HIP FRACTURES IN MANITOBA:

AN EVALUATION OF THE QUALITY OF CARE

BY

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A Thesis
Submitted to the Faculty of Graduate Studies in Partial
Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

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THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES
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A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirements of the degree

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This thesis is dedicated to my husband, Lawrence, and my son, Alexander, for their patience.

Susan Roberecki

ABSTRACT

<u>Problem</u>: Roos et al. (1990) compared mortality rates following various surgical procedures in Manitoba and New England. Individuals treated with procedures with a high mortality rate, hip fracture repair and bypass surgery, had a higher risk of death in Manitoba within the first year after surgery than in New England. However, the survival for other surgical procedures was better in Manitoba. These findings suggest the need for evaluating the quality of hip fracture care in Manitoba.

<u>Method</u>: All hip fracture patients, age 65 years and over, in their initial episode of care from April 1, 1979 to March 31, 1993 (N=12,271) in Manitoba were identified from hospital abstracts in the provincial health insurance system. Death at three months, death between three months and one year, readmission within one year, nursing home admission within one year, occurrence of a second hip fracture, diagnosis of a late effect of hip fracture care, a repeat primary repair procedure, a secondary repair procedure and length of stay greater than 100 days were the adverse outcomes studied.

The predictors of adverse outcomes were examined using multivariate analysis. Variables were grouped into demographic variables, fracture characteristics, comorbidities, treatment variables and delivery of care variables.

<u>Results</u>: In general, delivery of care variables appeared to be more important in the three month mortality model than the three month to one year mortality model. Readmission to hospital was associated with comorbidity variables, demographic variables, delivery of care variables (region of residence and hospital of admission or treatment) and complications of care (accidents in hospital, long length of stay, second hip fracture, late effect diagnosis, and repeat primary repair).

Nursing home admission was significantly associated with comorbidities that require significant caregiver support(e.g. dementia, cerebral vascular disease) and the potential resources available for such support(rural residence). Region of residence and admitting hospital type were very predictive of nursing home admission and suggest that delivery of care factors are associated with nursing home admission as well.

Very few variables were associated with a second hip fracture. However, age and nursing home residence were extremely predictive. As well, some of the comorbidity factors often associated with falling (e.g. seizure disorder, alcoholism) were also predictive. COPD was also found to be very predictive of a second fracture.

In the late effect, repeat primary and secondary repair models, fracture characteristics and repair types played a prominent role. In addition, significant variables, such as hospital repair frequency and admission day suggest that improvements could be made in delivery of care. Sex differences were found in the subsequent procedures. Women were more likely to receive a repeat primary repair procedure and men were more likely to receive a secondary repair procedure.

Length of stay greater than 100 days was found to be non-specific as an outcome variable. It reflects comorbidity, complications and discretionary care practises. It was not possible from this study to determine how these three factors influence length of stay since the study did not examine in hospital medical complications.

Conclusions: The study provided a framework for examining quality of care on a population basis and identified areas for action/research in Manitoba. Important indicators were identified and difficulties with others were determined.

Specific recommendations for future research were made in several areas. Since one hospital was found to be superior to others on most outcomes, an analysis of their practises was recommended. Since arthroplasty appeared to have much better outcomes than internal fixation, discussions with the orthopaedic community and further specific research was recommended. Nursing home patients have a very short stay in hospital but a significantly increased likelihood of a second fracture. The quality of rehabilitative care received by these patients was highlighted for investigation. Patients who fracture their hip while in hospital are at risk for significant complications. The importance of prevention of in hospital fractures was emphasized. Finally, patients transferred without admission to hospital were at risk for a number of adverse outcomes. These patients may constitute a high risk patient group or reflect a poor patient management practise. Further investigation was recommended.

Acknowledgements

Thank you to my thesis committee for their guidance: Dr. Les Roos, Professor Evelyn Shapiro and Dr. David Lyttle.

Thank you also to Professor Tom Hassard and Bob Tate for their statistical advice.

Thank you to Dr. Colin Powell for his guidance in the early study years.

Thank you also to the programmers at the Manitoba Centre for Health Policy and Evaluation for their programming assistance, particular thanks to Randy Waldt and Andre Wajda.

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HIP FRACTURES IN MANITOBA:

AN EVALUATION OF THE QUALITY OF CARE

I. The Introduction

A. Thesis Objective

The objective of this study is to evaluate the quality of hip fracture care in Manitoba by identifying patient characteristic, treatment and delivery of care indicators which impact on hip fracture outcomes in seniors, 65 years and older and to highlight areas of concern for further investigation.

B. Problem Definition

The ageing of the population has led to increased interest in diseases which cause significant morbidity and mortality in the elderly.[1] As a result, hip fractures have been the focus of intense study in recent years. However, many questions remain unanswered. Studies have shown wide variations in the rates of hip fracture[2,3,4,5,6,7,8,9,10,11,12] and the outcomes of hip fracture repair across geographic areas[2,8,13,14,15,16]. These findings suggest that there is room to improve the morbidity and mortality of hip fractures on two fronts. First, if we can identify factors which lead to the incidence of hip fractures, we can employ preventative strategies to avoid their occurrence. Secondly, if we can determine and assure the best method of care for a given patient, we can reduce unnecessary morbidity and mortality.

A study comparing the mortality rates following various surgical procedures in Manitoba and New England showed that individuals treated with procedures with a high mortality rate, hip fracture repair and bypass surgery, have a higher risk of death in Manitoba within the first year after surgery than in New England.[15,16] However, the survival for other surgical procedures was better in Manitoba.[15,16] These findings suggest the need for evaluating the quality of care of hip fracture in Manitoba.

II. Literature Review

A. Evaluating Quality of Care

Introduction

The increased hip fracture mortality within the first year in Manitoba provided fuel for those anxious to show that the American health care system produces better results than the Canadian Medicare system.[17] One might argue that in high mortality conditions, real differences in quality of care can be demonstrated because the margin for error is smaller, ie. mortality is a more sensitive measurement with these procedures. The differences in survival with the moderate and low mortality conditions may reflect the overall improved longevity of Manitobans.[15] If Manitobans are expected to live longer, the higher mortality of the hip fracture patients increases in significance.

Since the occurrence of adverse outcomes are usually rare events for a given hospital or for a given surgeon, quality assurance efforts have tended to focus on maintaining the standards or policies thought to be necessary for quality care. However, more global lapses in quality, such as flaws in hospital policy, systemic training flaws, reduced access to health care, etc., may go unnoticed. These population health concerns must be addressed on a larger scale than the quality assurance efforts conducted within a given hospital or with a given physician.

Population-based administrative data provide the opportunity to amass larger numbers of adverse outcomes so that trends can be identified. These data also provide the ability to compare one population with another. Using population-based administrative data, the Manitoba/New England study compared the mortality rates for multiple surgical procedures to identify areas where quality of care may be improved.[15,16] They identified hip fracture repair as an area of concern in Manitoba. The findings of this study represent an overall assessment of the effectiveness of the multiple technologies used in the care of hip fracture patients, simultaneously. However, further study is necessary to determine which aspects of hip fracture care may be contributing to adverse outcomes. This section outlines a framework for the assessment of the quality of hip fracture care in Manitoba.

Quality of Care

Numerous definitions of quality care have been offered but to date a satisfactory definition has not been achieved.[18] The Health Services Research Group (1992) reviewed the various definitions of quality care and identified missing elements in each definition, concluding that "... any definition must be incomplete and arbitrary..." and suggested focusing instead on "Quality Pursuits". This approach involves "...assessing needs, defining goals of care, recognizing the attributes of care deemed to be important, designing measures to assess those goals and attributes and responding to the results."

However, without a unifying principle to assess need and to set goals for care, it is difficult to compare one quality assessment with another and to be sure that all the important aspects of care have been covered. Therefore, the following definition of Quality Care was developed to account for the shortcomings of the previous definitions and will be used as a guiding principle in the development of the quality assessment strategies in this study.

Broadly defined, quality care is the optimal balance between health preservation, patient autonomy and protection from adverse events.

This definition incorporates the concepts of achieving a balance between risks and benefits[19], maximizing health status[18], meeting the needs of the patient[20] and the avoidance of care which has unknown or has suboptimal results. The latter point incorporates the tension between the definition offered by Lee and Jones (1933) regarding working within the bounds of accepted medical care[21], the growing movement toward evidence-based care[22,23,24] and the pressure to implement promising technologies to improve the care of patients.[25]

The definition does not directly address the debate between individual and collective perspectives on health care investment[26]. However, given the finite resources available for health care, the maximization of health status would also involve ensuring that the most efficient methods of maintaining health status are utilized, allowing excess resources to be redeployed for other health needs. Thus, assessments of the quality of health care should also consider the resources expended to achieve the desired result. The higher quality care would be that which achieves the same result at a lower cost. However, where differences in outcomes occur, the decision on how much money to spend for a particular health outcome becomes a value judgement[27,28].

Quality Assurance Frameworks

Quality Assurance is the term given to the process of ongoing monitoring of quality. Donabedian outlined three approaches to assessing the quality of health care[29] (Figure 1). His framework assumes that to produce beneficial outcomes, excellence in the structure and delivery of care must be present. Conversely, adverse outcomes suggest deficiencies in the structure and process of care.

Figure 1

Conceptual Framework for Quality Assessment

STRUCTURE ⟶ **PROCESS** ⟶ **OUTCOME**

The evaluation of structural aspects of care involves ensuring that the necessary components for quality care are available. Structural aspects of care include: appropriate facilities and equipment, trained health care providers, infection control procedures, etc.,. The evaluation of structure of care also includes examining the framework of the overall health care system, including concepts such as accessibility to care, universal health care coverage, etc.

With the evaluation of the process of care, care given is measured against implicit or explicit standards, norms or peer judgements as to what constitutes quality care for a given intervention. An evaluation of the process of care would also include an examination of how patients are dealt with and move through the health care system.

The evaluation of outcomes involves the comparison of current outcomes with past trends or outcome rates on other wards, in other hospitals, other provinces, etc.,. Outcomes, such as death, disease, disability, discomfort, dissatisfaction, absence of disease, etc., are measured. Elevation in adverse outcomes may be indication of a deterioration in quality of care and may prompt an investigation into the structure and process of care to determine the factors responsible.

Adverse outcomes are often used as indicators to measure the quality of care. However, other indicators are often used to measure the quality of structural or procedural aspects of care. A quality indicator is

> a quantitative measure that can be used as a guide to monitor and evaluate the quality of important patient care and support service activities....An indicator is not necessarily a direct measure of quality, more often it serves as a screen or flag that directs attention to a problem area.[30]

The quality indicator which triggered concern in Manitoba was a higher mortality rate than the standard set by

New England for hip fracture cases. However, in contrast to the usual quality investigations, which involve investigating the events surrounding a small numbers of cases (eg. death reviews), this study involved all hip fracture repairs in Manitoba in individuals over age 65 years from 1980 to 1986.[16] The factors which may have contributed to the high mortality rate are numerous. A framework is needed to narrow the investigation.

The Health Care Financing Administration, the agency responsible for managing Medicare and Medicaid programs in the United States, proposed a framework for quality assurance investigations[31] (Figure 2). The first step, monitoring trends and outcomes, was accomplished by the Manitoba/New England study, which, using mortality as a measure of quality, identified hip fracture repair as an area of concern in Manitoba. These findings provided an overall assessment of the effectiveness of the multiple technologies used in the care of hip fracture patients, simultaneously.

However, further analysis is necessary to determine which aspects of hip fracture care may be contributing to adverse outcomes (Step 2). The variation in outcomes may result from many sources: differences in the patient population; differences in the types of care given to a particular type of patient (ie. variation due to differences in efficacy of treatment); and differences in the structural aspects and process of care (ie. differences in effectiveness of care) (Figure 3).

Figure 2

The Health Care Financing Administration (HCFA) Framework for Quality Assurance[31]

1. Monitoring Trends and Outcomes
2. Further Characterization to Determine Areas of Reduced Quality of Care
3. Review of Specific Aspects of Care
4. Feedback Findings to Health Care Providers

The third step is to assess specific interventions. Tugwell, Bennett, Feeny, Guyatt and Haynes (1986) proposed a framework, The Technology Assessment Iterative Loop, for evaluating the quality of individual technologies.[22] The framework subdivides the spectrum of health information into sub-groups that constitute a logical progression of evaluation. These steps include quantifying the burden of illness, examining the use technology to diagnose the disease, validating interventions which prevent or ameliorate the disease, examining the application and diffusion of these interventions, and finally evaluating the reduction in burden of illness.

A related framework, the Measurement Iterative Loop, provides a method for organizing the information necessary to develop quality indicators for hip fracture care (Figure 4).[32] This approach will be discussed further in the following section. The final step involves the reporting of findings to health care providers to incite change in those practices which contribute to adverse outcomes.

This study will identify patient characteristics, treatment options, and delivery of care indicators which best predict adverse outcomes of hip fracture care in Manitoba (ie. Step 2 of the HCFA framework).

Figure 3

Analysis of Variation in Outcome

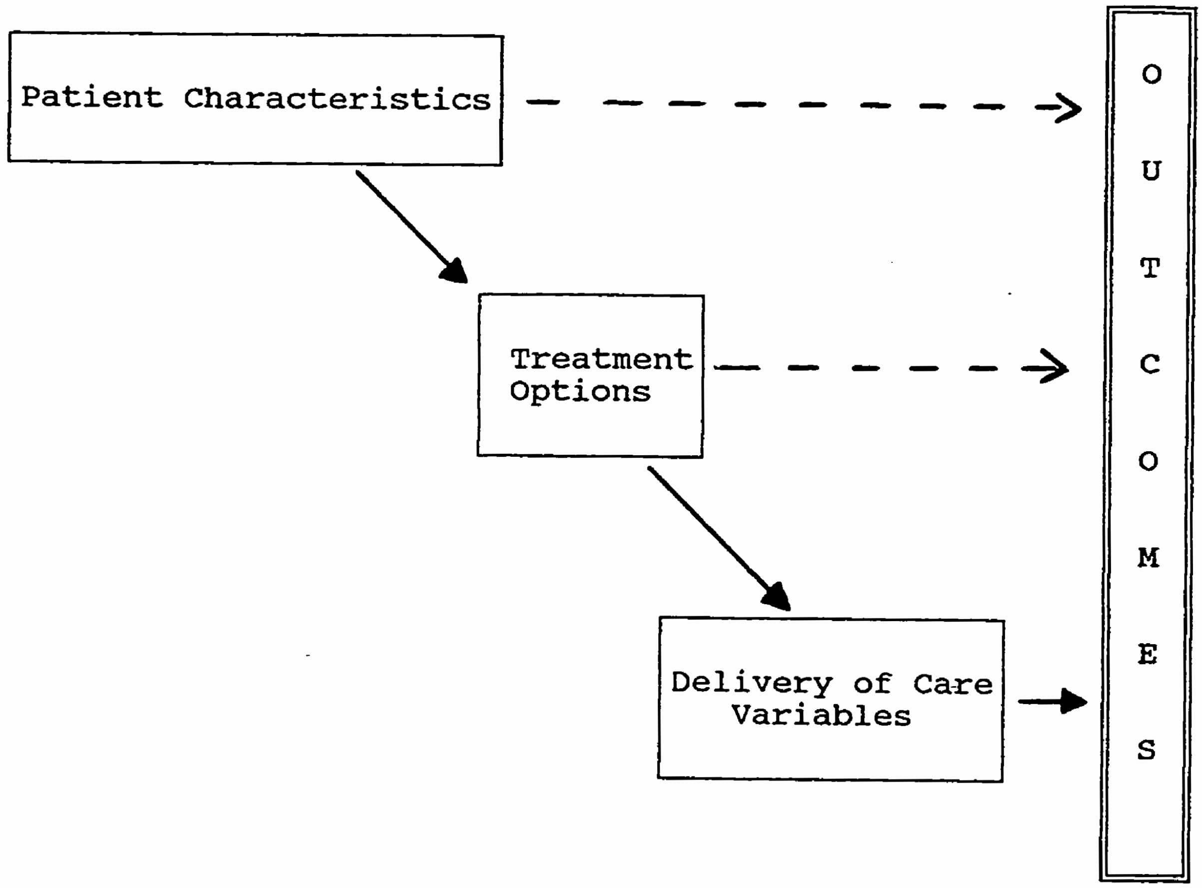
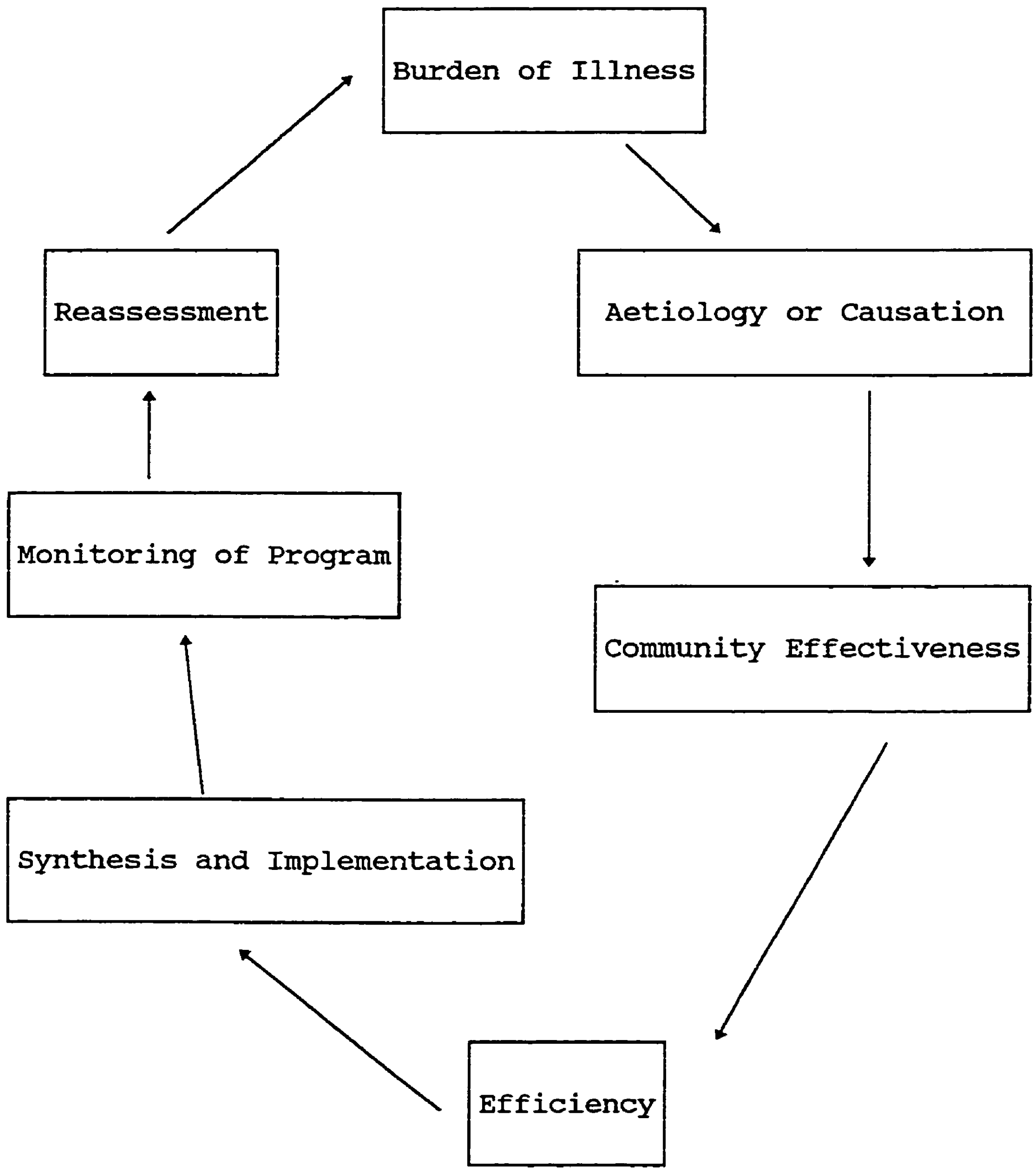


Figure 3 represents the sources of variation to consider when examining variation in outcomes. The solid arrows represent the standard flow of medical care and the dashed lines illustrate confounding influences which must be considered. In a multivariate analysis, these influences may be untangled.

Figure 4

The Measurement Iterative Loop[32]



B. The Evaluation Framework

To study quality, needs must be assessed, problems must be identified, goals of care must be established, important attributes of care must be recognized and adequate measures of the goals and attributes must be validated.[18] This section reviews the available literature surrounding hip fracture care to establish quality indicators.

The Measurement Iterative Loop (Figure 4) will be used for

> assembling the specific subset of health information that is most likely to tell us how to reduce the burden of both morbidity (symptoms; physical, emotional an social functional impairment) and mortality.[32]

This model takes into account factors which influence health status, patient autonomy and adverse events and will be used as the underlying framework to organize quality assessment in this thesis.

The elements of the framework are organized into four sections: Part I, The Epidemiology of Hip Fractures; Part II, The Effectiveness of Hip Fracture Care; Part III, The Delivery of Hip Fracture Care in Manitoba; and Part IV, Quality Assurance Efforts in Hip Fracture Care in Manitoba.

Chapter I

The Epidemiology of Hip Fractures

The Burden of Illness

Distribution

The rate of hip fracture varies throughout the world.[3,4,6,7,9,11,33,34,35] The age-adjusted incidence of hip fractures was 111.6/100,000 for women and 82.2/100,000 for men in a study done in Manitoba and Saskatchewan.[6] Several papers have compared the age-specific hip fracture rates in various countries using a standard population.[9,10] Northern Europeans (Sweden, Norway, Denmark) tend to have the highest rates of hip fracture, followed by the Southern United States, the Northern United States, Great Britain and Canada.[9] Central Europe (Yugoslavia), Asia (Hong Kong) and Africa (South African Bantus) have progressively lower rates.[10]

The incidence of hip fracture increases progressively with age.[6,9,10] Martin et al. (1991) observed an exponential rise in the age-specific hip fracture rates with each 5 year increase in age.[6] For women 90 years or older in Manitoba and Saskatchewan, the age-specific incidence of a hip fracture was 4% and for men of this age, about 2%. The life time risk of a hip fracture for a 90 year old woman was close to 18%. For a 90 year old man, it was about 8%.

Studies from Europe suggest that the incidence of hip fracture has been increasing beyond what could be expected by the aging of the population.[6] In the United States, a study of the incidence of hip fractures in Rochester from 1928 to 1982 showed an increasing age-specific incidence of hip fracture for males but not for females.[7] Rodriguez et al. (1989) analyzed the data collected by the ongoing National Hospital Discharge Survey which reviews a probability sample of all discharges from short stay hospitals in the United States.[36] Between 1970 to 1983, an increasing secular trend was identified.

A study combining the administrative health insurance data in Manitoba and Saskatchewan from 1972 to 1984 also found an increased incidence of hip fractures.[6] The population of women age 50 years and over increased by 18.7% but the incidence of hip fracture in these women increased 59.7%. For men, the population increase was 9% but the increase in hip fracture rate was 42.2%. However, Ray et. al. (1990) did not find increasing age specific rates when examining persons 65 years and over in Saskatchewan with a hip fracture between 1976 to 1985.[9] This study was much smaller (6,267 versus 18,214 fractures) and was monitored over a shorter period of time than the Martin et al. (1991)

study. Thus, the number of individuals in the study may not have been large enough to detect a significant trend.

Morbidity and Mortality

The morbidity and mortality following a hip fracture is considerably higher than that of an age-matched control population.[1,37,38,39] The one year mortality has been reported at between 12 and 25 percent,[1,9,38] and another 33 to 50 percent of the survivors may require long term care.[1] For individuals considered to be at "good risk" for undergoing surgical hip pinning, fewer than one quarter can expect to gain a full recovery at six months, over one half need assistance to walk and one quarter will not walk.[40] The rates of hip fracture complications vary across geographic areas and between hospitals.[2,8,13,15]

The total direct medical care costs in the United States were estimated to be 6 billion dollars per year in 1990, much of which was reinbursed by Medicaid or Medicare.[1] For women, recovering from hip fractures was one of the top seven diagnoses resulting in hospital stays greater than 60 days.[41] With the aging of the population, the total number of hip fractures can be expected to increase because the risk of hip fracture increases with age. Statistics Canada predicts that the number of individuals 65 years and over in 2031 will increase to 23% of the population from 11% of the population in 1991.[42] The over 75 age group will increase to 12% in 2031 from 5% in 1991. Martin et al (1991) predicts the number of hip fractures will increase 72.8% by 2006 and will increase even further if the increasing age-specific incidence continues.[6]

Aetiology

Risk factors can be broken down into risk markers and determinants. Risk markers are exposures or attributes associated with an increased probability of an outcome but are not necessarily causal.[43] Determinants are attributes or exposures which increase the probability of the outcome of interest.[43] Although many attributes have been associated with the incidence of hip fractures,[10] the current literature suggests three determinants contribute to the incidence of hip fractures: fragile bones, trauma and the ability to dissipate the energy of trauma.

Fragile Bones

The risk of a hip fracture relates to the underlying strength of the bone. Conditions which produce bone weakness are considered risk factors for fracture. Congenital abnormalities of bone, metabolic bone diseases, inflammatory disorders involving the bone, neuromuscular disorders, avascular necrosis, and neoplasms of bone are conditions which predisposed to fracture. Fractures which occur through weakened bones are called pathological fractures.[44] Figure 5 shows Salter's classification of the conditions that predispose to pathological fractures.

Figure 5

CLASSIFICATION OF DISORDERS THAT PREDISPOSE BONE TO PATHOLOGICAL FRACTURE

I. Congenital Abnormalities

- Localized
  - Congenital Defect of Tibia (leading to pseudoarthrosis)
- Disseminated
  - Enchondromatosis
- Generalized
  - Osteogenesis Imperfecta (fragile bones)
  - Osteopetrosis (chalk bones)

II. Metabolic Bone Disease

- Rickets
- Osteomalacia
- Scurvy
- Osteoporosis
- Hyperparathyroidism

III. Disseminated Bone Disorders of Unknown Etiology

- Polyostotic Fibrous Dysplasia
- Skeletal Reticuloses
  - Hand-Schuller-Christian disease
  - Eosinophilic Granuloma
  - Gaucher's disease

IV. Inflammatory Disorders

- Haematogenous Osteomyelitis
- Osteomyelitis Secondary to Wounds
- Tuberculous Osteomyelitis
- Rheumatoid Arthritis

V. Neuromuscular Disorders (with Disuse Osteoporosis)

- Paralytic Disorders
  - Poliomyelitis
  - Paraplegia (Spina Bifida and Acquired Paraplegia)
- Disorders of Muscle
  - Muscular Dystrophy

VI. Avascular Necrosis of Bone

- Post-traumatic Avascular Necrosis
- Post-irradiation Necrosis

VII. Neoplasms of Bone

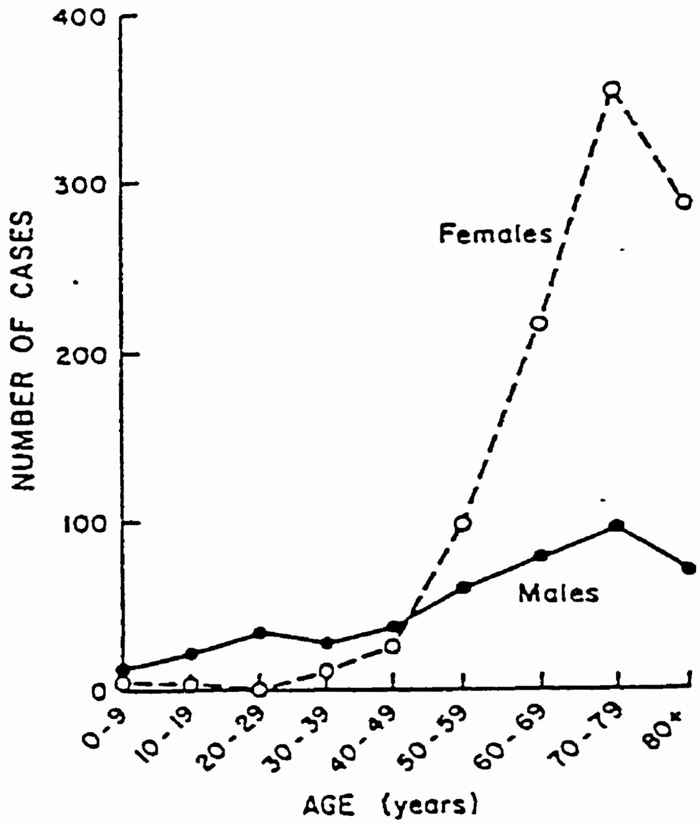
- Primary Neoplasms and Neoplasm-like Lesions
  - Non-osteogenic Fibroma
  - Monostotic Fibrous Dysplasia
  - Simple Bone Cyst
  - Enchondroma
  - Angioma
  - Aneurysmal Bone Cyst
- True Primary Neoplasms of Bone
  - Osteogenic Neoplasms
    - Osteosarcoma
  - Chondrogenic Neoplasms
    - Benign Chondroblastoma
    - Chondromyxoid Fibroma
    - Chondrosarcoma
  - Collagenic Neoplasms
    - Fibrosarcoma
  - Myelogenic Neoplasms
    - Plasma Cell Myeloma
    - Ewing's Tumour
    - Reticulum Cell Sarcoma
    - Hodgkin's Disease
    - Acute Leukaemia
  - Osteoclastoma (giant cell tumour)
  - Metastatic Neoplasm of Bone
    - Metastatic Carcinoma
    - Metastatic Neuroblastoma

The impact of osteoporosis on hip fractures has received considerable study. Melton et al. (1986) was able to correlate the degree of osteoporosis measured by bone densitometry with the incidence of hip fracture.[45] The frequency of hip fractures increased significantly after the femoral bone density dropped below 1.0 g/cm^2. This association between bone density and fractures has been shown in numerous subsequent studies.[46] Women, especially white women, have an increased likelihood of osteoporosis and the incidence of osteoporosis increases with age. These findings correlate with the incidence of hip fractures. The differences in peak bone mass may explain in part racial and sexual differences in the incidence of hip fractures. White women have the lightest skeletons and black men have the heaviest; white men and black women have intermediate skeleton density.[47] In addition, white women with the lowest bone mass are at the greatest risk.

Trauma

Trauma is an independent risk factor for the development of a hip fracture. Figure 6 shows the distribution of hip fractures throughout the human life span.[48] Males have a higher incidence of hip fractures than females until about age 50 years when the incidence in women increases dramatically. In the younger age groups, significant force is required to cause a hip fracture.[36,49] Hip fractures most often result from motor vehicle accidents or sports injuries. A fracture of the shaft of the femur is

Figure 6



Age distribution of cases admitted to a hospital with hip fracture.

Source: Buhr (1959)

more common than a hip fracture.[50] Since men are more likely to be involved in major trauma, the hip fracture rates are higher in men until age 45 years.[36]

In older age groups, falls are the most common cause of hip fractures. The risk of falling increases with age.[47] Older women fall more than older men until age 75 years.[37] Due to the impact of osteoporosis, the amount of trauma necessary to cause a hip fracture declines with age.[7,36,49] Therefore, after age 45 years, the hip fracture rates are higher in women.[36]

Falls

Determining risk factors for falls has become an intermediate endpoint where much work has been done. The FICSIT studies have defined a fall as "...an unintentional event that results in a person coming to rest on the ground or other lower level."[51] The determinants of falls are thought to be: difficulty with ambulation; disruption of consciousness; altered central processing; sensory deprivation; and environmental causes.[51,52,53,54] A previous fall is a significant predictor of a future fall.[51,52,53,54]

In addition, the characteristics of falls appear to influence the incidence of hip fracture. Grisso et al. (1991) noted that 90% of hip fractures in the elderly are the result of a fall.[55] However, less than 5% of falls are associated with a hip fracture.[56] In a case-control study, Nevitt et al. (1993) were able to show that women who suffered a hip fracture were more likely to have fallen sideways or straight down and landed on their hip than women who did not fracture their hip when they fell.[57] Women who landed on their hip were taller, less likely to have tried to break their fall, had weaker triceps and were more likely to have landed on a hard surface than women who did not fracture.

Among women who fell on their hip, the risk of fracturing that site more than doubled for each standard deviation decrease in bone density at the site of the fracture. Greenspan et al. (1994) also showed that falls to the side appear to be significantly associated with hip fracture and that falls with higher potential energy were more likely to produce a hip fracture.[56]

Energy Dissipation

Energy adsorption has been suggested to be a determinant of hip fractures. Insufficient soft tissue energy dissipation during the fall is thought to lead to hip fracture.[58] Studies showing reduced hip fracture incidence in individuals who wear hip protectors support the role energy dissipation in fracture reduction.[58] The failure of a protective response during the fall- due to aging, cerebrovascular disease, medication, etc., appears to contribute to the increased risk of fracture on the occasion of a fall.[57]

Nevitt et al. (1993) noted that with age the incidence of hip fracture rises much faster than the incidence of falls or bone mass loss.[57] This finding suggests an intervening factor which relates to how well the individual responds to a fall or perhaps the type of fall that occurs in old age. Therefore, conditions that make the individual sluggish, weak and thin result in a failure to dissipate the potential energy of a the fall. The scenario of increasing bone fragility, increasing probability of falling and increasing difficulty in coping with a fall increase with age and with many chronic diseases and are often present together in one individual. A global term has emerged for individuals on the verge of decompensation - frailty.

Frailty has been defined as "a state of reduced physiologic reserves associated with increased susceptibility to disability".[59] This concept tends to portray a global view of the patient and is not disease specific. Moreover, frailty describes individuals who have minimal reserves to withstand an insult. Rockwood et al. (1994) makes a distinction between the healthy elderly who have many assets to deal with an adverse event and frail individuals with limited resources.[60] Recent studies have examined the impact of implementing procedures to reduce frailty in the elderly (as defined by weakness and malnutrition).[61]

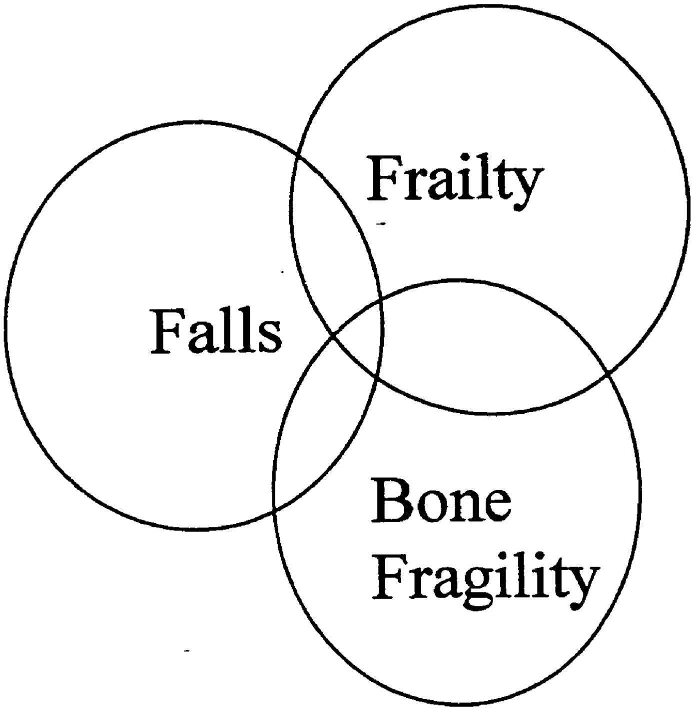
However, frailty does not explain all hip fractures. Hip fractures often occur in functional and active individuals. Greenspan et al. (1994) suggests that bone mass, fall characteristics and the ability to dissipate the energy in a fall independently contribute to the risk for hip fracture.[56] Therefore, since overlap occurs between conditions which lead to hip fractures, falls, frailty and bone fragility and yet each appears to contribute independently to the risk of hip fracture, the relationship between the variables can be expressed as illustrated in Figure 7. The risks, when they interact, may be additive/multiplicative.

Summary

A hip fracture for an elderly person can be a devastating event with a high likelihood of not returning to their previous level of functioning. Hip fractures are a significant public health problem. They occur frequently in the elderly population and with the aging of the population, the absolute number of hip fractures are increasing. In addition, the age-specific incidence of hip fractures may also be increasing. Hip fractures cause significant morbidity and mortality and result in considerable expense to society.

Many disorders have been associated with an increased risk of hip fracture in the elderly. However, the literature suggests that these disorders may all be associated with three major factors: bone fragility; falls and frailty. Knowledge of the these determinants and their risk factors allows the development of mechanisms to prevent hip fracture occurrence. In addition, awareness of the underlying conditions predisposing to hip fracture allows the development of indicators reflecting important demographic characteristics and pre-existing illnesses that may impact on hip fracture recovery. (See IV. Method).

Figure 7



Chapter II

The Effectiveness of Hip Fracture Care

The variations in incidence rates and outcomes of care suggest that preventative strategies to reduce the occurrence of hip fractures and improve hip fracture care may reduce unnecessary morbidity and mortality. Interventions to prevent falls and osteoporosis have been proposed.[10,47,51,52,54,62,63,64] As well, screening procedures for osteoporosis have been investigated.[65,66,67] However, this thesis focuses on the minimization of complications after the occurrence of a hip fracture (tertiary prevention). This section reviews the effectiveness of hip fracture care.

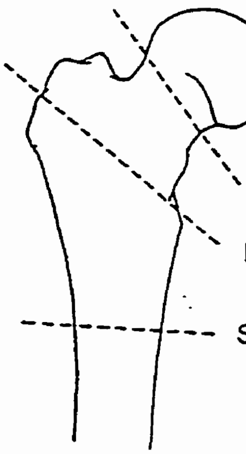
Effectiveness is a measure of whether an intervention works to prevent injury/disease in everyday practise. It depends on appropriate individuals being selected for care, the efficacy of the intervention, the compliance of health care providers and patients with recommended care and the treatment of all the patients in need of care.

Diagnostic Accuracy

A hip fracture is a fracture of the neck or head of the femur or a fracture between or through the trochanters of the femur.[44] These fractures can be classified into femoral neck (cervical) fractures, intertrochanteric fractures and

Figure 8

Anatomic Fracture Locations



Source: Robbins (1989)[10]

subtrochanteric fractures.[10] See Figure 8. Femoral neck and trochanteric fractures account for over 90 percent of the hip fractures, occurring in approximately equal proportions, and subtrochanteric fractures account for the remaining 5 to 10 percent.[68]

Several levels of evidence when found together point to the existence of hip fracture:

- a history of trauma, hip pain, inability to walk;
- physical signs such as external rotation, limb shortening, pain with movement, swelling, ecchymosis;
- x-ray evidence.

The evaluation of all of the various indicators used in the diagnosis of a hip fracture is beyond the scope of this thesis. (See Meyers 1985).[33] However, the x-ray evidence is usually predominant in making the diagnosis. The location and degree of displacement of a hip fracture are difficult to estimate clinically and are important for determining the appropriate repair procedure for the fracture.[10,33,69]

A study by Parker (1992) found that out of 825 consecutive hip fracture patients, 16 cases were not diagnosed immediately, and of these 16 undisplaced fractures, 15 became displaced as a result of the delay.[70] In three cases, x-rays were not performed. However in ten cases, the x-rays were incorrectly interpreted, and in three cases, the fracture was not visible. Therefore from these figures, the sensitivity of x-rays for picking up hip fractures was 98.4% for the selected population sent for hip x-ray. There was no information on the number of false positive cases referred to surgery.

Anderson et al. (1986) found hip fractures to be a low discretionary diagnosis, or a condition that was consistently diagnosed among physicians.[71]

Efficacy

The information on efficacy of many surgical repairs and care techniques for hip fractures is far from complete. Many interventions have been implemented without full evaluation. The efficacy of the treatment of hip fractures was examined in the following areas: preoperative routines; prevention of wound infection; prevention of venous thromboembolism; operative treatment of femoral neck, trochanteric and subtrochanteric fractures; and postoperative care.

Preoperative Routines

Obrant (1996) in a review of the orthopaedic treatment of hip fractures outlined several important preoperative procedures: the use of traction; the timing of the surgery in relation to admission; and preoperative assessment of the health of the patient.[72] Usual hip fracture management requires the application of about 5 kilograms of pin-traction for displaced fractures to reduce pain and improve the ability to reduce the fracture. Undisplaced hip fractures are commonly immobilized in bed with sandbags on either side of the fracture.[72] Anders and Ornellas (1997) in their review of the acute management of patients with hip fracture did not find any evidence that this practise reduced hip fracture pain.[73]

The time to surgery was identified by Obrant (1996) and others as an important factor in patient outcome.[72,74,75] Although a general trend has been to arrange for surgery as soon as possible after the hip fracture, a competing issue is the assurance that the patient is appropriately stabilized before undergoing surgery, including consultation with the appropriate specialists.

Morrison et al. (1998) in their review of the medical consultant's role in caring for patients with hip fractures found evidence from cohort studies indicating that for medically stable patients who do not have active comorbid illness, surgical repair of hip fracture within the first 24 to 48 hours of admission is associated with a decrease in one year mortality. Patients who would benefit from a delay in surgery have not been well characterized.[76] Zohman and Lieberman (1995) in their review of hip fracture care presented evidence to suggest that the medical stabilization of the patient was more important than the absolute time to surgery.[77]

Thomas and Ritchie (1995) reviewed the important factors to consider in a preoperative assessment of older adults.[78] They noted that patient specific factors play a large role in patient outcome. The factors related to poor outcomes were:

- increasing age;
- poor general health status, as measured by Dripp's American Society of Anesthesiology (ASA) Physical Status Scale;
- limited functional status as measured by Activities of Daily Living (ADL) scales;
- decreased nutritional status;
- poor neopsychological status (few social support systems, decreased "will to live", dementia and delirium);
- specific organ system disease factors (existing cardiovascular disease, poor exercise tolerance, pulmonary disease, pulmonary complication risk factors, such as obesity, cough, dyspnea, smoking, history of lung disease certain pulmonary function abnormalities, prolonged anesthesia (> 3 hours), a repeat surgery in

less than one year, renal disease, decreased creatinine clearance; and

- emergency surgery.

Craik (1994), in her review of the disability following hip fracture, indentified similar patient characteristics.[79] She suggests that preexisting impairment of mental status, coexisting medical conditions, and functional disability prior to fracture were good predictors of poor outcome. Depression and coping strategies were also implicated as factors in the patient's ability to recover from a fracture. Advanced age and male sex have also been associated with poor outcomes. She identifies arteriosclerotic heart disease, organic dementia and cerebrovascular disease as the greatest threats to recovery from a hip fracture.

Thomas and Ritchie (1995) suggest that the role of the medical consultant is to identify the problems, correct them, and then point out the uncorrectable to the unsuspecting.[78] They note changes in attitude toward the estimation of surgical risk in the elderly in the early 1980s. The decline in mortality from surgical procedures and the increase in life expectancy has led to an increase the number of elderly patients who have been offered surgery in recent years.

Prevention of Wound Infection

Morrison et al. (1998) in their review of the use of prophylactic antibiotics to prevent wound infection found considerable evidence from 11 randomized control trials supporting the use of prophylactic antibiotics (first and second generation cephalosporins) in patients with hip fracture.[76] Antibiotics seemed to reduce the risk of deep-wound infection by 44% and therapy should be continued for 24 hours. Some evidence suggests that the optimal time for administration of antibiotics is 0 to 2 hours before surgery.

Prevention of Venous Thromboembolism

Strong evidence supports the use of low-dose heparin or low molecular-weight heparin as prophylaxis for deep venous thrombosis starting at hospital admission.[72,76] There is some evidence that low molecular-weight heparin may be slightly more effective.[76] Aspirin and low-dose warfarin have some benefit and may be considered under certain circumstances. Insufficient research has been done to determine the optimal duration of anticoagulation.

Compression stockings seem to be beneficial with negligible risk and are recommended.[72,76] Early mobilization of the patient is also recommended to reduce the incidence of venous thrombosis.[68,72,79,80] However, Morrison et al. (1998) in their review of early mobilization of hip fracture patients found that the data to support the potential benefits of early mobilization (within 48 hours of surgery) of hip fracture patients was lacking.[76]

<u>The Operative Treatment of Hip Fractures</u>

For most patients, surgical treatment of their hip fracture is the best method of returning them to their prefracture level of function. At some point, however, the net effect of the expected surgical outcome, must be weighed against the overall impact on the patient.[78] For some patients, surgery poses a substantial increased risk of morbidity and mortality.[68] However, the six-month mortality rates for nonoperative treatment have been as high as 60 percent.[77] Nonoperative management may be preferable for nonambulatory, institutionalized patients with marked dementia who experience minimal discomfort within the first few days after injury.[68] The type of anaesthesia has not been found to affect the incidence of post operative confusion or mortality in elderly patients with hip fractures.[68]

The practice of surgical repair of hip fractures appears to have evolved over time and is based largely on uncontrolled studies and clinical experience and not randomized control trials (efficacy studies). Lu-Yao et al.

(1994) in a meta-analysis of displaced fractures of the femoral neck found that

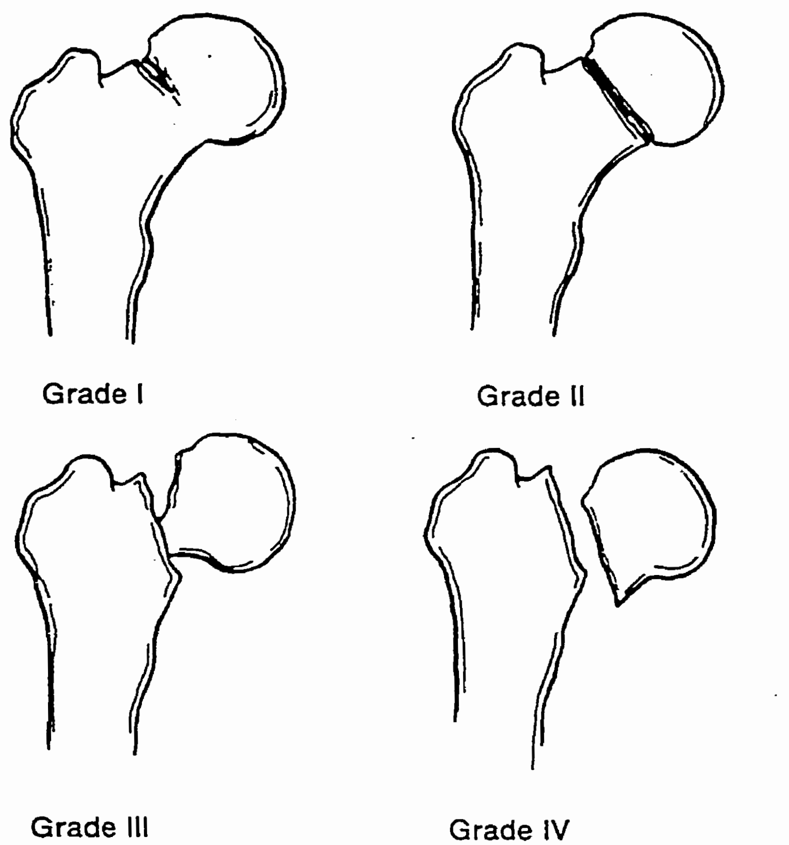
> Although randomized, controlled trials provide the strongest evidence, we found few reports of such trials in the literature on fractures of the femoral neck...Although prone to bias, case-series reports represent the overwhelming bulk of published knowledge in this field as well as the accumulated experience of hundreds of surgeons and thousands of patients.[82]

The following section examines the available evidence for the management of femoral neck fractures, trochanteric fractures and subtrochanteric fractures.

Femoral Neck Fractures

The natural history of the different types of hip fracture vary. Fractures of the neck of the femur rarely heal on their own due to difficulty with avascular necrosis of the femoral head and non-union of the fracture.[82,83] The disruption of the blood supply to the femoral head is usually dependent on the degree of displacement of the fracture. Radiographs of femoral neck fracture are classified into "Garden Stages" (in ascending order of severity): I, incomplete or impacted fracture: II, complete but undisplaced fracture; III, complete and partially displaced fracture; and IV, complete and totally displaced fracture.[1] See Figure 9.[10]

Figure 9



Garden's classification of femoral neck fracture.

Source: Robbins (1989)[10]

In a review of a well-handled series of cases in the 1930's, good results were obtained in 60% to 70% of patients.[83] While surgical repair on femoral neck fractures began in 1902, these techniques (screws and nails) were primarily reserved for cases with delayed union. The treatment of choice in 1930 was reduction by traction, inversion and adjustment of the trochanteric portion of the femur to fit its displacement on the basis of roentgenographic evidence. Immobilization was maintained by a plaster cast.[83] However, internal fixation subsequently became more popular for femoral neck fractures due to claims of improved results and the reduction of some of the complications associated with prolonged immobilization.

For impacted or undisplaced femoral neck fractures (Garden Stages I and II), Obrant (1996) described a few reports of conservative management that have been advanced in the literature. Treatment consists of early mobilization with no or only partial weight bearing.

However, in 8 to 49 percent of these fractures secondary displacement takes place. There have been no comparative prospective trials comparing conservative function with nailing or arthroplasty. However, in practise, surgery seems to be the treatment of choice for undisplaced femoral neck fractures.[72]

Currently, Garden stage I and Garden Stage II fractures are usually managed by an internal fixation device (nail or nail and plate).[1] Difficulties in getting a firm grip on the loose femoral head and the subsequent attachment to the rest of the femur as well as the vulnerability of the blood supply to the femoral head has lead to rates of displacement or nonunion of 30% and of avascular necrosis of 15% for all internal fixation devices within two years of the procedure.[72] However, the complication rates for Garden Stages I and II are less than 10 percent.[68]

For Garden Stage III and IV fractures, various methods of intervention are used: reduction and internal fixation; primary hemiarthroplasty (ie. replacement of the femoral head by prosthesis); or primary total hip replacement (replacement of both the femoral head and acetabulum by prosthesis). The current treatment recommendations are based on an assessment of the patient's age, functional status and comorbidities[84] and in some cases, an assessment of the displacement of the fracture.[85] A report by the Institute of Medicine in the United States suggests that most physicians elect to treat femoral neck fractures based on their own personal experience.[1] Non-surgical therapy for debilitated or institutionalized patients have been supported by some authors but most recommend surgery.[10]

In their meta-analysis of displaced femoral neck fractures, Lu-Yao et al. (1994) found only one randomized control trial and four studies which compared repairs of displaced femoral neck fractures without assigning treatment on the basis of patient characteristics or surgeon preference.[82] Comparison of arthroplasty and internal fixation in these studies found no significant difference in 30 day mortality after arthroplasty or internal fixation; significantly higher complication rates within two years of repair for internal fixation; and the risk of reoperation within two years after internal fixation was 2.6 times that of hemiarthroplasty (20-36% versus 6-18%). Most of the reoperations for internal fixation were conversions to arthroplasty (two-thirds), followed by removals of implants and revision of the internal fixation. For arthroplasty patients, the most common revision procedure was conversion to a total hip replacement, followed by removal or revision of prosthesis and debridement of the wound.

There were no differences in rates of pulmonary embolism or deep vein thrombosis. However, deep infection was higher with unipolar arthroplasty. Pain relief was found to be better after arthroplasty than internal fixation (15% versus 30% of patients complained of pain) but there was no significant difference in mobility.

With internal fixation, the occurrence of non union was 33% and the occurrence of avascular necrosis was 16% within two years of internal fixation. Dislocation was the most common cause of arthroplasty revisions. Acetabular erosion and femoral stem loosening were the most common causes of dislocation.

Lu-Yao et al. (1994) found comparison studies of primary total hip replacement and other hip fracture repairs to be limited. The available evidence suggested no differences in mortality, a higher rate of dislocation but a better long term result.[82] However, the patients who received total hip replacements were generally younger. They concluded that more study was needed in this area.

Data on the long term impacts of hip fracture repairs are scarce. Some studies suggest a complication rate of 10 percent for bipolar arthroplasty and 20 percent for unipolar hemiarthroplasty after seven years.[82]

Finally, studies which have compared the various anatomic operative approaches to arthroplasty have shown that short term mortality was consistently lower when an anterior approach was used, but the trend did not reach statistical significance.[82]

Trochanteric Fractures/Subtrochanteric Fractures

For trochanteric fractures, internal fixation is generally recommended in elderly patients[1,10,62]. Obrant (1996) in his review of the orthopaedic treatment of hip fractures concluded that internal fixation with a sliding screw produces outcome results which are similar to other fractures.[72,86,87] The usual approach to surgery involves the insertion of a blade and plate or a compression screw through an incision in the upper femur.[10] The compression screw allows impaction of the fracture fragments which facilitates healing but causes limb shortening.[72] Intramedullary rods have also be used.[10] Trochanteric fractures are not usually complicated by avascular necrosis.[10]

Very little information on the most appropriate repair for displaced subtrochanteric fractures is available.[88] However, open reduction and internal fixation of the fracture fragments is most commonly recommended.[1]

Postoperative Procedures

For all procedures and in the vast majority of cases, the patient is allowed partial or full weight bearing on the first postoperative day.[72] For arthroplasty, special precautions must be taken for several months to avoid dislocation of the hip.[72] Although data on the impact of early mobilization is lacking, studies of interdisciplinary rehabilitation, featuring geriatric assessment, suggest improved functional outcomes and an increased likelihood that the patient would return to the community.[76] Cohort studies examining physiotherapy suggest that frequency of physical therapy has an important effect on outcome and that more than one session per day is probably beneficial.[76]

Post operative bladder problems (urinary retention, incontinence and urinary tract infections) occur frequently after hip fracture surgery. Morrison et al. (1998) examined the use of indwelling catheters in hip fracture care.[76] They found very few studies that examined hip fractures specifically. However, based on evidence from other orthopaedic surgeries, they concluded that whenever possible, indwelling catheters should be removed within 24 hours of surgery, and patients should be managed with scheduled intermittent straight catherization.

Delirium occurs in up to 61% of hip fracture patients and has been associated with increased length of stay, risk for complications, mortality and institutionalization.[76] Although most studies of delirium have not focused specifically on hip fracture patients, the available evidence suggests the attention to the management of fluid and electrolyte abnormalities, infections, drugs, metabolic disorders and low cerebral perfusion may improve outcomes.[76,89] Environmental manipulation and supportive reorientation seem to reduce the incidence of delirium and benefit the delirious patient.[76]

Malnutrition is associated with increased surgical morbidity and mortality[76,90] and one study suggests that as many as 20 percent of patients experiencing hip fractures have severe malnutrition.[91] The results of four randomized control studies suggest that oral protein supplementation may be beneficial in reducing minor complications, preserving body protein stores, and reducing overall length of stay. Patients with evidence of moderate to severe malnutrition may benefit from nocturnal enteral tube feeding if they can tolerate it.[76]

In addition, Bonjour et al. (1996) in their review of the nutritional aspects of hip fractures found evidence to support the use of calcium, Vitamin D and Vitamin K supplements in the post operative period. Calcium and Vitamin D are critical to the formation of new bone and many elderly have been found to have a low intake of calcium and mild to severe vitamin D deficiency. Vitamin K has also be suggested to play a role in bone formation but the exact mechanism has not been elucidated.[92]

Postoperative management should also address the prevention of future falls. Research in this area suggests some efficacy in reducing falls by targeting specific risk factors in individual patients and by exercise and balance training.[76]

Due to the impact of depressive symptoms on hip fracture recovery,[93] Strain et al. (1991) evaluated the impact of psychiatric consultation intervention with elderly hip fracture patients and found some evidence to suppport this intervention.[94]

Compliance

The compliance of physicians and other health care professionals to evidence-based practise is another issue for consideration. The parameters for hip fracture repair and care are broad and leave room for considerable discretion.[85] Only recently have care maps for hip fracture care been considered in the literature.[95]

Ogilvie-Harris et al. (1993) found that the use of care maps which included medical and nursing protocols for patients with a fractured hip significantly reduced adverse outcomes, post-operative complications and length of stay.[95] Herberts and Malchau (1997) claim that just feeding back information to physicians and hospitals on complication rates following total hip replacement surgery from a population based registry has improved surgical outcomes and reduced the infusion of new treatments which are not fully evaluated.[96]

Treatment decisions may also be impacted on by external forces, such as available operating time, hospital policies, availability of nursing staff, the availability of specialist consultation, distance / time to a hospital where surgical care can be performed, the availability of rehabilative support, etc. In addition, the skill of the surgeon has associated with the outcome of hip fracture care.[38]

Patient compliance and choice is not thought to play a large role in the initial treatment of hip fractures[97] but may have an impact on the rehabilitation process.[98,99]

Patient Coverage

In Canada, it is likely that all patients in need of care for a hip fracture would receive care because there are no financial barriers to access to health care. A hip fracture is a condition that usually requires medical attention (except perhaps stable impacted fractures) and is almost universally treated in hospital.[1] However, timely access to the most appropriate services may be an issue.

Effectiveness

Very few studies have looked at the overall effectiveness of hip fracture repair on a population basis, and these studies have either examined very few outcomes of care[2,10,82,100,101] or had a limited follow up period.[8,10,102] A few studies have compared the effectiveness of different repairs, but only broad classifications of repairs were used.[8,101] Only one study has examined the impact of hip fracture type on effectiveness of hip fracture care on a population basis.[101] However, the only outcome examined was mortality.

Most effectiveness studies on hip fractures have reported on the outcomes of care in a series of patients but have not systematically looked at the factors which contribute to these outcomes, eg. physician factors, hospital factors, patient factors, etc. It should be noted that the outcomes vary across hospitals and geographic areas,[2,8,13,16] even after control for patient comorbidity age and sex.[16]

Complications following Hip Fractures

Numerous studies have recorded the complications following hip fracture care. The rates of major complications of hip fracture care, increased mortality, increased disability, increased nursing home admission and increased length of stay were discussed in the Burden of Illness section on page 15.

In addition to these major outcomes, the complications can be broken down into those that follow any surgery and those that are relatively specific to hip fracture care. The complications which may follow any surgery include: allergic reaction[103], disorders of blood chemistry,[104] including hypoalbuminemia and hypoproteinuria;[90] post operative psychoses;[89,105] depression;[93,104] cardiac complications,[106] including myocardial infarction,[86,90,107,108,109] congestive heart failure[8,74,104] and pulmonary embolism;[33,74,86,105,106,110,111] cerebrovascular accidents;[8,86,105,106,108,109] vascular ischemia,[105] including gangrene;[90,110] postoperative infection,[104,105,108] including pneumonia,[74,86,90,104,105,106,108,109] wound infections[33,74,86,104,105,109,110,111] and urinary tract infections;[8,74,86,104,105,111] other urinary complications[104,105] including renal failure and urinary retention; decubitus ulcers;[74,90,104,105,106,108,109] respiratory compromise;[104,105,110] gastrointestinal bleed;[90,104,105] hepatic failure;[105,109] ileus;[104,105] shock;[33,104,105,110] anaemia;[8,105] deep venous thrombosis;[86,105,111] wound dehiscence;[86,90,105] and other misadventures in medical care.[86,104]

Some of the complications which are more specific to hip fracture care include: infection of the hip prosthesis;[110,111] arthritis of the hip,[110] including acetabular erosion, osteomyelitis;[86,110,111] nerve injury;[33] mechanical defects of the prosthesis,[86,90,106,109,110] including loosening of the prosthesis; dislocation of the hip;[33,104,108] pain in hip;[33,38,105] difficulty walking;[38,86,106] malunion/nonunion of the fracture;[38,86,106,107,112] necrosis of the femoral head (avascular necrosis);[33,38,86,106,107,110,112] and repeat hip fracture.[102,113]

Since most of these complications have been found in small studies, it is not possible, aside from the Lu-Yao et al. (1994) study on transcervical fractures,[82] to determine the frequency of these complications on a population basis for the various types of hip fractures.

Zuckerman et al. (1995) in a prospective study of 367 hip fracture patients found a 5% rate of major complications (myocardial infarction, cardiac arrhythmia, pneumonia, pulmonary embolism, thrombophlebitis, decubitus ulcers, urinary tract infection, allergic reaction and deep wound infection) within the first year of the hip fracture.[103]

Thomas and Ritchie (1995) identified urinary tract infections, surgical wound infections and lower respiratory tract infections as the top three hospital acquired infections. Postoperative pneumonia has a 27% mortality rate. For hip surgery, the most frequent complications were deep vein thrombosis (DVT) (occurs in 20% of patients even with prophylactic measures in place), pulmonary embolism (20% of patients with DVTs), pressure ulcers (20% to 70% develop pressure sores by fifth hospital day), delirium, and urinary retention and / or infection (urinary retention occurs in 28% to 52% of patients).[78]

Mullen and Mullen (1992), in a prospective, multifactorial study of hip fracture mortality in 400 consecutive patients, identified a complication rate of 9% in otherwise "healthy" patients and a complication rate of 21% in patients who were "unhealthy".[114] Clayer and Bauze (1989), in a retrospective study of all hip fracture patients who had surgery in one year in one hospital in Australia (441), found, at three years, a medical complication rate of 30% and a surgical complication rate of 14%. For those patients still alive at three years, 55% described unlimited walking range but 32% described poor or nonambulation. The factors significantly associated with poor mobility at three years were increased age, female sex, institution residence, pre-existing cerebrovascular insufficiency, dementia and not being transferred to a rehabilitation ward. Decreased mobility was not associated with operation type, the level of fracture or the development of a surgical complication postoperatively.[115]

Summary

The care of hip fracture patients has developed over time based largely on trial and error. The diagnostic accuracy for a hip fracture is very good. However, the efficacy of the most of the treatment options in use today have not been fully evaluated. Numerous complications from hip fracture care in the elderly can occur. However, these have not been fully documented on a population basis. With a universal health care system, it is likely that virtually all Manitoba hip fracture cases receive medical attention for their hip fracture. However, due to lack of clear information on many aspects of hip fracture care, variations in the skill of the health care providers, and the impact of ward, hospital, provincial and federal policies and standards on health care, the care received by a hip fracture patient may vary by physician, by ward, by hospital, and over time.

Chapter III

The Delivery of Hip Fracture Care in Manitoba

The system of hip fracture care in Manitoba has evolved over time. There is no organized overall hip fracture program. Although some hospitals may have guidelines for hip fracture care, in the majority of cases, physicians manage fractures on an individual basis within the general program of health care delivery in Manitoba. The overall effectiveness and efficiency of hip fracture care delivery has received very little evaluation. This section describes the health care delivery system in Manitoba.

Geography

Manitoba is a province located in the centre of Canada. It has an area of 246,512 square miles[116] and a population of over 1.1 million people with 56% of this population in one large southern city (Winnipeg).[117] The northern areas of the province are sparsely populated. Many villages and towns are accessible by plane only. At the time of this study, Manitoba was divided into 10 health regions. See Appendix 1. Three of the regions were within Winnipeg and are not shown on the map. The 1991 population of each of the regions is shown in Appendix 2.

The Medical Care System in Manitoba, 1979-1993

In 1958, Manitoba passed The Hospitals Act and The Hospital Services Insurance Act to provide universal hospital insurance for residents of Manitoba. In 1970, all medical services became covered under medicare. The Manitoba Health Insurance System (MHIS) is the single payer, except for worker compensation claims. Physicians submit fee claims for reimbursement. During the time of this study, hospitals were block funded but required to submit detailed data regarding all admissions to hospital. Appendix 3 shows the hospital claim form. Nursing Homes were funded based on the number and level of care of their residents and were required to submit data on their residents. Appendix 4 shows the nursing home reporting form. Since April 1, 1979, MHIS has used ICD-9CM codes to abstract data.

Many small towns in Manitoba have small hospitals. The secondary referral hospitals are in the major centres of each region. Winnipeg has two tertiary care hospitals and Brandon has one. Remote communities may only have a nursing station to allow stabilization of a patient for transfer to a larger centre.

Chapter IV

Quality Assurance Efforts in Hip Fracture Care in Manitoba

Although very little evaluation of hip fracture care has occurred on a population basis, an evaluation infrastructure for health care exists in Manitoba and evaluation of hip fracture care is occurring at many levels. Hip fracture care involves integration of the efforts of physicians, nurses, hospitals, physiotherapists, ambulance services, home care, occupational therapy, social services, and family. The following section outlines the quality monitoring and evaluation efforts occurring within these professions and organizations.

Structure

In Manitoba, the structure for assuring appropriate physician practise includes activities conducted by the Royal College of Physicians and Surgeons of Canada, the College of Family Physicians of Canada, the College of Physicians and Surgeons of Manitoba, the Medical Review Committee, Hospital Medical Standards Committees, and physicians themselves. Nursing practise is monitored through the Manitoba Association of Registered Nurses, the Manitoba Association of Licensed Practical Nurses and Nursing Standards committees within hospitals. Nurses usually also receive performance evaluations from their supervisors in their area of work. Other health professions have similar standard bodies and evaluation procedures. Physicians, nurses, physiotherapists, occupational therapists and social workers have legislative requirements to self-regulate.

Ongoing education within any profession is not mandated except by the College of Family Physicians of Canada. The College of Physicians and Surgeons of Manitoba creates practise standards by which every physician must abide and publishes guidelines for suggested practise.[118] The Manitoba Association of Registered Nurses also publishes standards of care but guidelines for practise are usually made by the specific program.

In 1985, the College of Physicians and Surgeons of Manitoba published a guidelines recommending only Class D facilities (those who have access to portable X-ray machines) be allowed to perform open reductions of hip fractures.[118] In 1992, the College published a guideline for the Total Hip Replacements in Manitoba. The guideline recommended a minimum volume of 20 cases per year at a facility and minimum requirments for surgical qualifications.[118]

Hospitals are accredited by the Canadian Council on Health Services Accreditation.[119] In addition, the <u>Hospitals Act</u> mandates multiple operational standards that must be in place to operate a hospital, including regulations regarding ward structure and staffing, hospital maintenance, the existence of standards committees, hospital equipment, staff appointments and duties, patient care criteria, etc.[120]

Personal Care Homes are required by law to meet certain standards including infection control programs; death review programs, etc.,.[121] Home Care exists as an organized program within Manitoba Health, and staff must meet professional and program standards. Several external reviews of the program have been done, but no ongoing evaluation of the effectiveness and efficiency of the program occurs.

The Manitoba Centre for Health Policy and Evaluation is part of the Department of Community Health Sciences at the University of Manitoba. The Centre has a contract with the Government of Manitoba to provide a scheduled number of deliverables evaluating health services and studying indicators of health status in Manitoba.[122]

Process

All of the self-regulating bodies have the responsibity for ensuring the competency of all their licensed providers and for investigating complaints against their members. The Medical Review Committee of Manitoba Health reviews physician practise patterns of fee for service physicians, evaluates aberrant claims and refers unexplained abberations to the Formal Inquiry Committee, who may require repayment of inappropriate billings. The authority for the Medical Review Committee and the Formal Inquiry Committee is found in the Health Services Insurance Act.[123] Approximately 90% of the physicians seeing patients in Manitoba are fee for service physicians.

Outcomes

Within hospitals, physicians conduct death and adverse event reviews under the auspices of the Hospital Medical Standards Committee. This committee reports to the College of Physicians and Surgeons of Manitoba. The Hospital Infection Control Program also reports to the Hospital Medical Standards Committee. Nursing Standards Committees monitor adverse incidents in the hospital such as falls, medication errors, etc. There is also a legislative requirement of medical examination of certain deaths in The Fatality Inquiries Act.[124]

On a larger scale, several studies have been conducted using the MHIS insurance data which have examined hip fractures on a population basis in Manitoba. The Manitoba/New England study compared the mortality rate for patients 65 years and over undergoing hip fracture repair in Manitoba and New England. Manitoba had higher mortality rates in the first year after surgery.[15,16] A study by Shapiro and Tate (1993) examined the quality of care in

Personal Care Homes in Manitoba.[125] They found that proprietary Personal Care Homes had higher rates of falls and fractures. In addition, the higher the level of care of the resident, the less likely they were to suffer a fracture.

Roos and Shapiro (1994) examined the impact of bed closures on hip fracture care and found a decrease in the hip fracture mortality rate over time.[126] A second component of this study involved a chart review of hip fracture admissions in Manitoba before and after the bed closure period. Although not linked to the bed closure study, this thesis may help focus quality assurance efforts involving the analysis of chart review data based on the indicators of lower quality identified in this study.

Summary

There have been several attempts to evaluate the outcomes of hip fracture care in Manitoba on a population basis. The study by Shapiro and Tate (1993) was detailed enough to allow specific recommendations for further investigation to physicians, nursing home staff and governments.[125] The Manitoba / New England Study provided a red flag for further investigation and has spawned the development of this thesis.[15,16] The study examining the impact of bed closures on hip fracture patients did not find any indication of decreased quality of care which could have reversed government policy on bed closures.[126]

These outcome analyses provide an impetus to look at the total care of the patient, not just the specific piece that is owned by each profession, each hospital, etc.,. A structure or process that examines hip fracture care across the various jurisdictions, brings stakeholders together to examine the quality of hip fracture care in the province, and establishes recommendations for best practise is not in place.

III. Design

A. Quality Assessment

Needs

The U.S. Institute of Medicine reviewed hip fractures in detail to determined the issues to be addressed in effectiveness research.[1] They recommended that "disease specific" measures of hip fracture risk and prognosis be developed. They also recommended the development of a comprehensive definition of outcomes, a mechanism to acquire data across the full spectrum of care delivery sites, longitudinal follow-up to obtain information on short-, mid- and long-term outcomes, adequate measurements for comorbidity and the ability to analyze different patterns in care.[1]

In the Manitoba / New England studies,[15,16,127] many of these issues were not addressed. For instance, although the Manitoba / New England study groups were comparable in terms of age and comorbidity, other patient characteristics, not controlled for in these studies, have been associated with adverse outcomes in elderly patients.[9,10,93,128,129,130,131]

The variation in the outcomes between Manitoba and New England may also be due to differences in the structure and process of care.[132] Many sources of variation in delivery of care occur between regions operating under different medical care systems. In fact, the Manitoba/New England study demonstrated considerable variability in hip fracture mortality between hospitals within Manitoba.[15] However, other issues, such as surgical skill, postoperative care, etc., not addressed in this study may have an impact on outcome. Finally, the only measure of adverse outcomes in the Manitoba / New England studies was death. The impact of hip fracture care on morbidity was not addressed. A more detailed analysis of the management of hip fracture patients within the existing system of health care in Manitoba may identify specific areas that require closer examination.

Problems

The sources of variation in hip fracture outcomes between Manitoba and New England are substantial. Indeed, the sources of variation of hip fracture outcomes from within Manitoba may be significant. A population-based analysis is required to focus quality assurance efforts.

In a population based analysis, there are limitations as to the study design and the inferences that can be drawn. Although touted as the gold standard in study design, a randomized control trial evaluating existing care with a representative sample of the hip fracture patient population in Manitoba would be difficult to achieve for a number of reasons. Surgical tradition, expert opinion, and limited case series evidence suggests that certain patients should be treated in certain ways. It, therefore, may be unethical to randomly assign patients to different types of existing care. However, randomized control trials are now being conducted comparing new techniques with established care. Only one aspect of care can be examined at one time because trails are inefficient when the source of the adverse outcomes could be due to many factors.

Therefore, observational, not experimental studies have been the preferred method of studying current hip fracture care. Prospective cohort studies are the optimal form of observational study because information on all relevant factors can be obtained prospectively. However, they require a very large sample size to study rare outcomes and take a considerable period of time and expense. Primary data collection is also often required. Finally, causal inferences can only be inferred from associations demonstrated between variables and outcomes since both may be associated with a confounder that was not measured in the study.

Retrospective cohort studies reduce the amount of time and expense of cohort study but often suffer from recall bias and the lack of information on the factors leading to adverse outcomes. Evaluating care decisions after the fact is difficult because patient characteristics may bias the interpretation, and certain surgeons may prefer one type of procedure over another and may be more skilled at that procedure.

Case series studies provide a limited view of the clinical spectrum of cases. They usually suffer from selection bias and have insufficient numbers to draw conclusions on outcomes. Case-control studies have the advantage of selecting cases on the basis of rare adverse outcomes but usually suffer from recall bias and difficulties in generating an appropriate control group.

Information gained from good population-based secondary data eliminates many of the potential biases which occur in traditional study methods. The characteristics of a good database include: comprehensiveness; quality of information; and the capacity for linkage.[133] Roos and Roos (1989) classified databases with these qualities as Level 1 databases.[133]

Comprehensiveness

Comprehensive data are data which: include the entire population; have the ability to uniquely identify individual persons; and have ability to monitor the enrolment of individual persons in the system.[134] Level 1 databases have comparable follow-up capability over time when compared with primary data[134] and eliminate the reliance on an individual's recall for study information. Pre and post event histories are relatively easy to construct with administrative data, and the study size can be changed easily by adding more years to the analysis. However, treatments and medical practises change over time, this approach may reduce the comparability of the population and limit the conclusions that can be drawn. In addition, since the data are already there, administrative data are relatively inexpensive and less time consuming to use when compared to primary data collection (especially experimental and prospective cohort studies). As well, bias is not introduced by conducting the study itself because the subjects are unaware they are being studied.

The opportunity to use an entire population and to study large numbers of people represents an important methodological advance. This opportunity eliminates most of the sampling biases of other designs and increases the power of the study or the chance of finding a significant relationship if it is there, which makes it particularly good for determining rare outcomes. Rare outcomes were traditionally addressed by case-control studies which are fraught with methodological deficiencies.[135] Level 1 studies provide the opportunity for multiple control groups and an adequate sample frame from which to select a control group.

The Manitoba Health Insurance System data includes almost the entire population of Manitoba,[136,137] allows monitoring of an individual's use of the health care system over time, and records the enrolment of individuals in the system so that the incidence of the disease among the persons at risk can be determined.

Quality of Information

Quality data are data which: accurately record the phenomenon in question; do not miss any persons receiving treatment for the disorder; and do not miss the incidence in persons who are not accessing treatment. Administrative data can not answer every research question. The desired information may not be available or may be inaccurately recorded. In addition, the researcher has no control over an individual's contact with the system. Contact depends on the individual's definition of illness and ability to access the system. Therefore, the need for primary data is never eliminated.

The use of administrative health insurance data to evaluate quality of care is in its infancy. Concern has been raised over the completeness of coding and whether hospitals code different illnesses differently. Green and Wintfeld (1993) compared data collected from a chart audit with original hospital discharge abstracts submitted for California and found under reporting of comorbidities and variation in hospital coding accuracy.[138] They also found that some codes were more likely to be erroneously coded than others and that patients who died in hospital tended to have fewer comorbidity codes recorded than patients who were discharged alive.

The authors recommend investigating the accuracy of the desired codes to minimize the possibility of serious errors. As Green and Wintfeld (1993)[138] and others[131] suggest, the diagnoses and treatments most likely to be recorded accurately are those which are required for payment. However, codes required for payment may be given preferential ranking.[138] Further, differences in coding bias may exist between the United States and Canada because the Canadian payment system is not based on DRG rating. However, it is difficult to dismiss the mortality trends for hip fracture repair and bypass surgery in the Manitoba/New England study[15,16] on the basis of differential coding because the trends observed were substantially different in the other procedures examined.

Despite coding discrepancies, several studies using blinded reviewers found quality of care problems more often in hospitals with higher mortality rates as determined by hospital claims analysis.[139] The quality of the data in the Manitoba Health Information System is variable and will be discussed specifically in the next section.

Data Linkage

The capacity to link data to other administrative data sets, while not absolutely essential, greatly improves the amount of information that can be obtained from a study. The Manitoba database has the capacity to link many types of data due to the existence of a registry file which contains unique identifying information.[140]

Using Administrative Data to Study Hip Fractures

Although the Manitoba/New England study found that hip fracture repair in Manitoba had higher mortality, the study provided very little indication as to what aspect of care may be substandard. Therefore, further analysis of the population based Manitoba Health Insurance System (MHIS) data is needed to focus quality assurance efforts on factors which produce the greatest number of adverse outcomes. A retrospective cohort design involving the regression analysis of administrative health insurance data was used in this thesis to further evaluate the quality of hip fracture care in Manitoba. This method allows a large and representative group of subjects to be studied in a relatively efficient manner. The challenge of this method is to include the significant predictors of outcome in the analysis and to measure these variables accurately.

Goals

Salter (1983) outlined the goals for fracture care: to relieve pain; to obtain and maintain satisfactory position of the fracture fragments; to allow, and if necessary encourage bony union; and to restore optimum function not only in the fractured limb but also in the patient as a person.[44] Based on the definition of quality of care discussed earlier, the goals for hip fracture care can be expressed more broadly as *care that can return the individual to their prefracture level of functioning, allow the individual optimal autonomy and minimize the occurrence of adverse events such as early mortality, nursing home admission, prolonged hospital stay, readmission to hospital and complications of care, including reoperation.*

The goals of this study are to:

a) identify hip fracture specific indicators of prognosis in administrative data based on literature review and determine their importance in predicting hip fracture adverse outcomes.

b) examine a more comprehensive set of hip fracture outcomes than has previously been investigated in a population-based study.

c) provide information on short, intermediate and long term outcomes hip fracture outcomes.

d) identify hip fracture specific indicators of important attributes of care delivery in administrative data based on literature review and determine their importance in hip fracture outcomes.

e) highlight areas of possible decreased quality for further investigation

f) provide recommendations for the reduction of hip fracture morbidity and mortality in Manitoba.

Important Attributes of Hip Fracture Care

The care of a hip fracture patient can be divided into patient assessment; the preoperative period; the surgical procedure; the post operative period; and the convalescent period. The factors that effect the patient as she/he moves through this process are multiple and they all may impact on patient outcome.

Inherent patient characteristics play a role in health outcomes at each step of the process. These factors may include: age; sex; socioeconomic status; functional; mental and emotional status; social supports and pre-existing comorbid diseases. The characteristics of the fracture may also play a role in the outcome of hip fracture care.

In the initial assessment phase, structural characteristics, such as the location of initial medical assessment, the availability of diagnostic tests and the availability of consultants may play a role in patient outcome. As well as process issues such as, pain relief; fluid and electrolyte stabilization; nutrition; the recognition of comorbidities and their management; the appropriate use of consultants; the appropriate and timely transfer to another hospital for appropriate care if necessary; and the necessary support during transfer. This assessment period is usually conducted in one or more emergency departments prior to transfer to a surgical ward.

During the preoperative phase, the structural issues include: the number and availability of experienced staff; availability of orthopaedic surgeons; availability of consultants; and the availability of operating room time. Process issues would include: pain relief; nutritional support; fluid and electrolyte management; choice of preoperative therapy, such as the use of thrombolytic agents, antibiotics, etc.; attention to comorbidities; and the surgeon/patient relationship.

During the operation, the structural factors include: the training and experience of the operative team; time of day/day of the week of the operation; and the availability of appropriate equipment. The process issues include: type of anaesthesia; approach to surgery; choice of treatment; compliance with appropriate procedures; and length of time of operation.

During the post operative period, the following structural features may become important: number and availability of appropriate staff; the availability of physiotherapy; and the availability of a multidisciplinary discharge planning team. The process issues include: appropriate pain control; nutritional support; fluid and electrolyte management; venous thrombosis prophylaxis; supportive stockings; timing and appropriateness of physiotherapy; urinary catheter management; assessment and intervention with regard to fall prevention; appropriateness of discharge planning; the utilization of psychiatric support and the early identification and appropriate management of complications or comorbid conditions.

The convalescent period begins approximately two weeks after their hip fracture repair. Patients are usually no longer acutely managed on the orthopaedic or surgical ward unless they have experienced significant complications. Some of these complications may necessitate transfer to a medical ward. However, for the majority of patients, attention turns to how to discharge the patients from hospital. Structural issues which relate to the discharge destination of the patient include: the features of the patient's previous residence, including the suitability of the floor layout for living with a disability and the availability of home care or a support person; the availability of nursing home beds or convalescence beds in local hospitals; and the availability of other home aid programs, such as meals on wheels, physiotherapy or other day hospital programs. The process issues that relate to discharge planning include: the appropriate assessment of the patient's functional abilities and the care and attention to detail taken in discharge planning to assure the patient's needs are met at their discharge destination.

Measurement

The choice of variables or indicators to measure quality of care on a population basis are central to this thesis. The indicators were chosen on the basis of a literature review of the factors that may influence hip fracture outcomes. The variables were divided into four types: patient characteristics, treatment characteristics; delivery of care variables and outcomes. The Method section provides a detailed discussion of the origin and validity of each of the variables.

IV. Method

A. Data Description

The Manitoba Health Insurance System (MHIS) data are derived from claims for services rendered by physicians or hospitals for the care of patients. Almost all Manitobans are included in this insurance system.[136,137] Hip fractures are particularly suited for study with the MHIS insurance claims data because the acute phase is universally treated in hospital.[1]

The reliability of hospital claims data in detecting hip fractures has been demonstrated at over 90% if ICD-9-CM codes are compared with physician claims.[1] [141] Ray et. al. (1990) compared the hip fracture ICD-9 codes to hospital charts in Saskatchewan and found that the ICD-9 codes were able to detect greater than 95% of the hip fracture cases.[9,100] Ray et al. (1990) also investigated the accuracy of primary diagnosis of hip fracture using ICD-9-CM codes.[100] They were able to detect greater than 93% of the hip fractures on their initial admission.

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[1] It should be noted that while physician claims tend to be made during the course of an investigation of an illness, hospital claims are made after the patient is discharged, when many of the diagnostic uncertainties have been clarified. Therefore, hospital records are thought to be more accurate than physician claims. In addition, an accurate diagnosis is not required for physician payment.

To determine if patients diagnosed with hip fractures in nursing homes were being missed by considering only hospital claims, physician claims for hip fracture care for nursing homes residents in 1990 were compared with hospital claims for hip fractures. Of the 160 nursing home residents with a diagnosis of hip fracture on a physician claim, 65 (41%) did not have a hip fracture admission between 1988 and 1991. Only 18 of the these patients (11% of 160) had more than one physician claim with a hip fracture diagnosis. Of the 18, 7 had previously suffered a hip fracture between 1979 and 1988.

Therefore, although 943 hip fractures were admitted to hospital in 1990, there may have been about 11 more who were cared for in a nursing home. If these figures are representative of the entire hip fracture population, about one percent of the hip fractures may not have received care in hospital. A review of nursing home charts for patients with hip fracture claims would be necessary to clarify which physician claims represent true hip fractures, hip fracture investigations or care of a previous hip fracture.

B. Ethical Considerations

Strict security measures are in place to protect the MHIS files. Although an analysis of the frequency of hip fracture surgery by surgeon were performed, no information to identify an individual surgeon was reported. In addition, although comparisons were made between hospitals, no attempt was made to identify hospitals other than by hospital type and size. All publications and presentations to scientific meetings are subject to approval of the MHIS to assure that the anonymity of individuals is preserved. Approval for the study was granted by the Manitoba Health Insurance System and the Ethics Committee of the University of Manitoba.

C. The Study Population

All hip fracture separations for Manitoba residents age 65 years and over were selected from the MHIS hospital claims data for the period beginning between April 1, 1979 and ending March 31, 1993. All separations in the previous year and for all the subsequent years for the duration of the study were also analyzed. The hospital claims were initially selected on the basis of either a hip fracture diagnosis or the presence of a hip fracture primary repair procedure (Appendix 5). For separations from hospital in the fiscal years of 1979-80 to 1990-91, 15,864 individuals were identified. Discrepancies in personal identification number (phin), name, sex and birth date forced the exclusion of the 757 phins and left 15,107 individuals (95.5%) for study.

Cases selected for the years, 1991-92 and 1992-93, were not assessed for these discrepancies. However, the quality of the claims data has substantially improved since the mid 1980s making discrepancies with the registry data unlikely.[2]

A total of 18,010 individuals were identified as having a hip fracture diagnosis or a hip fracture repair procedure in hospital separations from April 1, 1979 to March 31, 1993. Of these individuals, 14,981 had a hip fracture diagnosis (Table 1). In those with a hip fracture diagnosis, 12,898 (86.1%) were 65 years of age or older.

This study, like other studies,[2,6,9,16,100,142] used ICD-9-CM codes of 820.00 to 820.99 to identify hip fracture cases from hospital records (Appendix 6). Subjects age 65 years and over at the time of hip fracture admission were chosen in order to have a comparable population to other studies conducted in this area.[2,8,15,16] In addition, the management considerations for older subjects are different.[69] Elderly patients are more likely to have a surgical hip repair procedure[69] and the fractures are more likely to be due to osteoporosis.[143]

Individuals with postal codes indicating residence outside of Manitoba at anytime during the study period were excluded (156 cases). These individuals were younger (average age = 78.2. ± 7.0 years) and more likely to be women

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[2] Verbal Communication from Andre Wajda, Systems Consultant, Manitoba Centre for Health Policy and Evaluation.

(76.3%) in comparison to the study population. (See V. Results).

Table 1
Exclusions

Total number of individuals identified as having a hip fracture repair without a hip fracture diagnosis who were discharged hospital from April 1, 1979 to March 31, 1993*	3,029
Number under 65 years of age	2,083
Number who did not live in Manitoba for the entire study period	156
Number with secondary repair procedures, primary repair procedures or late effect diagnoses before their index hip fracture diagnosis	174
Number who received a secondary repair procedure without or before a primary repair procedure	40
Number with a primary repair procedure occurring before March 31, 1978	28
Number who were admitted at the end of the hip fracture episode of care at the beginning of the study	194
Number who had admissions beyond their insurance coverage end date	8
Number whose insurance began after their initial hip fracture admission	25
Number of duplicate records	2

* See text for discussion of linkage

The first hip fracture separation occurring since March 31, 1979 defined the index separation. To select only the initial fracture for study, individuals with a secondary repair procedure (Appendix 7) in an admission before their index hip fracture diagnosis (64 cases), individuals with a primary repair procedure (Appendix 5) in an admission before their index hip fracture diagnosis (77 cases) and individuals with diagnoses of late effects of hip fracture (Appendix 8) in an admission before their index hip fracture diagnosis (33 cases) were excluded from the analysis.

Since transfers from one hospital to another may occur during the care of a hip fracture, the definition of a hip fracture index admission was expanded to include admissions to several hospitals if they occurred within one day of separation from the previous hospital. Admissions with hip fracture repair procedures occurring after the index episode of admission defined above were analyzed separately.

Cases who received a secondary repair without or before a primary repair procedure over an episode of hip fracture care (40) were excluded. To remove repair procedures which may have occurred long before the start of the study, individuals (28) admitted before March 31, 1978 were excluded. As well, to eliminate individuals at the end of their episode of care at the beginning of the study, individuals admitted with a hip fracture diagnosis before June 23, 1979 who did not have a repair procedure before July 1, 1979 were excluded (194 cases).

Eight cases were eliminated from the study due to admissions beyond their insurance coverage dates, and twentyfive cases were eliminated because their insurance coverage began after their hip fracture index admission. Finally, duplicate index hip fracture records for two individuals were removed from the sample. Therefore, for the period between April 1, 1979 and March 31, 1993, 12,271 individuals were eligible for study. Twenty-nine individuals were not linked to the nursing home data or to the population files for standardization due to late inclusion into the study. However, their inclusion did not effect the average age or the overall sex distribution of the sample.

D. Variables

Independent

The variables were derived from MHIS claims data and are listed in Figure 10. The independent variables were divided into patient characteristics, treatment variables and delivery of care variables. The variables with the asterisks are those which are required to be coded by MHIS or are derived from variables required to be coded by MHIS.

Figure 10

Variables

Independent Variables

Patient Characteristics

Demographic Variables
*Age
*Sex
Region of Residence
Socioeconomic Status
Urban/Rural Residence
Nursing Home Residence

Fracture Characteristics
Fracture Type
*Day of the Week of Admission
*Season of Fracture
*Fiscal Year of Fracture
*Accident Location
Presence of Pelvic Fracture
Presence of Other Limb Fracture
Presence of Head Injury
Presence of Other Injury
Presence of Second Hip Fracture on First Admission

Comorbidity
Charlson Index
Individual Comorbidities of Charlson Index
Depression before Admission
Coagulopathy
Osteoarthritis
Rheumatoid Arthritis and Other Polyarthropathies
Parkinson's Disease and Other Movement Disorders
Malnutrition
Deafness
Blindness
Mild / Moderate Hypertension
Severe Hypertension
Previous Hospital Stay in Last Year
Previous Depression
Arrhythmia
Seizure Disorder
Osteoporosis
Pathological Fractures
Bone Cancer
Disseminated Malignant Neoplasm
*Previous Admission

Treatment Variables

*Surgical Procedure used
*No Repair

Delivery of Care Variables

Transferred without Admission (Preindex Admission Transfer)
*Transferred before the Repair Admission
*Length of Stay
*Scheduled Admission
*Type of Hospital
Admitting
Repair
*Time to OR
*Frequency of Hip Fracture Surgery by Treating Surgeon
*Frequency of Hip Fracture Care by Hospital
*High Frequency Hospitals - A,B,C,D,E

Dependent Variables

*Death before three months++
*Death between three months and one year++
*Length of Stay > 100 days++
*Nursing Home Admission++
*Readmission in year post surgery++
*Orthopaedic Procedure
Primary Procedure+ (Appendix 5)
Secondary (Repair) Procedure+ (Appendix 7)
Second Hip Fracture+
Late Effects of Hip Fracture Care+ (Appendix 8)
Possible Early Second Hip Fracture

* Data Required by MHIS

\+ Proportional Hazards Analysis
++ Logistic Regression Analysis

Patient Characteristics

Demographic Variables

The patient characteristic variables were further classified into demographic variables, fracture characteristic variables, and variables representing patient comorbidity. Information on Age and Sex were obtained directly from the MHIS data. The classification of Region of Residence changed in the 1989-1990 fiscal year. Therefore, municipal codes were used to classify all patients into the seven original regions. See Appendix 1 for maps of Manitoba before and after the regional changes. Municipal codes are assigned to patient addresses by the Manitoba Health Insurance System staff. Postal codes and patient addresses are not required to be reported by MHIS. Therefore, this information may not be as up to date as the required data.[137]

Nursing home residence has been shown to be a risk factor for adverse outcomes in the elderly.[131] Nursing home residence prior to and after hip fracture admission was measured by linking the MHIS hospital claims data with Personal Care Home Data. Roos et. al. (1988) have determined that MHIS data are valid for the detection of major health events such as repeat hospitalization, nursing home admission and death.[137]

Shapiro (1993) found that all of the clients identified by the Manitoba Home Care Program as being in a nursing home were all recorded in the MHIS files as being in a nursing home as well.[3] For this study, nursing home residence was determined by selecting the first recorded date of admission to nursing home either on the longitudinal nursing home (header) file or on the annual updated (statistical) file.

Residents with level of care codes indicating a respite admission either on first admission or on last separation were not noted to be nursing home residents unless their index fracture admission indicated a transfer from nursing home. Individuals with an initial hip fracture hospital admission indicating a transfer from a nursing home were also considered to be nursing home residents although they did not appear in the nursing home registry. See Appendix 12 for a discussion of the validity of the Transfer from Nursing Home Variable.

Socioeconomic status and Urban/Rural Residence were derived by linking the postal code recorded in the MHIS data with the average household income of a 20% sample of people living in area defined by postal code from the Statistic Canada Public Use tapes of the 1986 Census.[144] Since rural postal codes often include areas with heterogeneous incomes, socioeconomic status was only determined for patients living in urban areas. In addition, residents living in a nursing

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3 Personal communication, December 16, 1993.

home for two or more years were also excluded from this analysis because they receive the address of the nursing home as their own address at this time. The incomes of nursing home residents were not surveyed by Statistics Canada.

Fracture Characteristics

The Hip Fracture Type was determined from the diagnostic codes (Appendix 6). The diagnosis most responsible for hospitalization is required to be recorded, but up to fifteen additional diagnostic codes can be recorded. However, these diagnostic codes do not distinguish between fracture of the left or right hip and do not provide information on the displacement of the fracture. Fracture displacement is important for hip fracture outcome[145] and for the decision as to which repair to use.[10,33,69] Therefore, supplemental information on fracture displacement should be obtained from a chart review on a representative sample of patients.

The "best fracture diagnosis" was determined by selecting the hip fracture diagnosis recorded during the admission with the index repair procedure. If this diagnosis was either a closed unspecified fracture or an open unspecified fracture, a more specific diagnosis was selected from the hip fracture diagnoses in the episode of care. Priority was given to diagnoses in the earlier admissions in the index episode of care. If the subject did not receive a hip fracture repair, the diagnosis on the initial admission was taken as the best diagnosis. The presence of different specific hip fracture diagnoses over several admissions in the episode of care were recorded coded as a "possible early second hip fractures" and may represent a second fracture in the same hip or a fracture in the other hip. Both the "best hip fracture diagnosis" and the dichotomous variable, "possible early second hip fracture", were used in the regression analysis.

Day of the Week, Season of Fracture and Year of Fracture were derived from admission date, and Accident Location was obtained directly from the MHIS data. In addition, the presence of pelvic fractures, limb trauma, head injuries, another hip fracture and other trauma during the initial index admission were also recorded (Appendix 9).

Comorbidity

Several measures of comorbidity have been used in this study. The Charlson Index is an index created and validated to control for the confounding effects of coexistent comorbid conditions on mortality.[146] The ICD-9-CM codes have been adapted to correspond to these diagnoses.[137,147,148,149] The Romano et al. (1993) version of the index was used in this analysis.[148] In this version, AIDS and Rheumatoid Arthritis were excluded from the Charlson program due to insufficient numbers of cases. Coagulopathy, on the other hand, was a suggested addition.[148] These diagnoses were not included in the Charlson index variable but were analyzed independently.

Index admissions were searched for diagnoses of chronic or previous Charlson conditions. Diagnoses from admissions during the year prior to the index admission were searched for the presence of high risk Charlson diagnoses. Since records were not obtained for 1978, patients with their index admission in 1979 were found to have less comorbid conditions than the patients in other years with a full year of previous admissions analyzed. Therefore, patients admitted in 1979 were excluded from the regression analysis.

The Charlson index was not validated on the hip fracture population or for outcomes other than mortality. Therefore, the individual diagnoses in the index were examined separately to determine which factors were important in predicting adverse outcomes in hip fracture patients. Other diagnoses thought to have an impact on hip fracture outcome were included: Coagulopathy,[38,148] Depression[93], Osteoarthritis,[33] Rheumatoid Arthritis and other polyarthropathies,[69] Malnutrition,[74] Deafness,[10] Blindness,[10] Hypertension,[10] Alcoholism,[37,150] Seizures,[37] Arrhythmias,[37] Parkinson's Disease[151] and other disorders of movement.[1,111,151]

The diagnostic codes used to create these variables are shown in Appendix 10. The diagnosis of depression was considered only if it occurred in an admission before the index admission.

Since fracture healing may be compromised, patients with primary or metastatic bone cancer and patients with a diagnosis of pathological hip fracture were identified (Appendix 10). Previous Hospital Stay in the last year has also been shown to be a risk factor for adverse outcomes.[131]

Treatment

The surgical procedure codes were used to determine the types of repairs conducted (Appendix 5). When hospital operative procedures were compared with physician operative billings, the agreement was found to be 96%.[141] These codes were divided into four broad types of repairs for analysis purposes (Appendix 11). Repair type is based on the first repair code in the index episode of care. One of the limitations of this variable is that it is not possible to specify whether the right hip or the left hip was repaired. In addition, the procedure codes do not provide enough detail with regard to the specific types of repairs used to conduct a conclusive effectiveness analysis. Finally, some of the patients with a hip fracture diagnosis may not have received a repair, due to conservative treatment or perhaps uncertain diagnosis. A no repair variable was included in the model.

Delivery of Care

The delivery of care variables were derived from the MHIS data and represent aspects of the structure and process of hip fracture care. Transfers to another hospital during the hip fracture index episode were identified as an important factor in health care delivery. A "Transfer without Admission" was coded when the "transfer from" variable on the MHIS hospital claim of the initial hip fracture admission showed a transfer but no corresponding hospital admission claim for that individual was found for the transferring hospital. A Transfer before Repair was coded if there were one or more admissions before the index repair procedure.

Length of Stay, and Type of Hospital were obtained directly from the MHIS data. The Scheduled Admission variable was derived from the admission status category in the MHIS data. The Time to Operation variable was derived from the admission date and date of hip fracture surgery. However, there may be some difficulty with these calculations if the hip fracture did not occur prior to admission but at some other point during their hospital stay. Therefore, this calculation was only conducted if the hip repair occurred within 10 days of admission. The date of operation was obtained by linkage with physician claims for the operative procedure.

The variable, Frequency of Hip Fracture Surgery by Treating Surgeon was created by examining the frequency of hip fracture repair per year per surgeon and creating variables of low, medium and high frequency of surgery to each physician code per year. The physician code number is required for payment by MHIS. The same approach was used to develop the Frequency of Hip Fracture by Hospital variable.

Dependent

Figure 11 shows the relationship of the dependent variables to time. The dependent variable, death, is found in the MHIS enrolment file and has been added to the hospital data. The date of death has been verified with the Death Registry File.[137,149] Nursing Home Admission and Readmission to hospital were also measured. Length of Stay greater than 100 days was derived from the Length of Stay variable.

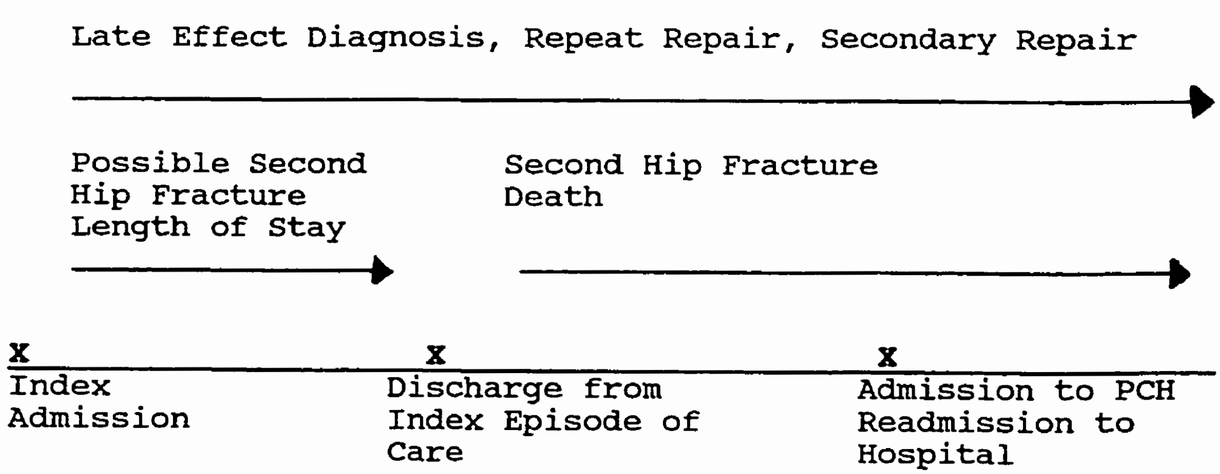
Admissions were searched for orthopaedic hip procedures (both primary and secondary) occurring after the initial repair procedure (Appendix 5 and 7) regardless of whether or not there was a hip fracture diagnosis or a late effect diagnosis. Procedure codes are considered more reliable than the diagnostic codes because only the diagnostic code most responsible for admission is required by MHIS. However, all procedure codes are required.

Diagnostic codes which could represent complications of treatment were also examined (Appendix 8). Although these complication codes represent only a fraction of the possible complications which could follow hip fracture repair, they were chosen because they are relatively specific to hip fracture repairs.

The Second Hip Fracture outcome variables were derived from the diagnostic codes and were examined separately as outcomes of hip fracture care. See discussion on the validity of hip fracture diagnoses. Specific new hip fractures occurring within the index episode of care were separated from those occurring after the index episode of care due to concerns over the reliability of the diagnoses.

Figure 11

The Dependent Variables in Relation to Time



E. Analysis Strategy

SAS software was used to analyze the data. Descriptive statistics were generated for each variable. The age and sex distribution of the Manitoba population age 65 years and over at the midpoint of the study (1986) was used as a reference population to calculate the distribution of the expected number of hip fractures had hip fractures been randomly distributed in the elderly population. The age / sex distribution was obtained from the annual statistical reports generated by the Manitoba Health based on the number of individuals registered in the Manitoba Health Insurance system. These data are thought to be more accurate than Statistics Canada data since Statistics Canada data over count RCMP and Armed Forces Personnel and under count Status Indians by up to 40 percent.[4] However, these difficiencies have been corrected in the last few years. See Appendix 12.

Similarly, the age and sex distribution of the Manitoba 1986 nursing home population 65 years of age and over was used as a reference population to calculate the distribution of the expected number of hip fractures had hip fractures been randomly distributed in the nursing home population. This age / sex distribution was determined from all nursing home client records submitted for 1986 and represents the

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4 Anne Hakansson, Manitoba Health, October 28, 1997

nursing home population at the midpoint of the study. From examination of Appendix 13, 1986 is a year with low discrepancy between nursing home claim files and "transfer from" codes.

Since the Charlson Index variable was developed for determining risk of death in patients admitted to medical wards and not the risk for surgical mortality, models using the Charlson Index variable and the other individual Charlson comorbidity diagnoses were tested (Appendix 14). The individual Charlson diagnoses and not the composite index gave the best model for predicting six month mortality. Therefore, only the individual Charlson comorbidities were used in all the regression analyses.

The outcomes examined can be placed in three categories: markers of poor care (late effects; fractures during the index episode of care, fractures after the index admission, and length of stay greater than 100 days); treatment decisions for complications (repeat primary and secondary repairs); and general complication measures (death, nursing home admission, readmission to hospital within one year). Some of the outcome measures in this study may be related to each other. Therefore, these outcome variables were included in some regression models to determine the degree to which hip fracture care complications contribute to important health outcomes.

Logistic regression models were generated for admission to nursing home within one year (excluding previous nursing home residents), readmission within one year, length of stay greater than 100 days, death before three months and death between three months and one year (Figure 10). The Hosmer and Lemeshow goodness-of-fit test was used to test the validity of the model,[152,153] and Nagelkerke coefficient of determination was used to test the explanatory power of the model.[152,154,155] Proportional hazard regression models were generated for secondary repairs, repeat primary repairs, second hip fractures and late effects of hip fracture care to account for censored follow up time due for individuals who may have left the study at various times due to death or end of coverage. Model fit was not calculated for proportional hazards analysis due to controversy in the literature as to the best method.[157] Backward regression was used to analyze the impact of the variables on the various outcomes.

The number of patients used in each model was dependent on the exclusion factors (Table 2). In all models, patients with the missing values on various parametres (N = 299) were excluded. This figure includes 10 individuals who had their late effect diagnosis before their index episode of care due to a counting error in the analysis which reversed the order of admissions where there were two or more admissions and discharges on the same day. Those patients with separation

Table 2

Numbers of Patients in the Various Models

Exclusions	Outcome Variable	Number of Patients	Number with Outcome
1979* Death - 3 months**	Length of Stay > 100 days	9,447	2,168 (22.9%)
1979* Death - 3 months** Repair in 10 days***	Length of Stay > 100 days	7,751	1,370 (17.7%)
1979*	Second Hip Fracture	11,187	1,017 (9.1%)
1979*	Late Effect of Hip Fracture Care	11,187	987 (8.8%)
1979*	Repeat Primary Repair	11,187	1,461 (13.1%)
1979*	Secondary Repair	11,187	955 (8.5%)
1979* December 31, 1992****	Death within 3 months	10,913	1,701 (15.6%)
1979* Death - 3 months** 1992*****	Death between three months and one year	8,619	1,103 (12.8%)
1979* 1992*****	Readmission within one year	10,213	4,504 (44.1%)
1979* 1992***** Previous Nursing Home Residents ******	Admission to Nursing Home within one year of separation	7,144	1,213 (17.0%)

1979* 1992***** Previous Nursing Home Residents ****** Urban Residents only*******	Admission to Nursing Home within one year of separation	5,588	851 (15.2%)

* Patients with separations in the fiscal year of 1979 were excluded
** Patients who died within three months of admission were excluded
*** Patients who did not have a repair within 10 days of initial admission were excluded
**** Patients with separations after December 31, 1992 were excluded
***** Patients with separations in the 1992 fiscal year were excluded
****** Previous residents of nursing homes were excluded
******* Patients who were not urban residents were excluded

dates in the 1979 fiscal year were also not included in all the models due to insufficient comorbidity data (N=785).

Therefore, the following models have 11,187 patients: Second Hip Fracture; Late Effect of Hip Fracture Care; Repeat Primary Repair; and Secondary Repair. The Length of Stay greater than 100 days model excluded all patients who died within three months of their admission (N=1740) because the two outcomes were highly correlated. The Length of Stay greater than 100 days analysis was the only model with a significant time to treatment variable. In this model, 1696 additional patients were excluded because they did not have a repair within 10 days of admission.

The Mortality between admission and three months model excludes patients who had separation dates after December 31, 1992. This model has 10,913 patients. The Mortality between three months and one year model has 8619 patients, excluding those patients who died within three months of admission and those patients admitted after March 31, 1992.

The Readmission model has 10,213 patients due to the exclusion of patients with separations dates after March 31, 1992 (N=974). These patients were also excluded from the Nursing Home Admission within one year outcome model. This nursing home model also excluded all patients who were previous residents of a nursing home (N=3069). For the urban nursing home model, only 5588 patients were included in the model because non-urban residents were excluded (N=1556).

Table 3 shows the variables used in all the regression models. The interaction between fiscal year and repair type and the interaction between age and nursing home residence were investigated for each outcome. Hospitals conducting more than 1000 repairs were included individually in the models. Table 4 shows the complications of care used in some of the models.

Table 3
Variables used in the Regression Models

Variable	Comparison Category
Age (in years)	Continuous Variable (65 years to 100+)
Sex	Male
Nursing Home Resident	Non-Nursing Home Resident
Age / Nursing home Interaction	Non-Nursing home residents of any age
Socioeconomic Status (urban residents only)	Continuous Variable (1=low and 10=high)
Region of Residence Norman Central Eastman Interlake Westman Parkland	Winnipeg
Residence in a Rural area	Residence in a non-rural area
Other Trauma Associated with admission	No known other trauma
Season Winter Spring Summer	Fall
Day of Admission	Saturday
Fracture Type Open Closed Transcervical Closed Subtrochanteric Closed Unspecified	Closed Trochanteric
Accident Location Home Hospital No Known Accident	Other Specific Accident Locations
Previous Admission in the Last Year	No Previous Admission in the last year

Metastatic Cancer	No Metastatic Cancer
Other Cancer	No Other Cancer
Severe Diabetes	No Severe Diabetes
Mild to Moderate Diabetes	No Mild to Moderate Diabetes
Renal Disease	No Renal Disease
Paralysis	No Paralysis
Ulcer	No Ulcer
Dementia	No Dementia
COPD	No COPD
Cerebral Vascular Disease	No Cerebral Vascular Disease
Peripheral Vascular Disease	No Peripheral Vascular Disease
Liver Disease	No Liver Disease
Congestive Heart Failure	No Congestive Heart Failure
Myocardial Infarction	No Myocardial Infarction
Pathological Fracture	No Pathological Fracture
Osteoporosis	No Diagnosis of Osteoporosis
Rheumatoid Arthritis	No Rheumatoid Arthritis
Arrythmia	No Arrythmia
Deafness	No Deafness
Diagnosis of Depression in the year before the Index Admission	No Diagnosis of Depression in the year before Index Admission
Severe Hypertension	No Severe Hypertension
Mild to Moderate Hypertension	No Mild to Moderate Hypertension
Blindness	No Blindness

Parkinson's Disease and Other Disorders of Movement	No Parkinson's Disease or other Disorders of Movement
Seizure Disorder	No Seizure Disorder
Alcohol Abuse	No Alcohol Abuse
Nutritional Deficiency	No Nutritional Deficiency
Osteoarthritis	No Osteoarthritis
Repair Type Open Reduction Internal Fixation Other Repairs Closed Reduction Internal Fixation Internal Fixation No Reduction No Repair	Arthroplasty
Fiscal Year	Continuous Variable (1979 to 1992)
Repair Type / Fiscal Year Interaction Fiscal Year / Open Reduction Internal Fixation Fiscal Year / Other Repairs Fiscal Year / Closed Reduction Internal Fixation Fiscal Year / Internal Fixation No Reduction Fiscal Year / No Repair	Arthroplasty and any year
Admitting Hospital Type Urban Non-Teaching Hospitals Major Rural Hospitals Intermediate Rural Hospitals Small Rural Hospitals Out of Province Hospitals Other Hospitals	Teaching Hospitals
Repair Hospital Type	Teaching Hospitals

Urban Non-Teaching Hospitals Major Rural Hospitals Other Hospitals	
Repair Day Sunday Monday Tuesday Wednesday Thursday Friday	Saturday
Hospital Repair Frequency > 1000 Repairs Hospital A Hospital B Hospital D Hospital E 125-1000 Repairs < 125 Repairs	Hospital C
Surgical Repair Frequency > 125 Repairs 25-124 Repairs	Less than 25 repairs per surgeon
Admission to Hospital before initial repair procedure	No admission to Hospital before initial repair procedure
Transfer without Admission before the initial hip fracture admission	No Transfer without Admission before the initial hip fracture admission
Time to Treatment (in days) for patients who had a repair within 10 days of admission	Continuous variable (Range 0 to 10 days)
Scheduled Admission	Unscheduled Admission

Table 4
Complications used in the Regression Models

Possible Second Hip Fracture during the Index Episode of Care	No Second Fracture during the Index Episode of Care	All Models
Log Length of Stay (in log days)	Continuous logged variable	II, III, IV, V, VII, VIII, IX
Second Hip Fracture after Index episode of Care	No Second Hip Fracture after Index Episode of Care	III, IV, V, VI, VII, VIII, IX
Diagnosis of a Late Effect of Hip Fracture Care	No Diagnosis of a Late Effect of Hip Fracture Care during the study	IV, V, VI, VII, VIII, IX
Repeat Primary Repair	No Repeat Primary Repair	VI, VII, VIII, IX
Secondary Repair	No Secondary Repair	VI, VII, VIII, IX
Death within 3 months of an admission for a hip fracture	No death within 3 months of an admission for a hip fracture	VIII, IX
Death between 3 months and one year after initial admission for a hip fracture	No Death between 3 months and one year after initial admission for a hip fracture	VIII, IX
Readmission within one year after hip fracture	No readmission within one year after hip fracture	IX

Model I - Length of Stay > 100 days
Model II - Second Hip Fracture
Model III - Late Effect of Hip Fracture Care
Model IV - Repeat Primary Repair
Model V - Secondary Repair
Model VI - Death within 3 months
Model VII - Death between 3 months and one year
Model VIII - Readmission within one year
Model IX - Admission to Nursing Home

The power calculations for the logistic regression models were based on the work of Hsieh (1989).[157] For model I, 9447 patients with an outcome frequency of 23% allowed the detection of odds ratios of 1.1 with a 5% probability of making a type one error (one-tailed) and 95% power of detecting an effect on the basis of testing with one variable. When the time to treatment variable was used, the model easily detects an odds ratio of 1.2 with the same specifications as the larger model and a 1% probability of making a type I error. For multiple variables, if the correlation between the variables was 30% then the above statements would still be true. If the correlation was 50% between the variables, the model would only be able to detect a difference if the odds ratio was 1.2 or greater. However, this is with a 1% probability of making a type 1 error.

Models II, III, IV, and V, use proportional hazards analysis. Tables outlining the power to detect an effect for a given sample size were unavailable for this type of analysis. However, since the sample sizes for these models were larger than for the logistic regression models, it is hypothesized that the power to detect outcomes is similar.
It is thought that all of these models would be able to detect an odds ratio 1.2 with a 1% probability of making a type 1 error and 95% power of detected an effect if it is present.

For model VI, 10,913 patients with an outcome frequency of 16% allows the detection of odds ratios of 1.1 with a 5% probability of making a type one error (one-tailed) and 95% power of detecting an effect on the basis of testing with one variable. For multiple variables, if the correlation between the variables was 50%, the model would be able to detect a difference if the odds ratio was 1.2 or greater. However, this could be done at a 1% probability of making a type 1 error and at 95% power.

For model VII, 8,619 patients with an outcome frequency of 13% allows the detection of odds ratios of 1.2 with a 1% probability of making a type one error (one-tailed) and 95% power of detecting an effect on the basis of testing with one variable. For multiple variables, if the correlation between the variables was 50%, the above statement would still be true.

For model VIII, 10,213 patients with an outcome frequency of 44% allows the detection of odds ratios of 1.1 where there with a 1% probability of making a type one error (one-tailed) and 95% power of detecting an effect on the basis of testing with one variable. This statement would still be true at 50% correlation among variables in a multiple variable model.

For model IX, 7144 patients with an outcome frequency of 17.0% allows the detection of odd ratios of 1.2 where there is a 1% probability of making a type one error (one-tailed) and 95% power of detecting an effect on the basis of testing the model with one variable. For the urban model, 5588 patients with an outcome frequency of 15% also allows the detection of odd ratios of 1.2 where there is a 1% probability of making a type one error (one-tailed) and 95% power of detecting an effect on the basis of testing the model with one variable. If there was a 50% correlation among multiple variables, these statements would still be true.

V. Results

A. Descriptive Analysis

<u>Patient Characteristics</u>

Demographic Variables

The average age at index fracture was 81.7 ± 7.9 years and 72.5% of the cases were women. The average age for males (80.7± 8.1 years) was slightly younger than the average age for females (82.0 ± 7.8 years).

Table 5

The Age and Sex Distribution of Index Hip Fractures Compared to the 1986 Manitoba Population Age 65 Years and Over

	Males			Females		
	Obs.	**Exp. ***	**Obs/Exp**	**Obs.**	**Exp. ***	**Obs/Exp**
65-69 Years	348	1783	19.5%	646	2096	30.8%
70-74 Years	466	1483	31.4%	1067	1842	57.9%
75-79 Years	679	998	68.0%	1540	1360	113.2%
80-84 Years	714	585	122.1%	2032	914	222.3%
85-89 Years	643	262	245.4%	1987	500	397.4%
90-94 Years	381	95	401.1%	1169	226	517.3%
95-99 Years	124	23	539.1%	407	60	678.3%
100+ Years	11	4	275.0%	28	11	254.5%
Total	**3366**	**5234**	**64.3%**	**8876**	**7008**	**126.7%**

Does not include 29 cases

* Calculation based on 1986 age-sex distribution of the Manitoba Population

Table 5 shows the age and sex distribution of index fractures in the study population (observed) compared to the expected distribution of hip fractures had they been randomly distributed in the 1986 elderly population (expected). See Appendix 13. Review of the resulting ratios of observed to expected fractures showed that females were more likely to have hip fractures than males at all ages except the 100+ group. In both sexes, the rate of hip fracture increased with age until age 100 years when the rate declined slightly.

Figure 12a and 12b show the distribution of fractures according to provincial regions of residence before and after the reclassification of regions in 1989. Appendix 1 shows maps of these regional boundaries. Figure 12c shows the regional variation in hip fractures based on municipal code reassignment of the newer regions into the previous seven regions. Most of the fractures (57.8%) occurred in Winnipeg. The lowest number occurred in the Norman (2.2%).

Figure 12d shows the age and sex distribution of index hip fractures in the study population (observed) compared to the expected distribution of hip fractures had they been randomly distributed in the 1986 elderly population (expected). In contrast to the crude rates presented in Figure 12c, Norman has the highest ratio of observed to expected index hip fractures. Westman and Winnipeg also have elevated ratios while Parklands has less than 80% of its predicted index fracture ratio.

Figure 12a

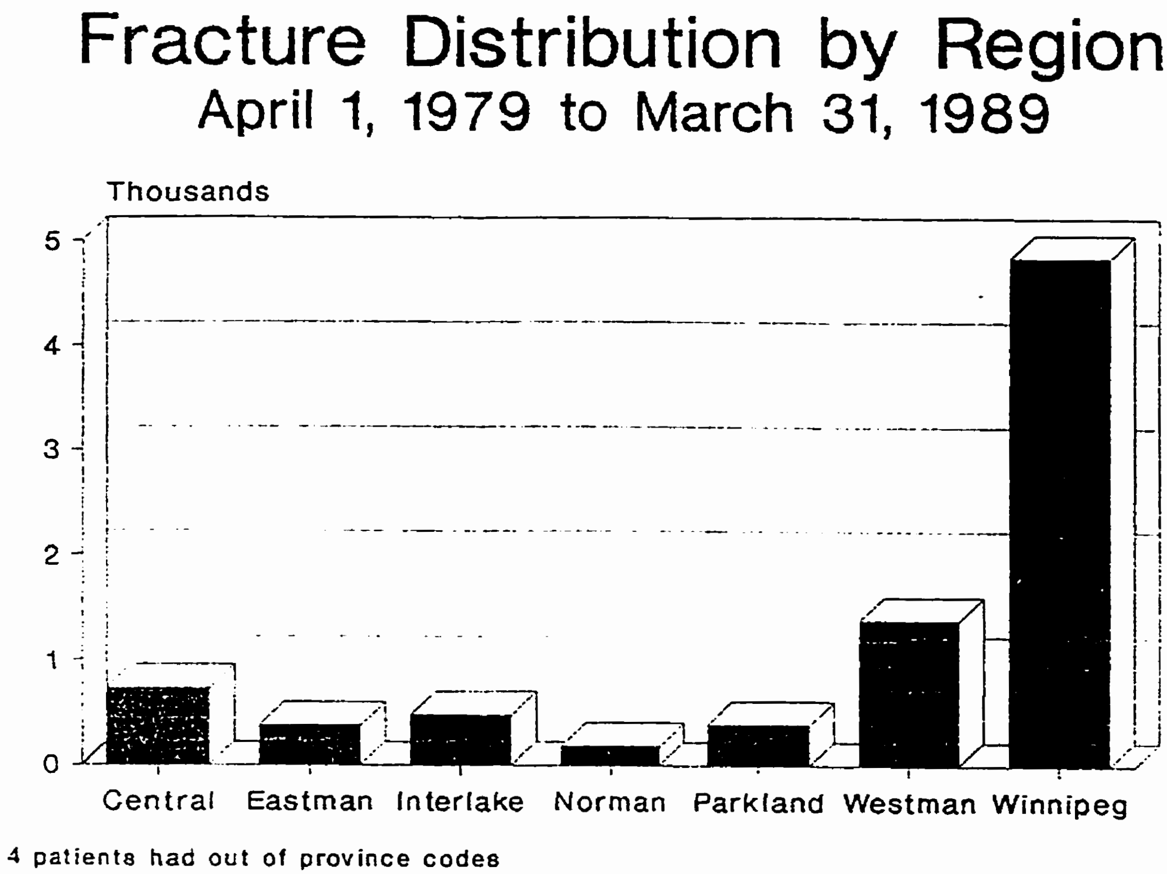


Figure 12b

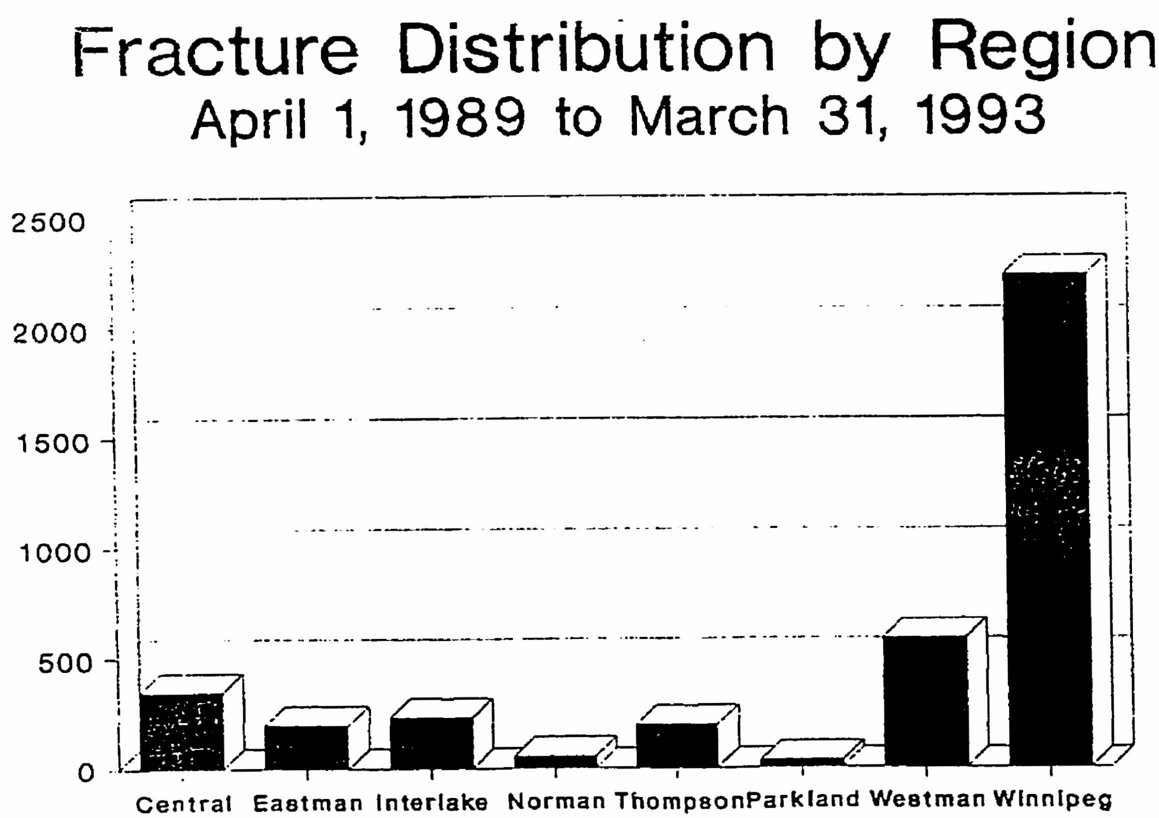
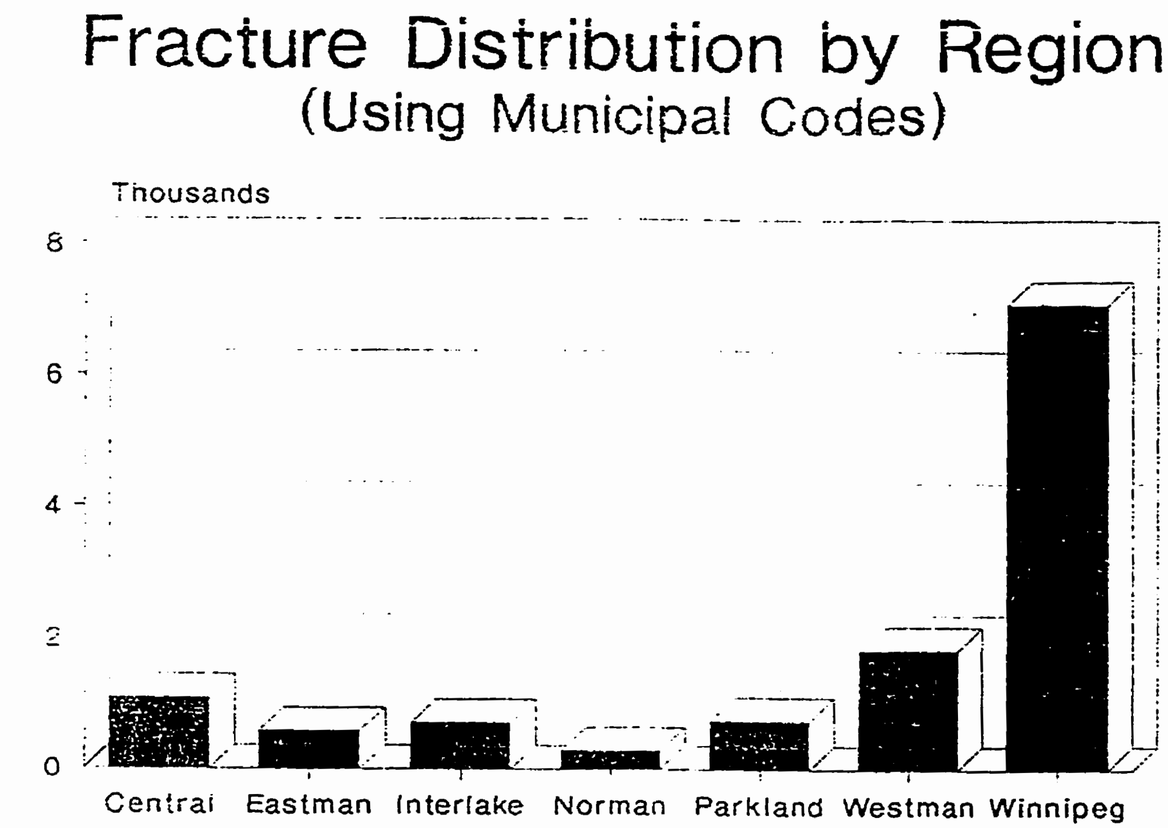
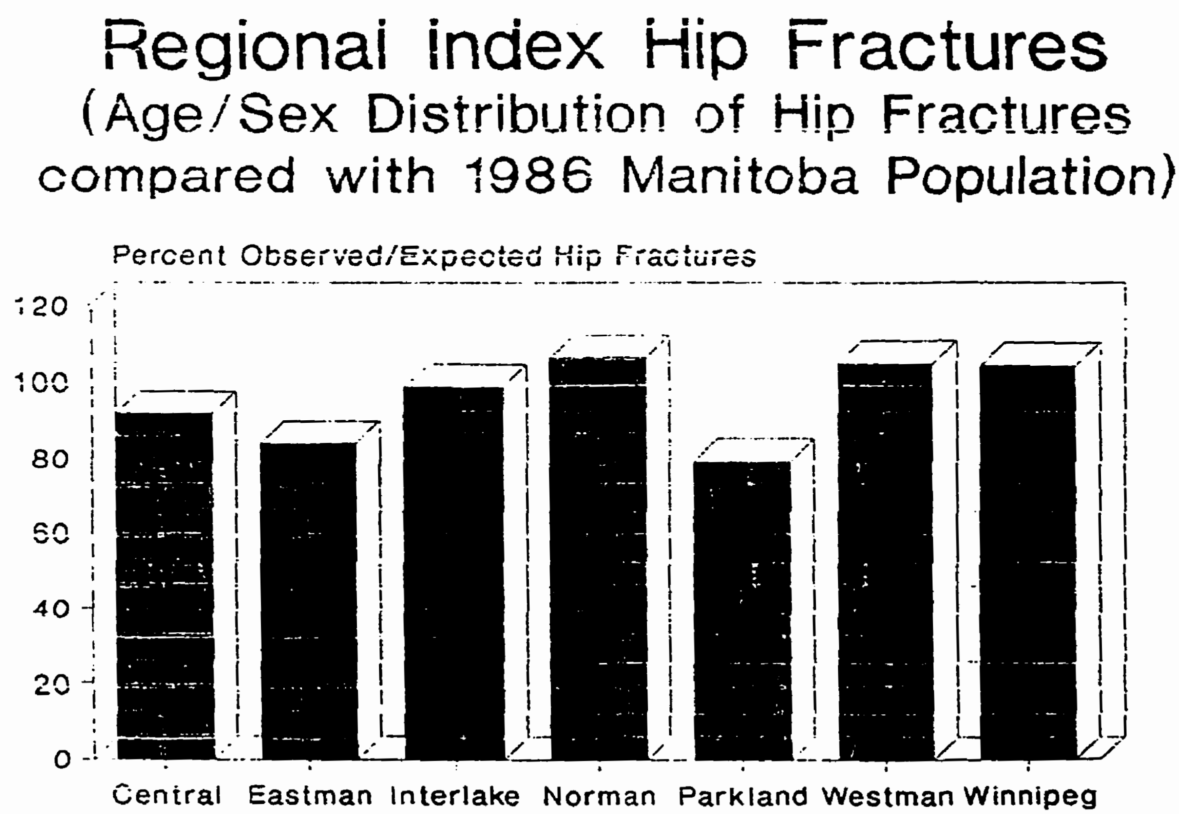


Figure 12c



4 patients had out of province codes

Figure 12d



4 patients had out of province codes

Seniors residing in nursing homes at the time of their fracture made up 29.0% of the hip fracture cases (3549 individuals). Individuals with level of care codes indicating a respite admission either on first admission or on last separation were not included unless their index fracture admission indicated a transfer from nursing home. However, individuals with an initial hip fracture hospital admission indicating a transfer from a nursing home were included (Appendix 14).

Table 6

The Age and Sex Distribution of Index Hip Fractures in the Nursing Home Population Compared to the 1986 Manitoba Nursing Home Population Age 65 Years and Over

	Males			Females		
	Obs.	**Exp. ***	**Obs/Exp**	**Obs.**	**Exp. ***	**Obs/Exp**
65-69 Years	32	73	43.8%	44	75	58.7%
70-74 Years	69	130	53.1%	123	153	80.4%
75-79 Years	133	179	74.3%	268	330	81.2%
80-84 Years	175	226	77.4%	631	573	110.1%
85+ Years	475	439	108.2%	1599	1371	116.6%
Total	**884**	**1047**	**84.4%**	**2665**	**2502**	**106.5%**

Does not include 29 cases

* Calculation based on 1986 age-sex distribution of the Nursing Home Manitoba Population

Table 6 shows the age and sex distribution of individuals in nursing homes at the time of their initial fracture (observed) compared to the expected distribution of hip fractures had they been randomly distributed in the 1986 Nursing Home Population (expected). See Appendix 15. Again, the resulting ratios of observed to expected fractures revealed an increased rate of hip fracture with age and among women. However, these trends were not as strong as those witnessed in the general elderly population (Table 5).

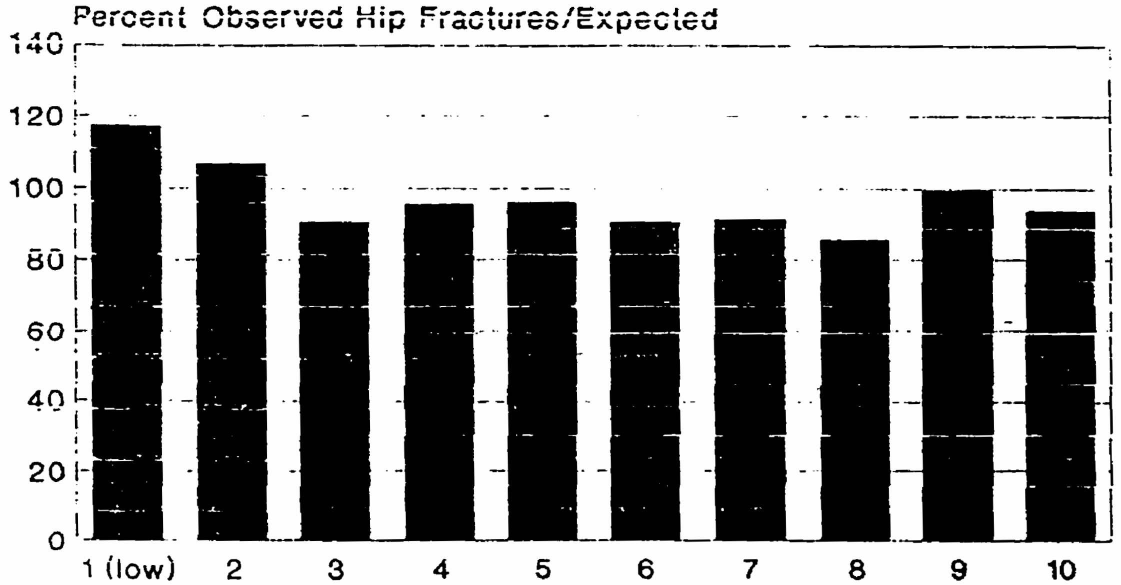
The majority of hip fractures (74.1%) occurred in patients living in urban areas (as defined by postal code). However, comparison of the observed and expected distribution of hip fractures based on the age and sex distribution of the rural and urban residents showed that urban residents fracture their hips less often than rural residents (97.7% versus 107.2%).

Figure 13 shows the age, sex and socioeconomic status distribution of hip fractures patients (observed) compared to the expected distribution of hip fractures had they been randomly distributed in the 1986 elderly population. Seniors in the two lowest income categories appear more likely to suffer hip fractures than seniors in other income categories. However, a graded relationship between income and index hip fractures is not apparent.

Figure 13

Income Distribution

(Age/Sex/Income Distribution of Hip Fractures compared to 1986 Population)



Urban Seniors Only

Fracture Characteristics

The distribution of index hip fracture types is shown in Table 7. Almost all of the hip fractures were closed fractures (98.9%). Closed trochanteric fractures and closed transcervical fractures made up the majority of the fractures, 48.7% and 38.8% respectively.

The distribution of the index fractures by year of admission is shown in Figure 14. A general increase in the number of index fractures is evident. However, these data are not adjusted for the aging of the population. The data for 1992 may not be entirely complete as individuals admitted in 1992 may still be in hospital at the end of the study. Cases are only included in the study after they are discharged from hospital.

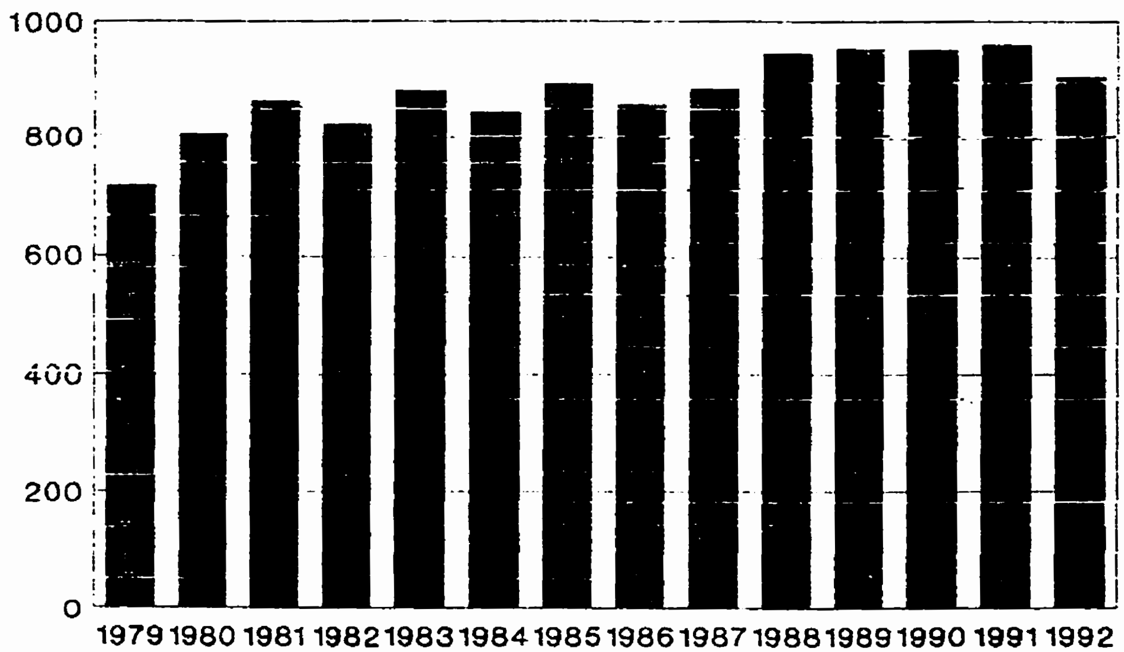
Table 7

Index Hip Fracture Types

Closed Trochanteric Fracture	5973	(48.7%)
Closed Transcervical Fracture	4760	(38.8%)
Closed Subtrochanteric Fracture	376	(3.1%)
Closed Unspecified Fracture	981	(8.0%)
Open Trochanteric Fracture	74	(0.6%)
Open Transcervical Fracture	22	(0.2%)
Open Subtrochanteric Fracture	4	(0.0%)
Open Unspecified Fracture	41	(0.3%)
Unspecified Hip Fracture/Fracture of Epiphyseal Plate of Hip	40	(0.3%)
Total	**12,271**	

Figure 14

Distribution of Index Hip Fracture
(by fiscal year)



1992 data may not be complete - see text

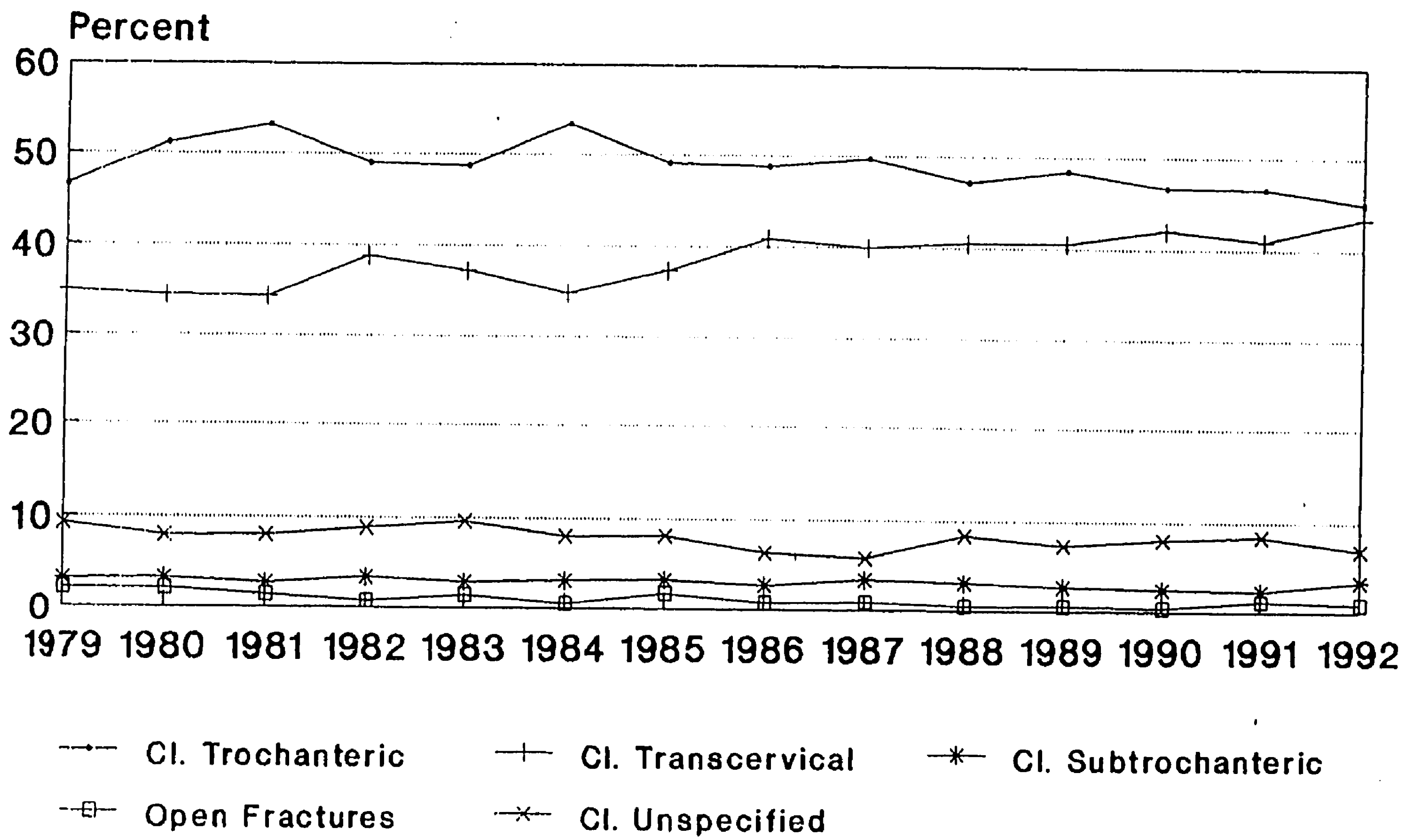
Figure 15 illustrates the changing proportions of index hip fractures types over time. Closed transcervical fractures may have become more common while the percentage of closed trochanteric fractures may have declined slightly over the study period. The percentage of fractures attributable to closed unspecified fractures, closed subtrochanteric fractures or open fractures has remained relatively constant.

Additional hip fractures diagnosed during the initial admission (not subsequent admissions in an episode of care) were identified as a possible bilateral hip fracture cases and were analyzed separately during the assessment of the impact of associated traumatic injury on hip fracture outcome. Table 8 shows 199 cases of two hip fracture diagnoses on the initial admission. In addition, there were 60 distinct hip fracture diagnoses which occurred on subsequent admissions in the index episode of care. These diagnoses may represent early second fractures.

Table 8 also shows other traumatic injuries associated with the initial hip fracture admission. Upper limb injuries appear to be most common additional injury (4.5%). Overall, 8.0% of the initial admissions were associated with additional injuries.

Figure 15

Distribution of Index Fractures
Over 14 Years



1992 data may not be complete

Table 8

Index Admissions Associated with Other Injuries (N=12,271)

Head Injury	40	(0.3%)
Lower Limb Injury	67	(0.5%)
Upper Limb Injury	547	(4.5%)
Pelvis Injury	84	(0.7%)
Second Hip Fracture	199	(1.6%)
Other Injury	145	(1.2%)
* **Any Injury**	**981**	**(8.0%)**

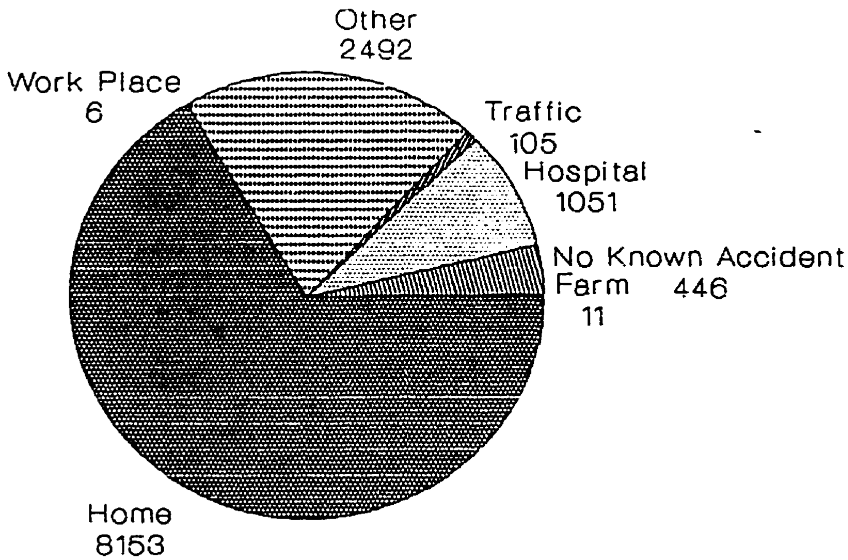
* Any Injury is the total number of individuals who had a trauma diagnosis on their initial index admission.

The location of most of the hip fractures was the home (66.5%) (Figure 16). The "other" category accounted for 20.3% of the accident locations. This category appears to be the default category and can not be easily explained: 13.0% of these fractures were in patients from nursing home and 17.4% were individuals transferred from another hospital on their index admission (See Appendix 14 for an explanation of transfers occurring on index admission). Hospital accidents appear to account for 8.6% of all hip fractures.

The hip fractures were slightly more common in the fall and winter (Figure 17). Figure 18 shows that patients with hip fractures were less likely to be admitted on weekends.

Figure 16

Accident Location



7 missing values

Figure 17

Season of Index Fracture

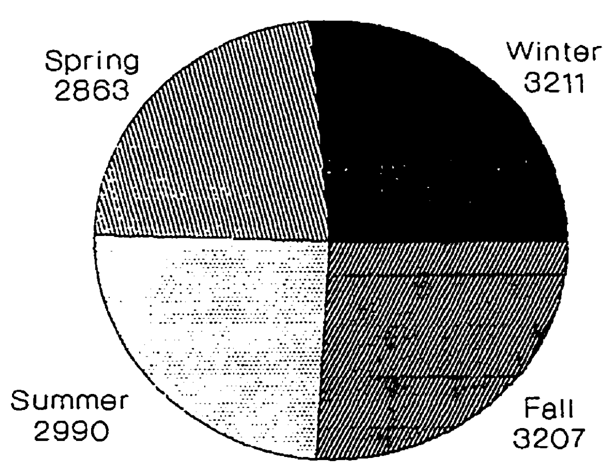
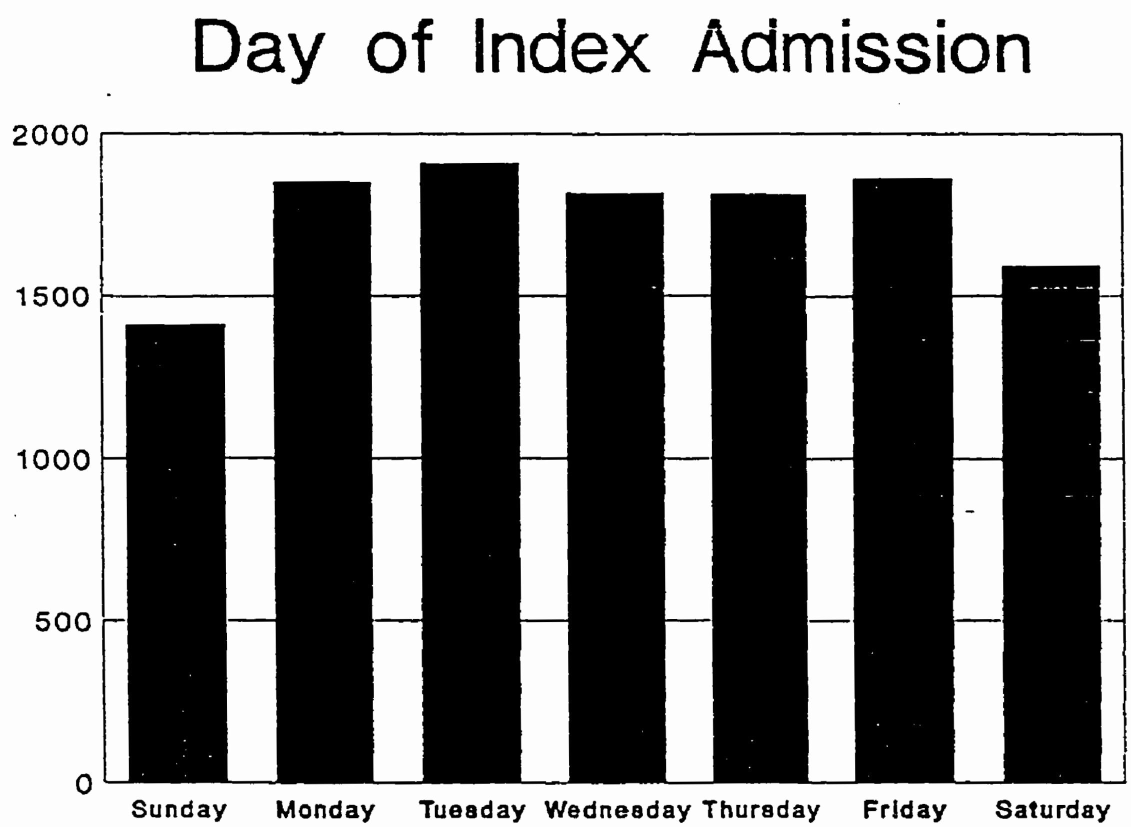


Figure 18


Day of Index Admission
2000
1500
1000
500
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

Comorbidity

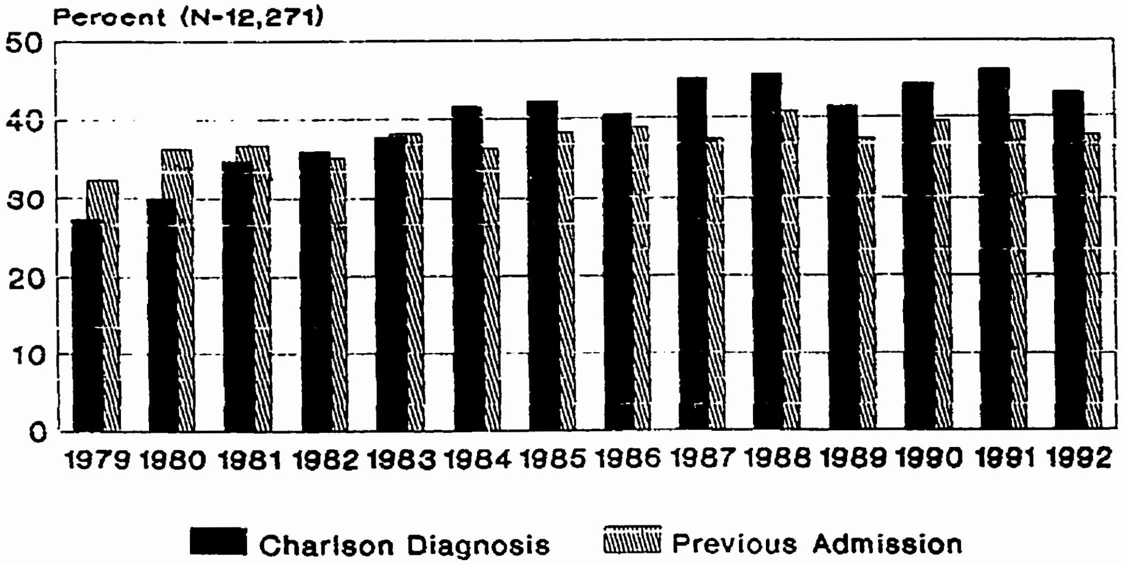
Over one third of the hip fracture index cases (37.2%) were admitted to hospital within the year prior to admission. The percentage of index fracture patients with an admission in the previous year increased until 1983 and then has remained constant at about 38% per year. The number of patients with at least one Charlson Index diagnosis continued to climb until 1988, and plateaued at about 44% of the new hip fracture cases per year (Figure 19). However, this may be a reflection of improved coding practises.

Since the Charlson Index captures all of the selected comorbidity diagnoses for admissions prior to the index admission as well as diagnoses in the index admission which indicate a chronic disease (eg. COPD), patients admitted in 1978 or 1979 were not included in the analysis of comorbid disease due to incomplete information on their previous admissions.

The distribution of the various types of comorbidities within the Charlson Index is shown in Table 9. Dementia (11.5%), chronic obstructive lung disease (9.7%) and mild to moderate diabetes (6.7%) were among the most common comorbidity disorders found in the hip fracture patients.

Figure 19

Time Trends
Admission in Previous Year / Presence of Charlson Diagnosis



1979 data may not be complete

Table 9

Distribution of Comorbidities in the Charlson Index

Myocardial Infarction	361 (3.1%)
Congestive Heart Failure	611 (5.3%)
Peripheral Vascular Disease	399 (3.5%)
Chronic Obstructive Pulmonary Disease	1114 (9.7%)
Cerebrovascular Disease	584 (5.1%)
Dementia	1323 (11.5%)
Diabetes (mild to moderate)	772 (6.7%)
Severe Diabetes	227 (2.0%)
Liver Disease (mild)	50 (0.4%)
Severe Liver Disease	29 (0.3%)
Ulcer	136 (1.2%)
Paralysis	186 (1.6%)
Renal Disease	226 (2.0%)
Any Malignancy	462 (4.0%)
Metastatic Solid Tumour	217 (1.9%)

* **Excluding Index Fractures Admitted in 1979**

In addition to the diseases identified by the Charlson Index, Table 10 shows other comorbidities thought to be associated with hip fractures. Among these comorbidities, mild hypertension (11.2%), blindness (5.3%) and Parkinson's Disease and other movement disorders (4.4%) were the most prevalent. All records of hospital admissions in the previous year and the index admission were searched for these diagnoses.

Table 10

Other Comorbidities occurring Before or on Admission for Index Hip Fracture

Pathological Fracture	118	(1.0%)
Osteoporosis	404	(3.5%)
Bone Cancer	2	(0.0%)
Depression before Fracture	243	(2.0%)
Depression at time of Fracture	277	(2.4%)
Mild Hypertension	1285	(11.2%)
Severe Hypertension	125	(1.1%)
Deafness	105	(0.9%)
Blindness	608	(5.3%)
Parkinson's Disease and Other Movement Disorders	508	(4.4%)
Arrhythmia	378	(3.1%)
Seizures before Fracture	141	(1.2%)
Seizures at the time of Fracture	200	(1.7%)
Alcoholism	150	(1.3%)
Nutritional Insufficiency	152	(1.3%)
AIDS	0	(0.0%)
Osteoarthritis	282	(2.5%)
Coagulopathy	47	(0.4%)
Rheumatoid Arthritis	198	(1.7%)

- **Excluding Index Fracture Admitted in 1979**

Almost half of the individuals with a diagnosis of a pathologic fracture (49.2%) also had a diagnosis of osteoporosis.

Only 44 (15.9%) of the individuals diagnosed with depression during their index admission also received the diagnosis of depression in an earlier hospital admission, but over half of patients depressed on admission (54.2%) were admitted in the previous year.

For seizure disorders, 75 (37.5%) of the individuals with the diagnosis at time of hip fracture had been also been diagnosed with the disorder on a previous admission. Of the patients with a diagnosis of a seizure disorder on previous admissions, all but 17 (8.5%) seizure diagnoses were coded on index admission.

Treatment

The majority of index fractures (10,906 or 88.9%) had a surgical repair of their hip during their index episode of care. Table 11 shows the types of repairs performed during the index episode of care.

The most common index episode of care repair procedure was open reduction with internal fixation (52.9%). Since the diagnostic codes for arthroplastic repair changed during the course of the study, it was necessary to combine the relevant

Table 11

Primary Repair Procedures in Initial Episode of Care

'7855'	Internal Fixation of Bone Without Fracture Reduction	**1442** (13.2%)
'7905'	Closed Reduction of Fracture Without Internal Fixation	**46** (0.4%)
'7915'	Closed Reduction of Fracture With Internal Fixation	**1069** (9.8%)
'7925'	Open Reduction of Fracture Without Internal Fixation	**26** (0.2%)
'7935'	Open Reduction of Fracture With Internal Fixation	**5768** (52.9%)
'7975'	Closed Reduction of a Dislocated Hip	**3** (0.0%)
'7985'	Open Reduction of a Dislocated Hip	**13** (0.1%)
'8140'	Repair of Hip Not Elsewhere Classified - includes Arthroplasty (used only after 1990)	**6** (0.1%)
'8151'	Total Hip Replacement with Methyl Methacrylate	**52** (0.5%)
'8152'	Partial Hip Replacement - Bipolar Endoprosthesis (used only after 1990)	**563** (5.2%)
'8159'	Other Total Hip Replacement (Before 1990) Revision of Joint Replacement, not Elsewhere Classified (after 1990)	**29** (0.3%)
'8161'	Replacement of the Head of the Femur with use of Methyl Methacrylate (Used only before 1990)	**198** (1.8%)
'8162'	Other Replacement of the Head of Femur (Used only before 1990)	**1617** (14.8%)
'8164'	Other Replacement of the Acetabulum	**8** (0.1%)
'8169'	Other Repair of the Hip (Used only before 1990)	**66** (0.6%)
	TOTAL	**10,906**

codes to form an arthroplasty variable (8140, 8152, 8161, 8162, 8164). Arthroplasty made up 21.9% of the fracture repairs, followed by internal fixation of bone without hip fracture reduction (13.2%) and closed reduction of the hip with internal fixation (9.8%). Total Hip replacement, as a primary procedure, was performed on only 52 of the hip fractures (0.5%).

The type of repair performed appeared to be related to the type of fracture. Table 12 shows the relationship between hip fracture diagnosis and repair procedure. Two thirds of the open reductions with internal fixation were performed on closed trochanteric fractures (66.6%), and almost one-quarter were performed on closed transcervical fractures (22.7%). Close to all of the arthroplasties were performed on closed transcervical fractures (89.0%). No reduction with internal fixation and closed reduction with internal fixation were performed more often on individuals with closed trochanteric fractures, 58.7% and 56.2% of the repairs respectively.

Over time, the number of arthroplasties and internal fixations without reduction may have increased slightly. Whereas, internal fixations with open or closed reductions may have declined. However, magnitude of these changes appear relatively small and the relative proportions of these repairs have remained fairly constant (Figure 20).

Table 12

Distribution of Repair Procedure

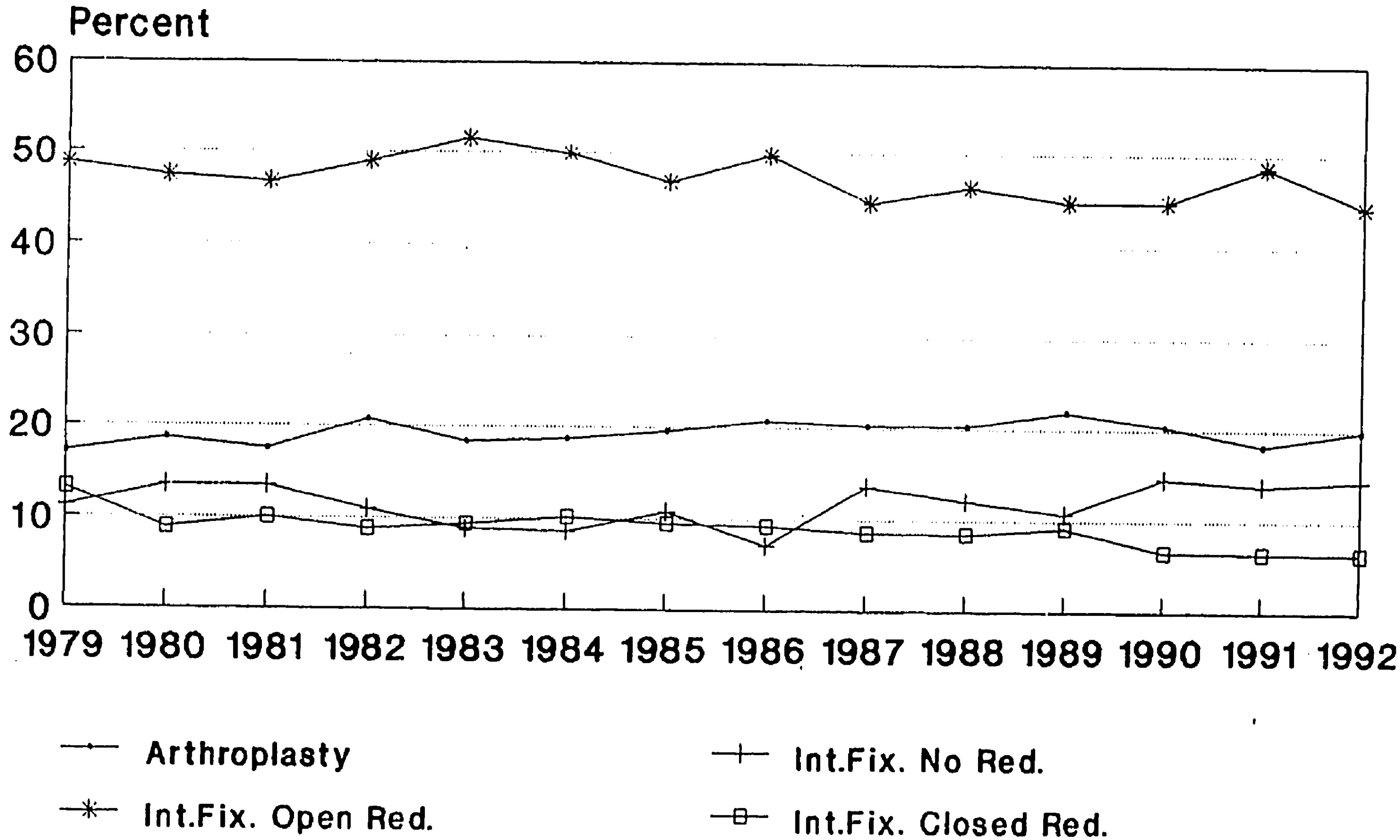
by Fracture Type

	Closed Trochan-teric	Closed Trans-cerv-ical	Closed Subtrochan-teric	Open Frac-tures	Un-speci-fied	TOTAL
Open Reduction Internal Fixation	3840	1312	295	76	245	5768
Arthro-plasty	35	2128	1	6	222	2392
No Reduction Internal Fixation	846	438	33	17	108	1442
Closed Reduction Internal Fixation	601	377	22	9	60	1069
Other Care*	651	505	25	33	386	1600
Total	5973	4760	376	141	1021	12,271

* Includes patients who did not receive a hip fracture primary repair in their index episode of care and also the additional repairs noted in Table 11 and not specified here.

Figure 20

Distribution of Index Repairs
Over 14 Years



1992 data may not be complete

Delivery of Care

The average length of stay in an episode of care for an index fracture was 85.7 ± 163.7 days with a range of 1 day to 3469 days. Figure 21 shows the distribution of length of stay. Almost one third (30.9%) of the cases had lengths of stay over 60 days and 19.4% had stays over 100 days.

One third of the patients (32.2%) were transferred to at least one other hospital during their hip fracture episode of care and 11.0% of patients were transferred before their repair procedure. In addition, 4.0% patients had "transfer from another hospital" noted on their initial hospital claim without a corresponding hospital admission claim. See Appendix 14 for a discussion of transfers.

Figure 22 shows a comparison between admitting hospital type and repair hospital type. Hip fracture repairs tend to be concentrated in urban non-teaching hospitals, followed by teaching hospitals and major rural hospitals. The fractures presenting to the smaller rural centres and rehabilitation hospitals appear to be transferred for hip fracture repair.

The average time to surgery from admission was 11.3 ± 57.7 days. However, this time includes individuals who may have had their fracture occur while in hospital. Therefore, the time to operation will be considered only for those patients who had their procedure within ten days of initial

Figure 21

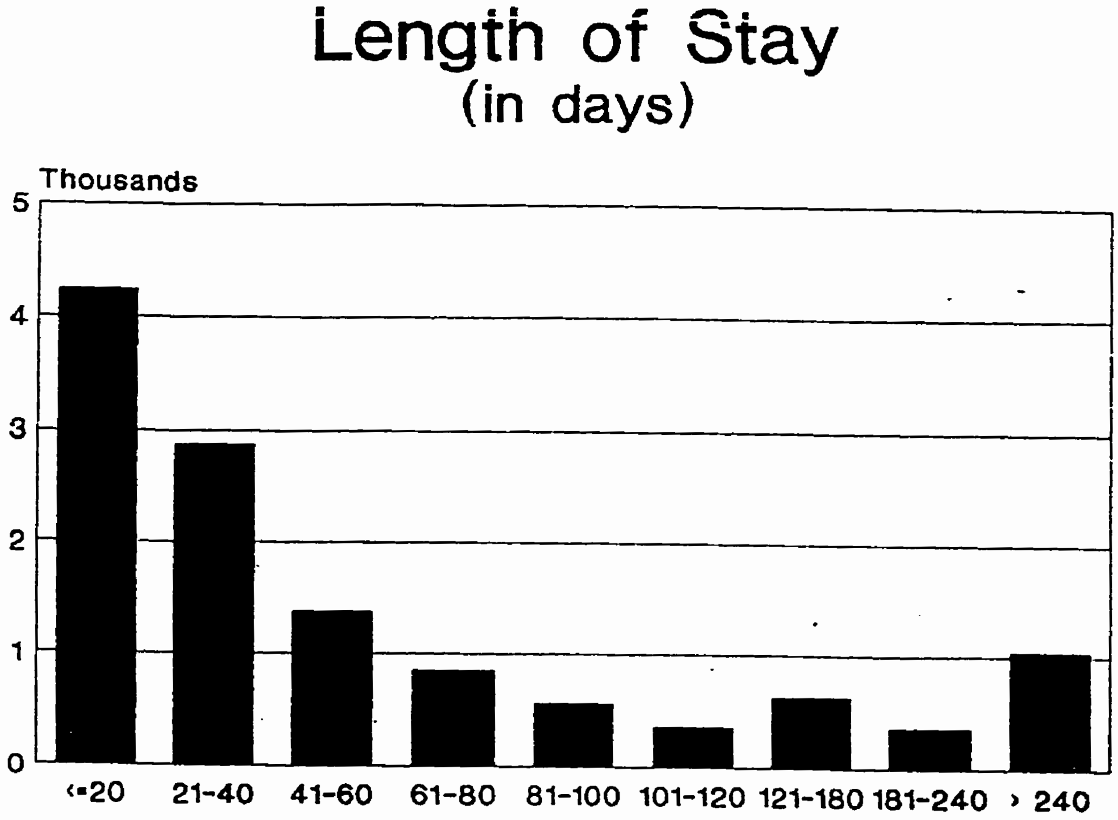
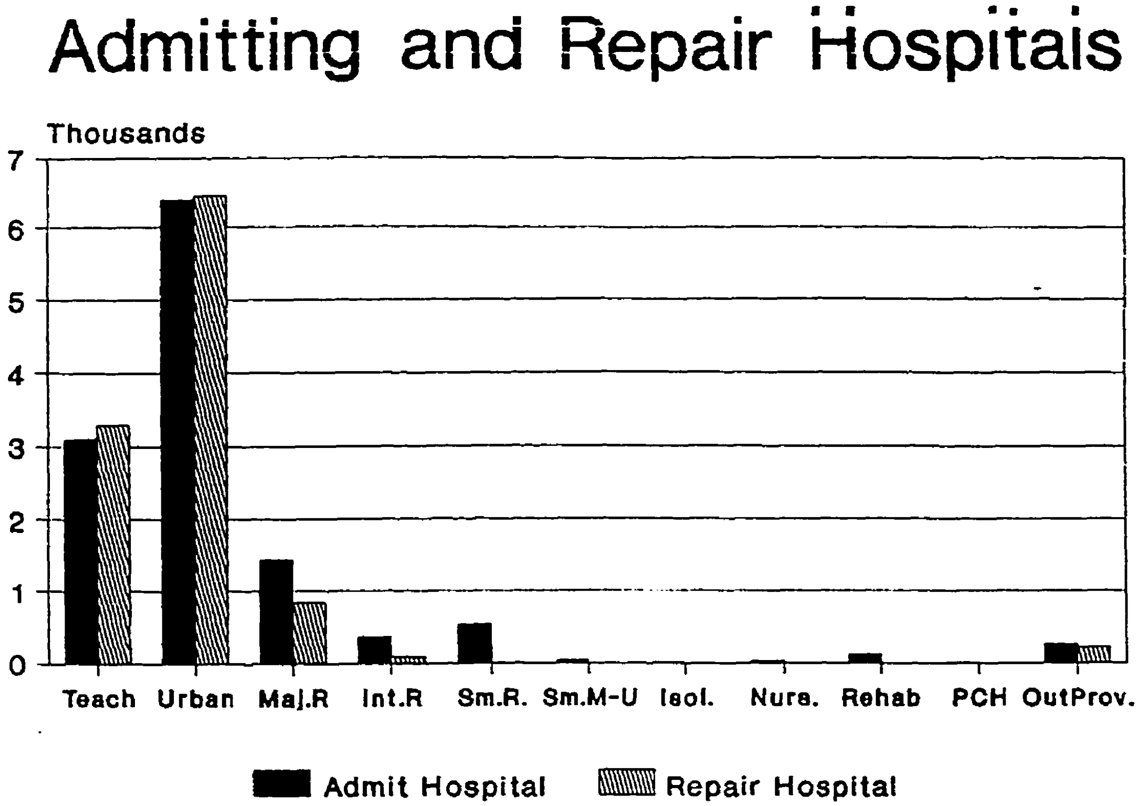

Length of Stay
(in days)
Thousands
5
4
3
2
1
0
<=20
21-40
41-60
61-80
81-100
101-120
121-180
181-240
> 240

Figure 22



Admitting (N=12,271) Repair (N=10,906)

KEY

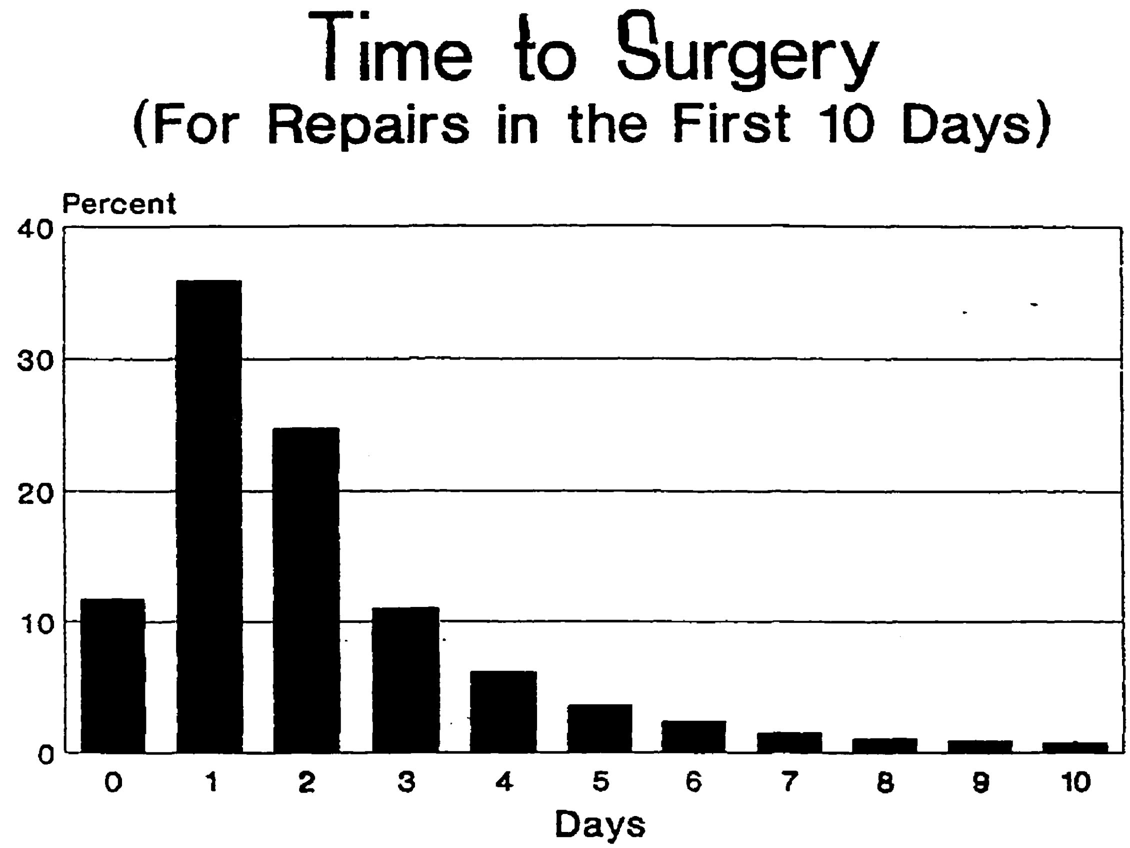
Teach	Teaching Hospital
Urban	Winnipeg Non-Teaching Hospital
Maj.R.	Major Rural Hospital
Int.R.	Intermediate Rural Hospital
Sm.R.	Small Rural Hospital
Sm.M-U	Small Multi-Use Facility
Isol.	Northern / Isolated Facility
Nurs.	Nursing Station
Rehab.	Chronic/Rehabilitation Centre
PCH	Personal Care Home
OutProv.	Out of Province Hospital

admission (9556 individuals). For this group, the average time to operation was 2.1 $\pm$ 1.9 days. Figure 23 shows the time of repair in relation to the date of admission to first hospital for hip fracture. Surgery on the first or second day of admission is the most common practise. More hip fracture repairs appear to be conducted on Wednesdays and Fridays (Figure 24). Of the hip fracture admissions, 3.5% were recorded as elective admissions.

There were 59 physicians who conducted 25 repairs or less over the duration of the study period. These physicians performed 1.9% of the total cases. Physicians conducting 25 to 124 repairs during the study period (N=15) treated 10.0% of the study cases physicians performing 125 repairs or more (N=26) conducted 88% of the repairs.

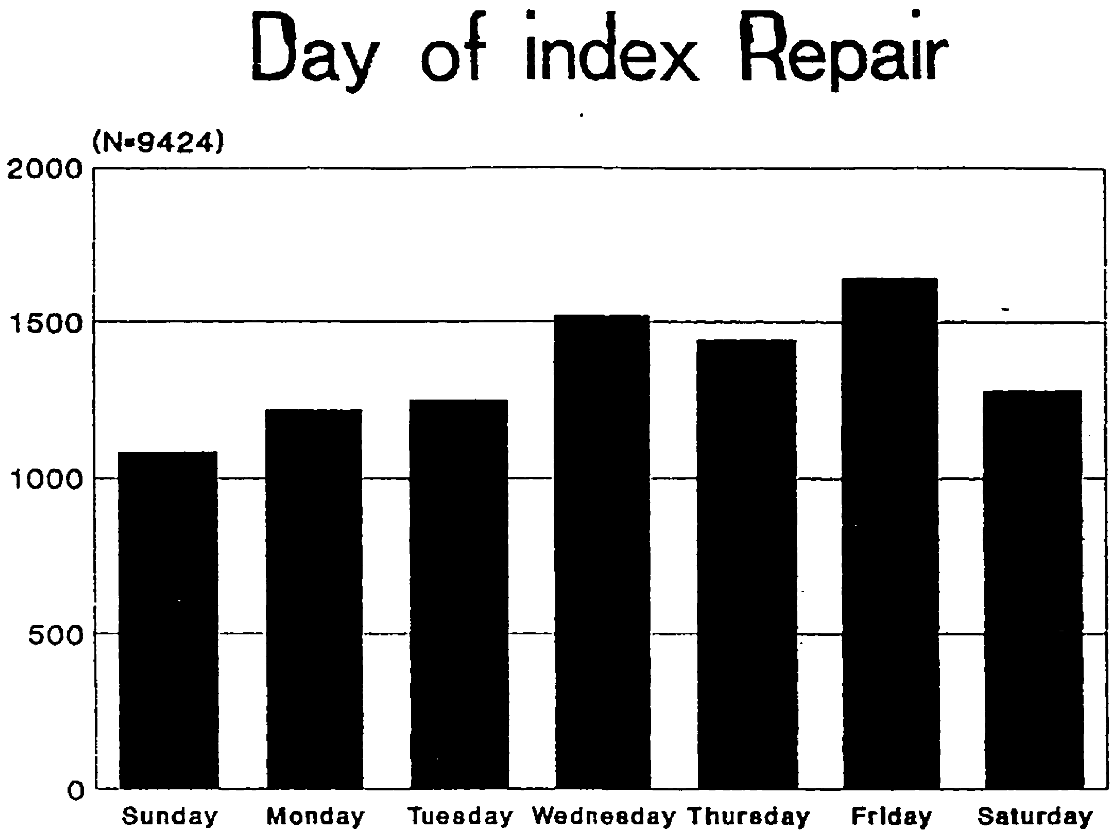
A similar categorization was used for hospitals. Most of the hospitals involved in hip fracture repair (N=80) saw 25 or less hip fracture patients over the study period and treated only 1.1% of the hip fracture patients. Hospitals who saw over 1000 patients over the study period (N=5) treated 69.9% of the patients.

Figure 23



(N=9556)

Figure 24



(Missing 13.6% of repair dates)

Outcomes

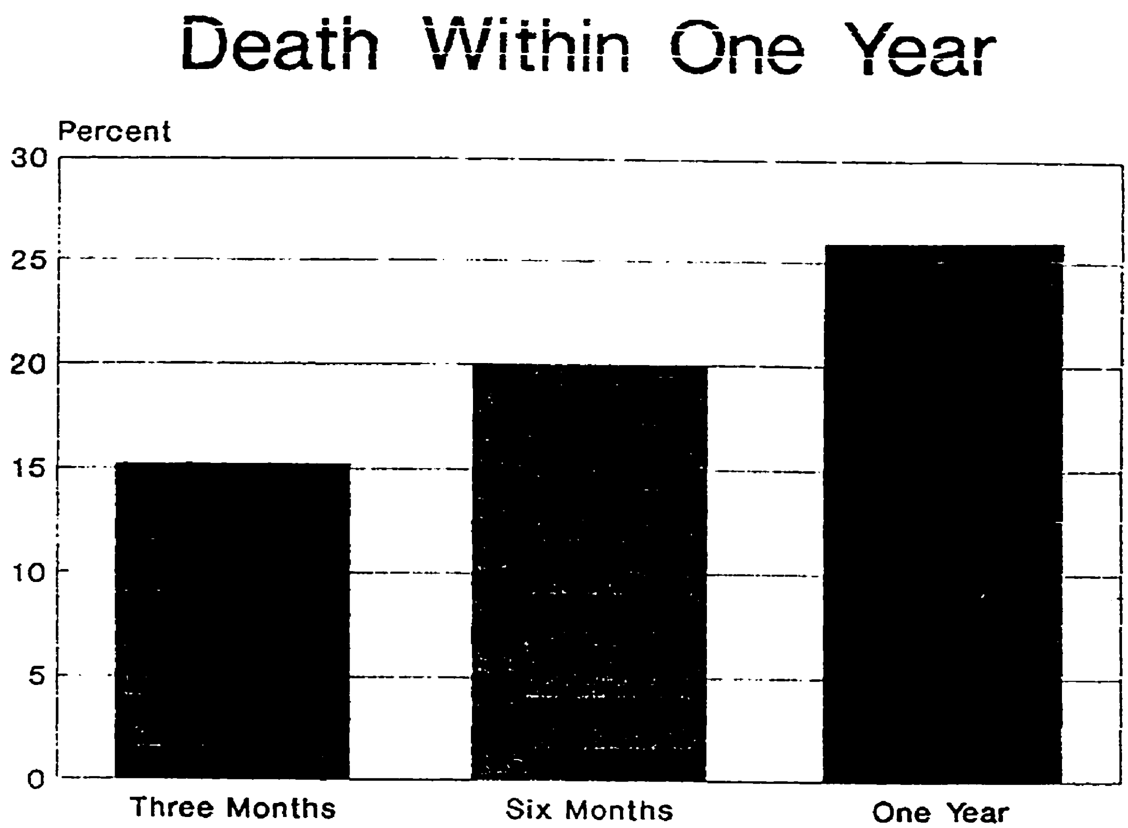
At three months, 15.2% percent of the hip fracture patients had died. At six months, this figure increased to 19.9% and at one year, it was 25.5% (Figure 25). Individuals not followed long enough to have a three, six or one year mortality were censored.

Over one third of the hip fracture patients (36.9%) were discharged to a nursing home within one year after their hip fracture admission. Over one third of these individuals (36.0%) were new nursing home admissions. The outcomes presented for nursing home admission are for events occurring within one year of the hip fracture episode of care and do not include index fractures discharged in the 1992 fiscal year (N=11,347). The 29 individuals not linked to nursing home data were excluded from this analysis.

Readmission in the year following the hip fracture episode of care occurred in 44.4% of the hip fracture cases. Over the study period, 1147 individuals had an additional hip fracture diagnosis after their index episode of care and 60 individuals appeared to have had an additional hip fracture during their initial episode of care.

Of the individuals diagnosed with a fracture after their index episode of care, 568 had primary repairs and 204 had secondary repairs. It should be noted that 77 of these patients had their first repair on refracture.

Figure 25



Excludes Index Fractures in 1992

Table 13

Primary Repair Procedures After the Initial Repair

'7855' Internal Fixation of Bone Without Fracture Reduction	**193** (12.5%)
'7905' Closed Reduction of Fracture Without Internal Fixation	**42** (2.7%)
'7915' Closed Reduction of Fracture With Internal Fixation	**95** (6.2%)
'7925' Open Reduction of Fracture Without Internal Fixation	**10** (0.6%)
'7935' Open Reduction of Fracture With Internal Fixation	**523** (33.9%)
'7975' Closed Reduction of a Dislocated Hip	**28** (1.8%)
'7985' Open Reduction of a Dislocated Hip	**12** (0.8%)
'8140' Repair of Hip Not Elsewhere Classified - includes Arthroplasty (used only after 1990)	**1** (0.1%)
'8151' Total Hip Replacement with Methyl Methacrylate	**165** (10.7%)
'8152' Partial Hip Replacement - Bipolar Endoprosthesis (used only after 1990)	**123** (8.0%)
'8161' Replacement of the Head of the Femur with use of Methyl Methacrylate (Used only before 1990)	**31** (2.0%)
'8162' Other Replacement of the Head of Femur (Used only before 1990)	**300** (19.5%)
'8164' Other Replacement of the Acetabulum	**2** (0.1%)
'8169' Other Repair of the Hip (Used only before 1990)	**17** (1.1%)
TOTAL	**1542**

There were 1542 individuals (12.6% of the study population) who received primary repairs after their initial repair. The distribution of the first subsequent primary repair procedure is shown in Table 13. The proportion of arthroplasty repairs is higher in the subsequent primary repairs (29.6%) than in the initial primary repairs (21.9%) (Table 11). The proportion of total hip replacements is also higher (10.7% versus 0.5%). Open reductions with internal fixations declined from 52.9% to 33.9% of the primary repairs.[1]

Secondary repair procedures were performed on 1065 individuals (8.7% of the study population) over the study period. Table 14 shows the distribution of the first secondary repair procedure performed on the patient. The most common initial secondary repair was the removal of a internal fixation device from the femur (68.9%), followed by total hip replacement with methyl methacrylate (13.7%). Three quarters (75.0%) of the secondary repairs performed were associated with a diagnosis of a late effect.

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[1] Forty percent of the patients who received a primary repair after their index episode of care also received a secondary repair. A late effect diagnosis was associated with 36.7% of these patients. The procedures ('7975', '7985', '8151') are found in both the primary and secondary procedure lists (Table 13 and Table 14). The numbers are not the same because the tables show only the procedure types of the <u>first</u> noted primary or secondary repairs.

Diagnoses of late effects of hip fracture were found in 1118 study cases (9.1% of the study population) (Table 15). Mechanical complication of internal orthopaedic devices was the most common (46.9%), followed by after care involving the removal of a fracture plate or other internal fixation device (18.2%) and necrosis of the femoral head (17.7%).

Table 14

SECONDARY REPAIR PROCEDURES

'7705'	SEQUESTECTOMY OF FEMUR	1
'7715'	OTHER INCISION OF FEMUR	4
'7845'	OTHER REPAIR OR PLASTIC OPERATIONS ON FEMUR	1
'7860'	REMOVAL OF AN INTERNAL FIXATION DEVICE, UNSPECIFIED SITE	2
'7865'	REMOVAL OF INTERNAL FIXATION DEVICE OF FEMUR (78.65 REMOVAL OF IMPLANTED DEVICES FROM BONE -1990)	734
'7975'	CLOSED REDUCTION OF A DISLOCATED HIP	24
'7985'	OPEN REDUCTION OF A DISLOCATED HIP	11
'8005'	ARTHROTOMY FOR THE REMOVAL OF PROSTHESIS	47
'8015'	OTHER ARTHROTOMY OF HIP	11
'8095'	EXCISION OF A HIP JOINT	1
'8151'	TOTAL HIP REPLACEMENT WITH METHYL METHACRYLATE	146
'8153'	REVISION OF HIP REPLACEMENT -1990	16
'8159'	OTHER TOTAL HIP REPLACEMENT (BEFORE 1990) REVISION OF JOINT REPLACEMENT, NOT ELSEWHERE CLASSIFIED (AFTER 1990)	66
'8163'	REPLACEMENT OF ACETABULUM WITH USE OF METHYL METHACRYLATE - (BEFORE 1990)	1
	TOTAL	**1065**

Table 15

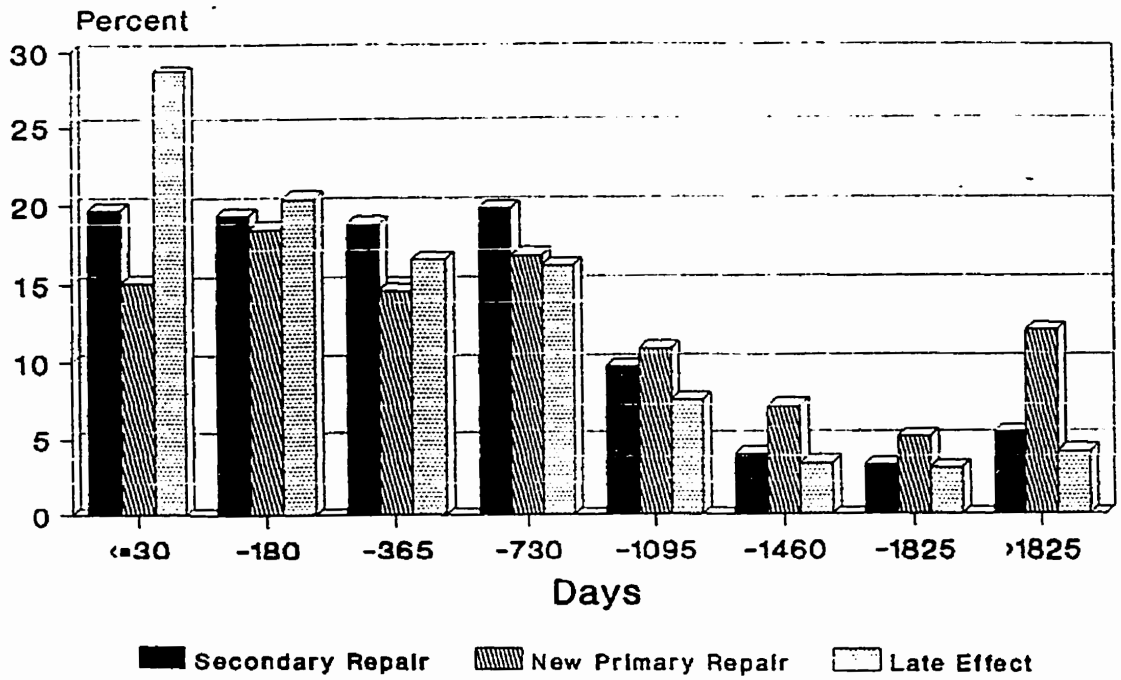
Late Effects of Hip Fracture Care

'73342'	Necrosis of the Femoral Head	198
'9053 '	Late Effect of Fracture of Femur	146
'9964 '	Mechanical Complication of Internal Orthopaedic Device, Implant, and Graft	524
'99666'	Infection and Inflammatory Reaction Due to Internal Joint Prostheses	6
'99667'	Infection and Inflammatory Reaction Due to other Internal Orthopaedic Device, Implant and Graft	8
'99677'	Other Complications of Internal Joint Prosthesis	10
'99678'	Other Complications of Other Internal Orthopaedic Device, Implant and Graft	22
'V540 '	After Care Involving the Removal of Fracture Plate or Other Internal Fixation Device	204
	Total	1118

Figure 26 shows the percentage time distribution of complications for new primary repairs, secondary repairs and the diagnosis of late effects of hip fracture care. Diagnoses of late effects of hip fracture care decline over time with a large drop in the number of reports after two years. The number of secondary repairs remain constant for about a two year period and then drop substantially. Repeat primary repairs also appear to be concentrated within the first two years after the initial admission but did not show the substantial drop noted for secondary repairs.

Figure 26

Time to First Complication



Figures 27, 28, 29 and 30 show the complication free surviving patients over time for the second hip fractures, repeat primary repairs, secondary repairs and late effects of hip fracture care, respectively. At five years, Figure 27 shows that 86% of the surviving hip fracture cases had not suffered a second hip fracture. Figure 28 shows that 81% had not had a primary repair after their index episode of care at five years. At five years, Figure 29 shows that 87.5% of the patients had not had a secondary repair and Figure 30 shows that about 88% of the hip fracture cases did not have a diagnosis of a late effect of hip fracture care.

The secondary repairs and diagnoses of late effect of hip fracture care tend to drop off sharply and begin to plateau at about three years after the initial hip fracture separation. However, second hip fractures and repeat primary repairs decline at a relatively constant rate throughout the follow up period.

Figure 27

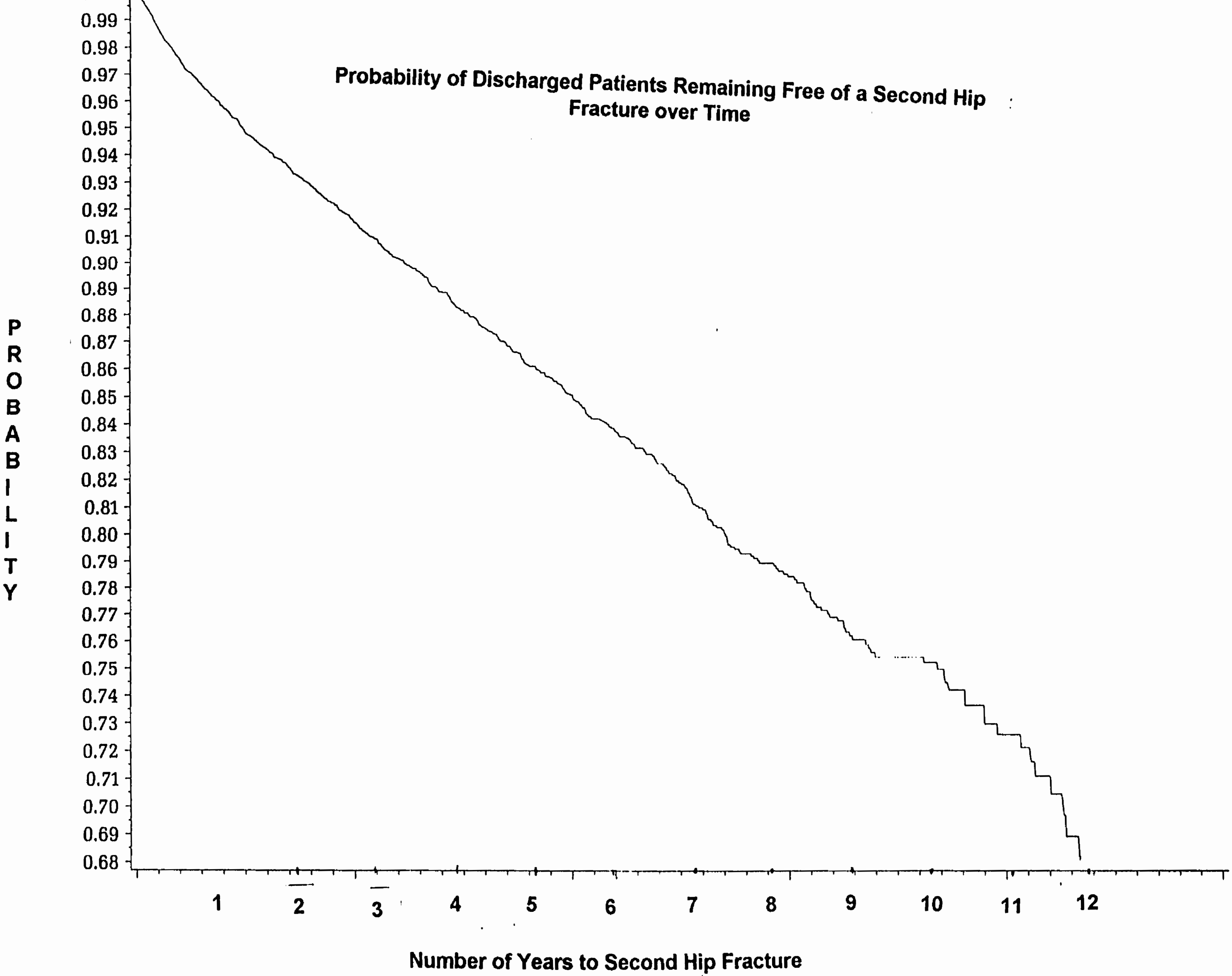
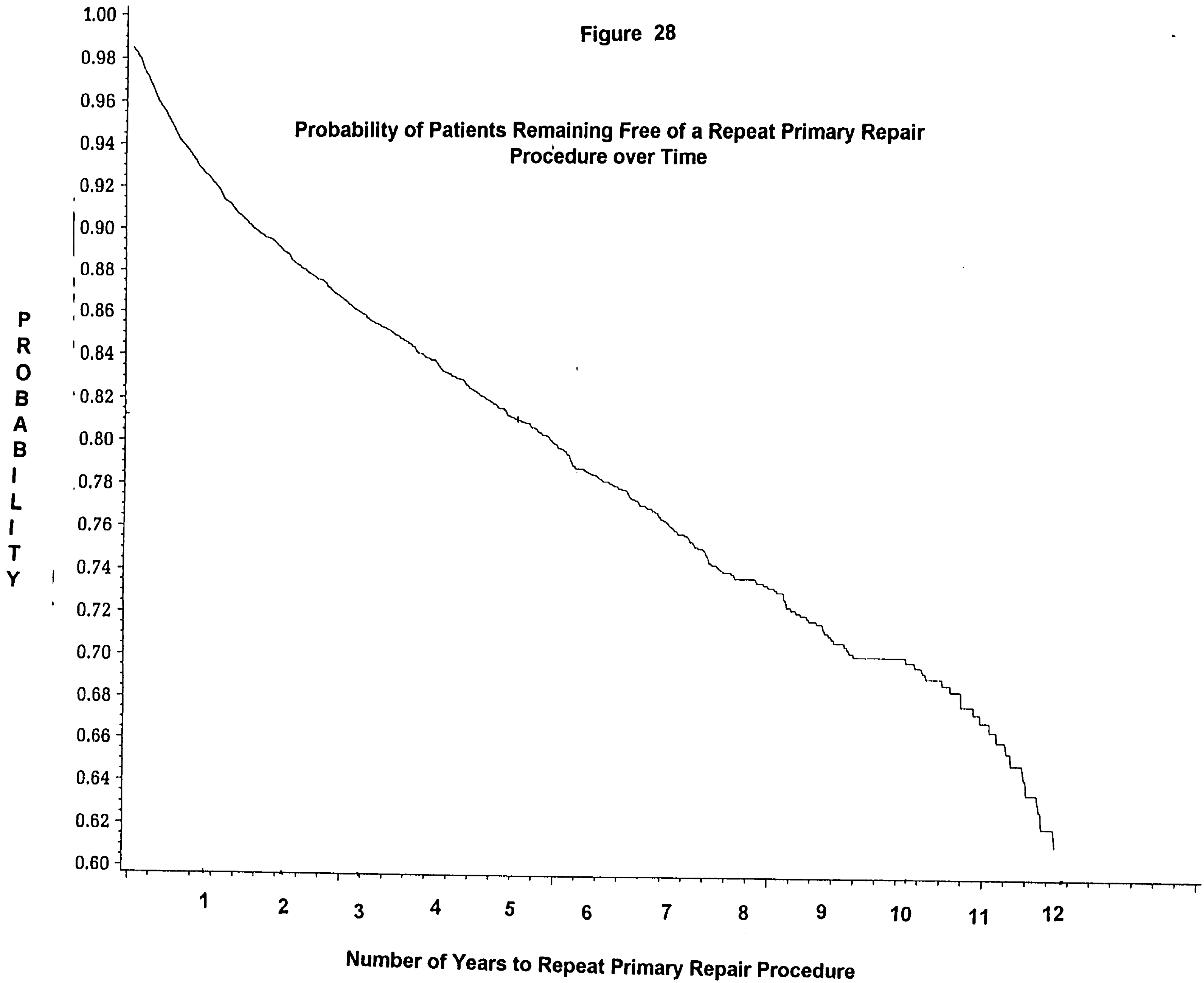

Probability of Discharged Patients Remaining Free of a Second Hip Fracture over Time
PROBABILITY
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
0.82
0.81
0.80
0.79
0.78
0.77
0.76
0.75
0.74
0.73
0.72
0.71
0.70
0.69
0.68
1
2
3
4
5
6
7
8
9
10
11
12
Number of Years to Second Hip Fracture

Figure 28



Probability of Patients Remaining Free of a Repeat Primary Repair Procedure over Time
PROBABILITY
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
0.80
0.78
0.76
0.74
0.72
0.70
0.68
0.66
0.64
0.62
0.60
1
2
3
4
5
6
7
8
9
10
11
12
Number of Years to Repeat Primary Repair Procedure

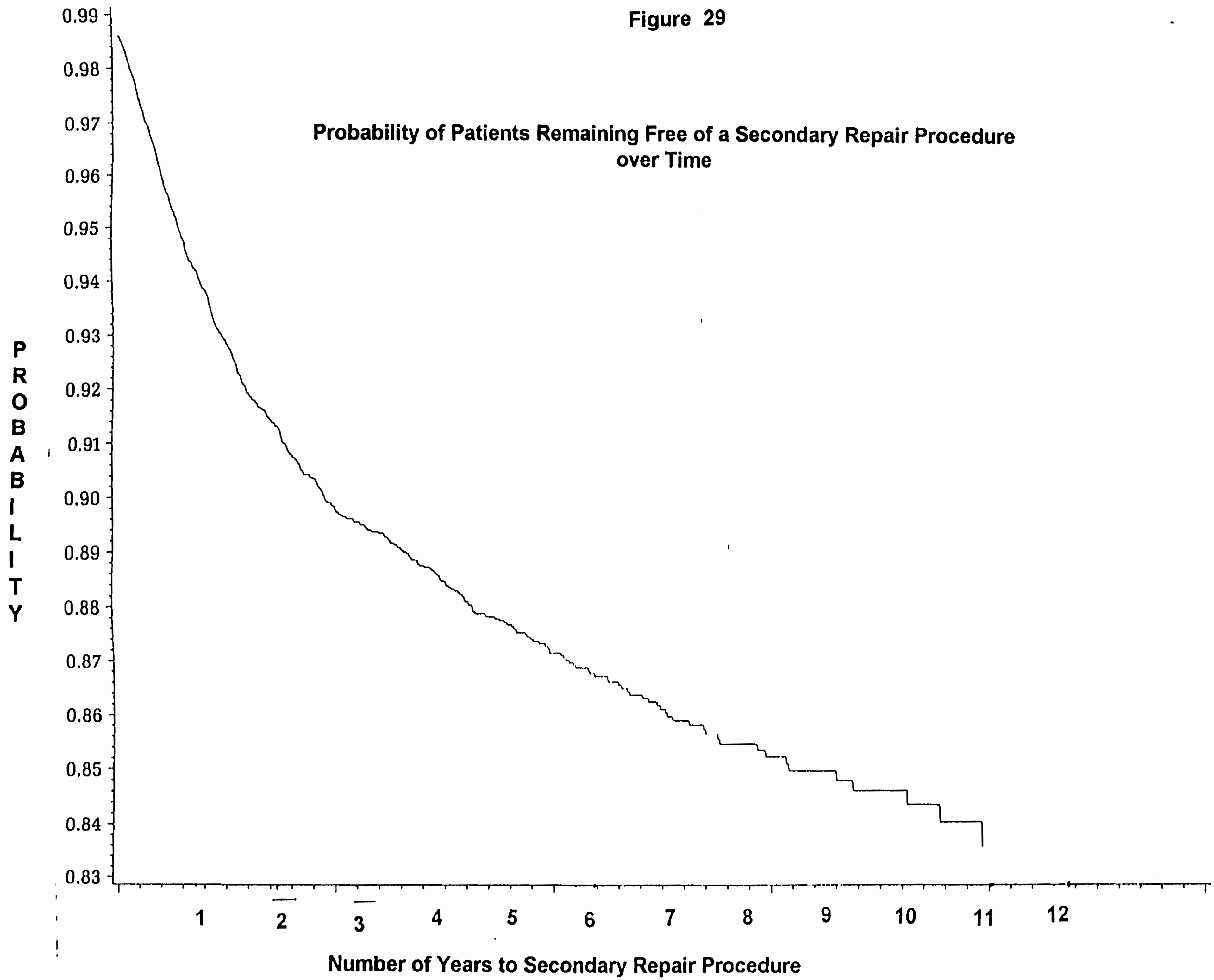
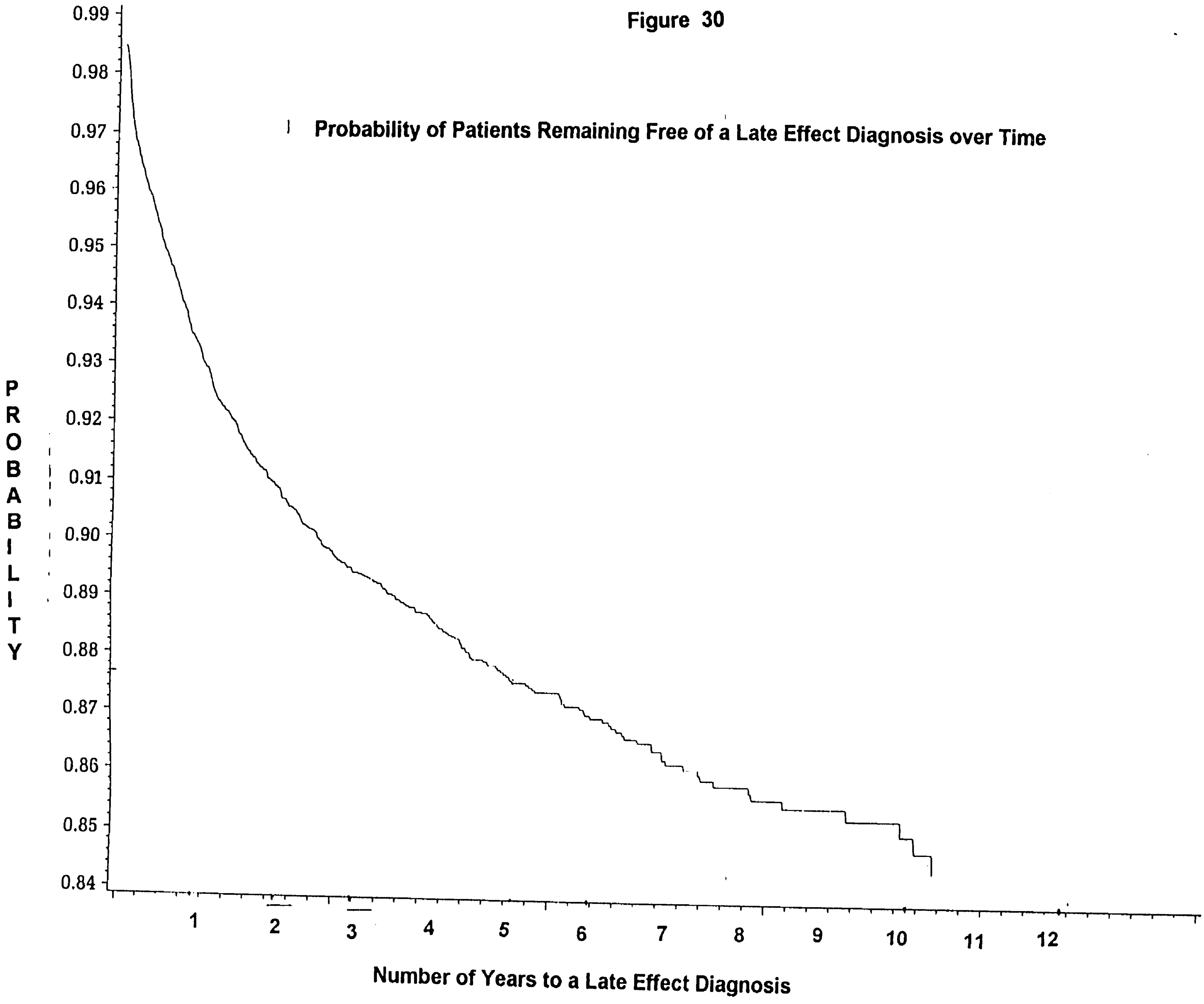


Figure 29
Probability of Patients Remaining Free of a Secondary Repair Procedure over Time
PROBABILITY
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
1
2
3
4
5
6
7
8
9
10
11
12
Number of Years to Secondary Repair Procedure

Figure 30


Probability of Patients Remaining Free of a Late Effect Diagnosis over Time
PROBABILITY
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
1
2
3
4
5
6
7
8
9
10
11
12
Number of Years to a Late Effect Diagnosis

B. Regression Analysis

Markers of Poor Care

The category "markers of poor care" was designated for the outcome variables: possible second hip fracture during the index episode of care; a length of stay in index episode of care of greater than 100 days; a hip fracture diagnosis after index episode of care; and a diagnosis of a late effect of hip fracture care. These outcomes are unfortunate events which may occur during or after index hip fracture care. They are not an exhaustive list of complications of hip fracture care. Once the use of claims data for short term complications is validated, other complications could be applied to this methodology.

Second fractures, late effects of hip fracture care and factors contributing to long lengths of stay may influence the need for further admissions, surgical procedures, nursing home admission or death.

Possible Early Second Fractures

Since only 60 hip fractures were identified after the index admission but within the index episode of care, this variable was not modelled as an outcome. However, it was included in each model as a factor that may contribute to other adverse outcomes.

Length of Stay Greater than 100 days

Logistic regression was used to determine the factors that predict a hip fracture episode of continuous hospital admission of greater than 100 days. Individuals who died within 90 days of initial admission to hospital for hip fracture care were excluded from this analysis. The factors which predict early mortality will be examined separately.

Table 16 shows the factors which are predictive of a length of stay in hospital of at least 100 days. Increasing age elevates the chance of staying in hospital. However, female sex and prior residence in nursing home significantly reduces the likelihood of a long hospital stay. Region of residence is significantly associated with length of stay. Winnipeg residents appear to have a greater probability of spending 100 days or more in hospital. Individuals who live in rural areas of the province are also more likely to have long stays in hospital. Socioeconomic status was not significantly associated with length of stay.

Individuals diagnosed with other traumatic injuries at the time of their initial hip fracture admission have a higher probability of a long hospital stay. Season of the year is significantly associated with hospital stay. Individuals admitted in the winter appear to be less likely to have a long stay in hospital than patients admitted in the

Table 16

Discharge from Hospital in 100 Days or Greater
(excluding individuals who died within
90 days of initial admission)

N = 9447
Stays 100 days or greater = 2168

	Odds Ratio	95% Confidence Limit
Age (in years)	1.073	1.064-1.082***
Sex (female)	0.769	0.672-0.881***
Nursing Home Resident (yes/no)	0.072	0.059-0.088***
Region (Winnipeg)		***
Norman	0.279	0.172-0.453
Central	0.423	0.317-0.563
Eastman	0.569	0.422-0.767
Interlake	0.369	0.269-0.508
Westman	0.408	0.331-0.503
Parkland	0.660	0.480-0.906
Rural Resident (yes/no)	1.314	1.125-1.535**
Other Trauma (yes/no)	2.127	1.764-2.564***
Season (Fall)		
Winter	0.845	0.720-0.992
Spring	1.062	0.905-1.246
Summer	1.027	0.874-1.207
Admission Day (Saturday)		
Sunday	0.987	0.784-1.243
Monday	0.885	0.710-1.103
Tuesday	0.996	0.803-1.236
Wednesday	1.001	0.804-1.247
Thursday	0.970	0.778-1.209
Friday	1.275	1.029-1.580

Fracture Type (Closed Trochanteric)		**
Open	1.294	0.712-2.351
Closed Transcervical	0.744	0.657-0.843
Closed Subtrochanteric	1.442	1.067-1.949
Closed Unspecified	0.873	0.688-1.107
Accident Location (Other Specific Accident)		***
Home	1.624	1.395-1.892
Hospital	11.907	9.445-15.011
No Known Accident	1.385	0.924-2.077
Severe Diabetes (yes/no)	2.243	1.550-3.246***
Mild to Moderate Diabetes (yes/no)	1.482	1.190-1.846**
Dementia (yes/no)	2.858	2.346-3.483***
COPD (yes/no)	1.502	1.236-1.827***
Cerebral Vascular Disease (yes/no)	1.861	1.465-2.364***
Osteoporosis (yes/no)	1.479	1.112-1.966*
Depression on Previous Admission (yes/no)	1.887	1.313-2.712**
Deafness (yes/no)	2.073	1.190-3.613
Parkinson's Disease (yes/no)	2.354	1.817-3.048***
Seizure Disorder (yes/no)	2.819	1.956-4.065***
Alcohol Abuse (yes/no)	2.181	1.412-3.371**
Nutritional Deficiency (yes/no)	3.186	2.014-5.042***
Admitting Hospital (Teaching)		***
Other	2.564	1.598-4.114
Urban	1.446	1.237-1.692
Major Rural	2.198	1.633-2.959
Intermediate Rural	1.282	0.850-1.932
Small Rural	1.375	0.983-1.924
Out of Province	0.667	0.301-1.475

No Repair Procedure (yes/no)	0.586	0.372-0.922
Hospital Repair Frequency (< 125 repairs)		
> 1000 repairs	0.703	0.457-1.082
125-1000 repairs	0.615	0.401-0.942
Transfer without Admission (yes/no)	0.224	0.144-0.349***
Fiscal Year (in years)	0.912	0.898-0.927***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise logistic regression model significant variables. Number of patients/Number of with lengths of stays greater than 100 days = 9,447/2,168. Goodness of fit statistic = 18.0 with 8 df (p =0.0215). NagelKerke's proportion of explained variation by the model $R^2_{max} = 0.3759$.

fall. Day of admission is also significantly associated with long hospital stays. Individuals admitted on Friday appear to stay longer in hospital than patients admitted on Saturday.

Location of the accident is predictive of long length of stay. Individuals who had an accident at home or in hospital appear more likely to have an extended length of stay compared to those who have accidents in other specified locations. Fracture type is also a significantly predictor of long stays in hospital. Patients with closed transcervical fractures appear to be less likely to stay in hospital compared to patients with closed trochanteric fractures while closed subtrochanteric fractures appear to remain in hospital longer.

The comorbidity diagnoses that significantly increase the likelihood of a long length of stay were: severe diabetes, mild to moderate diabetes; dementia; chronic obstructive pulmonary disease; cerebral vascular disease; osteoporosis; deafness; depression on a previous admission; Parkinson's Disease or other disorders of movement; seizure disorder; alcohol abuse; and nutritional deficiency.

The delivery of care variables significantly less likely to be associated with a length of stay of 100 days or more were: the absence of a repair procedure; transfer from a hospital without admission and a fracture in the later years of the study.

Initial admission to a teaching hospital appeared to reduce the likelihood of a long length of stay, particularly in comparison to other large hospitals in Manitoba. Patients with repairs done in a facility which handles 125 to 1000 repairs per year had a reduced length of stay in comparison to those hospitals who did fewer repairs.

The model fit, using the Goodness of Fit statistic, was not good. This will be discussed further in the discussion.

Table 17

Discharge from Hospital in 100 Days or Greater for Individuals Treated within 10 days of First Admission
(excluding individuals who died within 90 days of initial admission)
N = 7751
Stays 100 days or greater = 1370

	Odds Ratio	95% Confidence Limit
Age (in years)	1.075	1.065-1.086***
Sex (female)	0.753	0.643-0.880**
Nursing Home Resident (yes/no)	0.068	0.054-0.086***
Region (Winnipeg)		***
Norman	0.369	0.210-0.651
Central	0.478	0.358-0.638
Eastman	0.598	0.426-0.839
Interlake	0.501	0.360-0.698
Westman	0.715	0.439-1.167
Parkland	0.989	0.728-1.343
Rural Resident (yes/no)	1.337	1.122-1.593*
Other Trauma (yes/no)	1.843	1.478-2.297***
Admission Day (Saturday)		
Sunday	0.954	0.738-1.234
Monday	0.828	0.645-1.063
Tuesday	0.951	0.747-1.212
Wednesday	0.875	0.681-1.123
Thursday	0.809	0.628-1.043
Friday	1.187	0.932-1.510
Fracture Type (Closed Trochanteric)		***
Open	1.092	0.522-2.284
Closed Transcervical	0.652	0.565-0.752
Closed Subtrochanteric	1.294	0.927-1.807
Closed Unspecified	0.777	0.571-1.056

Accident Location (Other Specific Accident)		***
Home	1.687	1.421-2.002
Hospital	3.745	2.511-5.585
No Known Accident	0.850	0.493-1.466
Previous Admission (yes/no)	1.178	1.013-1.369
Metastatic Cancer (yes/no)	1.797	1.110-3.110
Severe Diabetes (yes/no)	2.052	1.374-3.252*
Paralysis (yes/no)	2.003	1.166-3.354
Mild to Moderate Diabetes (yes/no)	1.573	1.234-2.018**
Dementia (yes/no)	2.749	2.205-3.532***
COPD (yes/no)	1.371	1.075-1.699*
Cerebral Vascular Disease (yes/no)	1.483	1.068-2.074
Depression on Previous Admission (yes/no)	1.952	1.265-3.011*
Deafness (yes/no)	2.029	1.070-3.849
Parkinson's Disease (yes/no)	2.554	1.885-3.462***
Seizure Disorder (yes/no)	2.682	1.740-4.134***
Alcohol Abuse (yes/no)	1.989	1.174-3.370
Nutritional Deficiency (yes/no)	3.103	1.824-5.277***
Osteoarthritis (yes/no)	1.572	1.089-2.270
Treatment Time (in days)	1.074	1.037-1.112***
Hospital Repair Frequency (<125 repairs)		***
Hospital A	0.400	0.213-0.752
Hospital B	0.470	0.290-0.760
Hospital C	0.411	0.253-0.666
Hospital D	0.642	0.393-1.048
Hospital E	0.688	0.419-1.131
125-1000 repairs	0.595	0.376-0.942
Transfer without Admission (yes/no)	0.138	0.070-0.272***

Fiscal Year (in years)	0.914	0.898-0.931***
Scheduled Admission (yes/no)	0.522	0.304-0.899

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise logistic regression model significant variables. **Number of patients/Number of with lengths of stays greater than 100 days = 7,751/1,370. Goodness of fit statistic = 10.8 with 8 df (p =0.2133). NagelKerke's proportion of explained variation by the model R^2_{max} = 0.2829.**

Increased time to treatment was significantly associated with a long length of stay. Table 17 shows the model for only those individuals who received a repair procedure within 10 days of initial admission. Most of the variables in the model were similar to main model for length of stay. However, season of the year, osteoporosis and admitting hospital were no longer significant. Previous admission within the last year, metastatic disease, paralytic disease and osteoarthritis were additional comorbidities which increased the likelihood of a stay of 100 days or greater for individuals treated within 10 days by a repair procedure. Hospital repair frequency in this model was significant with the additional hospital variables added. Patients who had their repair in hospitals which performed less than 125 repairs during the study period were significantly more likely to stay in hospital longer than admissions to most other hospitals. A scheduled admission significantly decreased the probability of a long stay.

Second Hip Fractures

Table 18 shows the factors that were predictive of a second hip fracture diagnosis outside the index episode of care. Since the probability of a second hip fracture is dependent on the length of follow up, proportional hazards analysis was used.

Nursing home residence prior to the initial hip fracture substantially increased the relative risk of a diagnosis of a second hip fracture outside the index episode of care. Older age at time of initial hip fracture also increased the likelihood that a subsequent hip fracture would be diagnosed. The age / nursing home residence interaction was also significant. Individuals of old age in a nursing home were less likely to receive a second hip fracture diagnosis.

The comorbidity variables significantly associated with a diagnosis of a second hip fracture were: chronic obstructive lung disease; seizure disorder; and alcohol abuse. Length of stay was the only delivery of care variable which was predictive of a second hip fracture diagnosis. Individuals who spent less time in hospital on their initial hip fracture admission were more likely to have a diagnosis of a second hip fracture. Time to treatment of the initial fracture and socioeconomic status were not significant predictors of a diagnosis of a second hip fracture.

Table 18

Second Hip Fracture Diagnosis
N = 11,187
Second Hip Fractures = 1017

	Risk Ratio	95% Confidence Limit
Age (in years)	1.033	1.023-1.044***
Nursing Home Resident (yes/no)	29.722	5.447-162.170***
Age / Nursing Home Resident Interaction (years*yes/no)	0.957	0.938-0.977***
Chronic Obstructive Lung Disease (yes/no)	1.277	1.018-1.602
Seizure Disorder (yes/no)	1.588	1.087-2.321
Alcohol Abuse (yes/no)	1.727	1.100-2.713
Length of Stay (in log days)	0.854	0.804-0.907***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise proportional hazards model significant variables. **Number of patients / Number of second hip fractures = 11,187 / 1,017. Explained variation by the model is very small but R^2_{max} can not be calculated with proportional hazards analysis.**

Late Effects of Hip Fracture Care

The diagnosis of a late effect of hip fracture care (Appendix 8) was used as a measure of poor hip fracture care. The diagnoses used are relatively specific adverse outcomes of hip fracture care. Proportional hazards analysis was used to account for the period of time the individual was available for follow up.

Table 19 shows the factors which predict a diagnosis of a late effect of hip fracture care. Older patients and patients who resided in a nursing home prior to admission were less likely to have a diagnosis of a late effect. Those patients who were residents of Westman and Parkland were less likely to have this diagnosis than Winnipeg residents.

Individuals admitted to hospital on Monday were less likely to suffer late effects compared to patients admitted on Saturday. All fracture types were significantly more likely to suffer a late effect than closed trochanteric fractures. Individuals who suffered from paralysis or congestive heart failure before their index admission were less likely to have a late effect diagnosis.

Individuals who received arthroplasties were less likely to be diagnosed with a late effect. Individuals with longer lengths of stay and those diagnosed in the early years of the study had a greater risk of a late effect diagnosis. Patients treated in Hospital C had more late effect diagnoses

Table 19

Diagnosis of Late Effect of Hip Fracture Care

N = 11,187
Numbers of Late Effect Diagnoses = 987

	Risk Ratio	95% Confidence Limit
Age (in years)	0.973	0.964-0.981***
Nursing Home Resident (yes/no)	0.770	0.636-0.931*
Region (Winnipeg)		*
Norman	0.683	0.406-1.147
Central	0.928	0.725-1.188
Eastman	1.027	0.774-1.363
Interlake	1.173	0.913-1.508
Westman	0.602	0.363-0.999
Parkland	0.576	0.407-0.815
Admission Day (Saturday)		*
Sunday	1.253	0.980-1.602
Monday	0.746	0.579-0.961
Tuesday	1.005	0.795-1.271
Wednesday	0.933	0.733-1.186
Thursday	1.015	0.801-1.284
Friday	1.053	0.833-1.330
Fracture Type (Closed Trochanteric)		***
Open	3.134	1.853-5.298
Closed Transcervical	2.862	2.460-3.330
Closed Subtrochanteric	1.535	1.087-2.168
Closed Unspecified	2.483	1.932-3.190
Paralysis (yes/no)	0.480	0.264-0.874
CHF (yes/no)	0.649	0.435-0.968
Log Length of Stay (log days)	1.201	1.134-1.271***

Repairs (Arthroplasty)		***
Open Reduction Internal Fixation	2.756	2.260-3.361
Other Repair	1.833	1.131-2.973
Closed Reduction Internal Fixation	3.009	2.341-3.867
Internal Fixation No Reduction	2.717	2.128-3.470
No Repair (yes/no)	0.851	0.412-1.759
Hospital Repair Frequency (<125 repairs)		*
Hospital A	1.210	0.625-2.341
Hospital B	1.375	0.847-2.233
Hospital C	2.105	1.300-3.409
Hospital D	1.465	0.883-2.430
Hospital E	1.270	0.764-2.112
125-1000 repairs	1.335	0.836-2.133
Surgical Frequency (<125 repairs)		***
> 125 repairs	0.970	0.596-1.580
25-124 repairs	1.597	0.966-2.641
Fiscal Year (in years)	0.968	0.950-0.986**
Diagnosis of Second Hip Fracture (yes/no)	1.614	1.365-1.907***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise proportional hazards model significant variables.
Number of patients / Number of late effect diagnoses = 11,187 / 987.

than patients treated in hospitals conducting less than 125 repairs. Finally, individuals with a diagnosis of a second hip fracture commonly had a late effect diagnosis.

Socioeconomic status and time to treatment were not found to be significantly associated with a diagnosis of a late effect of hip fracture care.

Treatment Decisions for Complications

Repeat Primary Repair Procedure

Appendix 5 shows the primary repair procedures used to generate the outcome variable. Proportional hazards analysis was used to account for the period of time the individual was available for follow up.

Table 20 shows the variables that were significantly associated with receiving a repeat primary repair procedure. Women and residents of nursing homes were more likely to have a repeat primary repair procedure. In addition, the type of fracture was a significant predictor of a second repair. Individuals who suffered an initial closed transcervical fractures were more likely to receive a repeat primary repair than patients who had a closed trochanteric fracture.

A long length of stay was associated with a repeat primary repair procedure. The type of initial repair procedure performed was also significantly associated with a repeat primary repair procedure. Individuals who received an

Table 20

Repeat Primary Repair Procedure

N = 11,187
Repeat Primary Repairs = 1461

	Risk Ratio	95% Confidence Limit
Sex (female)	1.270	1.115 - 1.447**
Nursing Home Resident (yes/no)	1.415	1.235 - 1.622***
Fracture Type (Closed Trochanteric)		***
Open	0.869	0.430 - 1.756
Closed Transcervical	1.509	1.331 - 1.710
Closed Subtrochanteric	1.101	0.814 - 1.488
Closed Unspecified	1.075	0.863 - 1.340
Log Length of Stay (in log days)	1.143	1.088 - 1.202***
Repairs (Arthroplasty)		***
Open Reduction Internal Fixation	1.450	1.233 - 1.706
Other Repair	3.481	2.513 - 4.822
Closed Reduction Internal Fixation	1.712	1.389 - 2.110
Internal Fixation No Reduction	1.328	1.089 - 1.620
No Repair (yes/no)	1.278	0.991 - 1.647
Fiscal Year (in years)	1.102	1.083 - 1.121***
Diagnosis of Second Hip Fracture (yes/no)	13.424	12.039 - 14.969***

Diagnosis of Late Effect (yes/no)	4.467	3.987 - 5.004***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise proportional hazards model significant variables. **Number of patients / Number of repeat primary repairs = 11,187 / 1461.**

arthroplasty as their initial repair procedure were less likely to have another primary repair. Individuals who had other repairs had a very high risk of a subsequent primary repair procedures. A repair procedure in the later part of the study also increased the likelihood of a repeat primary repair procedure. A diagnosis of a second hip fracture or a diagnosis of a late effect significantly increased the probability of a repeat primary repair.

Socioeconomic status and time to treatment were not significantly associated with a repeat primary repair procedure.

Secondary Repair

Appendix 7 shows the secondary repair diagnoses used to generate the outcome variable. Proportional hazards analysis was used to account for the period of time the individual was available for follow up. Table 21 shows the variables that were significantly associated with receiving a secondary repair procedure.

Female patients and patients who were older at the time of first fracture were less likely to receive a secondary repair procedure. Fracture type was also predictive of a secondary repair. Closed transcervical fractures and unspecified fractures had significantly more secondary repairs than those patients with closed trochanteric fractures.

A comorbidity diagnosis of a pathological fracture significantly reduced the likelihood of receiving a secondary repair procedure. However, comorbidity diagnosis of liver disease or osteoarthritis significantly increased the likelihood of a secondary repair.

Individuals who stayed longer in hospital on their initial episode of care and those treated in the later years of the study were more likely to receive a secondary repair. The type of repair procedure was also predictive of a secondary repair. Individuals who received an arthroplasty procedure and those who did not receive a repair procedure were less likely to receive a secondary repair. Individuals admitted to Hospital C were less likely to have a secondary repair in comparison to most of the other hospitals. A diagnosis of a second hip fracture or a diagnosis of a late effect over the investigation period significantly increased the probability of a secondary repair.

Time to treatment and socioeconomic status were not a significant predictors of a secondary repair.

Table 21

Secondary Repair Procedures

N = 11,187
Number of Secondary Repairs = 955

	Risk Ratio	95% Confidence Limit
Age (in years)	0.987	0.979 - 0.996*
Sex (male)	0.822	0.707 - 0.955
Fracture Type (Closed Trochanteric)		***
Open	0.950	0.503 - 1.794
Closed Transcervical	1.715	1.462 - 2.012
Closed Subtrochanteric	0.828	0.570 - 1.201
Closed Unspecified	1.587	1.214 - 2.074
Liver Disease (yes/no)	2.358	1.044 - 5.328
Pathological Fracture (yes/no)	0.118	0.016 - 0.840
Osteoarthritis (yes/no)	1.539	1.078 - 2.198
Log Length of Stay (in log days)	1.138	1.073 - 1.206***
Repairs (Arthroplasty)		***
Open Reduction Internal Fixation	2.533	2.039 - 3.147
Other Repair	1.430	0.855 - 2.391
Closed Reduction Internal Fixation	2.517	1.948 - 3.251
Internal Fixation No Reduction	1.916	1.479 - 2.481

No Repair (yes/no)	0.392	0.171 - 0.899
Hospital Repair Frequency (Hospital C)		*
Hospital A	1.552	1.213 - 1.986
Hospital B	1.295	1.025 - 1.637
Hospital D	1.595	1.247 - 2.041
Hospital E	1.455	1.126 - 1.881
125- 1000 repairs	1.401	1.150 - 1.708
< 125 repairs	1.047	0.674 - 1.626
Fiscal Year (in years)	1.038	1.018 - 1.059**
Diagnosis of Second Hip Fracture (yes/no)	1.299	1.102 - 1.532*
Diagnosis of Late Effect (yes/no)	32.717	27.996 - 38.234***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise proportional hazards model significant variables. **Number of patients / Number of secondary repairs = 11,187 / 1461.**

General Measures of Complications

Measures of survival, admission to nursing home and readmission within the first year after the index hip fracture are general indicators of adverse outcomes. These outcome indicators are easy to measure but may be influenced by many variables, including the care decisions made in treating the hip fracture and its complications. Therefore, these variables were included in the models in this section.

Death Within Three Months

The variables which were significantly associated with mortality within three months following admission for hip fracture are shown in Table 22. The length of stay variable was not used in this analysis because all individuals with early mortality will have a short length of stay.

The demographic variables significantly associated with early hip fracture mortality were increasing age, male sex and residence in a nursing home. Season of hip fracture was also a significant predictor of mortality. Individuals admitted in the spring appeared to survive longer than individuals admitted in the fall.

Both the fracture type and the location of the fracture were significant fracture characteristics associated with early mortality. Compared to individuals who suffered closed trochanteric fractures, patients with closed transcervical fractures were less likely to die within three months of admission. Patients who suffered their fracture at home, in hospital or were not known to have had an accident associated with their fracture were more likely to die within three months than individuals who suffered fractures in other environments.

The presence of cancer, either metastatic or other cancer, was significantly associated with death. Renal disease, mild to moderate diabetes, COPD, peripheral vascular

Table 22

Mortality within Three Months+

N = 10,913
Number of Deaths within Three Months = 1701

	Odds Ratio	95% Confidence Limit
Age (in years)	1.058	1.049-1.066***
Sex (female)	0.517	0.457-0.584***
Nursing Home Resident (yes/no)	1.841	1.617-2.095***
Season (Fall)		
Winter	1.021	0.873-1.193
Spring	0.806	0.685-0.947
Summer	0.926	0.791-1.084
Fracture Type (Closed Trochanteric)		*
Open	1.617	0.988-2.648
Closed Transcervical	0.814	0.717-0.923
Closed Subtrochanteric	0.797	0.558-1.138
Closed Unspecified	1.006	0.809-1.249
Accident Location (Other Specific Accident)		***
Home	1.478	1.245-1.754
Hospital	1.955	1.542-2.480
No Known Accident	1.614	1.074-2.427
Metastatic (yes/no)	3.817	2.752-5.293***
Other Cancer (yes/no)	1.869	1.466-2.382***
Renal Disease (yes/no)	3.213	2.346-4.401***
Paralysis (yes/no)	0.506	0.302-0.848*
Mild to Moderate Diabetes (yes/no)	1.242	1.003-1.537
COPD (yes/no)	1.750	1.470-2.084***

Peripheral Vascular Disease (yes/no)	1.432	1.093-1.876*
Liver Disease (yes/no)	3.895	2.001-7.584***
CHF (yes/no)	1.626	1.314-2.011***
Malnutrition (yes/no)	1.705	1.100-2.643
Admitting Hospital Type (Teaching)		*
Urban Hospital	0.786	0.598-1.033
Major Rural Hospital	0.786	0.599-1.032
Intermediate Rural Hospital	0.933	0.635-1.372
Small Rural Hospital	0.910	0.647-1.281
Out of Province Hospital	0.350	0.160-0.766
Other Hospitals	0.359	0.193-0.666
No Repair (yes/no)	2.750	1.735-4.360***
Fiscal Year No Repair Interaction (years* yes/no)	1.043	1.002-1.085
Hospital Repair Frequency (Hospital C)		
Hospital A	1.513	1.077-2.125
Hospital B	1.311	1.023-1.680
Hospital D	1.396	0.976-1.997
Hospital E	1.490	1.036-2.143
125-1000 repairs	1.716	1.248-2.361
< 125 repairs	1.984	1.220-3.226
Transfer without Admission (yes/no)	2.259	1.698-3.004***
Fiscal Year (in years)	0.980	0.963-0.998
Scheduled Admission (yes/no)	0.629	0.434-0.910
Second Fracture Diagnosis (yes/no)	0.082	0.040-0.168***

Secondary Repair (yes/no)	0.262	0.162-0.425***
Primary Repair (yes/no)	0.568	0.372-0.867*

*** p < 0.0001
** p < 0.001
* p < 0.01

Stepwise logistic regression model significant variables. **Number of patients/Number of who died within 3 months of admission = 10,913/1,701. Goodness of fit statistic = 8.4 with 8 df (p =0.3916). NagelKerke's proportion of explained variation by the model R^2_{max} = 0.2389.**
+ Does not include the log length of stay variable

disease, congestive heart failure and liver disease were also correlated with mortality. Overall, nine of the thirteen Charlson diagnoses used to generate the Charlson index variable were significantly associated with increased mortality among hip fracture patients. However, patients with paralysis were significantly less likely to die within three months than most patients with hip fractures. Only one additional comorbid condition was found to be associated with mortality after hip fracture - diagnosis of nutritional insufficiency.

With regard to the delivery of care variables, admitting hospital was found to be significantly associated with early mortality. Patients initially admitted to hospitals outside of Manitoba or to other specific hospitals in Manitoba appeared to have a better short term survival rates than patients treated in Manitoba's teaching hospitals. Patients with repair procedures conducted in every major Manitoba hospital except Hospital D had a higher short term mortality rate than patients treated in Hospital C. Hospital C also had a significantly reduced short term mortality as compared to patients who received repairs in hospitals which conducted 1000 repairs or less during the study period.

Patients who did not have a repair procedure were significantly more likely to die within three months of admission. Early mortality in patients without a repair procedure was more likely in the later years of the study. However, in general admission for a hip fracture in the early years of the study was more likely to result in early mortality.

Patients transferred to another hospital without admission were more likely to die within three months than patients who were not. Patients with a scheduled admission were less likely to die.

Individuals diagnosed with a second hip fracture after their index episode of care were significantly less likely to have died within three months after their initial fracture. This was also true for individuals with a repeat primary repair or a secondary repair.

Socioeconomic status was not found to be a significant predictor of early mortality. The time to treatment variable approached statistical significance.

Death between Three Months and One Year

The variables associated with death between three months and one year after initial hip fracture repair are shown in Table 23. Individuals who died before three months were excluded from the analysis.

The demographic variables which were significantly associated with hip fracture mortality were increasing age, male sex and residence in a nursing home. Season of the hip fracture was also a significant predictor of mortality. Individuals admitted in the spring were more likely to die three months to one year after their initial hip fracture admission than those admitted in the fall.

The location of the fracture was the only fracture characteristic significantly associated with mortality between three months and one year after fracture admission. Individuals with accidents occurring in hospital or at home or who did not have a known accident appeared to be associated with increased mortality compared to those who had other types of accidents.

Table 23

Mortality between Three Months and One Year
(Excludes Patients who died before three months after their initial admission)

N = 8619
Number of Deaths between Three Months and One year = 1103

	Odds Ratio	95% Confidence Limit
Age (in years)	1.043	1.033-1.053***
Sex (female)	0.560	0.483-0.651***
Nursing Home Resident (yes/no)	1.587	1.360-1.852***
Season (Fall)		
Winter	0.916	0.752-1.116
Spring	1.221	1.012-1.474
Summer	1.113	0.919-1.348
Accident Location (Other Specific Accident)		***
Home	1.559	1.271-1.913
Hospital	3.949	3.022-5.160
No Known Accident	1.525	0.968-2.402
Metastatic (yes/no)	12.565	8.384-18.830***
Other Cancer (yes/no)	2.237	1.673-2.990***
Severe Diabetes (yes/no)	2.652	1.806-3.894***
Renal Disease (yes/no)	2.126	1.368-3.304**
Mild Diabetes (yes/no)	1.436	1.120-1.840*
COPD (yes/no)	1.764	1.424-2.186***
Peripheral Vascular Disease (yes/no)	1.760	1.285-2.411**
CHF (yes/no)	1.792	1.381-2.326***
Blindness (yes/no)	0.681	0.497-0.935
Seizure Disorder (yes/no)	1.625	1.101-2.400

Repair Type (Arthroplasty)		
Open Reduction Internal Fixation	1.175	0.696-1.983
Other Repair	4.384	1.120-17.161
Closed Reduction Internal Fixation	0.691	0.319-1.496
Internal Fixation No Reduction	0.513	0.247-1.068
No Repair (yes/no)	1.321	0.659-2.647
Fiscal Year / Repair Interaction (Fiscal Year/ Arthroplasty)		
Fiscal Year/ Open Red. Int. Fix. Interaction	1.011	0.955-1.070
Fiscal Year/ Other Repair Interaction	0.916	0.791-1.062
Fiscal Year/ Cl. Red. Int. Fix. Interaction	1.081	0.995-1.174
Fiscal Year/ Int. Fix. No Red. Interaction	1.100	1.020-1.186
Fiscal Year/ No Repair Interaction (years* yes/no)	1.048	0.972-1.130
Fiscal Year (in years)	0.969	0.922-1.018
Scheduled Admission (yes/no)	0.649	0.452-0.931
Second Hip Fracture Diagnosis (yes/no)	0.261	0.183-0.372***
Secondary Repair (yes/no)	0.518	0.378-0.710***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise logistic regression model significant variables. **Number of patients/Number of who died between 3 months and one year of admission = 8,619/1,103. Goodness of fit statistic = 20.5 with 8 df (p =0.0085). NagelKerke's proportion of explained variation by the model R^2_{max} = 0.1797.**

The presence of cancer, either metastatic or otherwise, was significantly associated with death. Both severe and mild diabetes, renal disease, COPD, peripheral vascular disease and congestive heart failure also correlated with mortality. Overall, nine of the thirteen Charlson diagnoses used to generate the Charlson index variable were significantly associated with increased three month to one year mortality among hip fracture patients.

Of the additional comorbid disorders, seizure disorders were found to be significantly associated with increased long term mortality after a hip fracture. The diagnosis of blindness on hip fracture admission was associated with a reduced long term mortality rate compared to other individuals who suffered a hip fracture.

Among the treatment variables, hip fracture repair type was significantly associated with long term mortality as was the repair type fiscal year interaction. Individuals who received an uncommon specific repair or a unspecified repair were more likely to die than individuals who received an arthroplasty. In addition, individuals who received an internal fixation with no reduction in the later years of the study were also more likely to die than those individuals who received an arthroplasty.

Individuals who were diagnosed with a second hip fracture outside their index admission or a secondary repair procedure were significantly less likely to die between three months and one year after their initial hip fracture admission.[2] The model fit, using the Goodness of Fit statistic, was not good. This will be discussed further in the discussion. Socioeconomic status was not found to be a significant predictor of mortality within one year and the time to treatment variable approached statistical significance.

Readmission Within One Year

The variables associated with readmission within one year after initial hip fracture repair are shown in Table 24. Individuals discharge after March 31, 1992 were excluded from the analysis due to incomplete follow up time.

The demographic variables significantly associated with readmission within one year after discharge from the hip fracture episode of care were sex, residence in a nursing home and region of residence. Females and residents of

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[2] When the analysis was repeated without late effects, repeat fracture diagnosis, primary and secondary repair variables, no additional variables were found to be predictive of survival.

nursing homes were less likely to be readmitted. Residence in any region except Winnipeg significantly increased the likelihood of readmission.

Table 24

Readmission within One Year

N = 10,213
Number of Readmissions = 4504

	Odds Ratio	95% Confidence Limit
Sex (male)	0.826	0.747-0.912***
Nursing Home Resident (yes/no)	0.883	0.789-0.989
Region of Residence (Winnipeg)		***
Norman	3.865	2.725-5.483
Central	2.157	1.766-2.635
Eastman	2.382	1.920-2.956
Interlake	2.513	2.064-3.060
Westman	1.923	1.473-2.509
Parkland	2.250	1.770-2.861
Accident Location (Other Specific Accident)		***
Home	1.051	0.941-1.175
Hospital	0.577	0.475-0.701
No Known Accident	0.933	0.682-1.277
Previous Admission (yes/no)	1.541	1.398-1.698***
Other Cancer (yes/no)	1.321	1.057-1.650
Severe Diabetes (yes/no)	1.567	1.140-2.153*
Renal Disease (yes/no)	0.711	0.515-0.983
Mild to Moderate Diabetes (yes/no)	1.222	1.030-1.450
Dementia (yes/no)	0.788	0.680-0.912*

Congestive Heart Failure (yes/no)	1.277	1.033-1.578
Arrhythmias (yes/no)	1.317	1.013-1.713
Log Length of Stay (in log days)	1.347	1.289-1.408***
Transfer before repair (yes/no)	2.339	1.851-2.956***
Admitting Hospital (Teaching Hospital)		***
Other	1.756	1.088-2.835
Urban	0.955	0.790-1.154
Major Rural	0.709	0.554-0.908
Intermediate Rural	0.999	0.700-1.425
Small Rural	1.219	0.880-1.687
Out of Province	2.814	1.584-5.000
Hospital Repair Frequency (Hospital C)		*
Hospital A	1.200	0.911-1.580
Hospital B	1.264	1.078-1.482
Hospital D	1.280	1.040-1.575
Hospital E	1.053	0.849-1.306
125-1000 repairs	1.142	0.961-1.356
< 125 repairs	0.657	0.464-0.929
Transfer without Admission (yes/no)	0.478	0.374-0.610***
Fiscal Year (in years)	1.029	1.015-1.042***
Scheduled Admission (yes/no)	1.342	1.021-1.763
Second Hip Fracture Diagnosis (yes/no)	1.693	1.392-2.060***
Late Effect Diagnosis (yes/no)	2.449	2.076-2.889***
Repeat Primary Repair (yes/no)	1.293	1.081-1.546*
Death within 3 months (yes/no)	0.636	0.553-0.732***

Death between 3 months and 1 year (yes/no)	2.274	1.968-2.627***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise logistic regression model significant variables. **Number of patients/Number of readmissions within one year = 10,213/4,504. Goodness of fit statistic = 88.7 with 8 df (p = 0.0001). NagelKerke's proportion of explained variation by the model $R^2_{max} = 0.2267$.**

The location of the accident was the only fracture characteristic significantly associated with readmission. Patients whose accident occurred in hospital are less likely to be readmitted compared to patients with other specified accidents.

Individuals with an admission within the year prior to their hip fracture were more likely to be readmitted after their hip fracture episode of care. Individuals with cancer, severe or mild diabetes and congestive heart failure as comorbidities were significantly more likely to be readmitted. However, individuals with renal disease and dementia were less likely to be readmitted. Of the additional comorbid disorders, arrhythmias were found to be significantly associated with readmission after a hip fracture.

With regard to the delivery of care variables, individuals who were transferred without admission before their initial admission for hip fracture care were significantly less likely to be readmitted. However, individuals who were admitted and then transferred for repair were significantly more likely to be readmitted after their index episode of care.

Admitting hospital was significantly associated with readmission. Individuals admitted to facilities other than the facilities already listed in Table 24 and patients admitted to out of province hospitals were significantly more likely to be readmitted within one year than individuals treated in teaching hospitals. Individuals initially admitted to major rural hospitals were less likely to be readmitted than individuals who were treated in a teaching hospital.

Individuals who received their repair in Hospital B and Hospital D were more likely to be readmitted to hospital than patients who had their repair in Hospital C. Individuals who had their repair in hospitals which conducted less than 125 repairs were less likely to be readmitted.

Individuals who received their repairs in the latter part of the study were more likely to be readmitted as were patients with a scheduled admission for their initial hip fracture admission. Individuals who had a long length of stay on their index episode of care were more likely to be readmitted within one year.

The diagnosis of a second hip fracture or a late effect of a hip fracture were significantly associated with a readmission. Individuals who had a repeat primary repair were more likely to have been readmitted.

Individuals who died within three months of their initial hip fracture admission were less likely to have been readmitted, but those who died within three months and one year after their initial hip fracture were significantly more likely to have been readmitted.

Socioeconomic status and time to treatment were not found to be predictive of repeat admission. However, time to treatment approached statistical significance. The model fit, using the Goodness of Fit statistic, was not good. This will be discussed further in the discussion.

Nursing Home Admission

The variables significantly associated with admission to nursing home within one year of discharge from hip fracture episode of care are shown in Table 25. The analysis does not include subjects discharged from their index episode of care less than one year before the study ended. All subjects residing in a nursing home prior to index hip fracture admission or noted to be transferred from a nursing home on initial admission were also excluded.

The demographic variables significantly associated with admission to nursing home after hip fracture were increasing age, region of residence and residence in a rural area. Residents of the Interlake region were more likely to be admitted to nursing home than residents in Winnipeg. On the other hand, residents of Parkland region and Norman region were significantly less likely to go to a nursing home. The accident location associated with the hip fracture was also a significant predictor of nursing home admission. Individuals whose accident occurred at home or in hospital were more likely to be admitted to a nursing home than individuals whose fracture occurred in other specified locations.

The Charlson Index diagnoses significantly associated with nursing home admission were dementia and cerebral vascular disease. Parkinson's disease and alcohol abuse were also significantly associated with nursing home admission. However, peripheral vascular disease was inversely associated the nursing home admission.

With regard to the delivery of care variables, admitting hospital was significantly associated with placement in a nursing home. Individuals initially admitted to an urban hospital or a small rural hospital were more likely to be admitted to a nursing home than individuals treated in a teaching hospital. Individuals treated out of province were significantly less likely to be admitted to a nursing home.

The interaction between fiscal year and repair type was significant. In comparison to those patients who received arthroplasty, those patients with an open reduction and internal fixation, a closed reduction and internal fixation and an internal reduction without reduction were more likely to be admitted to a nursing home in the later years of the study. Generally, individuals admitted earlier in the study were more likely to be admitted to nursing home within one year of discharge.

Repair day was also significantly associated with admission to nursing home. Individuals who had their repair on Thursday were more likely to be admitted to a nursing home than those patients who had their repair on Saturday.

Length of stay and repeat admission within one year were also significantly associated with nursing home admission. Death within one year of admission significantly reduced the likelihood of being admitted to a nursing home.

Time to treatment for a hip fracture was not significantly associated with nursing home admission. However, the socioeconomic status variable was significantly associated with nursing home admission. The model fit, using the Goodness of Fit statistic, was not good. This will be discussed further in the discussion.

Table 25

Nursing Home Admission Within One Year of Hip Fracture Separation

N=7144
Number of Nursing Home Admissions = 1213

	Odds Ratio	Confidence Limits
Age (in years)	1.059	1.047-1.072***
Residence Region (Winnipeg)		**
Norman	0.472	0.233-0.955
Central	0.911	0.631-1.316
Eastman	0.877	0.588-1.306
Interlake	1.647	1.134-2.391
Westman	1.056	0.811-1.374
Parkland	0.578	0.375-0.892
Rural Residence (yes/no)	1.790	1.453-2.206***
Accident Location (Other Specific Accident)		*
Home	1.412	1.138-1.751
Hospital	1.760	1.298-2.387
No Known Accident	1.544	0.896-2.659
Dementia (yes/no)	3.611	2.730-4.776***
Cerebral Vascular Disease (yes/no)	2.533	1.874-3.424***
Peripheral Vascular Disease (yes/no)	0.569	0.360-0.899
Parkinson's Disease (yes/no)	1.644	1.168-2.312*
Alcoholism (yes/no)	1.870	1.054-3.318
Admitting Hospital (Teaching Hospital)		***
Urban	1.235	1.009-1.512
Major Rural	1.424	0.980-2.070
Intermediate Rural	1.412	0.856-2.329
Small Rural	1.750	1.132-2.706
Out of Province	0.131	0.033-0.519
Other	0.372	0.205-0.675

Repair Type (Arthroplasty)		
Open Reduction Internal Fixation	0.453	0.260-0.789
Other Repair	1.188	0.175-8.049
Closed Reduction Internal Fixation	0.322	0.133-0.777
Internal Fixation No Reduction	0.341	0.157-0.742
No Repair (yes/no)	0.681	0.275-1.684
Fiscal Year/ No Repair Interaction (years/no repair)	1.064	0.964-1.175
Fiscal Year / Repair Interaction (years / Arthroplasty)		
Fiscal Year/ Open Red. Int. Fix. Interaction	1.074	1.010-1.141
Fiscal Year/ Other Repair Interaction	0.993	0.815-1.208
Fiscal Year/ Cl. Red. Int. Fix. Interaction	1.144	1.039-1.259
Fiscal Year/ Int. Fix. No Red. Interaction	1.104	1.017-1.198
Fiscal Year (in years)	0.936	0.889-0.985*
Repair Day (Saturday)		*
Sunday	0.861	0.610-1.215
Monday	0.842	0.601-1.180
Tuesday	1.154	0.843-1.578
Wednesday	1.236	0.917-1.665
Thursday	1.490	1.100-2.019
Friday	1.178	0.876-1.585
Log Length of Stay (log days)	3.326	3.041-3.638***

Readmission (yes/no)	1.220	1.036-1.436
Death within 3 months (yes/no)	0.035	0.013-0.095***
Death between 3 months and 1 Year (yes/no)	0.113	0.081-0.157***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise logistic regression model significant variables. **Number of patients/Number of nursing home admissions within one year = 7144/1213. Goodness of fit statistic = 114.8 with 8 df (p = 0.0001). NagelKerke's proportion of explained variation by the model R^2_{max} = 0.2998.**

Urban Residents

Table 26 shows an analysis of only urban residents. This analysis was performed to utilize the socioeconomic status variable which is valid for urban residents only. Residence in an area of low income was a significant predictor of nursing home admission in urban areas.

Most of the variables significant for all Manitoba residents were also significant for urban residents alone. In addition to the Charlson variables significant in the previous model, the diagnosis of metastatic cancer was found to reduce the likelihood of admission to a nursing home. For the other comorbidity variables, Parkinson's disease was not associated with nursing home admission in this model but the diagnosis of a pathological fracture was found to reduce the risk of nursing home admission.

With regard to the delivery of care variables, fiscal year / repair type interaction, day of repair and treatment at Hospital C were no longer significant in this model. However, a scheduled admission was significantly associated with nursing home admission.

Table 26

Nursing Home Admission Within One Year of Hip Fracture Separation: Urban Residents

N=5588
Number of Nursing Home Admissions = 851

	Odds Ratio	Confidence Limits
Age (in years)	1.054	1.040-1.068***
Socioeconomic Status (1=low income)	0.962	0.928-0.998
Residence Region (Winnipeg)		*
Thompson	1.092	0.460-2.593
Central	1.452	0.876-2.407
Eastman	1.200	0.688-2.093
Interlake	2.263	1.329-3.856
Westman	1.325	0.975-1.802
Parkland	0.647	0.347-1.205
Accident Location (Other Specific Accident)		*
Home	1.528	1.186-1.971
Hospital	1.654	1.148-2.382
No Known Accident	1.539	0.765-3.096
Metastatic Cancer (yes/no)	0.232	0.072-0.750
Dementia (yes/no)	3.113	2.265-4.280***

Cerebral Vascular Disease (yes/no)	2.254	1.545-3.288***
Peripheral Vascular Disease (yes/no)	0.546	0.314-0.951
Pathological Fracture (yes/no)	0.418	0.184-0.949
Alcoholism (yes/no)	1.917	1.017-3.612
Admitting Hospital (Teaching)		***
Other	0.216	0.095-0.490
Urban	1.252	0.994-1.577
Major Rural	1.336	0.820-2.178
Intermediate Rural	1.456	0.807-2.624
Small Rural	3.228	1.709-6.097
Out of Province	0.271	0.067-1.099
Log Length of AStay (yes/no)	3.484	3.140-3.866***
Scheduled Admission (yes/no)	1.898	1.087-3.315
Diagnosis of a Late Effect of Hip Fracture Care (yes/no)	0.718	0.535-0.963
Readmission (yes/no)	1.347	1.113-1.631*
Death within 3 months (yes/no)	0.060	0.022-0.165***
Death between 3 months and 1 Year (yes/no)	0.110	0.073-0.165***

*** $p < 0.0001$
** $p < 0.001$
* $p < 0.01$

Stepwise logistic regression model significant variables. **Number of patients/Number of nursing home admissions within one year = 5588/851. Goodness of fit statistic = 59.66 with 8 df (p = 0.0001). NagelKerke's proportion of explained variation by the model R^2_{max} = 0.4770.**

Among urban residents, the diagnosis of a late effect of hip fracture care was significantly associated with admission to a nursing home within one year of admission for hip fracture care. The model fit, using the Goodness of Fit statistic, was not good. This will be discussed further in the discussion.

VI. Discussion

A. Significance

This study is the one of the first to utilize the Health Care Financing Administration Framework for Quality Assurance[31] to conduct quality assurance investigations on a population basis and to focus efforts to areas of greatest need. The study looks at the effectiveness of hip fracture care on a population basis and examines a more comprehensive set of outcomes of care than previously examined in the literature. Insight is provided into the various factors (patient characteristics, fracture characteristics, treatment provided or the delivery of care setting) which may influence these outcomes.

In addition, this study has provided a methodological basis for further studies measuring the impact of the medical care system on the health of the population. Indicators have also been developed to provide information on the factors which influence the quality of hip fracture care. These indicators identify aspects of hip fracture care which require improvement or further investigation; and provide much needed information on the effectiveness of hip fracture repairs.

B. Limitations

The indicators used in this study were based on a literature review of the various studies on hip fracture care and a basic understanding of the physiology of hip fractures.

The validity of the indicators depend, in part, on the accuracy of the data upon which the analysis was based. Since the administrative data used in this study was collected for the purpose of payment of physicians and hospitals and not for quality assurance analysis, omissions in data and inaccuracies will have implications for the results of this study. This would be particularly true if different institutions or specific types of patients were consistently coded differently. Random misclassifications would tend to reduce the ability of the study to detect a significant relationship if it was present, but systematic biases could result in misleading conclusions.

The validity of the indicator is also a reflection of how well it measures the factors which influence hip fracture outcomes. This will be discussed in the next section.

Additional indicators, such as pre fracture functional status, the availability of a support person, the amount of blood loss, the delay from the time of fracture to the time of admission, etc., may be associated with hip fracture outcomes. However, data on these factors were not available for the study population. Chart reviews and other sources of data should be used to identify additional indicators which may explain the significant associations found in this study or provide additional explanatory power to the models.

In addition, not all of the complications of hip fracture care potentially measurable by MHIS data were included in this study. Only diagnoses indicating outcomes specific to hip fracture care were investigated. Several researchers have created diagnostic codes which could be used to study complications within a hospital admission.[158,159] These codes were not used in this study because they have not been validated. If certain hospitals code more complications than other hospitals, their outcomes would look worse in comparison. A future study linking MHIS diagnostic codes for complications with chart review data would be beneficial.

Outcomes, such as mortality, readmission, revision of a hip fracture repair, increased length of stay and nursing home admission can serve as overall indications of lower quality care and will likely show less variation in coding. The serious individual complications, for example, pulmonary embolus, wound infections, etc. will likely be reflected by one of these longer term outcomes. Once areas of decreased quality are determined, studies with a narrower focus, such as a case-control study comparing regions with high and low nursing home admission, could identify the causes of the poor outcomes.

Many variables were tested in these models, the more tests, the greater the possibility of a Type 1 error. In other words, rejecting the null hypothesis when it is in fact true.[160] One method of preventing Type 1 errors is to raise the level of significance required to reject the null hypothesis. However, this decreases the power of the study.

In this study, $p < 0.05$ was used the cut off level but the levels of significance are indicated in the tables for reference. Some Type 1 errors may have been committed using this strategy. On the other hand, important relationships may have been recognized. In the next section, findings which are inconsistent with the literature or do not have face validity are highlighted. Since this study was hypothesis generating and attempted to identify factors that contribute to adverse outcomes in Manitoba to provide focus for further research, more inclusive significance criteria were used.

C. Implications of the Findings

Evaluation of the Indicators

Critical to the interpretation of the results of this study is an evaluation of the validity of the indicators. The indicators used in this study were classified into four categories: patient characteristics; treatment options; delivery of care variables and indicators of adverse outcomes. Each category provides useful information about the factors which contribute to the outcomes of hip fracture care. The following discussion will examine each indicator and its contribution to adverse outcomes, review the results of its use in previous studies and provide an interpretation of the findings in this study. The impact of the indicator on all outcome variables will be examined simultaneously to provide a more comprehensive picture of its impact.

Patient Characteristics

Demographic Variables

Age

Like other studies,[6,9,10] the incidence of hip fractures increased with age. This is consistent with the assumption that osteoporosis and frailty increase with age.[1] This study shows that hip fractures increase with age until the very oldest age groups, then the rate declines. Most studies have not looked separately at individuals over 100 years.[4,6,10] Due to the small numbers of individuals involved, the rates may not be stable. However, Jacobson et al. (1990) studied the hip fracture population in the U.S. and found a drop in the rate of hip fracture for white women over 95 years of age.[35] The authors suggested that it may represent a non sampling error or a survival bias. A competing hypothesis could be that these patients are less likely to be ambulatory and have less opportunity to fracture their hips.

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[1] See Pages 16 to 24

The comparison of physician claims and hospital records in the nursing home population in this study revealed that about one percent of the hip fractures could have been missed by our analysis. Theoretically, palliation and lack of hospital admission is more likely to occur in the oldest, most frail patients who fracture their hips. Lyon and Nevis (1984) found that in debilitated patients managed without surgery, survival is longer with fewer complications than in patients managed with surgery.[161] Further investigation of nursing home and community dwelling patients with a physician claim of a hip fracture diagnosis and no hospital admission is required to answer this question.

The influence of age on the incidence of hip fractures was found to be reduced in nursing homes in Manitoba. This finding may be explained in part by the work of Shapiro and Tate (1993).[126] They found that over time the level of care and the age of individuals in nursing homes have increased. They also noted that patients in nursing homes with higher levels of care were significantly less likely to fracture their hip. Respite admissions, who are more commonly level 2, may have an increased rate of fracture.[2] Baudoin et al. (1996) also found that the impact of age was reduced in patients who depended on a collective service versus patients who lived independently.[162]

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[2] Manitoba Health - Connie Sawchuk - impression of respite hip fracture levels in Winnipeg January 7, 1994.

With regard to the impact of age on the various outcome variables, it was found that increasing age was more commonly associated with a stay in hospital of over 100 days and increased mortality. These finding make intuitive sense because elderly patients are usually more frail and have more comorbidities. Baudoin et al. (1996) found, in general, elderly patients had more pressure sores and urinary tract infections and elderly patients admitted from home had more pulmonary infections after suffering a hip fracture.[163] Craik (1994) suggested that older patients appear to require a longer time to recover from their hip fracture. More intensive rehabilitation and a longer period of rehabilitation appeared to yeild a better recovery.[79]

Increasing age was also significantly associated with the risk of a second hip fracture. However, elderly nursing home residents were significantly less likely to have a second hip fracture diagnosis. This finding was consistent with the work of Shapiro and Tate (1993).[126] Baudoin et al. (1996) did not find a relationship between a second hip fractures and age.[162]

Elderly individuals were significantly less likely to have a diagnosis of a late effect of hip fracture care and to receive a secondary repair. This trend may relate to the reduced survival rate of elderly individuals or a bias against making the diagnosis of a late effect of hip fracture care or doing secondary repair surgery in the elderly.

Age was not a significant predictor of a repeat primary repair. The increased rate of second hip fractures may have offset the trend displayed with the secondary repair procedures. The performance of secondary repair procedures may be more discretionary. In a prospective study, Baudoin et al. (1996) found no difference in surgical or orthopaedic complications or thromboembolism with increasing age.[162]

Age was not predictive of readmission but it was significantly associated with nursing home admission. A possible explanation for this trend would be that only the most functional of the elderly patients are returned to the community.

Sex

About three quarters (72.5%) of the hip fractures over age 65 years were suffered by women. Jacobson et al. (1990) found that women made up 79 percent of the fractures in individuals 65 years and over registered with either the Health Care Financing Adminstration or the Department of Veterans Affairs in the United States.[35] Anderson et al. (1993) also found that women made up 79 percent of the hip fractures in a county in England.[163]

In relation to the outcome measures, in most cases, males tended to have more adverse outcomes than females. Males stayed in hospital longer, had significantly higher mortality within the first year of the fracture and were more likely to be readmitted within that year. Baudoin et al. (1996) in a prospective outcome study of hip fracture patients also found males to have a higher mortality rate than females.[162] In their study, men also had more pulmonary infections, surgical complications and pressure sores, but women had more urinary tract infections and thromboembolisms. Poor et al. (1995) in their study of the determinants of reduced survival following a hip fracture in men found that the excess mortality could be explained best by interaction of the fracgure with serious underlying medical conditions.[164]

Sex did not influence the risk of a second hip fracture, the diagnosis of a late effect of hip fracture care, or nursing home admission.

With regard to repeat primary and secondary repair procedures, the results showed that females had significantly more repeat primary repairs while males had more secondary repair procedures. Since there was no difference in the drivers of additional repairs (second hip fractures and late effect diagnoses) between the sexes, these findings suggest that the choice of procedure may be discretionary or relate to inherent differences between the kinds of complications experienced by males and females which warrant different kinds of repairs. Both the repeat primary procedure model and the secondary procedure model controlled for fracture type and the type of initial repair procedure.

Nursing Home Resident Prior to First Hip Fracture

About one third of the hip fracture cases (29%) resided in a nursing home prior to their initial hip fracture. DeCoster et al. (1993) showed that 13.3% of Manitoba population 75 years of age and over resided in a Nursing home.[165] They also showed that individuals 65 to 75 years of age utilized nursing homes at a much lower rate. Therefore, the hip fracture rate in nursing homes is increased to at least twice what would be expected if hip fractures were distributed evenly in the Manitoba population age 65 years and over.

In a case-control study in Australia, Cumming (1996) found the age and sex adjusted odds ratio for suffering a hip fracture while living in a nursing home compared to community dwelling was 2.7.[166] However, when a variety of comorbidity factors were controlled for, the difference in the rate of hip fractures between community and nursing home dwelling disappeared. Cognitive impairment was found to be the most important confounder.

Shapiro and Tate (1993) examined the rates of fractures in different nursing homes in Manitoba.[125] Residents of proprietary personal care homes were more likely to suffer falls and fractures. Level of care required to manage the resident was used as the indicator of disability. However, cognitive impairment was not included as a discrete variable.

Residence in a nursing home was extremely predictive of a second fracture. (RR=29.722) Nursing home residence was also extremely predictive of a very short length of stay in hospital. Nursing home residents were discharged 13.9 times faster than non-nursing home residents. These findings suggest that the short length of stay may be contributing to the increased number of second hip fractures. It is common practise to hold the individual's nursing home bed for two weeks before it is given away to another client. Thus, there is extreme pressure to return the patient to the nursing home within two weeks. Further study of quality of patient care, rehabilitation, etc., received by the resident on return to nursing home is required.

In keeping with the increased number of second hip fractures, nursing home residents receive more repeat primary repairs. Nursing home residence is not predictive of a secondary repair, but it reduces the likelihood of a diagnosis of late effects of hip fracture care.

Nursing home residents are more likely to die within one year of admission after a hip fracture. However, after controlling for second hip fractures, early mortality, repeat primary repairs, the demographic, comorbidity and delivery of care variables, nursing home residents appear to be less likely to be readmitted within the next year. This may be related to regular medical and nursing attention received at the nursing homes or less aggressive treatment of disorders.

Baudoin et al. (1996) found significant increases in a number of adverse outcomes for patients who resided in a institutionalized setting compared to those who lived at home. Patients in a institution were more likely to have a hip fracture in the first place, more likely to die within two years, more likely to have pulmonary infections, surgical complications, pressure sores and urinary infections.[162]

Region of Residence

Although residents of Norman have the highest age adjusted rate of hip fractures, they do not appear to have more adverse outcomes than other regions. Parklands has the lowest age adjusted incidence of hip fractures, a significantly lower nursing home admission rate, and a significantly reduced rate of diagnosis of late effects of hip fracture care. Westman also has a low rate of late effect diagnosis and Norman has a lower rate of nursing home admission. On the other hand, Interlake residents have significantly more nursing home admissions. These findings may reflect the availability of nursing homes rather than differences in adverse outcomes.

After controlling for residents who resided in rural areas within each region, Winnipeg residents were found to spend significantly more time in hospital on their index episode of care than residents of any other region. However, residents of all other regions were significantly more likely to be readmitted within one year of discharge from their index episode of care. An examination of discharge planning practises in Winnipeg and in other areas of the province may prove instructive. Multidisciplinary geriatric teams exist in Winnipeg, but their presence in other areas of the province is limited. In addition, Tataryn et al. (1994) noted that there were more physicians per 1000 people in Winnipeg than elsewhere in the province.[167]

Region of residence was not predictive of second hip fracture, repeat primary repair, secondary repair or mortality within the first year after the index fracture.

Residence in a Rural Area

Examination of the observed distribution of index hip fractures compared to the expected distribution of hip fractures had they been randomly distributed in the 1986

Manitoba population revealed proportionately more hip fractures in individuals living in rural areas (107.2% versus 97.7%) than in urban areas. Ray et al. (1990) studied the Saskatchewan population and found that for all ages and for both sexes, the incidence of hip fractures in cities and towns was greater than that in villages and rural areas.[9] Villages had the lowest rate. The difference between the two studies are interesting. The Saskatchewan study did not identify how they classified their subjects in the residential classifications. This study used rural postal codes and the analysis did not include nursing home residents.

With regard to the outcome variables, rural residents stayed in hospital significantly longer than urban residents. Residence in a rural area was also a significant predictor of nursing home admission. These findings suggest that rural residence may impact on the ability to obtain home support or rehabilitation or that there are more nursing home beds available in rural areas. Rural residence was not predictive of any other outcome.

Socioeconomic Status

Socioeconomic status is associated with the incidence of many diseases and the relationship is usually graded.[168,169,170,171] This relationship was not seen with the variable used to measure socioeconomic status in this study. Since the relationship between socioeconomic status and hip fractures has not been investigated previously, it is difficult to determine if the lack of relationship is a true finding or relates measurement difficulties.

Although area of residence may be a useful measure of socioeconomic status with younger people, it may not reflect poverty in the elderly because many elderly stay in their house for years. An area which is depressed now may have been relatively affluent when they moved in.

In this study, the socioeconomic status variable was only significantly associated with nursing home admission. Residents in the more affluent urban neighbourhoods were less likely to be admitted to nursing home. Perhaps their homes are more suited to living with a disability and / or they have more resources for home support.

Characteristics of the Hip Fracture

Fracture Type

Closed Trochanteric Hip Fractures

The ratio of closed trochanteric fractures to closed transcervical fractures in this study was 1.25, with eight percent of the fracture diagnoses unspecified. Over time, the rate of ratio of trochanteric to transcervical fractures appeared to decline slightly. Rates in the literature range from 1.04 to 1.43.[172,173,174] A population based study of the U.S. Medical claims data for patients age 65 years and over showed a ratio of other hip fractures to femoral neck fractures (transcervical) of 1.01.[101] This ratio is substantially different than the ratio found in Manitoba.

A large U.S. study which examined the Hospital Discharge Data Base of the Maryland Health Services Cost Review Commission for 1979 through 1988 for individuals over 65 years of age found that for women the ratio of trochanteric to femoral neck (transcervical) fractures increased progressively with age.[172] The ratio for white women age 65 to 69 was 0.75 but the ratio was 1.47 for women over 90 years. Mautalen et al. (1996) suggests that the two types of fractures have different physiological processes.[176]

Two thirds of the closed trochanteric fractures were treated with an open reduction with internal fixation. The remaining third of the repairs were divided among closed reductions with internal fixation and no reduction and internal fixation. Almost no arthroplasties were performed (< 1%). Of the 176 patients who had a trochanteric fracture in a study of hip fractures in Adelaide Hospital, 99% received compression screw repair.[115] Population data from studies on the distribution of repair types for closed trochanteric hip fractures is not available for comparison.

With regard to the outcome variables, patients with closed trochanteric fractures were significantly less likely to receive a diagnoses of a late effect of hip fracture care than patients with any other fracture type. This finding makes intuitive sense because trochanteric fractures, unlike transcervical fractures, do not usually result in avascular necrosis, they are less likely than open fractures to suffer from infection and subtrochanteric fractures are notoriously difficult to manage.[177]

Open Hip Fractures

Open fractures were uncommon (1%). Just over half of these patients received an open reduction with internal fixation, but a quarter received other care. It was hypothesized that open fractures may have a higher mortality rate since they tend to be the result of more severe trauma and are often linked with other injuries and infection due to exposure of the bone. In this study, patients with open fractures were more likely to have a diagnosis of late effect of hip fracture care than patients with a diagnosis of a closed trochanteric fracture. Significant differences in outcomes were not found in the other regression models.

Closed Transcervical Hip Fractures

Almost half of the individuals with a transcervical hip fracture (45%) had an arthroplasty repair. Meanwhile, almost a third (28%) had an open reduction with an internal fixation. No information on the Garden Stage of these fractures was available. The frequency of impacted or undisplaced hip fractures have been reported in the literature at between 8 and 27 percent.[178] Lu-Yao et al. (1994) found that two thirds (64%) of the patients age 65 years and over with transcervical fractures in the U.S. medical claims data had an arthroplasty repair.[101]

Individuals with transcervical fractures left hospital significantly earlier than individuals with trochanteric fractures and were less likely to die within three months of their fracture. A reduced mortality for intracapsular fractures compared to extracapsular fractures was also found by Keene et al. (1993).[175] Lu-Yao et al. (1994), in a population based study of 5 percent of the U.S. Medicare claims data, also reported similar findings.[101] However, patients with transcervical fractures were more likely to receive a late effect diagnosis, a repeat primary repair or a secondary repair than individuals with a trochanteric fracture. Further analysis of this data could establish whether these findings are the result of survival bias or represent a true increase in complications.

Subtrochanteric Hip Fractures

About 3% of the hip fractures were subtrochanteric. A recent study by Michelson et al. (1995) found that 14% of the fractures were subtrochanteric.[179] However, the total sample size was only 169 patients. Clayer and Bauze (1989) found rates of 4%.[115]

Over three quarters of these fractures were treated by open reduction and internal fixation. Very little population based data on the distribution of repair types for subtrochanteric fractures exists for comparison. Patients with a subtrochanteric fracture stayed in hospital significantly longer than individuals with trochanteric fractures, but this relationship disappeared if the patient received a repair within the first 10 days of admission. In addition, subtrochanteric fractures were more likely to receive a diagnosis of late effect of hip fracture care than patients with a trochanteric fracture. These findings appear to reflect the increased difficulty in managing these types of fractures in comparison to trochanteric fractures. Subtrochanteric fractures did not appear to otherwise influence the outcomes.

Closed Unspecified Hip Fracture Diagnosis

These cases made up 3% of the total number of hip fractures in the study. These diagnoses may represent admission to investigate the presence of hip fracture, hip fractures that were treated conservatively, hip fractures sustained in association with other injuries, a fracture of a previously repaired hip, individuals receiving care for a previous fracture, improper hip fracture coding, etc.,. It should be noted that if one institution codes more unspecified fractures, the findings for this variable may reflect institution characteristics. However, admitting and repair hospitals were controlled for in this study.

About one quarter of the unspecified diagnoses received an open reduction and an internal fixation (24%) and about one quarter received an arthroplasty (22%). Over one third (38%) of the patients with this diagnosis did not receive one of the common hip fracture repair procedures.

Individuals with a diagnosis of a closed unspecified hip fracture were more likely to receive a secondary repair than individuals with trochanteric fractures. This finding suggests that the category of unspecified fractures may include more complicated fractures or that many of the fractures are actually transcervical fractures which show a higher secondary repair rate.

The hypothesis that miscoded transcervical fractures predominate in this category is also supported by the shorter length of stay. Those patients who received a repair within ten days of admission were discharged earlier than individuals with trochanteric fractures. However, this finding also supports the notion that these cases are being admitted for a planned secondary repair. A chart review of individuals who received this diagnosis would be instructive.

Other Trauma

Other trauma at the time of the fracture was hypothesized to have a negative impact on recovery. Additional trauma was associated with 8% of initial admissions for hip fractures. Two hip fracture diagnoses were noted on the initial admission of 1.6% of the subjects. Since right and left is not coded in the hospital abstracts, it is not possible to determine if these diagnoses represent bilateral hip fractures or a second hip fracture of the same hip during one admission.

The impact of this additional hip fracture was analyzed with the other trauma indicators as a dichotomous "other trauma" variable in the final models. It was associated with a significantly increased length of stay in hospital, but no other adverse outcomes.

"Possible early second hip fracture", measuring subsequent distinct hip fracture diagnoses over the remaining admissions in the index episode of care, was included in the final models. It was not associated with any adverse outcome. However, the number of cases involved were very small (N=60). On the other hand, some of these diagnoses may reflect an admission relating to the same fracture.

Accident Location

The assumption with this variable is that the accident location coded on admission to hospital is referring to the hip fracture. Only 7 of the patients had a missing code for this variable. Very little has been written in the literature regarding the use of the location of the fall as a predictor of the outcome of a hip fracture. It was hypothesized that patients suffering a fracture while in hospital would do substantially worse than those who enter hospital with a hip fracture as their main complaint.

Home

Two thirds of the accidents associated with hip fracture admissions occurred in the home. Gerber et al. (1993) also found that 67% of the hip fracture accidents occurred at home.[180] Compared to patients who suffered other specific accidents (farm accidents, traffic accidents and workplace accidents) and other unspecified accidents, home accident patients more commonly had hospital stays greater than 100 days. They were also more likely to die within one year of their hip fracture diagnosis or be admitted to a nursing home than patients who had other accident locations.

Since frailer elderly would likely spend more time at home than in other areas, it would make sense that their accident would occur at home. Individuals who have their accidents in other areas may be less frail since they are able to go to these areas. Cobey et al. (1976) found that a history of going outside the home was predictive of improved hip fracture outcomes at six months.[181]

Tinetti et al. (1996) evaluated the findings from the Multiple Risk Factor Reduction trial of the Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) which showed significant reductions in falls in the intervention group of community dwelling elderly.[182] The interventions included postural exercises, elevation of the head of the bed, medication review and adjustment, transfer training, environmental adjustments (eg. grab bars, raised toilet seats), gait training, balance and or strengthening exercises and resistence exercises. Similar interventions in the community dwelling elderly in Manitoba may reduce the number of falls in the home.

Hospital

About nine percent of the accidents associated with hip fracture admissions occurred in hospital. Patients suffering an accident in hospital had substantially longer length of stays than patients with any other accident location. This finding makes intuitive sense as the patients were likely in hospital for another reason prior to their hip fracture.

The mortality rate and the nursing home admission rate are also increased for patients who had an accident in hospital as compared to patients who had accidents in other locations, but these patients were less likely to be readmitted to hospital. The reduced readmission rate may relate to the reduced likelihood that these patients will return home to the community. These findings support the hypothesis that patients who fracture their hip in hospital have very poor outcomes. Every effort should be made to prevent hip fractures in hospitals, including identifying patients at high risk for falls, reducing the use of medications which cause central nervous system depression, ensuring the presence of appropriate lighting and hand rails, careful examination of circumstances where falls and fractures have occurred to reduce the risk of recurrences, etc,..

No Known Accident

Patients with no known accident make up about 4% of the hip fracture cases. It was hypothesized that patients without an accident as a cause of their fracture may have very fragile bones. Therefore, they would be at risk for poor fracture healing. However, these patients did not stay in hospital longer, did not have more late effect diagnosis, primary or secondary repair procedures and did have a greater incidence of readmission or admission to nursing home. However, they were more likely to die within one year of admission than patients who had accidents in other locations. Perhaps, early mortality prevented the recording of other adverse outcomes. Alternatively, these patients may be a mixture of patients with fragile bones, those unable to communicate the location of their fracture and those admitted for a planned repair of a previous fracture. A chart review of patients with no known accident is necessary to determine the characteristics of these patients.

Specific Accidents and Other Accidents

Less than 1% of the accidents were specifically noted as a farm, workplace or traffic accidents. Therefore, this category was combined with the "other accident" category which is not well characterized. It is assumed that "other" accidents take place in locations aside from those specified. Chart reviews are required to further characterize this indicator. Gerber et al. (1993) found that 9% of the hip fracture accidents were traffic accidents in patients over 60 years of age. They also found that 23% of accidents were other accidents.[180] In this study, "other accidents" made up 20.3% of the hip fracture accidents.

Patients in this category were less likely to stay in hospital for more than 100 days and less likely to be admitted to a nursing home than patients with accidents at home or in hospital. They were less likely to die within three months than patients with accidents in any other location, and less likely to die than patients with accidents at home or in hospital at three months to one year after the fracture. However, they were more likely to be readmitted than patients who had their accident in hospital.

These findings suggested that these patients are in better health than most of the other hip fracture patients. The increased readmission rate may reflect the fact that more of these patients are discharged home.

Day of Week of Fracture Admission

Determining when hip fractures occur may be beneficial in understanding their etiology. Fractures which occur on the weekend for example, may be more likely to be associated with alcohol which could impact their outcome. However, the use of the variable for this purpose may not be that accurate as it represents the day on which the patient presents to hospital for care of the fracture and not the time of fracture. It is presumed that the patient would reach hospital within 24 hours of the fracture. However, in some cases this assumption may be wrong. This variable is more accurate for determining whether the outcomes of fractures are different depending on the day of the week that they are admitted (ie. a delivery of care variable).

Less hip fractures are admitted on weekends and slightly more hip fractures are admitted on Monday and Tuesday. This finding suggests that either less fractures occur on the weekend, family or home care staff don't find patients until Monday, or patients are managed outside of hospital until the week begins. This same trend was found by Dolk (1989) in a prospective study of hip fracture patients.[38]

Patients admitted on Friday spend significantly more time in hospital than patients admitted on Saturday. This may be the result of the reduced weekend staffing on the first few days of admission or the temptation to delay surgery to Monday.

Patients admitted on Monday are significantly less likely to have a late effect diagnosis than patients admitted on Saturday. Could this be due to a well rested orthopaedic team? These patients would have the benefit of the most experienced staff being around for the most critical times of their care: the initial assessment, perioperatively and the first two days post surgery. Access to consultants and to other necessary care may also be better at this time. A study looking at how hip fracture care varies during the week would be of interest.

Season

More hip fractures occur in the fall and the winter. In Manitoba, ice and snow provide a slippery uneven surface for walking during these months. However, seniors are less likely to leave their home during this time. During the winter months, length of stay in hospital is significantly less than in the fall. However, season of the year is not a significant predictor of length of stay for individuals treated within 10 days of their initial fracture admission date.

Individuals admitted in the spring are less likely to die within three months but are more likely to die between three months and one year than patients admitted in the fall. Late fall and winter in Manitoba is influenza season.[183] Hospital admissions and mortality increase during the period of intense influenza activity.[183,184] Most of the deaths occur in persons aged 65 years and older.[184] Therefore, the increased mortality seen in the fall and winter months may reflect the overall increase in mortality in this population related to influenza season. Alternately or additionally, seasonal affective disorder may play a role.[185]

In addition, as a consequence of influenza season, patients admitted in the winter may be more likely to transferred out of the hospital faster due to more vacancies in nursing homes and a greater pressure on the hospital system to free up beds to admit more patients. Influenza and other illnesses which circulate in the fall and winter months in Manitoba may also serve to increase the frailty of the elderly population and increase their likelihood of a fall and consequently a hip fracture.

Fiscal Year

The absolute number of hip fracture cases have increased with time and this will likely continue to occur due to the aging of the population.[186] However, this analysis was not the focus of this study. It was hypothesized that the outcomes of hip fracture care would improve over time due to improved techniques. This has been found in other studies.[187] Over time, the length of stay of hip fracture patients has declined significantly. There have been less diagnoses of late effects of hip fracture care, less deaths within three months of admission, and less admissions to nursing homes. These findings suggest that hip fracture care is improving in Manitoba.

In addition, patients who received arthroplasty were significantly less likely to be sent to nursing home in the later years of the study than patients in the major repair categories except those who received "other repairs". This significant interaction effect between arthroplasty and time suggests substantial improvements in the effectiveness of the arthroplasty procedure or the tendency to use arthroplasty in those patients more likely to return to the community. However, the annual percentage of arthroplasty repairs in relation to the total number of repairs performed over the study duration has been consistently about 20%.

On the other hand, the rate of readmission within a year, repeat primary repairs and secondary repairs have increased over time. This increased intensity of servicing may have a number of causes: increased survival has led to an increased need to conduct additional repair procedures; repair procedures have improved, giving surgeons the confidence to address the pain and suffering of more patients; the shortened hospital stays have put patients at risk for complications and further procedures; the quality of initial repairs have deteriorated resulting in more revisions; or surgeons are subjecting patients to needless surgery. The first two explanations seem to be the most plausible. The survival bias makes these hypotheses very difficult to test.

In addition to the apparent increase in servicing noted above, one finding suggests a possible decline in the quality of care over time. Patients who received internal fixation and no reduction died more commonly in the three month to one year period than patients who received arthroplasty. This finding may be a reflection of the improved survival of arthroplasty or a spurious result. This issue is explored further in the Repair Procedure discussion.

Comorbidity

The Charlson Index

The Charlson Index was a tool developed by Charlson et al. (1987) to identify characteristics of a patient that would predict early mortality for medical patients.[146] The index was not validated for surgical patients or for adverse outcomes aside from mortality. The unweighted summary score validated by Romano et al. (1993) and the individual comorbidity diagnoses were evaluated for use as a measure of comorbidity for hip fracture patients.[148] See Appendix 16. The individual Charlson comorbidity variables performed better than the Charlson Index. Therefore, the individual diseases were included in the models. These variables are denoted with a "(C)" in the following discussion.

Cancer

Metastatic Solid Tumour (C)

A diagnosis of metastatic solid tumour was found in 1.9% of the hip fracture patients. As would be expected, this diagnosis was associated with a significantly increased three month mortality rate and three month to one year mortality. Robbins (1989) in a prospective cohort study found metastatic cancer to be predictive of 6 month postfracture mortality.[10] Urban residents with metastatic cancer were less likely to be admitted to a nursing home. This result suggests that home support for the dying may be better in urban areas or that the access to nursing home for these types of patients is more restricted in urban centres.

Other Cancer (C)

Patients with other cancer diagnoses made up 4.0% of the hip fracture cases. Like metastatic cancer, any diagnosis of cancer significantly increased the three month mortality and the three month to one year mortality. However, due to the prognostic variability of the many types of cancers found in this variable and the less advanced stage of illness, the relative risk was not as pronounced. As would be expected, this diagnosis increased the risk of readmission within the year after the hip fracture admission.

Respiratory Disease

Chronic Obstructive Lung Disease (C)

Patients with a diagnosis of Chronic Obstructive Lung Disease (COPD) made up 9.7% of the hip fracture cases. COPD increased the risk of mortality within the first year after admission, the risk of a second hip fracture and the risk of a length of stay greater than 100 days. Galasko et al. (1985) found that peak expiratory flow rate correlated well with 3 month postfracture mortality.[188] Robbins (1989) found that an abnormal lung physical exam and a history of smoking was predictive of 6 month postfracture mortality in a prospective cohort study.[10]

COPD is identified as a major risk factor for surgery.[78,189] Reduced ventilatory reserve can lead to significant problems postoperatively when patients experience atelectasis or pneumonia. Respiratory insufficiency or heart failure may occur. In addition, since the majority of COPD patients were likely to have been smokers, they were at greater risk for other smoking related complications, such as myocardial infarction.

The increased length of stay for hip fracture patients with COPD suggests the need for increased recovery time or an increased risk of complications. Mullen and Mullen (1992) noted a complication rate of 21% for patients who had significant comorbidity, but their study did not identify COPD as a significant predictor of mortality.[114] However, they did not perform a multivariate analysis.

The increased risk of a second hip fracture for COPD patients may relate to a number of factors. Patients with COPD are likely to have had minimal exercise over a long period of time thereby causing increased osteoporosis. This problem will likely be enhanced due to the increased effort required to ambulate following the initial fracture. Steriods, which cause bone loss, are often used in the management of COPD.[190] In addition, weakness and hypoxia when walking may lead to falls and a reduced ability to break the impact of the fall.

Grisso et al. (1997) in a case control study of male hip fracture patients found, among other factors, men in the lowest quintile of body mass had the greatest risk for fracture and smoking cigarettes or a pipe increased the risk of hip fracture independent of body mass. Previous physical inactivity was also major predictor of a hip fracture.[191] Smoking is thought to increase the risk of osteoporosis through decreasing body weight, earlier menopause in women, a decrease in testosterone levels in men, and a reduction in gastrointestinal adsorption of calcium.[191]

Gastric Disease

Ulcer (C)

Patients with a diagnosis of a previous ulcer made up 1.2% of the hip fracture cases. This variable was in the original Charlson paper.[146] However, it was omitted from the Romano et al. (1993) analysis because of its lack of predictive power.[148] The treatment for ulcer has dramatically improved over the last few years and the mortality from the disorder has declined. In keeping with this, the presence of an ulcer was not predictive of any adverse outcome.

Liver Disease (C)

This variable is made up of both the mild and severe liver disease variables from the Charlson Index.[146] Patients with these diagnoses made up 0.7% of the hip fracture cases. As would be predicted from the Charlson work, liver disease was very predictive of early mortality. However, it was not predictive of mortality between three months and one year. Mullen and Mullen (1992) found cirrhosis to be significantly predictive of early mortality.[114] Liver disease affects the major metabolic functions of the body, particularly protein metabolism, which is important in fracture healing and the ability to fight infection. Bleeding complications are also of concern.

Patients with liver disease were also more likely to receive a secondary repair. This finding was unexpected. Perhaps, it relates to poor fracture healing in these patients.

Diseases Affecting the Vascular System

Severe Diabetes (C)

Patients with a diagnosis of severe diabetes made up 2.0% of the hip fracture cases. This diagnosis significantly increased the three month to one year mortality but not the three month mortality. It was also significantly associated with readmission within one year of the hip fracture and a length of stay greater than 100 days.

Mild to Moderate Diabetes (C)

Michelson et al. (1995) found on interview that 9% of the hip fracture patients said they had diabetes.[180] The findings in Manitoba were similar if severe and mild to moderate diabetes were combined (2.0% + 6.7%). Patients with diagnoses of mild to moderate diabetes were more likely to die within a year after fracture than those without this diagnosis. Mild to moderate diabetes was also associated with readmission within one year of discharge and a length of stay greater than 100 days.

McCredie et al. (1986) suggest several hypotheses as to why patients with mild to moderate diabetes may be more difficult to manage within the perioperative period (before 3 months) than patients with severe diabetes. The diagnosis of diabetes may not be known at the time of the fracture. The stress of the fracture or the operation may result in a hyperglycemic coma. Due to the necessity to control blood sugar more precisely during the interruption in nutrition and the increases in blood sugar due to stress of a surgical procedure, oral hypoglycemic agents are usually stopped before elective surgery and converted to insulin if safe levels of blood sugar are exceeded.[189]

However, in the case of a hip fracture, blood sugar levels are likely to be high due to the stress and pain of the fracture creating difficulties in controling blood sugar prior to surgery. Attention to the need to control and monitor blood sugar in patients previously on oral hypoglycemics may not be as apparant as it would be for a diabetic on insulin.

Diabetics in general have a higher incidence than normal of vascular complications after operation, such as coronary and cerebral thrombosis because of the high incidence of atherosclerosis in diabetics. Wound healing is slow and infections are more frequent, especially if the diabetes is not well controlled.[189] These findings appear to explain the increased three month to one year mortality, length of stay and readmission rates amoung diabetics.

Renal Disease (C)

A diagnosis of renal disease was found in 2.0% of the hip fracture patients. Consistent with the Charlson et al. (1987) findings for medical patients, renal disease was a significant predictor of three month mortality and three month to one year mortality.[146] Robbins (1989) found that hip fracture patients with an elevated urea were more likely to die within the 6 month postfracture period.[10] Mullen and Mullen (1992) also found renal failure to be predictive of mortality in a prospective study of 400 hip fracture patients.[114]

Patients with renal disease were less likely to be readmitted with the next year than other patients. This finding is unexpected. Early mortality was controlled for in this analysis. Perhaps, they are receiving regular care by specialists which prevents readmission or that their dialysis care is not counted as an admission to hospital. The impact of renal disease on readmission requires further investigation.

Peripheral Vascular Disease (C)

The diagnosis of peripheral vascular disease (PVD) was found in 3.5% of the hip fracture patients. Consistent with the Charlson et al. (1987) findings,[146] peripheral vascular disease was associated with an increased relative risk of death within the three months after the hip fracture admission and also over the next nine months.

Patients with peripheral vascular disease were significantly less likely to be admitted to a nursing home even with control for early mortality. This finding was unexpected. Perhaps these patients are too unstable to be panelled for a nursing home.

Myocardial Infarction (C)

A diagnosis of an old myocardial infarction (MI) or a MI in the year prior to admission was found in 3.1% of the hip fracture patients. Previous myocardial infarction was not predictive of adverse outcomes in any of the models. The treatment and care of patients with myocardial infarctions has improved significantly over the last few years resulting in improved survival.[191] This may explain the lack of a relationship with mortality and morbidity in this study. In addition, there may have been collinearity with the conjestive heart failure variable. The MI variable may reflect those patients with a MI without significant heart damage.

Congestive Heart Failure (C)

A diagnosis of congestive heart failure in the year prior to admission was found in 5.3% of the patients. Congestive heart failure increased the relative risk of mortality in the next year after admission and of returning to hospital in the next year. Robbins (1989) in his prospective multivariate analysis of a group of hip fracture patients found that a chest X-ray suggestive of heart disease was predictive of mortality in the 6 month postfracture period.[10]

Congestive heart failure reduced the risk of being diagnosed with a late effect of hip fracture care. This finding is unexpected but perhaps speaks to the idea that patients who would be poor candidates for surgery may be less likely to receive a late effect diagnosis.

Severe Hypertension and Mild to Moderate Hypertension

A diagnosis of severe hypertension was made in 1.1% of the hip fracture patients. Mild to moderate hypertension was found in 11.2% of the hip fracture patients. A study by Michelson et al. (1995) found that on interview 39% of the hip fracture patients said they had high blood pressure.[179]

This finding suggests an under reporting of hypertension in this study or an over reporting by self report in hip fracture patients or both.

A diagnosis of hypertension was not predictive of any adverse outcomes. Based on the work by Charlson et al. (1987), it was hypothesized that hypertension would play a role in predicting hip fracture mortality.[146] If the self-reported incidence is correct, then less than one third of the hypertension patients were captured in this study. This may explain why hypertension did not influence outcomes. However, Mullen and Mullen (1992) in a prospective study of 400 hip fracture patients 65 years and over also did not find an impact of hypertension on hip fracture mortality.[114] Therefore, data from both a retrospective chart review and from a prospective study suggest that it is not an important indicator.

Diseases which Increase the Probability of Falling

Cerebral Vascular Disease (C)

Patients with a diagnosis of cerebral vascular disease (CVD) made up 5.3% of the patients. On interview, Michelson et al. (1995) found that 20% of hip fracture patients reported a previous stroke.[179] These findings suggest that cerebral vascular disease may be under reported in claims data or that self-reports exaggerate the rate.

Although CVD is a vascular disease, it usually has a profound effect on mobility. It is likely that these mobility problems have led to the significantly increased length of stay in hospital and nursing home admission rate associated with this diagnosis in this study.

This study did not find a relationship cerebral vascular disease and mortality as had been identified by Charlson et al. (1987) in their study of medical patients.[146] Gordon (1993) notes that a decline in stroke mortality has been observed internationally since the early 1900s with three distinct time trends: 1900-1950, average rate of decline less than 1%; 1950-1970; 1.5% per year; and from the mid-1970s to the present, 4-5% per year. Changing risk factor patterns as well as improvements in blood pressure are responsible for the decline in stroke mortality in most populations. The reduction in stroke mortality may reflect changes in stroke incidence, declines in case fatality or both.[194]

The lack of a relationship between hypertension and mortality in this study may be related to the declining influence of hypertensive stroke on mortality. In fact, the literature suggests that overall the mortality for patients with stroke has also declined. This phenomenon may be reflected in the lack of a relationship between previous cerebral vascular disease and mortality in this study.

Parkinson's Disease and Other Disorders of Movement

Patients with a diagnosis of Parkinson's Disease or another diagnosis of a disorder of movement made up 1.2% of the hip fracture cases. Michelson et al. (1995) found that 5% of the hip fracture patients in Baltimore reported Parkinson's Disease.[179] A study of the prevalence of Parkinson's disease in Aberdeen, Scotland revealed rates of 0.3% in patients 60 to 69 years, 0.8% in 70 to 79 year olds and 1.9% in those patients over 80 years.[195]

Parkinson's Disease was significantly associated with a length of stay in hospital of over 100 days and nursing home admission. However, a relationship with nursing home admission was not found for urban residents. These findings can be explained by the influence of Parkinson's Disease on mobility. Difficulty with mobility would increase the time in hospital and increase the likelihood that the patient would be unable to go home. The lack of a relationship with nursing home admission in urban residents suggests that more options for care in the home may be available in urban areas.

Jonsson et al. (1995) compared the rehabilitation of Parkinson's disease hip fracture patients with patients without the disease. Prior to the fracture, Parkinson's disease patients were less likely to be independently living in their own home. Postoperatively, women with Parkinson's disease were hospitalized for a significantly longer period and rehabilitation was slower and less successful.[196]

Paralysis (C)

Patients with the diagnosis of paralysis made up 1.6% of the hip fracture cases. Individuals with this diagnosis who were operated on within the first 10 days of admission were more likely to stay in hospital greater than 100 days than other patients operated on within 10 days of admission. This finding may be explained by increased difficulty in mobilization or an increased complication rate. However, it is not clear why nursing home admission rates were not associated with the diagnosis of paralysis. Perhaps the number of patients were insufficient to reach significance since all of the patients in nursing home already were excluded from the nursing home outcome analysis.

The diagnosis of paralysis was less likely to result in a patient receiving a diagnosis of a late effect of hip fracture care. This finding makes some intuitive sense since pain is usually a trigger to this diagnosis. In addition, the degree of osteoporosis is usually high in a paralysed limb. Healing of a fracture may to be compromised. Therefore, consistent with previous observations, there may be a tendency to not to diagnose poor surgical candidates with late effects of hip fracture care.

Blindness

Patients with a diagnosis of blindness on previous admissions within the year prior to hip fracture care or in their index episode of care made up 5.3% of the hip fracture patients. On interview, Michelson et al. (1995) found that 36% of hip fracture patients reported cataracts.[179]

Individuals with this diagnosis were less likely to die within three to twelve months after the fracture than other hip fracture patients. This finding suggests that these patients may be otherwise healthier than other hip fracture patients but due to their blindness are more likely to fall. In a prospective study of 7575 women age 75 and over, Dargent-Molina et al. (1996) found that decreased bone-mineral density, neuromuscular and visual impairment were significant and independent risk factors for the risk of hip fracture.[197]

Deafness

Patients with a diagnosis of deafness made up 0.9% of the study population. These patients were more likely to stay in hospital longer than 100 days. The extended length of stay for deaf patients may be related to vestibular abnormalities which may accompany hearing loss. These patients may take longer to gain functional mobility.

Robbins (1989) suggests that hearing loss may be associated with increased mortality after hip fracture.[10] The physiological mechanism for this may be that some causes of hearing loss may be associated with systemic pathological conditions, such as stroke, brain tumors, etc. However, a relationship between mortality and deafness was not found in this study.

Arrhythmia

Patients with a diagnosis of an arrhythmia within the year prior to the hip fracture admission made up 3.1% of the hip fracture patients. It was hypothesized that arrhythmias may be associated with a second fracture, due to the possible risk of a fall from a sudden decrease in cardiac function. However, there was no association with a second fracture in this study. There was also no association with increased mortality.

This diagnosis was a significant predictor of readmission within one year of the hip fracture episode of care. Arrythymias are risk factors for syncope, strokes, falls, myocardial infarctions, conjestive heart failure, and the need for a pacemaker. All of which may result in hospitalization.

Dementia (C)

Patients with the diagnosis of dementia made up 11.5% of the hip fracture cases. Melton et al (1994), in a retrospective cohort study, found a statistically significant increase (odds ratio of 2.8) in the risk of hip fracture in the year of onset the of diagnosis of Alzheimers disease.[198] In 25 of the 26 cases, the diagnosis of Alzhiemer's disease was made following the hip fracture event suggesting that the fracture brought the patient to medical attention or caused deterioration in a marginally compensating individual. The increased hip fracture risk for patients with Alzheimer's disease continued over the 10 year study follow-up period (SMR = 2.9).[198]

In addition, Melton et al. (1994) found a relationship between Alzheimers diseases and early mortality.[198] Robbins (1989) also found that patients with a decreased mental status were more likely to die within 6 months of their hip fracture.[10] A relationship between dementia and mortality was not found in this study, but the Robbins study did not control for previous nursing home residence.

Patients with dementia were more likely to remain in hospital more than 100 days and to be admitted to a nursing home. However, they are less likely to be readmitted within the next year. Ensberg et al. (1993) also found that patients with dementia were more likely to have a longer stay in hospital.[199] The longer stays in hospital and the increased nursing home admission rates are not surprising since patients with dementia require a large amount of support. A patient with dementia and mobility problems may be too much to handle for the previous care givers and require placement in a nursing home. Many people must wait in hospital for a nursing home bed to become available.

In addition, as noted in the Melton et al. (1994) study,[198] the diagnosis of dementia may be a new issue for the patient and their family requiring careful assessment of their capabilities. Cognitive function may improve after the patient has recovered from their hip fracture. A patient must be stable to be panelled for a nursing home.

The decrease in readmission rates among patients with dementia may be due to receiving most of their care in a nursing home or that they are otherwise relatively healthy aside from dementia.

Rheumatoid Arthritis (C)

Patients diagnosed with rheumatoid arthritis made up 1.7% of the hip fracture patients. Rheumatoid arthritis reduces the range of movement of joints, causes pain on movement, and reduces the ability to react to a loss of balance. Joint pain may also cause osteoporosis due to lack of movement of the joints. It was hypothesized that this diagnosis would lead to mobility problems and added difficulty in hip fracture recovery. However, rheumatoid arthritis was not predictive of any adverse outcome.

Osteoarthritis

Patients with the diagnosis of osteoarthritis in the year before their fracture or during their hip fracture episode of care made up 2.5% of all hip fracture cases. Osteoarthritis causes joint pain and limited range of motion. For patients who had their surgery within 10 days of admission, this diagnosis was associated with a greater risk of being in hospital for more than 100 days. It was also associated with increased risk of a secondary repair procedure.

Osteoarthritis is a discretionary diagnosis, with a tendency for more of the severe cases, or the cases leading to an intervention being captured. Michelson et al. (1995) found that on interview 50% of the hip fracture patients said they had arthritis.[179] Rottensten (1996) also reports rates in the Canadian population age 75 and over of 51%.[200]

This diagnosis during the index episode of care may represent a complication of the hip fracture repair, or a preexisting condition which makes a secondary repair more likely. Therefore, as this variable is derived, its use as a comorbidity indicator is not valid. In a future analysis, only diagnoses prior to the index admission should be considered.

Seizure Disorder

Patients with a diagnosis of a seizure disorder on previous admissions within the year prior to the hip fracture or on the initial hip fracture admission were significantly more likely to remain in hospital more than 100 days, suffer a second hip fracture, and to die between three months and one year after initial admission. It was hypothesized that a seizure disorder, due to the likelihood of a fall during a seizure, would contribute to a second hip fracture. The increased length of stay and the relationship with mortality was unexpected. However, if the seizures are the result of brain metastases or other progressive disorders, these findings could be explained.

Alcoholism

Patients with diagnoses indicating alcohol abuse made up 1.3% of the hip fracture patients. Fink et al. (1996) estimates that the prevalence of alcohol-related problems in the community dwelling elderly range from 1% to 6% and from 7% to 22% in elderly persons hospitalized for medical reasons.[201] Alcohol related problems may include both physical and psychological disorders such as: alcoholic liver disease; alcoholic dementia; peripheral neuropathy; depression; insomnia; loss of libido; late-onset seizure disorder; confusion (masquerading as dementia); poor nutrition; incontinence; diarhea; myopathy; congestive heart failure; inadequate self-care; hypertension; fractures; macrocytosis; and adverse drug reactions.[201]

Patients with alcohol abuse were more likely to stay in hospital greater than 100 days, suffer a second hip fracture and be admitted to nursing home. Felson et al. (1988) also found that heavy and long-term alcohol consumption increased the risk of hip fracture from falls.[202] In addition, it makes intuitive sense that alcoholics will have difficulty functioning at home and require more time in hospital and nursing home admission.

Systemic Diseases

History of Depression

Michelson et al. (1996) reported that major depression affects 5 to 9 percent of women.[203] They also found that past or current depression in women was associated with decreased bone mineral density.[203] In this study, patients with a diagnosis of depression from admissions in the previous year before their admission made up 2.0% of the hip fracture patients. It is likely that this does not capture all the patients with a history of depression as many patients are treated on an out patient basis or had their depression episode more than a year before admission. Therefore, the probability of detecting a difference due to a history of depression is diminished.

However, if the patient did have depression noted on a previous hospital abstract, they were more likely to stay in hospital greater than 100 days. Mossey et al. (1990) found that depression following a hip fracture was associated with a reduced likelihood of returning to full physical functioning. They also found that patients who had high depressive symptoms scores following a hip fracture (84%) had a history of depressed mood before the fracture.[93]

Nutritional Insufficiency

Patients with a diagnosis of nutritional insufficiency on their hospital admission in the year prior to their hip fracture or during their index episode of care made up 1.3% of the hip fracture cases. However, it is estimated that up to 20% of patients experiencing hip fractures have malnutrition.[91]

In this study, nutritional insufficiency was strongly predictive of a length of stay in hospital greater than 100 days. It was also predictive of three month mortality. Bonjour et al. (1996) were able to show that nutritional supplementation of hip fracture patients substantially reduced complications such as bed sores, anemia, lung or renal infections and mortality.[92] Length of stay in hospital was also substantially reduced. Robbins (1989) found that low serum albumin levels approached statistical significance in predicting 6 month mortality.[10] However, there were only 216 hip fracture patients in the study. Patterson et al. (1992) also found that patients who were protein depleted had a higher prevalence of complications, stayed in hospital longer and had significantly lower probability of surviving one year.[90]

Diseases which Affect Bone Healing

Pathological Fracture

A diagnosis of a pathological fracture was found in 1.0% of the hip fracture patients. Half also had a diagnosis of osteoporosis. In a retrospective study of all patients managed operatively (441) over a twelve month period in Adelaide, Australia, Clayer and Bauze (1989) found a 6% pathological fracture rate related to disseminated malignancy.[115] However, the rate of metastatic cancer in the Manitoba hip fracture patients appears to be only 1.9%.

Patients with a diagnosis of a pathological fracture were significantly less likely to have a secondary repair procedure. This is an interesting finding. One would expect that pathological fractures may be the most difficult to heal and may required additional repair procedures. This finding suggests that decision to under go secondary repairs may take into account the overall health of the patient and the probability of success.

Urban residents with a pathological fracture were less likely to be admitted to a nursing home. This finding is unexpected, but consistent with the reduced rate of nursing home admission for patients with metastatic disease. However, since the finding was found only for urban residents, it may be that in urban areas more resources are available to allow these patients to remain at home.

Osteoporosis

Patients with a diagnosis of osteoporosis made up only 3.5% of the hip fracture patients. It was hypothesized that the actual incidence would be higher. Osteoporosis is likely a discretionary diagnosis, with a tendency for more of the severe cases being captured within this group of patients. On interview, Michelson et al. (1995) found that only 10% of the hip fracture patients had ever been told that they had osteoporosis.[179]

A diagnosis of osteoporosis was associated with a significantly increased likelihood of staying in hospital for greater than 100 days. However, this relationship was not found in patients who had their operation within 10 days of admission. These findings suggest that the severity of osteoporosis must be quite high in these patients as it appears to be related to delays in surgical management and discharge. Perhaps its impact on the management of the patient is a trigger to osteoporosis being identified as a significant diagnosis. This indicator appears discretionary and caution should be applied in its usage.

Previous Admission

The frequency of previous admissions to hospital in the year prior to hospitalization for hip fracture (37.2%) suggests that a large portion of the hip fracture patients have other debilitating illnesses significant enough to warrant hospitalization. Wolinsky et al. (1997) found that 28% of hip fracture patients in the U.S Longitudinal Study on Aging had a previous admission in the year prior to their fracture and this was significantly more than those individuals in the study who did not suffer a hip fracture.[204] Magaziner et al. (1997) divided hip fracture patients up into those who had 0 to 2 impairments of Activities of Daily Living (ADL) and those who had 3 or more.[39] They found differences in mortality trends for both groups. For those with 0 to 2 impairments, the differences in the survival from the control population with similar ADL function continued to increase over time. However, for those study participants who had 3 or more impairments in ADL, a significant difference in survival was shown at 6 months post hip fracture. However, at about 4 years the survival curves were the same. The authors suggest these findings indicate that among those who are frail, a hip fracture may be one of the many events that occur and accelerate an older person's chance of dying. For older persons without significant disease or disability, a hip fracture appears to have a more insidious effect that may signify the beginning of the end.[39]

In this study, previous admission to hospital was not predictive of premature mortality. Although previous admission is not a good measure of ADL, it was hypothesized to be capturing patients who were not doing well in the community. However, it is likely that the comorbidity variables had collinearity with this variable.

Previous admission to hospital within the year prior to initial admission for a hip fracture was found to be predictive of readmission within one year of discharge from the index episode of care. It was also predictive of an increased length of stay of over 100 days for those individuals who received their hip fracture repair within 10 days of admission.

Summary of the Comorbidity Variables

Generally, it appears that cancer, liver disease and vascular diseases have their biggest impact on mortality. Severe diabetes also had a strong influence on length of stay. The systemic diseases increased length of stay and, in the case of nutritional deficiency, mortality. Chronic respiratory disease increased mortality, length of stay and second hip fracture risk. Diseases which impact mobility appear to have their largest influence on increasing length of stay, nursing home admission and in some cases, second hip fracture risk. Disorders of bone and gastric disease appear to have little impact on outcomes, although the diagnosis of osteoporosis was predictive of an increased length of stay.

The diagnosis of a late effect of hip fracture care, and the occurrence of a repeat primary or secondary repair were largely unaffected by comorbidity. However, it appeared that diseases that would make patients a poor surgical risk were less likely to receive a late effect diagnosis or a secondary repair.

Readmissions were affected mildly by a variety of comorbidities with no apparent pattern based on the above classification. Previous admission was extremely predictive of repeat admission. Perhaps more comorbidity variables would have been significant if this variable was not included.

The ability of the claims data to capture the true incidence of these comorbidities is called in question by the interview study of hip fracture patients by Michelson et al. (1995).[179] However, there are inaccuracies in self reporting of illness. Physicians will likely diagnose the most severe cases or debilitating cases of disease, particularly if it was perceived to impact on the management of the hip fracture. Therefore, claims data, based on physician diagnoses, may pick up the most severe cases and detect a relationship if present. On the other hand, if the reporting of these diagnoses are relatively random, then it is unlikely that a relationship will be detected even if present. Therefore, conclusions can not be drawn if these diagnoses fail to show a relationship in this type of study.

Treatment Variables

In this study, only repair type was examined as a treatment variable. Other factors may be equally important, such as approach to surgery (anterior versus posterior), use of antibiotics, the use of thrombolytic therapy, nutritional support, fluid and electrolyte management, pain control, physiotherapy, the use of pressure stockings, consultation with specialists, the appropriate management of comorbidities and complications, geriatric multidisciplinary team assessment, etc., but were not assessed in this study.

Repair Type

The distribution of repair types was discussed in the review of the fracture type findings. However, several additional points need to be made. Based on usual clinical practise, open reduction of the hip fracture in 47% of the patients would be very unusual. Most internal fixations (approximately 90%) would have a closed reduction before the internal fixations.[3] Therefore, it appears that the coding practises for internal fixation are not accurate. This may reflect lack of understanding by the coding staff, the way in the surgeons dictate their operative reports or both. Future studies should not look at how the reduction was performed and combine *Open Reduction and Internal Fixation '7935', Closed Reduction and Internal Fixation '7915'* and *No Reduction and Internal Fixation '7855'* into one Internal Fixation variable.

In the analysis of the data in this study, these three internal fixation procedures appear to be performing similarly and the major findings have been their differences with the arthroplasty, no repair procedures, and other repair procedures. However, there is one exception, patients who received internal fixation and no reduction died more commonly in the three month to one year period than patients

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[3] Dr. David Lyttle, Director of Orthopaedics, Rehabilition Hospital, Health Sciences Centre, Winnipeg, Manitoba. March 25, 1999.

who received arthroplasty. The odds ratio was 1.1 at the 95% confidence limits suggesting the relationship was not very strong and may have occurred by chance. In addition, this finding was not in keeping with the hypothesized determinants of three month to one year mortality. Other studies have found treatment factors were not associated with mortality after 90 days.[101]

Lu-Yao et al. (1994) examined patterns of treatment specific mortality for patients who had femoral neck fractures.[101] They found that patients treated with other care suffered higher mortality than those treated with internal fixation or hemiarthroplasty. Patients treated with arthroplasty had a modestly elevated short-term mortality (RR=1.2 CI=1.06,1.38). However, among those who survived 90 days, there was no detectable difference in mortality beyond three months after the hip fracture.[101]

In this study, arthroplasty was not significantly associated with 90 day mortality. The reason for the difference between the two studies may be the utilization of arthroplasty on a broader range of patients in the United States (arthroplasty rates of 64% in patients with transcervical fractures versus 45% in this study). On the other hand, Lu-Yao et al. (1994) study may have had more power to detect a relationship since they had 13,167 transcervical fracture patients and this study had 4760.[101]

Alternatively, this relationship could have appeared by chance, since the relative risk was low (RR=1.2) and it was only significant at the 95% confidence limits. A question for the orthopaedic community is whether a relative risk of 1.2 is clinically significant? Further population based studies of this issue are required.

Repair type was also not related to length of stay, repeat hip fracture, three month to one year mortality, or readmission within one year. However, patients who did not receive a repair procedure on their index admission had shorter stays in hospital (controlling for early mortality), were less likely to receive a secondary repair, but were more likely to die within three months of admission to hospital with a hip fracture.

The increased mortality rate for patients who did not receive a repair is not unexpected.[77] However, in this study, patients who did not have a repair at their initial admission made up 11.1% of the hip fracture cases. Keene et al. (1993) found in a consecutive prospective study that 5.3% of the patients were medically unfit to receive a repair or received conservative treatment.[175] This finding suggests that the "no repair" variable may be composed of additional patients in this study. Further analysis of the patients who did not receive a repair would be important.

Patients who received arthroplasties were significantly less likely to have a diagnosis of a late effect of hip fracture care, to have a repeat primary repair or to have a secondary repair compared to all other types of repairs. Obrant (1996), in his review of hip fracture procedures, noted that arthroplasty repairs for transcervical fractures were showing lower reoperation rates within two years of the repair and better pain relief and mobility in the first year after operation.[72] An interesting further analysis on this study data would be to examine the complications for each repair procedure five years after the hip fracture.

This study also shows that over time, fewer of the patients entering nursing home for the first time after a hip fracture episode of care had received an arthroplasty repair. Lu-Yao et al. (1994) also showed that nursing home residents were less likely to receive an arthroplasty repair.[101] These findings suggest that patient characteristics play a role in the selection of the repair procedure.

Delivery of Care Variables

Delivery of care variables represent systemic factors or influences that impact hip fracture care.

Transfers (See Appendix 14)

Transfer Before Repair

Patients admitted to another hospital before their repair made up 11.0% of the cases. Delays in receiving a repair due to assessment in another hospital were hypothesized to have an adverse effect on patient outcomes and thought to be an issue in Manitoba due its geographic size and relation to appropriate referral centres for hip fracture repair.

However, this indicator was only predictive of readmission. The increased readmission rate may reflect the propensity for these patients to spend a great deal of time in hospital. In this analysis, region of residence was controlled for. Further study of this group of patients may be revealing.

Transfer Without Admission

Patients transferred from another hospital without admission made up 4.0% of the patients in the study. Patients actually admitted to hospital and then transferred are likely to be more stable than those individuals seen in the emergency department and transferred directly out.

Patients transferred without admission were significantly more likely to die within the first three months after their fracture. However, they spend less time in hospital than the average hip fracture patient and were less likely to be readmitted. The reduced length of stay in hospital and the reduced readmission rate may be a reflection of the early mortality.

The pattern of adverse outcomes tends to reflect a group of patients who do worse in the short term, whether this be due to the severity of their injury or the delay in receiving appropriate care. This suggests that this variable is capturing an important characteristic of hip fracture patients which is independent of the absolute time prior to surgery. Further characterization of these patients to determine if what is captured here is an inherent characteristic of the patient or a delivery of care factor leading to adverse outcomes is an important research area.

Admitting Hospital

Patients admitted to a teaching hospital on their initial admission stayed in hospital significantly less time than patients in other urban hospitals, major rural hospitals and other specified hospitals. However, this relationship disappeared when in patients who received their repair within the first ten days of admission. In other words, in the typical hip fracture episode of care, admitting hospital type did not appear to make a difference in length of stay.

Admitting hospital type was also not predictive of second hip fractures, late effect diagnoses, primary repair procedures, or secondary repair procedures.

Three month mortality was significantly lower in patients initially admitted to out of province hospitals and other specific hospitals as compared to teaching hospitals. It is likely that patients who are travelling out of province when they sustain their injury are healthier than those who remain behind. Admission to one of the specialized hospitals at the time of the hip fracture may mean that the patient is more stable and is not transferred directly. Almost no repairs are done at these hospitals.

Patients initially admitted to other specified hospitals or out of province hospitals were significantly more likely to be readmitted within the next year than those admitted to teaching hospitals. This may be related to the increased survival in these groups of patients. Patients admitted to major rural hospitals were significantly less likely to be readmitted than patients in teaching hospitals.

Patients admitted to urban hospitals or small rural hospitals were significantly more likely to be admitted to nursing home than patients initially admitted to a teaching hospital. Patients admitted to out of province hospitals and other specific hospitals initially were less likely to be admitted to a nursing home.

In summary, it appears that patients admitted out of province and to other specific hospitals are the least likely to have adverse outcomes, but they may be the most stable patients. Urban hospitals and small rural hospitals do not appear to be as aggressive in discharging their patients home as the teaching hospitals. However, this appears to result in increased readmission rates for teaching hospitals as compared to major rural hospitals.

Repair Hospital

Repair hospital type was not a significant predictor of any outcome. Classification of the hospitals by repair frequency was found to be a better predictor of adverse events.

Time to Surgery

Separate analyses were conducted looking at the impact of this variable on the various outcomes because only 9556

(78%) of the hip fracture patients had their repair within 10 days of admission.

Delayed time to surgery was significantly predictive of a length of stay greater than 100 days. This finding suggests that delays in surgery may result in increased complications or that there may be patient factors which contributed to the delay in repair which were not captured in our comorbidity analysis. Ensberg et al. (1993) found that greater than 3 days to treatment was predictive of an increased length of stay.[199]

Russin and Russin (1981) found in a study of a consecutive series of patients that delays in getting the patient to surgery were due to the need for prior medical treatment of concurrent illness.[109] Holt et al. (1994) noted an increase in morbidity and mortality after a 30 hour delay in hip fracture repair but they comment that they were unable to rule out confounding due to patients with comorbid conditions.[205] From their review of the literature, Morrison et al. (1998) suggest that for patients who do not have active comorbid illness, surgical repair of the hip fracture between 24 and 48 hours is associated with a decrease in one year mortality.[76] Therefore, the inability to show an significant impact on mortality in this study may be due to an interaction effect with comorbidity. Further study in this area should control for this possible interaction.

Time to hip fracture repair was also not predictive of a second hip fracture, a diagnosis of a late effect of hip fracture care, a repeat primary repair, a secondary repair, readmission or nursing home admission.

Day of Hip Fracture Repair

Most of the repairs were conducted on Wednesdays and Fridays. However this pattern does not correspond to the admission days which were relatively even throughout the week with a dip on the weekend. Therefore, the pattern suggests that it may correspond to when operating time is available in the high frequency repair hospitals. The only outcome significantly associated with this variable was nursing home admission. Patients who received their repairs on Thursday were more likely to end up in nursing home than patients admitted on Saturday. This finding is unexpected and difficult to explain.

Frequency of Surgery by Surgeon

Few hip fracture studies have actually looked at the impact of surgeon skill on hip fracture care. However, Dolk (1989) found that hip fracture outcomes were better when a non-specialist surgeon performed the surgery.[38] Holt et al. (1994) found that surgical skill played only a minor role in the outcomes of 1000 consecutive patients in Britain.[205]

Chiasson et al. (1997) found similar outcomes for generalist and orthopaedic surgeons who overall did similar volumes of repairs.[206]

Frequency of hip fracture repair by treating surgeon was only predictive of the diagnosis of a late effect of hip fracture care. Patients whose surgeons performed 25 to 124 repairs were more likely to have a late effect diagnosis than patients whose surgeon performed less than 25 repairs. There were no significant differences with those surgeons who performed more than 125 repairs. This finding does not make sense according to the findings in the literature unless the surgeons who performed less than 25 cases during the study were operating on easy cases. This finding requires further investigation.

Herberts and Malchau (1997) suggest that a population based registry of adverse outcomes from total hip replacement has improved hip fracture practise in Sweden by providing evaluation to facilities and physicians of hip fracture outcomes and thereby allowing targeted improvements to be made in certain kinds of patients and certain kinds of procedures.[96] The provision of feed back to physicians has been a documented way of improving practise and is used by the Medical Review Committee in Manitoba. A hip fracture registry for adverse events may be something that could be incorporated into this process. Herberts and Malchau (1997) reported an improvement over time in their hip fracture complication rates for the total hip replacement and revision procedures.[96] However, this phenomenon was also observed in this study in the absence of such a system. It is difficult to say whether a registry would further improve the outcomes.

In Manitoba, no provincial guidelines for hip fracture care exist. Care maps have been shown to improve the outcomes of hip fracture patients.[95] It is recommended that the College of Physicians and Surgeons of Manitoba and the Manitoba Association of Registered Nurses establish guidelines for hip fracture care.

Frequency of Hip Fracture Care by the Repair Hospital

The concept of experience makes perfect was extended to the repair hospital as well. It was hypothesized that those hospitals who treated more hip fracture patients would have better outcomes than those hospitals who treated fewer patients. Patients of hospitals providing less than 125 repairs in the study stayed in hospital significantly longer than those patients in hospitals performing 125 to 1000 repairs. When only repairs occurring within 10 days of admission were considered, patients in Hospital A, Hospital B and Hospital C also spent significantly less time in hospital than patients cared for in hospitals with less than 125 repairs.

This finding may have been influenced by the 1985 College of Physicians and Surgeons of Manitoba guideline designating the class of hospital that can perform open reductions of hip fractures.[118] Some hospitals may have stopped performing hip fracture repairs. Therefore, certain types of repair hospitals or hospitals with low frequency of repairs in this study may also be reflecting a time bias, since most of their repairs would have been in 1985 or earlier. An examination of the number of repairs by hospital type before and after 1985 may provide insight as to the impact of the guidelines.

Patients in hospitals performing less than 1000 repairs during the study period and patients with repairs done in all of the very high frequency hospitals except Hospital D had a significantly higher three month mortality rate than patients in treated in Hospital C. Patients treated in Hospital B and Hospital D were significantly more likely to be readmitted than patients treated in Hospital C.

Patients with their repair done in Hospital C were significantly more likely to be given a diagnosis of a late effect of hip fracture care compared to patients who received a repair in hospitals who performed less than 125 repairs during the study. However, they were significantly less likely to receive a secondary repair compared to most of the other hospitals. One would expect that the more late effect diagnoses the more likely a secondary repair procedure. Perhaps, this hospital has a tendency to code more late effect diagnoses. On the other hand, this hospital may be reluctant to perform secondary repairs. Further investigation of hospital C is warranted.

Hospital C seems to differ from most of the other hospitals. In most cases, it appears to have better outcomes of care than other hospitals of its size. It may also be useful to examine the practises of hospital C to determine how they were able to obtain their outcomes. Evans et al. (1980) found differences in mortality between two hospitals.[207] They tested multiple factors and found that in the hospital with the poorer outcomes, patients were more likely to be a resident of an institution, of lower socioeconomic status, less likely to have been injured in a public place, and more likely to be mentally impaired, had a longer delay before surgery, and possibly subject to lower staffing levels. However, regression analysis were not done on these variables to determine the most significant factors.

Scheduled Admissions

Scheduled admissions accounted for 3.5% of the hip fracture cases. It is not clear why a hip fracture repair would be scheduled unless the patient was having a subsequent repair procedure. Interviews with admitting and triage staff at the two major teaching hospitals in Winnipeg suggest that all hip fractures would be sent throught the emergency department and the patients would be triaged and assessed in department before being sent to the ward, even if the ward and the orthopaedic surgeon were expecting them. These patients would not be coded as scheduled. However, they cautioned that not all triage nurses may code the same way. Planned elective surgery would be sent through admitting and would be coded as a scheduled admission.[4] A chart review may be the only way to determine the characteristics of these patients who have scheduled admissions. Since this variable appears to have a unique impact on hip fracture recovery, this research would be of interest.

A scheduled admission reduced the likelihood of early mortality and for patients who received a repair within 10 days of admission, a long length of stay. However, a scheduled admission increased the likelihood of a readmission and for urban residents, nursing home admission. These latter two findings may be related to the increased survival rates for these patients. The literature suggests that the outcomes for emergent or unplanned surgery are substantially worse than for scheduled surgery.[78] The relationship between this indicator and these outcomes suggests that the indicator

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[4] Discussions with Health Sciences Centre and St. Boniface Hospital admitting clerks and triage nurses on duty, February 11 and 12, 1999.

may be measuring planned admissions and these patients have unique characteristics.

Outcome Variables

The factors predictive of the adverse outcomes are presented in the Results Section. These findings and the contribution of the outcome variables to the various models are discussed here.

Length of Stay

Length of stay in hospital for hip fracture care is considerably longer than for other types of admissions. In this study, about one third of the patients had hospital stays greater than 60 days. A stay in hospital beyond 100 days was used as an indicator of various difficulties involved in the management of hip fracture care. These difficulties may be other comorbid medical conditions not measured in this study; complications of hip fracture care; social or economic difficulties leading to a delay in finding suitable accommodation in the community or in an nursing home; or care decisions by health care providers.

Length of stay is influenced by comorbidity. A number of comorbidity, demographic and fracture characteristic variables were significant in the length of stay model. A long length of stay in hospital can also be a reflection of complications of care. Many of the potential complications, such as pulmonary embolism, wound infection, etc. were not controlled for in this study. However, they could contribute to an increased length of stay. Log length of stay was used as a variable in the other outcome models as a proxy for complications and other factors that were not captured by the variables in the model.

Most of the adverse outcomes were associated with an increased length of stay. However, length of stay was not included as a variable in the mortality within three months model since individuals with a short length of stay would to a large part be those who died.

As would be expected, individuals diagnosed with a late effect of hip fracture care tended to stay in hospital much longer than those patients without this diagnosis. Individuals who received a repeat primary repair or a secondary repair also tended to stay in hospital longer. A long length of stay was also predictive of a repeat admission within the next year.

On the other hand, individuals with a second hip fracture diagnosis were less likely to stay in hospital a long time. Whether this diagnosis represents a new hip fracture or additional care for the previous hip fracture, it is difficult to determine. A chart review of patients with second hip fracture diagnoses would be helpful in resolving these issues.

Length of stay was extremely predictive of nursing home admission. Patients often wait in hospital for a nursing home bed due to difficulties in supporting the individual at home during the waiting period.

Length of stay can also be a reflection of hospital practises. Black et al. (1993), after controling for a number of factors, determined that length of stay still varied significantly by hospital in Manitoba.[208] Within the Length of Stay Greater than 100 day model, region, rural location, admission day, transfer without admission, fiscal year, admitting and repair hospital variables contributed significantly to the variation in length of stay. These findings suggest a significant delivery of care contribution to the length of stay in hospital.

In summary, length of stay is influenced by a number of factors, and many of these, such as complication incidence, presence of a support person at home, preadmission functional status, etc., were not controlled for in this study. Better characterization of these factors would improve the length of stay model and the ability to understand and influence the drivers of a long and costly hospital stay.

Second Hip Fracture

A diagnosis of a second hip fracture after the index episode of care occurred in 9.3% of the hip fracture patients, consistent with the literature which suggests a range of 6.5% to 10.6%.[113] Hip fractures which occur after the index episode of care may be the result of the factors which determine falls, osteoporosis and frailty. A second hip fracture is a sign of failed tertiary prevention and could be a measure of the effectiveness of preventative efforts. The degree to which initial hip fracture management contributes to further fractures would be important in terms of improving the quality of care for hip fracture patients.

In this study, very few of the variables were predictive of a second hip fracture. However, age and nursing home residence were extremely predictive and some of the comorbidity characteristics associated with falling (seizure disorder, alcoholism) were also predictive. There are number reasons why chronic obstructive lung disease may have been associated with second hip fracture (see previous) but this finding has not been observed elsewhere.

Chiu et al. (1992) found that nursing home admission, Parkinson's disease, cerebral vascular disease and osteomalacia were significant predictors of a second hip fracture.[113] Wolinsky and Fitzgerald (1994), in their multivariate analysis of data from the charts of second hip fracture patients enrolled in the Longitudinal Study on Aging, found only poor perceived health status and dizziness were predictive of a second fracture.[209] Nursing home residence, history of breathing problems or chronic obstructive lung disease, alcoholism or seizure disorder were not included as variables in this study.

With regard to the outcome variables, as would be expected, second hip fracture was significantly associated with a repeat primary repair, a secondary repair procedure and readmission. Second hip fracture was also associated with the diagnosis of a late effect of hip fracture care. This finding may indicate a fracture in the same hip as the initial surgery or that the hip fracture diagnosis is being used for admissions for failed repairs.

Interestingly, second hip fracture was inversely related to mortality within a year of hip fracture admission. Early mortality may not provide an opportunity to refracture a hip. However, the length of stay for patients who have a second fracture is much shorter than for those did not have a second fracture. It is possible that longer hospitals stays may improve the chances for recovery from the fracture and may reflect more careful discharge planning. A second hip fracture was not associated with a new nursing home admission.

Diagnosis of a Late Effect of Hip Fracture Care

In this study, late effect diagnoses were grouped together to form a single outcome variable. The diagnoses used as late effect diagnoses were restricted to those diagnoses that would be specific to a repair failure and not general complications of a procedure, such as pulmonary embolus, inability to walk, etc. These could be addressed in a future study. In addition, with further analysis of this study, some of these specific outcomes could also be identified for the specific repair procedures.

Overall 9.1% of the hip fracture patients suffered a late effect. At 5 years, the surviving patients, had a 12% chance of having this diagnosis. Lu-Yao et al (1994), in a metaanalysis, documented a number of late effects after transcervical fractures and found that the rate of loss of fixation or reduction after an internal fixation ranged from 9 to 27 percent. However, for arthroplasty, the range was between 2 and 3 percent.[82] This difference in late effect outcomes between arthroplasty repair and other types of repairs was confirmed in the logistic regression analysis conducted in this study.

The regression analysis shown in Table 16 reveals that except for age, the patient demographic characteristics and comorbidity characteristics play less of a role than the fracture characteristics, treatment and delivery of care variables. The significance of factors, such as choice of repair procedure, hospital repair frequency, surgical repair frequency and even admission day, suggest that significant improvements in delivery of care factors would substantially improve repair complications.

With regard to the impact of the late effect diagnosis on other outcomes, as would be expected, this diagnosis was significantly associated with a repeat primary repair procedure, a repeat secondary repair procedure and repeat admission within one year. However, late effect diagnoses were not associated with mortality or nursing home admission.

Subsequent Repairs

A second hip fracture or a failure of a fixation device may result in the decision to surgically repair the femur. These repairs may be primary or secondary depending on the problem and the presence of a previous fixation device. However, the decision to repair a second fracture or a failing fixation device may be much more variable than the initial hip fracture repair. Factors such as age, chronic disease, anaesthetic risk, severity of the problem, functional status and surgical experience may play a more important role. The degree of surgical discretion involved in performing additional repair procedures has not been well studied. However, the degree of surgical discretion for total hip replacements is high.[111]

The validity of these outcome variables is dependent on how the repairs relate to the index fracture. Using administrative data there is no way to determine if the subsequent repair was conducted on the same or the other hip. This issue introduces some degree of uncertainty in the conclusions that can be drawn from these results.

Overall 12.6% of the hip fracture patients had a repeat primary repair. Of these patients, 36.8% had a diagnosis of a second hip fracture. For the secondary repairs, 8.7% of the hip fracture patients underwent these procedures. Of these patients, 19.2% had a diagnosis of a second hip fracture. The factors associated with subsequent repairs were mainly the fracture type, the length of stay in hospital (which suggests complications), the repair type, fiscal year, the diagnosis of a late effect or a second hip fracture. These factors all suggest that improved management of the different types of fractures may decrease the likelihood of a subsequent repair. In addition, the sex difference between the two types of subsequent repair procedures warrants investigation.

The relationship of the subsequent repair procedures to time shows differences between the two types of procedures. Secondary repair procedures seem to mirror the late effect diagnoses trends over time. They both occur primarily within the first two years after the fracture and occur far less frequently than primary repair procedures (15% at 10 years versus 28% at 10 years). Primary repair procedures show a linear relationship with time and seem to mirror the second hip fracture time trends. From this data, it appears that the driver of the secondary repair procedures are late effects and that repeat primary repair procedures may be the result of second hip fractures. Long term follow up of subsequent procedures and their relationship with complications for all types of hip fractures have not investigated on a population basis in the literature before. Further investigation of these trends are recommended. An important follow up to this analysis would be to examine repair specific outcome trends.

Lu-Yao et al. (1994), in a meta-analysis of transcervical fractures, found that the overall reoperation rate for a displaced transcervical fracture was 2.5 times greater for those patients who received an internal fixation than those who received an arthroplasty.[82] This lower reoperation rate for arthroplasty was supported by the regression analysis for both primary and secondary repairs in this study.

With regard to the other outcome variables, repeat primary repair procedures were associated with readmission within the next year after discharge from the index episode of care. However, secondary procedures were not associated with readmission within one year and were inversely related to mortality within one year of hip fracture admission. These findings suggest that many secondary repair procedures may be occurring after one year from hip fracture admission.

Neither of the subsequent repair procedures were associated with nursing home admission within one year of discharge.

Survival

Since 25.5% of the hip fracture patients die within one year, death appears to be a relatively sensitive indicator for adverse events. This mortality was better than the 33.5% on year mortality found by Keene et al. (1993) in a study of 1000 consecutive fractures in Britain.[175] Fisher et al. (1991) in a population based study of the Health Care Financing Administration data found that hip fracture patients from 1984 to 1986 had a one year mortality of 23.7%.[2] The values for one year mortality in the literature range from 14% to 33% and the six month mortality values range from 10% to 44%.[175] In this study, 19.9% of the patients were dead by six months.

Death within the first three months of care after initial admission for hip fracture was chosen as an indicator of the effectiveness of the early management of hip fractures. Since one third of hip fracture patients were still in hospital after 60 days, 90 days was chosen as an indicator of the quality of early hip fracture management. In this study, the three month mortality rate was 15.2%. Fisher et al. (1991) found a 90 day mortality of 12.5%.[2]

Death between three months and one year was used to determine long term indicators of mortality. Long term indicators of mortality were hypothesized to be different from the short term indicators of mortality which were more likely to represent delivery of care concerns.

Robbins (1989) noted that it has been well established in the literature that the mortality rate after hip fracture was significantly greater than that seen in age, sex and race matched controls. Mortality was noted not to be specifically related to the period of hospitalization, but to remain increased until about six months after the initial fracture.[10] Robbins (1989) also noted in his review of hip fractures that very few studies have looked at the interrelationships of the various factors that affect hip fractures.[10] His study looked at various physiological indicators of poor outcomes, such as low mental status, weakness, restricted activities of daily living, high urea, chest film suggesting heart disease, low albumin, abnormal lung exam, malignant disease by history, or heart, lung, neurological or endocrine disease by history in a regression model. His findings compliment to those found in this study with regard to comorbidity. He did not find that age was a predictor of mortality in his study after controlling for the other variables but he did find that males were more likely to die than females.

In the current study, it appears that certain patient characteristics, including demographic variables, fracture characteristics and comorbidities play important roles in mortality. As well, a number of treatment and delivery of care variables were also important but were less significantly associated with mortality. Transfers without admission and accidents that occur in hospital were, the exceptions. Further study of these indicators would be important to determine what aspects of care make mortality more likely.

As was hypothesized, the delivery of care concerns were much less important for mortality between three months and one year than it was within the first three months after admission.

With regard to the influence of mortality on other outcomes, as would be expected, death within three months of the hip fracture was inversely related to readmission within one year and nursing home admission.

Death between three months and one year after the hip fracture procedure was also inversely related to nursing home admission. However, three month to one year mortality was significantly predictive of readmission within the next year.

Readmission within one year

Readmission within one year of discharge from the hip fracture episode of care was not associated with any of the treatment variables. However, readmission was associated with comorbidity characteristics, delivery of care variables and complications of care. The complications of care are prominent in this model: accident in hospital; long length of stay; second hip fracture; late effect diagnosis; repeat primary repair. Also prominent are the variations between regions and hospitals. This finding suggests considerable discretionary practises among the various hospitals. However, this may be related to the availability of community supports, but this should not be a factor within urban areas. Further research in this area may determine best practise.

As would be expected, readmission within one year of the fracture was predictive of nursing home admission.

Nursing Home Admission

Overall, 36.9% of the hip fracture patients were in a nursing home within one year after discharge from their index episode of care. Of the people not in a nursing home at the time of their fracture, 13.3% were admitted to nursing home within one year after their fracture. The logistic regression analysis was performed on these individuals.

The association with age, dementia, cerebral vascular disease, Parkinson's Disease, alcoholism and total length of stay and readmission and even accident location are predictable. The association with residence region and admitting hospital suggests discretionary practises in nursing home admission. However, the association between fiscal year and the repair interaction and nursing home admission is less clear. It may be that patients selected for open reduction and internal fixation and internal fixation and no reduction in the latter part of the study are less functional than those receiving other repairs. Finally the relationship between repair day and nursing home admission is unexpected. This relationship disappears when only urban residents are analyzed.

The inverse relationship between death and metastatic cancer and nursing home admission, suggests that the nursing home admission criteria is adept at identifying those patients who are unstable.

Evaluation of the Models

The intent of this thesis was to determine the extent to which patient characteristics, treatment options and the delivery of health care services impact on hip fracture outcomes. The models presented here examined a series of indicators intended to measure these factors. For the models using logistic regression, the Goodness of Fit statistic was calculated. For length of stay, the model using the patients treated within 10 days was found to be a good model. However, the model using all the patients did not fit the data. This finding is not unexpected since the larger model includes those patients who had their hip fracture in hospital and those patients who did not have a repair procedure. These patients were not typical hip fracture patients.

The readmission model also did not fit the data. This finding suggests there are other factors that are involved in predicting readmission. This study did not control for the various medical complications that could arise after a hip fracture. Further analysis using variables controlling for these factors is recommended. In addition, various social factors, such as presence of a support person in the home, may also contribute to the ability of the individual to cope at home.

The mortality within three months of admission model was found to fit the data but the mortality from three months to one year model did not. This finding was not unexpected. In fact, factors associated with the hip fracture were hypothesized to have less of an impact on mortality over time. Control for medical complications may also improve this model.

Finally, the nursing home admission models did not fit the data. Social factors, such as the presence of a support person in the community may influence nursing home admission. This factor was not controlled for in this study.

Testing of the models could not be performed on proportional hazards analysis because similar statistical tests do not exist. However, several models appeared to predict very little of the variation in the outcome.

For second hip fractures, the model did not appear to be capturing the major predictors of a second hip fracture. Conversely, a problem in defining a second hip fracture itself may be present. This area requires further research.

The prediction of a diagnosis of a late effect of hip fracture care was another outcome for which the model appeared to predict a low amount of the total variation. In this case, the diagnosis of a late effect itself is likely discretionary and may not represent the true incidence of late effects.

Pre-existing functional disability has been shown in the literature to have a significant impact on hip fracture outcomes.[79] No direct measure of this in the hospital claims data exists. The accident location and history of previous admission variables may be capturing some measure of this. However, the exact relationship is unknown. The predictive power of future research would be significantly enhanced if a mechanism to assess this factor could be included in administrative data analysis.

D. Conclusions

This thesis has provided information on the outcomes of hip fracture care in Manitoba and the various factors which influence these outcomes. Important indicators were established for use in future studies and difficulties in the use of other indicators have been identified. Direction has been given for further research and a methodology has been demonstrated to help others analyzing outcomes of care in Manitoba. Although definitive action can not been derived from most of the findings presented here, the intent of the study was not to do so, but to focus future research into areas where important findings are likely. Step II in the Health Care Financing Administrative Framework for Quality Assurance[31] has been accomplished.

The review of specific aspects of care constitutes Step 3 of the Health Care Financing Administration Framework for Quality Assurance.[31] This step has been enabled by this study. The suggested areas for future research into the determinants of adverse outcomes for hip fracture patients in Manitoba are listed in Table 27.

Specific recommendations for future research on the delivery of care in Manitoba were made in several areas. Arthroplasty appeared to have much better outcomes than internal fixation. Discussion with the orthopaedic community and further specific research was recommended. Nursing home patients often have very short stays in hospital but have a significantly increased likelihood of a second fracture. The quality of rehabilitative care received by these patients was highlighted for investigation.

Patients who fracture their hip while in hospital are at risk for significant complications. The importance of prevention of in hospital fractures was emphasized. Recommendations for the avoidance of home accidents were also provided. Patients transferred without admission to hospital were at risk for a number of adverse outcomes. These patients may constitute a high risk patient group or reflect a poor patient management practise. Further investigation was recommended.

The sex differences in the types of subsequent repairs received by women and men raise interesting questions. Are hip fracture complications different for men and women or are there sex biases in treatment? Further research is required in this area.

Hospital, regional and rural versus urban differences in length of stay, nursing home admission and readmission suggest differences in the services provided in different areas. Some of these differences may reflect care decisions but differential access to services may also be occurring.

This thesis provided a framework for assessing quality of care. Currently, no overall evaluation of hip fracture care occurs. The use of overall feedback on outcomes of care procedures to physicians and care providers and the use of care maps have been shown to improve hip fracture outcomes.[95,96] Evidence in Manitoba suggests that at least one hospital (Hospital C) may be superior in their care practises. Opportunities exist for collaboration and to share information. Guidelines should be developed for health care professionals. Sweden has a population based data system for providing complication rates for total hip replacements to health care providers. Consideration should be given to a similar program in Manitoba to evaluate hip fracture care.

This thesis provided a detailed evaluation of a number of indicators and their impact on outcomes. A study of this size had the opportunity to explore the impact of rarer risk factors and identify their unique influence on hip fracture outcomes. Important comorbidity indicators, specific to hip fractures, were identified. Different outcomes were found to be influenced by different comorbidities. Nursing home admission was significantly associated with comorbidities that required significant care giver support, such as dementia and cerebral vascular disease. Mortality was associated with many but not all of the Charlson Variables. Chronic Obstructive Lung Disease (COPD) was identified as important predictor of several adverse outcomes. This relationship is not well described in the current literature.

The increase in mortality during the fall in comparison to the spring proposes interesting questions. What is the relationship between influenza and hip fractures? Further investigation into this relationship is recommended.

Population based data on a number of hip fracture outcomes was provided by this study. In addition to short term outcomes, the trends in complications were followed over 12 years. Following complications for this length of time had not been seen in the literature on a population basis for hip fracture complications. The discussion and comparison of indicators across outcomes is unique to this study and provides a comprehensive picture of how a particular factor influences a number of outcomes. This discussion allows linkages and relationships to be seen that otherwise would have gone unrecognized. For example, the sex differences in subsequent procedures or the short hospital stays for nursing home patients and the high refracture rates.

Certain factors could not be measured by this study, such as prefracture functional status and the presence of social support at home. The literature suggests that these factors play a prominent role in hip fracture recovery. If a measure of these variables could be found in administrative data, more refined assessments of hip fracture care could occur. Consideration should be given to added fields for this data. In addition, the evaluation of the medical complications of hip fracture care would provide better explanations for long lengths of stay and may identify particular problem areas in the different hospitals. A study of these complications is possible using administrative data. The use of these variables may have improved the fit of the models.

Time to surgery was hypothesized to play an important role in adverse outcomes in Manitoba due to the large geographic distances that some patients must travel for a hip fracture repair. The lack of its importance may be related to an interaction between comorbidity and time to surgery. Further research evaluating this interaction is recommended.

The burden of illness resulting from a hip fracture and the cost of hip fracture care is significant in Manitoba. With the ageing of the population, these impacts will likely increase. Increased effort into further evaluating hip fracture care and into striving for excellence by providing both effective and efficient care are likely to make significant gains into the quality of hip fracture care. However, increased effort should also be put into strategies for preventing hip fractures. Exercise, social contact, and the absence of depression, diabetes, chronic obstructive lung disease, arthritis, and hearing problems are factors that have been associated with successful ageing.[210] Prevention of bone fragility, falls and frailty in the elderly has the potential to reduce the incidence of hip fractures.[59] However, for many of these factors, for example, the development of bone mass, the avoidance of COPD, diabetes, etc., preventative activities are required much earlier in life.

Table 27

Summary of Future Research Requirements

Indicator / Issue	Research/Activity Required
Accident Location Indicator -	
Very predictive of adverse events - may be a proxy measure for functional status	The relationship between this indicator and prefracture functional status should be explored.
No Known Accident and Other Accidents	These indicators may be a mixture of patient types. A chart review is necessary to determine the characteristics of these patients.
In hospital hip fractures were very predictive of adverse outcomes	Examination of the risk factors for in hospital falls and hip fractures may help decrease their incidence
Two Thirds of the accidents occurred at home	Examination of approppropriate strategies to prevent falls in the home in Manitoba should be considered.
Age -	
less hip fractures identified in patients over 100 years of age.	Examine the 1% discrepancy between physician and hospital claims for hip fracture to determine age of physician claims patients to determine if these patients are treated out of hospital

Arthroplasty - Results of this study suggest superior outcomes with the arthroplasty technique. This is supported by recent evidence in the literature. Arthroplasty (continued) This study did not find a relationship between three month mortality and arthroplasty that was found by Lu-Yao et al. (1994)[101]	Consideration should be given to consultation within the orthopaedic community as to their experience and the design of more definitive studies if necessary. The long term outcome diagrams of each repair (See Repair Type) and a more detailed breakdown of the complications may be instructive Further population based studies are required to clarify this issue. The orthopaedic community should assess the clinical significance of a RR= 1.2 to their practise.
Closed Unspecified Hip Fracture Indicator - The types of patients who are classified with this diagnosis are unknown. Analysis in this study suggests a mix of patients.	A chart review to further characterize this group may be instructive to determine the true distribution of fracture types and eliminate those patients who did not have a true hip fracture.
Complications - All the potential complications of hip fracture care were not included in this study.	Further expansion of this study to examine major complications of care, such as deep vein thrombosis, pulmonary embolus, etc., would be instructive. Linkage with the evaluation of the Winnipeg Hospital System Study chart review data may provide insight into the accuracy of the coding of the complications.[187] In addition, the specific complications of hip fracture procedures could also be examined for each procedure in this way.

COPD Strongly associated with a number of adverse hip fracture outcomes but has not been identified previously in the literature	Further studies of this indicator are needed to confirm this relationship
Day of the Week of Fracture Admission - Length of Stay and Late Effect Diagnoses were associated with a particular day of admission.	Examination of weekly care patterns in emergency departments and orthopaedic wards may reveal whether variation in patient care occurs based on the day of the week of admission.
Fracture Type - Differences in complication rates may be explained by a survival bias (Also see Closed Unspecified Hip Fractures)	Further analysis of the data in this study, specifically, plotting survival curves and major complication curves by fracture type or controlling for early mortality in the Repeat Primary Repair Model may provide insight.
Functional Status - There is no true measure of functional status in hospital claims data. This factor is very predictive of hip fracture outcomes	If future evaluative efforts for hip fracture care and other medical care procedures using hospital claims data are to be conducted, inclusion of an indicator of function status in the hospital abstracts would improve the conclusions that can be drawn.
Guidelines - No provincial guidelines exist for hip fracture care	It is recommended that the College of Physicians and Surgeons of Manitoba and the Manitoba Association of Registered Nurses develop practice guidelines for hip fracture care.

Hospital C - Hospital C seems to differ from most of the other hospitals. In most cases, it appears to have better outcomes.	Examination of the practises in this hospital compared to other hospitals of its size may be instructive in determining factors to improve hip fracture outcomes in Manitoba.
Hospital Repair Type and Hospital Frequency Indicators The 1985 guideline on appropriate facilities for hip fracture repair may have had an impact on this study	Examine the number of repairs before and after 1985 for each hospital type and hospital repair frequency level to determine if the guideline had any impact on practise
No Repair Indicator The percentage of patients in the no repair group is higher than reported in the literature - may contain patients other than those that were medically unfit for surgery.	A chart review of patients in this category may be instructive. In addition, it may be beneficial to plot this indicator over time. Some information in the literature suggest that more patients are being considered for surgery now than in the past due to improved surgical techniques.[78,96]
Nursing Home Residence - Nursing Home residence was extremely predictive of a second fracture. In addition, Nursing home residence was extremely predictive of short length of stay. These findings suggest that these patients may not be receiving appropriate rehabilitation	An examination of the rehabilitative care that these short stay hip fracture patients receive in nursing home may provide insight into ways to improve the quality of care.

Readmission - **Findings suggest discretionary practises as to who gets admitted to hospital among the various hospitals**	**A comparison of Hospital C with other urban hospitals may be a useful.** **A comparison of admission rates with community supports may also be instructive**
Region of Residence **- Winnipeg- longer hospital stay but less readmissions**	**Examination of the discharge planning practises and community supports available for Winnipeg and Non-Winnipeg residents may be instructive**
Renal Disease - **Reduced readmissions for patients with renal disease**	**Examination of the care of renal patients to determine frequency or contact with the medical system and whether all hospital / dialysis admissions are counted.**
Repair Type **Very little research has been done on the long term complications of each repair type.** **Internal Fixation** **(also see arthroplasty)**	**A logical extension of this study would be plot the probability of patients remaining free of a late effect diagnosis, repeat primary repair or secondary repair by repair type over time.** **Future research should combine procedure codes '7855', '7915' and '7935'.**
Scheduled Admission Indicator	**Research is required to determine the attributes of the patients characterized by this indicator - chart review suggested.**

Second Fracture -Determine if what is coded as a second hip fracture actually is a second fracture	Review of charts which were coded as a second fracture.
Sex differences in repeat primary and secondary repairs The reason for these sex differences is not obvious in this study and a number of confounding variables were controlled for.	More research is needed to determine what factors lead to the choice of a repeat primary or a secondary repair procedure in Manitoba.
Socioeconomic Status Indicator	The development of an indicator not based on location of residence is recommended to assess the relationship between socioeconomic status and hip fracture in the elderly
Surgical Skill	Research suggests that a registry of hip fracture replacement procedures may inform and improve repair outcomes. A structure exists in Manitoba to inform and disseminate this information to physicians. Manitoba has a population based data base with repair procedures already coded. Modification of this system could be made to make it more accurate for conclusions to be drawn. Interest and feasibility of this proposal should be explored further. It is not clear why physicians performing less than 25 repairs per year would have less late effect diagnoses than those performing 25 to 125 repairs. Investigation as to who these surgeons are may help explain the finding.

Time to Surgery - **The findings from this study and others suggest a possible interaction effect between comorbidity and time to surgery.**	 **A future study should examine this interaction**
Transfers - **The transfer without admission variable is very predictive of adverse outcomes. It is not clear what this variable is measuring but it has a significant impact on outcomes** **Transfer before a repair variable has a different influence on outcomes than the above variable.**	 **Analysis of the hospital charts to determine the characteristics of patients with and without these codes may give an indication of the reason for their relationship with adverse outcomes.**

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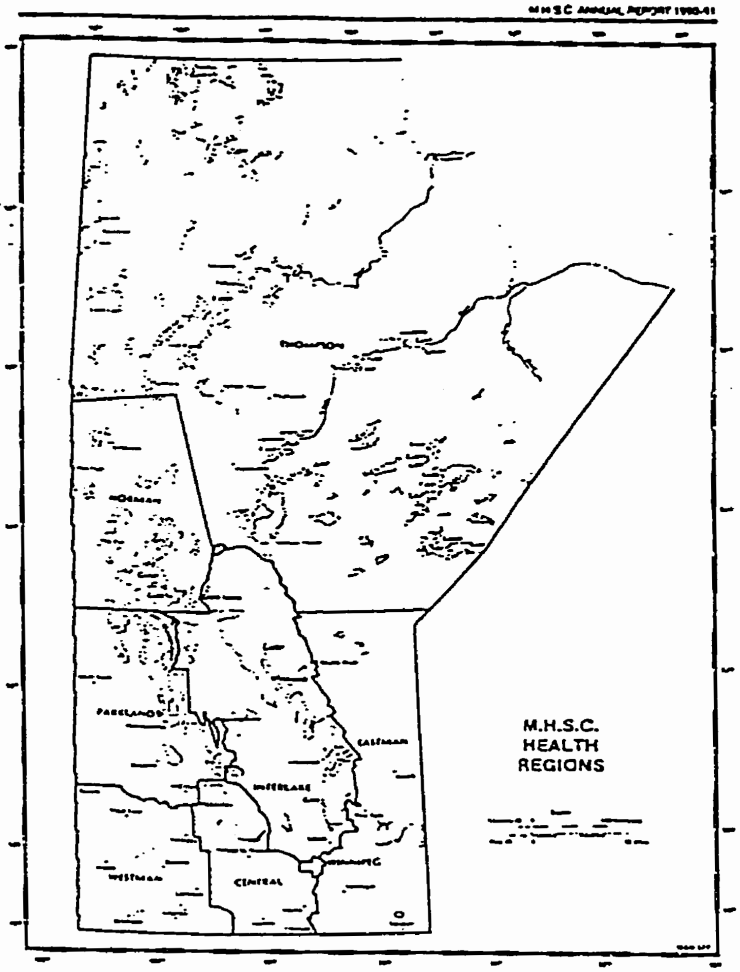
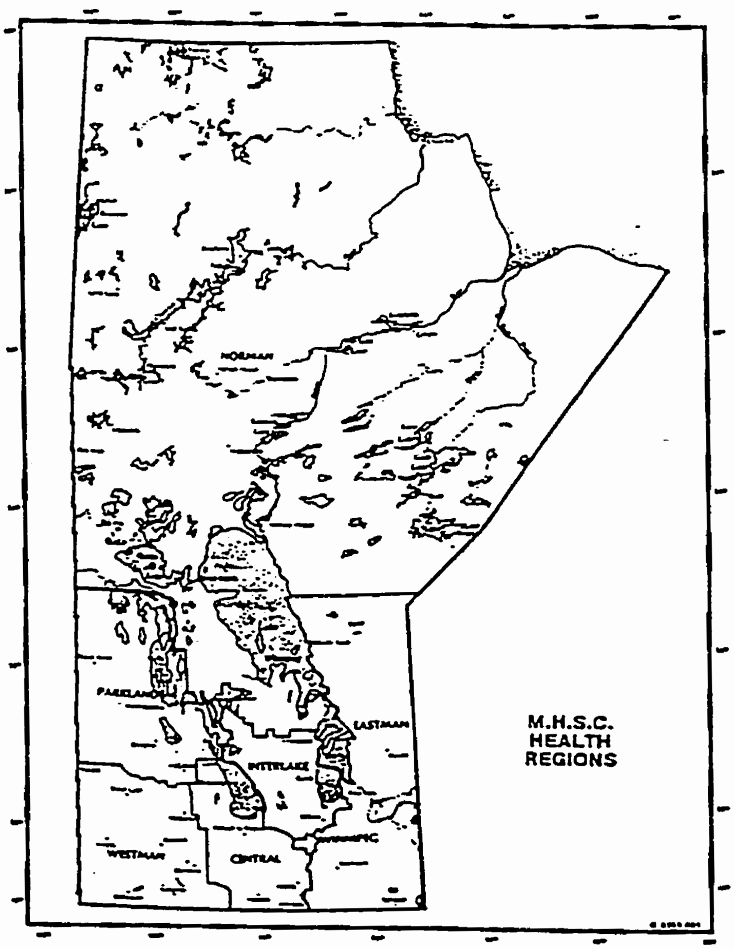

M.H.S.C.
HEALTH
REGIONS

APPENDIX 1


NORMAN
EASTMAN
INTERLAKE
WESTMAN
CENTRAL
M.H.S.C.
HEALTH
REGIONS

Appendix 2

Population of Manitoba

TABLE 1

Population of Manitoba by Health Region[1], Age and Sex – June 1, 1991

HEALTH REGION	SEX	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+	Total
	M	4,034	4,376	4,092	3,978	3,301	3,481	3,774	3,421	2,939	2,377	2,069	1,862	1,855	1,782	4,109	47,450
Central	F	3,867	4,122	3,938	3,738	3,015	3,519	3,679	3,323	2,764	2,293	2,067	1,873	2,012	2,073	5,383	47,666
	T	7,901	8,498	8,030	7,716	6,316	7,000	7,453	6,744	5,703	4,670	4,136	3,735	3,867	3,855	9,492	95,116
	M	3,877	4,095	3,991	3,846	3,164	3,490	3,745	3,482	3,051	2,491	1,997	1,778	1,683	1,462	2,868	45,020
Eastman	F	3,807	3,922	3,855	3,502	2,891	3,422	3,601	3,413	2,830	2,238	1,864	1,655	1,576	1,468	3,252	43,296
	T	7,684	8,017	7,846	7,348	6,055	6,912	7,346	6,895	5,881	4,729	3,861	3,433	3,259	2,930	6,120	88,316
	M	2,967	3,018	2,915	3,239	2,656	2,804	2,934	2,976	2,734	2,225	1,830	1,841	1,650	1,451	2,999	38,239
Interlake	F	2,703	2,817	2,779	2,943	2,395	2,749	2,910	2,816	2,625	2,047	1,785	1,759	1,548	1,558	3,507	36,941
	T	5,670	5,835	5,694	6,182	5,051	5,553	5,844	5,792	5,359	4,272	3,615	3,600	3,198	3,009	6,506	75,180
	M	1,127	1,108	1,094	1,213	973	1,075	1,241	1,014	961	606	545	443	391	313	548	12,652
Norman	F	1,151	1,065	1,065	1,118	1,017	1,096	1,115	913	790	601	490	375	360	303	712	12,171
	T	2,278	2,173	2,159	2,331	1,990	2,171	2,356	1,927	1,751	1,207	1,035	818	751	616	1,260	24,823
	M	1,710	1,813	1,870	1,954	1,564	1,489	1,591	1,603	1,470	1,278	1,126	1,106	1,214	1,238	2,809	23,835
Parklands	F	1,586	1,669	1,822	1,786	1,262	1,411	1,531	1,537	1,370	1,245	1,021	1,114	1,206	1,270	3,443	23,273
	T	3,296	3,482	3,692	3,740	2,826	2,900	3,122	3,140	2,840	2,523	2,147	2,220	2,420	2,508	6,252	47,108
	M	3,361	2,849	2,616	2,644	2,374	2,418	2,002	1,602	1,459	1,187	938	612	406	249	431	25,148
Thompson	F	3,208	2,694	2,443	2,424	2,339	2,374	1,890	1,628	1,310	970	744	504	329	246	435	23,538
	T	6,569	5,543	5,059	5,068	4,713	4,792	3,892	3,230	2,769	2,157	1,682	1,116	735	495	866	48,686
	M	4,185	4,377	4,297	4,332	3,723	4,127	4,459	4,247	3,856	2,908	2,528	2,557	2,866	2,699	6,162	57,323
Westman	F	4,022	4,223	4,038	4,073	3,605	4,232	4,456	4,093	3,752	2,909	2,652	2,685	2,856	3,020	8,443	59,059
	T	8,207	8,600	8,335	8,405	7,328	8,359	8,915	8,340	7,608	5,817	5,180	5,242	5,722	5,719	14,605	116,382
	M	22,644	21,387	20,252	21,425	24,529	30,140	29,730	26,427	23,396	17,605	14,091	13,399	12,366	11,465	21,259	310,115
Winnipeg	F	21,603	20,119	19,357	20,683	25,342	29,647	28,975	26,732	24,130	17,914	14,608	13,764	14,102	14,950	35,465	327,391
	T	44,247	41,506	39,609	42,108	49,871	59,787	58,705	53,159	47,526	35,519	28,699	27,183	26,468	26,415	56,724	637,506
	M	43,905	43,023	41,127	42,631	42,284	49,024	49,476	44,772	39,866	30,677	25,124	23,598	22,431	20,659	41,185	559,782
Manitoba	F	41,947	40,631	39,297	40,267	41,866	48,450	48,157	44,455	39,571	30,217	25,231	23,729	23,989	24,888	60,640	573,335
	T	85,852	83,654	80,424	82,898	84,150	97,474	97,633	89,227	79,437	60,894	50,355	47,327	46,420	45,547	101,825	1,133,117
Indian	M	4,859	3,959	3,320	3,200	2,931	2,631	2,173	1,528	1,250	987	781	609	460	365	638	29,691
Bands	F	4,633	3,681	3,148	3,095	3,065	2,843	2,182	1,599	1,187	870	712	675	424	332	642	28,988
	T	9,492	7,640	6,468	6,295	5,996	5,474	4,355	3,127	2,437	1,857	1,493	1,184	884	697	1,280	58,679

[1] *Indian Band Populations are included in respective regional and Manitoba counts.*

Source: Manitoba Health, 1992. Annual Report: 1991-1992, Manitoba: Government of Manitoba

Appendix 3

...ealth Services Commission

ADMISSION/SEPARATION ABSTRACT

M.H.S.C. 48A (10/80)

M.H.S.C. USE ONLY

ABSTRACT TYPE
1 - ADULT/CHILD
2 - PEDIATRIC
3 - OBSTETRICAL
4 - NEWBORN
5 - REHAB. & RESPIRATORY

HOSP. NO. | M.H.S.C. REG. NO. | ADMISSION TIME & DATE (HR. MIN. DAY MO. YR.) | SEPARATION TIME & DATE (HR. MIN. DAY MO. YR.) | DAYS OF CARE (PRIV. SEMI) | TOTAL DAYS STAY | HEALTH RECORD NO.

PATIENT'S SURNAME | GIVEN NAME | SEX | DATE OF BIRTH (DAY MO. YR.) | AGE | PREVIOUS NAME(S)

PERMANENT HOME ADDRESS R.R. GROUP BOX AND OR STREET AND NUMBER | CITY, TOWN, VILLAGE | MUNICIPALITY, POSTAL CODE | TELEPHONE NO.

HOSPITAL USE ONLY

REGISTRANT (IF PATIENT IS A DEPENDANT) SURNAME - GIVEN NAME & INITIAL | REGISTRANT'S EMPLOYER | PATIENT'S EMPLOYER

NEAREST RELATIVE OR FRIEND - NAME & ADDRESS | TELEPHONE NO.

DATE PREVIOUSLY ADMITTED TO THIS HOSPITAL | COMPLETE IF PATIENT NOT REGISTERED WITH M.H.S.C. ARRIVED IN MAN. ON | PREVIOUS ADDRESS: | ○ TEMPORARY STAY | ○ PERMANENT STAY

PATIENT TYPE | ACCOM. REQ. | RESPONSIBLE FOR PAYMENT (IF Code 93 Provide Declaration Number) | ENTRY CODE/ADMIT STATUS

ACCIDENT: DAY | MO. | YR. | LOCATION | MEDICAL ALERT

REASON FOR ADMISSION | TRANSFERRED FROM FACILITY

ATTENDING PHYSICIAN | ADMITTING PHYSICIAN | REFERRING PHYSICIAN | FAMILY PHYSICIAN

PHYSICIANS: TYPE | PHYSICIAN NO. | SERVICE (1 M, 2, 3, 4, 5, 6, 7, 8) | NO. OF CONSULTATIONS | TOTAL DAY CARE VISITS

DIAGNOSES CODES/TYPES: 1 M, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

TOPOGRAPHY: 1, 2, 3 | MORPHOLOGY: 1, 2, 3

PROCEDURES: DAY | MO. | PROCEDURE CODE | TISS. | OUT. | SURGEON | SERVICE | LOC. | ANAES. (1–6)

TRIPS TO O.R.

OBSTETRICAL: ANAES. CODE | C.S. TYPE | DELIVERY PHYS. | SERVICE | GRAVIDA | PARA | ANTE-PARTUM DAYS | NO. OF PREVIOUS ADMISSIONS THIS PREGNANCY

ANTE-PARTUM RISK SCORE (1ST VISIT, ON ADMISSION, ON DELIVERY) | GESTATION (1ST VISIT, ON DELIVERY) | NUMBER OF PRENATAL VISITS | FOETAL ASSESSMENT | WEIGHT IN GRAMS | HEALTH RECORD NO.

NEWBORN: PRESENTATION | ELEVATED BILIRUBIN | RESUSCITATION | FEEDING | WEIGHT IN GRAMS | GESTATION | HEALTH RECORD NO.

PATIENT SERVICE: SERVICE CODE | DAY | MO.

FACILITY TRANSFER

AUTOPSY | MEDICAL EXAMINER | DEATH O.R. RELATED | TRAUMA | PREGNANCY | OTHER

ABSTRACT NO.

0 76858 5

CLAIM NUMBER

1 - M.H.S.C. COPY

Admission/Separation Form for Personal Care Home and Respite Care

Appendix 4

Manitoba Health Insured Benefits Branch
P.O. Box 925
599 Empress Street
Winnipeg, Manitoba
R3C 2T6

THIS FORM MUST BE COMPLETED WITHIN 96 HOURS OF ADMISSION OR SEPARATION, AND DISTRIBUTED AS INDICATED AT THE BOTTOM OF EACH PAGE.

1. INSTITUTION DATA

NAME OF INSTITUTION	INSTITUTION NO.
ADDRESS	POSTAL CODE
	M.H.S.C. USE ONLY

2. RESIDENT DATA

SURNAME	GIVEN NAMES	DATE OF BIRTH (DAY / MO. / YEAR)	MALE 1.	FEMALE 2.	M.H.S.C. REGISTRATION NO.
RESIDENCE IMMEDIATELY PRIOR TO ADMISSION	R.R. GROUP, BOX AND/OR STREET AND NO.	CITY, TOWN, VILLAGE, MUNICIPALITY			

3. ADMISSION DATA

DATE OF ADMISSION (DAY / MO. / YEAR)	ADMITTED FROM	HOME 1.	ACUTE HOSP. 3.	EXT. TRT. HOSP. 4.	MEN. HLTH. CTR. A.	RES. CARE FAC. B.	OUT-OF-PROV. C.	P.C.H. 6.	OTHER (SPECIFY) 8.

NAME OF TRANSFERRING INSTITUTION (IF APPLICABLE)	FOR M.H.S.C. USE ONLY

ADMITTED AT LEVEL		1, 2, 3, 4 MUST BE THE SAME AS LAST ASSESSED LEVEL	ACCOMMODATION STANDARD 1.	PAID PREFERRED 2.	PREFERRED ACCOMMODATION CHARGED TO

RESPONSIBLE FOR PAYMENT						
	RESIDENTIAL CHARGE	PROV. OF MAN. 1.	GOVT. OF CAN. 2.	W.C.B. 3.	SELF 4.	OTHER (SPECIFY) 5.
	PER DIEM CHARGE	M.H.S.C. 1.	GOVT. OF CAN. 2.	W.C.B. 3.	SELF 4.	OTHER (SPECIFY) 5.

NAME OF ATTENDING PHYSICIAN	

4. CLINICAL DATA ON ADMISSION

DIAGNOSES:	FOR M.H.S.C. USE ONLY
1)	
2)	
3)	

5. SEPARATION DATA

DATE OF SEPARATION (DAY / MO. / YEAR)	TYPE OF SEPARATION	DEATH 9	IN P.C.H. OR WITHIN 24 HRS. OF TRANS. TO HOSP.	HOME 1	ACUTE HOSP 3	EXT TRT HOSP 4	MEN HLTH CTR A	RES. CARE FAC. B.	OUT-OF-PROV. C.	P.C.H. 6.	OTHER (SPECIFY) 8

TRANSFERRED TO: INSTITUTION NAME OR HOME ADDRESS (IF APPLICABLE)	FOR M.H.S.C. USE ONLY

6. CLINICAL DATA ON SEPARATION

DIAGNOSES:	FOR M.H.S.C. USE ONLY
1)	
2)	
3)	

Authorized Signature (Institution)	Date

FORM M.H. 300 (MG-1088)

no date

SEND TO M.H.S.C. ON ADMISSION

M.H.S.C. USE

Appendix 5
Primary Hip Repair Procedures

'7855'	Internal Fixation of Bone Without Fracture Reduction
'7895'	Other Operations on Bone
'7905'	Closed Reduction of Fracture Without Internal Fixation
'7915'	Closed Reduction of Fracture With Internal Fixation
'7925'	Open Reduction of Fracture Without Internal Fixation
'7935'	Open Reduction of Fracture With Internal Fixation
'7975'	Closed Reduction Dislocated Hip
'7985'	Open Reduction Dislocated Hip
'7995'	Unspecified Operation on Bone Injury
'8140'	Repair of Hip Not Elsewhere Classified - includes Arthroplasty (used only after 1990)
'8151'	Total Hip Replacement with Methyl Methacrylate
'8152'	Partial Hip Replacement - Bipolar Endoprosthesis (used only after 1990)
'8159'	Other Total Hip Replacement (before 1990) Revision of Joint Replacement, not Elsewhere Classified (after 1990)*
'8161'	Replacement of the Head of the Femur with use of Methyl Methacrylate (Used only before 1990)
'8162'	Other Replacement of the Head of Femur (Used only before 1990)
'8164'	Other Replacement of the Acetabulum
'8169'	Other Repair of the Hip (Used only before 1990)

Other Primary Procedures

'7805'	Bone Graft of the Femur**
'7965'	Debridement of an Open Fracture Site of the Femur**
'934 '	Skeletal Traction and Other Traction**
'935 '	Other Immobilization, Pressure, and Attention to Wound**

* Separate analysis conducted with and without this code as a primary repair procedure - may include both initial and revision procedures.

** Not considered primary repairs in the exclusion criteria

Appendix 6

Hip Fracture Diagnoses

Transcervical - Closed

'82000'	Intracapsular section, Unspecified
'82002'	Midcervical Section (Transcervical NOS)
'82003'	Base of the neck (Cervicotrochanteric section)
'82009'	Other (Head of the Femur, Subcapital)

Transcervical - Open

'82010'	Intracapsular section, Unspecified
'82012'	Midcervical Section
'82013'	Base of Neck
'82019'	Other

Trochanteric - Closed

'82020'	Trochanteric Section, Unspecified
'82021'	Intertrochanteric Section

Subtrochanteric - Closed '82022'

Trochanteric - Open

'82030'	Trochanteric Section, Unspecified
'82031'	Intertrochanteric Section

Subtrochanteric - Open '82032'

Unspecified Part of the Neck of the Femur - Closed '8208 '

Unspecified Part of the Neck of the Femur - Open '8209 '

Appendix 7

SECONDARY (COMPLICATION) REPAIR PROCEDURES

'7705'	SEQUESTRECTOMY
'7715'	OTHER INCISION OF FEMUR
'7835'	CHANGE IN BONE LENGTH OF FEMUR (78.35 LIMB LENGTHENING PROCEDURES - 1990)
'7845'	OTHER REPAIR OR PLASTIC OPERATIONS ON FEMUR
'7860'	REMOVAL OF AN INTERNAL FIXATION DEVICE, UNSPECIFIED SITE
'7865'	REMOVAL OF INTERNAL FIXATION DEVICE OF FEMUR (78.65 REMOVAL OF IMPLANTED DEVICES FROM BONE - 1990)
'7895'	UNSPECIFIED OPERATION ON FEMUR (NOT INSERTION OF BONE GROWTH STIMULATOR - 1990)
'7975'	CLOSED REDUCTION OF A DISLOCATED HIP
'7985'	OPEN REDUCTION OF A DISLOCATED HIP
'8000'	ARTHROTOMY FOR THE REMOVAL OF PROSTHESIS, UNSPECIFIED SITE
'8005'	ARTHROTOMY FOR THE REMOVAL OF PROSTHESIS
'8015'	OTHER ARTHROTOMY OF HIP
'8025'	ARTHROSCOPY OF HIP
'8095'	EXCISION OF HIP JOINT
'8121'	ARTHRODESIS OF HIP
'8151'	TOTAL HIP REPLACEMENT WITH METHYL METHACRYLATE*
'8153'	REVISION OF HIP REPLACEMENT -1990
'8159'	OTHER TOTAL HIP REPLACEMENT (BEFORE 1990) REVISION OF JOINT REPLACEMENT, NOT ELSEWHERE CLASSIFIED - (AFTER 1990)
'8163'	REPLACEMENT OF ACETABULUM WITH USE OF METHYL METHACRYLATE - (BEFORE 1990)

* Not included in exclusion criteria

Appendix 8

Late Effects Diagnoses

'9053 ' - '90539'	LATE EFFECTS OF FEMORAL NECK FRACTURE
'9964 ' - '99649'	MALFUNCTION OF AN INTERNAL ORTHOPAEDIC DEVICE
'99666' - '99667'	INFECTION AND INFLAMMATORY REACTION DUE TO INTERNAL JOINT PROSTHESIS OR OTHER INTERNAL ORTHOAPEDIC DEVICE, IMPLANT OR GRAFT
'99677' - '99678'	OTHER COMPLICATION OF INTERNAL JOINT PROSTHESIS OR OTHER INTERNAL ORTHOPAEDIC DEVICE, IMPLANT OR GRAFT
'V540 ' - 'V5409'	AFTERCARE INVOLVING REMOVAL OF FRACTURE PLATE OR OTHER INTERNAL FIXATION DEVICE
'73342'	ASEPTIC NECROSIS OF HEAD AND NECK OF FEMUR

Appendix 9

Other Trauma

Pelvic Fractures

'8080 ' - '80899'

Upper Limb Fractures

'810 ' - '81999'

Lower Limb Fractures

'8210 ' - '82119'	Shaft or Unspecified Part of the Femur
'8212 ' - '82999'	Other Lower Limb Fractures

Head Injury

'800 ' - '80499'	Skull Fractures
'850 ' - '85499'	Intracranial Injuries excluding Skull Fractures

Other Injury

'805 ' - '80699'	Vertebral Fractures
'807 ' - '80799' '809 ' - '80999'	Fractures of the Trunk excluding Pelvic Fractures
'860 ' - '86999'	Internal Injuries of the Chest, Abdomen and Pelvis
'900 ' - '90499'	Injury to Blood Vessels
'831 ' - '83499'	Dislocation of Upper Limb Part
'835 ' - '83599'	Dislocation of Hip
'836 ' - '83899'	Other Dislocation of Lower Limb
'839 ' - '83999'	Vertebral or Other Ill-Defined Dislocations

Appendix 10

Diagnositic Codes for Non-Charlson Comorbid Conditions

Coagulopathy

'2860 ' - '2869 '		Coagulation Defects
'2870 ' - '2871 '		Allergic purpura and Qualitative Platelet Defects
'2873 ' - '2875 '		Thrombocytopenia
'2878 ' - '2879 '		Other Hemorrhagic Conditions

Depression

'2962 ' - '2963 '	Major Depressive Disorder
'2965 ' - '2968 '	Bipolar Disorders
'3004 '	Neurotic Depression
'3090 ' - '3091 '	Reactive Depression
'311 '	Depressive Disorder not Elsewhere Classified

Osteoarthritis

'7150 ' - '7159 '

Nutritional Deficiency

'260 ' - '2699 '

Deafness

'389 ' - '3899 '

Blindness

'365 ' - '36849'	Glaucoma, Cataracts, Visual Disturbances
'3686 ' - '3699 '	Blindness and Other Visual Disturbances not including Colour Blindness

Hypertension

Mild / Moderate

'401 ' - '4019 '	Essential Hypertension
'405 '		Secondary Hpertension
'4051 ' - '40599'	Benign and Unspecified Secondary Hypertension

Severe

'402 ' - '40291'	Hypertensive Heart Disease
'403 ' - '40390'	Hypertensive Renal Disease
'404 ' - '40490'	Hypertensive Renal and Heart Disease
'4050 ' - '40509'	Malignant Secondary Hypertension

Alcoholism

'2910 ' - '2919 '	Alcoholic Psychoses
'3030 ' - '3039 '	Alcohol Dependence
'3050 '	Alcohol Abuse

Seizures

'3450 ' - '3459 '	Epilepsy
'7803 '	Convulsions

Parkinson's Disease and Other Movement Disorders

'3320 ' - '3369 '	Parkinson's Disease, Other Disorders of Movement, Muscle Weakness and Myelopathies
'340 ' - '3419 '	Multiple Sclerosis and Other Demylinating Disorders

Bone Tumors Involving the Hip

'1706 ' - '17079'	Malignant Neoplasm of Pelvis, Sacrum and Coccyx and Malignant Neoplasm of Long Bones of Lower Limb
'1953 ' - '19539'	Malignant Neoplasm of Pelvis
'1955 ' - '19559'	Malignant Neoplasm of Lower Limb
'2137 ' - '21379'	Benign Neoplasm of Long Bones of Lower Limb

Disseminated Metastatic Tumours

'1985 ' - '19859'	Seconadary Malignant Neoplasm of the Bone and Bone Marrow
'1990 ' - '19909'	Disseminated Malignant Neoplasm

Pathologic Fractures

'7331 ' - '73319'	Pathologic Fractures but not those with a diagnosis of osteoporosis '7330 ' - '73309'

Osteoporosis

'7330 ' - '73309'

Arrhythmias

'426 ' - '42699'

'4270 ' - '4279 '

Appendix 11

Categories of Primary Hip Repair Procedures for Regression Analysis

No Reduction and Internal Fixation

'7855' Internal Fixation of Bone Without Fracture Reduction

Closed Reduction and Internal Fixation

'7915' Closed Reduction of Fracture With Internal Fixation

Open Reduction - Internal Fixation

'7935' Open Reduction of Fracture With Internal Fixation

Arthroplasty

'8140' Repair of Hip Not Elsewhere Classified - includes Arthroplasty (used only after 1990)

'8152' Partial Hip Replacement - Bipolar Endoprosthesis (used only after 1990)

'8161' Replacement of the Head of the Femur with use of Methyl Methacrylate (Used only before 1990)

'8162' Other Replacement of the Head of Femur (Used only before 1990)

'8164' Other Replacement of the Acetabulum

Other Care

'7805' Bone Graft

'7895' Other Operations on Bone

'7905' Closed Reduction of Fracture Without Internal Fixation

'7925' Open Reduction of Fracture Without Internal Fixation

'7965' Debridement of an Open Fracture Site

'7975' Closed Reduction Dislocated Hip

'7985'	Open Reduction Dislocated Hip

'7995'	Unspecified Operation on Bone Injury

'8151'	Total Hip Replacement with Methyl Methacrylate

'8159'	Other Total Hip Replacement (before 1990)
Revision of Joint Replacement, not Elsewhere Classified (after 1990)*

'8169'	Other Repair of the Hip (Used only before 1990)

'934 '	Skeletal Traction and Other Traction

'935 '	Other Immobilization, Pressure, and Attention to Wound

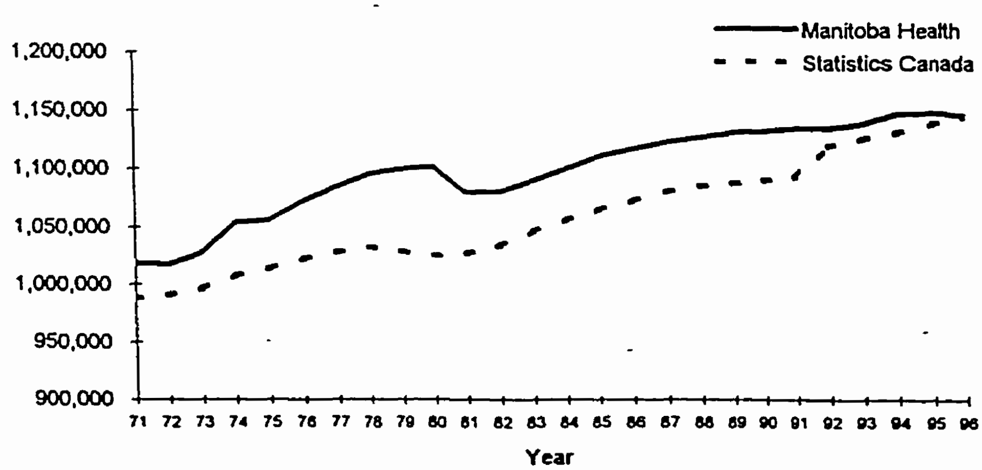
Note: Categories were formed after the frequency analysis.

Manitoba Population
June 1, 1971 - 1996

Appendix 12

Year	Manitoba Health	Statistics Canada	Difference (MH - SC)
71	1,018,535	988,200 *	30,335
72	1,017,666	991,200	26,466
73	1,027,866	996,200	31,666
74	1,053,382 **	1,007,500	45,882
75	1,055,676	1,013,600	42,076
76	1,071,788	1,021,506 *	50,282
77	1,083,509	1,027,400	56,109
78	1,094,470	1,032,000	62,470
79	1,098,904	1,028,000	70,904
80	1,100,731	1,024,900	75,831
81	1,078,513 ***	1,026,241 *	52,272
82	1,079,520	1,033,300	46,220
83	1,088,289	1,045,600	42,689
84	1,098,763	1,055,100	43,663
85	1,108,760	1,064,000	44,760
86	1,115,585	1,071,232 *	44,353
87	1,121,128	1,079,000	42,128
88	1,125,414	1,084,100	41,314
89	1,129,810	1,086,300	43,510
90	1,130,845	1,089,000	41,845
91	1,133,117	1,091,942 *	41,175
92	1,133,120	1,117,600	15,520
93	1,136,857	1,124,100 @ #	12,757
94	1,145,767	1,129,600 @ #	16,167
95	1,146,995	1,137,500 @@ #	9,495
96	1,144,643	1,143,500 @@ #	1,143

* Census count.
** December 31 count.
*** December 1 count.
@ Updated postcensal estimate.
@@ Preliminary postcensal estimate.
\# July 1 estimate.



Manitoba Health Population Counts versus Census Canada Counts

Historically the population counts produced by Census Canada have consistently been 3 to 4 percent lower than Manitoba Health counts. The variance was the result of different methods in the capture and compilation of the data.

Census Canada

In 1994 Statistics Canada revised the post censal population counts to include individuals who were not captured before. The definition of a person changed to include a group called "non-permanent" residents such as refugees, students on visa, as well as those on ministerial and work permits.

In 1996 Census has also introduced a "net under-coverage" equation which estimates "missed" individuals and subtracts "over-coverage"(residents counted more than once). There were also unenumerated First Nation's bands that will be added to the 1996 census revisions.

The new methodology will impact all Census population figures going back to 1971 as the federal government requires a 20 year time frame to adjust the calculation for federal transfer payments. It has also brought the Census figures closer to those of Manitoba Health.

Manitoba Health

Population counts produced by Manitoba Health are based on residents registered for health care in Manitoba. These include RCMP and Armed Forces personnel and their families (even though the members are covered under a federal plan). Foreign students are not covered. Presently Manitoba Health registers new residents upon entry to the province and coverage begins immediately upon their notifying the ministry of their arrival and proof of eligibility. It is to be noted that new residents from other provinces and territories are covered under the Reciprocal Agreement by their province or territory of origin for balance of the month in which they establish residence in Manitoba plus two consecutive months. Conversely, residents moving from Manitoba to other Canadian provinces are covered by Manitoba Health under the Reciprocal Agreement for the remainder of the month in which they left plus two consecutive months.

There is an inter-provincial data exchange on a monthly basis, so that each province can reconcile its registration databases and adjust population counts. For residents leaving the country Manitoba Health relies on the residents' notification that they are no longer eligible for coverage. If Manitoba Health is not notified the residents' coverage remains in tact and they are counted in the population data. A program is run monthly to flag registrations that have been inactive for more than one year. Attempts are made to contact the person(s) and depending on the response, action is taken to keep the registration active or cancel it thereby excluding them from the next population reporting.

Manitoba Health also receives quarterly Vital Statistics births and deaths data that are used to update and reconcile the registration database.

<u>Source</u>: Anne Hackinson, Manitoba Health, March 5, 1998

Appendix 13

Manitoba Population Report

Manitoba Health Services Commission

TOTAL POPULATION	MALE	FEMALE	FILE STATUS AS AT (YR MO DAY)	REPORT PRODUCED (YR MO DAY)	PAGE
1,115,585	552,159	563,426	86 06 01	86 12 09	281

AGE GROUP	TOTAL AGE GROUP	MALE	FEMALE
45	11,262	5,614	5,648
46	10,676	5,394	5,282
47	10,426	5,246	5,180
48	10,242	5,191	5,051
49	9,757	4,898	4,859
SUB-TOTAL	52,363	26,343	26,020
50	10,035	4,954	5,081
51	9,859	5,002	4,857
52	9,572	4,868	4,704
53	10,080	5,098	4,982
54	10,064	5,008	5,056
SUB TOTAL	49,610	24,930	24,680
55	9,812	4,837	4,975
56	10,137	5,021	5,116
57	9,812	4,745	5,067
58	10,044	4,929	5,115
59	9,802	4,755	5,047
SUB TOTAL	49,607	24,287	25,320
60	9,907	4,708	5,199
61	10,139	4,787	5,352
62	10,063	4,698	5,365
63	10,001	4,629	5,372
64	9,767	4,456	5,311
SUB TOTAL	49,677	23,278	26,599
65	9,451	4,318	5,133
66	9,279	4,306	4,973
67	8,377	3,895	4,482
68	7,979	3,681	4,298
69	7,976	3,681	4,295
SUB TOTAL	43,062	19,881	23,181
70	7,745	3,479	4,266
71	8,091	3,646	4,445
72	7,554	3,416	4,138
73	7,023	3,079	3,944
74	6,387	2,795	3,592
SUB TOTAL	36,800	16,415	20,385
75	6,085	2,642	3,443
76	5,632	2,442	3,190
77	5,053	2,100	2,953
78	4,789	1,988	2,801
79	4,323	1,750	2,573
SUB TOTAL	25,882	10,922	14,960
80	4,037	1,597	2,440
81	3,588	1,389	2,199
82	3,326	1,326	2,000
83	2,927	1,159	1,768
84	2,527	970	1,557
SUB TOTAL	16,405	6,441	9,964
85	2,203	784	1,419
86	1,912	655	1,257
87	1,600	547	1,053
88	1,381	432	949
89	1,168	381	787
SUB TOTAL	8,264	2,799	5,465

AGE GROUP	TOTAL PER AGE GROUP	MALE	FEMALE
90	1,036	328	708
91	819	237	582
92	616	171	445
93	564	180	384
94	387	112	275
SUB-TOTAL	3,422	1,028	2,394
95	320	82	238
96	235	72	163
97	168	46	122
98	109	30	79
99	147	66	81
SUB TOTAL	979	296	683
100	58	13	45
101	44	8	36
102	34	8	26
103	14	5	9
104	6	2	4
SUB TOTAL	156	36	120
105	7	2	5
106	6	2	4
107	1	1	0
108	1	0	1
109	1	0	1
SUB TOTAL	16	5	11
110	0	0	0
111	2	1	1
112	0	0	0
113	0	0	0
114	0	0	0
SUB TOTAL	2	1	1
115 +	1	1	0
	TOTAL POPULATION	MALE	FEMALE
	1,115,585	552,159	563,426

SELECTED ANALYSES

AGE GROUP	TOTAL PER AGE GROUP	MALE	FEMALE
0 - 17	303,665	155,663	148,002
18 - 64	676,931	338,671	338,260
65 - 79	105,744	47,218	58,526
80 +	29,245	10,607	18,638

AGE GROUP	TOTAL PER AGE GROUP	MALE	FEMALE
65 +	134,989	57,825	77,164
70 +	91,927	37,944	53,983
85 +	12,840	4,166	8,674
90 +	4,576	1,367	3,209

AGE GROUP	TOTAL PER AGE GROUP	MALE	FEMALE
0 - 14	250,710	128,756	121,954
15 - 24	189,277	95,515	93,762
25 - 34	193,884	97,985	95,899
35 - 44	145,268	73,240	72,028
45 - 54	101,973	51,273	50,700
55 - 64	99,484	47,565	51,919
65 - 74	79,862	36,296	43,566
75 +	55,127	21,529	33,598

Source: Manitoba Health Services Commission

Appendix 14

Transfers

Transfers were determined by the presence of an additional hospital admission within one day (±1) of discharge from index admission. Up to five admissions were searched for consecutive transfer after their index admission. Each hospital record also contains the variables, "transfer to" and "transfer from".

Transfer to Hospital

In this study, there were 267 (2.2%) reported transfers to another institution from initial hip fracture hospital admission with no corresponding admission reported by the hospital insurance claims. When the transfer parameters were expanded to include all transfers within ten days (±10) of admission with a hospital number equal to the transfer to variable on the previous admission, no additional records were found.

Therefore, it is uncertain if these discrepancies are the result of missing hospital insurance claims, coding error or misinformation on the chart. The claims with unmatched transfers were spread relatively evenly over the study years, except more missing records were found in 1992. (See Table 1AIII). The missing 1992 data may be partially explained by the fact that individuals may not have been discharged from their transfer admission by the end of the study and the records were unavailable for study.

On the other hand, 628 additional transfers (5.1%) were found using the episode of admission transfer protocol that were not found using just the "transfer to" code. Transfers to another hospital are required to be reported by MHIS.

Both of these methods of determining transfers were used to develop the Transfer before Repair variable.

Transfer From Hospital

Initial hip fracture admissions with a "transfer from" code, indicating a transfer from another hospital, occurred in 14.4% (1763) of the cases. This phenomenon was spread evenly across all study years. The most likely explanation for the failure to document hip fractures on these admissions is that the patients were not actually admitted to the transferring hospital but only stabilized in the emergency department. Emergency department records are not maintained in a centralized data base and are thus unavailable for study. A variable will be created in the regression analysis to account for these individuals.

Transfers to Nursing Home

For transfers to nursing home, 224 cases (1.8%) were reported as transferring to nursing home but were not found on the nursing home file. The early years of the study, 1979, 1980 and 1981 make up about two thirds (63.9%) of the unmatched cases. Since this trend was not witnessed in the hospital admissions, it raises concern regarding the completeness of the nursing home records for these years. An elevation in unmatched nursing home discharges was also present in 1991. This problem may relate to the fact that the nursing home claims file may not be updated to include all the 1991 and 1992 data. Therefore, index admissions indicating a transfer to a nursing home were added to the protocol established for nursing home admissions after index episode of care.

Transfers from Nursing Home

For transfers from nursing home recorded on index admission, 414 individuals (3.4%) were noted to have transferred in their hospital claim but were not found in the personal care home claims file. An analysis of these records over time again revealed a clustering of cases in the early part of the study and a large number of unrecorded transfers in the later years of study. Again, these findings are likely related to the incompleteness of the nursing home file. Therefore, the transfer from nursing home data were included in the protocol to determine admissions from nursing home.

On the other hand, the personal care home claims data identified 856 nursing home residents (7.0% of hip fracture cases) who did not have a transfer from nursing home code on their index admission. The implications of these findings are that the study may be missing nursing home information for some individuals in the early part of the study and in the final years.

A preliminary analysis of subjects identified by both the nursing home registry and by the "transfer from" code revealed that they both predicted increased early mortality in a similar manner. Therefore, they were combined into a single admission from nursing home variable.

Figure 1.AIII

Distribution of Discrepancies between Hospital and Nursing Home Claims and the "Transfer to" and "Transfer from" Codes

	Transfer from Hospital	Transfer to Hospital	Transfer from P.C.H.	Transfer to P.C.H.
1978	14(0.8%)	0	2(0.5%)	3(1.3%)
1979	81(4.6%)	13(4.6%)	93(22.5%)	66(29.5%)
1980	93(5.3%)	15(5.3%)	79(19.1%)	45(20.1%)
1981	116(6.6%)	20(7.0%)	60(14.5%)	30(13.4%)
1982	110(6.2%)	17(6.0%)	8(1.9%)	6(2.7%)
1983	124(7.0%)	16(5.6%)	9(2.2%)	7(3.1%)
1984	120((6.8%)	17(6.0%)	5(1.2%)	6(2.7%)
1985	129(7.3%)	21(7.4%)	7(1.7%)	4(1.8%)
1986	138(7.8%)	18(6.3%)	3(0.7%)	8(3.6%)
1987	117(6.6%)	14(4.9%)	3(0.7%)	5(2.2%)
1988	135(7.7%)	14(4.9%)	4(1.0%)	6(2.7%)
1989	150(8.5%)	18(6.3%)	6(1.4%)	4(1.8%)
1990	144(8.2%)	14(4.9%)	2(0.5%)	7(3.1%)
1991	140(7.9%)	25(8.8%)	9(2.2%)	27(12.1%)
1992	152(8.6%)	62(21.8%)	124(30.0%)	*
Total	1763 (100.0%)	284 (100.0%)	414 (100.0%)	224 (100.0%)

* Follow-up data for index cases in 1992 were not available. Therefore, these cases will not be included in this analysis.

Appendix 15

Table VI

Personal Care Home Residents by Age Group, Sex, and Level of Care,

March 31, 1986.

Age Group	Sex	Level 1	Level 2	Level 3	Level 4	Total	Percent
Under 65	M	10	74	72	50	206	2.5
	F	11	51	67	70	199	2.5
65 - 69	M	16	52	55	35	158	1.9
	F	13	69	45	36	163	2.0
70 - 74	M	34	103	94	50	281	3.5
	F	34	112	115	71	332	4.1
75 - 79	M	48	138	123	80	389	4.8
	F	86	286	196	148	716	8.8
80 - 84	M	78	161	149	103	491	6.1
	F	154	504	347	237	1,242	15.3
85 +	M	162	359	279	153	953	11.8
	F	369	1,157	775	673	2,974	36.7
Total		**1,015**	**3,066**	**2,317**	**1,706**	**8,104**	
Percent		**12.5**	**37.9**	**28.6**	**21.0**	**100.0**	**100.0**

Source: Manitoba Health Services Commission

Appendix 16

Comorbidity Analysis

Since the Charlson index was validated to predict mortality for patients admitted to a medical services and not mortality in patients undergoing surgery, the ability of the Charlson index to predict death in the hip fracture population was examined. For this analysis, six month survival was used as the outcome measure. Five scenarios were examined: the variance explained by the presence of the Charlson index value; the variance explained by the Charlson index variable and all the individual Charlson diagnoses retained in the model, the variance explained by the unweighted addition of the Charlson diagnoses; the variance explained by the additive Charlson diagnoses and the individual Charlson diagnoses; and the variation explained using only the individual Charlson diagnoses.

The overall variance explained for each model is shown in Table A. Model V appears to provide the most sensible model with the highest model X^2. Although Model IV has a slightly higher X^2, it uses more degrees of freedom. In addition, with Model IV, many of the individual Charlson comorbidities are required in the model to modify the risk of death, suggesting that the relationship between the comorbidities is not additive. Model V is shown in Table B.

Table A

Model		Model X^2	df
I.	Presence of Charlson Diagnosis	1458	30
II.	Presence of Charlson Diagnosis and Individual Charlson Diagnoses	1664	38
III.	Additive Charlson Index	1471	30
IV.	Additive Charlson Index and individual Charlson Diagnoses	1693	42
V.	Individual Charlson Diagnoses only	1669	37

Table B

Model V

Age	1.049	1.043 - 1.055
Female Sex	0.564	0.516 - 0.617
PCH Resident	1.614	1.467 - 1.775
Fracture Type		
Open	1.330	0.923 - 1.918
Cl. Transcerv	0.835	0.762 - 0.916
Cl. Subtroch	0.833	0.635 - 1.092
Cl. Unspecify	0.921	0.790 - 1.075
Accident Site		
Home	1.154	0.886 - 1.502
Other	0.805	0.605 - 1.071
Hospital	1.589	1.198 - 2.108
Metastatic Cancer	3.459	2.851 - 4.197
Other Cancer	1.601	1.356 - 1.889
Renal Disease	2.402	1.992 - 2.898
Diabetes	1.272	1.095 - 1.477
COPD	1.562	1.384 - 1.764
Cerebral Vascular Disease	0.778	0.642 - 0.994
Peripheral Vascular Disease	1.560	1.311 - 1.856
Congestive Heart Failure	1.564	1.352 - 1.808
Severe Hypertension	1.467	1.079 - 1.993
Malnutrition	1.685	1.259 - 2.255
Number of Transfers	0.802	0.744 - 0.864
Treatment Time		
<= 2 days	0.885	0.792 - 0.989
3-10 days	1.072	0.966 - 1.189

Admitting Hosp.		
Teaching	1.921	1.328 - 2.780
Urban	1.993	1.383 - 2.872
Major Rural	2.296	1.588 - 3.319
Int. Rural	2.586	1.721 - 3.886
Small Rural	2.406	1.634 - 3.544
Out of Prov.	1.159	0.619 - 2.172
No Hip Fracture Repair	1.945	1.642 - 2.305
Repair Day		
Sunday	0.969	0.808 - 1.162
Monday	1.000	0.842 - 1.188
Tuesday	0.877	0.736 - 1.044
Wednesday	0.823	0.694 - 0.977
Thursday	0.904	0.763 - 1.071
Friday	0.773	0.652 - 0.917
Transfer without admission	1.497	1.206 - 1.859

Since the individual Charlson diagnoses without the Charlson index variable produced the best model. The individual Charlson variables was used in the further analysis.