (Niagara Region Public Health, 2004). [see *Appendix 5: Fall-Risk Drugs for the Elderly* for more details]

Both dose and time since starting a medication have been found to increase the risk of falling with different drugs – benzodiazepine risk increases in the first 1 to 2 weeks after starting on higher doses, but antidepressant use results were less clear (Ruddock, 2004).

A review of literature found that psychotropic drugs had the strongest association with falls (Riefkohl et al., 2003).

Medication use is a major risk factor among the elderly, especially when used in combination (Riefkohl et al., 2003; Impact, 2005; Public Health Agency of Canada: Division of Aging and Seniors, 2005). The use of multiple medications at one time is often called polypharmacy, but there are many different definitions of what constitutes polypharmacy, ranging from being on 2 or more drugs at one time (Larsen & Hoot Martin, 1999), to 4 or more (Close et al. in (Impact, 2005), 5 or more (Ko, Ko P.S., & Tsang, 1996), up to 9 or more (Doupe et al., 2006). Regardless of the definition, the important point is that risk of falling increases with increasing medication use. There is evidence that it is the total number of medications, regardless of class, that increases the risk of falls and fractures (Boyle, Naganathan, & Cumming, 2010; Ruddock, 2004; Neutal, Perry, & Maxwell, 2002). This effect is not limited to the elderly, but because of their poorer health status, they are much more likely to be on multiple drugs (Neutal et al., 2002).

The intended and unintended pharmacological effects of these medications include sedation, psychomotor impairment, cognitive changes, dizziness, and orthostatic hypotension and are believed to increase the risk of falls, although research results are mixed (Riefkohl et al., 2003). Because of this, physicians are encouraged to seriously weigh the advantages and disadvantages when prescribing for elderly people at risk of falling (Riefkohl et al., 2003).

Some efforts to prevent falls can actually increase the risk of falling (Tideiksaar 2002; Kane 2001) (Cameron et al., 2007). Specifically, physical and/or chemical restraints have

been found to be more detrimental than helpful (Rubenstein et al. 1994). Restraints have commonly been used to protect residents from falls and fall-related injuries (Rask et al., 2007). However, not only do restraints hamper quality of life by restricting residents' interaction and involvement in life, the decreased activity contributes to muscle atrophy which, in turn, decreases residents' strength, balance and ultimately confidence – all of which increase the risk of falling (North Eastman Health Association Inc., 2005a; Komara, 2005; Takasaki, 1997). Moreover, many injuries are sustained from residents trying to escape from the restraint (Tideiksaar, 2002; Poutney, 2009). Thus, a resident's decline may be affected more by care approaches than by the aging process itself (Ogden, 1998). Since the 1990s, there has been a national effort to reduce and eventually eliminate the use of restraints (Tideiksaar, 2002).

These restrictive fall prevention efforts are associated with more traditional models of care which strive for safety over quality of life (Kane, 2001). Task-oriented institutionalized routine has guided care rather than residents' needs and choices (Boise & White, 2004; Boumans, Berkhout, & Landeweerd, 2005). This type of care is narrowly focused on safety as the ultimate goal of care (Flesner & Rantz, 2004; Boise et al., 2004; Boise et al., 2004; Boumans et al., 2005; Kane, 2001). Currently, US long-term care policies and programs are aimed at technical quality which is associated with poor quality of life (QOL) (Kane, 2001).

However, the limited research that has been done that asks PCH residents what they want indicates that relationships, activity, stimulation, security, control and autonomy are the things most valued by them (Kane, 2003). While safety is obviously important, quality of life is even more so. As Sharon Grigsby, president of the Visiting Nurse

Association of Los Angeles points out, "we're doing a good job of making people live longer, but not helping them live a rewarding, quality life" (Long-Term Care, 1990). Quality of life is so much more than simply the prevention of falls and injuries and an ability to carry out activities of daily living (Kane, 2003). Perhaps, rather than trying to provide the best quality of life that is consistent with safety goals, it would be better to promote the best safety outcomes that are consistent with efforts to maintain a meaningful quality of life (Kane, 2001).

Fortunately, there is a new approach to falls that is consistent with efforts to balance quality of life and safety – fall management.

2.3. About Fall Management

'Managing' rather than 'preventing' seniors' falls is a relatively new philosophy. It includes most of the principles of traditional fall prevention efforts. However, rather than focusing on the *prevention* of *falls* (e.g., by using restraints), the goal of fall management is to *prevent*, or at least *minimize injuries* while simultaneously encouraging mobility and functionality as part of a larger effort to improve residents' quality of life (North Eastman Health Association Inc., 2005a). Falling is indicative of mobility and activity. Lach (2010) discourages the very use of the term 'prevention' in favour of 'intervention' or 'management' which avoid much of the negativity associated with falls.

2.3.1. Fall Management Builds on Fall Prevention

Fall management builds on the established theory of fall prevention, keeping components found to be effective (e.g., minimization of fall risk factors, increased

exercise, proper nutrition, etc.) and minimizing or eliminating those found to be ineffective (i.e., restraint use).

Fall management is consistent with the recognition that it is impossible to prevent every fall given that they result from a complex interaction of individual and environmental risk factors (Tideiksaar, 2002; Lach, 2010; Magaziner, Miller, & Resnick, 2007; Nazarko, 2007). It is also acknowledged that many seniors' conditions and disabilities are chronic and not likely to improve (Theodos, 2003). The goal should be to eliminate or reduce as many risk factors and negative consequences as possible (Komara, 2005; Theodos, 2003; Rubenstein et al., 1994; Nazarko, 2007) while maintaining and improving seniors' mobility, activity (Tideiksaar, 2002) and psychological well-being, as much as possible (Theodos, 2003). It is important to remember that patient safety must be "balanced with independence, rehabilitation, privacy and dignity – a patient who is not allowed to walk alone will very quickly become a patient who is unable to walk alone" (Patient Safety First, 2009). There must be equal consideration given to a resident's autonomy and safety (Oliver, 2007) – fall risks must be managed within a context of respecting the importance of older people remaining independent and active (Poutney, 2009). As a 2005 PHAC report points out, it is imperative that seniors' right to live at risk be respected (Public Health Agency of Canada: Division of Aging and Seniors, 2005).

Everyone, including PCH residents have a right to live their lives the way they choose, and this can involve risk (Nazarko, 2007). Falling is an inherent risk that comes with physical activity and mobility, but limiting activity increases risk, especially for older people (Lach, 2010), and can limit rehabilitation (Commonwealth of Australia, 2009).

Physical activity has been found to be very beneficial for older people in all settings (Lach, 2010).

Fall management is also consistent with efforts to reduce and eventually eliminate the use of restraints. This movement started in the United States with the Omnibus Budget Reconciliation Act (OBRA) in 1987, which mandated PCHs to start finding alternatives to restraint use (Tideiksaar, 2002). Progress has been made in the nursing home population where restraint use decreased from 44% in 1989 to 9% in 2001 (Lach, 2010).

2.3.2. Fall Management is Consistent with Injury Prevention Theory

Fall management is consistent with the components of many injury prevention frameworks in the literature, and with the basic tenets of public health theory. All of these approaches are proactive and are aimed at preventing the occurrence of negative events such as falls.

Injury prevention frameworks such as the Epidemiological Model (EM), Haddon's Matrix (HM), The General Model of Injury Control (GMIC) and the Injury Prevention and Evaluation Cycle (IPEC) all involve a focus on risk factors that can be modified prior to a fall event occurring (i.e., risk factors in the physical and social environment).

Fall management also incorporates many other components of these injury prevention frameworks including the use of a post-fall protocol, education of all those involved (i.e., residents, families and staff) regarding risk factors and prevention strategies and evaluation using outcomes measures to assess program effectiveness.

Fall management is also consistent with public health efforts to 'think upstream' and prevent situations that can cause injury and disease, identify high risk groups and develop

and implement interventions that will reduce the incidence and prevalence of those injuries and diseases (Ashton & Lee, 1998).

2.3.3. Fall Management Incorporates Effective Program Components

The fall management program being studied in this research is multi-faceted, incorporating many individual program components that have been found to be effective including (i) identification of residents at high risk of falling (JEL Health Education Ltd., 2002), (ii) ensuring use of proper footwear and ambulation devices (Tideiksaar, 2002), (iii) restraint minimization (Theodos, 2004), (iv) education of staff, residents, and families (Tideiksaar, 2002), and (v) environmental safety audits (Commonwealth of Australia, 2009).

Structured multi-faceted and multi-disciplinary nursing home interventions designed to reduce injuries have been found to be effective (Vu et al., 2004; Rubenstein et al., 1994; Becker et al., 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003; Ray et al., 2005; Kannus et al., 2005; Queensland Government (Health), 2002; Jensen et al., 2003; Theodos, 2004; Johnson & Binney, 2003; Barry et al., 2001; Chang et al., 2004; Baker, Gottschalk, & Bianco, 2007; Impact, 2005; Neyens et al., 2009; Voermans et al., 2007). [see *Table 2.1: Comparison of NEHA's Fall Management Program with Recommendations in the Literature* for more details on individual components]

Table 2.1: Comparison of NEHA's Fall Management Program with Recommendations in the Literature

Recommended Program Component	NEHA's Program
• **risk assessment** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003); **individual initial and regular subsequent assessment of residents** (Poutney, 2009; Theodos, 2004; Jensen et al., 2003; Vu et al., 2004; Simpson et al., 2004; Moreland et al., 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003; Becker et al., 2003); **screening for deficits** (Moreland et al., 2003; Australian Commission on Safety and Quality in Health Care, 2009; Australian Commission on Safety and Quality in Health Care, 2009); **vision referral and correction** (Public Health Agency of Canada: Division of Aging and Seniors, 2005); **ensure residents have proper footwear and clothing** (Shanley, 2003; Tideiksaar, 2002)	• a fall risk assessment done within 1 week of admission, annually and after a fall using the assessment tool; residents' fall risk is assessed every 3 months not using tool; tool includes information about physical and mental health, medications, vision, and incontinence • vision is assessed at admission; if residents has glasses, it is ensured that they are used • footwear and clothing is assessed and information pamphlet provided to resident/family
• **education for staff** (Tideiksaar, 2002; Moreland et al., 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003; Becker et al., 2003; Jensen et al., 2003; Theodos, 2004; Impact, 2005; Rask et al., 2007; Australian Commission on Safety and Quality in Health Care, 2009)	• initial staff education prior to program implementation (training, self-study modules); reviewed 2 years after implementation; posters; pins
• **education for residents and families** (Tideiksaar, 2002; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Becker et al., 2003; Jensen et al., 2003; Theodos, 2004; Australian Commission on Safety and Quality in Health Care, 2009)	• fall information pamphlet ; posters; pins; resident/family meetings

Table 2.1: Comparison of NEHA's Fall Management Program with Recommendations in the Literature (cont'd)

Recommended Program Component	NEHA's Program
• **implementation of fall prevention strategies** (Tideiksaar, 2002) - **ensure residents have proper ambulation devices** (e.g., canes, walkers, wheelchairs) (Tideiksaar, 2002) - **screening for environmental hazards** (Moreland et al., 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003; Simpson, Lamb, Roberts, Gardner, & Grimley Evans, 2004; Becker et al., 2003) - **have a way to identifying residents at fall risk** (Tideiksaar, 2002; Kannus et al., 2000; Kannus et al., 2000) - **proper nutrition** (JEL Health Education Ltd., 2002; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003) - **vitamin D and calcium supplementation** (Australian Commission on Safety and Quality in Health Care, 2009) - **exercise programs** (Tideiksaar, 2002; Impact, 2005; Perry Schoenfelder & Rubenstein, 2004; Australian Commission on Safety and Quality in Health Care, 2009); **balance exercises** (Moreland et al., 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005) - **medication review** (Impact, 2005; Australian Commission on Safety and Quality in Health Care, 2009; Riefkohl, Bieber, Burlingame, & Lowenthal, 2003); **medication management** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003); **psychotropic medical withdrawal** (Moreland et al., 2003) - **be aware of incontinence problems** (Shanley, 2003)	• injury prevention strategies for <u>all</u> residents: (i) mobility and toileting devices, (ii) provision of adequate nutrition, (iii) provision of exercise/activities, (iv) orthostatic hypotension prevention, (v) medication review, (vi) prompted toileting, (vii) restraint minimization • incontinence is assessed at admission and prompted toileting is part of the injury prevention strategies • an environmental audit is done annually by the Workplace Health and Safety Committee • falling star logo • a nutritional assessment is done to ensure nutritional needs are being met • residents are kept hydrated and given calcium and vitamin D supplementation • exercise/activity program is part of the injury prevention strategies • medication review is part of the injury prevention strategies

Table 2.1: Comparison of NEHA's Fall Management Program with Recommendations in the Literature (cont'd)

Recommended Program Component	NEHA's Program
• **implementation of fall prevention strategies** (Tideiksaar, 2002) cont'd….. - **safety and protective aids** (Public Health Agency of Canada: Division of Aging and Seniors, 2005); **hip protectors** (Shanley, 2003; Tideiksaar, 2002; Jensen et al., 2003; Australian Commission on Safety and Quality in Health Care, 2009; Simpson et al., 2004; Becker et al., 2003; Kannus et al., 2000; Parker et al., 2006) - **reduce restraint use** (Shanley, 2003; Capezuti, Evans, Strumpf, & Maislin, 1996) - **use of established post-fall strategies** (Theodos, 2004; Australian Commission on Safety and Quality in Health Care, 2009); **assessment of resident immediately after a fall** (Tideiksaar, 2002); **refer to other health care workers (e.g., physiotherapy)** (Shanley, 2003) - **post-fall interventions to address fear of falling** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)	• call bell within reach, beds at kept at appropriate height and locked, good lighting, assistive devices as necessary, regular maintenance of walkers, wheelchairs and canes • restraint minimization is part of the injury prevention strategies • post-fall protocol
• **move high risk residents closer to those who can observe and assist them** (Shanley, 2003)	• residents identified on admission at higher risk are placed closer to the nursing station or are monitored more often throughout the day
• **flexible staff scheduling to ensure adequate staff supervision** (Shanley, 2003)	• staff shifts change at least every 12 hours, and some every 8 hours
• **appoint a falls coordinator** (Shanley, 2003)	• NEHA's Director of Long Term Care

Table 2.1: Comparison of NEHA's Fall Management Program with Recommendations in the Literature (cont'd)

Components Recommended in Multi-faceted Fall Programs	NEHA's Program
• **make fall and injury prevention an explicit and important part of facility's program and budget** (Shanley, 2003)	• education of staff, residents and families, posters, pins, falling star logo • program implemented within existing budget
• **formal reporting and investigative incidence reports** (Tideiksaar, 2002); **efficient falls monitoring system**(Shanley, 2003); **use of outcomes measures (e.g., falls, injuries)** (Theodos, 2004; Kannus et al., 2000; Parker, Gillespie, & Gillespie, 2006); **regular follow-up to see if interventions have decreased falls** (Tideiksaar, 2002; Moreland et al., 2003; Simpson et al., 2004)	• Occurrence and Investigative Reports completed after each fall • falls and injuries tracked monthly • formal evaluation of program

2.3.4. Fall Management is Consistent with a Social Model of Care

Fall management is consistent with a more social model of care that is starting to emerge. This social model is the antithesis of the traditional medical model that currently predominates care approaches – rather than focusing on technical quality and safety, which is associated with poor quality of life (Kane, 2003), social models are aimed at provision of more person-centered care (PCC) (Takasaki, 1997) and in turn, a better quality of life (Kane, 2003).

It is recognized that quality of life is more than simply injury prevention and functional ability (Kane et al., 2005). It is equally if not more important than simply extending life (North Eastman Health Association Inc., 2006b). Quality of life is a subjective entity that must be operationalized based on residents' voices (Kane, 2003)

which must be considered the gold standard (Kane, 2003; Paulus & Jans, 2005). This is the basis of person-centered care – individualized care that is intended to meet residents' needs and facilitate the most freedom and choice possible based on their health condition (Flesner et al., 2004; Boise et al., 2004; Boumans et al., 2005). It is an evidence-based approach to caregiving that uses residents' preferences and needs to guide provision of care (Amann Talerico, O'Brien, & Swafford, 2003).

Research on the effects of person-centered care are very positive. After its introduction, improvements have been seen in continuity of care (Banks, 1996) and in turn, quality of care (Boumans et al., 2005; Amann Talerico et al., 2003). Other positive effects of person-centered care include improved functional and behavioral resident outcomes, decreased restraint use (Amann Talerico et al., 2003), decreased resident injuries (North Eastman Health Association Inc., 2006b; Reese, 2001), lower resident agitation levels (Ogden, 1998), lower rates of circulatory disorders, hospitalization days and death (Altman, 2002 in (Frohlich et al., 2002) and greater resident and family satisfaction with care (Takasaki, 1997; Boumans et al., 2005; Banks, 1996; Sherbrooke Community Centre, 2004).

Some studies have even found a decrease in institutional operating costs associated with the introduction of person-centered care (Reese, 2001). In Denmark, efforts to move away from formal institutionalized care to more personalized care by building more home-like accommodations for seniors (Stuart and Weinrich, 2001 in (Frohlich et al., 2002) is associated with a drop in 'constant currency expenditures' (Altman, 2002 in (Frohlich et al., 2002).

Recent research by Tiessen et al. (2010) found that transforming the patient care model from fall *prevention* to fall *management* resulted in (i) a more elder-friendly environment, (ii) greater respect for patients' choices, even those involving personal risk, (iii) a restraints-free physical environment, and (iv) a lower than industry average falls resulting in serious harm (Tiessen, Deter, Snowdon, & Kolga, 2010). They adopted a patient falls philosophy of dignity, autonomy, and individual rights of elderly patients, even if it meant increased risk. Efforts were also made to educate residents and families about risks and harms related to patient choice, patients were supported in their right to move around, and strategies were used to protect residents form harm due to falls (Tiessen et al., 2010). The rate of falls with harm was 2% for 3 consecutive years, well below the rate reported by O'Connor (2006) of 4-7.5% (Tiessen et al., 2010).

One successful example of more holistic care is the Eden Alternative. It is a care philosophy, the goal of which is to provide a home-like environment and more person-centered care, helping to counter the "three plagues" of PCHs - loneliness, helplessness, and boredom (Kane, 2003). Since 1992, over 250 nursing facilities in the US and Canada have shifted to this model. After doing so, residents have shown improvement in their need for care, the need for restraints has decreased, drug costs have declined, there have been drops in the incidence of illness and death, and formerly stoic patients have begun to communicate (Day, 2005). Moreover, it is not that expensive to convert an existing nursing home to the Eden model – what has been difficult is changing the entrenched beliefs and getting support from facility owners, administrators and staff (Day, 2005).

Person-centered care also has the potential to increase family involvement, which in turn enables them to provide important information about the resident for the PCH,

provide a connection to the larger community, assist in resident care, and advocate on the resident's behalf (Boise et al., 2004). Person-centered care also enables greater involvement of staff in decisions about the provision of care, which has been found to increase job satisfaction (North Eastman Health Association Inc., 2006b). Day (2005) found that a friendlier, supportive environment between residents and staff results in happier employees, healthier residents, less worker turnover, and generally improved care (Day, 2005).

The small amount of research that exists which includes input from residents indicates that what is most important to them are things such as relationships (Kane, 2003; Paulus et al., 2005); activity; stimulation; security; control; autonomy (Kane, 2003); a comfortable atmosphere; staff kindness; good quality food; being able to have personal possessions; and having access to a park or garden (Paulus et al., 2005). The very effort to measure residents' quality of life by asking them directly about it, increases the chance that they will bond with staff, which in turn, makes depersonalization less likely (Kane, 2003). As Day (2005) points out, a more "humanizing" facility environment has been shown to result in happier staff and better retention, and in turn, better quality of care and healthier residents (Day, 2005). Moreover, residents' dignity and self-worth improves, while feelings of despair, loneliness, boredom and helplessness decrease (Day, 2005).

Fall management is aimed at decreasing helplessness by promoting mobility and functionality, and ultimately improving one's quality of life. Better management of falls facilitates the reduction of injuries and other harmful outcomes for individuals (e.g., pain discomfort, decreased mobility, increased dependence, hastened mortality) (North Eastman Health Association Inc., 2005b; Theodos, 2003; Vu et al., 2004), and contributes

to greater mobility and activity. The more mobile and active people are, the better their physical health (e.g., stronger muscles, improved circulation, etc.) and psychological well-being (e.g., increased mobility can increase independence which increases self-esteem and confidence, and can reduce social isolation, thus facilitating the formation and maintenance of relationships) (North Eastman Health Association Inc., 2005a; Komara, 2005; Takasaki, 1997). The better one's physical and psychological well-being, the better the chance of avoiding falls (JEL Health Education Ltd., 2002) and better their quality of life (Butler et al., 1998; Kane, 2003).

The traditional model is easier to administer in that the amount of time caring for residents can be documented and measured, which facilitates accounting and linking reimbursement to performance standards, but results in a detached environment for residents and staff (Day, 2005).

2.3.5. Fall Management is Consistent with Policies/Initiatives Worldwide

Traditionally, the seniors' issues that have received the most attention politically have been those related to indications of poor quality of healthcare (e.g., dehydration, malnutrition), while issues like quality of life have remained relatively invisible (Kane, 2001). However, things have started changing. Many of the goals of fall management (i.e., injury reduction, promotion of mobility and functionality, and improved quality of life) are consistent with recent proactive policies and initiatives at the provincial, national and international levels.

Several Canadian provinces and territories have identified seniors' falls as a serious public health issue and are developing interventions for fall prevention (Public Health

Agency of Canada: Division of Aging and Seniors 2005). There has also been development of practice guidelines on seniors falls at multiple levels of government: (i) The Registered Nurses Association of Ontario, (ii) the American Geriatrics Society, (iii) The National Institute for Clinical Excellence (NICE) (UK), (iv) National Health Service Framework for Older People (UK), (v) Department of Health and Aging (Australia) (Public Health Agency of Canada: Division of Aging and Seniors, 2005). Moreover, in 1996, the Canadian Council on Health Services Accreditation changed its focus to a client-centered approach (Banks, 1996).

In the United States, there have been several initiatives that have recognized and attempted to remedy some of the issues facing seniors and nursing homes. In 1983, the Institute of Medicine commissioned a study on nursing home quality. This led to the report Improving the Quality of Care in Nursing Homes (1986). The report concluded that a uniform assessment tool was needed to help improve quality of care. This led to the development of the Minimum Data Set (MDS). The MDS has 18 areas for caregiver observation of residents which potentially signal problems (Achterberg, van Campen, Margriet, Kerkstra, & Ribbe, 1999).

In 1987, the Omnibus Budget Reconciliation Act (OBRA) was enacted, requiring that all Medicare- and Medicaid-certified nursing facilities: (i) do periodic standardized comprehensive assessments of all residents using the Minimum Data Set (MDS) (Kiely, Kiel, Burrows, & Lipsitz, 1998), and (ii) provide ‘home-like’ atmospheres and an individualized approach to patient care (Smith & Gamroth, 1995) with directives for maintaining resident dignity, choice/autonomy, and participation in one’s own care planning and facility governance (Kane, 2003).

A follow-up report found that there had been improvements in quality of care in LTC since the implementation of OBRA, but also cautioned that regulation is necessary but not sufficient for ensuring high quality of care in LTC (Wagner et al., 2005). This has resulted in conflicting expectations of consumers and regulators, but has paved the way for improvements (e.g., new standards of care and training, use of standardized assessments such as the MDS, new rules on enforcement procedures) (Vladeck & Feuerberg, 1995), and a reduction in use of restraints.

The Patient Self-Determination Act (1991) was enacted with the intent to encourage people to make advance directives regarding care (Mezey & Ramsey, 1994). The Patient Self-Determination Act (PSDA; 1991) pertains to all health care institutions getting Medicare and/or Medicaid, the intent of which is to encourage people to make advance directives regarding provision of care when the individual is unable, not to encourage people to not accept treatment (Mezey et al., 1994). The PSDA has increased the use of living wills and advance care plans, and quality of life issues are addressed as part of a survey process (Vladeck et al., 1995).

There were also several promising seniors-related Health Care Financing Administration Initiatives in 1995. These included: (i) a revised survey process that makes greater use of data, quality of life guides, a new protocol for non-interviewable residents, etc.; (ii) reimbursement policies based on use of resources according to case-mix; (iii) provision of a quality of life profile as a benchmark for comparison for facilities; (iv) use of a conceptual model from market research to identify desired LTC features by residents and families and develop a satisfaction scale; (v) improved

dissemination of information to consumers to facilitate informed LTC decision making (Vladeck et al., 1995).

In 2002, the Centres for Medicare and Medicaid Services launched the Nursing Home Quality Initiatives which provided quality improvement information (general information rather than specific failures) about LTC to LTC and consumers (Wagner et al., 2005).

As well, two Institute of Medicine reports put person-centered care at the top of the priorities for the health care system (Amann Talerico et al., 2003). However, regulation is necessary, but not sufficient on its own, for ensuring high quality long term care (Wagner et al., 2005).

Falls and fall-related injuries have also become "a national and state health priority area" in Australia. Long term care is starting to focus on fall prevention in an effort to take a proactive approach and ultimately significantly improve seniors' health through a statewide action plan (2002-2006) that is based on on-going collaboration between government and non-government stakeholders to enable better coordination of effective prevention strategies (Queensland Government (Health), 2002; Queensland Health Australia, 2003).

The fact that similar seniors'-related issues are receiving attention worldwide helps to validate decisions to address these issues through efforts like fall management programs.

2.3.6. Limitations of Fall Programs

2.3.6.1. Research Results are Mixed

Research results from fall-related interventions has been mixed. Some studies have found no change in fall rates (Vu et al., 2004), injuries (Kerse et al., 2004) or patient

well-being (Boumans et al., 2005). Some studies have even found an increase in fall rates (Kerse et al., 2004). However, many of these studies have acknowledged shortcomings that could affect the results, such as small samples (Vu et al., 2004; Oliver, 2007) and differences in the intervention, outcome measures, geography, and/or sample sizes (Becker et al., 2003). Moreover, many of these studies did have positive results for other fall-related outcomes such as improved orthostatic hypotension, visual acuity, and significantly fewer resident hospitalizations (Vu et al., 2004). Finally, it is important to remember the tenet of fall management - an increase in falls is not necessarily bad, and can even be beneficial if falls have non-injurious outcomes and resident mobility is increased (Kerse et al., 2004).

Moreover, results can be skewed by the Hawthorne effect (Oliver, 2007; Lach, 2010) – implementing or researching a program increases peoples' awareness and can result in things such as more care being taken when reporting falls, thus increasing the fall rate (Lach, 2010).

2.3.6.2. Difficulties with Fall Program Assessment and Implementation

Fall management programs can be difficult to implement. It is challenging to attempt to promote independence and safety simultaneously (Theodos, 2003). However, maximizing resident choice, which is consistent with person-centered care, can help take some of this decision-making responsibility off care providers. Even though striving for this balance is acknowledged as being valued in long term care, it is implemented to a limited extent (Amann Talerico et al., 2003) and continues to be trumped by safety concerns (Kane, 2003).

Moreover, simply because a fall program is in place does not guarantee that its guidelines are being followed – the implementation of fall programs and the management of falls remain difficult (Lach, 2010). It has been found that incident forms are often filled out, but much less often acted upon (Oliver, 2007).

As Capezuti et al. (2005) found, the degree of adherence to a fall program varied among studies and facilities – successful adoption of the program depends on support from administration in initiating and sustaining innovative practices, and proper administration requires appropriate reimbursement Grabowski et al, 2004 in (Capezuti, Taylor, Brown, Strothers, & Ouslander, 2007).

Even if fall programs can be implemented, they are difficult to sustain (Rantz et al., 2001; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Dempsey, 2004). Commonly cited reasons for failure include: (i) inadequate staff numbers and/or training (Resnick, Quinn, & Baxter, 2004); (ii) high staff turnover (Amann Talerico et al., 2003); (iii) lack of understanding and/or support by family (e.g., insisting on the use of restraints after a fall) (Boise et al., 2004); (iv) lack of administrative support (Amann Talerico et al., 2003; Baker et al., 2007); (v) a tendency for nursing homes to remain focused on regulatory requirements; and (v) healthcare financing that continues to reward technical, standardized care rather than care aimed at prevention and/or the provision of person-centered care (Amann Talerico et al., 2003). Even when there is minimal expense and/or time required for program implementation, difficulties have been encountered trying to maintain such programs (Amann Talerico et al., 2003). Because of difficulties sustaining long-term compliance to interventions, it is likely that some interventions have

appeared ineffective, when the cause was actually inadequate effort at implementation (Kannus et al., 2005).

Multi-faceted research itself can also be difficult to implement because it requires more time, resources and expertise than single-method designs (Reichardt, 1979). Moreover, in interpreting data from multi-faceted fall interventions, it can be difficult to separate out the effects of individual modified risk factors necessary for determining which specific components/efforts have been effective (Kannus et al., 2005; Oliver, 2007; Rapp et al., 2008).

However, these limitations do not mean that multi-faceted designs should not be employed. Given the complexities of program outcomes and the multitude of uncontrollable factors that affect a social condition, every possible effort must be made to isolate the program effect size (Rossi, Lipsey, & Freeman, 2004e). This entails using a multi-faceted approach (e.g., multiple samples, time periods, etc.) (Fenwick & Parsons, 2000) in order to gather as much information about the program as possible. There will always be some uncertainty about the true program effect, but this can be lessened by using multi-faceted designs (Reichardt & Mark, 1998). Moreover, statistical techniques exist that can easily handle the complexities associated with multi-faceted designs including structural equation modeling (SEM) (Reichardt & Gollob, 1986) and GLMs (sfsu.edu, 2002; StatSoft Inc., 2006).

Despite the limitations associated with attempting to implement fall programs, research indicates that many are not insurmountable and may be offset by the benefits. Given the serious consequences of falls, it is critical that the effectiveness of fall prevention efforts be studied (Jensen et al., 2003). Ensuring the education of residents,

families, staff/administration and policy makers about all the benefits of fall management efforts is a necessary first step in gaining the buy-in needed to promote program sustainability.

2.4. Research Design

The evaluation research design to be used in this research is a quasi-experimental, pre-post, comparison group, mixed methodological design.

2.4.1. Evaluation Research

Evaluation research is the systematic use of quantitative and qualitative research methods to assess the effectiveness and efficiency of a program or practice. While not infallible, this approach is less likely to produce errors than other information sources (e.g., information from authorities, traditional beliefs, or 'common sense') (Weinbach, 2005). Evaluation research is useful for: (i) benchmarking and targeting; (ii) guiding managers in making program modifications; (iii) identifying people deserving of credit; (iv) highlighting aspects of the program that are working well; and (v) enabling a timely response to problems if evaluation is done continuously (Rutman, 1980b).

Before conducting an evaluation, an 'evaluability assessment' should be done – a procedure for assessing how ready the program is to be evaluated (Rutman, 1980b; Rossi, Lipsey, & Freeman, 2004d). Program goals and objectives should be examined (Rossi et al., 2004d) to determine if they are (i) defined clearly enough to permit their objective measurement, (ii) consistent with the way the program is being implemented, (iii)

realistic, and/or (iv) in conflict with other goals/objectives (Rutman, 1980b). If goals and objectives are not properly defined, it is difficult to tell if a program has been effective.

It is also important to determine if there are other potential program-related issues that could interfere with program delivery and/or the evaluation (e.g., insufficient resources to support the program and/or the evaluation, lack of a theoretical basis for the program) (Posavac & Carey, 2003). Addressing such issues not only makes the program more evaluable, it can improve program effectiveness and efficiency (Rossi et al., 2004d) and reduces the risk of wasting resources on a full-fledged evaluation if the program is not ready to be evaluated (Rutman, 1980b).

There are several reasons for doing an evaluation. They are useful for (i) *exploration*, to learn more about a program, when little is known about it, (ii) *describing* relevant variables in a sample/population and how they are associated, and (iii) *explaining* possible cause-and-effect relationships among variables (Weinbach, 2005).

There are also several different types of evaluations: (i) goal-based – evaluating the extent to which the program meets the program's goals and objectives; (ii) process-based – gaining and understanding of how the program works and how results are produced; and (iii) outcomes-based – determining if the organization is doing the appropriate program activities needed to bring about clients' required outcomes (McNamara, 2007). Usually, only one or two aspects of a program are targeted for evaluation rather than attempting to evaluate the entire program.

There are several drawbacks associated with conducting evaluations. The increased scrutiny can create fear and resentment (Posavac et al., 2003), and this is exacerbated when evaluations are done for unethical reasons such as justification of a decision that

has already been made, or requesting that it be done from within the same organization with the intent of biasing results (Weinbach, 2005). Moreover, evaluations tend to have limited external validity: (i) samples are often convenience-based rather than randomly selected, and are thus not likely representative of the larger population; and (ii) because no two programs are identical, it is often difficult to compare results (Weinbach, 2005).

However, limited external validity is not a critical limitation of evaluations given that this is not their main intent. Evaluations are aimed primarily at increasing knowledge and understanding about a specific program, for those involved with that program (Weinbach, 2005). It is an added benefit if results can be generalized or used to inform other programs and/or professional literature.

2.4.2. Quasi-Experiments

Quasi-experiments are natural experiments where "nature has assigned subjects to [different] conditions" (sociologicalindex.com, 2011). Rather than manipulating independent variables to assess causality, a statistical baseline is established, and followed by a naturally occurring intervention, which provides information about a trend rather than a 'cause' – the goal is to find the one 'true' trend (sociologicalindex.com, 2011). Quasi-experiments are often necessary when randomization is not possible (Bawden & Sonenstein, 2011; Bickman, Rog, & Hedrick, 1998).

Randomization controls for unrelated, confounding variables, which helps to isolate program effects – participants are divided into groups, and only one receives the intervention, which helps to determine whether it is the intervention groups characteristics that affected the outcome (Creswell, 2003). Randomization also helps to

ensure that the intervention and comparison groups are similar – while it does not guarantee that groups are equivalent in all respects, it does guarantee, that mathematically differences are likely to be insignificant (Shadish, Cook, & Campbell, 2002). Not being able to randomize threatens internal validity by potentially introducing bias because groups are not statistically equivalent, so that what appears to be a program effect could actually be caused by group differences (Rutman, 1980a).

However, when studying the benefits of interventions, it is not always possible to randomize (Bickman et al., 1998; Shadish et al., 2002; Salkind, 2006; Des Jarlais, Lyles, Crepaz, & The TREND Group, 2004; Bawden et al., 2011). It is often not ethical to randomize treatment administration and withhold it from some people/groups. Moreover, it is not possible to randomize existing groups (e.g., residents in a PCH), a common unit of analysis in evaluations (Rossi, Lipsey, & Freeman, 2004c; Salkind, 2006).

However, in some cases, quasi-experimental designs are more appropriate than randomized experimental designs (Bawden et al., 2011). It is increasingly accepted that programs should be tested under 'real life' conditions, as 'laboratory conditions' can render results non-generalizable (Bawden et al., 2011). Experimental settings may be on a smaller scale than the natural setting and this could affect program results (Bawden et al., 2011).

Moreover, quasi-experiments do meet two important criteria for establishing causality – (i) the intervention precedes the outcome, and (ii) it is possible to determine if the outcome varies statistically with the intervention (Harris et al., 2006).

As well, there are components that can be added to quasi-experiments that strengthen their design and help to compensate for the difficulties associated with non-

randomization, including the use of pre/post-intervention measures and comparison groups (Bickman et al., 1998; Harris et al., 2006). These help to strengthen claims about causal relationships between the intervention and an outcome by controlling for several threats to internal validity (Lie, 2007).

The use of pre-tests provides comparative benchmark information about outcomes of interest prior to program implementation. As well, the pre/post time structure reduces ambiguity about causal direction (Cook & Campbell, 1979). Moreover, pre-tests help to establish the similarity of intervention and comparison groups (Harris et al., 2006). The more similar these groups are in the pre-test in terms of characteristics believed to influence the program outcome, the greater the likelihood that the comparison group is a valid reference for estimating program effects (Bawden et al., 2011). But, even if there are differences, it is often possible to statistically control for them (Bawden et al., 2011). To the degree that they are similar to the intervention group, the comparison group provides information about what would have happened without the intervention (Shadish et al., 2002). As Campbell and Stanley (1963) note, "in studies of major administrative change, it is wise to seek out a similar institution not undergoing the treatment (Campbell & Stanley, 1963).

This design can be further strengthened if it can be expanded into a time series structure (Shadish et al., 2002; Reichardt et al., 1998). The use of multiple pre- and post-tests provides more data from multiple points in time, thus providing a more comprehensive and reliable assessment of a program and information about trends, compared to a single pre- or post-test (Gribbons & Herman, 1997).

Quasi-experimental designs are a strong alternative to randomized experiments. A quasi-experimental, pre-post intervention, comparison group design is one of the stronger quasi-experimental designs possible, providing the high internal validity and sound evidence for establishing a causal relationship between the intervention and outcome (Harris et al., 2006; Shadish et al., 2002). Design features and statistical adjustments can compensate for initial differences between groups (Shadish, Cook, & Houts, 1986). When applied together, these allow for causal inference even when sample sizes are small (Shadish et al., 1986).

2.4.3. Mixed Methods Research

Quasi-experiments are also amenable to a mixed methods study design. A mixed methodology uses numerous different quantitative and/or qualitative research methods to evaluate one or more program components (Creswell, 2003), thus triangulating different types of evidence about program outcomes, increasing the reliability and credibility of results (Gribbons et al., 1997) and strengthening certainty about program effect size (Rossi et al., 2004c; Golafshani, 2003; Reichardt et al., 1998).

Quantitative methods are based on numbers and quantification (Gifford, Baum, & Encel, 1995) and data are collected using procedures such as experiments and surveys (Pope & Mays, 1996). The goal of quantitative methods is to answer questions or test hypotheses by conducting a research study, which typically involves comparing groups in terms of independent variables to see how these affect a dependent variable (Creswell, 2003). In evaluation research, such methods are used to assess the effectiveness of individual practices and to evaluate how effective programs are at achieving their goals

and objectives (Weinbach, 2005), while controlling for other confounding factors that could also affect that outcome (Bickman et al., 1998). Quantitative data analysis involves the use of various statistical tests to determine whether an observation or pattern is significant (Patton, 2002). Examples of such tests include t-tests, ANOVA, regression, correlation, and GLMs.

Conversely, qualitative methods are based on concepts and classification (Pope et al., 1996), and data are collected using procedures such as interviews, direct observation and written data (e.g., program documents) (Gifford et al., 1995). The goal is to develop concepts to help understand phenomena in a natural, as opposed to experimental, unnatural, and contrived setting (Pope et al., 1996). Qualitative data analysis involves reading through the material multiple times to get a general sense of it and reflect on its overall meaning (Patton, 2002; Pope et al., 1996). There are no statistical tests to indicate whether an observation or pattern is significant, so qualitative researchers must rely on their own intelligence, experience and judgment (Patton, 2002).

There are many benefits associated with the use of a mixed methods approach. Because all methods have biases, using multiple techniques can help converge on the true program effect (Reichardt & Cook, 1979; Shadish et al., 2002). Insights are offered that neither one alone could provide (Reichardt et al., 1979). Estimates of bias are more accurate than from single measurement approaches (Shadish et al., 1986; Gribbons et al., 1997). If there is consistency in the overall patterns of data from different sources and reasonable explanations for these differences, this contributes significantly to the overall credibility of the findings (Patton, 2002).

The use of mixed methods is not without limitations. It is more expensive, time consuming, and can necessitate the reliance on interdisciplinary teams (Reichardt et al., 1979). Even though the use of mixed methods is becoming more widely accepted across a range of health research areas (Gifford et al., 1995), it is unlikely that one researcher possesses all of the skills needed to conduct such a study alone. Moreover, multiple design or measurement strategies can produce contradictory evidence (Cordray, 1986). How to weigh the evidence is a judgment call on the part of the analyst (Cordray, 1986).

Despite these limitations, the use of multiple measures helps to assess complex programs and increases the certainty about the program effect size (Reichardt et al., 1998; Rossi et al., 2004e). Given the reality of limited time and resources, it may not be possible to incorporate as many different components as desired, but expanding a single design by using even only one additional component improves efforts to triangulate on the true program effect.

2.5. Statistical Design

Because the data in this research were counts of rare events, which are discreet and non-negative, they were assumed to follow a Poisson distribution (Twisk, 2003). Poisson regression analyses were thus used to examine these data – the natural log of the expected count is modeled (Dallal, 2008; Ballinger, 2004) which makes coefficients linear and thus analyzable using linear regression methods (Ballinger, 2004). The natural log of person time is modeled using an offset in the model (Dallal, 2008) which enables the estimation of the relative risk of rates rather than events (Ballinger, 2004). These indicate how much change there is in the outcome for each one-unit change in a covariate (Dallal, 2008).

When many of the same people are measured on more than one occasion, these observations are correlated and not independent. GLMs can be used to analyze time series data that are correlated thus not independent (Ballinger, 2004). This is accomplished by using a generalized estimating equation (GEE) which is not a model, but a method of parameter estimation for correlated data (Manitoba Centre for Health Policy, 2002) which corrects for the within-subject correlations (Twisk, 2003). Fitting a GEE model involves specifying a link function, a distribution, and a correlation structure of the dependent variable (Ballinger, 2004). Correlation structures allow coefficients to vary between individuals which corrects for the correlation (Twisk, 2003). An autoregressive correlation structure was used because it best fit these data.

CHAPTER 3: CONCEPTUAL FRAMEWORK

Early in the research process, it is essential to specify a conceptual framework (Rossi et al., 2004d). The basic purpose of conceptual frameworks is to serve as an approximation of the 'real' world (www.matedu.cinvestav.mx, 2006), and to illustrate the assumption that a sequence of events leads to an outcome (Andersen & Newman, 1973). These frameworks help to identify relevant and measurable variables in a study and illustrate the hypothesized relationships between them (Bickman et al., 1998; Borgatti, 1999; Andersen et al., 1973). Frameworks help to guide the overall research process (Borgatti, 1999), providing a reference point for data interpretation (The Higher Education Academy: Social Policy and Social Work (SWAP), 2006) or a standard for judging whether outcomes are better or worse (Rossi et al., 2004e), and a means for making predictions (Schaie, 1988).

3.1. Background for the Conceptual Framework Used in this Research

Several harm reduction/injury prevention frameworks were found in a review of literature. However, no one framework on its own was sufficient for the purpose of this research. The framework used for this research builds on several concepts from these other models, which are briefly outlined in the following sections.

3.1.1 Epidemiologic Model (EM)

The focus of this model is the interrelationship between (i) the host (e.g., the injured person), (ii) the agent (e.g., the entity that can be redesigned, such as a car that was involved in a car accident in which the person was injured), and (iii) the environment

(e.g., the roadway and societal laws and practices that were involved in the accident) (Center for Injury Prevention Policy & Practice, 2005). This model enables the consideration of multiple causes of injury and responses that facilitate injury prevention (Center for Injury Prevention Policy & Practice, 2005).

3.1.2. Haddon's Matrix (HM)

This conceptual model, developed by William Haddon Jr., builds on the Epidemiologic Model by looking at events in terms of the involvement of a host, an agent and the physical/social environment over time (Center for Injury Prevention Policy & Practice, 2005). Use of a matrix structure enables the incorporation of a time element, further breaking the event down into a pre-event, event, and post-event stage. This facilitates the identification of modifiable and preventable risk factors at each stage, for the host, agent, and environment.

3.1.3. General Model of Injury Control (GMIC)

The basic components of injury control are outlined in this iterative model. The process begins with monitoring injury incidence by collecting and analyzing data. The next step is to identify risk factors to help determine how and where to intervene. After intervening, the incidence of injury is evaluated to determine if there was an effect (Center for Injury Prevention Policy & Practice, 2005). The iterative structure of the model indicates that this is a continuous process.

3.1.4. Injury Prevention & Evaluation Cycle (IPEC)

The IPEC is a multidisciplinary iterative framework intended to guide research about the differences between and among populations given the diversity in age, gender, ethnicity, attitudes, resources, social structure, and environments, all of which affect type, severity and rate of injury (Raina, Turcotte, & Soubhi, 2006). It is similar to the GMIC above in that the burden of injury is assessed, injury risk factors are identified, and the intervention is evaluated. But, the IPEC provides more detail about the evaluation: the intervention is assessed in terms of its effectiveness, efficiency and feasibility, and continually monitored and reassessed in order to sustain a continued reduction in injuries (Raina et al., 2006). Moreover, the authors stress the importance of incorporating additional theories and conceptual frameworks within the cycle, such as the use of HM, to help identify individual-level risk factors.

3.1.5. Three E's' of Prevention (TEP)

This framework outlines three basic types of interventions that can be employed: educational, enforcement and engineering/environmental. The educational approach is aimed at changing behavior by providing information to target groups about potential hazards, risk factors and safer behavior. Legislation and its enforcement are often used to reduce risky behaviors. Engineering/environmental interventions are aimed at changing the physical environment and/or product design that will automatically protect everyone (e.g., reflective traffic signs) (Center for Injury Prevention Policy & Practice, 2005).

3.1.6. Spectrum of Prevention (SP)

In this framework, developed by Larry Cohen at the Prevention Institute in Oakland California, the interrelated actions that facilitate the development and implementation of injury prevention efforts are outlined: (i) strengthening individual knowledge and skills, (ii) promoting community education, (iii) educating providers, (iv) fostering coalitions and networks, (v) changing organizational practices, and (vi) influencing policy and legislation (Center for Injury Prevention Policy & Practice, 2005). These are organized hierarchically, starting with actions that have the potential to affect the least number of people, to those with the potential to affect the most (Center for Injury Prevention Policy & Practice, 2005).

3.2. Conceptual Framework Used for This Research

The framework used for this research draws on some of the concepts from the frameworks found in the literature. It is comprised of three main stages: (i) context, (ii) intervention, and (iii) outcomes. [see *Figure 3.1: Conceptual Framework for the Evaluation of NEHA's Fall Management Program*]

3.2.1. Context Stage

At the context stage, the situation is analyzed, and the burden of injury and risk factors are assessed (Raina et al., 2006; Center for Injury Prevention Policy & Practice, 2005) so that an appropriate intervention can be developed.

This context stage aligns with several components of the constituent models from the literature, including (i) the 'pre-event' stage in 'Haddon's Matrix', (ii) assessing the

burden of injury and identifying risk factors in the 'General Model of Injury Control' and 'Injury Prevention and Evaluation Cycle', and (iii) all of the 'Epidemiologic Model'.

In this research, the program director's concerns about the rates and negative consequences of falls and injuries, corroborated by a review of the literature served as the impetus for the introduction of the fall management program (Director of Long Term Care (NEHA), 2005). The decision was made to develop a program based on the amalgamation of two programs currently in use elsewhere – (i) the Capital Health Falls Management Program, and (ii) the Queensland Health Australia Falls Prevention Best Practice Guidelines (Capital Health, 2004; Queensland Health Australia, 2003).

The risk factors used in this research were chosen because (i) there is evidence in the literature that they are fall-risk factors and (ii) they were measureable using the available data. [see Appendix 1: Fall Risk Factors for Older Adults]

3.2.2. Intervention Stage

At the intervention stage, the new program is implemented. In this research, the program was implemented at the institutional, rather than individual, level. The program applies to all residents regardless of fall history or risk, using additional strategies for residents at higher fall risk (e.g., falling star logo). This proactive approach recognizes that all PCH residents are at higher fall risk simply in virtue of being in the institution, and is consistent with the larger move from a curative to preventative approach to health.

The program is designed to respond to modifiable risk factors through education of staff and residents/families, implementation of injury minimization strategies, and monitoring and evaluation to ensure program goals are being met.

This intervention stage aligns with the 'intervene' stage of the 'General Model of Injury Control'. It also aligns with the pre-event stage in 'Haddon's Matrix'. Because the Fall Management Program is being implemented for all residents, regardless of whether or not there is a fall event, the model used in this research does not include an event stage. The goal is to be proactive and intervene whether residents have previously fallen or not.

The 'Three E's of Prevention' and the 'Spectrum of Prevention' are also relevant at this stage - they outline important issues to consider when devising interventions. Each specific situation will dictate which approach to prevention is most appropriate - educational, enforcement, engineering/environmental, or some combination of these ('Three E's of Prevention'). Prevention efforts should also attempt to incorporate components from the 'Spectrum of Prevention', including training, fostering coalitions, and changing practices.

The fall program in this research incorporates all of these components – staff, residents, and families are educated, program practices are enforced through various policies, and environmental risks are modified once identified (e.g., poor lighting, loose handrail). Moreover, internal coalitions are fostered through the use of multi-disciplinary care teams and external coalitions through communication of findings from monitoring and evaluating the program.

3.2.3. Improved Outcomes Stage

The final component of the proposed framework – improved outcomes – explicitly states the expected outcomes or goals and objectives of the intervention. The goal of the

Fall Management Program is to minimize injurious falls while maximizing the activity and mobility of residents. Through program monitoring and evaluation, it is possible to assess whether program goals and objectives are being met.

This improved outcomes stage aligns with the (i) post-event stage of Haddon's Matrix, and the evaluation/reassessment stages of the 'General Model of Injury Control' and 'Injury Prevention and Evaluation Cycle'.

The iterative structure allows information that has been collected and analyzed to be fed back into the program to facilitate efforts at continuous improvement, as well as out to external audiences (e.g., the community, similar programs, policy makers, professional literature, etc.). While it is acknowledged that the main goal of evaluations is not to inform the profession knowledge base (Weinbach, 2005), it is worthwhile to make the effort. Even though programs are often very specific to local populations, much can be learned from them. Moreover, it is imperative that local governments and policy makers are aware of program successes and failures. The more that is known and understood about programs operating in their constituencies, the better able they are to make effective decisions about what efforts to fund and which ones are ineffective and should be altered or discontinued.

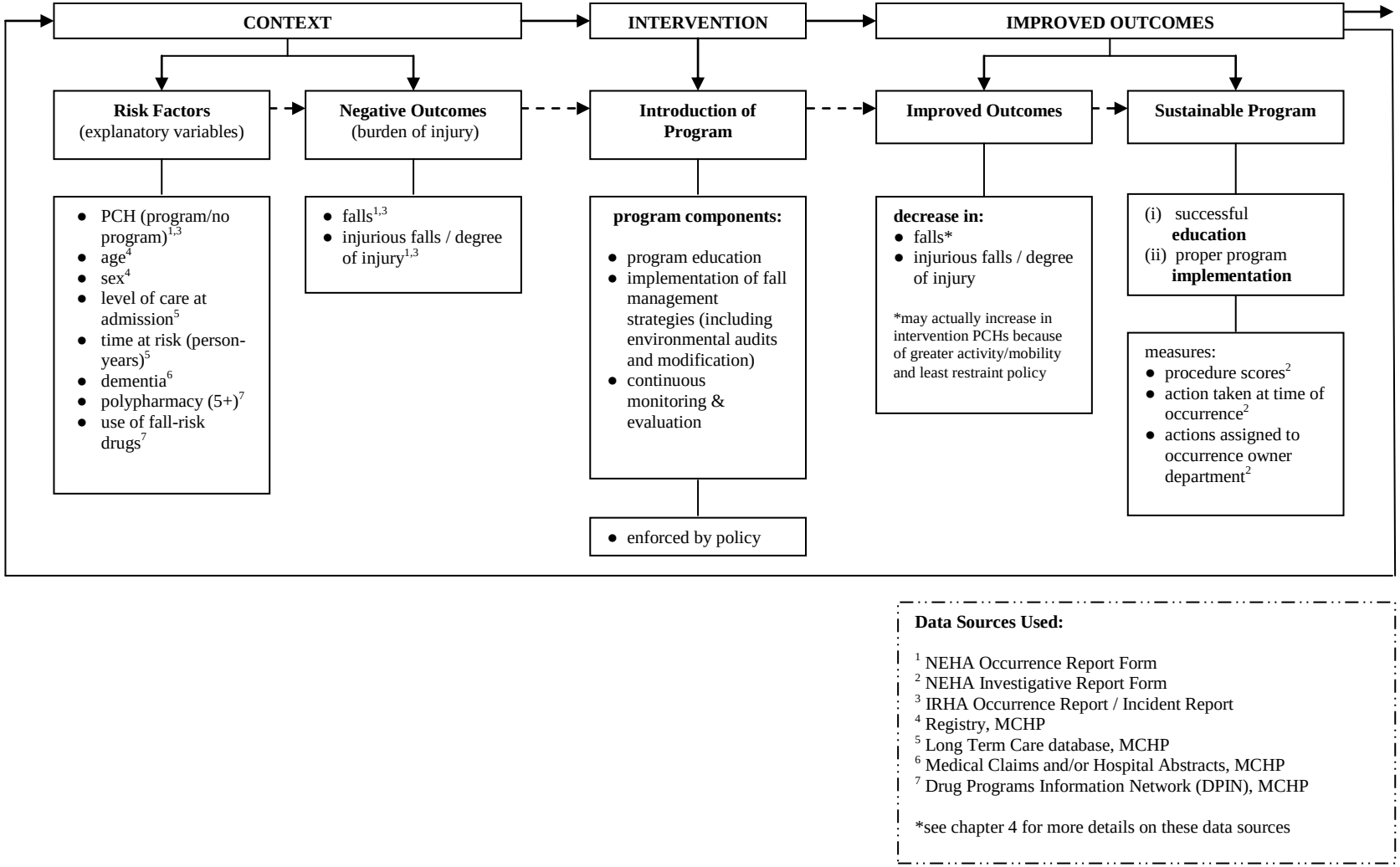
3.3. Purpose of this Framework

This framework fulfills the basic purposes of conceptual frameworks outlined at the beginning of this chapter. It is intended to serve as an approximation of the 'real' world and to illustrate the sequence of events leading to an outcome. In a PCH context, falls are a significant problem, increasing in likelihood as the number of risk factors increases.

Many risks can be prevented by implementing interventions aimed at addressing modifiable risk factors, thus increasing the chance of improved outcomes.

This framework also helps to visualize the basic components of the phenomenon: the relevant and measurable study variables and outcomes and the hypothesized relationships between them. It also helps to guide the overall research process by providing a reference point for interpreting data and statistically analyzing the hypothesized relationships to see if the data support them. For example, it was expected that implementation of the intervention would lead to either no change or a decrease in the injury rate. If the injury rate had actually increased, this deviation from what was predicted by the model helps to alert of the need for further investigation, such as statistical analysis which could reveal that this increase was not significant and thus not necessarily a cause for concern.

Figure 3.1: Conceptual Framework for the Evaluation of NEHA's Fall Management Program



Data Sources Used:

[1] NEHA Occurrence Report Form
[2] NEHA Investigative Report Form
[3] IRHA Occurrence Report / Incident Report
[4] Registry, MCHP
[5] Long Term Care database, MCHP
[6] Medical Claims and/or Hospital Abstracts, MCHP
[7] Drug Programs Information Network (DPIN), MCHP

*see chapter 4 for more details on these data sources

CHAPTER 4: EVALUATION DESIGN AND METHODS

4.1. Introduction

This evaluation research was undertaken to determine if NEHA's Fall Management Program was effective in minimizing injuries from falls while promoting mobility and activity, since its implementation in March 2005.

4.2. Description of the Fall Management Intervention

North Eastman Health Association (NEHA) implemented a Fall Management Program in 2005 in its five provincial PCHs. The goals of the program are to decrease the fall rate[3], severity of injuries, and mortality associated with falls for all residents while maximizing their mobility and activity, and to implement a program that is sustainable.

The Fall Management Program is intended to maximize the safety of PCH residents through a collaborative, multidisciplinary approach. The program involves the implementation of various strategies aimed at reducing the severity of consequences associated with falls, and includes education of staff, residents and families about the program and risk reduction strategies; regular falls risk assessments; annual environmental audits; implementation of proactive injury prevention strategies (e.g., logo to identify high-risk fallers, exercise, minimization of restraints); and a post-fall protocol (e.g., take vital signs, monitor resident regularly, implement appropriate fall strategies) (North Eastman Health Association Inc., 2005c). [see *Appendix 6: Overall NEHA Program Model* and *Appendices 7.1-7.3* for more on specific program components].

[3] While NEHA's program goals state that one aim is to decrease the fall rate, it is recognized that falling is indicative of mobility and activity, which is a positive outcome if not accompanied by an injury. Thus, the main goal is *injury* prevention, not *fall* prevention.

A multidisciplinary care team comprised of nurses, aides, dietitians, recreation coordinators, occupational therapists and other PCH staff (e.g., maintenance), *collaborate* in an effort to provide the safest and highest quality of life for residents. Residents and their families also have roles to play – residents are encouraged to attempt to live as independently as possible, and families are asked to ensure that residents have all of the necessarily uninsured assistive devices (e.g., canes, walkers, hip protection, proper footwear). The 2009 Best Practice Guidelines for Australian Residential Aged Care Facilities identifies the engagement of the older people themselves as "an integral part of preventing falls and minimizing harm from falls" (Commonwealth of Australia, 2009). [see *Appendix 8: Roles for a Successful Program in NEHA*]

The Fall Management Program is consistent with NEHA's move away from a medical model of care towards a more social one, which recognizes that "one's quality of life is equally if not more important than simply prolonging one's life" (North Eastman Health Association Inc., 2006b). Fall management is part of a larger effort to move toward more patient-centered care, which also includes the provision of: (i) a respectful environment; (ii) a spirituality program; (iii) a healthy and safe (work)place for staff and residents; (iv) advanced care planning; (v) regular resident/family council meetings; (vi) resident, family and staff surveys; (vii) a resident bill of rights; and (viii) protection of care.

Prior to the implementation of the Fall Management Program in NEHA, interventions were individualized, being considered only after a resident fell. There was no formal risk assessment, risk management, or corresponding documentation. Most of the response related to falls focused on managing the fall itself, and this was not done consistently between PCHs (Director of Long Term Care, 2010). Implementing fall strategies *after* a

resident is identified at high risk is the general approach used across American PCHs, but the success of such programs has been variable (Rask et al., 2007).

After the Fall Management Program was implemented, all residents were considered to be part of the program, regardless of their fall-risk or -history. As well, all staff members, including nurses, health care aides, dieticians, and housekeeping, were now considered to have roles in fall management (North Eastman Health Association Inc., 2005c).

The impetus for the introduction of the Fall Management Program came from the proactive efforts of the regional Long Term Care committee. Information from literature reviews about effective responses to the problem of residents' falls as well as concerns about the rates and negative consequences of falls and fractures among PCH residents served as the catalyst for action (Director of Long Term Care (NEHA), 2005).

NEHA's Fall Management Program goals are to: (i) implement a sustainable Falls Management Program that includes all residents, staff and family members, (ii) encourage an environment that reinforces least restraint policy, (iii) identify residents at risk of falling, (iv) decrease the fall rate and / or severity of injuries associated with falls at our long term care facilities, and (v) decrease the incidence of mortality related to a recent fall (North Eastman Health Association Inc., 2005c).

Specific Fall Management Program objectives are to: (i) educate all residents, families and staff about the program, (ii) educate all staff about the risks and multi-factor causes of falls in older adults, (iii) initiate both protective and preventative fall intervention strategies, (iv) flag residents at high risk of falling, through the use of the Falls Risk Assessment tool, (v) perform a comprehensive post-fall assessment when necessary so

that the interdisciplinary team can explore underlying causes of residents' falls, (vi) monitor residents' fall rate and to evaluate the efficacy of the program, and (vii) to encourage each facility's interdisciplinary team to assume responsibility for the safety and well-being of their residents by actively participating in the *Fall Management Program* (North Eastman Health Association Inc., 2005c).

This fall management program has formally been in operation since the completion of the introductory education component, provided in all of NEHA's PCHs between January and May 2005. This education involved (i) a 1-hour session for all staff (i.e., nurses, health care aides, recreation, housekeeping, maintenance, and social work) and a self-paced learning package with follow-up quiz for those unable to attend session, (ii) an additional half-day session for nurses and health care aides with shift modules for those unable to attend the session, and (iii) an orientation on strength training and exercise for the recreation department. Once a PCH received the half-day session, it was considered to have implemented the program.

Phase 1 of the education component took place between December 2004 and January 2005 and involved (i) informing all sites about the program and upcoming education sessions and (ii) developing education strategies, materials and timetables. [see *Appendices 9.1-9.3* for more on specific education components]

Phase 2 occurred during January and February 2005. It entailed (i) completing the development of the education strategies and materials (e.g., pins, posters) (ii) booking space for the education sessions, (iii) distributing the time table, (iv) beginning the development of the exercise and recreation programs, and (v) conducting the introduction educational sessions for all staff. NEHA's Staff Development Coordinator travelled to

each PCH to conduct this education. Topics include an introduction to the program, goals and objectives, definitions, issues, strategies and next steps. Staff that were unable to attend this one-hour session were given a self-paced learning package which covers similar material to the one-hour education session. The program's Recreation Coordinator and Occupational Therapist developed exercise and recreation programs. Another component of this education involved the residents and their families. Meetings involving PCH administration, staff, residents and their families were already regularly being conducted and were used as a venue for informing them about the program and keeping them up to date on program progress and outcomes (Director of Long Term Care (NEHA), 2005).

Phase 3 took place between March and April 2005, during which a half-day specialized educational session was conducted by the Staff Development Coordinator with all nursing, recreation and health care aide staff. Prior to attending, staff were asked to review the Long term Care: Fall Management Program document. Staff that were unable to attend this half-day session were required to review the material via weekly shift modules. A different module (five in total) was introduced each week for five weeks. Each nurse on each shift reviewed the material with their staff on duty and the staff signed a sheet indicating that they have heard the material; those who had heard the material (either at the half-day session or at the beginning of a previous shift that week) were not required to stay. I accompanied the Staff Development Coordinator to an education session in order to (i) increase my understanding of the realities of the program and educational component and (iii) take an opportunity to meet some program staff.

In the fall of 2007, there was a mandatory training session for most staff, including nursing, health care aides, recreation, team leaders, care team managers, and occupational therapists. The laundry, housekeeping, and maintenance departments did not receive this training. The Fall Management component included information about this evaluation research - the focus of the evaluation, the evaluation process, progress to-date, expected outcomes, and how findings will be disseminated. As well, the staff were given a pre- and post-test about fall management knowledge, and results were reviewed in a discussion that followed.

The components of NEHA's program are supported in the literature. Evidence from meta-analyses and comprehensive literature reviews supports the effectiveness of multi-faceted PCH interventions to reduce falls and injuries. These interventions include exercise, minimization of environmental risks, identifying high risk residents, and the education of staff, residents and families (Rubenstein et al., 1994; Becker et al., 2003; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Shanley, 2003; Ray et al., 2005; Kannus et al., 2005; Queensland Government (Health), 2002; Jensen et al., 2003; Vu et al., 2004; Becker et al., 2003; Theodos, 2004; Johnson et al., 2003; Barry et al., 2001; Chang et al., 2004).

NEHA's program administrator did not identify specific targets for an effect size with regard to falls. An increase in falls was actually expected given that program goals include keeping residents as mobile and active as possible, while minimizing restraint use. With regard to injurious falls, the overall goal was to minimize injuries from falls and reduce fractures by 10 percent (Director of Long Term Care (NEHA), 2005).

In the comparison PCHs in IRHA there are fall-safety measures in place, but they do not have a formal fall-program. Several of the fall-safety measures are similar to components of NEHA's Fall Management Program, such as fall-risk assessments, medication reviews, exercise, and a least restraint policy. However, most of these measures are individualized and targeted only at residents at risk of falling, unlike NEHA's program, which targets all residents. [see *Appendix 10: Fall Procedures – NEHA vs IRHA*]

4.3. Evaluability Assessment of Program

Prior to this evaluation research, an *evaluability assessment* of NEHA's fall management program was conducted in 2005, in order to determine if the program was ready to be evaluate. This entailed reviewing program documents, relevant literature, and interviewing program staff. Specifically, the program was assessed to determine (i) if there were problems that could interfere with program delivery and/or the evaluation, (ii) which program components were ready to be evaluated, (iii) if there were sufficient resources to support the program and/or the evaluation, (iv) possible positive and negative unintended program effects, and (v) the varying stakeholder perspectives (i.e., program staff). The results of the evaluability assessment indicated that the program was ready to be evaluated.

There were no problems identified that could interfere with the program or the evaluation. One potential and common problem facing evaluations is resistance from stakeholders (e.g., fear of a hidden agenda, lack of free time to participate, aversion to change, lack of understanding of the program, etc.) (Posavac et al., 2003). Fortunately,

there were no such problems, and the Director of Long Term Care did not anticipate any, as other changes that have been introduced have all eventually been relatively well-accepted and ingrained (Director of Long Term Care (NEHA), 2005). Moreover, this evaluation was minimally intrusive as data were collected retrospectively.

There were several program components that were ready to be evaluated, including the education component, but given the seriousness of seniors' falls, the decision was made to focus on this outcome.

At the time of the evaluability assessment, there were no negative unintended program effects identified. There was a positive unintended program effect – many staff were interested in learning fall management techniques for family members and friends still living in the community. Efforts have been made to provide information to the community via the resident/family pamphlet, posters, and an article in the local newspaper.

Regarding the stakeholders' perspectives, there was regular contact between the evaluator and program staff via site visits, meetings in person, by phone and email, in order to gather information necessary to conduct the evaluability assessment and evaluation. Generally, the program staff that were contacted supported the overall idea of the program (i.e., it is a good thing to reduce severity of falls and the program is a logical way to accomplish this end). However, in practice, there was concern that implementing the program would cause challenges (e.g., some training time is unpaid, and too time-consuming for staff, some staff are slow to convert, not everyone wears the pins with the program logo, etc.). Some insight into the implementation was gained from the analysis of procedure information from Investigative report data (see Chapter 6).

4.4. Population and Sample Information

4.4.1. Population

There are 5 non-proprietary PCHs in the intervention RHA (NEHA) and 11 PCHs in the comparison RHA (IRHA), nine of which are non-proprietary and two are proprietary. [see *Table 4.1: Total PCH Beds* below] All five PCHs in NEHA were included in the analysis. Of the eleven PCHs in IRHA, data were available from seven of the non-proprietary ones, so all seven were included.

NEHA was chosen because they were interested in having the Fall Management Program evaluated. IRHA was chosen because it is geographically close and demographically similar to NEHA, but does not have a formal fall program in place.

Table 4.1: Total PCH Beds

RHA	PCH Name	Location	# Beds	Totals
North Eastman (NEHA) intervention PCHs	Eastgate Lodge	Beausejour	80	196 total beds
	Kin-Place PCH	Oakbank	40	
	Lac du Bonnet PCH	Lac du Bonnet	30	
	Sunnywood Manor PCH Inc.	Pine Falls	20	
	Whitemouth PCH Inc.	Whitemouth	26*	
Interlake (IRHA) comparison PCHs	Ashern PCH	Ashern	20	200 beds (7 of 11 PCHs) with accessible data
	~~Bethel Home Foundation~~	~~Gimli~~	~~80~~	
	~~Bethel Home Foundation~~	~~Selkirk~~	~~92~~	
	Eriksdale PCH	Eriksdale	20	
	Fisher PCH	Fisher River	30	
	Goodwin Lodge Inc.	Teulon	20	
	Lundar PCH	Lundar	20	
	Pioneer Health Services Inc.	Arborg	40	
	Rosewood Lodge	Stonewall	50	
	~~Red River Place~~**	~~Selkirk~~	~~180 total for both~~	
	~~Tudor House~~**	~~Selkirk~~		

***** 6 interim beds in Whitemouth PCH counted since 2003 (Director of LTC, NEHA; 2009)
****** proprietary PCHs
~~strikethrough~~ = PCHs with inaccessible data

There was a similar resident turnover rate in each RHA. Of all the residents in the PCHs during the study period, just under one-quarter were only in the pre-period (NEHA: 23%; IRHA: 22%). Just over one-third of residents lived in the PCH only in the post-period (NEHA: 35%; IRHA: 37%). Over 40% of residents in both RHAs were in the PCH in both the pre- and post-period (NEHA: 42%; IRHA: 41%).

4.4.2. Power Calculation

Based on a preliminary sample of the data gathered for this research for reliability testing purposes, over 21% of falls resulted in a minor injury[4]. Assuming a baseline injury rate of 21% and a sample of approximately 1,000 observations (196 NEHA PCH beds x 5 years), there was a power of 92% to detect a change of at least 40% (response rate ratio – 0.6) to a 12.6% injury rate, with a probability of a Type 1 error at 0.05 and two-tailed testing.

4.4.3. Sampling

Purposive sampling was used to select PCHs to participate in the research. The intervention PCHs were selected after learning of the Fall Management Program through a contact in one of the RHAs. It was a newly implemented program and the RHA was interested in having it evaluated as part of this doctoral research. Similarly, another contact in a different RHA was approached to see if there was interest in participating in the research as matched comparison sites. This particular RHA was chosen because it is demographically similar and geographically adjacent to the intervention RHA, and its

[4] Note: Minor injuries were used as a conservative estimate of total injuries. It was not possible to use fractures because these were not specifically measured – fractures were included in the 'major' injury category, among other types of major injuries. Moreover, the number of major injuries in this preliminary sample was too small to use in power calculations.

PCHs did not have a formal fall intervention in place during the study period. All five of the PCHs in NEHA were included in the sample and all PCHs with accessible data were included in IRHA (n=7).

Occurrence reports from the intervention and comparison PCHs were used for information about the number of residents falls, degree of injury, etc. In the intervention PCHs, additional reports (Investigative reports) were also used to gather information about program implementation. Random sampling was used to select some of these Investigative Reports in the intervention PCHs before and after program implementation. Thirty pre- and thirty post-intervention reports were randomly chosen in order to compare post-fall procedures with existing guidelines, which helped to supplement the quantitative data from the Occurrence Reports. Because investigative reports were not numbered, dates were randomly generated and reports from those days selected for analysis.

Using pseudo-random number generation, 30 days were randomly selected from a three-year 'pre' period (April 1, 2002 to March 31, 2005), and then each day was randomly assigned to a PCH based on bed size (i.e., the more beds in a PCH, the more reports sampled). All of the days in the pre-period were assigned a random number (or probability of selection, between 0 and 1) using a random seed, then sorted by descending probability, retaining the first 30 dates. An iterative seed method was used so that the last seed generated in the first step was used to generate another random number (and seed) for the 30 retained dates. Each of these 30 dates was then assigned another random number (and seed) and sorted by descending probability. Each date was then assigned to a PCH, with the probability of assignment based on PCH bed size: the first 13 dates were assigned to the largest PCH, down to the three dates being assigned to the smallest PCHs.

[see *Table 4.2: Process for Sampling Investigative Reports in NEHA*] This process was then repeated to obtain 30 dates for the post period.

Table 4.2: Process for Sampling Investigative Reports in NEHA

PCH	beds in PCH/total NEHA beds*	proportion of reports to be sampled	number of reports sampled
#1 Eastgate Lodge	80/190	42%	30 days x 0.42=12.6 or **13** reports
#2 Kin-Place	40/190	21%	30 days x 0.21=6.3 or **6** reports
#3 Lac du Bonnet PCH	30/190	16%	30 days x 0.16=4.8 or **5** reports
#4 Sunnywood Manor	20/190	10.5%	30 days x 0.105=3.2 or **3** reports
#5 Whitemouth PCH	20/190	10.5%	30 days x 0.105=3.2 or **3** reports

*__Note:__ at the time of this calculation, it was estimated that NEHA had 190 beds; actual n=196 beds

If there was *more than one report* on a particular day, all were selected for analysis. If there were *no reports* for a particular day, then those from the preceding day were chosen. If there were no reports the preceding day, those from the day after were chosen. If there were no reports from the day after, those from two days before were chosen. The days prior to or following increased alternately until a day was found that had at least one report.

4.4.4. Study Period

Because falls and injuries are relatively rare events, multiple years of data were used to increase the stability of rates and to provide enough data to detect a program effect, if one existed.

At the time data access was being requested (March 2008) there were three years of post-intervention data - the Fall Management Program has been in place since April 2005. A consultant from the University of Manitoba Biostatistical Consulting Unit (Mary Cheang, MSc.) recommended that data from an equal time period prior to the intervention for both the intervention and comparison PCHs be obtained.

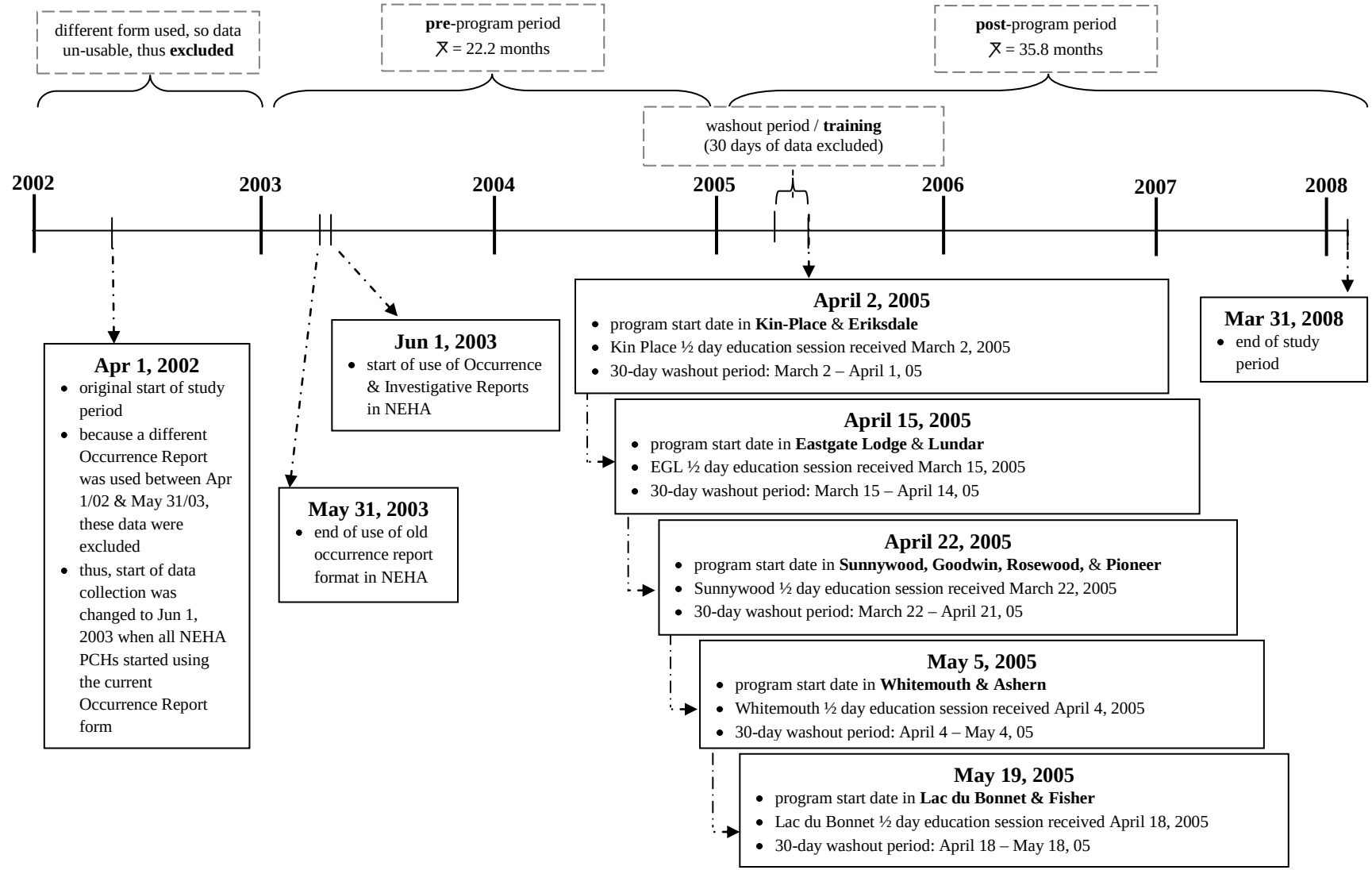
However, when data collection began for this research project, it was discovered in the intervention PCHs that the data prior to June 1, 2003 were collected using a different reporting form which does not contain all of the information required for this research. Moreover, these earlier forms did not have the accompanying Investigative follow-up report, which also contains some needed information. The decision was made to exclude these forms, and collect data from June 1, 2003 onward, when all NEHA PCHs began using the new form. Consequently, data collected in the comparison PCHs in IRHA also began on June 1, 2003.

In order to allow time for the program to become familiar to PCH staff, a 30-day washout period was incorporated by the researcher when analyzing data. For the 30 day period following the start of the program in each PCH, data were excluded. It should be noted that there is not an exact program start date. Once an NEHA PCH received the required education sessions about the program, delivered between January and April 2005, they were considered to be implementing the program. However, this education was delivered to the various PCHs on different days between March and April 2005. Thus, there is a different program start date for each NEHA PCH. [see *Figure 4.1: Timeline for Study Period* below]

The PCHs in the comparison RHA were randomly matched with the intervention PCHs in NEHA. The IRHA PCHs were randomized, and the first five of seven were matched with NEHA's five PCHs. The remaining two IRHA PCHs were arbitrarily assigned to the middle program start date – the Rosewood and Pioneer PCHs were assigned to the April 22, 2005 start date.

Thus, the data collection period consisted of an almost two-year pre-intervention period (June 1, 2003 to the date the education was received [Mar 2 – Apr 18, 2005]; approximately 22 months) and a three-year post-intervention period (end of the washout period [Apr 1 – May 18, 2005] to March 31, 2008; approximately 36 months). The total study period was 4.83 years or 58 months.

Figure 4.1: Timeline for Study Period



4.5. Data Sources and Collection

Two types of quantitative data were used in this research – administrative data and descriptive report data. All PCHs in this research require that an Occurrence Report be filled out each time a resident fall occurs. The number of these reports was a measure of the number of falls. 'Degree of injury' data were also obtained from these reports. Each RHA records the degree of injury from a fall as either none, minor, major or death. Administrative claims data from MCHP were also used. As well, data included open-ended information from a sample of NEHA Investigative Reports.

4.5.1. Data Sources

4.5.1.1. Data from the Intervention RHA: NEHA

In NEHA, the data sources include the Occurrence Reports and Investigative Reports. An Occurrence Report is filled out following a PCH resident's fall. These reports provide information about the resident's fall including: (i) date of the fall; (ii) time of fall; (iii) degree of injury sustained from the fall (i.e., none, minor, major, death); (iv) the faller's name; and (v) the faller's PHIN. It was recommended by staff in the intervention RHA that occurrence reports be used rather than individual patient charts because information on falls would be too difficult to find in the charts (personal communication, April 2008).

An Investigative Report is also filled out after a resident's fall, in conjunction with the Occurrence Report. The information contained in the Investigative Reports is open-ended, providing details about (i) the action taken at the time of the occurrence, and (ii) the action(s) assigned to the occurrence owner department.

These original reports exist for the period of June 1, 2003 to March 31, 2008. Chart auditors were hired to collect the needed information from these forms. All chart auditors were trained to ensure reliability and validity of chart abstraction. These data were transferred to Manitoba Health for PHIN scrambling and de-identification.

4.5.1.2. Data from the Comparison RHA: IRHA

IRHA also uses Occurrence Reports following a resident's fall in all of its PCHs. These reports contain information similar to NEHA: (i) date of the fall, (ii) time of fall, (iii) degree of injury (none, minor, major, death), (iv) residents' name, and (v) residents' PHIN number.

Prior to April 1, 2004, IRHA used an Incident Report following a resident's fall. However, even though a different format, this earlier form collected all the same information required for this research. However, 'degree of injury' was recorded using different categories: none apparent, slight – no treatment required, moderate – first aid, serious, or transfer to another facility required. See *Table 4.3: Alignment of Injury Categories on IRHA's Occurrence vs Incident Reports* below for more information on how these categories align, and *Appendix 11: Occurrence Reports – NEHA vs IRHA* for a more detailed comparison of each RHA's reports.

Table 4.3: Alignment of Injury Categories on IRHA's Occurrence vs Incident Reports

Occurrence Report Injury Categories for NEHA & IRHA	**IRHA Incident Report Injury Categories** (prior to Apr 1, 2004)
none apparent	none apparent
minor	slight – no treatment required
	moderate – First Aid
major	serious*
	transfer to another facility required
death	serious*

Notes regarding Table 4.4:
NEHA:

- **major** = fractures (levels 3 & 4); equipment failures constituting a fall with no fractures a level 3
- **death** is an unlikely injury outcome – death has occurred quickly after a fall, but not so immediate that it is entered as an outcome on the report

IRHA:

- **minor** = minimal injury requiring first aid (e.g., scrape, scratch, bruise, treatment by nursing or attending staff); physician and family notified, but not immediately
- **major** = more serious requiring physician assessment and treatment (e.g., fracture, need for drug therapy, sutures, etc.); physician and family notified at time of injury
- ***serious** = none of the 'serious' incidents during the study period were deaths

These records exist since regionalization in 1997, and most are in electronic format (i.e., Excel spreadsheets), except for PHIN numbers for the first two years of the study period (2002 – 2004). A chart auditor was hired to collect the needed information from the hard copies of the reports, and was transferred along with a copy of the electronic data (from Apr 1, 2004 onward) to Manitoba Health for PHIN scrambling and de-identification.

4.5.1.3. Data from MCHP

Additional data from the Manitoba Population Health Research Data Repository ("Repository") housed at MCHP was used to supplement the data obtained from the PCH reports to provide data about additional outcome and explanatory variables. The Repository contains de-identified administrative data on the insured population of Manitoba organized by family registration numbers, including information about use of physician and hospital services, drug prescriptions, and long-term care use (MCHP Glossary). Administrative data are information that has been collected for an administrative purpose, such as keeping track of people who are eligible for specific benefits, and for paying doctors and hospitals (Spasoff, 1999 from the MCHP glossary (Manitoba Centre for Health Policy, 2006). This information is useful for many things including research, evaluation and health services planning (Institute for Clinical Evaluative Services (ICES), 2007).

Administrative data from the Repository have been de-identified through a process involving Manitoba Health (MH) and MCHP. The PHINs for the individuals in the data set are verified, scrambled specifically for MCHP and any identifying information (e.g., name, address) removed. Files containing only the scrambled PHINs and the program data for each individual are then sent to MCHP where each data file is stored separately in an unlinked format (MCHP, 2005).

The Repository databases used in this research were: (i) long-term care/nursing homes; (ii) hospital claims; (iii) medical claims; (iv) pharmaceutical claims; and (v) registry files. An additional five years of hospital, medical, and pharmaceutical data were

used so that people with certain conditions prior to admission (i.e., dementia, fall-risk drug use, polypharmacy) could be identified.

The long-term care database was used to provide information about residents' (i) level of care on admission to the PCH, and (ii) PCH admission and separation dates. Residents' level of care on admission is a categorical variable, ranging from levels 1 to 6. At the time of admission, all PCH residents are assessed, and then assigned a level of care (between levels 1 and 4) based on the number of nursing hours they require. Level 1 is the least at 0.5 hours per day (minimal care – hostel care), level 2 at 2 hours per day (average care – personal care), and levels 3 and 4 at least 3.5 hours per day (3 = above average care – extended care; 4 = intensive care – extended care 2) (Martens et al., 2004; Manitoba Centre for Health Policy, 2003). Levels 5 and 6 are for temporary residents in the PCH – residents at level 5 receive respite care, and those at level 6 are chronic care residents who will be going to Deer Lodge Hospital or Riverview likely for palliative care (Manitoba Centre for Health Policy, 2003). PCH admission and separation dates were used to determine the number of person-days each resident contributed to the denominator, or time at risk.

The hospital claims database was used for information about PCH residents' use of hospital services. Hospital abstracts are completed at the point of discharge for all separations from acute care facilities in Manitoba. Prior to April 1, 2004, hospital claims included up to 16 diagnosis codes and 12 procedure codes based on the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). On April 1, 2004, hospitals in Manitoba updated coding practices to the 10th version which includes up to 25 diagnosis codes based on the International Statistical Classification of Diseases

and Related Health Problems, 10th Revision, Canada (ICD-10-CA) and 20 intervention (procedure) codes based on the Canadian Classification of Health Interventions (CCI). (Martens et al., 2010).

The medical claims database was used to provide information about residents' use of physician services. Medical claims are based only on the ICD-9-CM.

The hospital and medical claims were used to define dementia, one of the explanatory variables. Similar to Martens et al. (2004) dementia was defined by ICD-9-CM codes 290 (organic psychotic condition), 294 (other organic psychotic conditions), 331 (cerebral degenerations) or 797 (senility) in either hospital abstracts or medical claims. ICD-9-CM codes 291 and 292 were also included when using the *hospital claims data* because more digits of code are available so it is possible to identify the 291 and 292 codes that pertain to dementia - 291.1 (alcohol-induced persisting amnestic disorder), 291.2 (alcohol-induced persisting dementia), and 292.82 (drug-induced persisting dementia). However, ICD-9-CM codes 291 and 292 were not included in the dementia definition when using *medical claims data* because it is not possible to access the level of ICD-9-CM codings required to identify the 291 and 292 codes that pertain to dementia, so this would result in false positives (Martens et al., 2007). As of April 1, 2004, hospitals switched from using ICD-9-CM, to using ICD-10-CA/CCI. The corresponding ICD-10-CA/CCI codes for dementia that were used were: F00-F04, F05.1, F06.5, F06.6, F06.8, F06.9, F09, F10.7, F11.7, F12.7, F13.7, F14.7, F15.7, F16.7, F18.7, F19.7, G30, G31.0, G31.1, G31.9, G32.8, G91, G93.7, G94, and R54. [see *Appendix 12: ICD Codes Used in this Research* for more information about each code used] Dementia was defined as a dichotomous categorical variable – residents either have it or they do not.

The hospital data were also used to identify an additional outcome – accidental falls resulting in hospitalization. ICD-9-CM codes E880-E888 and ICD-10-CA codes W00-W19 within 30 days after a fall were identified in the hospital records. Falls that occurred in the hospital (i.e., those with C-codes) were not included in the analysis.

Information about prescription drugs used by residents was obtained from DPIN – the Drug Program Information Network, a point-of-sale database. Drugs are classified by (i) an ATC code (Anatomical Therapeutic Chemical Drug Classification System, 5^{th} level) according to the organ or system on which they act and/or therapeutic and chemical characteristics, and (ii) a DIN, or drug identification number assigned by Health Canada (Martens et al., 2010). DPIN was used to define the fall-risk drug and polypharmacy variables.

The drugs included in the definition of *fall-risk drugs* were derived from a list used in the intervention PCHs (NEHA), supplemented with drugs based on consultation with the pharmacist in NEHA's PCHs and an MCHP researcher specializing in pharmacy (C. Raymond). [see *Appendix 13: Drugs Used to Define Fall-Risk Drugs*] Residents taking one or more of these drugs during one-month periods were considered to be on fall-risk drugs from the date of the first prescription for the first drug, to the end of the month. Pharmaceutical data starting from one month prior to the start of the study (May 1, 2003) were used to identify people already on at least one fall-risk drug when the study began. This is a categorical variable – residents are either on one or more such drugs or they are not.

Polypharmacy was defined as a resident being on five or more of any drug simultaneously within 100-day periods. Pharmaceutical data starting from 100-days

before the beginning of the study (Jan 18, 2003) were used to identify people already on polypharmacy at the start of the study. Polypharmacy is also a categorical variable – residents taking five or more different drugs, or those taking 4 or less. Over-the counter drugs were excluded because rates would be an underestimate – not all over-the-counter drugs are entered into DPIN, such as those brought to residents by family/friends. As well, this definition is based on previous work at MCHP (Doupe et al., 2006) which excludes them. [see *Table 4.4: Definitions for MCHP Indicators*]

The Manitoba Health Insurance Registry was used to obtain data about residents' *age*, *sex*, and *duration of health coverage* (Manitoba Centre for Health Policy, 2011).

Data from five years prior to the start of the study period were accessed in order to define some of the variables, including dementia and drug use. In doing so, residents with a dementia diagnosis and/or prescriptions for drugs prior to PCH admission could be properly categorized at the start of the study.

Table 4.4: Definitions for MCHP Indicators

***see Appendices 12 & 13 for more details on ICD and ATC codes*

Indicator	Definition	Data Source
accidental falls resulting in hospitalization	• ICD-9-CM E880 to E888 • ICD-10-CA W00 to W19	• hospital abstracts
drugs that increase fall-risk	• psychotropics • antiparkinsonian agents • anti-hypertensives • narcotics	• ATC codes in the Drug Programs Information Network (DPIN)
polypharmacy [5+ drugs]	• the proportion of PCH residents dispensed five or more different drug categories of medications during 100-day periods	• DPIN
dementia	• ICD-9-CM 290, 291.1, 291.2, 292.82, 294, 331 or 797	• hospital abstracts *[up to March 31, 2004]*
	• ICD-9-CM 290, 294, 331, and 797	• medical claims
	• ICD-10-CA/CCI F00-F04, F05.1, F06.5, F06.6, F06.8, F06.9, F09, F10.7, F11.7, F12.7, F13.7, F14.7, F15.7, F16.7, F18.7, F19.7, G30, G31.0, G31.1, G31.9, G32.8, G91, G93.7, G94, or R54	• hospital abstracts *[from April 1, 2004 on]*
level of care on admission to PCH	• level 1 to 6	• long term care database
time at risk	• person-years	• long term care database
age	• date of birth	• registry files
sex	• male/female	• registry files

4.5.2. Data Collection

Data were collected during July and August 2009. Data were sent to Manitoba Health to be encrypted (i.e., scrambled) and de-identified, and then sent to MCHP to be linked to administrative data before being made accessible to the researcher for analysis.

Routinely collected reports from the intervention and comparison PCHs were the primary data sources. Information was collected from the Occurrence Reports in order to identify eligible occurrences – (i) date of occurrence [must be between June 1, 2003 and March 31, 2008], and (ii) who was involved in the occurrence [must be "inpatient/resident/client"].

Auditors in the intervention RHA travelled to each of the five PCHs to collect data. The auditor in the comparison RHA was able to access the needed occurrence reports in one location. Information from specific fields on the paper copies of the reports were entered into the spreadsheet by the auditors.

Each RHA copied the data to a password protected CD and couriered it to Manitoba Health for de-identification before being sent to the researcher for analysis.

Intra-rater reliability was assessed at the beginning of the data collection process. Intra-rater reliability involves the same data collector obtaining data from the same chart on two separate occasions (Gearing, Mian, Barber, & Ickowicz, 2006). Intra-rater reliability was high for all of the data collectors. Each data collector performed, on different days, a duplicate abstraction of their first 20 records collected.

The two data collectors in NEHA each had a reliability of 99% - 199 out of 200 responses were coded the same at the time of the re-test (Cronbach's alpha = 0.9). The data collector in IRHA had 100% agreement between test and re-test.

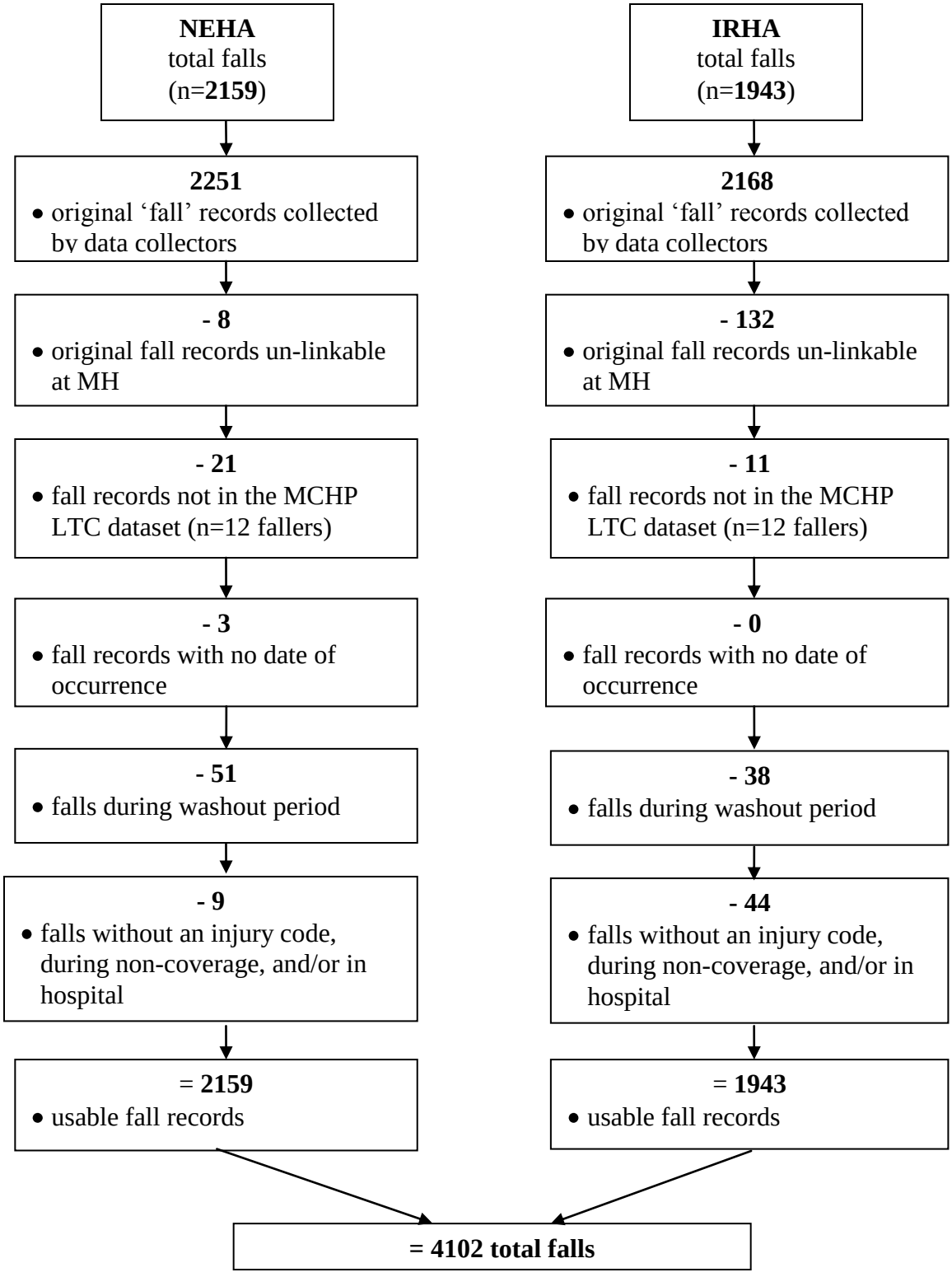
Additional data from the Manitoba Population Health Research Data Repository ("Repository") housed at MCHP was used to supplement data obtained from the above PCH reports as additional outcome and explanatory variables.

4.5.3. Inclusions and Exclusions

All Occurrence Reports completed for a fall during the study period were included in this analysis. It was also possible to include all 12 PCHs in the drug-related analyses because the majority of their drugs were from community-based pharmacies which are tracked through DPIN. Data are not available for PCHs getting their drugs from hospital-based pharmacies.

There were multiple records that were excluded for various reasons, including: (i) the PHIN was un-linkable with MH data, (ii) the PHIN was not in the LTC database, (iii) there was no date of occurrence, (iv) the fall occurred during the washout period, (v) the resident was not covered by MH, (vi) there was no injury category identified, or (vii) the fall occurred in the hospital, not in the PCH. [see *Figure 4.2: PCH Fall Data Exclusions* below]

Figure 4.2: PCH Fall Data Exclusions



4.6. Research Design

A quasi-experimental, pre-post, comparison group design (Shadish et al., 2002) that triangulates different methods and data sources, was used to evaluate the effectiveness of this Fall Management Program. [see *Figure 4.3: Quasi-Experimental, Pre-/Post-, Comparison Group Research Design* below]

Figure 4.3: Quasi-Experimental Pre-/Post-Comparison Group Research Design

intervention PCH_1 O_1 X O_2
- -
intervention PCH_2 O_1 X O_2
- -
intervention PCH_3 O_1 X O_2
- -
intervention PCH_4 O_1 X O_2
- -
intervention PCH_5 O_1 X O_2

comparison PCH_1 O_1 O_2
- -
comparison PCH_2 O_1 O_2
- -
comparison PCH_3 O_1 O_2
- -
comparison PCH_4 O_1 O_2
- -
comparison PCH_5 O_1 O_2
- -
comparison PCH_6 O_1 O_2
- -
comparison PCH_7 O_1 O_2

O_1 = data from fall-related reports; MCHP administrative data prior to NEHA intervention (Jun 2003 – Mar 2005)

O_2 = data from fall-related reports; MCHP administrative data after NEHA intervention (Apr 2005 – Mar 2008)

X = introduction of the *Fall Management Program*

- - - = groups not randomized

True to a quasi-experimental design, randomization has not been employed – the five intervention PCHs are all of the provincial PCHs in North Eastman, one of Manitoba's RHAs. The comparison PCHs were chosen by the researcher because: (i) they are in an RHA that is demographically similar and geographically adjacent to the intervention PCHs' region, and (ii) while they have safety procedures in place, they do not have a formal fall-related program in place. Rates in the comparison PCHs provide information about historical trending while rates in the treatment PCHs reflect historical trending plus an intervention.

Because it is possible to access data prior to and following the intervention in both the intervention and comparison PCHs, pre- and post-intervention and comparison group elements can be added to the research design. In *Figure 4.1* above, the 'O_1s' represent data from the fall reports in the pre-period and the O_2s, data from the post-period. The Xs in the intervention PCHs represent the introduction of the program (thus, there are no Xs in the comparison PCHs). The dashed lines separating the individual PCHs indicate that groups were not randomized.

Further, because it was possible to access Investigative Report data in addition to Occurrence Report data in the intervention PCHs, it was possible to triangulate data sources. NEHA's Occurrence Report contains closed-ended information (e.g., type of fall, contributing factors) and the follow-up Investigative Reports have open-ended information about the actions taken at the time of the occurrence and actions assigned to the incident owner department.

The quasi-experimental design – 'matching through cohort controls' is often necessary in institutions such as PCHs, where there is regular turnover of residents (Shadish et al.,

2002). This rate of turnover is on the rise as age and level of care upon admission to Manitoba PCHs is increasing and resulting in shorter lengths of stay (Menec, MacWilliam, Soodeen, & Mitchell, 2002). Thus it is unlikely to expect that reports for the same people could be analyzed prior to and following program implementation. This design is based on the assumption that cohorts will have fewer selection differences than non-cohort comparison groups (Shadish et al., 2002).

4.7. Statistical Design

This research involved two types of quantitative analyses – one using administrative claims data, and the other using descriptive report data. The main unit of analysis in this research was residents' falls and injuries. Data were aggregated to the RHA level, comparing PCH residents over time, and those with and without a program.

Prior to analysis, the data were cleaned which included checking for missing and erroneous values. As well, variables derived from the administrative data were defined and data were structured to enable analysis using GLMs. [see section 4.7.2. for more details]

4.7.1. Descriptive Statistics

Descriptive analyses were conducted to provide an overview of the data and help to visualize trends. All of the covariates in this research were categorical, but an age grouping was created from continuous age data, so basic parametric statistics could also be provided for age.

Chi-square tests were used to test for associations between the categorical covariates by RHA and over time. For some comparisons, there were more than two levels of a categorical variable (i.e., age groups, levels of care), so results were more difficult to interpret. For any chi-square test of the full contingency table that indicated there was an association between the variables, a series of 2x2 tests were conducted to investigate specific hypotheses (Hassard, 1991). The more tests that are carried out, the greater the risk of type 1 error (i.e., erroneously concluding significant differences), so to help counteract this, the overall error rate (0.05 in this research) was divided by the number of additional tests conducted to derive a stricter critical value for testing these additional hypotheses (Hassard, 1991). This is called the Bonferroni correction factor and is used to control for the increased risk of Type I error (Goldman, 2008).

The standard 5% test statistic was used to assess the significance of group differences. Setting alpha at 0.05 indicates there is a 5% chance of a type 1 error, or erroneously concluding differences are significant (Hassard, 1991). Two-tailed testing was used which evaluates the truth of a general hypothesis that groups are different (Hassard, 1991).

A univariate analysis of the continuous age variable was also conducted. The mean, standard deviation, variance, range, median, and mode were derived over time and by RHA. Basic descriptive statistics for baseline resident characteristics are reported in Chapter 5, section 5.2.

4.7.2. Analyses of Outcomes

The focus of this part of the analysis was on RHA-level effects of the Fall Management Program (i) on the intervention PCH populations over time and (ii) relative to the comparison PCH populations. This individual-level data was aggregated to the PCH-level for analysis.

In order to determine if the Fall Management Program had an effect and there was a change in falls and injurious falls over time (from pre- to post-program implementation) in the intervention PCHs, and in relation to the comparison PCHs, individual-level data from these PCHs were analyzed. Two main types of analyses were done: (i) the rate of falls per person-year, and (ii) the rate of injurious falls per person-year. Falls and injurious falls are expressed per person-year to reflect the different lengths of time each resident was at risk of falling while living in the PCH. Residents' lengths of stay varied because of factors such as different admission and/or separation dates and hospitalization. An analysis was also done of falls resulting in hospitalization. It should be noted here that falls that occurred while the PCH resident was in the hospital were excluded from the analysis.

Comparisons were made in terms of time (i.e., pre- and post-study period), intervention (i.e., with or without a fall program), and a time by intervention interaction, controlling for several confounding variables: (i) age, (ii) sex, (iii) level of care on admission, (iv) polypharmacy rates, (v) use of fall-risk drug rates, and (vii) dementia. Including a time by intervention interaction term produced an outcome rate for both the pre- and post-period, thus adjusting for differences in outcomes in the pre-period. Controlling for the confounding variables enabled a more fair comparison among PCHs

that may have different compositions of residents – these initial differences between groups are accounted for, or 'removed' while maintaining group differences from the treatment (Trochim, 2006). This helps reduce bias (i.e., their affect on outcomes) and generate better estimates of program effects (Rossi, Lipsey, & Freeman, 2004b; Fransoo et al., 2009), or the amount of difference in groups' means that is caused by real differences in the effectiveness of the treatment (Hassard, 1991). These variables were chosen because they (i) were measurable using administrative data, and (ii) have been identified in the literature as being fall-risk factors.

Randomization was not possible in this research for ethical and practical reasons. Moreover, the data in this research were observational (i.e., administrative counts of rare events), which are not likely to be normally distributed (Khazanie, 1990). Most of the commonly used statistical tests (e.g., t-tests, ANOVA) assume randomization (Sheppard, 2004), large sample sizes and normality (Mertens, 1998), so it was necessary to use GLMs which do not rely on these assumptions (sfsu.edu, 2002). GLMs have more flexible assumptions and are a more powerful alternative to multiple regression (Garison, 2006; sfsu.edu, 2002; Mertens, 1998). GLMs can examine the association between a dependent outcome variable and a set of continuous and/or categorical explanatory variables (StatSoft Inc., 2008), and are appropriate for use with correlated data from time series designs (StatSoft Inc., 2006).

Some of the variables in this research were time constant variables, meaning that they did not change. These included sex and level of care. Level of care was assessed once at admission and was not changed, unless the resident had multiple admissions and was assessed at a different level in subsequent admissions.

Most of the explanatory variables in this research were 'time-varying' meaning that it was possible for their values to change over time (Dickman, 2005; Fisher & Lin, 1999). In order to capture their time-varying nature, an observation was created for each person, for each day they were in the study, so a value was assigned to each day for each outcome and covariate (n=675,846 total person-days). [see *Table 4.5: Example of Time-Varying Data Structure* below] Incorporating time-varying covariates is important given that "time-dependent confounding is often an important source of bias" in longitudinal research (Petersen, Deeks, Martin, & van der Laan, 2007).

Table 4.5: Example of Time-Varying Data Structure

obs	date	phin*	fall[1]	dementia[1]	fallrxs[1]	polypharm[1]	loc[2]	age[2]	sex[3]	period[2]	rha[2]
1	Jun 1, 03	123456789	0	0	0	1	4	89	1	pre	NEHA
2	Jun 2, 03	123456789	0	1	1	1	4	89	1	pre	NEHA
3	Jun 3, 03	123456789	1	1	1	1	4	90	1	pre	NEHA
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
896	Feb 24, 05	123456789	1	1	0	1	4	90	1	pre	NEHA
897	Feb 25, 05	123456789	1	1	0	1	4	90	1	pre	NEHA
898	Feb 26, 05	123456789	0	1	0	1	4	90	1	pre	NEHA
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
345,789	May 23, 07	345678910	0	0	1	0	3	78	2	post	IRHA
345,780	May 24, 07	345678910	0	0	1	0	3	78	2	post	IRHA
345,781	May 25, 07	345678910	0	0	1	0	3	78	2	post	IRHA
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
675,844	Mar 29, 08	567890123	0	1	0	1	5	67	1	post	IRHA
675,845	Mar 30, 08	567890123	0	1	0	1	5	67	1	post	IRHA
675,846	Mar 31, 08	567890123	1	1	0	1	5	67	1	post	IRHA

* The PHINs in this table are fictitious

1. Fall, Dementia, Fall-Risk Drugs (fallrxs), or Polypharmacy (polypharm) = 0 if condition not met; = 1 if condition met
2. Level of Care (loc), Age, Period and RHA represent actual value.
3. Sex = 1 for male and 2 for female

The following definitions were used to define these time-varying covariates. For *dementia*, residents were considered to have it from the day of diagnosis onward. Data five years prior to the start of the study period were used to identify residents with a dementia diagnosis. *Polypharmacy* was defined as being on five or more drugs simultaneously, within 100-day periods. Data starting from roughly 100 days prior to the start of the study was used to identify residents already on polypharmacy at the start of the study. Residents were considered to be on *fall-risk drugs* if they were taking at least one such drug during 1-month intervals, starting one month prior to study start. The fall-risk drugs included were based on a list used in the intervention PCHs, and supplemented with drugs based on consultation with the pharmacist in the intervention PCH and an MCHP researcher specializing in pharmacy (C. Raymond) [see *Appendix 13: Drugs Used to Define Fall-Risk Drugs*] *Age* was a continuous variable, calculated per year based on birth date information. *Study period* was defined as pre- or post-period, based on date and PCH. Each study PCH was considered to be implementing the fall management program once they had received an education session. Because each PCH received this education on a different day, each PCH had a different program start date.

For example, observation 1 in Table 4.5 represents the first day fictitious resident with PHIN # 123456789 was in the study. On this day during the pre-period (June 1, 2003), this male resident did not fall (and thus, did not sustain an injury from falling), did not have dementia, was not on any fall-risk drugs, was on polypharmacy (i.e., taking 5 or more drugs at once), was at a level of care of 4, and was 89 years old. On the second day, all of the covariates were the same for this resident except that he had been diagnosed with dementia. On the third day, all of the covariates were the same except this resident

fell, sustained a minor injury from the fall, and it was his birthday (age increased from 89 to 90). For fictitious resident #345678910, these observations are during the post-period, and on May 23, 2007, she did not fall, did not have dementia, was on at least one fall-risk drug, was not on polypharmacy, required level 3 care, was 78 years old. For this same resident on the next two days, (May 24 and 25, 2007), there were no changes in any of her covariates.

This day-by-day dataset was then summarized by strata (i.e., covariates) rather than by PHIN. [see *Table 4.6: Example of Data Strata* below]

Table 4.6: Example of Data Strata (n=1351 strata)

obs	rha	agegrp	sex	dement	loc	polypharm	fallrx	study prd	fall count	pdays	strataid	
1	IRHA	0-79	1	0	2	0	0	1_pre	0	321	1	
2	IRHA	0-79	1	0	2	0	0	2_post	0	577	1	
3	IRHA	0-79	1	0	2	0	1	1_pre	0	306	3	
4	IRHA	0-79	1	0	2	0	1	2_post	0	440	3	
5	IRHA	0-79	1	0	2	1	0	1_pre	0	157	5	
6	IRHA	0-79	1	0	2	1	0	2_post	2	234	5	
7	IRHA	0-79	1	0	2	1	1	1_pre	0	151	7	
8	IRHA	0-79	1	0	2	1	1	2_post	0	124	7	
9	IRHA	0-79	1	0	3	0	0	2_post	1	21	9	no pre-period strata
10	IRHA	0-79	1	0	3	0	1	2_post	2	14	10	no pre-period strata
11	IRHA	0-79	1	0	3	1	0	1_pre	3	329	11	
12	IRHA	0-79	1	0	3	1	0	2_post	10	513	11	
*	*	*	*	*	*	*	*	*	*	*	*	
1302	NEHA	87-91	2	1	4	1	1	1_pre	0	159	1302	
1303	NEHA	87-91	2	1	4	1	1	2_post	0	332	1302	
1304	NEHA	87-91	2	1	5	0	0	2_post	0	8	1304	no pre-period strata
1305	NEHA	87-91	2	1	5	0	1	2_post	0	7	1305	no pre-period strata
*	*	*	*	*	*	*	*	*	*	*	*	
1348	NEHA	92+	2	1	4	0	1	1_pre	0	499	1348	
1349	NEHA	92+	2	1	4	0	1	2_post	0	625	1348	
1350	NEHA	92+	2	1	4	1	0	1_pre	0	19	1350	no post-period strata
1351	NEHA	92+	2	1	4	1	1	1_pre	0	81	1351	no post-period strata

In effect, the dataset was collapsed, keeping only those records where a time-varying covariate changed. For resident #123456789 in Table 4.2, all six records would be kept in the summarized dataset. Observation 1 would be included in the stratum for male residents in NEHA in the pre-period, who did not fall, did not have dementia, were not taking fall-risk drugs, were on polypharmacy, required level 4 care, and were in the 87-91 year age group. Observation 2 for this same male resident would be included in the stratum for similar covariate values, except for dementia and fall-risk drugs - the resident now had dementia and was taking at least one fall-risk drug. Observation 3 would be in a similar stratum as observation 2, except that the resident fell this day and his age changed from 89 to 90 years old. This record would still be within the 87-91 years age group, but in a stratum for residents with these values who also fell. Observations 4-6 would similarly be included in the appropriate strata.

For resident #345678910, only one of these records would be kept because they are all identical – no time-varying covariates changed values. This record would be included in the stratum for females in the IRHA in the post-period, who did not fall, did not have dementia, were taking at least one fall-risk drug, were on polypharmacy, required level 3 care, and were in the 0-79 year age group. However, while only one record would be kept, it would contribute three person-days to the total time at risk (pdays). Even though no covariates changed for these three days, each day would still be counted as time at risk. The ‘pdays’ column in Table 4.3 shows the total person-days contributed by residents in each stratum.

Not every stratum existed in each time period. For example, in Table 4.3, there were no matching stratum for ‘strataid’ 9 or 10. In the post-period, 21 person-days were

contributed by males, aged 0-79 in IRHA who did not have dementia, required level 3 care, and were not taking and fall-risk drugs, nor were on polypharmacy. However, in the pre-period, no such group existed, so no person-days were contributed.

Summarizing by strata and study period ensured that overall, relatively homogeneous groups were compared in the pre- and post-period. If data had been summarized by individual PHINs, strata would have been less homogeneous as residents' characteristics changed over time (e.g., age, dementia status, polypharmacy, fall-risk drugs, etc.).

Because these data were counts, which are discreet and non-negative, they were assumed to follow a Poisson distribution (Twisk, 2003). However, if the Poisson model is overdispersed (i.e., more variable than expected), a negative binomial model should be employed, which uses a different probability model that allows for more variable or overdispersed data (Dallal, 2008; Ballinger, 2004). The analyses for this research revealed that the Poisson models consistently fit the data better than the negative binomial models, so Poisson models were used to analyze the two main outcomes – falls and injurious falls.

Because many of the same people were measured on more than one occasion (i.e., in the pre- and post-period), these observations are correlated and not independent (Ballinger, 2004). This necessitated the use of a GEE which is a method of parameter estimation which corrects for within-subject correlations (Twisk, 2003).

For this research, models were run using different age groupings, definitions of polypharmacy and correlation structures in order to find the combination which best fit the data. Grouping age into (i) 80 years and under, (ii) 81-86 years, (iii) 87-91 years, and

(iv) 92+ years, and defining polypharmacy as residents taking 5 or more drugs simultaneously, yielded the best fitting models for the main outcomes (i.e., falls, injuries).

The two drug-related covariates – polypharmacy and fall-related drugs – were also analyzed to check for multicollinearity. The resulting Phi value of 0.1035 indicated that these covariates were not multicollinear.

The standard 5% test statistic was used to assess the significance of group differences. Setting alpha at 0.05 indicates there is a 5% chance of a type 1 error, or erroneously concluding differences are significant (Hassard, 1991). One- and two-tailed testing was also used – one-tailed evaluates the truth of a specific directional hypothesis and two-tailed, the truth of a general hypothesis that groups are different (Hassard, 1991).

In order to maintain confidentiality, counts of events or populations based on five or fewer occurrences were suppressed (i.e., not reported), or variables were re-grouped (e.g., levels of care 5 & 6 are grouped together). Actual values of zero were reported.

Quantitative data were analyzed using SAS software, Version 9.2 of the SAS System for Sun or Solaris Operating System, Copyright 2002–2008, SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc.,
Cary, NC, USA.

4.7.3. Descriptive Results from the Analysis of Investigative Reports

Data derived from a sample of the Investigative Reports in the intervention PCHs were analyzed to determine how consistent practices were with program guidelines. The Investigative Reports contain open-ended information about (i) action taken at the time of

the occurrence and (ii) action(s) assigned to the occurrence owner department. This information was compared with the program's post-fall protocol, which outlines 10 steps or procedures to be followed after a fall occurs. [see *Overview of Post-Fall Protocol for NEHA's Fall Management Program* below]

Overview* of Post-Fall Protocol for NEHA's Fall Management Program

1. Check resident for injury, take vital signs.
2. Measure severity of the injury [none; minor; major]
3. Alert other staff if needed.
4. Assist resident off floor via appropriate means [see policy #7-9 Transfer Safety]
5. Monitor resident regularly following fall.
6. Review reason for falls with resident and family.
7. Review and implement appropriate fall prevention strategies and injury minimization strategies.
8. Provide appropriate referral to other health professionals.
9. Document all details in resident chart.
10. Complete an occurrence reporting form.

*see program guide for full details

This open-ended section of each Investigative Report was analyzed by looking for documentation that these 10 procedures were carried out. For each procedure documented, a score of 1 was assigned. If there was no documentation that a procedure was carried out, it was assumed that it was not and a score of 0 was assigned. There was one exception – for procedure #1 (check resident for injury, take vital signs), half a point (0.5) was given for documentation of checking resident for injury, and a full point (1) for documentation of checking resident for injury and taking vital signs.

This score out of 10 provided an indication of the extent to which the required post-fall procedures were being carried out in the pre- and post-periods, with the former serving as a benchmark indication of how falls were dealt with in the past, prior to program implementation.

4.8. Validity Checks

There are two types of validity – internal and external. Internal validity is the degree to which one can be confident that different outcomes in different groups of participants are caused by different treatments and not by some third confounding variable (Lie, 2007; Cook et al., 1979). External validity is the degree to which generalization is possible to other measures, people, settings and/or time (Cook et al., 1979).

There are many things that can threaten internal validity, including:(i) history – an effect could be due to an event occurring between the pre- and post-test, rather than the treatment, (ii) maturation – an effect could be due to the respondent growing older or wiser, rather than the treatment, (iii) instrumentation – an effect could be due to a change in the measuring instrument between the pre- and post-test, rather than the treatment, and (iv) selection – an effect could be due to differences between the kinds of people in each group, rather than the treatment (Cook et al., 1979).

There are several ways to counter threats to internal validity. Some of these include using a control group (Lie, 2007), mixed research designs (e.g., triangulating on the truth via the use of mixed methods) (Golafshani, 2003), and removing or controlling for confounding effects via statistical procedures (Lie, 2007).

All of these methods were employed in this research. In addition, a validity check was conducted using PCH Occurrence Report and hospital data. In this research, the outcome 'falls resulting in a hospitalization' was derived by identifying falls in occurrence reports that had a hospitalization within 30 days after the fall, with an ICD-9 or 10 code for an accidental fall. [see *Appendix 12: ICD Codes Used in This Research*] In order to assess the validity of these PCH data, the analysis was reversed – the ICD-9 and -10 codes for falls were identified in the hospital data and tracked back to the PCH Occurrence Report data to determine how many had a corresponding occurrence report.

Results indicate that the occurrence report data are highly valid as virtually all falls identified in the hospital data could be matched to occurrence report falls. There were 60 falls in the occurrence reports that had a hospitalization within 30 days after a fall. There were 58 falls in the hospital data that had a corresponding Occurrence Report. There were two fewer records in the hospital data than in the occurrence reports because of the way the analysis was conducted when starting with the hospital data – hospital records that were not within the resident's length of stay in the PCH were excluded. For both of these records, residents fell in the PCH and were admitted to the hospital, but not until several days after they had been separated from the PCH. So, for these two records, the fall was within the resident's time in the PCH, but their admission to the hospital was not. It is not know why there was a delay between PCH separation and hospital admission for these residents – it may simply be that these dates were recorded incorrectly.

Thus, technically, the Occurrence Reports had a sensitivity of 0.97, or a 97% probability of correctly identifying a fall resulting in hospitalization. However, the sensitivity was actually 100% because these two records were in the Occurrence Report

data, but had simply been excluded in the analysis process. Because it is not possible to know how many falls occurred that were not in the Occurrence Reports or hospital data, specificity and negative predictive values (NPV) could not be calculated. The positive predictive value (PPV) was low as expected – only 58 falls resulted in a hospitalization, while 4,042 did not. [see *Table 4.7: Comparison of Occurrence Report and Hospital Claim Data* below]

Table 4.7: Comparison of Occurrence Report and Hospital Claim Data

		hospital claims		
		fall	**no fall**	**totals**
occurrence reports	**fall**	58	4,042	4,100
	no fall	2	0	2
	totals	60	4,042	4,102

sensitivity = 58 / (58 + 2) = 0.967
specificity = 0 / (4042 + 0) = 0
PPV = 58 / (58 + 4042) = 0.014
NPV = 0 / (2 + 0) = 0

Another validity check of the data was possible using person-days data. Data from NEHA, collected independently by the Director of Long Term Care for internal tracking purposes (see *Table 4.8: NEHA Resident Days per Year* below) were compared with results from this research. Overall, the numbers were close – there were 355,383 person-years in the data from NEHA and 336,258 in this research. There were fewer person-days in this research, but this is expected given that records were excluded (i.e., falls during

the washout period, hospitalizations). The person-days for NEHA from this research were also comparable with person-days for IRHA residents (n=339,588).

Table 4.8: NEHA Resident Days per Year

PCH	2007/08	2006/07	2005/06	2004/05	2003/04	Total Days
East-Gate Lodge	29,075	29,033	28,962	29,089	29,000	145,159
Pine Falls	7,302	7,188	7,289	7,282	7,264	36,325
Kin Place	14,510	14,510	14,497	14,472	14,472	72,461
Lac du Bonnet	10,917	10,897	10,883	10,928	10,963	54,588
Whitemouth	9,405	9,417	9,286	9,343	9,399	46,850
Total Days	71,209	71,045	70,917	71,114	71,098	355,383

source: NEHA

4.9. Ethical Considerations

Ethical approval was sought from all stakeholders and data providers prior to the collection of data, including the University of Manitoba's Health Research Ethics Board (HREB), the Health Information Privacy Committee (HIPC), and the two participating RHAs.

Institution	Date Research Approval Granted
Health Research Ethics Board (HREB)	May 1, 2009
Health Information Privacy Committee (HIPC)	July 7, 2009
Manitoba Centre for Health Policy (MCHP)	April 30, 2009
North Eastman Regional Health Authority (NEHA)	April 22, 2009
Interlake Regional Health Authority (IRHA)	June 2008

The privacy and confidentiality of research participants will be maintained through a series of protocols. Before data collection began, this research was reviewed and approved by: (i) the Research Ethics Board at the University of Manitoba (REB) in accordance with Section 24(2)(b) of the Personal Health Information Act (PHIA), (ii) the Health Information Privacy Committee (HIPC), (iii) MCHP, (iv) and by the Research Committees in the intervention and comparison regions.

PHINs were collected, along with relevant data, from patient charts and related incidence reports for each resident sustaining a fall. This information was sent to Manitoba Health (MH) for scrambling and de-identification. These de-identified data were then be sent to MCHP and linked to data in the Manitoba Population Health Research Data Repository (Repository) via the use of a crosswalk file that matched the scrambled PHINs, before being made available to the researcher. Thus, the researcher never knew the identity of the fallers.

Data housed at MCHP is done so under rigorous privacy and confidentiality protocols. The REB and Provincial Health Information Privacy Committee (PHIA) control access and use of the Repository. Data can only be accessed on MCHP UNIX-based analysis and development systems. Data subsets can only be extracted, linked and maintained on these systems for the project duration as approved by the REB and HIPC (MCHP, 2006).

Data from the Repository and any extracted subsets are held in accordance with the University of Manitoba policy on research materials (1401 Guidelines on Responsibilities for Researchers, section 2 Authenticity of Data). Data will be returned to the trustee (or agency providing the data), or destroyed as directed by any agreement with the trustee. All project-related data and programming code will be archived once the project is

completed and removed from the analysis system. MCHP will destroy data provided or generated as part of approved projects as specified in any agreements and University of Manitoba guidelines at the completion of the research project for a period of at least seven years and no more than ten years after project completion, to allow for publication-related questions and clarifications. Programming code may be retained indefinitely. Backup data copies will be stored for a period of at least seven years and no more than ten years after project completion, at which time they will be destroyed or overwritten (MCHP, 2006).

Data suppression requirements also help to maintain participant anonymity. MCHP employs a rule similar to Statistics Canada that requires that rates based on five or less events be suppressed (i.e., not reported) in order to prevent confidentiality violations (Martens et al., 2008).

CHAPTER 5: QUANTITATIVE RESULTS FROM OCCURRENCE REPORT AND MCHP ADMINISTRATIVE DATA

5.1. Introduction

The objective of this research was to evaluate the effectiveness of the Fall Management Program recently implemented in the five provincial PCHs in the regional health authority of North Eastman (NEHA). The goal of fall management is to prevent, or at least minimize, *injuries* while simultaneously encouraging mobility and functionality (North Eastman Health Association Inc., 2005a). Falling is an inherent risk of activity and mobility, but limiting activity actually increases risk, especially for older people (Lach, 2010), and can also hinder rehabilitation (Commonwealth of Australia, 2009). Thus, rather than focusing on *fall* reduction, the goal is to keep residents mobile and functional, and minimize their risk of *injury* if they do fall.

The specific hypotheses are that (i) there would be a change in the rate of falls from pre- to post-period in the intervention PCHs, (ii) the rate of falls in the intervention PCHs would be different from the comparison PCHs in the post-period, (iii) there would be either no change or a reduction in the rate of injurious falls and hospitalized falls from pre- to post-period in the intervention PCHs, and (iv) there would be a lower rate of injurious falls and hospitalized falls in the intervention PCHs than in the comparison PCHs in the post-period.

5.2. Baseline Characteristics of Residents

Overall, the PCH residents were not significantly different from each other by RHA or over time, from the pre-period to the post-period, with the exception of a few variables. Moreover, both RHAs had similar proportions of new residents in each time period.

In general, crude baseline resident characteristics in NEHA over time from the pre- to post-period were not significantly different, except for an increase in (i) levels of care ($p=0.04$), and (ii) residents on fall-risk drugs ($p<0.0001$). [see *Table 5.1: Crude Baseline Description of Residents in NEHA – Pre- vs Post-Period* below] Over time, the proportion of residents at a level of care of 2 decreased from 30.6% to 21.7%, while level 3s had a corresponding increase from 42.3% to 51.1%. The proportion of residents on fall-risk drugs also increased significantly over time from 26.5% to 54.7%. There was no significant difference over time in terms of age group, sex, residents on polypharmacy, or those with dementia. Thus, there were few differences in NEHA over time, and any were adjusted for in the analyses.

Table 5.1: Crude Baseline Description of Residents in NEHA, Pre- vs Post-Period

Variable		Total Residents (n=721)				chi-sqr	p-value
		Cases (NEHA) pre (n=310)		Cases (NEHA) post (n=411)			
Sex	Male	112	36.1%	154	37.5%	0.14	p=0.72
	Female	198	63.9%	257	62.5%		
Age	< 80	84	27.1%	110	26.8%	2.33	p=0.51
	80-86	82	26.5%	129	31.4%		
	87-91	87	28.1%	104	25.3%		
	92+	57	18.4%	68	16.5%		
Level of Care	2	**95**	**30.6%**	**89**	**21.7%**	**10.01**	**p=0.04**
	3	**131**	**42.3%**	**210**	**51.1%**		
	4	63	20.3%	75	18.2%		
	5 & 6	21	6.8%	37	9.0%		
Polypharmacy	yes	169	54.5%	196	47.7%	3.3	p=0.07
	no	141	45.5%	215	52.3%		
Fall-Risk Drugs	**yes**	**82**	**26.5%**	**225**	**54.7%**	**57.86**	**p<0.0001**
	no	**228**	**73.5%**	**186**	**45.3%**		
Dementia	yes	201	64.8%	279	67.9%	0.74	p=0.39
	no	109	35.2%	132	32.1%		

note 1: levels of care 2 and 3 where significantly different (chisq=8.52; p=0.004)
note 2: with Bonferroni correction for multiple testing: p=0.05/2 additional tests, so p=0.025

Comparing crude baseline resident characteristics by RHA, there were no significant differences in the pre-period [see *Table 5.2: Crude Baseline Description of Residents in NEHA and IRHA Pre-Period*]. However, by the post-period, NEHA had a significantly greater burden of care than IRHA (p=0.005) having more level 3s (51.1% vs 43.0%) and significantly fewer level 2s (21.7% vs 33.6%). [see Table 5.3: *Crude Baseline*

Description of Residents in NEHA and IRHA Post-Period below] In the post-period, NEHA also had significantly fewer residents on polypharmacy (48% vs 58%; p=0.003). There was no significant difference between RHAs in terms of age group, sex, residents on fall-risk drugs, or those with dementia.

Table 5.2: Crude Baseline Description of Residents in NEHA and IRHA Pre-Period

Variable		Total Residents (n=627)				chi-sqr	p-value
		Cases (NEHA) pre (n=310)		Controls (IRHA) pre (n=317)			
Sex	Male	112	36.1%	118	37.2%	0.08	p=0.77
	Female	198	63.9%	199	62.8%		
Age	< 80	84	27.1%	78	24.6%	1.81	p=0.61
	80-86	82	26.5%	98	30.9%		
	87-91	87	28.1%	89	28.1%		
	92+	57	18.4%	52	16.4%		
Level of Care	2	95	30.6%	111	35.0%	2.53	p=0.64
	3	131	42.3%	123	38.8%		
	4	63	20.3%	66	20.8%		
	5 & 6	21	6.8%	17	5.4%		
Polypharmacy	yes	169	54.5%	168	53.0%	0.15	p=0.70
	no	141	45.5%	149	47.0%		
Fall-Risk Drugs	yes	82	26.5%	88	27.8%	1.36	p=0.71
	no	228	73.5%	229	72.2%		
Dementia	yes	201	64.8%	193	60.9%	1.05	p=0.31
	no	109	35.2%	124	39.1%		

Table 5.3: Crude Baseline Description of Residents in NEHA and IRHA Post-Period

Variable		Total Residents (n=813)				chi-sqr	p-value
		Cases (NEHA) post (n=411)		Controls (IRHA) post (n=402)			
Sex	Male	154	37.5%	158	39.3%	0.29	p=0.59
	Female	257	62.5%	244	60.7%		
Age	< 80	110	26.8%	113	28.1%	0.79	p=0.85
	80-86	129	31.4%	115	28.6%		
	87-91	104	25.3%	107	26.6%		
	92+	68	16.5%	67	16.7%		
Level of Care	**2**	**89**	**21.7%**	**135**	**33.6%**	**14.75**	**p=0.005**
	3	**210**	**51.1%**	**173**	**43.0%**		
	4	75	18.2%	65	16.2%		
	5 & 6	37	9.0%	29	7.2%		
Polypharmacy	yes	**196**	**47.7%**	**233**	**58.0%**	**8.6**	**p=0.003**
	no	**215**	**52.3%**	**169**	**42.0%**		
Fall-Risk Drugs	yes	225	54.7%	236	58.7%	1.29	p=0.25
	no	186	45.3%	166	41.3%		
Dementia	yes	279	67.9%	266	66.2%	0.27	p=0.60
	no	132	32.1%	136	33.8%		

note 1: levels of care 2 and 3 where significantly different (chisq=12.89; p=0.003)

note 2: with Bonferroni correction for multiple testing: p=0.05/2 additional tests, so p=0.025

Table 5.4: Crude Baseline Description of Residents in IRHA, Pre- vs Post-Period

Variable		Total Residents (n=719)				chi-sqr	p-value
		Controls (IRHA) pre (n=317)		Controls (IRHA) post (n=402)			
Sex	Male	118	37.2%	158	39.3%	0.32	p=0.57
	Female	199	62.8%	244	60.7%		
Age	< 80	78	24.6%	113	28.1%	1.28	p=0.73
	80-86	98	30.9%	115	28.6%		
	87-91	89	28.1%	107	26.6%		
	92+	52	16.4%	67	16.7%		
Level of Care	2	111	35.0%	135	33.6%	5.08	p=0.28
	3	123	38.8%	173	43.0%		
	4	66	20.8%	65	16.2%		
	5 & 6	17	5.4%	29	7.2%		
Polypharmacy	yes	168	53.0%	233	58.0%	1.77	p=0.18
	no	149	47.0%	169	42.0%		
Fall-Risk Drugs	**yes**	**88**	**27.8%**	**236**	**58.7%**	**68.56**	**p<0.0001**
	no	**229**	**72.2%**	**166**	**41.3%**		
Dementia	yes	193	60.9%	266	66.2%	2.14	p=0.14
	no	124	39.1%	136	33.8%		

In both time periods, there were similar proportions of residents of each sex within RHAs over time and in each RHA. [see *Tables 5.2* and *5.3*] In the NEHA PCHs, males comprised 36.1% of the PCH population in the pre-period and 37.5% in the post-period, and females made up 63.9% and 62.5% respectively. In IRHA, 37.2% of residents were male in the pre-period and 39.3% in the post-period; females were 62.8% and 60.7% respectively.

There were similar proportions of residents in each age group within RHAs from the pre- to post-period, and between RHAs in each period. In NEHA in the pre-period, 27.1% of the PCH population was under 80 years of age compared to 26.8% the post-period. For those aged 80-86 years, there were 26.5% in the pre-period and 31.4% the post-period. In the 87-91 year age group, there were 28.1% in the pre-period and 25.3% in the post-period, and 18.4% and 16.5% respectively for those aged 92+ years. In IRHA in the pre-period, there were 24.6% under 80 years, 30.9% in the 80-86 age group, 28.1% in the 87-91 age group, and 16.4% aged 92+ years. In IRHA in the post-period, there were 28.1%, 28.6%, 26.6%, and 16.7% respectively.

The univariate analysis of age shows that there was little difference between RHAs or time periods. [see *Table 5.5: Univariate Analysis of Age (continuous)* below] The mean age of residents remained between 83 and 84 years. Median and mode values were also very similar, but there was more variation within the IRHA dataset indicated by higher standard deviation and variance values. Age was not normally distributed – skewness values ranged from -1.04 to -1.79 and kurtosis values from 1.57 to 5.47. The normal distribution has values of zero for skewness and kurtosis (Delwiche & Slaughter, 2003).

Table 5.5: Univariate Analyses of Age (continuous)

Variable: Age	**Overall**		**NEHA**		**IRHA**	
	pre	**post**	**pre**	**post**	**pre**	**post**
mean	83.5	83.1	83.8	83.3	83.2	82.9
standard deviation	9.92	9.99	9.03	9.64	10.72	10.35
variance	98.4	99.9	81.6	92.9	114.9	107.2
range	70.0	75.0	58.0	74.0	70.0	70.0
median	85.0	85.0	86.0	85.0	85.0	85.0
mode	88.0	89.0	87.0	89.0	88.0	89.0
skewness	-1.54	-1.61	-1.04	-1.69	-1.79	-1.55
kurtosis	3.95	4.47	1.57	5.47	4.77	3.69

In NEHA, there was a significant increase (p=0.04) in the level of care over time. [see *Table 5.1*] The proportion of residents at a level of care of 2 decreased from 30.6% to 21.7%, while level 3s had a corresponding increase from 42.3% to 51.1%. This increase could be due to the longer post-period and the trend towards people being admitted to PCHs at increasingly higher levels of care. The other levels of care (i.e., 4 & 5/6) had similar proportions of residents.

NEHA and IRHA had similar proportions of residents at all levels of care in the pre-period: (i) level 2 – 30.6% vs 35.0%, (ii) level 3 – 42.3% vs 38.8%, (iii) level 4 – 20.3% vs 20.8%, and (iv) levels 5 and 6 – 6.8% vs 5.4% respectively. [see *Table 5.2*] However, in the post-period, while NEHA and IRHA still had similar proportions of level 4 residents (18.2% vs 16.2%) and levels 5 and 6 (9.0% vs 7.2%), NEHA had significantly fewer level 2s than IRHA (21.7% vs 33.6%) and significantly more level 3s (51.1% to 43.0%) than IRHA (p=0.003). [see *Table 5.3*] In other words, NEHA had significantly more residents in need of higher levels of care than IRHA in the post-period. This difference is not due to a higher turnover rate in one RHA, as both had similar proportions of residents living in each period – approximately 22.5% were in the pre-period, 36% in the post-period, and 41.5% lived in the PCH in both time periods.

There were similar proportions of residents on polypharmacy in the RHAs in the pre-period. [see *Table 5.2*] In NEHA, 54.5% of residents were on polypharmacy compared to 53.0% in IRHA. However, by the post-period, there were significantly fewer residents on polypharmacy in NEHA compared to IRHA (47.7% vs 58.0%; p=0.003). [see *Table 5.3*]

There were also similar proportions of residents on fall-risk drugs in the RHAs in both time periods. In the pre-period, 26.5% of residents in NEHA and 27.8% in IRHA were

taking at least one fall-risk drug. [see *Table 5.2*] However, both RHAs had significant increases in residents taking these drugs over time. [see *Tables 5.1 and 5.4*] In NEHA, residents on fall-risk drugs increased to 54.7% (chi-squared $p<0.0001$), and to 58.7% in IRHA (chi-squared $p<0.0001$).

There was no significant difference between proportions of residents with dementia within RHAs over time, nor between RHAs in either time period. In the pre-period, 64.8% of residents in NEHA and 60.9% in IHRA had dementia. By the post-period, there were 67.9% and 66.2% respectively.

In sum, the residents in the intervention PCHs (NEHA) did not change significantly over time, except for level of care and residents on fall-risk drugs, both of which increased significantly. Compared to the residents in non-intervention PCHs (IRHA), NEHA residents were generally similar demographically. There were no differences in terms of sex, age, or dementia status. However, while similar in the pre-period, by the post-period, NEHA had (i) a greater burden of care, with more residents at level 3 and fewer at level 2, and (ii) fewer residents on polypharmacy than IRHA. All of these covariates, significant or not, were controlled for in the models in this research, given that they are all identified in the literature as being fall risk factors in older institutionalized adults.

5.3. Time of Day of Falls

Overall, falling occurred most frequently in the evening (8:00-8:59pm and 6:00-6:59pm), mid-afternoon (2:00-3:59pm), and early morning (7:00-7:59am). Stratifying fall

times by study period and RHA shows a similar pattern of most frequent fall times. [see *Figures 5.1-5.3: Time of Day of Falls*]

The general daily schedule for NEHA residents is:

- 7:00am-8:00am → waking; getting ready for breakfast
- 8:00am-9:00am → eat breakfast
- 9:00am-12:00pm → morning activity or time in room
- 12:00pm-1:00pm → eat lunch
- 1:00pm-5:00pm → afternoon activity or time in room
- 5:00pm-6:00pm → eat supper
- 6:00pm-9:00pm → evening activity or time in room
- 9:00pm-7:00am → sleeping / in bed

Thus, in NEHA, it appears that most falls occurred after supper and about one hour before bedtime when residents were participating in an evening activity or spending time in their room. The next most frequent times were mid-afternoon when engaged in an afternoon activity or spending time in their room and early morning when waking and preparing for breakfast.

It is also important to consider the staff schedule. In NEHA, before, during, and after a shift change are the busiest times for staff, and usually times of less resident supervision (personal communication with program staff, Mar 21, 2011) - staff are focused on communicating needed information with each other as they change over to the next shift.

In NEHA, there are four shift changes throughout a 24-hour period: (i) 7:30am, (ii) 3:30pm, (iii) 7:30pm, and (iv) 11:30pm, and all but one correspond to the times of frequent resident falls. The 11:30pm shift change occurs when most residents are

sleeping and at less risk of falls, so the rate is not expected to be as high as the others. The 7:30am, 3:30pm, and 7:30pm shift changes all coincide with frequent fall times.

Figure 5.1: Time of Day of Falls - Overall
RHAs and study periods combined

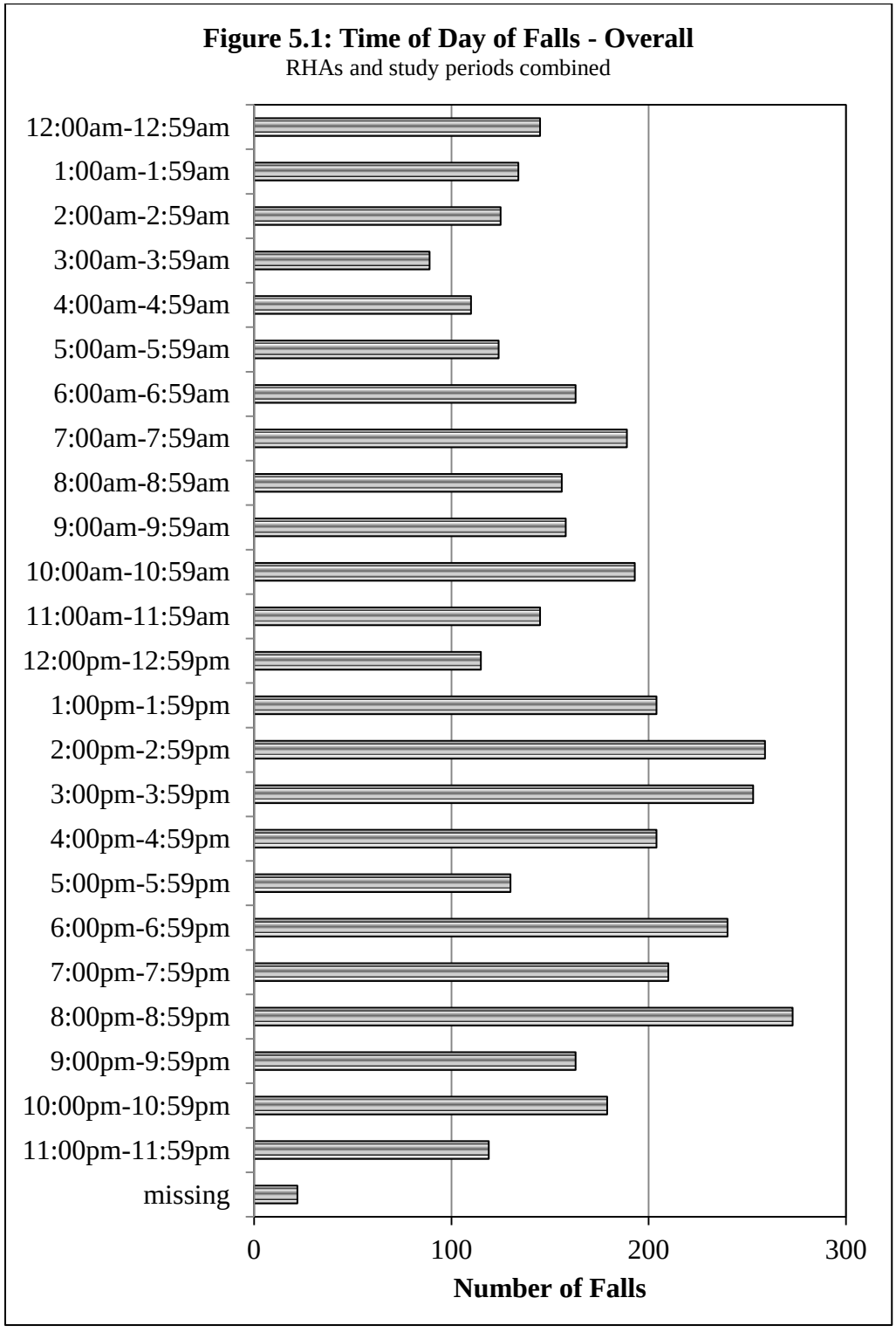


Figure 5.2: Time of Day of Falls by RHA - Pre-Period

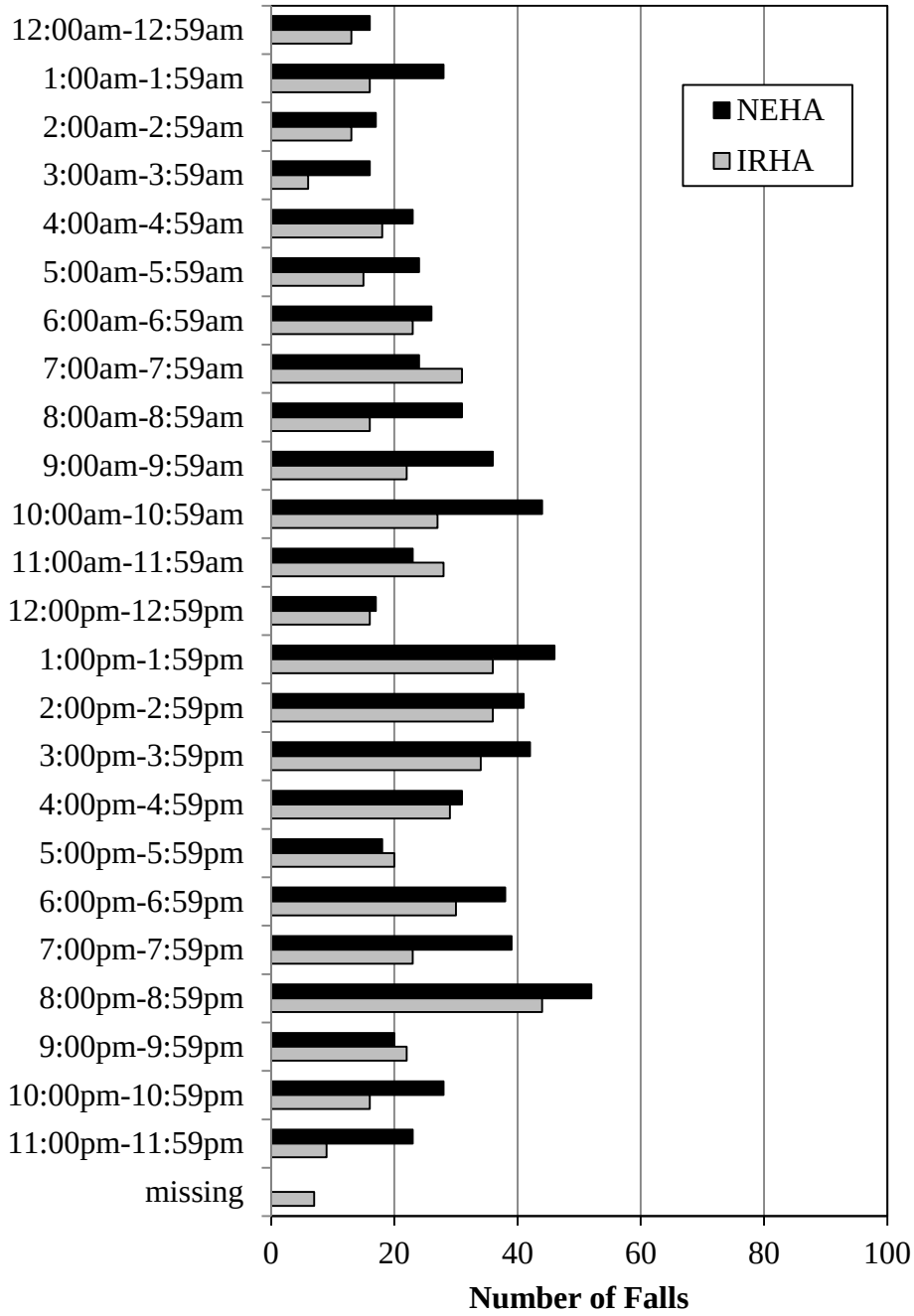
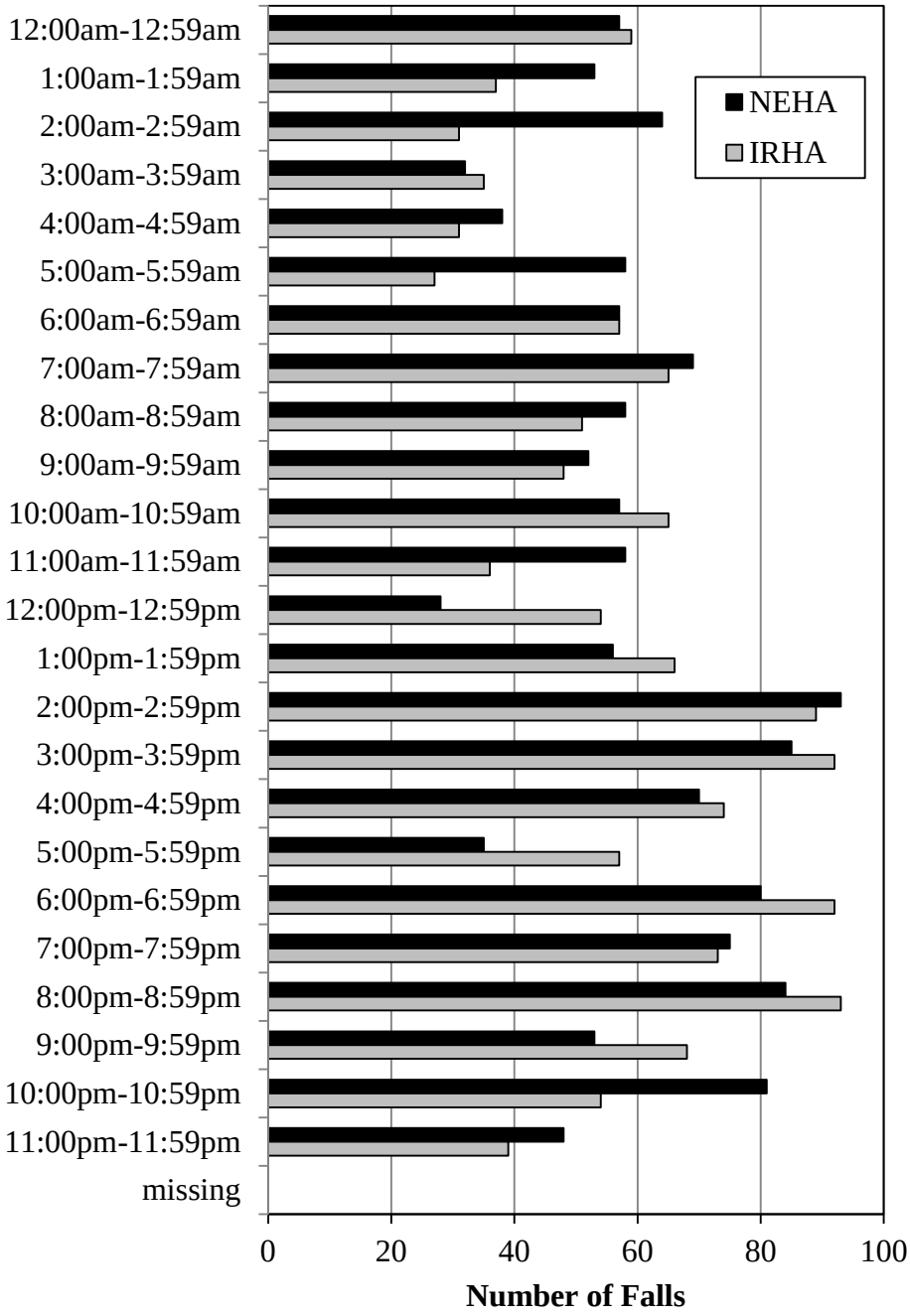


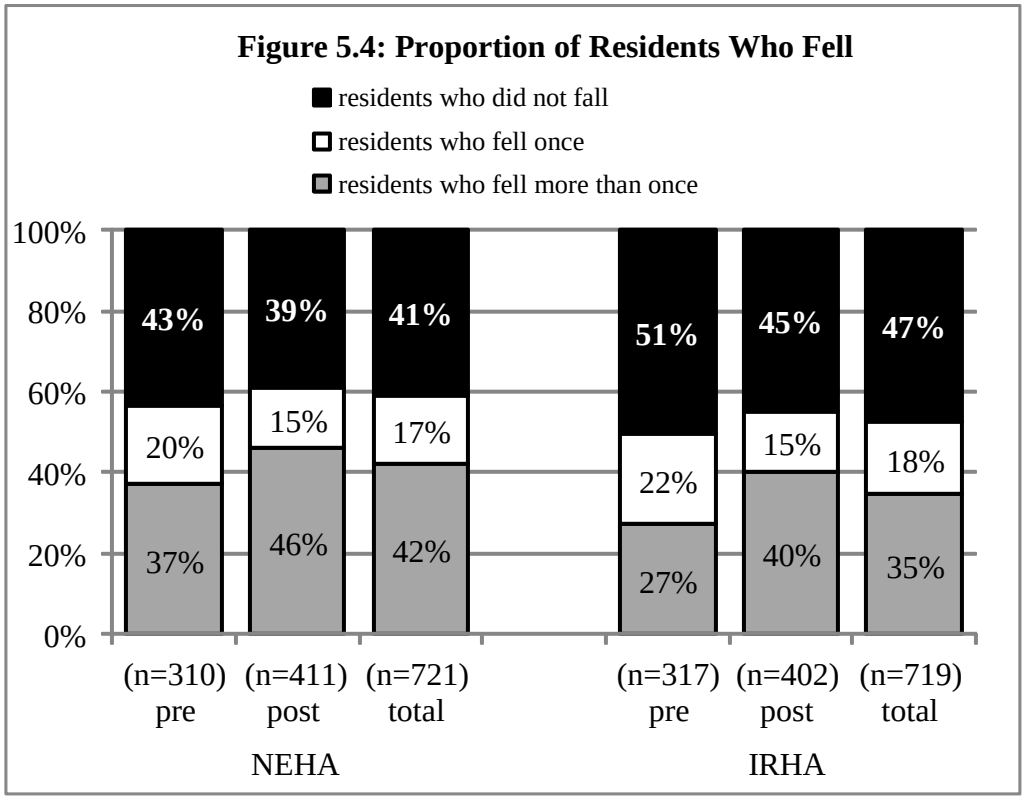
Figure 5.3: Time of Day of Falls by RHA - Post-Period



5.4. Proportion of Residents Who Fell

There was an increase in the crude proportion of residents who fell at least once in NEHA over time (fell once + fell more than once), from 57% in the pre-period, to 61% in the post-period. [see *Figure 5.4: Frequencies of Falling* below] NEHA also had a greater proportion of residents who fell than IRHA in both periods: 57% vs 49% in the pre-period and 61% vs 55% in the post period. Overall, 59% of residents fell at least once in NEHA compared to 52% in IRHA.

Over time, there was also an increase in the crude proportion of residents who fell multiple times in NEHA, from 37% to 46%. There was also an increase in multiple fallers in IRHA over time, from 27% to 40%, but NEHA's rates were higher in both time periods and overall (42% vs 34%).



*statistical testing not done on frequencies

5.5. Rate of Falls

To determine if the rate of falls changed in NEHA over time and whether there was a difference between NEHA and IRHA in the post-period, two hypotheses were investigated. The first hypothesis was that there would be *a change in the rate of falls from pre- to post-period in the intervention PCHs.* There was an increase in the crude rate of falls per person year, from 2.03 to 2.54. However, adjusted rates from modeling indicate that this increase was not significant – the adjusted rate of falls did not change significantly over time in NEHA, but there was a trend towards an increase from 1.95 to 2.24 falls per person year (ppy) (RR_{adj}*=1.15, 95% CIs**=0.96-1.38; p=0.14, NS). Thus, the first hypothesis was not supported. [see *Figures 5.5: Crude Rate of Falls and 5.6: Adjusted Rate of Falls; Tables 5.6: Total Falls by Covariate Groups* and *5.7:Relative Rates for Falls; *relative rate adjusted; **95% confidence intervals*]

However, there was a significant increase in the rate of falls in the comparison PCHs in IRHA over time from 1.54 to 2.43 ppy (adjusted: 1.54 to 2.24 falls ppy; RR_{adj} 1.46, 95% CIs=1.24-1.71, p<0.0001). In the pre-period, NEHA had significantly more falls than IRHA – 2.03 vs 1.54 ppy (adjusted: 1.95 vs 1.54 falls ppy; RR_{adj} 1.27, 95% CIs=1.03-1.56, p=0.023) but IRHA's significant increase over time resulted in this gap closing – there were 2.54 falls ppy in NEHA compared to 2.43 in IRHA, and after adjustment, both RHAs had 2.24 falls ppy by the post-period. [see Figure 5.5 and 5.6; Table 5.7] Thus, the second research hypothesis, that the rate of *falls in the intervention PCHs would be different from the comparison PCHs in the post-period* was also not supported. Both RHAs had the same adjusted rate of falls in the post-period.

When examining resident characteristics related to falls, the adjusted rate of falls was significantly greater among residents who (i) were male (RR_{adj} =1.34, 95% CIs=1.13-1.59, p=0.001), (ii) had dementia (RR_{adj} =1.44, 95% CIs=1.16-1.78, p=0.001), and (iii) were at a level of care of 5 (RR_{adj} =1.89, 95% CIs=1.18-3.02, p=0.008) compared to those at level 2. Residents at levels 4 and 6 had a significantly lower adjusted rate of falling (LOC 4 RR_{adj} =0.46, 95% CIs=0.34-0.62, p<0.0001; LOC 6 RR_{adj} =0.36, 95% CIs=0.13-0.98, p=0.045) than level 2 residents.

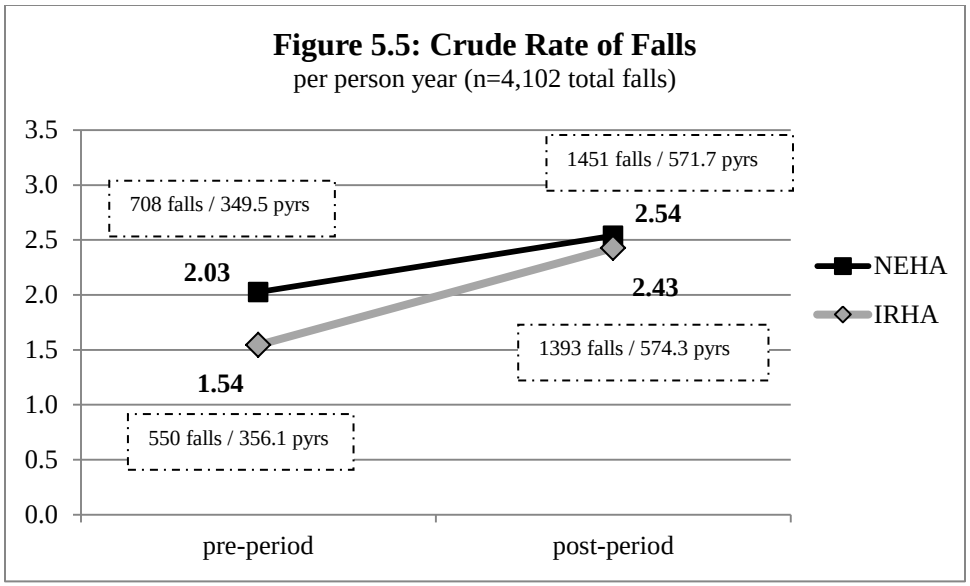
Most of these findings are as expected. Dementia is a common risk factor identified in the literature (Eriksson, Gustafson, & Lundin-Olsson, 2008; Mirolsky-Scala & Kraemer, 2009). Moreover, residents requiring level 5 care (respite) are likely to be more mobile than level 4s and 6s who tend to be sicker or more frail, thus less active. However, females were found to be at greater risk of falls in the literature (Lach, 2010; Public Health Agency of Canada: Division of Aging and Seniors, 2005), but males had a higher rate in this research. It is possible that other research did not adjust for sex, and counted actual fall numbers. In this research, women comprised approximately 60% of the PCH population, yet had a lower rate of falls than males.

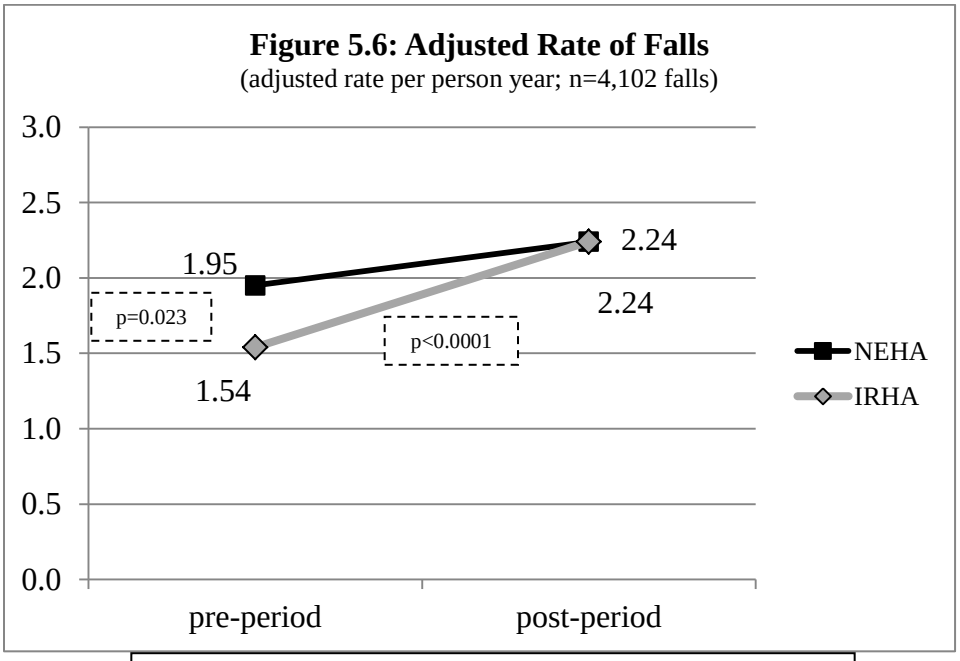
Interestingly, there was no significant difference in the adjusted rate of falls between residents (i) on polypharmacy and not on polypharmacy, (ii) on at least 1 fall-risk drug and those on none, or (iii) in different age groups. However, all of these covariates – polypharmacy (Beasley, 2009; Public Health Agency of Canada: Division of Aging and Seniors, 2005), certain drugs such as psychotropics (Tiessen et al., 2010; Shanley, 2003) and antidepressants (Public Health Agency of Canada: Division of Aging and Seniors, 2005), and advanced age (Lach, 2010; Theodos, 2003) – have all been identified in the

literature as being fall-risk factors. But in this research, falls are better explained by the covariates of sex, dementia, and level of care.

Table 5.6: Total Falls by Covariate Groups (n=4,102)

Variables		Pre-Period		Post-Period	
		NEHA	IRHA	NEHA	IRHA
age group	under 80	105	119	343	398
	80-86	190	107	388	362
	87-91	222	195	458	329
	92+	191	129	262	304
sex	male	293	207	540	576
	female	415	343	911	817
dementia	with	547	394	1167	1120
	without	161	156	284	273
LOC	2	280	262	397	591
	3	314	233	908	685
	4	99	50	137	104
	5 & 6	15	s	9	s
polypharmacy	yes	418	331	757	830
	no	290	219	694	563
fall-risk drugs	yes	420	277	1184	699
	no	288	273	267	694





interaction p-value = 0.058; NS

Table 5.7: Relative Rates for Falls

parameter	reference	RR (adj)	lower CI	upper CI	p-value	RR (unadj)	lower CI	upper CI	p-value
intercept		0.003	0.002	0.004	<.0001				
post-period	**pre-Period**	**1.455**	**1.240**	**1.707**	**<.0001**	1.351	1.192	1.531	<.0001
NEHA	**IRHA**	**1.268**	**1.033**	**1.557**	**0.023**	1.130	0.929	1.374	0.222
post x NEHA	see contrasts below				0.058				
age <80	age 92+	1.042	0.787	1.378	0.776	1.038	0.745	1.447	0.824
age 80-86	age 92+	0.928	0.744	1.159	0.510	0.973	0.754	1.254	0.831
age 87-91	age 92+	1.065	0.880	1.288	0.520	1.120	0.898	1.397	0.316
male	**female**	**1.340**	**1.129**	**1.591**	**0.001**	1.279	1.049	1.560	0.015
with dementia	**without dementia**	**1.437**	**1.164**	**1.775**	**0.001**	1.518	1.222	1.885	0.000
loc 3	loc 2	1.079	0.921	1.264	0.349	1.129	0.942	1.355	0.190
loc 4	**loc 2**	**0.463**	**0.344**	**0.623**	**<.0001**	0.464	0.346	0.621	<.0001
loc 5	**loc 2**	**1.889**	**1.181**	**3.019**	**0.008**	1.909	1.216	2.996	0.005
loc 6	**loc 2**	**0.356**	**0.130**	**0.979**	**0.045**	0.367	0.132	1.023	0.055
polypharm	not polypharm	1.149	0.963	1.373	0.124	1.211	0.990	1.482	0.063
on 1+ fall-rxs	not on 1+ fall-rxs	1.158	0.983	1.363	0.079	1.236	1.022	1.494	0.029
Contrasts:									
pre NEHA vs IRHA		**1.268**	**1.033**	**1.557**	**0.023**	1.306	1.044	1.633	0.020
post NEHA vs IRHA		1.001	0.820	1.221	0.996	1.092	0.878	1.358	0.429
post vs pre NEHA		1.148	0.955	1.381	0.143	1.243	1.030	1.501	0.024
post vs pre IRHA		**1.455**	**1.240**	**1.707**	**<.0001**	1.486	1.270	1.740	<.0001

5.6. Rate of Injurious Falls

To determine if the rate of injurious falls changed in NEHA over time and was different between NEHA and IRHA, two additional hypotheses were investigated. The third hypothesis was that there would *either be no change or a reduction in the rate of injurious falls and hospitalized falls from pre- to post-period in the intervention PCHs*. Results indicate that this hypothesis was supported – in NEHA, there was no significant change over time in the adjusted rate of injurious falls. [see *Figures 5.7: Crude Rate of Injurious Falls* and *5.8: Adjusted Rate of Injurious Falls; Tables 5.8: Total Injurious Falls by Covariate Group* and *5.9: Relative Rates for Injurious Falls*] In the pre-period, there were 0.6 injurious falls ppy and 0.63 in the post-period (adjusted: 0.599 and 0.596 ppy).

However, there was a significant increase in the rate of injurious falls in IRHA over time, from 0.59 to 0.78 ppy (adjusted: 0.59 to 0.75 ppy (RR_{adj} =1.27, 95% CIs=1.08-1.49; p=0.009). [see Figures 5.7 and 5.8] Both RHAs had a similar rates in the pre-period, but the significant increase in IRHA while NEHA's remained stable resulted in NEHA having a significantly lower rate of injurious falls than IRHA by the post-period – 0.63 vs 0.78 ppy (adjusted: 0.596 vs 0.746; RR_{adj} =0.799, 95% CIs=0.67-0.96; p=0.02). [see *Figures 5.7and 5.8; Table 5.9*] Thus, the fourth hypothesis, that there would *be a lower rate of injurious falls and hospitalized falls in the intervention PCHs than in the comparison PCHs in the post-period* was supported by these results, due to an increase in the rate of injurious falls in the comparison PCHs.

In terms of risk factors, there was a significantly greater adjusted rate of injurious falls among males (RR_{adj} =1.37, 95% CIs=1.18-1.58, p=0.000), residents with dementia (RR_{adj}

=1.29, 95% CIs=1.08-1.54, p=0.008), residents at level 5 compared to levels 2s (RR_{adj} =2.47, 95% CIs=1.50-4.04, p=0.001), and residents on polypharmacy (RR_{adj} =1.18, 95% CIs=1.01-1.36, p=0.037). There was a significantly lower adjusted rate of injurious falls among residents under 80 years of age compared to those 92+ years (RR_{adj} =0.73, 95% CIs=0.59-0.92, p=0.012), and among level 4 residents (RR_{adj} =0.38, 95% CIs=0.29-0.49, p<0.0001) compared to those at level 2.

These results are consistent with the findings from the analysis of falls in section 5.6. All of the covariates found to be significantly related to an increase in falls are also related to an increase in injurious falls – being male, having dementia, and requiring level 5 care. However, in the injurious fall analysis, polypharmacy was also found to be related to a significantly higher rate of injury, but was not related to significantly more falls. In other words, residents were not more likely to fall if they were on polypharmacy, but if they did fall, they were more likely to injure themselves than those not on polypharmacy. Rates for polypharmacy were also significantly higher in the non-program PCHs in IRHA in the post-period.

Also consistent with the fall results was the lower rate of injurious falls among residents requiring level 4 care – these residents fell less than the other residents, so it makes sense that they also injured themselves less from falling. However, unlike falls, where age was not significant, it was a significant factor related to injurious falls, but only for one age group – those under 80 years had a significantly lower rate of injurious falls than the other age groups. It is likely that the relatively better health of these younger residents made them more resilient to injury if they fell.

It is important to note that because hypotheses related to injurious falls were uni-directional (i.e., only one specific alternative was being tested), one-tailed testing was used.

Table 5.8: Total Injurious Falls by Covariate Groups (n=1,225)

Variables		Pre-Period		Post-Period	
		NEHA	IRHA	NEHA	IRHA
age group	under 80	23	43	63	94
	80-86	58	40	115	129
	87-91	73	71	112	117
	92+	54	55	71	107
sex	male	91	68	127	189
	female	117	141	234	258
dementia	with	165	143	277	355
	without	43	66	84	92
LOC	2	83	99	114	218
	3	91	96	217	188
	4	27	13	28	34
	5 & 6	s	s	s	s
polypharmacy	yes	115	118	195	268
	no	93	91	166	179
fall-risk drugs	yes	120	106	294	213
	no	88	103	67	234

Figure 5.7: Crude Rate of Injurious Falls
per person year (n=1,225 total injuries)

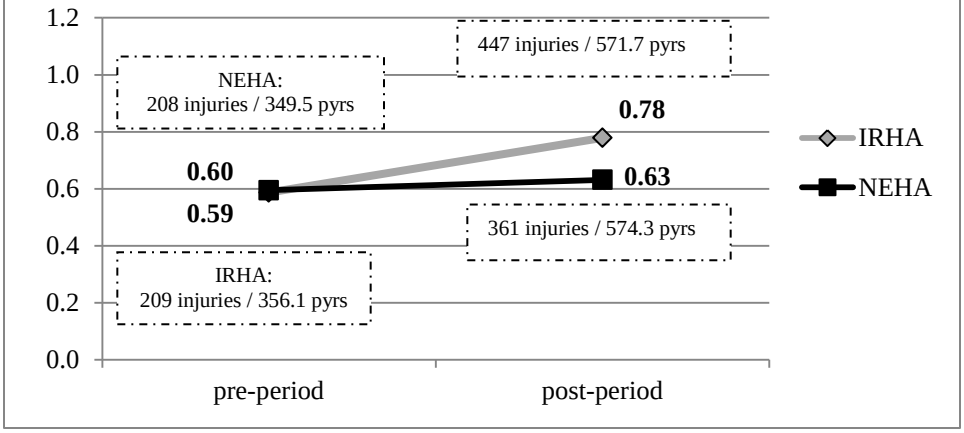
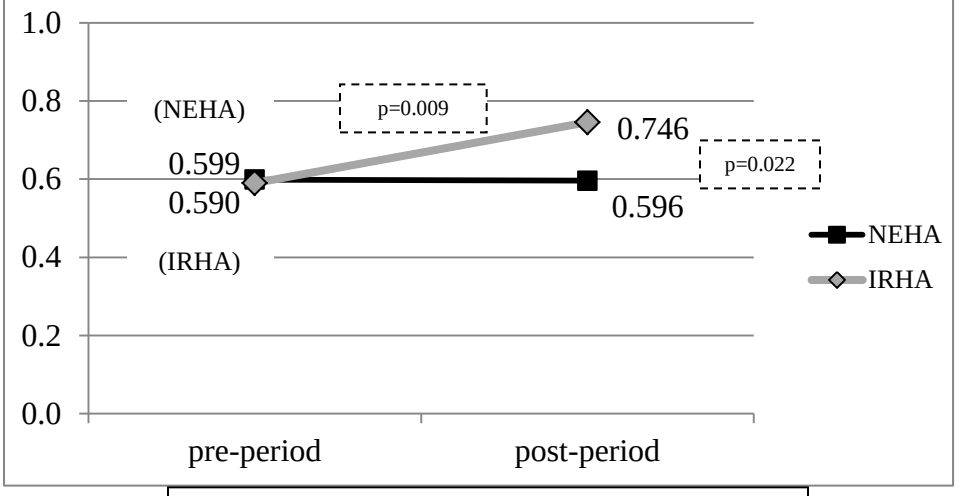


Figure 5.8: Adjusted Rate of Injurious Falls
(adjusted rate per person year; n=1,225 injuries)



interaction p-value = 0.069, NS

Table 5.9: Relative Rates for Injurious Falls

parameter	reference	RR (adj)	lower CI	upper CI	p-value	RR (unadj)	lower CI	upper CI	p-value
intercept		0.001	0.001	0.002	<.0001				
post-period	**pre-Period**	**1.265**	**1.076**	**1.487**	**0.009**	1.171	1.001	1.369	0.024
NEHA	IRHA	1.015	0.818	1.259	0.455	0.885	0.733	1.069	0.103
post x NEHA	see contrasts below				0.069				
age <80	**age 92+**	**0.733**	**0.586**	**0.917**	**0.012**	0.695	0.507	0.952	0.012
age 80-86	age 92+	0.918	0.740	1.139	0.259	0.933	0.705	1.234	0.313
age 87-91	age 92+	1.027	0.854	1.235	0.407	1.076	0.842	1.375	0.279
male	**female**	**1.366**	**1.182**	**1.580**	**0.000**	1.236	1.022	1.495	0.014
with dementia	**without dementia**	**1.292**	**1.084**	**1.540**	**0.008**	1.295	1.041	1.611	0.010
loc 3	loc 2	0.938	0.803	1.096	0.251	0.901	0.748	1.084	0.134
loc 4	**loc 2**	**0.380**	**0.294**	**0.491**	**<.0001**	0.349	0.255	0.476	<.0001
loc 5	**loc 2**	**2.465**	**1.504**	**4.039**	**0.001**	2.248	1.249	4.046	0.003
loc 6	loc 2	0.457	0.174	1.199	0.092	0.449	0.125	1.611	0.110
polypharm	**not polypharm**	**1.175**	**1.013**	**1.362**	**0.037**	1.246	1.026	1.514	0.013
on 1+ fall-rxs	not on 1+ fall-rxs	1.086	0.942	1.251	0.171	1.074	0.883	1.307	0.236
Contrasts:									
pre NEHA vs IRHA		1.015	0.818	1.259	0.455	1.011	0.771	1.326	0.468
post NEHA vs IRHA		**0.799**	**0.665**	**0.959**	**0.022**	0.834	0.668	1.042	0.055
post vs pre NEHA		0.995	0.804	1.232	0.485	1.058	0.821	1.365	0.331
post vs pre IRHA		**1.265**	**1.076**	**1.487**	**0.009**	1.284	1.063	1.550	0.005

5.7. Rate of Falls Resulting in Hospitalization

An additional analysis was conducted to investigate the rate of falls resulting in a hospitalization. Because of the rarity of this event (there were 60 total falls resulting in hospitalization from both RHAs and time periods combined), it was not possible to keep all of the covariates in the model. Level of care was kept in the model. However, it had to be grouped as levels 2 and 3 vs 4-6 to ensure adequate cell sizes.

In NEHA, there was a significant decrease in the crude rate of falls resulting in hospitalization over time, from 0.029 to 0.021 ppy (adjusted: 0.036 vs 0.020; RR_{adj} =0.56, 95% CIs=0.32-0.97; p=0.043). [see *Figures 5.9: Crude Rate of Falls Resulting in Hospitalization* and *5.10: Adjusted Rate of Falls Resulting in Hospitalization; Table 5.10: Relative Rates for Falls Resulting in Hospitalization*] NEHA also had a significantly lower rate than IRHA over time. After starting with similar rates in the pre-period (crude: 0.029 vs 0.034; adjusted: 0.036 vs 0.034) NEHA's rate decreased significantly (p=0.043) and IRHA's trended upward from 0.034 to 0.045 ppy (adjusted: 0.034 to 0.041; RR_{adj} =1.21, 95% CIs=0.93-1.56; p=0.11, NS) so that IRHA had a significantly higher rate than NEHA in the post-period (crude: 0.021 vs 0.045; adjusted: 0.020 vs 0.041; RR_{adj} =0.49, 95% CIs=0.27-0.88; p=0.023). Thus, the hypotheses that (i) there would be no change or a reduction in the rate of hospitalized falls from pre- to post-period in NEHA, and (ii) NEHA would have a lower rate of hospitalized falls than IRHA in the post-period were both supported.

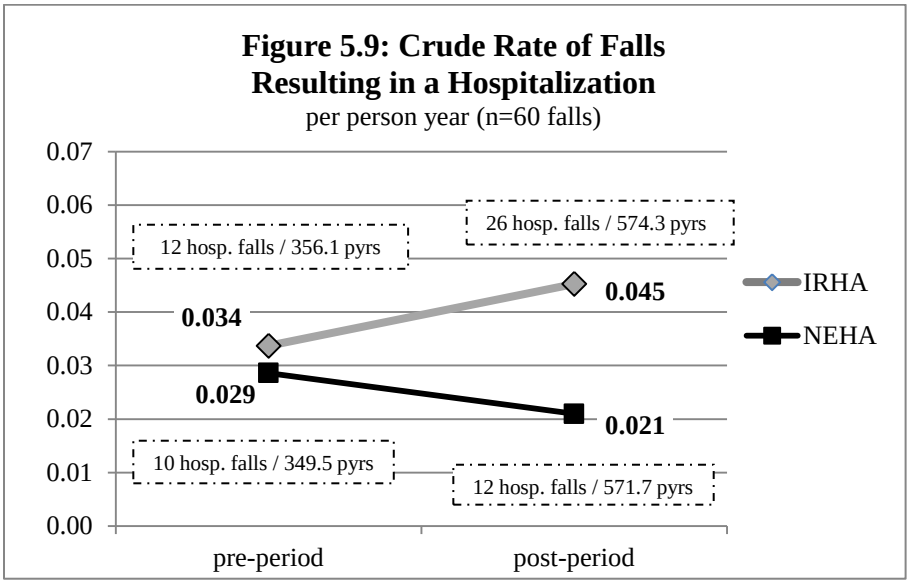
In terms of risk factors, level of care was significantly related to the rate of falls resulting in hospitalization. The high level of care group (i.e., levels 4-6) had

significantly fewer hospitalized falls compared to the low level of care group (levels 3 and 4) (RR_{adj} =0.77, 95% CIs=0.61-0.96; p=0.03).

Thus, even though the overall rate of injurious falls did not change in NEHA over time, serious falls resulting in hospitalization did significantly decrease. This is consistent with one of NEHA's program goals to decrease the severity of injuries associated with falls.

As with injurious falls, one-tailed testing was used because hypotheses related to hospitalized falls were uni-directional.

This analysis was additionally useful as it provided a means for checking the validity of the Occurrence Report data. Occurrence Reports were used to find falls resulting in hospitalization in the hospital data. The hospital data was then used to find corresponding Occurrence Reports. See section 4.8 for more details.



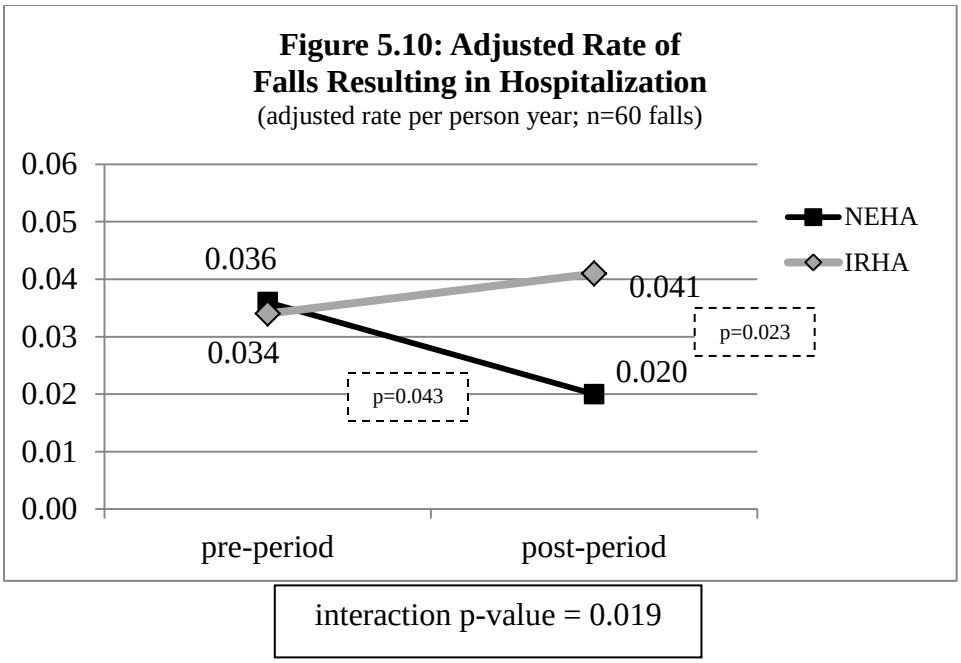


Table 5.10: Relative Rates for Falls Resulting in Hospitalization

parameter	reference	RR (adj)	lower CI	upper CI	p-value
intercept		0.000	0.000	0.000	<.0001
post-period	pre-Period	1.213	0.934	1.576	0.112
NEHA	IRHA	1.063	0.850	1.330	0.326
high loc	**low loc**	**0.766**	**0.610**	**0.961**	**0.027**
post x NEHA	**see contrasts below**				**0.019**

Contrasts:

pre NEHA vs IRHA	1.063	0.850	1.330	0.326
post NEHA vs IRHA	**0.492**	**0.275**	**0.880**	**0.023**
post vs pre NEHA	**0.562**	**0.324**	**0.975**	**0.043**
post vs pre IRHA	1.213	0.934	1.576	0.112

note: low loc = levels 2 & 3; high loc = levels 4-6

5.8. Additional Analyses

Some additional analyses were possible using the data collected. In the Occurrence Report data each fall was categorized as resulting in a level of injury – either none, minor, major, or death. The latter three were grouped and analyzed as 'injuries' (see section 5.6) and the non-injuries were analyzed separately (see *Appendix 14: Non-Injurious Falls*). The rate of falls resulting in a non-injury increased significantly over time in NEHA from 1.36 to 1.64 ppy (RR_{adj} =1.2, 95% CIs=1.02-1.42; p=0.032).

Because non-injurious falls are the alternate of injurious falls, which were tested as 1-tailed, the same was done for non-injurious falls.

As well, falls, injuries, and non-injuries were graphed by person-day in two-month periods to provide more descriptive information about trends over time [see *Appendix 15: Outcomes by Month*] In NEHA, falls decreased over the course of the pre-period, but increased following the program implementation in the post-period. However, while injurious falls decreased along with falls in the pre-period, they continued to decrease in the post-period while falls were increasing. Moreover, non-injurious falls also declined with falls and injuries in the pre-period, but increased in the post-period. Thus it appears that residents where more active in NEHA in the post-period, but were injuring themselves less frequently.

5.9. Summary

This research had a power of 92% to detect a 40% change in the rate of injurious falls, with a 5% probability of a type 1 error and two-tailed testing.

Of the four hypotheses for this research, two were supported by the results. The hypothesis that injurious falls would not change or decrease over time in the intervention

PCHs was substantiated – the adjusted rate ppy was 0.599 in the pre-period and 0.596 in the post-period (RR_{adj}=0.99, 95% CIs=0.80-1.23; p=0.49, NS). As well, the adjusted rate of falls resulting in a hospitalization decreased significantly over time in NEHA from 0.036 to 0.020 ppy (RR_{adj}=0.56, 95% CIs=0.32-0.96; p=0.043).

The hypothesis that there would be a lower rate of injurious falls in the intervention PCHs than in the comparison PCHs over time was also supported by these results - NEHA's adjusted rate of 0.596 ppy was significantly lower than 0.746 in IRHA (RR_{adj}=0.79, 95% CIs=0.67-0.96; p=0.022). The rate of falls resulting in hospitalization was also significantly lower in NEHA compared to IRHA in the post-period (0.020 vs 0.041; RR_{adj}=0.49, 95% CIs=0.28-0.88; p=0.023).

It was also hypothesized that the fall rate in NEHA would change over time and be different from IRHA in the post-period, but neither were supported by the results. The adjusted rate falls ppy in NEHA trended upward over time, from 1.95 to 2.24, but was not statistically significant. Moreover, the rates were the same for the RHAs in the post-period, both having 2.24 fall ppy. NEHA had significantly more falls than IRHA in the pre-period (1.95 vs 1.54; RR_{adj}=1.27, 95% CIs=1.03-1.56; p=0.023) but a significant increase in falls in IRHA over time (1.54 to 2.24; RR_{adj}=1.46, 95% CIs=1.24-1.71; p<0.0001) closed this gap.

Thus, overall, it appears that NEHA's Fall Management Program benefitted the residents by protecting them from an increase in injuries despite some evidence of increased mobility. Moreover, NEHA residents fared significantly better than the IRHA residents who did not have a program – in the post-period, after the program had been

implemented in NEHA, both RHAs had the same rate of falls, but NEHA had significantly fewer injurious falls and falls resulting in hospitalization.

These differences between RHAs are not due to differences in the residents – in the pre-period, residents' baseline characteristics were statistically similar (i.e., sex, age, and dementia status). By the post-period , NEHA had a significantly higher burden of care (i.e., more level 3s and fewer level 2s) and a significantly lower rate of polypharmacy than IRHA, but these differences were statistically controlled for in most of the analyses[5]. [see *Table 5.11: Overview of Outcomes* below]

[5] Due to small numbers, it was not possible to keep all of the covariates in the hospitalized falls model, which only controlled for level of care.

Table 5.11: Overview of Outcomes

Outcome	Change Over Time in NEHA (Pre- to Post-Period)
1. Falls	• similar (1.95 to 2.24 ppy; RR_{adj}=1.15, 95% CIs=0.96-1.38; p=0.14, NS)
2. Injurious Falls	• similar (0.599 to 0.596 ppy; RR_{adj} =0.99, 95% CIs=0.71-1.29, p=0.49, NS)
3. Falls Resulting in Hospitalization	• significantly lower (0.036 to 0.020 ppy; RR_{adj} R=0.56, 95% CIs=0.29-1.08, p=0.043)
4. Non-Injurious Falls	• increased (1.36 to 1.64 ppy; (RR_{adj} =1.20, 95% CIs=0.99-1.46, p=0.032)

Outcome	NEHA vs IRHA
1. Falls	• pre: significantly higher rate in NEHA (1.95 vs 1.54 ppy; RR_{adj} =1.27, 95% CIs=1.03-1.56, p=0.023) • post: no significant difference (2.24 vs 2.24 ppy; RR_{adj} =1.00, 95% CIs=0.82-1.22, p=0.99, NS)
2. Injurious Falls	• pre: no significant difference (0.599 vs 0.590 ppy; RR_{adj} =1.02, 95% CIs=0.78-1.31, p=0.45, NS) • post: significantly lower rate in NEHA (0.596 vs 0.746 ppy; RR_{adj} =0.79, 95% CIs=0.64-0.99, p=0.02)
3. Falls Resulting in Hospitalization	• pre: no significant difference (0.036 vs 0.034 ppy; RR_{adj} =1.06, 95% CIs=0.81-1.38, p=0.33, NS) • post: significantly lower rate in NEHA (0.020 vs 0.041 ppy; RR_{adj} =0.49, 95% CIs=0.25-0.98, p=0.023)
4. Non-Injurious Falls	• pre: significantly higher rate in NEHA (1.36 vs 0.96 ppy; RR_{adj} =1.42, 95% CIs=1.13-1.78, p=0.002) • post: no significant difference (1.64 vs 1.53 ppy; RR_{adj} =1.07, 95% CIs=0.85-1.33, p=0.29, NS)

Note: because hypotheses related to injurious falls/non-injurious falls and falls resulting in hospitalization were uni-directional (i.e., only one specific alternative was being tested), one-tailed testing was used

Table 5.12 Interactions

	RRadj	Lower CIs	Upper CIs	p-value
falls	0.789	0.617	1.008	0.0584
injurious falls	0.787	0.604	1.026	0.069
falls resulting in hospitalization	0.463	0.251	0.852	0.019

CHAPTER 6: DESCRIPTIVE RESULTS FROM NEHA INVESTIGATIVE REPORT ANALYSIS

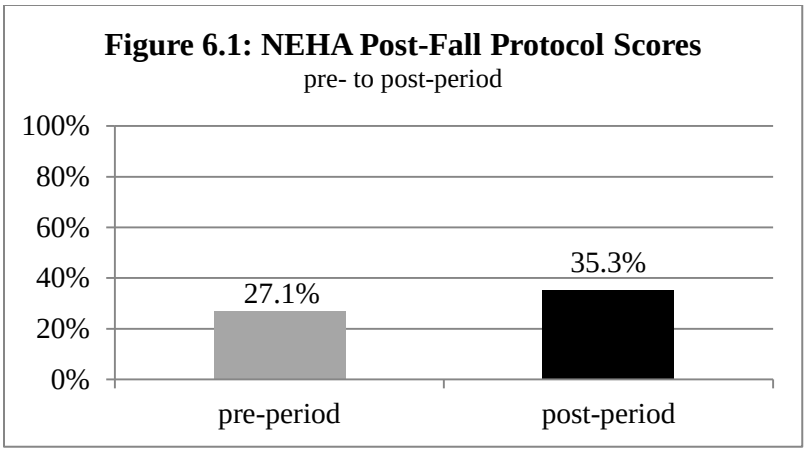
6.1. Introduction

Descriptive data about procedures performed by NEHA PCH staff at the time of and after a fall, are presented to provide an indication of how well the fall program was implemented over time. These data were collected from Investigative Reports that are to be completed along with an Occurrence Report whenever a PCH resident falls.

Statistical testing on these descriptive results was not conducted because of the small sample size – there were 70 total reports collected from NEHA PCHs in the pre- period and post-period. These descriptive results are intended to be an indicator of the extent to which program polices were adhered to and specific program procedures were implemented during the study period. Scores were compared by period – benchmark scores in the pre-period were compared to post-period scores, after the program had been implemented.

6.2. NEHA Post-Fall Protocol Analysis

There was an increase in total post-fall protocol procedure scores over time from 27.1% to 35.3%). Thirty-five Investigative Report forms were sampled from each time period, and there were 10 possible post-fall protocol procedures that could be documented on each form, so the total score possible for each period was 350. [see *Figure 6.1: NEHA Post-Fall Protocol Scores* below]



Comparing the frequency of individual procedures performed over time, some increased, some decreased, and some did not change. [see *Figure 6.2:Frequency of Procedures Pre- vs Post-Period in NEHA*, and *Tables 6.1: Comparison of Program Procedures from Pre- to Post-Period in NEHA* below]

Several procedures increased over time. Procedure 1(b), doing a more thorough check of a resident after a fall (by taking vital signs), increased significantly from 37% to 46%. This change is positive and noteworthy because it is the correct way to perform this procedure - many forms had only that the resident was checked for injury, with no documentation of having taken vital signs.

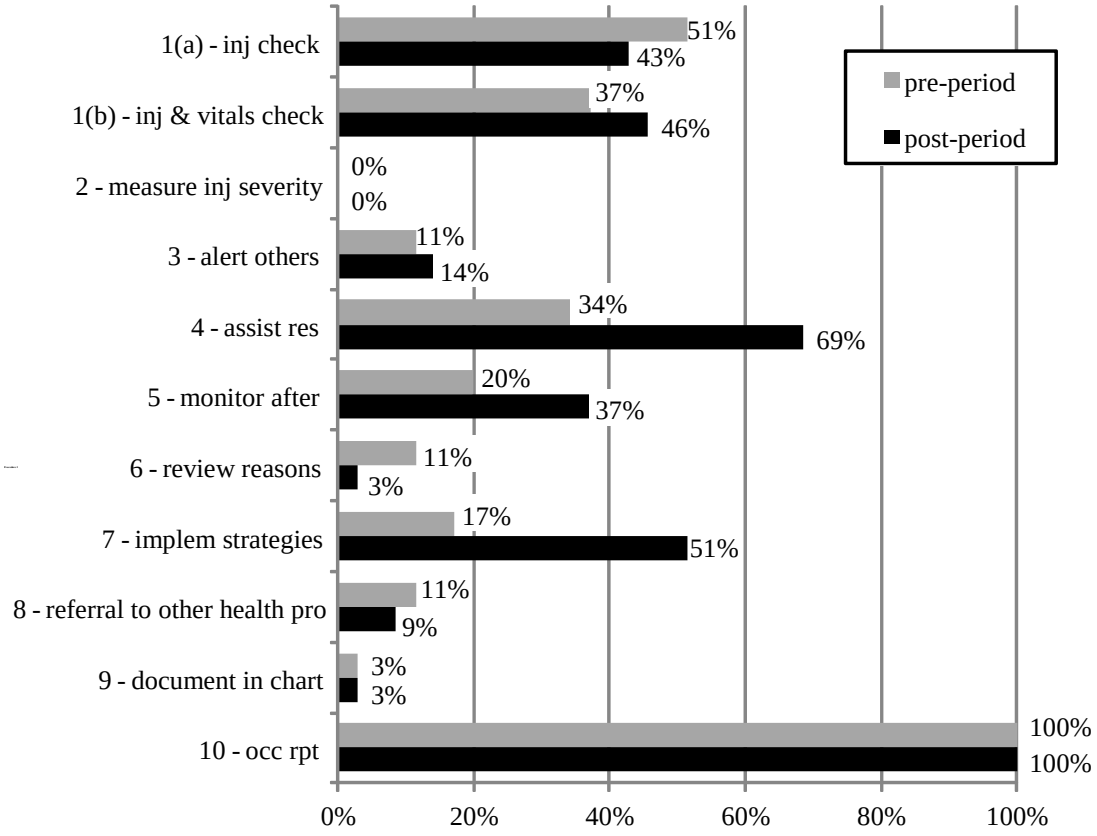
Other procedures that increased included procedure #4 'assisting the resident off the floor' (34% to 69%), procedure #5 'monitoring resident after a fall' (20% to 37%), and procedure #7 'implementing fall program strategies' (17% to 51%). There was also an increase in procedure #3 'alerting other staff as needed' (11% to 14%). However, an increase in this procedure is not necessarily indicative of improved staff performance as it may not have been necessary to alert other staff for some falls.

Procedures #1(a), #6, and #8 decreased over time. Procedure #1(a) checking the resident for injury, but not taking vital signs decreased from 51% to 43% over time. Of note, this decrease corresponds to an increase in doing the procedure correctly, or checking resident for injury and taking vital signs (procedure #1b). 'Reviewing reason for fall with resident or family' (procedure #6) decreased over time, from 11% to 3%. There was also a decrease in 'providing referral to other health professional' (procedure #8), from 11% to 9%. However, this is not necessarily indicative of declining staff performance, as it may not have been necessary to alert other health professionals for some falls.

There were several procedures that did not change over time – #2, #9, and #10. 'Measuring severity of injury' (procedure #2) was never documented on any investigative report in the pre- or post-period. However, the degree of injury was documented on most occurrence reports. Procedure #9 (document details in resident's chart) did not change in frequency – 3% of forms in each time period noted that this has been done. 'Completion of an Occurrence Report' (procedure #10) was done for every fall event in both time periods.

Figure 6.2: Frequency of Procedures Pre- vs Post-Period in NEHA

percent of reports where procedure was documented
(n=35 reports in each period)



Post-Fall Protocol Procedure Key:

1. Check resident for injury, take vital signs.
2. Measure severity of the injury [none; minor; major]
3. Alert other staff if needed.
4. Assist resident off floor via appropriate means [see policy #7-9 Transfer Safety]
5. Monitor resident regularly following fall.
6. Review reason for falls with resident and family.
7. Review and implement appropriate fall prevention strategies and injury minimization strategies.
8. Provide appropriate referral to other health professionals.
9. Document all details in resident chart.
10. Complete an occurrence reporting form.

Table 6.1: Comparison of NEHA Program Procedures from Pre- to Post-Period

		Pre-Period Total (out of 35 reports)	**Post-Period Total** (out of 35 reports)
	overall score	95 (27%)	123.5 (35%)
Procedure #			
	1(a)	18 (51%)	15 (43%)
	1(b)	13 (37%)	16 (46%)
	2	0	0
	3	4 (11%)	5 (14%)
	4	12 (34%)	24 (69%)
	5	7 (20%)	13 (37%)
	6	4 (11%)	1 (3%)
	7	6 (17%)	18 (51%)
	8	4 (11%)	3 (9%)
	9	1 (3%)	1 (3%)
	10	35 (100%)	35 (100%)

6.3. NEHA Investigative Report Form Completion

After a fall has occurred and an Occurrence Report has been filled out, a follow-up Investigative Report should also be completed. In the pre-period, 91% of forms sampled had an accompanying Investigative Report, but all 100% had one in the post-period. [see *Table 6.2: Comparison of Investigative Report Completion from Pre- to Post-Period in NEHA*] This is a positive finding because it is could be indicative of improved adherence to program procedures.

On the Investigative Report, there is a section ‘action(s) assigned to occurrence owner department’ section to be filled out. While many forms did not have this section completed in either period, there was an increase in the number of times it was

completed, from 37% to 46%. This increase could be indicative of improved adherence to program procedures.

Table 6.2: Comparison of Investigative Report Completion over Time in NEHA

	Pre-Period Total (out of 35 reports)	**Post-Period Total** (out of 35 reports)
Investigative Report completed	32 (91%)	35 (100%)
'Actions Assigned…..' section completed	13 (37%)	16 (46%)

6.4. Summary

The descriptive report analyses indicate that the implementation of program procedures increased in NEHA over time, including increases in specific procedures such as implementing injury minimization strategies. Overall scores for the implementation of program procedures increased over time in NEHA.

Specific procedures that increased from pre- to post-period included (i) properly assisting resident off the floor, (ii) implementing appropriate injury minimization strategies, (iii) alerting other staff as needed, (iv) monitoring residents after a fall, and (v) checking residents for injury and taking vital signs. Moreover, there was a corresponding decrease in the 'improper' implementation of this last procedure, which was to check residents without taking vital signs.

These descriptive results help to validate the fall and injury data in chapter 5, by providing another source of information related to residents' falls – i.e. staff performance. The increase in fall-related procedures over time coincides with a trend towards

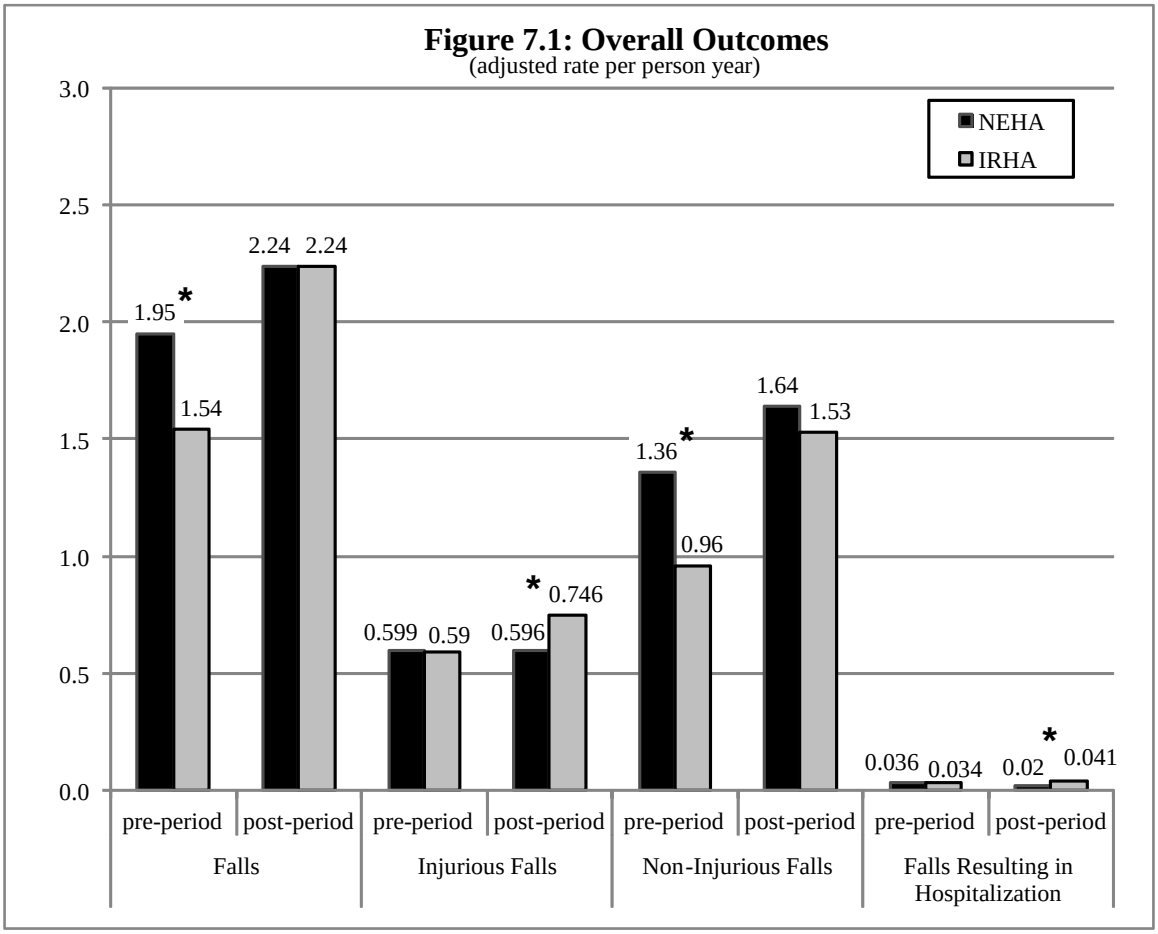
increasing mobility with a stable overall injury rate and significant decrease in serious falls resulting in hospitalization.

CHAPTER 7: DISCUSSION AND CONCLUSIONS

7.1. Overview of Study Results – The Effect of the Program

Overall, the results from this research provide evidence that the Fall Management Program in NEHA had some benefits for residents. Moreover, compared to similar PCHs without a fall program, rates of overall injuries and serious injuries resulting in hospitalization were significantly lower in NEHA after program implementation. While NEHA's rates remained stable or decreased, IRHA's were increasing. In other words, IRHA's situation worsened without a program while NEHA's remained stable with the introduction of a program. [see *Figure 7.1: Overall Outcomes* and *Table 7.1: Overall Outcomes*]

Differences in outcomes between NEHA and IRHA were not likely due to differences in residents' characteristics – both RHAs were statistically similar in the pre-period, and differences (i.e., level of care and polypharmacy) in the post-period were statistically controlled for in the falls and injurious falls models. However, due to small numbers, it was not possible to keep all of the covariates in the hospitalized falls model, which only controlled for level of care.



*denotes significantly different rates

Table 7.1: Overall Outcomes

Outcome	Study Period	Total Numbers		Crude Rates PPY		Adj. Rates PPY		p-value
		NEHA	IRHA	NEHA	IRHA	NEHA	IRHA	
Falls	pre-period	708	550	2.03	1.54	**1.95**	**1.54**	**0.023**
	post-period	1451	1393	2.54	2.43	2.24	2.24	0.99
Injurious Falls	pre-period	208	209	0.60	0.59	0.599	0.590	0.91
	post-period	361	447	0.63	0.78	**0.596**	**0.746**	**0.02**
Non-Injurious Falls	pre-period	500	341	1.43	0.96	**1.36**	**0.96**	**0.002**
	post-period	1090	946	1.91	1.65	1.64	1.53	0.29
Falls Resulting in Hospitalization	pre-period	10	12	0.029	0.034	0.036	0.034	0.33
	post-period	12	26	0.021	0.045	**0.020**	**0.041**	**0.023**

Results from the descriptive report data indicate that there was improvement in the implementation of program procedures. Even though these scores were low, there was still an improvement over time in key areas, including the implementation of injury minimization strategies. In addition, low scores are not necessarily indicative of low implementation – it could be that considerably more is done than is documented (i.e., staff are busy implementing the program which leaves less time to document) and/or procedures are documented elsewhere (e.g., in a resident's chart). It is also possible that documentation increased because of the program.

7.2. How Results from Different Data Sources Compare

The results from the analysis of falls and injuries are consistent with results from the analysis of the descriptive report data. Improvement in the performance of fall program procedures in NEHA corresponded with a trend towards increased mobility, while overall injurious fall rates remained stable and serious injuries resulting in hospitalization decreased significantly. Simultaneously, in comparison PCHs without a program, outcomes worsened as overall injuries increased significantly and serious injuries resulting in hospitalization trended upward.

These data from comparison PCHs are important because they give an indication of what outcomes might have occurred in NEHA without the program. Prior to program implementation, NEHA operated similarly to IRHA by responding to residents' falls after they occurred, on an individual basis. These results suggest that there were better outcomes in the PCHs with the fall program, compared to its pre-period state without the program and compared with a similar PCH without a fall program. Additional evidence

from the program PCHs' Investigative Reports indicates that improvement in outcomes corresponded to an increase in the documentation of program procedures implemented in NEHA over time.

7.3. How Results Compare with the Research Hypotheses

There were four hypotheses regarding the main outcomes in this research, and two were supported by the results.

Hypotheses:

1. there will be a ***change in the rate of falls*** from pre- to post-period in the intervention PCHs
2. the ***rate of falls in the intervention PCHs will be different from the comparison PCHs*** in the post-period
3. there will be either ***no change or a reduction in the rate of injurious falls and hospitalized falls*** from pre- to post-period in the intervention PCHs
4. there will be a lower ***rate of injurious falls and hospitalized falls in the intervention PCHs than in the comparison PCHs*** in the post-period

First, it was hypothesized that there would be a *change in the rate of falls from pre- to post-period in the intervention PCHs.* This hypothesis was not substantiated by this research. However, while the rate of falls did not change significantly, it did trend toward an increase over time in NEHA, from 1.95 to 2.24 ppy.

The second hypothesis, that the *rate of falls in the intervention PCHs would be different from the comparison PCHs in the post-period*, was not supported in this research either – there was no significant difference between RHAs in the post-period in

terms of the adjusted rate of falling. NEHA had significantly more falls than IRHA in the pre-period (1.95 vs 1.54 ppy, p=0.023) but this gap closed by the post-period as IRHA's rate increased significantly (1.54 to 2.2.4, p<0.0001) and NEHA's did not.

The third hypothesis, that there would be either *no change or a reduction in the rate of injurious falls and hospitalized falls from pre- to post-period in the intervention PCHs,* was supported by the results. There was no significant change in the rate of injurious falls, and serious falls resulting in a hospitalization decreased significantly (0.036 to 0.020 ppy, p=0.043).

The fourth hypothesis, that there would be a lower *rate of injurious falls and hospitalized falls in the intervention PCHs than in the comparison PCHs in the post-period,* was also supported by the data. Compared to PCHs without a program in IRHA, NEHA had a significantly lower rate of injurious falls (0.596 vs 0.746, p=0.022) and falls resulting in hospitalization (0.020 vs 0.041, p=0.023) in the post-period, after the program had been implemented. These differences are due more to increases in IRHA while NEHA's rates remained stable.

7.4. How Results Compare with the Conceptual Framework

The results of this research align with the conceptual framework created for this research (see Figure 3.1, Chapter 3). Given a burden of injury that concerned the Director of Long Term Care in NEHA, an intervention was devised to be applied to all PCH residents, regardless of their fall history or fall-risk score. The intervention was intended to target specific factors known to increase PCH residents' fall risk. This intervention was implemented via education of staff, residents and families, and was enforced through

policies. An evaluation of outcomes in the three-year period following program implementation indicated that there had been improvement – while not statistically significant, falls trended upward, providing some evidence of an increase in mobility, while total injuries remained stable and serious injuries resulting in hospitalization decreased significantly. Moreover, there were positive results in terms of program sustainability – an increase in the documentation of program procedures implemented could be indicative of successful program education and adoption of the program by staff. The results of this evaluation will be communicated internally to program staff and residents/families, and externally via reports, presentations, and ideally, publications in peer reviewed literature.

Thus, the validity of the framework for this research was supported by the research results. In this case, the framework served as an adequate approximation of the real world (www.matedu.cinvestav.mx, 2006) and illustrates how relevant and measureable variables are related (Bickman et al., 1998). Moreover, the framework provided a reference point for data interpretation (The Higher Education Academy: Social Policy and Social Work (SWAP), 2006) – even though falls trended upward, this was expected, and was accompanied by stable overall injury rates and a significant decrease in severe injuries resulting in hospitalization.

7.5. How Results Compare with the Program Goals/Objectives

Generally, results indicate that NEHA's program goals and objectives were being met. The overall goal of fall management is to prevent, or at least minimize, *injuries* while simultaneously encouraging mobility and functionality (North Eastman Health

Association Inc., 2005a). Rather than focusing on *fall* reduction, the goal is to keep residents mobile and functional, and *minimize* their risk of *injury* if they do fall. Falls trended upward, possibly indicating increased mobility, but injuries remained stable and serious falls resulting in hospitalization decreased significantly.

The specific program goals and objectives are listed in Table 7.2: below. This research was able to provide information regarding several of these specific program goals and objectives.

Table 7.2: Comparison of NEHA's Program Goals & Evaluation Results

Program Goals	Evaluation Results
1. to implement a sustainable Falls Management Program that includes all residents, staff and family members	● descriptive data indicate that there was an increase in adherence to fall-related procedures in NEHA from pre- to post-period ● to assess the program's sustainability requires multiple measures over time in the post-period; the post-period measure in this research can serve as a benchmark
2. to encourage an environment that reinforces least restraint policy	● not measured in this research
3. to identify residents at risk of falling	● not measured in this research
4. to decrease the fall rate and / or severity of injuries associated with falls at our long term care facilities	● the rate of falls increased, but not significantly ● the rate of injurious falls remained stable ● the rate of falls resulting in hospitalization decreased significantly ● the rate of non-injurious falls increased significantly
5. to decrease the incidence of mortality related to a recent fall	● not measured in this research

Table 7.2 continued on next page with program *objectives*

Table 7.2: Comparison of NEHA's Program Goals & Evaluation Results (cont'd)

Program Objectives	Evaluation Results
1. to educate all residents, families and staff about the *Falls Management Program*	● not measured in this research
2. to educate all staff about the risks and multi-factor causes of falls in older adults	● not measured in this research
3. to initiate both protective and preventative fall intervention strategies	● descriptive data indicate that there was an increase in adherence to fall-related procedures in NEHA from pre- to post-period
4. to flag residents at high risk of falling, through the use of the Falls Risk Assessment tool	● not measured in this research
5. to perform a comprehensive post-fall assessment when necessary so that interdisciplinary team can explore underlying causes of residents' falls	● there was a small increase in the number of investigative reports filled out from pre- to post-period (from 32 to 35) ● there was a small increase in the number of times section #2 of investigative report (actions assigned to occurrence owner department) was filled out (from 13 to 16)
6. to monitor residents' fall rate and to evaluate the efficacy of the program	● this research is an evaluation of this program, using fall and injury rates to help gauge program efficacy
7. to encourage each facility's interdisciplinary team to assume responsibility for the safety and well-being of their residents by actively participating in the *Fall Management Program*	● not measured in this research

In terms of the first goal – 'implementing a sustainable program' – descriptive report evidence suggests that there was an increased adherence to implementing program procedures. Overall scores for the implementation of post-fall procedures trended upward over time in NEHA. Even though scores in both time periods were low, it is encouraging to see an increase over time. Moreover, it is likely that there has been under-documentation – not everything that is done is recorded, or it has been recorded in another place (e.g., resident's chart), so actual scores may not be as low. While it is important to document events properly, it is also important to ensure that residents are getting the care they need, which many would argue takes precedence over proper documentation.

Similarly, it is possible that the increase in procedure scores from pre- to post-period was from an increase in documentation only and that implementation of procedures did not actually increase. Because the program was new, staff were more diligent about documentation. However, the results from the administrative data corroborate the descriptive findings that procedure implementation was increasing – while not significant, falls trended upward over time while injuries remained stable.

Regarding the fourth goal – 'seeing a decrease in the fall rate and/or severity of injuries associated with falls' – results indicate that falls did not change significantly over time, injurious falls remained stable, and serious injuries resulting in hospitalization decreased significantly. Thus, it appears that this goal was partially being met.

NEHA did not identify specific targets for an effect size with regard to falls. An increase in falls was actually expected given that program goals include keeping residents as mobile as possible and to decrease use of restraints. With regard to fractures, a 10%

reduction was the target program effect size (Director of Long Term Care (NEHA), 2005; Impact, 2005; Rask et al., 2007; JEL Health Education Ltd., 2002). While fractures were not specifically measured in this research, serious falls resulting in hospitalization did significantly decrease and overall injuries remained stable.

This research also addressed the third objective, which is to 'initiate both protective and preventative fall intervention strategies'. Descriptive report data indicate that there was an increase in several program procedures including implementing appropriate injury strategies. Moreover, there was an increase in the proper checking of residents after a fall – staff are to check vital signs as part of the procedure, but often this was not documented in the pre-period. By the post-period, this had reversed so that taking vital signs was done in the majority of cases. In other words, there was an improvement in how this procedure was carried out.

Some procedures trended downward over time including 'reviewing the reason for a fall with the resident and family' and 'referral to another health professional'. However, it is possible that reasons were reviewed but it was not documented in the form. Moreover, referral to another health professional may not always be warranted, so a decrease is not necessarily negative.

There was improvement regarding the fifth objective, 'to perform a comprehensive post-fall assessment when necessary so that the interdisciplinary team can explore underlying causes of residents' falls'. In the pre-period, 91% of sampled forms had an accompanying Investigative Report, but in the post-period, all 35 sampled forms had one (100%). As well, there was an upward trend in the number of times the second section on the Investigative Report was filled out – 'actions assigned to occurrence owner

department' – from 37% to 46%. While numbers are low for filling out the second section of the form, there was an increase over time, and it is possible that program procedures are being implemented but not documented, or documented elsewhere, such as the resident's chart.

This research project itself is evidence of efforts being made to accomplish the sixth objective – 'to monitor residents' fall rate and to evaluate the efficacy of the program'. This research is an evaluation of the fall program, using fall and injury rates to help gauge program efficacy.

More measurements over time are needed to see any real trends, and more Investigative Report forms need to be sampled each time to give a better representation of procedures performed. The available time and resources limited the amount of qualitative information that could be collected, but forms were chosen randomly, based on PCH bed size, so efforts were made to compensate for a small qualitative data sample.

7.6. How Results Compare with the Literature

Largely, results from this research corresponded with results from similar studies – implementing a fall program was associated with a downward trend in injuries. However, while there was a non-significant increase in falls in this research, results from other studies were mixed with some increasing and some decreasing.

Of all the related research that could be found on the evaluation of fall-related programs, only one was aimed at fall 'management'. All of the other studies evaluated fall prevention or fall reduction programs. Fall management is a new approach to falls which includes most of the principles of traditional fall prevention efforts, but rather than

attempting to prevent *falls*, the goal is to prevent or minimize *injuries* resulting from those falls, while simultaneously encouraging mobility and activity (North Eastman Health Association Inc., 2005c).

Results from eight non-randomized evaluations of fall prevention programs in institutional settings with older adults all indicated a decrease in falls after program implementation, although not all were significant (see section 2.1.1 for references). Some of these also reported significant decreases in fracture rates (Australian Commission on Safety and Quality in Health Care, 2009; Scott et al., 2008; Perry Schoenfelder et al., 2004; Tideiksaar, 2002). However, while all programs were 'multi-faceted' there was no consistency between them in terms of program components. One study evaluated a fall *management* program, but the focus was still actually fall prevention – falls remained stable in the intervention PCHs and increased in the comparison PCHs without a program (Rask et al., 2007; Riefkohl et al., 2003). Most studies were underpowered with small samples, short follow-ups and used statistical techniques that did not account for the correlation from measuring the same or similar residents over time (i.e., paired t-test vs GLMs). [see *Appendix 3: Review of Related Fall-Program Evaluations*]

Results from evaluations using a randomized study design were mixed. In some studies, there were significantly fewer falls (Ray et al., 1997; Haines et al., 2004), lower fall risk (Jensen et al., 2003; Becker et al., 2003; Bouwen et al., 2008; Rapp et al., 2008), and injury risk (Ray et al., 1997; Jensen et al., 2003) in the treatment groups, but not all studies' results were significant. In one study, there was no significant difference in the injury rate between study and control sites, and another study actually found a significantly higher rate of injuries in the treatment group (Kerse et al., 2004). As with

the non-randomized studies, while all programs were 'multi-faceted' there was no consistency between them in terms of program components. While not identical in research design, these results are still informative. Moreover, despite relatively short follow-up periods, these studies had larger sample sizes and used more appropriate statistical analysis techniques (i.e., GLMs) than the non-randomized evaluations.

In the literature, fall rates have been reported ranging between 1.5 to 3.0 falls per person year (Perry Schoenfelder et al., 2004; Theodos, 2003; Vu et al., 2004; Becker et al., 2003; Rubenstein et al., 1994; Cameron et al., 2010). In this research, falls per person year were within this range, with a rate of 1.54 in IRHA in the pre-period, to 2.24 in both RHAs in the post-period.

Approximately 50-60% of PCH residents fall each year, with half of them *falling repeatedly* (Hofmann et al., 2003; Kannus et al., 2005). The proportion of residents in this research who fell was similar to the literature, ranging from 49.4% in the pre-period in IRHA to 60.9% in NEHA in the post-period. Of the residents who fell, 27% to 46% fell multiple times.

A 2006 report from MCHP found that between 1999/2000 and 2003/04 NEHA had a rate of approximately 4.4 accidental falls resulting in hospitalization per 100 person years (Doupe et al., 2006). In this research, this rate in NEHA was 3.6 falls resulting in hospitalization in the pre-period (from June 2003-March 2005), and decreased to 2.0 in the post-period (from April 2005 to March 2008). In IRHA, there were 3.4 falls resulting in hospitalization in the pre-period, increasing to 4.1 in the post-period.

Innumerable fall *risk factors* for seniors have been identified in the literature. In this research, several of these risk factors were included in the models in order to determine how they affected outcomes.

Sex has been found to be a fall-risk factor – a 2005 Public Health Agency of Canada report identified females as being at greater risk of falls than males (Public Health Agency of Canada: Division of Aging and Seniors, 2005). However, in this research, males were found to be at significantly higher risk of falls and injuries. It is possible that in this particular study population, males had more fall risk factors than females, so it is not so much that one sex was at greater fall risk than the other, but that those with more risk factors were at greater fall risk. This analysis was not done is this research, but could be worth exploring in future research.

Advanced age has also been found to be a risk factor (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Kiely et al., 1998; Perry Schoenfelder et al., 2004; Theodos, 2003; Lach, 2010). In this research, four age groups were used [under 80 years, 80-86, 87-91, 92+] but there was no significant difference between them in terms of fall or injury risk, with the exception of residents under 80 years of age who were at significantly lower risk of an injurious fall than those 80 years or older. Of note, in models where age was continuous, there was a significantly greater risk of falls as age increased. Using age groups resulted in a better fit with the data, so the models with age as continuous were not used.

Long term care residents are becoming increasingly older and medically complex (Sharkey et al, in (Przybysz et al., 2009). They are at an ever-increasing risk of falls because of the age-related decline in their physical functioning (e.g., reduced strength,

poor balance, weakening bones) (Federal/Provincial/Territorial Committee of Officials (Seniors) for the Ministers Responsible for Seniors, 2001; Theodos, 2003), and from disability and illness (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Beasley, 2009; Perry Schoenfelder et al., 2004; Tiessen et al., 2010). At admission to a PCH in Manitoba, residents are assessed and assigned a level of care between 1 and 4 based on the number of nursing hours of care they require, level 1 requiring the least (0.5 hours per day) to 4 (at least 3.5. hours per day) (Martens et al., 2004; Manitoba Centre for Health Policy, 2003). Thus, it would be expected that the higher level of care required, the greater the risk of falls. However, in this research, fall risk did not increase with level of care. Compared to level 2s, level 3s were not at a significantly different risk of falls or injuries. Level 4s and 6s were at a significantly *lower* risk of falls and injuries, and level 5s were at a significantly *higher* risk. It is possible that level 4s and 6s were at lower risk of falls because of being less active and mobile compared to lower levels of care – these residents are likely to be more frail and less independent, some of whom (level 6s) are awaiting placement in a facility which provides even more care (e.g., Riverview, Deer Lodge). Level 5 residents are respite care recipients (i.e., temporary residents) and may be at greater risk of falls and injuries for several reasons. First, if they are still living predominantly in the community, they are likely to be more active than people who had been admitted to a PCH. Moreover, because they are not permanently PCH residents, they will be less familiar with their surroundings and more likely disoriented from changing living locations.

In the literature, there are many different definitions of *polypharmacy*, ranging from taking two or more medications at one time (Larsen et al., 1999) to four or more (Close et

al in (Impact, 2005), five or more (Ko et al., 1996), up to nine or more (Doupe et al., 2006). Polypharmacy increases the risk of falling (Riefkohl et al., 2003; Impact, 2005; Public Health Agency of Canada: Division of Aging and Seniors, 2005), and there is evidence that it is the total number of medications, regardless of class, that increases fall and fracture risk (Boyle et al., 2010; Ruddock, 2004; Neutal et al., 2002). Other research has found that the effect of polypharmacy is not limited to the elderly, but they are at greater risk of being on polypharmacy because of declining health status (Neutal et al., 2002). In this study, residents on polypharmacy did not differ from non-polypharmacy residents in terms of fall rate. However, their risk of an injurious fall was significantly greater than residents not on polypharmacy.

There is an extensive list of specific drugs that have been found to increase the risk of falls in the elderly, including psychotropics, anti-hypertensives, narcotics, antiarrhythmics, anticoagulants, and anti-Parkinsonian agents. See *Appendix 5: Fall-Risk Drugs for the Elderly* for a detailed list with references. However, in this research, residents on fall-risk drugs did not have a significantly higher rate of falls than those not on such drugs. [see *Appendix 13: Drugs Used to Define Fall-Risk Drugs*]

Cognitive impairments or altered mental states increase the risk of falls (Krueger et al., 2001; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Vu et al., 2004; Huda & Wise, 1998; Tiessen et al., 2010; Beasley, 2009; Fonad, Robins Wahlin, Winbald, Emami, & Sandmark, 2008; Impact, 2005), including dementia (Eriksson et al., 2008; Mirolsky-Scala et al., 2009). In this study, residents with dementia had a significantly greater rate of falls and injuries compared to non-dementia residents.

In sum, results from this research are generally similar when compared with findings in the literature. Overall, the implementation of a fall program resulted in a downward trend in injuries. Fall results were mixed, as some increased and others decreased, but many were not significant. Moreover, several risk factors identified in the literature were found to be significantly related to falls and injuries in this research, including sex, dementia, and level of care.

7.7. Strengths and Limitations of This Research

7.7.1. Use of Secondary Data

This research used secondary data, which have been collected for purposes other than research (e.g., payment claims, administration, management planning, etc.) (Institute for Clinical Evaluative Services (ICES), 2007; Sorensen, Sabroe, & Olsen, 1996). As a consequence, such data often do not contain all of the information desired by researchers (Roos, Nicol, & Cageorge, 1987; Ballinger, 2004; Creswell, 2003). Moreover, it is possible to speak only to those variables included in the model – variables not accounted for can affect the significance of variables in the model (Mertens, 1998).

For instance, the level of care variable is not time-varying – it is assessed only at admission, so as a resident's condition deteriorates over time, level of care becomes a less valid indicator. Thus, level of care is likely being understated. However, this is likely to have a similar effect in both RHAs, so the bias will be in the same direction.

Another problem with using secondary data is the possibility of a recording bias – staff may have started recording falls more often after program implementation, which would explain why injuries in NEHA remained stable rather than decreasing.

There is also a limitation associated with the change from ICD-9-CM to ICD-10-CA codes in the hospital data in the middle of the study. Because ICD-10-CA is much more detailed than ICD-9-CM, the two versions do not always map to each other and can result in many-to-many-matches (Wollman, 2010). In particular, injury codes have greatly expanded (Ellsworth, 2004) and are now grouped by anatomical site rather than injury category (Barta, McNeill, Meli, Wall, & Zeisset, 2008). Consequently, some codes that were categorized as injuries in ICD-9-CM are no longer in the injury category in ICD-10-CM. For example, 'fracture, cause unspecified' (code E887) was included in the injury fall category in ICD-9-CM, but is now coded as 'exposure to unspecified factor' (code X59) in ICD-10-CA and included in a different chapter (Public Health Agency of Canada, 2011; Pan et al., 2007). This could result in some codes being missed and rates being underestimated when converting from ICD-9-CM to ICD-10-CA[6].

However, in spite of these limitations, the use of secondary data enabled the investigation of data retrospectively for longer periods, was less expensive, and time consuming than prospective data collection. It also helped to rule out many threats to validity, including 'volunteer bias' (Martens et al., 2008), selection, instrumentation, testing, experimenter expectancies (Cook et al., 1979), and any other effect introduced by the act of primary data collection where people are aware they are being studied.

This research is unique in that it incorporates the use of administrative claims data in addition to program data, to evaluate a fall program in a PCH population. The use of administrative data is beneficial because it enabled (i) the investigation of the number of

[6] In this research, the ICD-10-CA code X59 was not included because of its indeterminate nature - it is possible that the 'factor' was not a fall. There were only five records with an X59 code.

falls that were serious enough to result in hospitalization, and (ii) a validity check of the program data.

7.7.2. Non-Randomized Design

Random assignment was not used in this research. Randomization is important for (i) increasing the likelihood that intervention and comparison groups are similar at the beginning (Shadish et al., 2002), and (ii) assessing causality (Harris et al., 2006) by controlling for unrelated confounding variables, helping to isolate program effects (Creswell, 2003). However, randomization was not possible in this study because the treatment and comparison groups were pre-existing PCH populations.

When randomization is not possible, it is necessary to use quasi-experimental research designs (Bickman et al., 1998; Gribbons et al., 1997). In this research, a quasi-experimental pre-post, comparison group design was used. While less controlled than a randomized experiment, this design provided an indication of program effects under 'real life' conditions, and as such are more generalizable than randomized experiments which are not generalizable beyond the 'laboratory setting' (Bawden et al., 2011). In applied health research, the goal is to translate research into public health practice, but this has been hindered by an emphasis on internal validity – while it is important to know whether a program is effective, it is also necessary to know if it is likely to be effective in other settings (Steckler & McLeroy, 2008).

Moreover, the use of a pre-test and comparison group did help to control for some threats to internal validity (Lie, 2007) by providing information about outcomes of interest in the absence of the program.

As well, because analyses were population-based – data were collected from all residents in the five provincial PCHs in one RHA and all residents from seven of the 11 provincial PCHs in a comparison RHA – results are representative of these PCHs. Thus, there is high content validity – because virtually everyone is included, it meets the criteria of being a "reasonable sample of the totality of events that characterize the variables of interest" (Rutman, 1980a).

Moreover, quasi-experiments meet two important criteria for establishing causality – (i) the intervention precedes the outcome, and (ii) it is possible to determine if the outcome varies statistically with the intervention (Harris et al., 2006).

In addition, this research incorporated a mix of methodologies (administrative and descriptive data) which helps to further strengthen certainty about a program effect size (Rossi, Lipsey, & Freeman, 2004a; Golafshani, 2003; Reichardt et al., 1998). Triangulating on the true program effect by using multiple methods provides more accurate estimates than those provided from single designs (Shadish et al., 1986). The use of mixed methods is more time consuming and expensive (Reichardt et al., 1979), but is necessary given the complexity of programs (Reichardt et al., 1998).

7.7.3. The Use of Only One Comparison Group

Because there was only one comparison group, it is not clear whether NEHA's Fall Management Program prevented a potential increase in injuries, or whether the increase in IRHA's injuries was due to other factors. For example, it is possible that IRHA's residents were in better general health than NEHA's, and thus more active and at greater risk of falls and injuries. Because level of care is only assessed at admission, it does not reflect any deterioration in a resident's condition. So, for example, NEHA and IRHA

might have similar proportions of level 3 residents, but if NEHA's level 3's are in worse general health and thus, more likely to be bed-ridden, they will be at a lower risk of falling compared to their more active level 3 counterparts in IRHA.

The use of multiple comparison groups would provide more information about outcomes in other similar PCHs with and without fall programs, and would help to triangulate on the true program effect in NEHA. If other PCHs with*out* a fall program had outcomes similar to IRHA (and/or other PCHs *with* a fall management program had outcomes similar to NEHA), confidence in the effectiveness of NEHA's program would be increased.

However, given the limited time and resources, it was not possible to expand the scope of this research to include the use of multiple comparison groups. Moreover, the use of the pre/post design did provide benchmarks which enabled additional comparisons for each RHA – rates of fall outcomes prior to program implementation (NEHA), and rates over time when no program is implemented (IRHA).

7.7.4. Duration of Study

This study was relatively short in duration in terms of being able to detect program effects. There is an unavoidable time lag between the implementation of a fall program and improvements in outcomes (Commonwealth of Australia, 2009), so program effects might not be detectable by the time the evaluation ends. Answering questions about program impact and efficacy may not be realistic in the early years of a program (Rossi, Lipsey, & Freeman, 2004f).

Moreover, there was only one time point measured in the post-period, so there is no indication of how the program is doing over time, after the program was implemented. The more post-program measurement times, the more information about trends.

However, despite this relatively short duration, this study is much longer than most comparable studies in the literature, which ranged from one month up to 2 years post-program implementation. This research is based on almost two years of data prior to the start of the program, and three years of data afterwards.

7.8. Summary

The results of this research suggest that the Fall Management Program had beneficial effects on the residents. Falls trended upwards, providing some evidence of increased resident mobility, but overall injuries remained stable and serious injuries resulting in hospitalization decreased significantly. Moreover, compared to PCHs without a program, rates of overall injuries and hospitalized injuries were similar in the pre-period, but significantly lower in NEHA in the post-period after program implementation. In other words, the situation worsened for residents in non-program PCHs.

These differences between NEHA and IRHA are not likely due to differences in resident characteristics – RHAs were statistically similar in the pre-period and any post-period differences were controlled for in two of the three the analyses[7]. Thus, it appears that IRHA had more difficulty preventing injuries when residents fell compared to NEHA PCHs with the Fall Management Program.

[7] Due to small numbers, it was not possible to keep all of the covariates in the hospitalized falls model, which only controlled for level of care.

The results from this research contribute to the knowledge base for fall interventions in general and fall management specifically, and provide some support for the benefits of being proactive and implementing injury prevention strategies universally and pre-emptively before a resident falls. Implementing a multi-faceted fall management program at the institutional level, regardless of residents' fall-risk, can help to keep residents active and mobile while preventing an increase in injuries. As well, results support the accuracy of the conceptual model developed for this research – identifying risk factors to target with a fall management intervention can result in improved outcomes and a sustainable program.

However, given some of the limitations of this research (i.e., use of only one comparison group, inability to assess on-going program effect), it is important that more research be conducted to help demonstrate that fall management programs can be effective over time and in other settings and populations.

7.9. Recommendations

Specific recommendations would be to:

1. Conduct larger scale research with more comparison groups over a longer period of time, to help identify the true effect of the Fall Management Program
2. Supplement/cover the costs of injury prevention items currently available only if purchased by the resident/family (e.g., hip protection, bed alarms)
3. Financially and politically support alternate, person-centered, social models of care such as fall management and the Eden Alternative

Recommendation 1: Conduct larger scale research to help identify the true effect of the Fall Management Program. This would not only provide more information about the effectiveness of the program itself, it would help to determine the generalizability of the results – i.e., whether similar programs are likely to be effective in other populations and settings. Generalizability is important in applied research fields because the goal is to translate results into public health practices that will improve the health of the public (Steckler et al., 2008). Thus, the more research that is conducted, the more that is learned about the program's effectiveness and whether it should be implemented elsewhere. As highlighted in the recent Canadian Patient Safety Institute (2007) report "*The next steps are to build the research capacity to accurately identify the issues specific to Canada, recommend priority actions, and collaborate with stakeholders and decision makers to implement these consistently in long-term care settings across the country.*

If results support the effectiveness of the Fall Management Program, similar program should be implemented as a standard practice of care for all residents in all PCHs, rather than just targeting residents at risk of falling. These programs should also require that evaluations be conducted regularly to ensure that program goals are being met and to enable modifications if necessary. Given the serious consequences of senior's falls (i.e., increased morbidity, mortality, and financial costs) (Kiely et al., 1998; Jensen et al., 2003) and the greater risk of falls among institutionalized seniors compared to their community counterparts (Kannus et al., 2005; Hoffman et al., 2003), it is imperative that long-term care institutions be proactive (Trotto, 2001). Failure to implement formal fall programs puts residents at increased risk of morbidity and mortality, and greatly hinders their independence and quality of life (Trotto, 2001). Conversely, making an effort to

minimize injuries from falls has potential benefits for residents, their families and friends, PCH staff and administration, the larger community, and the healthcare system.

Residents have a potential for a better quality of life from fewer injuries, avoidance of unnecessary suffering, greater mobility and independence. Assisting residents to remain as independent as possible for as long as possible has been associated with improved self-esteem (Takasaki, 1997).

For staff, the minimization of residents' injuries can minimize the risk of job strain because of fewer physical demands on them (North Eastman Health Association Inc. 2006), and the less time required per resident (Theodos 2003; Takasaki 1997). This can also make more staff time available for helping meet residents' social (e.g., belonging, friendship), esteem (e.g., having the respect of others), and actualization needs (e.g., spiritual fulfillment) – all components of a good quality of life. This can also contribute to the fulfillment of these needs for staff - there is more time to form relationships with residents and families, and this has been found to be associated with greater job satisfaction, and in turn, lower staff turnover (North Eastman Health Association Inc. 2006), greater resident satisfaction with care and a reduction in family complaints (Takasaki, 1997).

Family and friends have peace of mind from knowing residents are not suffering from injuries, and have lower personal costs for uninsured rehabilitative products and services (e.g., less need for medications, assistive devices, hospitalization, etc.) (Theodos, 2003).

There are also many social and economic benefits associated with being able to identify seniors with a high risk of falling (Kiely et al., 1998) and striving to prevent injuries. PCH administration benefits from fewer resident injuries in terms of less staff

time lost because of injury/work strain, and lower staff turnover due to greater job satisfaction (North Eastman Health Association Inc. 2006b; Takasaki, 1997), which in turn contributes to improved job performance (Theodos 2003; Takasaki 1997) and better continuity of care. As well, fewer resident injuries, results in lower institutional costs for caring for the resident (Theodos, 2003) – it is more economical to prevent injuries than to treat them after-the-fact (Kane 2001).

If fall management strategies can also be implemented at the community level, this can help to further reduce the chance of injuries to seniors that often result in premature institutionalization. The Public Health Agency of Canada found that 40% of all PCH admissions are necessitated because of a senior's fall (Public Health Agency of Canada: Division of Aging and Seniors 2005).

The healthcare system as a whole benefits from fewer resident injuries in terms of a reduction in healthcare costs - there is less need for expensive treatments, medications, assistive devices, hospitalization, etc. (Takasaki 1997; Theodos 2003; Butler et al. 1998). It has been estimated that a 20% reduction in injurious falls would result in 7,500 less hospitalizations, 1,800 less seniors with permanent disabilities, and a national savings of $138 million per year (Public Health Agency of Canada: Division of Aging and Seniors 2005). Moreover, today's "patch-work" health care system is not able to provide medical and social services required to properly care for the frail elderly (Canadian Institutes of Health Research (CIHR), 2003). Services are disorganized and providers are admitting that it is challenging to meet the needs of this group (Canadian Institutes of Health Research (CIHR), 2003). Thus, it is logical to try to improve these services and their delivery. The introduction of fall management programs could be one such improvement.

Practice guidelines and comprehensive assessments of residents who have fallen are needed to help minimize disintegrated and variable care (Moreland et al., 2003).

In addition, it is important to ensure that these programs are adequately funded to enable proper education, training, and program sustainability. For example, while NEHA was able to implement the Fall Management Program within its existing budget, it was sometimes necessary for staff to volunteer their time for training – due to limited resources, staff had to attend education and training sessions during their unpaid time off. This can contribute to staff burnout, decreased job satisfaction, turnover, and ultimately negatively impact program sustainability. Sufficient funding is necessary to ensure that the program can be properly implemented.

Recommendation 2: Supplement or cover the costs of injury prevention items currently not covered by health insurance. Currently, some effective injury minimization products are available, but only to residents who can afford to purchase them (e.g., hip protection, bed alarms). Investing in prevention can avert needless human suffering, and medical and hospital care costs. Residents should not have to do without effective injury minimization products because of an inability to pay. Moreover, it is logical to spend relatively little on prevention in order to save a lot on a curative response.

Recommendation 3: Financially and politically support alternate, person-centered, social models of care that are aimed at maximizing resident safety as well as quality of life, such as fall management and the Eden Alternative. Results from research on the effects of person-centered care are very positive, with improvements reported in

continuity (Banks, 1996) and quality of care (Boumans et al., 2005), and functional and behavioral resident outcomes (Amann Talerico et al., 2003; Day, 2005). Moreover, there have been decreases in restraint use (Amann Talerico et al., 2003), injuries (Reese, 2001), circulatory disorders, hospital days, and death (Altman, 2002 in (Frohlich et al., 2002), as well as lower PCH operating costs (Reese, 2001). Residents and families have also reported greater satisfaction with care (Takasaki, 1997; Boumans et al., 2005; Banks, 1996). The traditional medical model of care is easier to administer – resident care can be documented and measured for reimbursement and accountability purposes, but it results in a detached environment for residents and staff, whereas person-centered care is associated with happier staff, better staff retention, better quality of care and healthier residents (Day, 2005). "Nursing homes can be depressing places or they can provide an escape from loneliness and the risks of living alone" (Collopy et al., 1991).

It is believed that problems relating to falling (e.g., hip fractures) will quadruple over the next 40 years, which will likely place severe demands on the health care system (Canadian Institutes of Health Research (CIHR), 2003). Thus, investment in appropriate and cost-effective strategies to optimize balance and encourage safe mobility and independence could help prevent this anticipated increased demand (Canadian Institutes of Health Research (CIHR), 2003).

7.10. Future Research

As with most research, results generated more questions than were answered. For instance, what is the effect of the Fall Management Program over a longer period of

time? Has the program been sustained? Have injuries remained stable? With only three years of post-program data, it is difficult to get an indication of any trends. More research is needed to investigate the longer-term effects of the program to help determine whether fall management is effective. As well, comparisons should be made with more than just one other RHA – future research could include all of the RHAs in Manitoba rather than just two. Moreover, because of a single-payer, universal system across Canada, similar data exists in other provinces (Martens 2004) potentially making provincial and national comparative analysis possible.

Using a similar quasi-experimental, pre-post, comparison group design for future research would make results more comparable. In addition, it is arguably a more suitable design than a randomized controlled experiment because of greater generalizability, which is an important element in turning research into practice (Steckler et al., 2008).

As well, it would be beneficial if future research incorporated additional explanatory variables, such as MDS and ACG data, to provide a better indication of residents' functional and cognitive abilities, and general health status.

Another area of possible future research would be a more detailed investigation of some of the results found in this current research. For instance, there was a significant increase in the use of fall-risk drugs in both RHAs over time. This increase was unexpected given the known risks of using such drugs in older populations, as well as having a medication review component in the Fall Management Program. Additional research could provide more information about this increase in use and help to determine if it is necessary or whether alternate, safer drugs could be used.

Similarly, it would be worth investigating the significantly lower rate of polypharmacy in NEHA compared to IRHA in the post-period. After starting with similar rates, the number of residents on polypharmacy decreased in NEHA while increasing in IRHA. Future research could explore the cause of the decrease in NEHA – was it the result of the Fall Management Program's medication review? If so, why did fall-risk drug use not also decrease? Would implementing a similar medication review process help to lower injuries in IRHA?

Future research could also incorporate a better indicator of level of care. Because level of care is assessed only at admission, it loses validity as residents' conditions deteriorate. PCHs are starting to use more comprehensive measures than level of care, such as the Minimum Data Set (MDS), which assesses residents at regular intervals on multiple measures, and provides an indication of their functionality, cognitive condition, and other characteristics (Manitoba Centre for Health Policy (MCHP), 2010). However, while more detailed than level of care, the MDS measures also need to be regularly re-assessed or they will be as misrepresentative as level of care.

Including the use of additional measures of residents' health status, such as adjusted clinical groups (ACGs) would also be worth incorporating into future research. ACGs provide a measure of health status based on age, sex, and all known medical diagnoses (Manitoba Centre for Health Policy (MCHP), 2009). Using these additional measures could help to provide a better indication of the true program effect – being able to better control for residents' health would help to isolate the true effect of the program.

It would also be beneficial to investigate what specific aspects of the program were most successful. For example, are certain types of exercise programs, such as tai chi or

strength training, associated with better outcomes? Are certain types of restraint alternatives more effective than others (e.g. lowered beds vs bed alarms)? Additionally, it would be worth exploring whether the program benefitted only certain residents (e.g., younger age groups, residents in specific PCHs). The sample size in the current research was not large enough to conduct an investigation at this level.

The timing of falls also warrants further study. This research provided information about the different rates of falls throughout the day, but times were grouped by the hour. If analyses could be reduced to the minute level, it would be possible to see exactly when residents were falling within that hour. For example, it might be discovered that most falls occurred at the beginning and end of the lunch hour when residents are being seated or getting up. Thus, perhaps more supervision is required during these times, and less when residents are seated and eating. It would also be worth investigating different ways of counteracting a higher fall rate during staff shift changes. For example, would residents' falls decrease if shift changes occurred during times when residents were are lower risk, such as during a mealtime, engaged in a supervised activity, or sleeping? Similar analyses could also be conducted for injurious falls, as well as exploring if there are times during which major injuries are more likely than minor ones.

Qualitative research is also needed to provide more detailed, open-ended information from residents and staff about important aspects of the program. For example, interviews and surveys could be used to collect information such as (i) residents' quality of life, and whether it improved since the implementation of the program, (ii) how residents, families, and staff feel about the program, and (iii) suggestions for improvements and/or feedback about aspects of the program that are working well. This information could help

to improve program effectiveness and sustainability, as well as resident satisfaction and quality of life.

Finally, it would be very useful to conduct a cost analysis of implementing a fall management program. Costs associated with injurious falls could be compared prior to and following program implementation to provide an indication of how much money was saved. Moreover, comparisons could also be made between program and non-program PCHs.

Given the seriousness of the injuries seniors sustain from falling, it is imperative that there is continuous effort to minimize them. More research in this area would contribute greatly to this end.

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APPENDICES

Appendix 1: Fall Risk Factors for Older Adults
*the categories regarding the degree of modifiability of these risk factors have been created for this research; the references provided are for the risk factors only, not their degree of modifiability

<u>potentially modifiable by an intervention</u>*

- **lack of exercise** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Theodos, 2004)
- **wheelchair over-reliance** (Theodos, 2003)
- **hazardous walking surfaces,** slippery/wet floors (Perry Schoenfelder et al., 2004; Shanley, 2003) (Theodos, 2003) (Vu et al., 2004) (Trotto, 2001) (JEL Health Education Ltd., 2002)
- **poor nutritional status** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Theodos, 2003; Trotto, 2001)
- **low lighting** (Perry Schoenfelder et al., 2004); altered lighting (Theodos, 2003); poor lighting (Vu et al., 2004; JEL Health Education Ltd., 2002)
- **hazardous furniture & related,** lack of hand rails (Theodos, 2003), throw rugs (Perry Schoenfelder et al., 2004; Vu et al., 2004), IV poles, commodes, over-bed tables that move (Theodos, 2003), unstable furniture (Vu et al., 2004; JEL Health Education Ltd., 2002), high beds (Theodos, 2003), clutter (Vu et al., 2004), phone/electrical cords (JEL Health Education Ltd., 2002)
- **improper footwear** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Theodos, 2003; Trotto, 2001)
- **improper restraint use** (Theodos, 2003; Shanley, 2003)
- **inadequate numbers of staff** (Theodos, 2003; Shanley, 2003)
- **unsafe work practices** (e.g., delays in responding to requests, improper use of restraints, unsafe transfer practices, poor supervision) (JEL Health Education Ltd., 2002; Shanley, 2003)
- **low support from management** (Shanley, 2003)
- **poorly maintained / improperly used mobility aids** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Trotto, 2001; JEL Health Education Ltd., 2002)
- **use of multiple medications** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Trotto, 2001; Beasley, 2009) **and/or high risk medications**; tranquilizers, antidepressants, antihypertensives (Public Health Agency of Canada: Division of Aging and Seniors, 2005); psychotropics (Shanley, 2003; Tiessen et al., 2010); analgesics, diuretics, antihypertensives (Vu et al., 2004)
- **use of excessive alcohol** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Huda et al., 1998; Theodos, 2003; Trotto, 2001)
- **time constraints** (e.g., meal times) (Theodos, 2003)

Appendix 1: Fall Risk Factors for Older Adults (cont'd)

<u>possibly modifiable by an intervention</u>*

- **risk-taking behavior** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)
- **wandering** (Kiely et al., 1998)
- **lack of education** (education about program is modifiable, not formal education)
- **impaired gait/balance/slow walking speed** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Kiely et al., 1998; Perry Schoenfelder et al., 2004; Huda et al., 1998)
- **poor muscle strength / weakness** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Perry Schoenfelder et al., 2004; Vu et al., 2004)
- **impaired touch & proprioception** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)
- **fear of falling** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Trotto, 2001; Perry Schoenfelder et al., 2004)
- **depression** (Theodos, 2003; JEL Health Education Ltd., 2002)
- **loneliness / lack of social interaction** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; JEL Health Education Ltd., 2002)
- **relocation** (e.g., admission to a PCH or readmission after a hospital stay or room change (Theodos, 2003)
- **level of care** (Krueger et al., 2001)

<u>more difficult to modify / beyond the scope of an intervention</u>*

- **no monitoring system** (Shanley, 2003)
- **poor building design/maintenance** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Impact, 2005)
- **inadequate building codes** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)

Appendix 1: Fall Risk Factors for Older Adults (cont'd)

<u>non-modifiable by an intervention</u>*

- **advanced age** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Kiely et al., 1998; Perry Schoenfelder et al., 2004; Huda et al., 1998; Theodos, 2003; Lach, 2010); age greater than 75 years (Tiessen et al., 2010)
- **previous / history of falls** (Krueger et al., 2001; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Kiely et al., 1998; Izumi, Makimoto, Kato, & Hiramatsu, 2002; Perry Schoenfelder et al., 2004; Theodos, 2003; Shanley, 2003; Shanley, 2003; Tiessen et al., 2010; Lach, 2010)
- **cognitive impairments / altered mental state** (Krueger et al., 2001; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Vu et al., 2004; Huda et al., 1998; Tiessen et al., 2010; Beasley, 2009; Fonad et al., 2008; Impact, 2005); **dementia** (Eriksson et al., 2008; Mirolsky-Scala et al., 2009)
- **adverse reactions to medications** (Perry Schoenfelder et al., 2004; Brazeau, 2001)
- special **toileting** needs (Beasley, 2009)
- **females gender** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Lach, 2010)
- **chronic illness / disability** (e.g., stroke, Parkinson's) (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Perry Schoenfelder et al., 2004; Tiessen et al., 2010); incontinence (Trotto, 2001; JEL Health Education Ltd., 2002); dehydration, arthritis, diabetes, dementia, vascular disease, foot disorders, visual impairment; postural hypotension and syncope (brief loss of consciousness) (Theodos, 2003; Shanley, 2003); debilitating conditions and diseases (Beasley, 2009)
- use of **ambulatory aids** (Tiessen et al., 2010)
- unsteady **gait** (Beasley, 2009)
- **acute illness** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)
- **poor vision** (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Kannus et al., 2005; Trotto, 2001; JEL Health Education Ltd., 2002; Tiessen et al., 2010; Beasley, 2009; Impact, 2005)
- **low income** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)
- **lack of formal education** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)
- **low level of literacy/language barrier** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)
- **poor living conditions/unsafe housing** (Public Health Agency of Canada: Division of Aging and Seniors, 2005)

Appendix 2: Fall-Related Research References

Title	Reference Information
Fall Prevention Related Research	
Statistical Analysis of Efficacy in Falls Prevention Trials (2005)	*Journal of Gerontology*: Medical Sciences, 60A, 530-534
Using Information Technology to Assist in Redesign of a Fall Prevention Program (2003)	Allan Browne, J., Covington, B. G., & Davila, Y.; *J Nurs Care Qual*, 19, 218-225.
Guidelines for the Prevention of Falls in Older Persons (2001)	American Geriatrics Society, British Geriatrics Society, & American Academy of Orthopaedic Surgeons Panel on Falls Prevention; *American Geriatrics Society*, 49, 664-672.
Preventing Accidental Falls Among Older People in Long Stay Units (2001)	Barry, E., Laffoy, M., Matthews, E., & Carey, D.; *Irish Medical Journal, 94,* 172-176.
Benefits of Implementing and Interdisciplinary and Multifactorial Strategy to Falls Prevention in a Rural, Residential Aged-Care Facility (2009)	Beasley, K.; *Int J Evid Based Healthc*, 7, 187-192.
A Student-Led Demonstration Project on Fall Prevention in a Long Term Care Facility (2007)	Bonner,A.; MacCulloch,P.; Gardner,T.; Chase,C.W.; *Geriatric Nursing*, 28 (5), 312-318.
The Evolution of Seniors' Falls Prevention in British Columbia (2006)	British Columbia Ministry of Health; (Rep. No. March 2006). British Columbia Ministry of Health.
Interventions for Preventing Falls in Older People in Nursing Care Facilities and Hospitals (2010)	Cameron,I.D.; Murray,G.R.; Gillespie,L.D.; Robertson,M.C.; Hill,K.D.; Cumming,R.G.; Kerse,N.; The Cochrane Collaboration, 1-117.
Interventions for the Prevention of Falls in Older Adults: Systematic Review and Meta-analysis of Randomised Clinical Trials (2004)	Chang, J. T., Morton, S. C., Rubenstein, L. Z., Mojica.W.A., Maglione, M., Suttorp, M. J. et al.; *BMJ, 328*.
Falls Prevention Revisited: A Call for a New Approach (2004)	Dempsey, J.; *Journal of Clinical Nursing, 13*, 479-485.
A Best Practices Guide for the Prevention of Falls Among Seniors Living in the Community. Injury Prevention for Seniors and Veterans (2001)	Federal/Provincial/Territorial Committee of Officials (Seniors) for the Ministers Responsible for Seniors [On-line].
Effectiveness of Targeted Falls Prevention Programme in Subacute Hospital Setting: Randomized Controlled Trial (2004)	Haines, T. P., Bennell, K. L., Osborne, R. H., & Hill, K. D.; *BMJ, 328*.

Appendix 2: Fall-Related Research References (cont'd)

Title	Reference Information
Fall Prevention Related Research	
Insights Obtained From an Evaluation of a Falls Prevention Program Set in a Rural Hospital (2000)	Hathaway, J., Walsh, J., Lacey, C., & Saenger, H.; *Aust J Rural Health, 9,* 172-177.
Falls Prevention Initiative: Summaries of Funded Projects 2000-2004 (2003)	Health Canada / Veterans Affairs Canada; Minister of Public Works and Government Services Canada 2003
The Evolution of Seniors' Falls Prevention in British Columbia (2006)	Herman, M., Scott, V., & Graham, T.
Evolution of Compliance Within a Fall Prevention Program - Interdisciplinary Performance Improvement: Progress or Pitfalls? (1998)	Huda, A. & Wise, L.; *Journal of Nursing Care Quality, 12,* 55-63.
Preventing Falls Among Older Clients: Essential Guide for the Facilitator (Guidebook) (2002a)	JEL Health Education Ltd.
Prevention of Falls and Consequent Injuries in Elderly People (2005)	Kannus, P., Sievanen, H., Jarvinen, T., & Parkkari, J.; *The Lancet, 366,* 1885-1893.
Fall Prevention in Residential Care: A Cluster Randomized, Controlled Trial (2004)	Kerse, N., Butler, M., Robinson, E., & Todd, M.; *Journal of the American Geriatrics Society, 52,* 524.
Development of Common Outcome Data Set for Fall Injury Prevention Trials: The Prevention of Falls Network Europe Consensus. (2005)	Lamb, S. E., Jorstad-Stein, E. C., Hauer, K., & Becker, C. o. b. o. t. P. o. F. N. E. a. O. C. G.; *JAGS, 53,* 1618-1622.
Manitoba Institute for Patient Safety (MIPS) Tips: Fall Prevention (2007)	Manitoba Institute for Patient Safety . http://www.mbips.ca/mfalls.html
Evidence-based Guidelines for the Secondary Prevention of Falls in Older Adults (2003)	Moreland, J., Richardson, J., Chan, D. H., O'Neill, J., Bellissimo, A., Grum, R. M. et al.; *Gerontology, 49,* 93-116.
Statewide Action Plan: Falls Prevention in Older People 2002-2006 (2002)	Queensland Government (Health)
Falls Prevention Best Practice Guidelines: For Public Hospitals and State Government Residential Aged Care Facilities (2003)	Queensland Health Australia
Prevention of Falls in Nursing Homes: Subgroup Analyses of a Randomized Fall Prevention Trial (2008)	Rapp,K.; Lamb,S.E.; Büchele,G.; Lall,R.; Lindermann,U.; Becker,C.; J *Am Geriatr Soc*, 56, 1092-1097.

Appendix 2: Fall-Related Research References (cont'd)

Title	Reference Information
Fall Prevention Related Research	
Prevention of Falls and Fall Injuries in the Older Adult: Nursing Best Practice Guidelines (2002)	Registered Nurses Association of Ontario
Fall Prevention in Frail Elderly Nursing Home Residents: A Challenge to Case Management: Part 1 (2003)	Theodos, P.;*Lippincott's Case Management, 8,* 246-250.
Fall Prevention in Frail Elderly Nursing Home Residents: A Challenge to Case Management: Part 2 (2004)	Theodos, P.; *Lippincott's Case Management, 9,* 32-44.
Falls in the Nursing Home: Are They Preventable? Controversies in Long-Term Care (2004)	Vu, M. Q., Weintraub, N., & Rubenstein, L.; *Journal of the American Medical Directors Association, 5*, 401-406.
Fall and/or Injury Prevention	
Fall and Injury Prevention in Older People Living in Residential Care Facilities. (2002)	Jensen, J., Lundin-Olsson, L., Nyberg, L., & Gustafson, Y.; *Ann Intern Med, 136,* 733-741. [move to fall/injury prevention]
Fall and Injury Prevention in Residential Care - Effects in Residents with Higher and Lower Levels of Cognition (2003)	Jensen, J., Nyberg, L., Gustafson, Y., & Lundin-Olsson, L.; *J Am Geriatr Soc, 51,* 627-635.
Fall Management Related Research	
Implementation and Evaluation of a Nursing Home Fall Management Program (2007)	Rask,K.; Parmelee,P.A.; Taylor,J.A.; Green,D.; Brown,H.; Hawley,J.; Schild,L.; Strothers,H.S.; Ouslander,J.G.; *JAGS,* 55, 342-349.
Falls in Older People: Prevention and Management (2002)	Tideiksaar, R.; (3 ed.) Baltimore: Health Professions Press.
Use of a Content Analysis Procedure for the Development of a Falls Management Audit Tool (2005)	Wagner, Clark, Parmelee, Capezuti, & Ouslander; *Journal of Nursing Measurement,* 13, 101-113.
Fall and/or Injury Reduction Related Research	
Effectiveness of Multifaceted Fall-Prevention Programs for the Elderly in Residential Care (2008)	Cusimano,M.D.; Kwok,J.; Spadafora,K.; *Inj Prev,* 14, 113-122.
A Study of Falls in Long-Term Care and the Role of Physicians in Multi-Disciplinary Evidence-Based Prevention (2008)	Scott,V.J.; Johnson,S.; Kozak,J.-F.; Gallagher,E.M.; *Geriatrics & Aging,* 11(7), 395-400.

Appendix 2: Fall-Related Research References (cont'd)

Title	Reference Information
Fall and/or Injury Reduction Related Research (cont'd)	
Decreasing the Incidence of Falls in the Nursing Home in a Cost-Conscious Environment: A Pilot Study (2003)	Hofmann, M. T., Bankes, P. F., Javed, A., & Selhat, M.; *Journal of the American Medical Directors Association, March/April,* 95-97.
Reducing the Incidence of Falls and Hip Fractures in Care Homes (2003)	Johnson, T. & Binney, S.; *Nursing Times, 99,* 38-40.
A Structured and Individualized Safety Programme Reduced Falls in High Risk Nursing Home Patients (1998)	Ray, W. A., Taylor, J. A., Meador, K. G., & et al.; *Evidence-Based Nursing* 1[2], 52.
A Randomized Trial of a Consultation Service to Reduce Falls in Nursing Homes (1997)	Ray, W. A., Taylor, J. A., Meador, K. G., Purushottam, B. T., Brown, A. K., Kajihara, H. K. et al.; *JAMA, 278,* 557-562.
Falls and Injury Reduction in Residential Aged Care: Translating Research into Practice (2003)	Shanley, C.; *Contemporary Nurse, 15,* 81-93.
They All Fall: Strategies for Reducing Falls Among the Elderly (2001)	Trotto, N. E.; *Contemporary Long term Care, 24,* 38.
Fall Intervention Related Research	
Effectiveness of a Multifaceted Intervention on Falls in Nursing Home Residents (2003) [goal: to reduce the incidence rate of falls, fallers and fractures]	Becker, C., Kron, M., Lindemann, U., Sturm, E., Eichner, B., Walter-Jung, B. et al.; *J Am Geriatr* Soc, 51, 306-313.
Rate of Accidental Falls in Institutionalized Older People with and without Cognitive Impairment Halved as a Result of a Staff-Oriented Intervention (2008)	Bouwen,A.; Lepeleire,J.De; Buntinx,F.; *Age and Ageing*, 37, 306-310.
Community-Based Exercise Program Reduces Risk Factors for Falls in 65- to 75-Year Old Women with Osteoporosis: Randomized Controlled Trial (2002)	Carter, N. D., Khan, K. M., McKay, H. A., Petit, M. A., Waterman, C., Heinonen, A. et al.; *CMAJ, 167,* 997-1003
Current Approaches to Postfall Assessment in Nursing Homes (2004)	Gray Miceli, D., Strumpf, N. E., Reinhard, S. C., Zanna, M. T., & Fritz, E.; *JAMDA, Nov/Dec,* 387-394
A Randomized Trial of Exercise Programs Among Older Individuals Living in Two Long-Term Care Facilities: The FallsFREE Program (2001)	Nowalk, M. P., Prendergast, J. M., Bayles, C. M., D'Amico, F. J., & Colvin, G. C.; *Journal of the American Geriatrics Society, 49,* 859.
An Exercise Program to Improve Fall-Related Outcomes in Elderly Nursing Home Residents (2004)	Perry Schoenfelder, D. & Rubenstein, L. M.; *Applied Nursing Research, 17,* 21-31.

Appendix 2: Fall-Related Research References (cont'd)

Title	Reference Information
Fall Intervention Related Research (cont'd)	
Fall Risk Assessment in Very Old Males and Females Living in Nursing Homes (2004)	Sieri, T. & Beretta, G.; *Disability and Rehabilitation, 26,* 718-723.
Impact of a Falls Menu-Driven Incident-Reporting System on Documentation and Quality Improvement in Nursing Homes (2005)	Wagner, L. M., Capezuti, E., Taylor, J. A., Sattin, R. W., & Ouslander, J. G.; *The Gerontologist, 45,* 835-842.
Fall Risk Factors/Assessment of	
Physical Restraint Use and Falls in Nursing Home Residents (1996)	Capezuti, E., Evans, L., Strumpf, N., & Maislin, G.; *J Am Geriatr Soc* 44, 727-728.
Prospective Study of Fall Risk Assessment Among Institutionalized Eldery in Japan 2002)	Izumi, K., Makimoto, K., Kato, M., & Hiramatsu, T.; *Nursing and Health Sciences, 4,* 141-147.
Factors Associated with Falls Among Older, Cognitively Impaired People in Geriatric Care Settings: A Population-Based Study. (2005)	Kallin, K., Gustafson, Y., Sandman, P.-O., & Karlsson, S.; *Am J Geriatr Psychiatry, 13,* 501-509.
Risperidone and Falls in Ambulatory Nursing Home Residents with Dementia and Psychosis or Agitation: Secondary Analysis of a Double-Blind Placebo Trial (2004)	Katz, I. R., Rupnow, M., Kozma, C., & Schneider, L.; *Am J Geriatr Psychiatry, 12,* 499-508.
Risk Factors for Falls and Injuries in a Long-Term Care Facility in Ontario (2001)	Krueger, P. D., Brazil, K., & Lohfeld, L. H.; *Canadian Journal of Public Health, 92,* 117-120.
Case-Control Study of Exposure to Medication and the Risk of Injurious Falls Requiring Hospitalization Among Nursing Home Residents (1997)	Mustard, C. A. & Mayer, T.; *American Journal of Epidemiology, 145,* 738-745.
Antidepressants and the Risk of Falls Among Nursing Home Residents (1998)	Purushottam, B. T., Gideon, P., Cost, T. W., Milam, A. B., Pharm, D., & Ray, W. A.; *The New England Journal of Medicine, 339,* 875-882.
Injury Prevention Related Research	
Hip Protectors Improve Falls Self-Efficacy (2000)	Cameron, I. D., Stafford, B., Cumming, R. G., Birks, C., Kurrle, S. E., Lockwood, K. et al.; *Age and Ageing, 29,* 57-62.

Appendix 2: Fall-Related Research References (cont'd)

Title	Reference Information
Injury Prevention Related Research (cont'd)	
Comprehensive Injury Prevention Approach (2005)	Center for Injury Prevention Policy & Practice;http://www.eldersafety.org/models_for_success/comprehensive_injury_prevention_approach
Chief Medical Officer of Health Report - Injury: Predictable and Preventable (2002)	D'Cunha, C. O.; http://health.gov.on.ca/english/public/pub/ministry_reports/injury_rep02/injury_rep.html
Injury Prevention Model Broadens Safety Scope. HealthCare Benchmarks and Quality Improvement (2002)	Hartgarten, S. W.; http://findarticles.com/p/articles/mi_m0NUZ/is_1_1/ai_90752103/print
Development of Common Outcome Data Set for Fall Injury Prevention Trials: The Prevention of Falls Network Europe Consensus (2005)	Lamb, S. E., Jorstad-Stein, E. C., Hauer, K., & Becker, C. o. b. o. t. P. o. F. N. E. a. O. C. G.; *JAGS, 53,* 1618-1622.
Data Sampler: Injuries Associated with Falls by Seniors Canada (2002)	Public Health Agency of Canada, H. C.
The Injury Prevention and Evaluation Cycle (2006)	Raina, P., Turcotte, K., & Soubhi, H.; http://www.injuryresearch.bc.ca/Publications/Posters/IPEC% 20 Poster.pdf#search=%22model%20injury%20prevention%22
Prevention of Fall-Related Injuries in Long-Term Care: A Randomized Controlled Trial of Staff Education (2005)	Ray, W. A., Taylor, J. A., Brown, A. K., Gideon, P., Hall, K., Arbogast, P. et al.; *Arch Intern Med, 165,* 2293-2298.
Fall/Injury Risk Reduction	
Risk of Hip Fracture in Protected and Unprotected Falls in Nursing Homes in Norway (2004)	Forsen, L., Sogaard, A. J., Sandvig, S., Schuller, A., Roed, U., & Arstad, C.; *Injury Prevention, 10,* 16-21.
Identifying Nursing Home Residents at Risk for Falling (1998)	Kiely, D. K., Kiel, D. P., Burrows, A. B., & Lipsitz, L. A.; *American Geriatrics Society, 46,* 555.
The Slippery Slope: Reducing Fall Risk in Older Adults (2005)	Komara, F. A.; *Prim Care Clin Office Pract, 32,* 683-697.
Risk Indicators for Falls in Institutionalized Frail Elderly (2006)	Kron, M., Loy, S., Sturm, E., Nikolaus, Th., & Becker, C.; *Am J Epidemiol, 158,* 645-653.
Falls in the Nursing Home (1994)	Rubenstein, L. Z., Josephson, K. R., & Robbins, A. S.; *Ann Intern Med, 121,* 442-451.

Appendix 2: Fall-Related Research References (cont'd)

Title	Reference Information
General Fall-Related Reports	
An Epidemiologic Study of Fall-Related Fractures Among Institutionalized Older People (1995)	Cali, C. M. & Kiel, D. P.*; American Geriatrics Society, 43*, 1336-1340.
Data Sampler: Injuries Associated with Falls by Seniors Canada (2002)	Public Health Agency of Canada, H. C.
Report on Seniors' Falls in Canada Minister of Public Works and Government Services Canada (2005)	Public Health Agency of Canada: Division of Aging and Seniors
Falls in the Nursing Home (1994)	Rubenstein, L. Z., Josephson, K. R., & Robbins, A. S.; *Ann Intern Med, 121*, 442-451.

Appendix 3: Review of Related Fall-Program Evaluations

(a) Non-Randomized: (n=9)

Article / Author(s)	Study Objectives	Place and Sample Size (n=# persons / # total eligible sample)	Study Design	OR (95% CI), RR, or magnitude of effect	Comments
(Beasley, 2009)	• to improve practice in the prevention of falls among residents	• 20 residents previously assessed as medium/high fall risk, from a 56-bed rural residential aged-care facility, Queensland Australia	• an audit, feedback and re-audit strategy to improve practice, along with a program of multiple interventions aimed at minimizing residents' risk of falling were used • best practices were identified, implemented, and evaluated 1 month later to measure practice change and resident outcomes	• there was a significant increase in staff awareness of, and attendance at falls prevention training from 10% pre-implementation to 95% post-implementation • there were regularly 21-23 falls a month pre-implementation, which dropped to 12 per month after implementation; the authors state that this is a significant decrease but do not provide information about tests used or level of significance	• author's conclusion: the program achieved its aim to reduce fall risk for residents, thus supporting the evidence-based practice for interdisciplinary, multifactorial falls prevention programs

Appendix 3: Review of Fall-Related Program Evaluations

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Bonner, MacCulloch, Gardner, & Chase, 2007)	• to evaluate the effectiveness of a fall prevention training program in a long-term care setting	• 40% of the facility nursing and ancillary staff participated	• single group repeated measure design • baseline knowledge of fall prevention was assessed, information was delivered to nursing and ancillary staff, retention was evaluated by a 60-day post –test, and fall rates were compared at baseline and 2 months after the intervention	• although not significant, post-test scores suggest learning occurred (pre-test mean=86.78% vs post-test mean=90.69%; p=.057) • the fall rate before training was 16.1%; the 30-day post – training fall rate was 12.3% and the 60-day post-training fall rate was 9% (no details about statistical significance testing reported)	• author's conclusion: while not statistically significant, there was improvement in learning after the education, and improved fall rates suggests the new information may have been used

Appendix 3: Review of Fall-Related Program Evaluations

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Rask et al., 2007)	• to evaluate the feasibility and effectiveness of a falls management program • the intervention had three phases: (i) development of organizational support, (ii) training of team and provision of tools, and (iii) assistance from advanced practice nurses	• all residents in 19 non-profit nursing homes in Georgia, US between September 2004 and 2005	• quality improvement project • monthly census was used as the denominator and data were expressed as rate per 100 residents, averaged for the 12 months of the study • least squares lines were determined for each rate and tested for significant change	• falls rates remained stable in the intervention nursing homes (17.3 falls/100 residents per month at start and 16.4 falls/100 res. at end; p=0.92) vs an increase in the non-program homes (15.0/100 res to 18.9/100 res; p=0.008) (no details about statistical significance testing reported)	• the fall management program may be helpful in managing fall risk in nursing homes • the authors warn that results should be interpreted with caution given it is not a randomized, controlled clinical trial, this it is impossible to control for all possible confounders

Appendix 3: Review of Fall-Related Program Evaluations

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Scott, Johnson, Kozak, & Gallagher, 2008)	• to reduce falls and fall-related injuries among residents in Canadian Long term Care facilities via three phases of fall prevention-related collaborative activity: (i) start-up, (ii) implementation, and (iii) evaluation	• five long-term care facilities from three Canadian provinces participated in the project • 1691 resident falls	• falls were tracked over a 16-month period (surveillance – 180 days; training between phases – 120 days; intervention – 180 days)	• the rate of falls per 1,000 bed-days went from 8.4 during the surveillance phase to 7.8 during the intervention phase (not statistically significant); similarly, the rate of fallers (those who fell once or more) went from 3.1/1,000 bed-days to 3.4 (also NS) • all injurious falls decreased significantly during the intervention (no details about statistical significance testing reported)	• authors' conclusions: results indicate that interventions were successful in reducing the rate of falls and fall-related injuries

Appendix 3: Review of Fall-Related Program Evaluations

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments

(Hofmann, Bankes, Javed, & Selhat, 2003)	• evaluate the prevalence of falls
	• determine effectiveness of three *fall-reduction* interventions: (i) environmental audits; (ii) staffing changes; (iii) restorative activity programs
		• 120-bed frail *PCH population*, Philadelphia, PA
		• sample #: not stated
			• pre-/post intervention: retrospective - charts and records reviewed for all residents (no control group) one year prior to and one year following intervention
			• falls were tracked according to severity and time and place of occurrence
				• adjustment variables: not stated
				• type of analysis: not stated
				• 1-year pre-intervention: 479 falls resulted in 16 fractures
				  ○ mean falls = 40 ± 9 per month
				  ○ fracture rate = 3.3%
				  ○ 221 (46%) of falls occurred on the 3pm-11pm shift, resulting in 63% (n=10/16) of the fractures; 91 falls occurred during the 11pm-7am shift
				• 1-year post-intervention: 299 falls resulted in 8 fractures:
				  ○ mean falls = 25 ± 7 per month; a statistically significant 38% reduction in falls (p=0.0003)
				  ○ fracture rate = 2.7%; a 50% reduction in fractures (NS)
				  ○ falls on the 3pm-11pm shift were significantly reduced to 115 and to 29 on the 11pm-7am shift
				• other:
				  ○ there were 21% males in the pre-intervention time period and 28% post-intervention (NS different)
				  ○ 55% of residents were 85+ years old pre-intervention time period and 45% post-intervention (NS different)
				  ○ the institution was 64% Medicaid during the pre-intervention and 38% post-intervention (comparable with other Pennsylvania facilities during corresponding time periods)
					• author's conclusion: the 3 interventions may have contributed to a decrease in overall falls and resulting fractures
					• a restraint-free facility for several years
					• limitations: (i) confounding variables not controlled for; (ii) uncertainty about how well groups were matched before and after intervention; (iii) no control group; (iv) difficult to determine whether or not the intervention caused the decreases with retro design

Appendix 3: Review of Fall-Related Program Evaluations

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Theodos, 2003) (Theodos, 2004)	• to study the effectiveness of a multifaceted falls *prevention* program by studying changes in the rate of falls after the program was implemented • pre-assessment and post-fall assessment with suggestions for specific treatment and preventative interventions	• 156-bed skilled *PCH*, Oak Brook Illinois; currently a 93% occupancy rate; tend to have few available beds • initial population included all residents from Oct 1999 to Sep 2001 • mean age of residents: 88 years • 122 female: 23 male residents	• retrospective pilot study of fall incidents • examination of changes in the rate of falls after program implementation using occurrence and investigative reports	• 27-weeks prior to program: 207 falls; 137.4 average weekly census, for a 0.0609 (SD=0.022) falls per resident per week [= # patient falls per week / avg. weekly census for week] • post-intervention period (27-week period after program start): 173 falls; 141.34 average weekly census, for a 0.0473 (SD=0.026) falls per resident per week ○ p=0.0486 (paired t-test); p=0.009 (2-tailed Mantel-Haenszel Chi-Square analysis) • descriptive variables*: sex; age; repeated fallers; time of fall; use of safety devices; day of the week; resident activity and location at time of fall; chronic conditions; number of medications taken (not counting vitamins or as needed medications); dependent in ADLs; use of a cane, walker or wheelchair; urinary incontinence; prior fall(s); assessment of gait; confusion [*percentages reported for these variables]	• author's conclusion: the new program clearly enhanced safety; the program was effective in reducing falls rate of frail (i.e., complex medical and psychological problems) PCH residents by promoting their independence and safety, thus postponing problems resulting from inactivity • limitations: authors note that strategies used increased staff's awareness of patients at risk for falls which could have accounted for some change in the outcomes in addition to intervention effects

Appendix 3: Review of Fall-Related Program Evaluations

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Dempsey, 2004)	• to test a *Falls Prevention* Programme in an acute medical area to see if effects were sustainable • program included a risk assessment tool that matched individual risk factors to interventions, a graphic that alerted others to 'at risk' patients, and patient and staff education	• patients admitted to an acute medical area, in a *regional teaching hospital* in New South Wales, Australia	• 2 groups of patients admitted for the same amount of time, before and after the program, were compared after 5 years, in terms of number of falls using data from incident forms • the 1st group was a non-equivalent control-group of patients & the 2nd was the exp. grp.	• controlled variables: staffing, equipment, environment, and routines; *because of ethical constraints, age, mental status, mobility and gender were not controlled (program offered to <u>all</u> patients) • pre-program: 73 falls (1995); rate of patient falls 3.63 • post-program: 40 falls (1996); rate of patient falls 2.29 ◦ 55% reduction from pre- to post-tx; significant reduction in rate (p=0.05; non-paired t-test) ◦ there was a significant (p=0.05) relationship between incident of falling and age and mobility; gender, mental status, time and place of falls, and patient activity all NS (ANOVA) • after the project (2001), fall rates exceeded pre-program levels at 6.8	• author's conclusion: results supported the evidence in the literature available at the time that a falls prevention program can reduce the rate of falling amongst acute medical patients • using identical time periods in the consecutive years controlled for seasonal effects • during the study there were no changes in staffing numbers, supervision of patients, hospital routine, model of care, equipment • differences in admission numbers eliminated using the formula [rate of falls = # falls / occupied bed days x 1000] • limitations: authors note the limitation that nurses have varying thresholds for they types of falls considered worthy of an incident form so many falls are unreported

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Hathaway, Walsh, Lacey, & Saenger, 2000)	• to determine the effectiveness of a falls prevention program • program included identification of high risk patients, and staff education	• 111 patients aged 65+ (average age=81.2) in the general ward of a 29-bed rural hospital in New South Wales (Australia) • program start: Jan 1997	• retrospective analysis of patient incident reports	• 30.4% (n=34) of program participants had 1 or more falls • 14% (n=15) had multiple falls • 61 total falls in1997; 88 in 1995-96 • 50.8% (n=31) of falls were in the ward; 19.7% (n=12) in the bathroom; 14.8% (n=9) on verandah; 11.5% (n=7) in the corridor; 3.3% (n=2) in the doorway • 5.3 average falls per month (range 1-10); most in January (n=10) then October (n=8) • peak times for falls: 6pm-8pm; 2am-4am; 10am-noon • fallers had a significantly greater tendency to be using pick-up frames/forearm support frames: 41.4% of fallers vs 15.8% of non-fallers were using these (Chi-square = 8.5445 (3df) $p<0.05$ • fallers significantly associated with high risk category (vs medium or low): 73.3% of fallers and 54.5% of non-fallers (Chi-square = 6.0259 (2df) $p<0.05$	• authors conclude that the program was *"proven"* to be effective in reducing the total number of falls within the hospital; the program was less effective for the frail aged patients • authors note that the nature of rural settings required nursing staff to work in acute and emergency care, so there is no guarantee that staff will be able to stay by the side of clients the entire time they are mobile

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(a) Non-Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Barry, Laffoy, Matthews, & Carey, 2001)	• to develop and implement a ***fall prevention*** strategy for elderly patients and to improve awareness among the patients and staff (lecture, workshop, environment audits, risk factor assessments)	• 95 bed *District Hospital* in Ireland (Baltinglass District Hospital in West Wicklow) • average patient age = 81 years • bed occupancy is approx. 90% with 150 admissions per year	• pre-/post intervention: data on falls and resulting injuries compared for the year prior to the intervention (Jun 1997-May 1998) with equivalent data at one-year (Oct 1998-Sep 1999) and at two-years (Oct 1999-Sep 2000) after the intervention	• 1-year *pre*-intervention: 39 patients out of a total of 156 (25%) sustained 71 falls ◦ 0.75 falls/bed ◦ 23 patients were injured, sustaining a total of 27 injuries; 16 patients were uninjured after the fall • 1-year *post*-intervention: 36 patients out of a total of 172 (20.9%) sustained 56 falls ◦ 0.59 falls/bed ◦ 21% fewer falls in year-1 vs pre-intervention (chi-sqr, NS) ◦ 14 patients were injured, sustaining 19 injuries; 22 patients (61.1%) were uninjured after the fall • 2-years *post*-intervention: 26 patients out of a total of 149 (17.4%) sustained 36 falls ◦ 0.38 falls/bed ◦ 49.3%* fewer falls in year-2 vs pre-intervention (significant) [*says is significant in abstract but not denoted in table 4]; the difference between pre-, 1- & 2-year falls (chi-sqr. NS) ◦ 4* *patients* were injured, sustaining one injury each (n=4* *injuries*) (both significant reductions from the pre-intervention year; *p<.01); 22* patients were uninjured after the fall (a significant reduction from the pre-intervention year; *p<0.01)	• author's conclusion: this intervention reduced falls and their adverse consequences for older people living in the long stay unit • limitations: the baseline figure for the proportion of patients who fell in a year (25%) appears low compared to other research, unlikely due to under-recording given the importance of the Incident Report Form in the event of legal action; the overall rate of injury at baseline was high possible due to the frailty of patients in long-stay hospitals; it is unclear which of the interventions used in this study produced the greatest effect – further research is needed

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (n=9)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Bouwen, Lepeleire, & Buntinx, 2008)	• to evaluate the impact of a staff-oriented intervention on the number of accidental falls in residents with and without cognitive impairment	• nurses in 10 nursing wards from 7 nursing homes were randomized to 5 control or 5 intervention groups	• randomization to group • nurses in the intervention group were given multi-faceted fall training and asked to record relevant information when residents fell for • accidental falls were compared at baseline and 6 months post-intervention	• at baseline, 44/210 (21%) of intervention residents fell once vs controls (20/169 or 12%); at post-intervention, 28/203 (14%) intervention residents fell vs controls (38/158 or 24%) • crude relative risk of falling at least once post-intervention: 0.57 (0.37-0.89); adjusted OR after controlling for baseline results: 0.46 (0.26-0.79); after controlling for institution and baseline results OR=0.22 (0.07-0.64) • no significant difference between average number of falls between intervention and control residents • there were more falls around 6pm, but were spread equally over the weekdays	• author's conclusion: the intervention led to a 50% reduction of residents who fell after controlling for things like mobility and cognitive impairment • the authors point out that (i) because of normal turnover of residents in nursing homes, they were not completely the same group during the baseline and post-intervention period, but was acceptable because the focus is on the ward/nurses working on them, not the individual resident; (ii) only falls requiring medical intervention were analyzed

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Rapp et al., 2008)	• to evaluate the effectiveness of a multifaceted fall prevention program in nursing home resident subgroups • there were no specific fall prevention measures in the control group	• 6 nursing homes in Ulm, Germany • all 725 long-stay residents: 365 (intervention) and 360 (control) with a minimum of 4 weeks to follow-up • unit of randomization was the nursing home: three homes were randomized to the intervention group and three to the control group	• secondary analysis of a cluster-randomized controlled trial • the intervention included (i) education for staff and residents, and (ii) recommendations for changes to environment, to wear hip protection, and participate in balance/resistance training • baseline characteristics and fall risk profiles were recorded; predictors were chosen based on clinical judgment and resident characteristics • time to first fall and number of falls measured for 12-month intervention period	• all subgroup analyses involved dichotomized variables; time to first fall analyzed using Cox proportional model, incidence data and generalized linear estimating models with a negative binomial link function • baseline characteristics similar for the intervention and control nursing homes • the intervention was more effective in (i) cognitively impaired people (hazard ratio = 0.49, 0.35-0.69) vs the non-impaired (HR=0.91, 0.68-1.22); (ii) prior fallers (HR=0.47, 0.33-0.67) vs those who had not previously fallen (HR=0.77, 0.58-1.01); (iii) those with urinary incontinence (HR=0.59, 0.45-0.77) vs those not incontinent (HR=0.98, 0.68-1.42); (iv) those with no mood problems (incident rate ratio=0.41, 0.27-0.61) vs those with mood problems (IRR=0.74, 0.51-1.09) • the estimate of tx effect for time to first fall favored the intervention group (HR=0.70, 0.56-0.87); the IRR for the effect of the intervention on number of falls=0.56 (0.42-0.74) • there was a significant interaction between depression and previous fall – residents with no depression or previous fall benefitted more from the program re: number of falls	• authors' conclusion: program effectiveness varied among subgroups of nursing home residents; the cognitively impaired, prior fallers, with incontinence and depression were significant related to falls

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Ray et al., 1997)	• to evaluate a program to ***prevent falls*** and associated injuries in high-risk PCH residents • intervention: individual assessment with recs. targeting risk factors for env. and personal safety (wheelchair use, psychotropic drug use, transferring and ambulation)	• high-risk ***PCH*** residents, in 7 pairs of middle Tennessee PCHs • 482 residents (261 control; 221 intervention) • 1 facility in each pair assigned to intervention	• randomized controlled trial; falls identified using incident reports and medical records from index date to 365 days following, discharge, transfer, hospital stay of more than 30 days or death	• main outcomes: mean proportion of recurrent fallers, incidence rate of injurious falls • *control residents*: 19.9 injurious falls per 100 person years (n=44) • *intervention residents*: 13.7 injurious falls per 100 person years (n=28) • intervention facilities had 31.2% fewer injurious falls (CI, -24.6%-86.4%; NS; p=.22) than control facilities • Poisson modeling was used to test between-group differences • intervention occurrence was subtracted from the control to conduct a paired t-test; hypothesis: occurrence outcome was lower in the intervention facilities • multivariate, backward elimination analysis was conducted to determine if findings could be explained by maldistribution of fall risk factors; the final model for injurious falls included number of past falls, age and ambulatory status • the study designed to achieve a sample size of 500 residents, providing power (1-β=.80) to detect a 35% reduction in injurious falls; all p-values were 2-tailed	• author's conclusion: high rate of falls and injuries in PCHs can be improved via structured safety programs • injurious falls = falls with serious injuries (e.g., fractures) receiving medical treatment • multivariate modeling: 2 groups did not differ in baseline likelihood of sustaining injurious falls • limitations: (i) not known if risk factors studied were the most important ones; (ii) lack of validated instruments to measure change in safety practices; (iii) 'attention effects' could have contributed to a reduction in falls in the intervention facilities, vs control facilities with no program

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Ray et al., 2005)	• staff education for ***prevention*** of fall-related ***injuries***	• 112 ***PCH*** facilities (10,558 residents aged 65+) (US) randomized to control (n=56 facilities; 5626 residents) or intervention facilities (n=56; 4932 residents) • 5 geog. contiguous regions of the state	• cluster randomized clinical trial • each resident was followed from t_o to the earliest of the following dates: t_o + 364 (end of planned follow-up), death, discharge to another home or to a hospital for 30+ days [t_o = first day of study follow-up (day after training, conducted between Nov 9, 1999 and Jun 27, 2000] • used long-term care facility records	• variables: date of birth, sex, height, weight, transferring and ambulation, history of falls, psychotropic medication use • *control group*: per 1000 person-years of follow-up, 99.5 total injuries; 33.0 hip fractures; 28.8 other fractures; 37.8 soft tissue injuries • *treatment group*: 106.0 total injuries; 33.2 hip fractures; 30.0 other fractures; 42.8 soft tissue injuries • no difference between intervention and control groups for injury occurrence: total injuries (adjusted rate ratio=0.98; 95% CI, 0.83-1.16; p=.84); hip fractures (0.88; 0.67-1.15; p=.34); other fractures (1.03; 0.76-1.40; p=86); soft tissue injuries (1.05; 0.80-1.36; p-.73) • a Cox proportional hazards regression model used to compare time to first injury occurrence in intervention and control residents • study power: (α=.05; 1-β=.80) to detect a 20% or greater reduction in injuries; all p-values were 2-tailed	• author's conclusion: more intensive interventions are required to prevent fall-related injuries in long-term care facilities • injuries defined as fractures or sift tissue injuries • intervention and control facilities had similar baseline characteristics • limitations: key differences from previous studies finding interventions prevented falls: previous studies focused on falls and current study focused on serious fall-related injuries; included different study populations (present=all residents not bedridden; past=residents with a recent fall)

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Jensen, Lundin-Olsson, Nyberg, & Gustafson, 2002)	• to see if an 11-week multi-disciplinary fall and injury prevention program reduced falls and fall-related injuries • program components: staff educ; env. modification; exercise; supply or repair of aids; change in medication; hip protectors; post-fall problem-solving conferences; staff guidance	• 9 ***residential care facilities***, Umea Sweden • 402 residents, 65+ years @ start of intervention • control group= 5 facilities, 208 residents; intervention group= 4 facilities, 194 residents (reduced numbers at follow-up) • median age= 83 years (range= 65-100 yrs); 72% females	• cluster randomized, controlled, non-blinded trial • following an 11-week program, there was a 34-week follow-up period	• analyses: logistic (residents with 1 or more falls, and fractures); Poisson (incidence rate of falls); and Cox (time to first fall) regressions; adjusted for: clustering, Mini-Mental State Examination (MMSE) score, Barthel Index score, physical restraints, delirium, sex, history of falls, age • sample size calculated to detect a 12% difference in falling between intervention and control group at a significance of 0.05 • primary outcomes: number of residents sustaining a fall, the number of falls, and time to occurrence of first fall; secondary outcome: number of injuries resulting from falls • *control group*: 109 (of 194) residents (56%) fell; 346 total falls during 41, 590 days (8.3 per 1000 person days) • *intervention group*: 82 (of 188) residents (44%) fell; 237 total falls during 40, 898 days (6.7 per 1000 person days); longer time to first fall (vs control) • risk ratio of fallers in intervention group: 0.78 (CI, 0.64-0.96); adjusted odds ratio for falling in intervention group 0.49 (CI, 0.37-0.65); adjusted incident rate ratio of falls in intervention group: 0.60 (CI, 0.50-0.73); adjusted hazard ratio of time to first fall in intervention group 0.66 (CI, 0.54-0.79)	• author's conclusion: the program significantly reduced the number of residents who fell, total number of falls, time to first fall, and number of femoral fractures • limitations: intervention combined several measures that targeted risk factors, so estimating the effect of individual prevention measures cannot be done; more careful reporting possible in intervention groups; randomization was affected by staff that worked at multiple study sites that had to be part of the same study group

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Jensen, Nyberg, Gustafson, & Lundin-Olsson, 2003)	• to evaluate the effectiveness of a multi-factorial fall and injury prevention program in older people with higher and lower levels of cognition in intervention and control groups	• 9 ***residential care facilities***, Umea Sweden • all consenting residents aged 65+ who could be assessed with the MMSE (n=362; 181 control, 181 intervention) • @ 1st follow-up, control group: MMSE score ≥ 19, n=79 and MMSE score < 19, n=102; intervention group: MMSE score ≥ 19, n=112; MMSE score < 19, n=69	• pre-planned subgroup comparison of a cluster-randomized, non-blinded, usual care, controlled trial (see Jensen et al, 2002 above) • following an 11-week program, there was a 34-week follow-up period	• type of analyses: logistic (residents with 1 or more falls, and fractures); Poisson (incidence rate ratio of falls); and Cox (time to first fall) regressions • main explanatory variable: study group (intervention/control) categorized by higher or lower MMSE level [higher MMSE-intervention (reference) (HI), higher MMSE-control (HC), lower MMSE-intervention (LI), lower MMSE-control (LC)] • adjusted for: clustering , Barthel Index, physical restraints, delirium, sex history of falls, age • primary outcomes: number of residents falling, number of falls, time to first fall, number of injuries • *control group*: 54% of HCs fell, for 144 total falls; 61% of LCs fell, for 190 total falls • *intervention group*: 38%* of HIs fell, for 119 total falls; 54% of LIs fell, for 144 total falls • significantly fewer HIs fallers than HCs fallers (p=0.20); adjusted odds for falling in the higher MMSE group significantly higher in control group (2.5, CI, 1.7-3.6) vs reference intervention; incidence rate of falls significantly higher in HCs vs HIs (1.8, CI, 1.1-2.9); time to first fall significantly longer for HIs vs HCs, adjusted hazard ratio=1.8 (CI, 1.4-2.3); there were significantly fewer femoral fractures in the LIs vs LCs (10 fractures all in control group; p=.006)	• overall finding: the higher MMSE group had fewer falls and longer time to first fall in the intervention group • limitations: individual randomization not appropriate; there may be non-reporting of some events (e.g., unobserved falls); non-blinding of intervention status; not enough power to detect effect in the lower MMSE group

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Becker et al., 2003)	• to evaluate the effectiveness of a multifaceted, non-pharmaceutical intervention on incidence of falls and fallers • program components: staff training and feedback; information and education of residents; exercise; hip protectors	• ***long-stay residents*** in 6 community PCHs in Germany, (n=981; age 60+years) • mean age=85 years; 79% female	• prospective, cluster 12-month RCT (falls and fractures documented for 365 consecutive days from Oct 11, 1998)	• type of analyses: incidence density rates and relative risks calculated based on risks per resident year, using Poisson regression, adjusting for clustering; 2-sided p-values • outcomes: falls, fallers, and fractures • *control group*: 2,558 falls per 1,000 resident years; 247 fallers (52.3%); 39 incidence density rate of hip fractures per 1,000 resident years; 52 other fractures per 1,000 resident years • *treatment group*: 1,399 falls per 1,000 resident years (vs 2,558 in ctrl group); 188 fallers (36.9%); (vs 247 or 52.3% in ctrl group); 43 hip fractures per 1,000 resident years (vs 39 in ctrl group); 41 other fractures per 1,000 resident years (vs 52 in ctrl group) • relative risk of falls: 0.55 (CI, 0.41-0.73, p<.001); RR of fallers: 0.75 (CI, 0.57-0.98, p=.038); RR of hip fractures: 1.11 (CI, 0.49-2.51, p=.801); RR of other fractures: 0.78, (CI, 0.57-1.07, p=.128)	• author's conclusion: rate of falls and fallers differed considerably between intervention and control groups, but the study was underpowered for detecting fractures • limitations: drug use, vision impairment, calcium/vitamin D and footwear not specifically addressed; study underpowered partly because of unexpectedly low incidence of fractures in the control group, and partly because of differences in case mixes, staff/resident ratios, staff training, and residents' motivation to wear hip protectors

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Haines, Bennell, Osborne, & Hill, 2004)	• to assess the effectiveness of a targeted, multiple intervention falls prevention program in reducing falls and injuries related to falls • program components: fall risk alert card; exercise; staff education; hip protectors	• three sub-acute wards in a metropolitan hospital specializing in rehabilitation and care of elderly patients • 626 men and women aged 38-99 years (average 80) recruited from consecutive admissions to wards (n=310 intervention group; n=316 control group)	• randomized controlled trial of a targeted multiple intervention programme in addition to usual care compared to usual care alone	• there were 30% fewer falls in the intervention group vs control group (149 vs 105) (Peto log rank test p=0.045) • there was a lower proportion of residents who had one or more falls (71 vs 54; RR= 0.78; CI: 0.56-1.06) in the intervention group • incidence of falls with injury was 28% lower in the intervention group (23 vs 32; log rank test p=0.20) • assuming 33% fewer fallers in the intervention group vs the control group, using hospital administrative data, it was projected that 30% of control participants would fall, thus requiring 626 participants for a power of 0.80, 2-tailed alpha = 0.05	• a targeted multiple intervention falls prevention programme reduces the incidence of falls in the subacute hospital setting • results may be generalizable to other settings (e.g., residential facilities for elderly people) • limitations: (i) the study was insufficiently powered to detect a difference in hip fractures; (ii) there was an inability to completely blind staff and participants which may have affected results

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(b) Randomized: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Kerse, Butler, Robinson, & Todd, 2004)	• to establish the effectiveness of a multifaceted ***fall prevention*** program on reducing falls and injurious falls (compared to usual care in control sites) • program components: risk assessment tool; high risk logo; written suggested strategies for staff to follow for high risk fallers	• all older people in residential care (n=628) from 14 randomly selected ***residential care homes*** in Auckland, New Zealand	• cluster, randomized controlled trial; 12 month follow-up (Apr 28, 2000-Apr 2001) with a 5 month surveillance period to establish baseline rates (Dec 1999-Apr 28, 2000)	• 206 residents were needed in each arm of the trial to detect a 20% difference in residents sustaining a fall (power=0.8, alpha=0.05; inflated 2 times to account for clustering); 201 were needed to detect a 15% difference in injuries; allowing for attrition, 80% participation and average facility size, 460 total residents would be needed • outcome variable: fall-incidence rates (number of falls or injuries per resident year) • type of analysis: a negative binomial regression model was fitted to determine the incidence rate ratio (IRR); confounding variables were later added to the model (i.e., sex, mobility level, behavioral score, age) • *control group*: 103 (43%) residents fell; 20 injurious falls • *treatment group*: 173 (56%) residents fell; 34 injurious falls • difference between fallers ($p<.018$); adjusted incident rate ratio of falls was significantly higher in intervention homes (1.34; CI, 1.06-1.72); no significant difference in injurious fall rate (IRR=1.12; CI, 0.85-1.47)	• author's conclusion: this intervention did not reduce falls or injury from falls; a low intensity intervention may be worse than usual care • limitations: change in activity level was not measured; cognition was not measured; possible measurement bias as the intervention homes were more primed to report falls (the timing of the increase began after the intervention was implemented); even though baseline characteristics were similar between intervention and control groups, the sum of many small differences suggested a more mobile, less disabled intervention group that possibly was not properly adjusted for in the analysis

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(c) Meta-analyses/Reviews: (n=6)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Kannus, Sievanen, Jarvinen, & Parkkari, 2005)	• to update and summarize the evidence-based knowledge of prevention of falls and subsequent injuries in elderly adults	• searched Medline and PubMed up to May 31, 2005	• a review of meta-analyses and systematic reviews on prevention of falls and related injuries in elderly people	• many randomized trials have shown, and meta-analyses and systematic reviews corroborated, that multiple-intervention strategies can prevent falls in elderly adults by 20-45% by simultaneously affecting many intrinsic and extrinsic factors (see article for references) • however, less favorable results have been reported in PCH residents (see article for references) and systematic reviews of inpatients have shown no consistent evidence for the prevention of falls (see article for references) • multifactorial interventions to prevent falls in elderly people with cognitive impairment and dementia did not lead to favorable results (see article for references)	• the content/components of the multifaceted interventions varied substantially from study to study, illustrating not only the complexity of fall events, but the difficulty in doing direct study to study comparison needed for making straightforward recommendations regarding optimum interventions • prevention of fall-induced injuries by multiple intervention programs is uncertain given that (i) almost all randomized fall-prevention trials have lacked adequate power to detect significant changes in injury frequency, and (ii) there are mixed results with some studies showing decreases in injuries and others showing no change • it is difficult to interpret findings from multi-faceted fall-prevention interventions (e.g., it is often not clear what the independent role of an individual modified risk factor is, and thus which part of the intervention that is effective) • future studies must be large enough to see the effect of the intervention on falls and fall-induced injuries

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(c) Meta-analyses/Reviews: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Chang et al., 2004)	• to assess the relative effectiveness of interventions to prevent falls in older adults to either a usual care or control group	• searched Medline, HealthSTAR, Embase, the Cochrane Library, other health-related databases, reference lists from articles • 40 trials identified	• systematic review and meta-analyses	• random effects analysis combining trials with risk ratio data showed a reduction in the *risk of falling* (risk ratio 0.88, 95%CI 0.82-0.95) • combining trials with incidence rate data showed a reduction in the *monthly rate of falling* (incidence rate ratio 0.80, 0.72-0.88) • a multifactorial falls risk assessment and management program was the most effective component on risk of falling (0.82, 0.72-0.94) and monthly fall rate (0.63, 0.49-0.83; 11.8 fewer falls in treatment group per 100 patients per month)	• interventions to prevent falls in older adults are effective in reducing the risk of falling and the monthly rate of falling, the most effective being multifactorial fall risk assessment and management • the monthly rate of falling is susceptible to correlation within patients, but the studies did not provide adequate information to allow adjustment for this

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(c) Meta-analyses/Reviews: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Moreland et al., 2003)	• to provide evidence-based guidelines of assessment and treatment to prevent falls in older adults	• evidence from intervention effectiveness studies (n=40)* (*only 4 of these pertained to institutional settings; all others were community-based)	• search of the Cochrane Library, MEDLINE and CINAHL for systematic reviews of interventions to prevent falls (1995-2000)	• Cochrane meta-analyses (1997): hospital based study of bed alarms and risk bracelets; **effect on occurrence of any fall:** NS [evidence not graded by Moreland et al.] • Ray et al. (1997): PCH-based study of individualized environment and personal safety and overall facility safety; **effect on occurrence of any fall:** significant risk difference of 0.19 (p=0.03) [grade B evidence] • Close et al. (1999): emergency room fallers and medical and occupational therapy assessment; **effect on occurrence of any fall:** significant OR = 0.39 (95%CI: 0.23-0.66) [grade A evidence] • McMurdo et al. (2000): residential homes for elderly, targeting postural hypotension, medication review, visual acuity, lighting levels + sitting balance exercise class; **effect on occurrence of any fall:** NS OR = 0.45 (CI: 0.19-1.14) [grade B evidence]	• institutions should focus on systems for assessing falls and management for preventing further falls, and ongoing staff education and safety checks • a practice guideline needed to reduce fragmented and variable care, and promote the highest quality of care • screening for deficits and env. hazards followed by targeted interventions (i.e., multifactorial), effective for community- and institution-dwelling older adults • medication review is consistent in institutions which have shown effectiveness • for institutional settings, the establishment of falls program for safety check, ongoing staff education and monitoring is substantiated by research • major areas of deficit: blinding of subjects and treatment providers; and provision of placebo intervention to control group

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(c) Meta-analyses/Reviews: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Vu, Weintraub, & Rubenstein, 2004)	• interventions have been demonstrated to be successful in reducing falls in community-dwelling elderly patients, but less evidence supports the efficacy of fall prevention in PCH residents	• Medline search using keywords 'falls' and 'nursing homes'	• systematic review	• cites Ray et al. (1997); Jensen et al., (2002); Jensen et al., (2003); Becker et al., (2003); Hoffman et al., (2003); McMurdo et al. (2000)already cited above • Rubenstein et al., (1990) did not find a significant reduction in falls or injurious falls during a two-year follow-up of PCH patients randomized to a multifactorial fall prevention program vs usual care (n=160); the intervention group did have a significantly lower hospitalization rate	• based on current literature, an effective multifaceted fall prevention program for PCH residents should include risk factor assessment and modification, staff education, gait assessment and intervention, assistive device assessment and optimization, and environmental assessment and modification • extrapolation of results of these studies suggests that implementation of a successful fall prevention program could reduce falls by 20%--45%

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(c) Meta-analyses/Reviews: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Cusimano, Kwok, & Spadafora, 2008)	• an evaluation of the effectiveness of multifactorial intervention programs aimed at reducing falls, fallers, recurrent fallers, and injurious falls in care facility residents	• 5 studies met the inclusion criteria (RCTs, comparison groups, participants aged 60+, etc.)	• systematic review of randomized controlled trials	• 3 studies reported significant reductions in recurrent fallers; two found significantly fewer falls; one found a significant decrease in the number of fallers	• authors' conclusions: multifaceted programs with a wide range of intervention strategies were found to be effective

Appendix 3: Review of Fall-Related Program Evaluations (cont'd)

(c) Meta-analyses/Reviews: (cont'd)

Author(s)	Study Objs.	Sample	Study Design	OR (95% CI), RR, or effect	Comments
(Cameron et al., 2010)	• an evaluation of the effectiveness of fall reduction interventions in nursing care facilities and hospitals	• 41 trials (25, 422 participants) met the inclusion criteria (RCTs of fall reduction interventions for older people in nursing care facilities and hospitals)	• intervention review of randomized controlled trials	• 9 of the studies were on multifactorial interventions in nursing care facilities • pooled results showed that there was not a significant reduction in the rate of falls or risk of falling, but there was a significant reduction in hip fractures (based on 3 studies) • pooled data also showed a significant reduction in rate and risk of falling when programs were multidisciplinary and included exercise • trials guided by comprehensive geriatric assessment showed a significant reduction in fall rate • pooled results from 4 multifactorial studies in hospitals had significantly lower fall rates	• authors' conclusions: some fall programmes in nursing care facilities that focus on multiple individual risk factors can be effective

Appendix 4: Hypotheses

hypothesis	outcome	possible explanatory variables	statistical test	potential sample size & power	threats to validity / limitations / competing interpretations
1. there will be a change in the rate of falls from pre- to post-period in the intervention PCHs	• falls (source: NEHA & IRHA Occurrence Reports) • measured pre- and post-intervention	• time and date of event; PCH; RHA (source: Occurrence Reports • age; sex (source: Registry, MCHP) • level of care at admission; time at risk (person-years) (source: LTC database) • dementia (source: Hospital &/or Medical claims) • polypharmacy; use of fall-risk drugs (source: DPIN)	• generalized linear modeling (GLM); Poisson regression with generalized estimating equation (GEE) to help account for correlation from repeated measures • 2-tailed testing	• approximately 1,000 residents (196 NEHA beds + 200 IRHA beds x 5 years) • power of 92%, to detect a 40% change in the injurious fall rate from a baseline of 21% to 12.6%,with the probability of a Type 1 error at 0.05, and two-tailed testing	• a change in the definition of falls and how they are counted • unobserved falls resulting in underreporting/underestimate of rate • recording / data entry errors or inconsistencies within and between sites • potential bias from non-randomization (i.e., differences due to non-equivalent groups rather than intervention) • potentially low statistical power due to small sample sizes • administrative data is not collected for research purposes, so important information could be missing

Appendix 4: Hypotheses (cont'd)

hypothesis	outcome	possible explanatory variables	statistical test	potential sample size & power	threats to validity / limitations / competing interpretations
2. the rate of falls in the intervention PCHs will be different from the comparison PCHs in the post-period	• falls (source: NEHA & IRHA Occurrence Reports) • measured pre- and post-intervention	• time and date of event; PCH; RHA (source: Occurrence Reports • age; sex (source: Registry, MCHP) • level of care at admission; time at risk (person-years) (source: LTC database) • dementia (source: Hospital &/or Medical claims) • polypharmacy; use of fall-risk drugs (source: DPIN)	• generalized linear modeling (GLM); Poisson regression with generalized estimating equation (GEE) to help account for correlation from repeated measures • 2-tailed testing	• approximately 1,000 residents (196 NEHA beds + 200 IRHA beds x 5 years) • power of 92%, to detect a 40% change in the injurious fall rate from a baseline of 21% to 12.6%,with the probability of a Type 1 error at 0.05, and two-tailed testing	• a change in the definition of falls and how they are counted • unobserved falls resulting in underreporting/underestimate of rate • recording / data entry errors or inconsistencies within and between sites • potential bias from non-randomization (i.e., differences due to non-equivalent groups rather than intervention) • potentially low statistical power due to small sample sizes • administrative data is not collected for research purposes, so important information could be missing

Appendix 4: Hypotheses (cont'd)

hypothesis	outcome	possible explanatory variables	statistical test	potential sample size & power	threats to validity / limitations / competing interpretations
3. there will either be no change or a reduction in the rate of injurious falls and hospitalized falls from pre- to post period in the intervention PCHs	• degree of injury (source: NEHA & IRHA Occurrence Reports) • accidental falls resulting in hospitalization (source: Hospital Abstracts) • measured pre- and post-intervention	• time and date of event; PCH; RHA (source: Occurrence Reports • age; sex (source: Registry, MCHP) • level of care at admission; time at risk (person-years) (source: LTC database) • dementia (source: Hospital &/or Medical claims) • polypharmacy; use of fall-risk drugs (source: DPIN)	• generalized linear modeling (GLM); Poisson regression with generalized estimating equation (GEE) to help account for correlation from repeated measures • 1-tailed testing	• approximately 1,000 residents (196 NEHA beds + 200 IRHA beds x 5 years) • power of 92%, to detect a 40% change in the injurious fall rate from a baseline of 21% to 12.6%,with the probability of a Type 1 error at 0.05, and two-tailed testing	• a change in the definition of injuries and how they are counted • undetected injuries from unobserved falls resulting in underreporting/underestimate of rate • recording / data entry errors or inconsistencies within and between sites • potential bias from non-randomization (i.e., differences due to non-equivalent groups rather than intervention) • potentially low statistical power due to small sample sizes • administrative data is not collected for research purposes, so important information could be missing

Appendix 4: Hypotheses (cont'd)

hypothesis	outcome	possible explanatory variables	statistical test	potential sample size & power	threats to validity / limitations / competing interpretations
4. there will be a lower rate of injurious falls and hospitalized falls in the intervention PCHs than in the comparison PCHs in the post-period	• degree of injury (source: NEHA & IRHA Occurrence Reports) • accidental falls resulting in hospitalization (source: Hospital Abstracts) • measured pre- and post-intervention	• time and date of event; PCH; RHA (source: Occurrence Reports • age; sex (source: Registry, MCHP) • level of care at admission; time at risk (person-years) (source: LTC database) • dementia (source: Hospital &/or Medical claims) • polypharmacy; use of fall-risk drugs (source: DPIN)	• generalized linear modeling (GLM); Poisson regression with generalized estimating equation (GEE) to help account for correlation from repeated measures • 1-tailed testing	• approximately 1,000 residents (196 NEHA beds + 200 IRHA beds x 5 years) • power of 92%, to detect a 40% change in the injurious fall rate from a baseline of 21% to 12.6%,with the probability of a Type 1 error at 0.05, and two-tailed testing	• a change in the definition of injuries and how they are counted • undetected injuries from unobserved falls resulting in underreporting/underestimate of rate • recording / data entry errors or inconsistencies within and between sites • potential bias from non-randomization (i.e., differences due to non-equivalent groups rather than intervention) • potentially low statistical power due to small sample sizes • administrative data is not collected for research purposes, so important information could be missing

Appendix 5: Fall-Risk Drugs for the Elderly

- **psychotropics** (Niagara Region Public Health, 2004; Registered Nurses Association of Ontario, 2007; Registered Nurses' Association of Ontario (RNAO), 2005; Shanley, 2003; Riefkohl et al., 2003; Kallin, Gustafson, Sandman, & Karlsson, 2005; Poutney, 2009; Commonwealth of Australia, 2009)
    - ***anti-depressants*** (Niagara Region Public Health, 2004; Registered Nurses Association of Ontario, 2007; Australian Commission on Safety and Quality in Health Care, 2009; Riefkohl et al., 2003; Ruddock, 2004; Fonad et al., 2008; Messigner-Rapport et al., 2009)
        - tricyclic anti-depressants (Australian Commission on Safety and Quality in Health Care, 2009; Registered Nurses Association of Ontario, 2005; Riefkohl et al., 2003)
        - SSRIs (selective serotonin reuptake inhibitors) (Registered Nurses' Association of Ontario (RNAO), 2005; Australian Commission on Safety and Quality in Health Care, 2009; Riefkohl et al., 2003; Ruddock, 2004)
    - ***benzodiazepines*** (Niagara Region Public Health, 2004; Registered Nurses Association of Ontario, 2007; Australian Commission on Safety and Quality in Health Care, 2009; Riefkohl et al., 2003; Ruddock, 2004; Fonad et al., 2008; Messigner-Rapport et al., 2009)
        - short, intermediate and long-acting (Niagara Region Public Health, 2004)
        - long-acting (LABZs) valium, dalmane, librium, tranxene, doral, centrax, paxipam, klonopin (Cooper, 1993)
    - ***anti-convulsants*** (Niagara Region Public Health, 2004; Riefkohl et al., 2003; Ruddock, 2004; Messigner-Rapport et al., 2009)
        - antiseizure / antiepileptic (Registered Nurses Association of Ontario, 2007; Australian Commission on Safety and Quality in Health Care, 2009; Walker, Alrawi, Mitchell, Regal, & Khanderia, 2005)
            - carbamazepine (Walker et al., 2005)
            - gabapentin (Walker et al., 2005)
            - lamotrigine (Walker et al., 2005)
            - oxcarbazine (Walker et al., 2005)
            - phenytoin (Walker et al., 2005)
            - topiramate (Walker et al., 2005)
            - valproate (Walker et al., 2005)
    - ***Alzheimer's drugs*** (Niagara Region Public Health, 2004)
    - ***anti-psychotics*** (Niagara Region Public Health, 2004; Riefkohl et al., 2003)
        - mellaril, haldol, navane, prolixin, stelazine, moban, serentil, lixitane, thorazine, taractan (Cooper, 1993)

Appendix 5: Fall-Risk Drugs for the Elderly (cont'd)

  - ***antihistamines*** (Niagara Region Public Health, 2004; Riefkohl et al., 2003; Walker et al., 2005)
    - cyclizine (Walker et al., 2005)
    - fexofenadine (Walker et al., 2005)
  - ***anti-nauseants*** (Niagara Region Public Health, 2004)

- **anti-Parkinsonian agents** (Niagara Region Public Health, 2004; Cameron et al., 2010; Riefkohl et al., 2003)

- **anti-hypertensives** (Niagara Region Public Health, 2004; Registered Nurses' Association of Ontario (RNAO), 2005; Cameron et al., 2010; Vu et al., 2004; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Ruddock, 2004)
  - angiotensin II receptor antagonists (Niagara Region Public Health, 2004)
  - ace inhibitors (Niagara Region Public Health, 2004)
  - beta-blockers (North Eastman Health Association Inc., 2006a; Niagara Region Public Health, 2004; Ruddock, 2004)
  - calcium channel blockers (Niagara Region Public Health, 2004)
  - vasodilators (Niagara Region Public Health, 2004; Ruddock, 2004)
  - diuretics (Niagara Region Public Health, 2004; Registered Nurses Association of Ontario, 2007; Australian Commission on Safety and Quality in Health Care, 2009; Vu et al., 2004; Ruddock, 2004)

- **narcotics** (Niagara Region Public Health, 2004; Registered Nurses Association of Ontario, 2007; Ruddock, 2004)

- **sedatives and tranquilizers** (Registered Nurses Association of Ontario, 2007; North Eastman Health Association Inc., 2006a; Public Health Agency of Canada: Division of Aging and Seniors, 2005; Impact, 2005)
  - medications that could produce sedation or postural hypotension (Walker et al., 2005)
  - sedatives and hypnotics (Ruddock, 2004)

- **antiarrhythmics** (Australian Commission on Safety and Quality in Health Care, 2009; Registered Nurses Association of Ontario, 2007; Riefkohl et al., 2003; Ruddock, 2004; Messigner-Rapport et al., 2009)
  - procainamidem, quinidine (Ruddock, 2004)

- **anticoagulants** (Registered Nurses Association of Ontario, 2007; Boddice & Kogan, 2009)

Appendix 5: Fall-Risk Drugs for the Elderly (cont'd)

- **hypoglycemic agents** (Registered Nurses Association of Ontario, 2007; Riefkohl et al., 2003; Impact, 2005)

- **anesthetics** (Registered Nurses Association of Ontario, 2007)

- vitamin D, calcium and other **bone health mediation** (Cameron et al., 2010)

- **diabetic-related drugs** (Cameron et al., 2010; Cooper, 1993; Boddice et al., 2009)
    - glimepiride (Walker et al., 2005)
    - glipizide (Walker et al., 2005)
    - insulin (Walker et al., 2005)
    - rosiglitazone (Walker et al., 2005)

- **analgesics** (Vu et al., 2004)
    - opioid analgesics (Walker et al., 2005)
    - narcotic analgesics (Riefkohl et al., 2003)

- **anticholinergics agents** (Walker et al., 2005; Ruddock, 2004)
    - oxybutynin (Walker et al., 2005)
    - tolterodine (Walker et al., 2005)

- **gastrointestinal agents** (Walker et al., 2005)
    - dolasetron (Walker et al., 2005)
    - metoclopramide (Walker et al., 2005; Ruddock, 2004)
    - omeprazole (Walker et al., 2005)
    - ondansetron (Walker et al., 2005)
    - ranitidine (Walker et al., 2005)

- **cardiovascular agents** (Walker et al., 2005; Cooper, 1993)
    - amlidopine (Walker et al., 2005)
    - diltiazem (Walker et al., 2005)
    - nitrates (Walker et al., 2005; Riefkohl et al., 2003; Ruddock, 2004)

- **neuroleptics** (Ruddock, 2004; Messigner-Rapport et al., 2009)

- **nonsteroidal anti-inflammatory drugs** (Riefkohl et al., 2003)

- **corticosteroids** (Riefkohl et al., 2003)

- **muscle relaxants** (Riefkohl et al., 2003; Riefkohl et al., 2003)

Appendix 5: Fall-Risk Drugs for the Elderly (cont'd)

- **polypharmacy** / use of multiple drugs (Public Health Agency of Canada: Division of Aging and Seniors, 2005; Trotto, 2001; Australian Commission on Safety and Quality in Health Care, 2009; Riefkohl et al., 2003; Ruddock, 2004; Impact, 2005)
    - 5+ medications (Registered Nurses Association of Ontario, 2005)
    - more than 1 medication (Australian Commission on Safety and Quality in Health Care, 2009)
    - 3+ medications (Riefkohl et al., 2003)
    - 4-5 medications at more risk than those on less (Ruddock, 2004)
    - 4+ drugs was found to increase fall risk in the elderly(Impact, 2005)

- **specific drugs** mentioned
    - digoxin (Australian Commission on Safety and Quality in Health Care, 2009; Riefkohl et al., 2003; Ruddock, 2004; Boddice et al., 2009)
    - trazodone (Registered Nurses Association of Ontario, 2005)
    - NSAIDs (Walker et al., 2005; Hegeman, van dem Bemt, Duysens, & van Limbeek, 2009)

Appendix 6: Overall NEHA Program Model

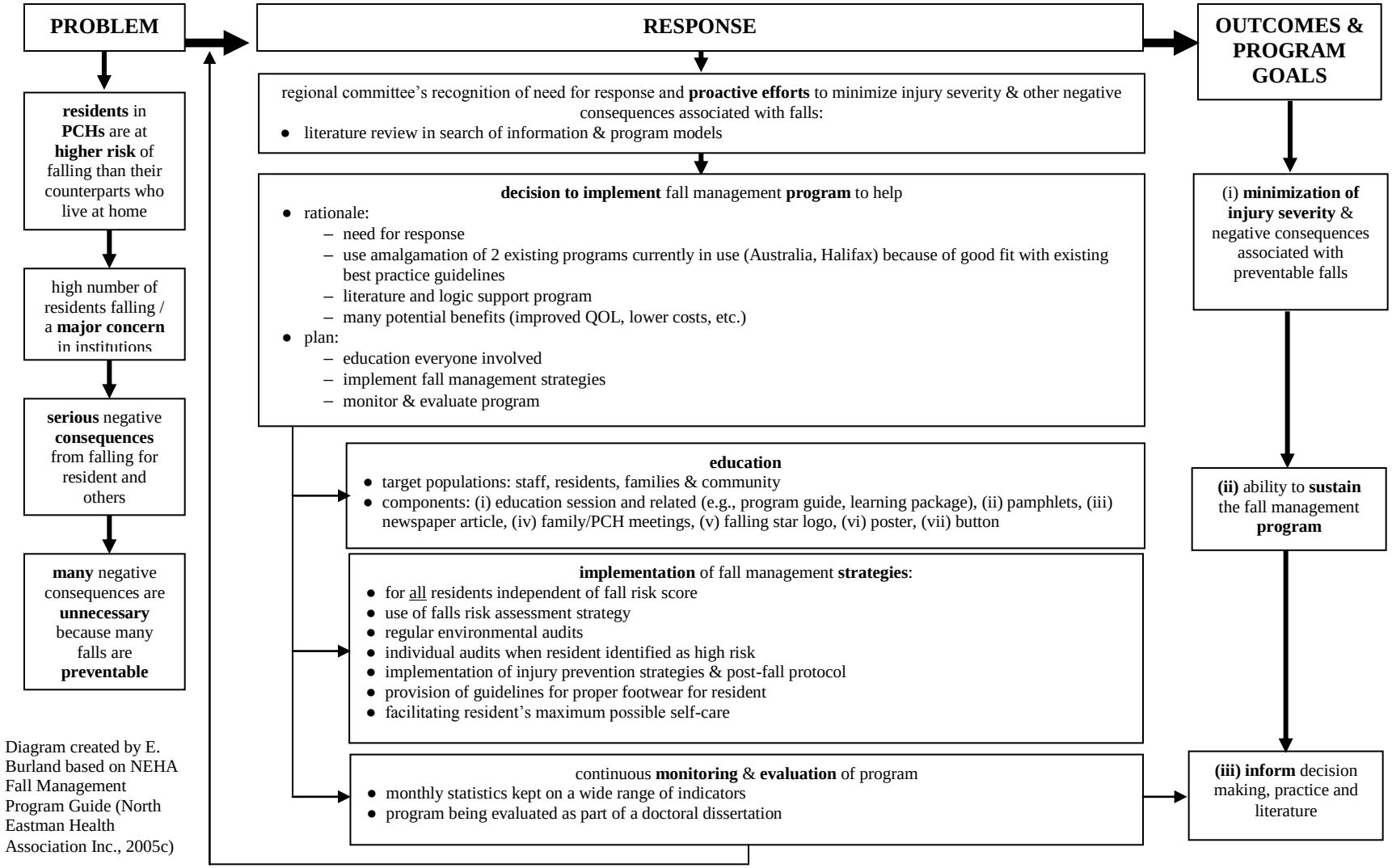
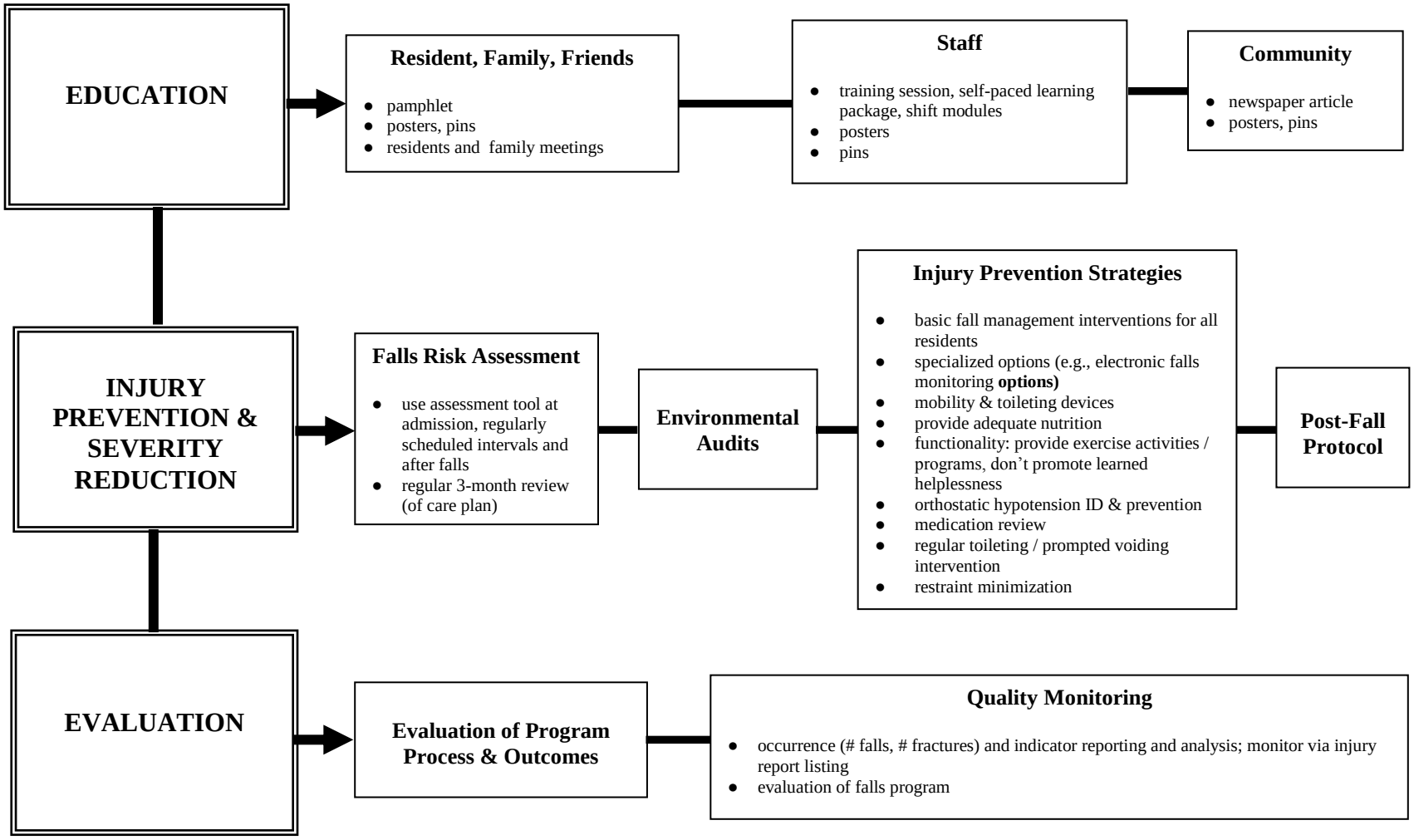


Diagram created by E. Burland based on NEHA Fall Management Program Guide (North Eastman Health Association Inc., 2005c)

Appendix 7.1: NEHA's Fall Program Components

Diagram created by E. Burland based on NEHA Fall Management Program Guide (North Eastman Health Association Inc., 2005c)



Appendix 7.2: NEHA's Fall Program – Table of Contents
(North Eastman Health Association Inc., 2005c)

Appendix 7.2: NEHA's Fall Management Program Guide – TOC (cont'd)

Appendix 7.3: Fall Risk Assessment and Monitoring
(North Eastman Health Association Inc., 2005c)

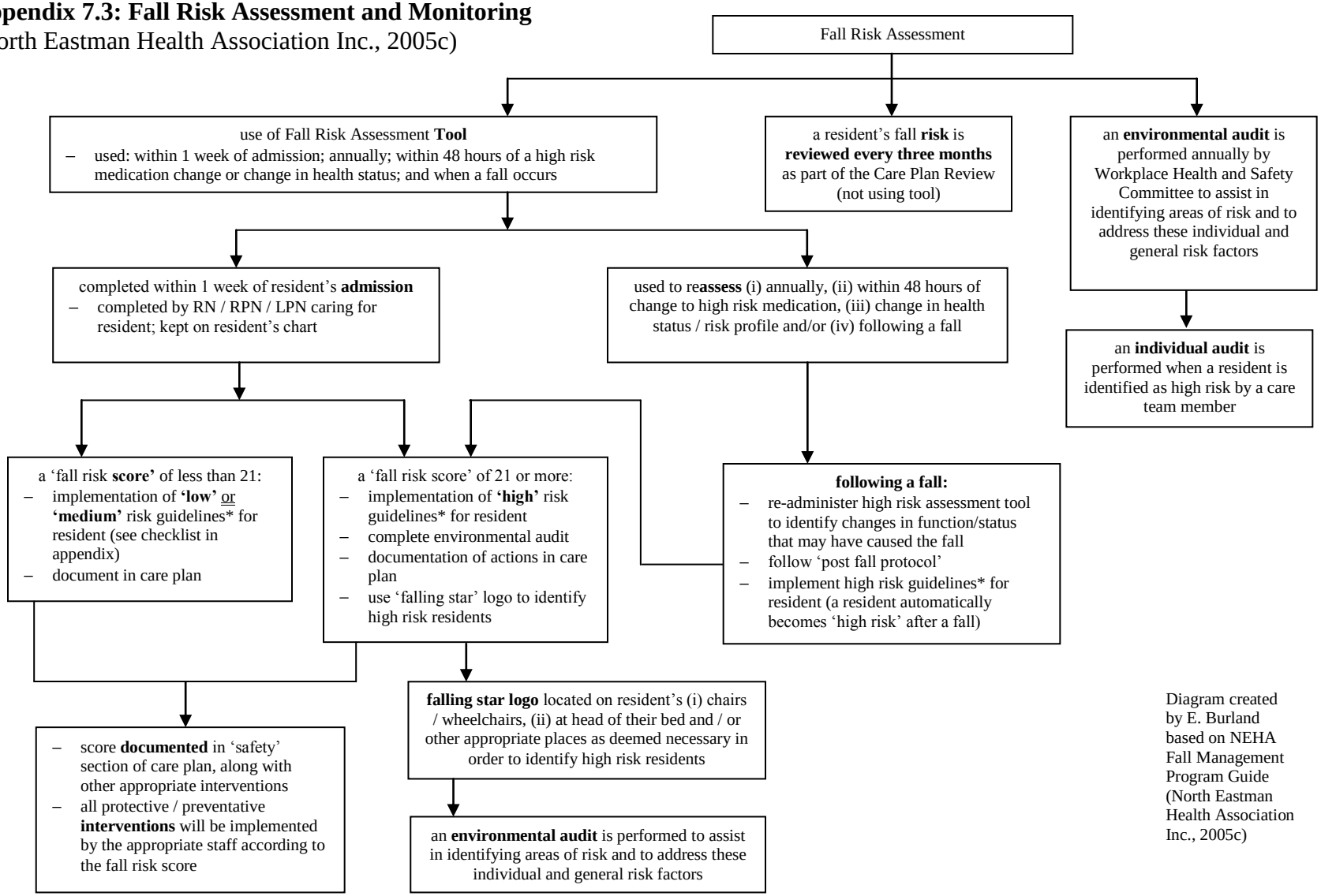


Diagram created by E. Burland based on NEHA Fall Management Program Guide (North Eastman Health Association Inc., 2005c)

Appendix 8: Roles for a Successful Program in NEHA

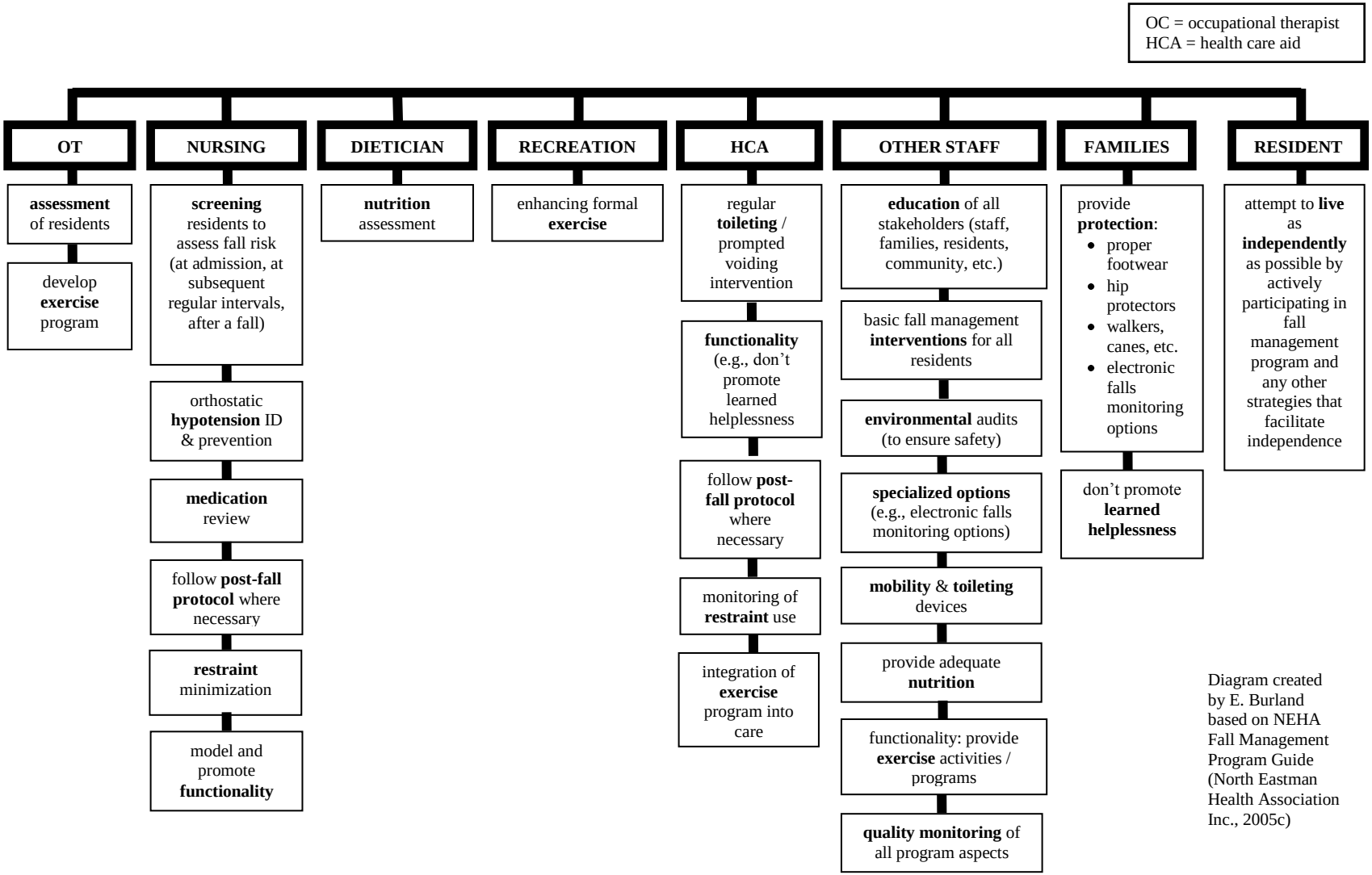


Diagram created by E. Burland based on NEHA Fall Management Program Guide (North Eastman Health Association Inc., 2005c)

Appendix 9.1: NEHA Staff Education - Overview
(North Eastman Health Association Inc., 2005a)

	Time Period	Participants	Description
Phase 1	Dec 2004 – Jan 2005	– Care Team Managers – Team Leaders	– inform about program and education session beginning in January 2005 – get buy in from support services to enable their staff to attend
		– Care Team Managers – Team Leaders – Support Services	– develop education strategies – develop session timetables
Phase 2	Jan – Feb 2005	– Care Team Mangers – Team Leaders – Recreation Coordinator	– education strategies completed – posters and education material developed – time table distributed – space booked
		– Occupational Therapist	– begin development of exercise programs for staff on units
		– Physical Therapist – Recreation Coordinator	– recreation program
		– all staff (nursing, health care aids, recreation, housekeeping, maintenance, social work) *Staff Development Coordinator, Care Team Managers and Team Leaders at each site	– introduction education session (1-hour): – program introduction – program goals & objectives – definition of a fall – issues related to falls (i.e., frequency outcomes, risk factors, consequences) – fall prevention strategies (environmental audits, maintaining functionality, promoting self-care, effects of restraints – falling star (logo and staff buttons) – illustrations via case scenarios – next steps
		– staff unable to attend 1-hour session	– self-paced learning package

Appendix 10.1: NEHA Staff Education Component – Overview (cont'd)

	Time Period	Participants	Description
Phase 3	Mar – Apr 2005	– Nursing – Health Care Aids	– specialized education (half day): – *review of Fall Management Program document prior to attending session* – overview of fall prevention strategies – overview of family/resident education pamphlets – continence management – nutrition management – restraint assessment/reduction – functionality as part of care – exercise programs
		– Nursing (15 minutes; part of half-day session)	– fall assessment – fall protocol – medication
		– Recreation	– functionality as part of programming and care – functionality exercise program implementation
		– staff unable to attend half-day session	– shift modules

Table created by E. Burland based on NEHA Fall Management Program Guide (North Eastman Health Association Inc., 2005c)

Appendix 9.2: HCA Education Component: Overview of Shift Modules
(North Eastman Health Association Inc., 2004)

Implementation of Modules	– at the **beginning of shift** (for approximately five minutes), a nurse (or designate) will review some aspects of the program with staff – staff **sign** attendance sheet – staff to **provide feedback** at the end of five-week period (i.e., how individual found the information and how this instruction format worked for the team)
Module Content	
Week #1	– **history** and statistics of falls – top three **reasons** for falls at PCHs in the regional health authority (survey: March 2004) – exercise: staff to talk about (i) what causes residents to fall, (ii) what could have been to prevent it, (iii) whether or not these strategies are in the residents' care plans, and why / why not
Week #2	– review of all fall management strategies; focus (over subsequent weeks) on those related to HCAs – strategy 1: **regular toileting** – how it prevent falls – how this can be incorporated into routine care / improved – how to implement a 'prompted voiding' strategy (i.e., monitoring, prompting, praising)
Week #3	– strategy 2: **functionality** – discussion of residents' expectations of care upon admission – review of importance of not promoting 'learned helplessness' of residents and discussion of ways to avoid it
Week #4	– strategy 3: **restraint minimization** – review of restraint policy – review of what 'restraint minimization' means, risks associated with use of restraints, and ways of decreasing falls without use of restraints
Week #5	– strategy 4: **falling star logo** – review of how this component is working so far – discussion of ideas for ensuring program is working to its full extent – review of importance of maintaining maximum resident functionality

Table created by E. Burland based on NEHA Fall Management Program Shift Modules
(North Eastman Health Association Inc., 2005c)

Appendix 9.3: Overview of the Self-Paced Learning Package
(North Eastman Health Association Inc., 2005b)

- Falls Background
  - many falls preventable
  - institutionalized at greater risk of falls
  - falls statistics
- Falls Prevention as a Team Effort
- Consequences of Falling
- Risk Factors Associated with Falling
- Environmental Hazards
- Functionality
  - what it is
  - how staff can help residents to maintain it
- Falls Prevention Strategies (for those at low, medium and high risk)
- Falling Star Logos
  - what they are
  - how to use them
- Risk Assessment Tool
  - what it is
  - how it is used in the region
- Environmental Audit Tools
  - what it is
  - how it is used in the region
- Falls Prevention Quiz:
  - to be completed and returned to manager / coordinator
  - topics:
    (i) list interventions to prevent falls
    (ii) list possible consequences of falls
    (iii) list factors leading to falls
    (iv) list fall prevention strategies personally used
    (v) list strategies for facilitating residents maintenance of maximum independence
    (vi) procedures for dealing with residents who have fallen

Appendix 10: Fall Procedures – NEHA vs IRHA

Intervention PCHs (NEHA)	Comparison PCHs (IRHA)
1. EDUCATION	
staff	
• training sessions • self-paces learning packages • shift modules • posters • pins	○ Power Point presentation for the first LTC Reviews in January and February 2006 (fall prevention education section included in the presentation) ○ fall prevention education section also included in the LTC orientation for new staff ○ reinforced fall prevention methods at all the LTC Reviews in 2007 and 2008 through case studies, Jeopardy game, etc.
residents & families/visitors	
• pamphlets • posters • pins • resident & family meetings	
community	
• newspaper article	
2. INJURY PREVENTION AND SEVERITY REDUCTION	
• **fall risk assessment** (within 1 week of admission; reviewed every 3 months; resident re-assessed annually, after a fall, or if change in risk profile)	○ do fall risk assessments on all Residents on admission
• **environmental & individual audits**	○ environmental alterations done for residents at risk for falls
○ *individual* environment audit upon resident identification as high risk	○ complete a safety assessment on admission which looks at the resident's abilities and any safety concerns; this is reviewed quarterly ○ most recently the new Safe Transfer and Mobility assessment form has been introduced along with "decal" labels to communicate the safest method of transfer and mobility ○ alterations to care; physiological and psychosocial strategies for residents at risk for falls
○ *general* environment audit annually	

Appendix 10: Fall Procedures – NEHA vs IRHA (cont'd)

Intervention PCHs (NEHA)	Comparison PCHs (IRHA)
2. INJURY PREVENTION AND SEVERITY REDUCTION (cont'd)	
• **fall management interventions** for <u>all</u> residents (implemented according to fall risk score – high or low/medium)	• some of the fall interventions put in place are <u>individualized</u> and have included, closer location of room, room doors left open, the low beds (and a fall pad beside the bed), baby monitors, fall exit pads, sentinels (movement alarms) frequent checks
○ orthostatic hypotension management (identification & prevention)	
○ medication review guidelines: done at admission, and after changes in medications and/or doses	○ review of medications; management of pain (part of 'physiological strategies')
○ assistive device options (e.g., hip protection, electronic falls monitoring)	○ used different equipment to help reduce the risks of falls (includes hip protector pants, grip strips by the beds, beds that lower right to the floor with half rails, motion detectors, & bed sensor pads) ○ getting the new electric beds that lower right to the floor with the half rails
○ functionality & exercise (e.g., provide exercise activities according to OT assessment on admission; don't promote learned helplessness)	○ walking programs/regular exercise or ambulation movement (part of 'alterations to activities and programs') for residents at risk for falls ○ change of seating/movement (part of 'alterations to activities and programs')
○ restraint minimization guidelines: deal with cause of problem and use alternatives to restraints when necessary	○ determination of the necessity of restraint is considered in this assessment; review and amendments to this assessment is in progress; do restraint assessment tools as indicated; follow the least restraint policy ○ 'alternatives to restraints' Power Point presented to various staff audiences in region
○ safe footwear guidelines and provision of information for families	
○ guidelines for adequate nutrition with regular assessments	
○ prompted voiding (schedule according to resident need)	○ continence routine (part of 'alterations to activities and programs')
○ mobility & toileting devices (e.g., transfer devices, raised toilet seat)	

Appendix 10: Fall Procedures – NEHA vs IRHA (cont'd)

Intervention PCHs (NEHA)	Comparison PCHs (IRHA)
2. INJURY PREVENTION AND SEVERITY REDUCTION (cont'd)	
• **post-fall protocol**	
○ check resident for injury, take vital signs	
○ measure severity of the injury [none; minor; major]	
○ alert other staff if needed	
○ assist resident off floor via appropriate means [see policy #7-9 Transfer Safety]	
○ monitor resident regularly following fall	
○ review reason for falls with resident and family	
○ review and implement appropriate fall prevention strategies and injury minimization strategies	
○ provide appropriate referral to other health professionals	
○ document all details in resident chart	
○ complete an occurrence reporting form	○ occurrence report completed when a resident falls (previously incident report)
3. MONITORING & EVALUATION	
• occurrence & investigative reports	
• incident investigations	
• audits	
• trend tracking	
• formal program evaluation (process & outcomes)	

- NEHA information from Fall Management Program Guide
- IRHA information compiled from LTC staff (2006-2008)
- blank cells = no evidence of procedure

Appendix 11: Occurrence Reports – NEHA vs IRHA

Needed Information	NEHA Occurrence Report	IRHA Occurrence Report (post-Apr 1, 2004 to present)	IRHA Incident Report (pre-Apr 1, 2004)	Comments
PHIN #	• recorded using a stamp with resident's name used on report	• recorded on Occurrence Report	• not specifically asked for on form	• not consistently recorded over time in IRHA
date of occurrence	• recorded on Occurrence Report	• recorded on Occurrence Report	• recorded on Incident Report	• tx and comparison sites record these data the same way
time of occurrence	• recorded on Occurrence Report	• recorded on Occurrence Report	• recorded on Incident Report	• tx and comparison sites record these data the same way
who occurrence involved	• recorded on Occurrence Report as option "inpatient/resident/client"	• recorded on Occurrence Report as option "resident of "PCH"	• recorded on Incident Report as option "PCH resident"	• tx and comparison sites record these data sufficiently similarly
fall	• recorded on Occurrence Report • Section 3 is filled out if the occurrence is a fall • sub-sections: o whether fall was *observed* [y/n] o (3a) *type* of fall [***bed***; slipped/tripped; ***chair***; ***toilet/commode***; ***tub/shower***; other] o (3b) contributing *factors* [incontinent; client behaviour/mental status; sedation; client physical condition; ***restraint in use***; ***transferring***; side rail in use; ***faulty equipment***; environmental conditions; fainted/seizure; unexpected movement; wet floor; inappropriate footwear; slipped/tripped; other]	• recorded on Occurrence Report • "Falls" is 1 of 11 options in Section 4.0: Category of Occurrence • sub-section 4.2: "Falls" o 4.2.1. *resident found* [own room; shower; bathroom; hallway; other] o 4.2.2. *fell from* [***bed***/crib; stairs; ***toilet/commode***; exam table; stretcher; ***chair***; wheelchair; ***tub***; other] o 4.2.3. *fell while* [ambulating; ***transferring***; standing; other] o 4.2.4. *details* [bed position up or down; side rails split or full length; rail position up down or partial; ***restrained***; brakes on; call system in reach; on falls protocol; light on] o 4.2.5. *related factors* [footwear; ***equipment failure***; obstacles present; falls protocol - resident non-compliant; falls protocol – staff non-compliant; decreased LOC/orientation; bowel/bladder problem; environmental conditions]	• recorded on Incident Report • Section A is filled out if the occurrence is a fall • sub-sections: o observed / not observed o client's behavior prior to the incident [oriented; confused; uncooperative; hyperactive; sedated; other/specify] o location/reason [***bed***/crib; ***chair***/Geri/wheel; stretcher/table; ***toilet/commode***; ***tub***/shower; lost balance; ***transfer***; slipped/tripped; other/specify] o contributing factors (client) [language barrier; hearing barrier; limited vision; seizures; intoxication/overdose; other o recent surgery [y/n, number of days post-op] o status of equipment at the time of the fall [bed-up/down; bedrails-both up/both down; brakes-on/off; ***restraints***-on/off; call light-in reach/not in reach; **equipment *malfunction***-specify]	• tx and comparison sites record falls the same way (i.e., fill out an occurrence report) • however, the subsequent sub-sections are not similar
degree of injury	• recorded on Occurrence Report • options: (i) none apparent; (ii) minor; (iii) major; (iv) death	• recorded on Occurrence Report • options: (i) none apparent; (ii) minor; (iii) major; (iv) death	• recorded on Incident Report • options: (i) none apparent, (ii) slight – no treatment required; (iii) moderate – First Aid; (iv) serious; (v) transfer to another facility required	• tx and comparison sites record these data similarly on Occurrence Reports • see Table 4.3: Alignment of Injury Categories on IRHA's Occurrence and Incident Reports

Appendix 12: ICD Codes Used in this Research
source: http://www.who.int/classifications/icd/en/

Variable	ICD Code	Description
Falls: • ICD-9-CM codes • source: hospital abstracts	E880	Accidental fall on or from stairs or steps
	E881	Accidental fall on or from ladders or scaffolding
	E882	Accidental fall from or out of building or other structure
	E883	Accidental fall into hole or other opening in surface
	E884	Other accidental falls from one level to another
	E885	Fall on same level from slipping, tripping or stumbling
	E886	Accidental fall on same level from collision pushing or shoving by or with other person
	E887	Fracture cause unspecified
	E888	Other unspecified fall
Falls: • ICD-10-CA codes • source: hospital abstracts	W00	Fall on same level involving ice and snow
	W01	Fall on same level from slipping, tripping or stumbling
	W02	Fall involving ice-skates, skis, roller-skates or skateboard
	W03	Other fall on same level due to collision with, or pushing by, another person
	W04	Fall while being carried or supported by other persons
	W05	Fall involving wheelchair
	W06	Fall involving bed
	W07	Fall involving chair
	W08	Fall involving other furniture
	W09	Fall involving playground equipment
	W10	Fall on and from stairs and steps
	W11	Fall on and from ladder
	W12	Fall on and from scaffolding
	W13	Fall from, out of or through building or structure
	W14	Fall from tree
	W15	Fall from cliff
	W16	Diving or jumping into water causing injury other than drowning or submersion
	W17	Other fall from one level to another
	W18	Other fall on same level
	W19	Unspecified fall

Appendix 12: ICD Codes Used in this Research (cont'd)

Variable	ICD Code	Description
Dementia: • ICD-9-CM codes • sources: (i) medical claims; (ii) hospital abstracts up to March 31, 2004)	290.0	Senile dementia, uncomplicated
	291.1	Alcohol-induced persisting amnestic disorder
	292.82	Alcohol-induced persisting dementia
	294	Persistent mental disorders due to conditions classified elsewhere
	331	Other cerebral degenerations (e.g., Alzheimer's)
	797	Senility without psychosis
Dementia: • ICD-10-CA codes • source: hospital abstracts from April 1, 2004 on)	F00	Dementia in Alzheimer's disease
	F00.1	Dementia in Alzheimer's disease with late onset
	F00.9	Dementia in Alzheimer's disease, unspecified
	F01	Vascular dementia
	F01.1	Multi-infarct dementia
	F01.9	Vascular dementia, unspecified
	F02	Dementia in other diseases classified elsewhere
	F02.3	Dementia in Parkinson's disease
	F02.8	Dementia in other specified diseases classified elsewhere
	F03	Unspecified dementia
	F04	Organic amnesic syndrome, not induced by alcohol and other psychoactive substances
	F05.1	Delirium superimposed on dementia
	F06.5	Organic dissociative disorder
	F06.6	Organic emotionally labile [asthenic] disorder
	F06.8	Other specified mental disorders due to brain damage and dysfunction and to physical disease
	F06.9	Unspecified mental disorder due to brain damage and dysfunction and to physical disease
	F09	Unspecified organic or symptomatic mental disorder
	F10.7	Mental and behavioural disorders due to use of alcohol; Residual and late-onset psychotic disorder
	F11.7	Mental and behavioural disorders due to use of opioids
	F12.7	Mental and behavioural disorders due to use of cannabinoids
	F13.7	Mental and behavioural disorders due to use of sedatives or hypnotics

Appendix 12: ICD Codes Used in this Research (cont'd)

Dementia: • ICD-10-CA codes (cont'd)	F14.7	Mental and behavioural disorders due to use of cocaine
	F15.7	Mental and behavioural disorders due to use of other stimulants, including caffeine
	F16.7	Mental and behavioural disorders due to use of hallucinogens
	F18.7	Mental and behavioural disorders due to use of volatile solvents
	F19.7	Mental and behavioural disorders due to multiple drug use and use of other psychoactive substances
	G30	Alzheimer's disease
	G31.0	Circumscribed brain atrophy
	G31.1	Senile degeneration of brain, not elsewhere classified
	G31.9	Degenerative disease of nervous system, unspecified
	G32.8	Other specified degenerative disorders of nervous system in diseases classified elsewhere
	G91	Hydrocephalus
	G91.2	Normal-pressure hydrocephalus
	G91.9	Hydrocephalus, unspecified
	G93.7	Reye's syndrome
	G94	Other disorders of brain in diseases classified elsewhere
	R54	Senility

Appendix 13: Drugs Used to Define Fall-Risk Drugs

PSYCHOTROPICS

1.1. Antidepressants

- N06AB 04: Citalopram
- N06AB 03: Fluoxetine
- N06AB 08: Fluvoxamine
- N06AB 05: Paroxetine
- N06AB 06: Sertraline
- N06AX 16: Venlafaxine
- N06AX 11: Mirtazapine
- N06AX 05: Trazodone
- N06AA 09: Amitriptyline
- N06AA 04: Clomipramine
- N06AA 01: Desipramine
- N06AA 12: Doxepin
- N06AA 02: Imipramine
- N06AA 10: Nortriptyline
- N07BA 02: Bupropion
- N06AG 02: Moclobemide

1.2. Benzodiazepines

- N05BA 02: Chlordiazepoxide
- N05BA 01: Diazepam
- N03AE 01: Clonazepam
- N05CD 01: Flurazepam
- N05BA 12: Alprazolam
- N05BA 06: Lorazepam
- N05BA 04: Oxazepam
- N05CD 02: Nitrazepam
- N05CD 07: Temazepam
- N05CD 05: Triazolam
- N05CD 08: Midazolam

1.3. Anticonvulsants

- N03AF 01: Carbamazepine
- N03AX 12: Gabapentin
- N03AX 09: Lamotrigine
- N03AX 11: Topiramate
- N03AA 02: Phenobarbital
- N03AB 02: Phenytoin
- N03AG 04: Vigabatrin
- N03AG 01: Valproic acid

1.4. Alzheimer's Drugs

- N06DA 02: Donepezil
- N06DA 04: Galantamine
- N06DA 03: Rivastigmine

1.5. Antipsychotics

- N05AH 02: Clozapine
- N05AH 03: Olanzapine
- N05AH 04: Quetiapine
- N05AA 01: Chlorpromazine
- N05AD 01: Haloperidol
- N05BB 01: Hydroxyzine
- N05AN 01: Lithium
- N05AH 01: Loxapine
- N05AB 03: Perphenazine
- N05AB 04: Prochlorperazine
- N05AB 06: Trifluoperazine
- N05AX 08: Risperidone
- N05AC 02: Thioridazine
- N05AA 02: Phenothiazine

1.6. Antihistamines/Antinauseants

- R06AA 02: Diphenhydramine
- A03FA 01: Metoclopramide
- N05AB 04: Prochlorperazine
- D04AA 10: Promethazine
- S01FA 02: Scopolamine patch

2. ANTIPARKINSONIAN AGENTS

- N04BB 01: Amantadine
- N04BC 01: Bromocriptine
- N04BX 02: Entacapone
- N04BA 03: Levodopa/ Benserazide
- N04BA 02: Levodopa/ Carbidopa
- N04BC 02: Pergolide
- N04BC 05: Pramipexole
- N04BD 01: Selegiline

Appendix 13: Drugs Used to Define Fall-Risk Drugs (cont'd)

3. ANTIHYPERTENSIVES

3.1. Angiotensin II Receptor Antagonists

- C09CA 06: Candesartan
- C09CA 02: Eprosartan
- C09CA 04: Irbesartan
- C09CA 01: Losartan
- C09CA 07: Telmisartan
- C09CA 03: Valsartan

3.2. Ace Inhibitors

- C09AA 07: Benazepril
- C09AA 01: Captopril
- C09AA 04: Perindopril
- C09AA 08: Cilazapril
- C09AA 02: Enalapril
- C09AA 05: Ramipril
- C09AA 03: Lisinopril
- C09AA 06: Quinapril
- C09AA 09: Fosinopril

3.3. Beta Blockers

- C07AB 04: Acebutolol
- C07AB 03: Atenolol
- C07AB 07: Bisoprolol
- C07AB 02: Metoprolol
- C07AG 02: Carvedilol
- C07AG 01: Labetalol
- C07AA 05: Propranolol
- C07AA 07: Sotalol
- S01ED 01: Timolol

3.4. Calcium Channel Blockers

- C08CA 01: Amlodipine
- C08CA 05: Nifedipine
- C08CA 02: Felodipine
- C08DB 01: Diltiazem
- C08DA 01: Verapamil

3.5. Vasodilators

- C01DA 14: Isosorbide
- C02DB 02: Hydralazine
- C01DA 02: Glyceryl trinitrate
- G04CA 03: Terazosin

3.6. Diuretics

- C03DB 01: Amiloride/HCTZ
- C03CA 01: Furosemide
- C03AA 03: Hydrochlorothiazide
- C03DB 02: Triamterene/HCTZ

4. NARCOTICS

- N02BE 51: Acetaminophen-Codeine-Caffeine
- R05DA 04: Codeine
- N02AB 03: Fentanyl
- N02AA 03: Hydromorphone

Appendix 14: Non-Injurious Falls

The rate of falls resulting in a non-injury increased significantly over time in NEHA from 1.43 to 1.91 ppy (adjusted: 1.36 to 1.64 ppy (RR_{adj}=1.20, 95% CIs=1.02-1.42, p=0.032). [see Appendix 20, *Figures A.20.1: Crude Rate of Non-Injurious Falls* and *A.20.2: Adjusted Rate of Non-Injurious Falls]*.

In the pre-period in NEHA, there was a significantly greater rate of non-injurious falls compared to IRHA – 1.43 vs 0.96 (adjusted: 1.36 vs 0.96 ppy; RR_{adj}=1.42, 95% CIs=1.17-1.72, p=0.001). In the post-period, the difference between RHAs was no longer significant, but NEHA's rate remained higher than IRHA's – 1.91 vs 1.65 ppy (adjusted: 1.64 vs 1.53; RR_{adj}=1.07, 95% CIs=0.89-1.28, p=0.29, NS).

Male residents, those with dementia, those at level of care 5, and those on fall-risk drugs had a significantly greater rate of a non-injurious falls (male RR_{adj}=1.36, 95% CIs=1.16-1.59, p=0.001; dementia RR_{adj}=1.49, 95% CIs=1.23-1.83, p=0.000; LOC 5 RR_{adj}=1.64, 95% CIs=1.04-2.59, p=0.039; fall rx RR_{adj}=1.18, 95% CIs=1.02-1.36, p=0.034). Level 4 and 6 residents had a significantly lower adjusted rate of non-injurious falls (LOC 4 RR_{adj}=0.49, 95% CIs=0.38-0.64, p<0.0001; LOC 6 RR_{adj}=0.29, 95% CIs=0.12-0.69, p=0.011) compared to level 2 residents.

There was no significant difference in chance of a non-injurious fall by age group, polypharmacy, nor residents at levels of care 2 or 3.

As done previously with injurious falls and falls resulting in hospitalization, because hypotheses related to injurious falls were unidirectional, one-tailed testing was used.

Appendix 14: Non-Injurious Falls (cont'd)

Table A.14.1: Total Non-Injurious Falls by Covariate Groups (n=2877)

Variables		Pre-Period		Post-Period	
		NEHA	IRHA	NEHA	IRHA
age group	under 80	82	76	280	304
	80-86	132	67	273	233
	87-91	149	124	346	212
	92+	137	74	191	197
sex	male	202	139	413	387
	female	298	202	677	559
dementia	with	382	251	890	765
	without	118	90	200	181
LOC	2	197	163	283	373
	3	223	137	691	497
	4	72	37	109	70
	5 & 6	8	s	7	s
polypharmacy	yes	303	213	562	562
	no	197	128	528	384
fall-risk drugs	yes	300	171	890	486
	no	200	170	200	460

Figure A.14.1: Crude Rate of Non-Injurious Falls
per person year (n=2,877 total non-injuries)

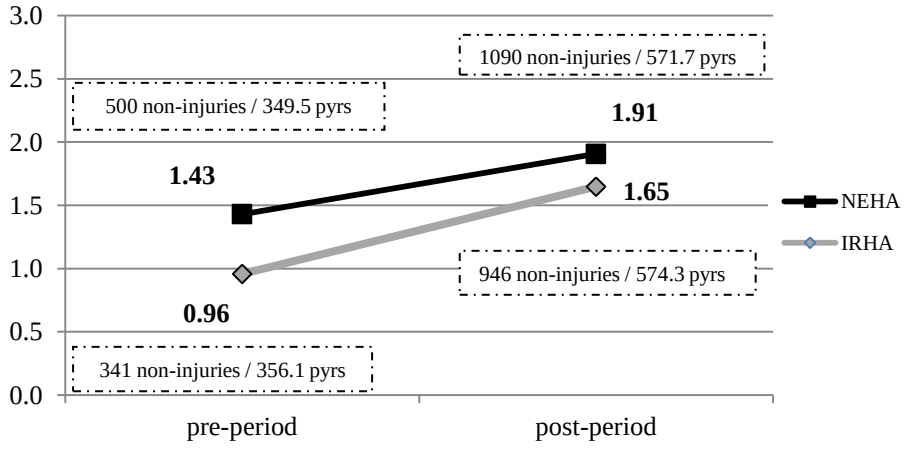
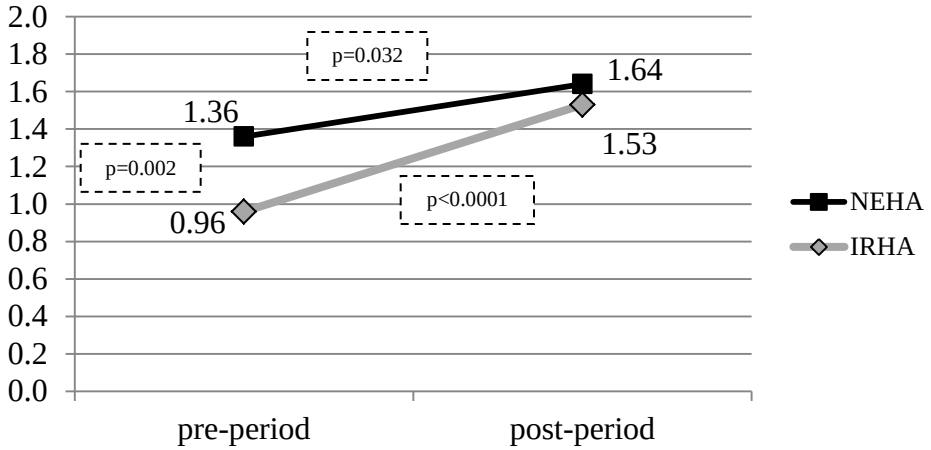


Figure A.14.2: Adjusted Rate of Non-Injurious Falls
(adjusted rate per person year; n=2,877 non-injuries)



Appendix 14: Non-Injurious Falls (cont'd)

Table A.14.2: Relative Rates for Non-Injurious Falls

parameter	reference	RR (adj)	lower CI	upper CI	p-value	RR (unadj)	lower CI	upper CI	p-value
intercept		0.002	0.001	0.002	<.0001				
post-period	**pre-Period**	**1.598**	1.344	1.899	<.0001	1.451	1.255	1.678	<.0001
NEHA	**IRHA**	**1.417**	1.170	1.716	0.001	1.239	0.999	1.537	0.026
post x NEHA	see contrasts below				0.026				
age <80	age 92+	1.129	0.872	1.462	0.220	1.151	0.806	1.644	0.219
age 80-86	age 92+	0.901	0.747	1.085	0.178	0.962	0.741	1.247	0.384
age 87-91	age 92+	1.058	0.894	1.253	0.292	1.125	0.892	1.420	0.160
male	**female**	**1.355**	1.157	1.587	0.001	1.317	1.057	1.641	0.007
with dementia	**without dementia**	**1.499**	1.232	1.825	0.000	1.607	1.264	2.042	0.000
loc 3	loc 2	1.149	0.997	1.324	0.055	1.236	1.011	1.512	0.020
loc 4	**loc 2**	**0.491**	0.378	0.638	<.0001	0.508	0.376	0.687	<.0001
loc 5	loc 2	1.637	1.036	2.588	0.039	1.714	1.012	2.903	0.023
loc 6	**loc 2**	**0.290**	0.120	0.699	0.011	0.305	0.109	0.852	0.012
polypharm	not polypharm	1.144	0.971	1.347	0.089	1.199	0.958	1.501	0.056
on 1+ fall-rxs	not on 1+ fall-rxs	1.183	1.017	1.375	0.034	1.295	1.054	1.591	0.007
Contrasts:									
pre NEHA vs IRHA		**1.417**	**1.170**	**1.716**	**0.001**	1.464	1.147	1.868	0.001
post NEHA vs IRHA		1.066	0.885	1.284	0.287	1.180	0.923	1.508	0.093
post vs pre NEHA		1.202	**1.021**	**1.415**	**0.032**	1.321	1.080	1.616	0.003
post vs pre IRHA		**1.598**	**1.344**	**1.899**	**<.0001**	1.638	1.332	2.015	<.0001

Appendix 15: Outcomes by Month

Falls by Month

Looking at falls by month in NEHA, there was a decrease during the pre-period and an increase during the post-period.

Figure A.15.1: Falls in the Pre-Period in NEHA
by 2-month periods, per person day

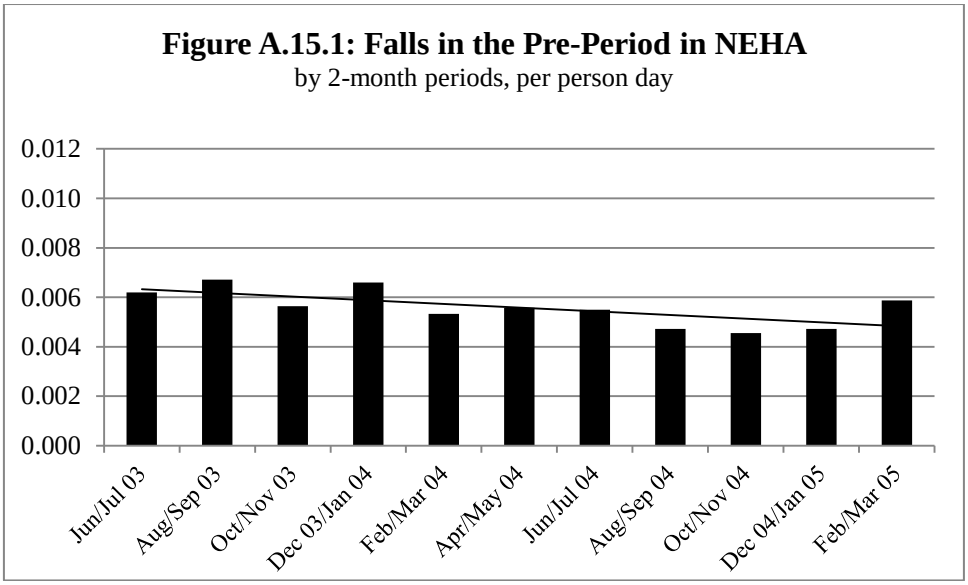
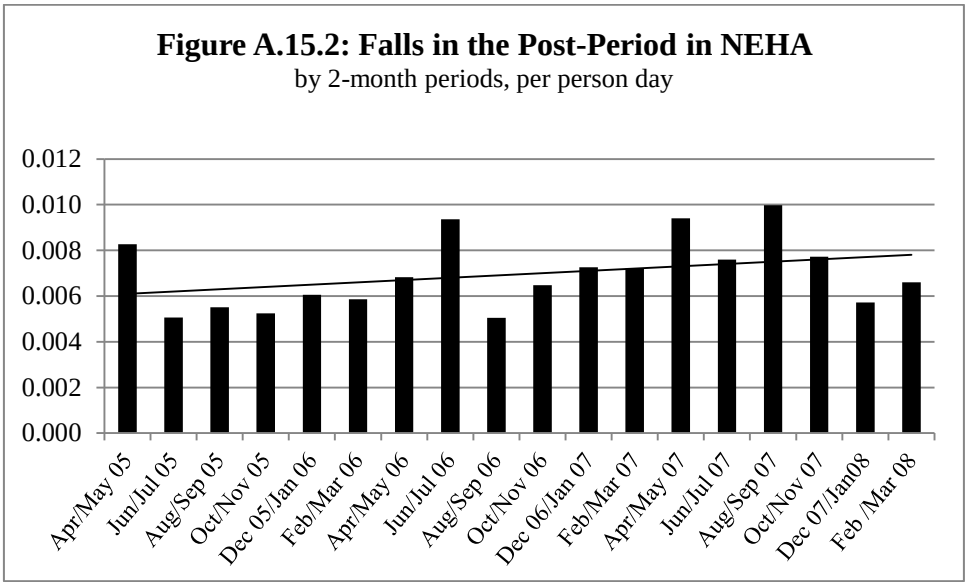
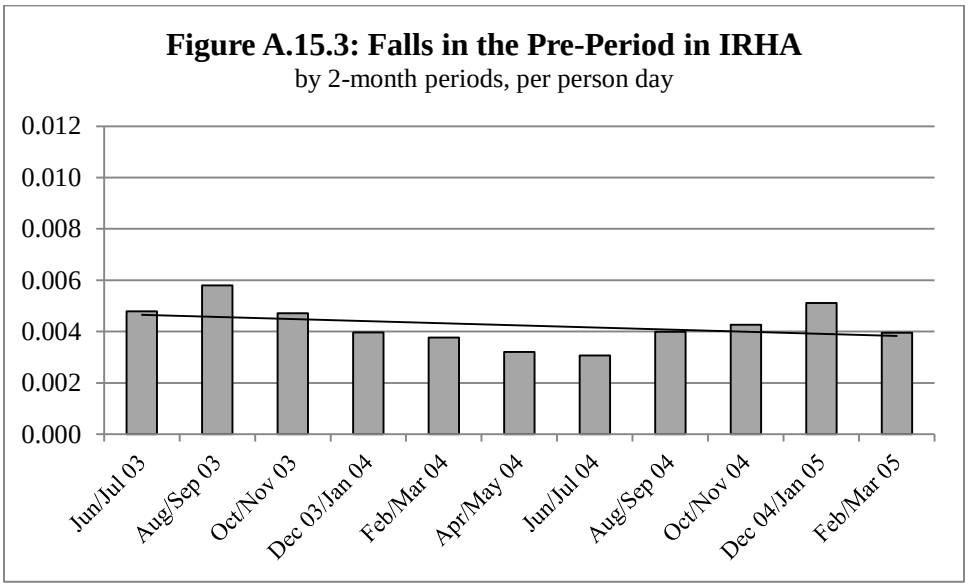
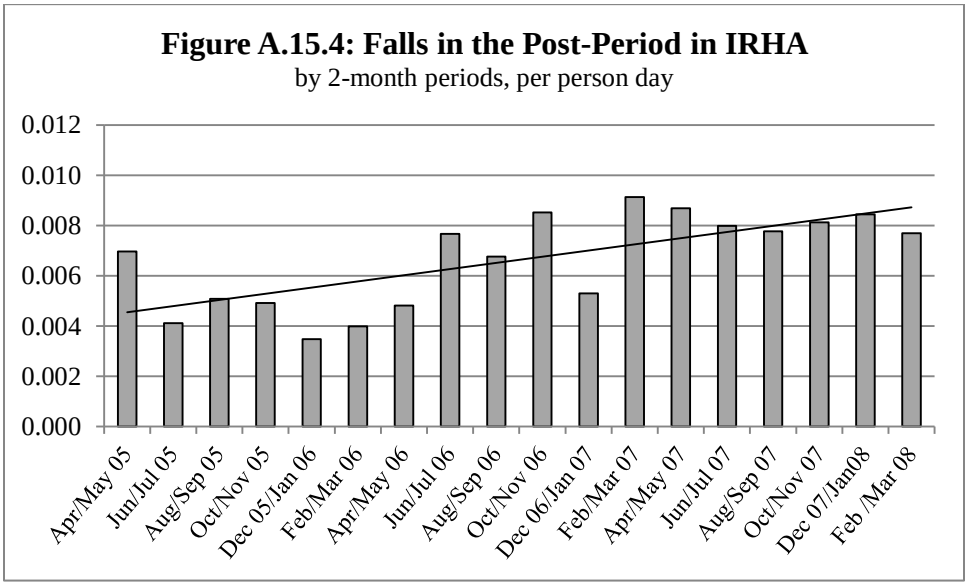


Figure A.15.2: Falls in the Post-Period in NEHA
by 2-month periods, per person day



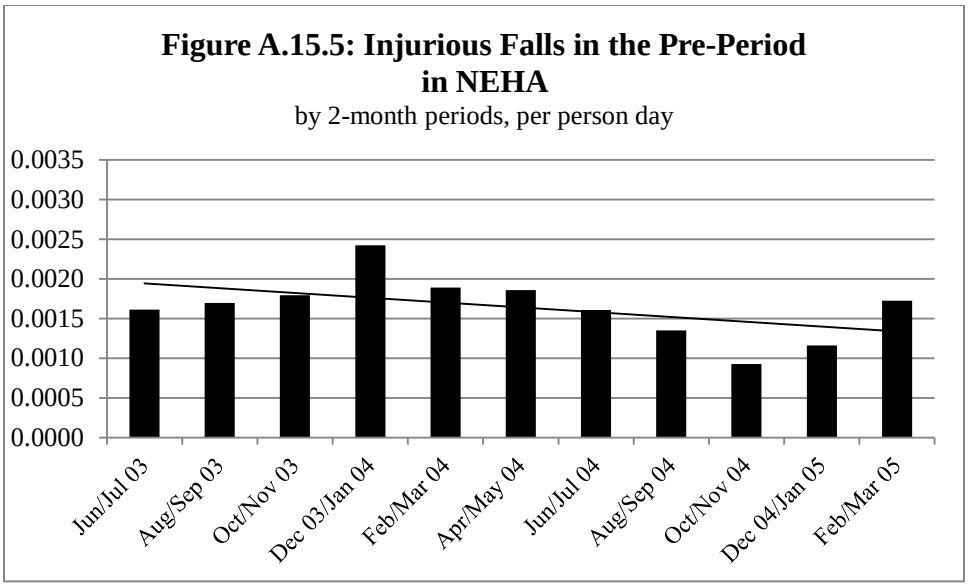
This same pattern was found in **IRHA** – a decrease in falls in the pre-period and an increase in the post-period. However, the rate of increase appears to be steeper in IRHA compared to NEHA.

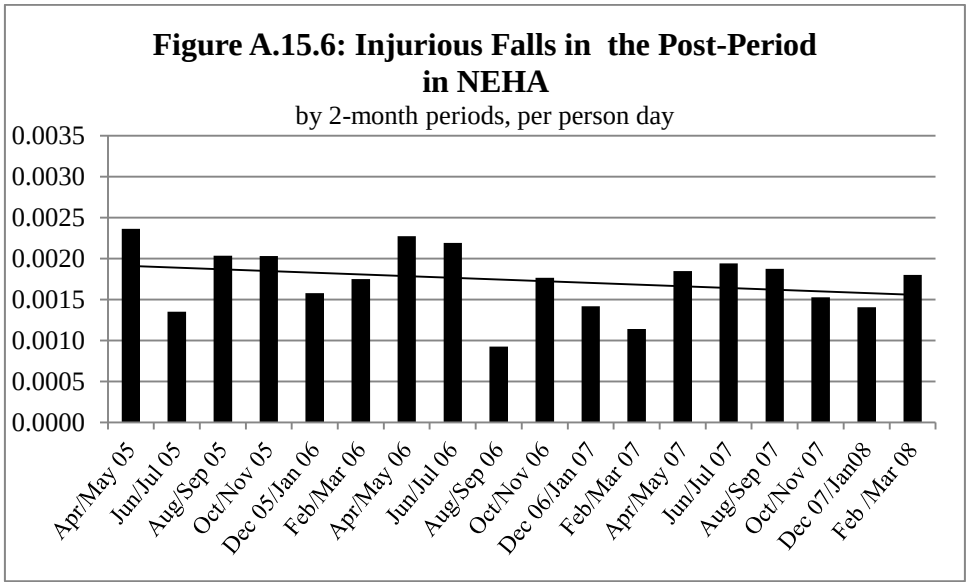




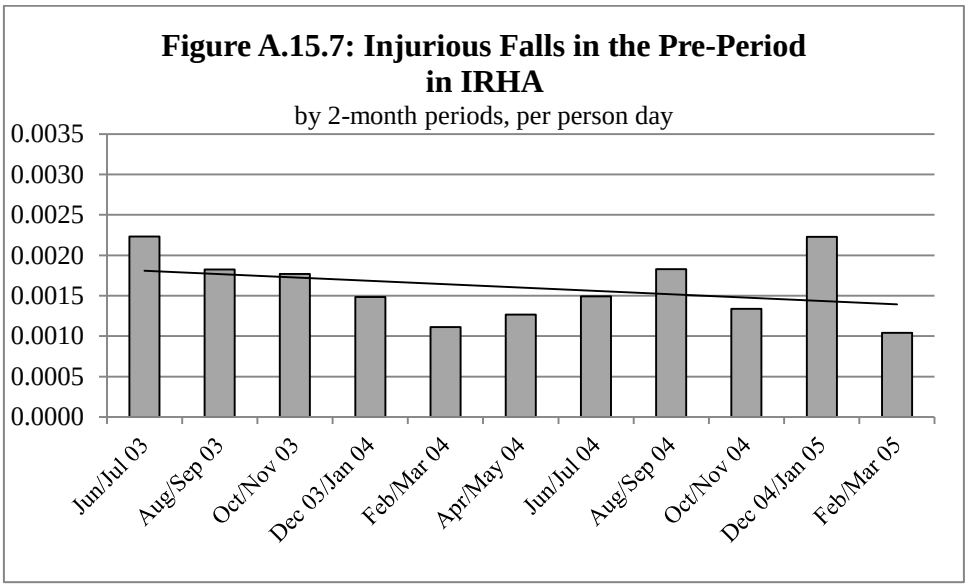
Injuries by Month

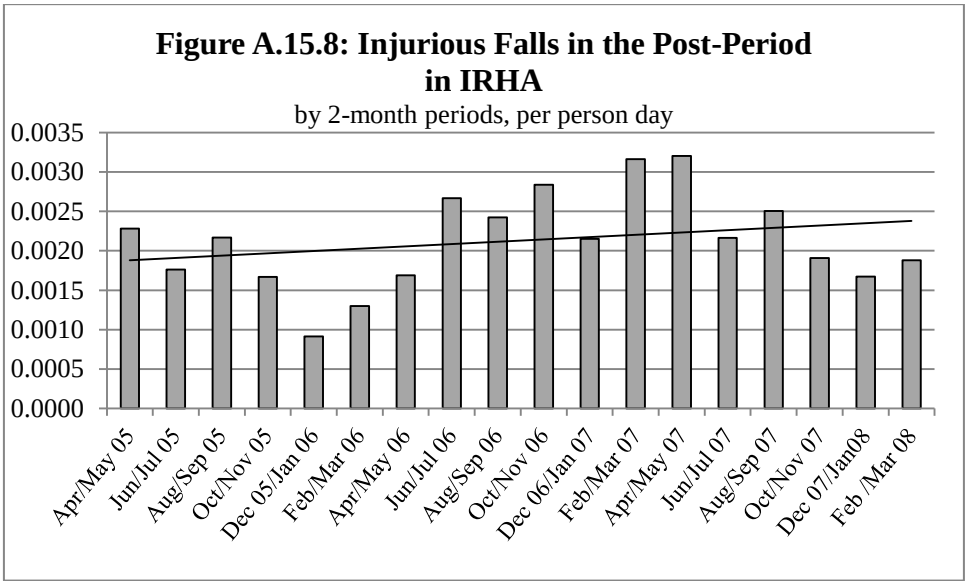
Looking at **injuries by month in NEHA**, there was a decrease during the pre-period, accompanying the decrease in falls per month in NEHA. Injuries stabilized, decreasing only slightly during the post-period.





In **IRHA**, injuries decreased in the pre-period along with the decrease in falls. However, in the post-period, injuries increased unlike NEHA where rates stabilized.





Non-Injurious Falls by Month

Looking at **non-injuries by month in NEHA**, there was a decrease in the pre-period and an increase in the post-period. This decrease in non-injuries in the pre-period accompanies a decrease in falls and injuries. However, the increase in non-injuries in the post-period accompanies an increase in falls and a slight decrease in injuries, so it would appear that residents are more active and falling more, but injuring themselves less (i.e., having more non-injurious falls).

Figure A.15.9: Non-Injurious Falls in the Pre-Period in NEHA

by 2-month periods, per person day

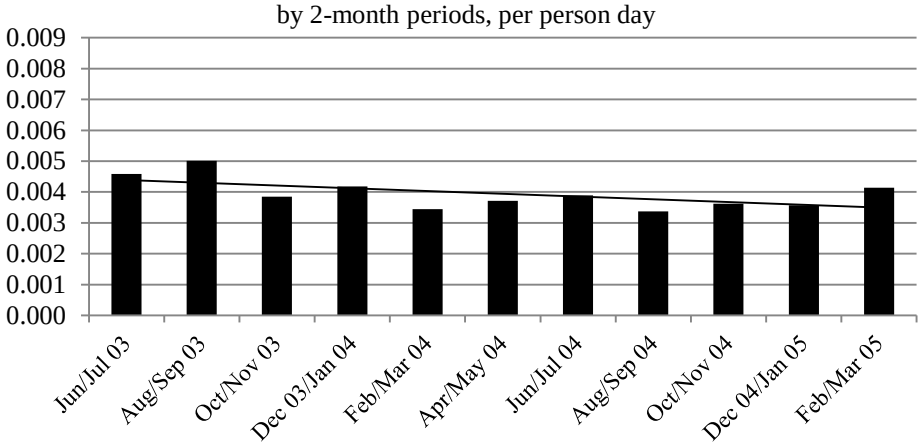
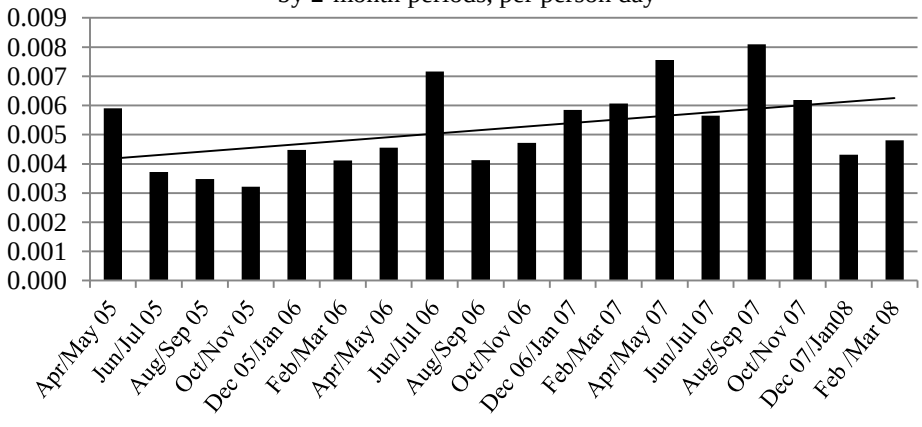


Figure A.15.10: Non-Injurious Falls in the Post-Period in NEHA

by 2-month periods, per person day



Looking at **non-injuries by month in IRHA**, there was a decrease in the pre-period and an increase in the post-period. This decrease in non-injuries in the pre-period accompanies a decrease in falls and injuries. However, the increase in non-injuries in the post-period accompanies an increase in falls and injuries.

Figure A.15.11: Non- Injurious Falls in the Pre-Period in IRHA

by 2-month periods, per person day

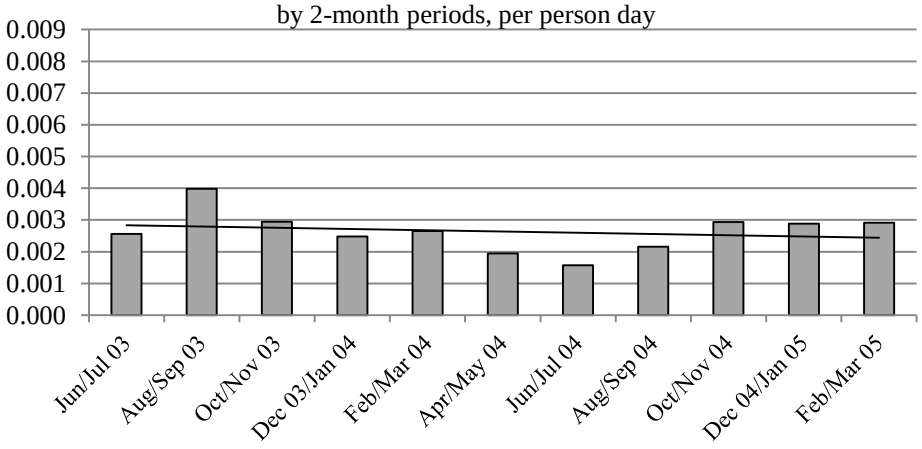


Figure A.15.12: Non- Injurious Falls in the Post-Period in IRHA

by 2-month periods, per person day